man pages section 1: User Commands
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Preface

Both novice users and those familiar with the SunOS operating system can use online man pages to obtain information about the system and its features. A man page is intended to answer concisely the question “What does it do?” The man pages in general comprise a reference manual. They are not intended to be a tutorial.

Overview

The following contains a brief description of each man page section and the information it references:

- Section 1 describes, in alphabetical order, commands available with the operating system.
- Section 1M describes, in alphabetical order, commands that are used chiefly for system maintenance and administration purposes.
- Section 2 describes all of the system calls. Most of these calls have one or more error returns. An error condition is indicated by an otherwise impossible returned value.
- Section 3 describes functions found in various libraries, other than those functions that directly invoke UNIX system primitives, which are described in Section 2.
- Section 4 outlines the formats of various files. The C structure declarations for the file formats are given where applicable.
- Section 5 contains miscellaneous documentation such as character-set tables.
- Section 7 describes various special files that refer to specific hardware peripherals and device drivers. STREAMS software drivers, modules and the STREAMS-generic set of system calls are also described.
- Section 9E describes the DDI (Device Driver Interface)/DKI (Driver/Kernel Interface), DDI-only, and DKI-only entry-point routines a developer can include in a device driver.
- Section 9F describes the kernel functions available for use by device drivers.
- Section 9S describes the data structures used by drivers to share information between the driver and the kernel.

Below is a generic format for man pages. The man pages of each manual section generally follow this order, but include only needed headings. For example, if there are no bugs to report,
there is no BUGS section. See the 1n tro pages for more information and detail about each section, and man(1) for more information about man pages in general.

NAME

This section gives the names of the commands or functions documented, followed by a brief description of what they do.

SYNOPSIS

This section shows the syntax of commands or functions. When a command or file does not exist in the standard path, its full path name is shown. Options and arguments are alphabetized, with single letter arguments first, and options with arguments next, unless a different argument order is required.

The following special characters are used in this section:

[ ] Brackets. The option or argument enclosed in these brackets is optional. If the brackets are omitted, the argument must be specified.

... Ellipses. Several values can be provided for the previous argument, or the previous argument can be specified multiple times, for example, “filename...”.

| Separator. Only one of the arguments separated by this character can be specified at a time.

{} Braces. The options and/or arguments enclosed within braces are interdependent, such that everything enclosed must be treated as a unit.

PROTOCOL

This section occurs only in subsection 3R to indicate the protocol description file.

DESCRIPTION

This section defines the functionality and behavior of the service. Thus it describes concisely what the command does. It does not discuss OPTIONS or cite EXAMPLES. Interactive commands, subcommands, requests, macros, and functions are described under USAGE.

IOCTL

This section appears on pages in Section 7 only. Only the device class that supplies appropriate parameters to the ioctl(2) system call is called ioctl and generates its own heading. ioctl calls for a specific device are listed alphabetically (on the man page for that specific device).
ioctl calls are used for a particular class of devices all of which have an io ending, such as mtio(7I).

OPTIONS This section lists the command options with a concise summary of what each option does. The options are listed literally and in the order they appear in the SYNOPSIS section. Possible arguments to options are discussed under the option, and where appropriate, default values are supplied.

OPERANDS This section lists the command operands and describes how they affect the actions of the command.

OUTPUT This section describes the output – standard output, standard error, or output files – generated by the command.

RETURN VALUES If the man page documents functions that return values, this section lists these values and describes the conditions under which they are returned. If a function can return only constant values, such as 0 or –1, these values are listed in tagged paragraphs. Otherwise, a single paragraph describes the return values of each function. Functions declared void do not return values, so they are not discussed in RETURN VALUES.

ERRORS On failure, most functions place an error code in the global variable errno indicating why they failed. This section lists alphabetically all error codes a function can generate and describes the conditions that cause each error. When more than one condition can cause the same error, each condition is described in a separate paragraph under the error code.

USAGE This section lists special rules, features, and commands that require in-depth explanations. The subsections listed here are used to explain built-in functionality:

Commands
Modifiers
Variables
Expressions
Input Grammar

EXAMPLES This section provides examples of usage or of how to use a command or function. Wherever possible a complete
example including command-line entry and machine response is shown. Whenever an example is given, the prompt is shown as example%, or if the user must be superuser, example#. Examples are followed by explanations, variable substitution rules, or returned values. Most examples illustrate concepts from the SYNOPSIS, DESCRIPTION, OPTIONS, and USAGE sections.

ENVIRONMENT VARIABLES  This section lists any environment variables that the command or function affects, followed by a brief description of the effect.

EXIT STATUS  This section lists the values the command returns to the calling program or shell and the conditions that cause these values to be returned. Usually, zero is returned for successful completion, and values other than zero for various error conditions.

FILES  This section lists all file names referred to by the man page, files of interest, and files created or required by commands. Each is followed by a descriptive summary or explanation.

ATTRIBUTES  This section lists characteristics of commands, utilities, and device drivers by defining the attribute type and its corresponding value. See attributes(5) for more information.

SEE ALSO  This section lists references to other man pages, in-house documentation, and outside publications.

DIAGNOSTICS  This section lists diagnostic messages with a brief explanation of the condition causing the error.

WARNINGS  This section lists warnings about special conditions which could seriously affect your working conditions. This is not a list of diagnostics.

NOTES  This section lists additional information that does not belong anywhere else on the page. It takes the form of an aside to the user, covering points of special interest. Critical information is never covered here.

BUGS  This section describes known bugs and, wherever possible, suggests workarounds.
This section describes, in alphabetical order, commands available with this operating system. Pages of special interest are categorized as follows:

1B Commands found only in the SunOS/BSD Compatibility Package.
1C Commands for communicating with other systems.
1S Commands specific to SunOS.

See the following sections of the SunOS Reference Manual for more information.
- Section 1M for system maintenance commands.
- Section 4 for information on file formats.
- Section 5 for descriptions of publicly available files and miscellaneous information pages.

For tutorial information about these commands and procedures, see System Administration Guide: Advanced Administration.

Unless otherwise noted, commands described in the SYNOPSIS section of a manual page accept options and other arguments according to the following syntax and should be interpreted as explained below.

\[
\text{name} [-\text{option...}] [\text{cmdarg...}] \text{ where:}
\]

\[
[ ] \quad \text{Surround an option or cmdarg that is not required.}
\]

\[
... \quad \text{Indicates multiple occurrences of the option or cmdarg.}
\]

\[
\text{name} \quad \text{The name of an executable file.}
\]

\[
\{\} \quad \text{The options and/or arguments enclosed within braces are interdependent, such that everything enclosed must be treated as a unit.}
\]

\[
\text{option} \quad \text{(Always preceded by a “−”.) noargletter... or, argletter optarg[, ...]}
\]

\[
\text{noargletter} \quad \text{A single letter representing an option without an option-argument. Notice that more than one noargletter option can be grouped after one “−” (Guideline 5, below).}
\]

\[
\text{argletter} \quad \text{A single letter representing an option requiring an option-argument.}
\]

\[
\text{optarg} \quad \text{An option-argument (character string) satisfying a preceding argletter. Notice that groups of optargs following an argletter must be separated by commas, or separated by a tab or space character and quoted (Guideline 8, below).}
\]

\[
\text{cmdarg} \quad \text{Path name (or other command argument) not beginning with “−”, or “−” by itself indicating the standard input.}
\]
Unless otherwise specified, whenever an operand or option-argument is, or contains, a numeric value:

- The number is interpreted as a decimal integer.
- Numerals in the range 0 to 2147483647 are syntactically recognized as numeric values.
- When the utility description states that it accepts negative numbers as operands or option-arguments, numerals in the range -2147483647 to 2147483647 are syntactically recognized as numeric values.
- Ranges greater than those listed here are allowed.

These command syntax guidelines are not followed by all current commands, but new commands are likely to obey them. *getopts(1)* should be used by all shell procedures to parse positional parameters and to check for legal options. It supports Guidelines 3-10 below. The enforcement of the other guidelines must be done by the command itself.

1. Command names (*name* above) should be between two and nine characters long.
2. Command names should include only lower-case letters and digits.
3. Option names (*option* above) must be one character long.
4. All options must be preceded by “−”.
5. Options with no arguments can be grouped after a single “−”.
6. The first option-argument (*optarg* above) following an option must be preceded by a tab or space character.
7. Option-arguments cannot be optional.
8. Groups of option-arguments following an option must either be separated by commas or separated by tab or space character and quoted (*-o xxx,z,yy or -o“xxx z yy”*).
9. All options must precede operands (*cmdarg* above) on the command line.
10. “−−” can be used to indicate the end of the options.
11. The order of the options relative to one another should not matter.
12. The relative order of the operands (*cmdarg* above) can affect their significance in ways determined by the command with which they appear.
13. “−−” preceded and followed by a white space character should only be used to mean standard input.

An expanded set of guidelines referred to as CLIP for Command Line Interface Paradigm has been developed for Solaris and other Sun products. Its intent is to provide a command line syntax more closely aligned with the GNU command line syntax popular on Linux systems. There is no intent to retrofit existing utilities or even to apply this to all new utilities. It is only intended to be applied to sets of utilities being developed when appropriate.
CLIP is a full superset of the guidelines discussed above which are closely aligned with IEEE Std. 1003.1-2001 (SUSv3). It does not include all the GNU syntax. The GNU syntax allows constructs that either conflict with the IEEE rules or are ambiguous. These constructs are not allowed.

The expanded CLIP command line syntax is:

```
utility_name -a --longopt1 -c option_argument \ 
  -f option_argument --longopt2=option_argument \ 
  --longopt3 option_argument operand
```

The utility in the example is named `utility_name`. It is followed by options, option-arguments, and operands, collectively referred to as arguments. The arguments that consist of a hyphen followed a single letter or digit, such as `-a`, are known as short-options. The arguments that consist of two hyphens followed by a series of letters, digits and hyphens, such as `--longopt1`, are known as long-options. Collectively, short-options and long-options are referred to as options (or historically, flags). Certain options are followed by an option-argument, as shown with `-c option_argument`. The arguments following the last options and option-arguments are named operands. Once the first operand is encountered, all subsequent arguments are interpreted to be operands.

Option-arguments are sometimes shown separated from their short-options by BLANKS, sometimes directly adjacent. This reflects the situation that in some cases an option-argument is included within the same argument string as the option; in most cases it is the next argument. This specification requires that the option be a separate argument from its option-argument, but there are some exceptions to ensure continued operation of historical applications:

- If the SYNOPSIS of a utility shows a SPACE between a short-option and option-argument (as with `-c option_argument in the example), the application uses separate arguments for that option and its option-argument.
- If a SPACE is not shown (as with `-f option_argument in the example), the application expects an option and its option-argument directly adjacent in the same argument string, without intervening BLANKs.
- Notwithstanding the preceding requirements, an application should accept short-options and option-arguments as a single argument or as separate arguments whether or not a SPACE is shown on the synopsis line.
- Long-options with option-arguments are always documented as using an equals sign as the separator between the option name and the option-argument. If the OPTIONS section of a utility shows an equals sign (=) between a long-option and its option-argument (as with `--longopt2=option_argument in the example), a application shall also permit the use of separate arguments for that option and its option-argument (as with `--longopt1 option_argument in the example).

CLIP expands the guidelines discussed with the following additional guidelines:
14. The form `command subcommand [options] [operands]` is appropriate for grouping similar operations. Subcommand names should follow the same conventions as command names as specified in guidelines 1 and 2.

15. Long-options should be preceded by `--` and should include only alphanumeric characters and hyphens from the portable character set. Option names are typically one to three words long, with hyphens to separate words.

16. `--name=argument` should be used to specify an option-argument for a long-option. The form `--name argument` is also accepted.

17. All utilities should support two standard long-options: `--version` (with the short-optionsynonym `-V`) and `--help` (with the short-option synonym `-?`). The short option synonyms for `--version` can vary if the preferred synonym is already in use (but a synonym shall be provided). Both of these options stop further argument processing when encountered and after displaying the appropriate output, the utility successfully exits.

18. Every short-option should have exactly one corresponding long-option and every long-option should have exactly one corresponding short-option. Synonymous options can be allowed in the interest of compatibility with historical practice or community versions of equivalent utilities.

19. The short-option name should get its name from the long-option name according to these rules:
   1. Use the first letter of the long-option name for the short-option name.
   2. If the first letter conflicts with other short-option names, choose a prominent consonant.
   3. If the first letter and the prominent consonant conflict with other short option names, choose a prominent vowel.
   4. If none of the letters of the long-option name are usable, select an arbitrary character.

20. If a long-option name consists of a single character, it must use the same character as the short-option name. Single character long-options should be avoided. They are only allowed for the exceptionally rare case that a single character is the most descriptive name.

21. The subcommand in the form described in guideline 1 of the additional CLIP guidelines is generally required. In the case where it is omitted, the command shall take no operands and only options which are defined to stop further argument processing when encountered are allowed. Invoking a command of this form without a subcommand and no arguments is an error. This guideline is provided to allow the common forms `command --help`, `command -?`, `command --version`, and `command -V` to be accepted in the command-subcommand construct.
Several of these guidelines are only of interest to the authors of utilities. They are provided here for the use of anyone wanting to author utilities following this syntax.

**Acknowledgments**

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This notice shall appear on any product containing this material.

**See Also**

getopts(1), wait(1), exit(2), getopt(3C)

**Diagnostics**

Upon termination, each command returns two bytes of status, one supplied by the system and giving the cause for termination, and (in the case of “normal” termination) one supplied by the program [see exit(2)]. The former byte is 0 for normal termination. The latter byte is customarily 0 for successful execution and non-zero to indicate troubles such as erroneous parameters, or bad or inaccessible data. It is called variously “exit code”, “exit status”, or “return code”, and is described only where special conventions are involved.

**Warnings**

Some commands produce unexpected results when processing files containing null characters. These commands often treat text input lines as strings and therefore become confused upon encountering a null character (the string terminator) within a line.
REFERENCE

User Commands
acctcom(1)

Name  acctcom – search and print process accounting files

Synopsis  acctcom [-abfhikmqrtv] [-C sec] [-e time] [-E time]
[-g group] [-H factor] [-I chars] [-\ line]
[-n pattern] [-o output-file] [-o sec] [-s time]
[-s time] [-u user] [filename]...

Description  The acctcom utility reads filenames, the standard input, or /var/adm/pacct, in the form described by acct.h(3HEAD) and writes selected records to standard output. Each record represents the execution of one process. The output shows the COMMAND NAME, USER, TTYNAME, START TIME, END TIME, REAL (SEC), CPU (SEC), MEAN SIZE (K), and optionally, F (the fork()/exec() flag: 1 for fork() without exec()), STAT (the system exit status), HOG FACTOR, KCORE MIN, CPU FACTOR, CHAR S TRNSFD, and BLOCKS READ (total blocks read and written).

A ‘#’ is prepended to the command name if the command was executed with super-user privileges. If a process is not associated with a known terminal, a ‘?’ is printed in the TTYNAME field.

If no filename is specified, and if the standard input is associated with a terminal or /dev/null (as is the case when using ‘&’ in the shell), /var/adm/pacct is read; otherwise, the standard input is read.

If any filename arguments are given, they are read in their respective order. Each file is normally read forward, that is, in chronological order by process completion time. The file /var/adm/pacct is usually the current file to be examined; a busy system may need several such files of which all but the current file are found in /var/adm/pacctincr.

Options  The following options are supported:

- a  Show some average statistics about the processes selected. The statistics will be printed after the output records.
- b  Read backwards, showing latest commands first. This option has no effect when standard input is read.
- f  Print the fork()/exec() flag and system exit status columns in the output. The numeric output for this option will be in octal.
- h  Instead of mean memory size, show the fraction of total available CPU time consumed by the process during its execution. This “hog factor” is computed as (total CPU time)/(elapsed time).
- i  Print columns containing the I/O counts in the output.
- k  Instead of memory size, show total kcore-minutes.
- m  Show mean core size (the default).
- q  Do not print any output records, just print the average statistics as with the -a option.
- r      Show CPU factor (user-time/(system-time + user-time)).
- t      Show separate system and user CPU times.
- v      Exclude column headings from the output.
- C sec  Show only processes with total CPU time (system-time + user-time) exceeding sec seconds.
- e time Select processes existing at or before time.
- E time Select processes ending at or before time. Using the same time for both -S and -E shows the processes that existed at time.
- g group Show only processes belonging to group. The group may be designated by either the group ID or group name.
- H factor Show only processes that exceed factor, where factor is the "hog factor" as explained in option -h above.
- I chars Show only processes transferring more characters than the cutoff number given by chars.
- L line Show only processes belonging to terminal /dev/term/line.
- n pattern Show only commands matching pattern that may be a regular expression as in regexp(3C), except + means one or more occurrences.
- o output-file Copy selected process records in the input data format to output-file; suppress printing to standard output.
- O sec  Show only processes with CPU system time exceeding sec seconds.
- s time Select processes existing at or after time, given in the format hr [:min [:sec ]].
- S time Select processes starting at or after time.
- u user Show only processes belonging to user. The user may be specified by a user ID, a login name that is then converted to a user ID, '# (which designates only those processes executed with superuser privileges), or '?' (which designates only those processes associated with unknown user IDs).

Files  
/etc/group       system group file
/etc/passwd     system password file
/var/adm/pacctincr active processes accounting file

Attributes  See attributes(5) for descriptions of the following attributes:
See Also  ps(1), acct(1M), acctcms(1M), acctcon(1M), acctmerg(1M), acctprc(1M), acctsh(1M), fwtmp(1M), runacct(1M), su(1M), acct(2), regcmp(3C), acct.h(3HEAD), utmp(4), attributes(5)

Oracle Solaris Administration: Common Tasks

Notes  acctcom reports only on processes that have terminated; use ps(1) for active processes.
adb(1)

Name adb – general-purpose debugger

Synopsis adb [-ka] [-I dir] [-P prompt] [-V mode] [object [core]]

Description The adb utility is an interactive, general-purpose debugger. It can be used to examine files and provides a controlled environment for the execution of programs.

The adb utility is now implemented as a link to the mdb(1) utility. mdb(1) is a low-level debugging utility that can be used to examine user processes as well as the live operating system or operating system crash dumps. The new mdb(1) utility provides complete backwards compatibility with the existing syntax and features of adb, including support for processing adb macro files. The Oracle Solaris Modular Debugger Guide and mdb(1) man page describes the features of mdb, including its adb compatibility mode. This mode will be activated by default when the adb link is executed.

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/debug/mdb</td>
</tr>
</tbody>
</table>

See Also mdb(1), attributes(5)

Oracle Solaris Modular Debugger Guide
Name: addbib

Synopsis: addbib [-a] [-p promptfile] database

Description: When addbib starts up, answering y to the initial Instructions? prompt yields directions. Typing n (or RETURN) skips the directions. addbib then prompts for various bibliographic fields, reads responses from the terminal, and sends output records to database. A null response (just RETURN) means to leave out that field. A ‘−’ (minus sign) means to go back to the previous field. A trailing backslash allows a field to be continued on the next line. The repeating Continue? prompt allows the user either to resume by typing y (or RETURN), to quit the current session by typing n or q, or to edit database with any system editor (see vi(1), ex(1), ed(1)).

Options: The following options are supported:

- a Suppresses prompting for an abstract. Asking for an abstract is the default. Abstracts are ended with a Control−D.
- p promptfile Uses a new prompting skeleton, defined in promptfile. This file should contain prompt strings, a TAB, and the key-letters to be written to the database.

Usage:

Bibliography Key Letters: The most common key-letters and their meanings are given below. addbib insulates you from these key-letters, since it gives you prompts in English, but if you edit the bibliography file later on, you will need to know this information.

%A Author’s name
%B Book containing article referenced
%C City (place of publication)
%D Date of publication
%E Editor of book containing article referenced
%F Footnote number or label (supplied by refer)
%G Government order number
%H Header commentary, printed before reference
%I Issuer (publisher)
%J Journal containing article
%K Keywords to use in locating reference
%L Label field used by -k option of refer
%M Bell Labs Memorandum (undefined)
%N    Number within volume
%O    Other commentary, printed at end of reference
%P    Page number(s)
%Q    Corporate or Foreign Author (unreversed)
%R    Report, paper, or thesis (unpublished)
%S    Series title
%T    Title of article or book
%V    Volume number
%X    Abstract — used by roffbib, not by refer
%Y,Z Ignored by refer

Examples  EXAMPLE 1 Editing the bibliography file
Except for A, each field should be given just once. Only relevant fields should be supplied.
%A  Mark Twain
%T  Life on the Mississippi
%I  Penguin Books
%C  New York
%D  1978

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>text/doctools</td>
</tr>
</tbody>
</table>

See Also  ed(1), ex(1), indxbib(1), lookbib(1), refer(1), roffbib(1), sortbib(1), vi(1), attributes(5)
alias, unalias – create or remove a pseudonym or shorthand for a command or series of commands

**Synopsis**

/usr/bin/alias [alias-name[= string...]]
/usr/bin/unalias alias-name...
/usr/bin/unalias -a

csh alias [name [def]]
unalias pattern
ksh88 alias [-tx] [name[= value]...]
unalias name...
unalias [-a]
ksh alias [-ptx] [name[= value]...]
unalias [-a] [name...]

**Description**

The alias and unalias utilities create or remove a pseudonym or shorthand term for a command or series of commands, with different functionality in the C-shell and Korn shell environments.

The `alias` utility creates or redefines alias definitions or writes the values of existing alias definitions to standard output. An alias definition provides a string value that replaces a command name when it is encountered.

An alias definition affects the current shell execution environment and the execution environments of the subshells of the current shell. When used as specified by this document, the alias definition does not affect the parent process of the current shell nor any utility environment invoked by the shell.

The `unalias` utility removes the definition for each alias name specified. The aliases are removed from the current shell execution environment. The `-a` option removes all alias definitions from the current execution environment.

`csh` aliases assign `def` to the alias `name`. The assigned `def` is a list of words that can contain escaped history-substitution metasyntax. `name` is not allowed to be alias or unalias. If `def` is omitted, the alias `name` is displayed along with its current definition. If both `name` and `def` are omitted, all aliases are displayed.

Because of implementation restrictions, an alias definition must have been entered on a previous command line before it can be used.

`unalias` discards aliases that match (filename substitution) `pattern`. All aliases can be removed by `unalias *`.
**alias** with no arguments prints the list of aliases in the form `name=value` on standard output.
An **alias** is defined for each name whose value is specified. A trailing space in value causes the next word to be checked for alias substitution. The `-t` flag is used to set and list tracked aliases. The value of a tracked alias is the full pathname corresponding to the specified `name`. The value becomes undefined when the value of `PATH` is reset but the aliases remained tracked. Without the `-t` flag, for each `name` in the argument list for which no value is specified, the name and value of the alias is printed. The `-x` flag is used to set or print exported aliases. An exported alias is defined for scripts invoked by `name`. The exit status is non-zero if a `name` is specified, but no value, and no alias has been defined for the `name`.

The **alias** specified by the list of `names` can be removed from the **alias** list with **unalias**.

**alias** creates or redefines alias definitions or writes the existing alias definitions to standard output.

An alias definition provides a string value that replaces a command name when the command is read. Alias names can contain any printable character that is not special to the shell. If an alias value ends in a SPACE or TAB, the word following the command name the alias replaces is also checked to see whether it is an alias.

If no names are specified, the names and values of all aliases are written to standard output. Otherwise, for each name that is specified, and `=value` is not specified, the current value of the alias corresponding to name is written to standard output. If `=value` is specified, the alias name is created or redefined.

**alias** is built-in to the shell as a declaration command so that field splitting and pathname expansion are not performed on the arguments. Tilde expansion occurs on value. An alias definition only affects scripts read by the current shell environment. It does not affect scripts run by this shell.

**unalias** removes the definition of each named alias from the current shell execution environment, or all aliases if `-a` is specified. It does not affect any commands that have already been read and subsequently executed.

**Options**

The following option is supported by **unalias**:

- `-a` Removes all alias definitions from the current shell execution environment.

The following option is supported by **alias**:

- `-t` Sets and lists tracked aliases.

The following options are supported by **alias**:

- `-p` Causes the output to be in the form of **alias** commands that can be used as input to the shell to recreate the current aliases.
- `-t` Specifies tracked aliases.
Tracked aliases connect a command name to the command's pathname, and are reset when the \texttt{PATH} variable is unset. The tracked aliases feature is now obsolete.

\texttt{-x} \quad Ignored, this option is obsolete.

The following option is supported by \texttt{unalias}:

\texttt{-a} \quad Causes all alias definitions to be removed. \texttt{name} operands are optional and ignored if specified.

\textbf{Operands} \quad The following operands are supported:

\begin{tabular}{ll}
\texttt{alias} & \texttt{alias-name} \quad Write the alias definition to standard output. \\
\texttt{unalias} & \texttt{alias-name} \quad The name of an alias to be removed. \\
& \texttt{alias-name=string} \quad Assign the value of \texttt{string} to the alias \texttt{alias-name}.
\end{tabular}

If no operands are specified, all alias definitions are written to standard output.

\textbf{Output} \quad The format for displaying aliases (when no operands or only \texttt{name} operands are specified) is:

\begin{quote}
"\texttt{%s=%s\n} name, value"
\end{quote}

The \texttt{value} string is written with appropriate quoting so that it is suitable for reinput to the shell.

\textbf{Examples} \quad \textbf{EXAMPLE 1} \quad Modifying a Command's Output

This example specifies that the output of the \texttt{ls} utility is columnated and more annotated:

\begin{verbatim}
example% \texttt{alias ls="ls -CF"}
\end{verbatim}

\textbf{EXAMPLE 2} \quad Repeating Previous Entries in the Command History File

This example creates a simple "redo" command to repeat previous entries in the command history file:

\begin{verbatim}
example% \texttt{alias r='fc -s'}
\end{verbatim}

\textbf{EXAMPLE 3} \quad Specifying a Command's Output Options

This example provides that the \texttt{du} utility summarize disk output in units of 1024 bytes:

\begin{verbatim}
example% \texttt{alias du=du -k}
\end{verbatim}

\textbf{EXAMPLE 4} \quad Dealing with an Argument That is an Alias Name

This example sets up the \texttt{nohup} utility so that it can deal with an argument that is an alias name:

\begin{verbatim}
example% \texttt{alias nohup="nohup"}
\end{verbatim}
See \texttt{environ(5)} for descriptions of the following environment variables that affect the execution of alias and unalias: LANG, LC\_ALL, LC\_CTYPE, LC\_MESSAGES, and NLSPATH.

**Exit Status** The following exit values are returned:

- \texttt{0}  Successful completion.
- \texttt{alias >0} One of the \texttt{alias-name} operands specified did not have an alias definition, or an error occurred.
- \texttt{unalias >0} One of the \texttt{alias-name} operands specified did not represent a valid alias definition, or an error occurred.

**Attributes** See \texttt{attributes(5)} for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>csh, ksh88</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
<td></td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td>See \texttt{standards(5)}.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ksh</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
<td></td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Uncommitted</td>
<td></td>
</tr>
</tbody>
</table>

**See Also** \texttt{csh(1), ksh(1), ksh88(1), shell_builtins(1), attributes(5), environ(5), standards(5)}
The `allocate` utility manages the ownership of devices through its allocation mechanism. It ensures that each device is used by only one qualified user at a time.

The `device` argument specifies the device to be manipulated. To preserve the integrity of the device's owner, the `allocate` operation is executed on all the device special files associated with that device.

The default `allocate` operation allocates the device special files associated with `device` to the `uid` of the current process.

Only authorized users may allocate a device. The required authorizations are specified in `device_allocate(4)`.

When the system is configured with Trusted Extensions, `allocate` runs the clean program for the device before it grants access to the caller to that device. For devices with removable media that have a mountable file system, `allocate` mounts the media if the caller chooses.

The following options are supported:

- `-F device` Force allocates either free or pre-allocated devices. This option is often used with the `-U` option to allocate/reallocate devices to a specific user. Only those users that have `solaris.device.revoke` authorization are allowed to use this option.

- `-g dev-type` Allocates devices with a device–type matching `dev-type`. The `dev-type` argument specifies the device type to be operated on.

- `-s` Silent. Suppresses any diagnostic output.

- `-U uname` Uses the user ID `uname` instead of the user ID of the current process when performing the `allocate` operation. Only a user with the `solaris.device.revoke` authorization is permitted to use this option.

The following options are supported with Trusted Extensions:

- `-w` Runs the device cleaning program in a windowing environment. If a windowing version of the program exists, it is used. Otherwise, the standard version is run in a terminal window.

- `-z zonename` Allocates device to the zone specified by `zonename`.

The following operands are supported:

- `device` Specifies the name of the device to be allocated.
Exit Status  The following exit values are returned:

   0      Successful completion.
   20     No entry for the specified device.
     other value  An error occurred.

Files  /etc/security/device_allocate
        /etc/security/device_maps
        /etc/security/dev/+  
        /etc/security/lib/+  

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>See below.</td>
</tr>
</tbody>
</table>

The invocation is Uncommitted. The options are Uncommitted. The output is Not-an-Interface.

See Also  deallocate(1), list_devices(1), device_allocate(1M), dminfo(1M), mkdevalloc(1M), mkdevmaps(1M), device_allocate(4), device_maps(4), attributes(5)

Controlling Access to Devices

Notes  The functionality described in this man page is available only if Solaris Auditing has been enabled.

The functionality described in this man page is available only if the device_allocate(1M) service is enabled.

On systems configured with Trusted Extensions, the functionality is enabled by default.

/etc/security/dev, mkdevalloc(1M), and mkdevmaps(1M) might not be supported in a future release of the Solaris Operating Environment.
 amt(1)

Name  amt – run abstract machine test

Synopsis  amt [ - s ]

Description  The amt command is for use in a Common Criteria security certified system. The command is used to verify that the low level functions necessary to enforce the object reuse requirements of the Controlled Access Protection Profile are working correctly. /usr/bin/amt is a shell script that executes tests specific to your system. For a 32–bit system, the tests run as a 32–bit application. For a 64–bit system, the tests run twice; once as a 32–bit application and once as a 64–bit application.

amt lists test results with a pass or fail for each test it performs, unless output is suppressed with the - s option.

Options  The following option is supported:
- s  Suppresses output.

Exit Status  The following error values are returned:
0  All tests passed.
>0  Count of the number of tests that failed.
<0  Incorrect command line argument.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  attributes(5)
The appcert utility examines an application's conformance to the Solaris Application Binary Interface (ABI). The Solaris ABI defines the runtime library interfaces in Solaris that are safe and stable for application use. More specifically, appcert identifies any dependencies on unstable runtime interfaces, as well as certain other risks that could cause the product to fail to work on a subsequent release of Solaris.

appcert checks for:

- **Private symbol usage in Solaris libraries.** These are private symbols, that is, functions or data, that are not intended for developer consumption. They are interfaces that Solaris libraries use to call one another. These symbols might change their semantic behavior or even disappear altogether (so-called demoted symbols), so it is a good practice to make sure your application does not depend upon any of them.

- **Static linking.** In particular, this refers to static linking of archives libc.a, libsocket.a, and libnsl.a, that is, instead of dynamically linking the corresponding shared object .so's. Because the semantics of private symbol calls from one Solaris library to another can change from one release to another, it is not a good practice to hardwire library code into your binary objects.

- **Unbound symbols.** These are library symbols (that is, functions or data) that the dynamic linker could not resolve when appcert was run. This might be an environment problem (for example, LD_LIBRARY_PATH) or a build problem (for example, not specifying -l Lib and/or -z defs with compiling). They are flagged to point these problems out and in case a more serious problem is indicated.

An entire product can be readily examined by appcert (that is, if the product is a collection of many programs and supporting shared objects) by referring appcert to the directories where the product is installed.

To perform its task, appcert constructs a profile of interface dependencies for each object file within the product (whether an executable object or shared object), to determine all the Solaris system interfaces that are depended upon. (Notice that appcert uses the Solaris runtime linker to make this determination.) These dependency profiles are then compared to a definition of the Solaris ABI to identify any interfaces that are Private (unsafe and unstable for application-level use).

appcert generates a simple roll-up report that indicates which of the product's components, if any, had liabilities and what those liabilities were. The report aids developers who are examining their product's release-to-release stability.

Notice that appcert produces complete interface dependency information, both the Public (safe and stable) Solaris interfaces and the Private (non-ABI) interfaces. This information can also be examined for each product component, if you want.
IMPORTANT: appcert must run in the same environment in which the application being checked runs. See NOTES.

Options The following options are supported:

-B If appcert is run in batch mode, the output report contains one line per binary, beginning with PASS if no problems were detected for the binary, FAIL if any problems were found, or INC if the binary could not be completely checked. Do not interpret these labels too literally. For example, PASS just means that none of the appcert warnings were triggered. These strings are flush left and so can be selected using grep ^FAIL . . ., and so forth.

-f infile Specifies the file infile that contains a list of files (one per line) to check. This list is appended to the list determined from the command line operands (see OPERANDS below).

-h Prints out the usage information.

-L appcert examines your product for the presence of shared objects. If it finds some, it appends the directories they reside in to LD_LIBRARY_PATH. Use this flag to prevent appcert from doing this.

-n When searching directories for binaries to check, this option does not follow symbolic links. See find(1).

-S Appends Solaris library directories (that is, /usr/openwin/lib:/usr/dt/lib) to LD_LIBRARY_PATH.

-w working_dir Identifies the directory in which to run the library components and create temporary files (default is /tmp).

Operands The following operands are supported:

{obj | dir} ... A complete list of objects and/or directories that contain the objects constituting the product to be checked. appcert recursively searches directories looking for object files; non-object files are ignored.

Exit Status The following exit values are returned:

0 appcert ran successfully and found no potential binary stability problems.
1 appcert failed to run successfully.
2 Some of the objects checked have potential binary stability problems.
3 No binary objects were located that could be checked.

Limitations If the object file to be examined depends on libraries, those dependencies must be recorded in it (by using the compiler’s -l switch).
If the object file to be examined depends on other shared libraries, those libraries must be accessible by way of LD_LIBRARY_PATH or RUNPATH when appcert is run.

To check 64-bit applications, the machine must be running the 64-bit Solaris kernel. See isalist(1). Also, the checks for static linking are currently not done on 64-bit applications.

appcert cannot examine:

- Object files that are completely or partially statically linked.
  - Completely statically linked objects are reported as unstable.
- Executable files that do not have execute permission set.
  - These are skipped. Shared objects without execute permission are not skipped.
- Object files that are setuid root.
  - Due to limitations in ldd(1), these are skipped. Copy and/or change the permissions to check them.
- Non-ELF file executables such as shell scripts.
- Non-C language interfaces to Solaris; for example, C++ and Java.
  - The code itself need not be in C as long as the calls to Solaris libraries are in C.

**Output Files**

appcert records its findings in the following files in the working directory (/tmp/appcert.????? by default):

- **Index** A mapping between checked binaries and the subdirectory in the working directory in which the output specific to that binary can be found.
- **Report** A copy of the rollup report that was displayed on stdout when appcert was run.
- **Skipped** A list of binaries that appcert was asked to check but had to skip, along with a brief reason why each was skipped.

In addition, there is per-object information in the subdirectories under appcert.?????/objects/, in the following files:

- **check.demoted_symbols** A list of symbols suspected to be demoted Solaris symbols.
- **check.dynamic.private** A list of private Solaris symbols to which the object makes direct bindings.
- **check.dynamic.public** A list of public Solaris symbols to which the object makes direct bindings.
check.dynamic.unbound  A list of symbols not bound by the dynamic linker when `ldd -r` was run. For convenience, `ldd` output lines containing `file not found` are also included.

summary.dynamic  A pretty-printed summary of dynamic bindings for the objects examined, including tables of Public and Private symbols used from each Solaris library.

Other files are temporary files used internally by appcert.

Output Messages

Private Symbol Use  Private symbols are functions or data variables in a Solaris library that are not intended for developer or external use. These symbols are interfaces that the Solaris libraries use to call and communicate with one another. They are marked in `pvs(1)` output with the symbol version name `SUNWprivate`.

Private symbols can change their semantic behavior or even disappear altogether (demoted or deprecated symbols), so your application should not depend upon any of them.

Demoted Symbols  Demoted symbols are functions or data variables in a Solaris library that were once private to that library and have been removed (or possibly scoped local to the library) in a later Solaris release. If your application directly calls one of these demoted symbols, it fails to run (relocation error) on the release in which the symbol was removed and releases thereafter.

In some rare cases, a demoted symbol returns in a later release, but nevertheless there are still some releases on which the application does not run.

Sun Microsystems Inc. performed most of the library scoping in the transition from Solaris 2.5.1 to 2.6. This action was done to increase binary stability. By making these completely internal interfaces invisible (that is, they cannot be dynamically linked against), a developer cannot accidentally or intentionally call these interfaces. For more information, see the Linker and Libraries Guide, in particular the chapter on versioning.

Unbound Symbols  Unbound symbols are library symbols (that is, functions or data) referenced by the application that the dynamic linker could not resolve when appcert was run. Note: appcert does not actually run your application, so some aspect of the environment that affects dynamic linking might not be set properly.

Unbound symbols do not necessarily indicate a potential binary stability problem. They only mean that when appcert was run, the runtime dynamic linker could not resolve these symbols.

Unbound symbols might be due to `LD_LIBRARY_PATH` not being correctly set. Make sure it is set, so that all of your binary objects can find all of the libraries they depend on (either your product's own libraries, Solaris libraries, or those of a third party). Then re-run appcert.
You might find it useful to write a shell script that sets up the environment correctly and then runs appcert on the binaries you want to check.

Another common cause for unbound symbols is when a shared object under test has not recorded its dynamic dependencies, that is, at build time the -l switch was not supplied to the compiler and ld(1). So the shared object requires that the executables that link against it have the correct dependencies recorded.

Notice that such a shared object can either be linked in the standard way (that is, specified at an executable's build time) or dynamically opened (for example, an executable calls dlOpen(3C) on the shared object sometimes when running). Either case can give rise to unbound symbols when appcert is run. The former can usually be resolved by setting LD_LIBRARY_PATH appropriately before running appcert. The latter (dlOpen) is usually difficult to resolve. Under some circumstances, you might be able to set LD_PRELOAD appropriately to preload the needed libraries, but this procedure does not always work.

How do you know if the environment has been set up correctly so that there is no unbound symbols? It must be set up so that running ldd -r on the binary yields no "file not found" or "symbol not found" errors. See ld.so.1(1) and ldd(1) for more information on dynamic linking.

In any event, appcert flags unbound symbols as a warning in case they might indicate a more serious problem. Unbound symbols can be an indicator of dependencies on demoted symbols (symbols that have been removed from a library or scoped local to it). Dependencies on demoted symbols lead to serious binary stability problems.

However, setting up the environment properly should remove most unbound symbols. In general, it is good practice to record library dependencies at build time whenever possible because it helps make the binary object better defined and self-contained. Also recommended is using the -z def's flag when building shared objects, to force the resolution of all symbols during compilation. See ld(1) for more information.

appcert runs /bin/ldd -r on each binary object to be tested. It sets the environment variable LD_DEBUG="files,bindings". (See ldd(1) and ld.so.1(1) for more information). If that command fails for some reason, appcert have no dynamic symbol binding information and finds "no bindings".

appcert can fail if any of the following is true:

- The binary object does not have read permission.
- The binary object is SUID or SGID and the user does not have sufficient privileges.
- The binary object is an executable without the execute permission bit set.
- The binary object is completely statically linked.
- The binary object has no library dependency information recorded.
Other cases exist as well (for example, out of memory). In general, this flag means that appcert could not completely examine the object due to permissions or environment. Try to modify the permissions or environment so that the dynamic bindings can be recorded.

**Obsolete Library**

An obsolete library is one whose use is deprecated and that might, in some future release, be removed from Solaris altogether. appcert flags these because applications depending on them might not run in future releases of Solaris. All interfaces, including Private ones, in an obsolete library are frozen and does not change.

**Use of sys_errlist/sys_nerr**

Direct use of the symbols `sys_errlist` or `sys_nerr` presents a risk in which reference might be made past the end of the `sys_errlist` array. These symbols are deprecated in 32-bit versions of Solaris and are absent altogether in 64-bit versions. Use ` strerror(3C)` instead.

**Use of Strong vs. Weak Symbols**

The "strong" symbols (for example, `_socket`) associated with "weak" symbols (for example, `socket`) are reserved as private (their behavior could change in the future). Your application should only directly reference the weak symbol (usually the strong symbols begin with ".").

*Note:* Under certain build environments, the strong/private symbol dependency gets recorded into your binary instead of the weak/public one, even though the source code doesn’t appear to reference the private symbol. Nevertheless, steps should be taken to trace down why this is occurring and fix the dependency.

**Notes**

appcert needs to run in the same environment in which the application being checked runs. Otherwise it might not be able to resolve references correctly to interfaces in the Solaris libraries. Take the following steps:

1. Make sure that `LD_LIBRARY_PATH` and any other aspects of the environment are set to whatever settings are used when the application is run. Also make sure that it contains the directories containing any non-Solaris shared objects that are part of the product, so that they can be found when referenced.

2. Make sure that all the binaries to be checked:
   - Are dynamically linked ELF objects
   - Have execute permission set on executables (this is not necessary for shared objects)
   - Are not SUID root (otherwise you have to be root to check them; make non-SUID copies and check those if necessary).

You might find it useful to write a shell script that sets up the environment correctly and then runs `appcert`.

Some potential problems that can be encountered are:

- `appcert` reports unbound symbols that appear to be part of Solaris libraries.
  This is probably caused when the application uses `dlopen(3C)` to access a shared object that does not have its Solaris dependencies recorded. appcert cannot resolve symbol use in such cases, since the dynamic linker is never invoked on the shared object, and there is
no other dependency information that could be used to resolve the Solaris symbol bindings. This can also occur with non-Solaris symbols.

To avoid this problem, make sure that when a shared object is built, its dependencies on Solaris libraries are explicitly recorded by using the `-l` option on the compile line (see `cc(1)` and `ld(1)`).

- _appcert_ reports that the application uses a Solaris private symbol that is not referenced in the application's source code.

  This problem is most likely due to static linking of a Solaris library that references that symbol. Since _appcert_ uses the dynamic linker to resolve symbols, statically linked libraries appear to _appcert_ to be part of the application code (which, in a sense, they are). This can also sometimes happen as a result of macro substitution in a Solaris header file.

  To avoid this problem, whenever possible do not statically link Solaris library archives into your application.

- _appcert_ does not recognize a library as part of Solaris.

  Some obsolete Solaris libraries are so old that they were obsoleted before their symbols could be versioned. Consequently, _appcert_ cannot recognize them as being part of Solaris.

**Bugs**

The use of the terms "public" and "private" as equivalent to "stable" and "unstable" is unfortunately somewhat confusing. In particular, experimental or evolving interfaces are public in the sense that they are documented and their use is encouraged. But they are unstable, because an application built with them might not run on subsequent releases. Thus, they are classified as private for _appcert_'s purposes until they are no longer evolving. Conversely, obsolete interfaces eventually disappears, and so are unstable, even though they have been public and stable in the past and are still treated as public by _appcert_. Fortunately, these two situations are rare.

**Attributes**

See _attributes(5)_ for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/appcert</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

**See Also**

`cc(1), find(1), isalist(1), ld(1), ldd(1), ld.so.1(1), pvs(1), dlopen(3C), strerror(3C), Intro(4), attributes(5)`
apptrace(1)

Name  apptrace – trace application function calls to Solaris shared libraries

Synopsis  apptrace [-f] [-F [!] tracefromlist] [-T [!] tracetolist]
         [-o outputfile] [ [-v] [!] call ,...,] command
         [command arguments]

Description  The apptrace utility runs the executable program specified by command and traces all function calls that the program command makes to the Solaris shared libraries. For each function call that is traceable, apptrace reports the name of the library interface called, the values of the arguments passed, and the return value.

By default, apptrace traces calls directly from the executable object to any of the shared objects it depends on. Indirect calls (that is, calls made between shared objects that the executable depends upon) are not reported by default.

Calls from or to additional shared objects may be traced using the -F or -T options (see below).

The default reporting format is a single line per call, with no formatted printing of arguments passed by reference or of data structures.

Formatted printing providing additional argument details is obtained using the -v option (see below).

By default, every interface provided by a shared object is traced if called. However, the set of interfaces to be traced can be restricted, using the -t and/or -v options.

Since it is generally possible to trace calls between any of the dynamic objects linked at runtime (the executable object and any of the shared objects depended upon), the report of each traced call gives the name of the object from which the call was made.

apptrace traces all of the procedure calls that occur between dynamic objects via the procedure linkage table, so only those procedure calls which are bound via the table will be traced. See the Linker and Libraries Guide.

Options  The following options are supported:

- f
          Follows all children created by fork(2). This option will also cause the process id to be printed at the beginning of each line.

- F [!] tracefromlist
          Traces calls from a comma-separated list of shared objects. Only calls from these shared objects will be traced. The default is to trace calls from the main executable only. Only the basename of the shared object is required. For example, libc will match /usr/lib/libc.so.1. Additionally, shell style wildcard characters are supported as described in fnmatch(5). A list preceded by a "!" defines a list of objects from which calls should not be traced. If the tracing of calls from command is required, then command must be a member of tracefromlist.
-o outputfile
  apptrace output will be directed to the outputfile. By default, apptrace output is placed on the stderr stream of the process being traced.

-t ![call,...
  Traces or excludes function calls. Those calls specified in the comma-separated list call are traced. If the list begins with a `!`, the specified function calls are excluded from the trace output. The default is `-t *`. The use of shell style wildcards is allowed.

-T ![tracetolist
  Traces calls to a comma-separated list of shared objects. The default is to trace calls to all shared objects. As above, the basename is all that is required and wildcarding is allowed. A list preceded by a `"!"` denotes a list of objects to which calls should not be traced.

-v ![call,...
  Provides verbose, formatted output of the arguments and return values of the function calls specified (as above in the `-t` option). Unlike `truss(1)`, calls named by the `-v` option do not have to be named by the `-t` option. For example, `apptrace -v open` is equivalent to `truss -t open -v open`.

**Examples**

**EXAMPLE 1**  Tracing the date command

```
% apptrace date
-> date    -> libc.so.1:atexit(0xff3bf9ac, 0x22000, 0x0) ** NR
-> date    -> libc.so.1:atexit(0x11550, 0xfee00, 0xab268) ** NR
-> date    -> libc.so.1:setlocale(0x6, 0x11560, 0x0) ** NR
-> date    -> libc.so.1:textdomain(0x11564, 0xfeece156, 0xfff160200) ** NR
-> date    -> libc.so.1:int getopt(int = 0x1, const char**= 0xffbffa5c, const char * = 0x11574 "a:u")
<- date    -> libc.so.1:getopt() = 0xffffffff
-> date    -> libc.so.1:time_t time(time_t * = 0x225c0)
<- date    -> libc.so.1:time() = 0x41ab6e82
-> date    -> libc.so.1:char * nl_langinfo(nl_item = 0x3a)
<- date    -> libc.so.1:nl_langinfo() = 0xfefd3e10
-> date    -> libc.so.1:struct tm * localtime(const time_t * = 0x225c0)
<- date    -> libc.so.1:localtime() = 0xfff160240
-> date    -> libc.so.1:memcpy(0xffbff9cc, 0xfff160240, 0x24) ** NR
-> date    -> libc.so.1:size_t strftime(char * = 0x225c4 "", size_t = 0x400, const char * = 0xfefd3e10 "%a %b %e %T %Z %Y", const struct tm * = 0xffbff9cc)
<- date    -> libc.so.1:strftime() = 0x1c
-> date    -> libc.so.1:int puts(const char * = 0x225c4 "Mon Nov 29 10:46:26 PST 2004")
  Mon Nov 29 10:46:26 PST 2004
<- date    -> libc.so.1:puts() = 0x1d
-> date    -> libc.so.1:exit(0x0, 0x22400, 0x0) ** NR
```
EXAMPLE 2  Tracing a specific set of interfaces with verbosity set

% apptrace -v localtime,strftime,puts date

-> date
  -> libc.so.1:struct tm * localtime(const time_t * = 0x225c0)
    arg0 = (const time_t *) 0x225c0
    return = (struct tm *) 0xff160280 (struct tm) {
      tm_sec: (int) 0x4
      tm_min: (int) 0x34
      tm_hour: (int) 0xa
      tm_mday: (int) 0x1d
      tm_mon: (int) 0xa
      tm_year: (int) 0x68
      tm_wday: (int) 0x1
      tm_yday: (int) 0x14d
      tm_isdst: (int) 0
    }

<- date
  -> libc.so.1:localtime() = 0xff160280

-> date
  -> libc.so.1:size_t strftime(char * = 0x225c4
                                 size_t = 0x400,
                                 const char * = 0xfefd3e10
                                "%a %b %e %T %Z %Y",
                                const struct tm * = 0xffbff99c)
    arg0 = (char *) 0x225c4
    arg1 = (size_t) 0x400
    arg2 = (const char *) 0xfefd3e10
    arg3 = (const struct tm *) 0xffbff99c (struct tm) {
      tm_sec: (int) 0x4
      tm_min: (int) 0x34
      tm_hour: (int) 0xa
      tm_mday: (int) 0x1d
      tm_mon: (int) 0xa
      tm_year: (int) 0x68
      tm_wday: (int) 0x1
      tm_yday: (int) 0x14d
      tm_isdst: (int) 0
    }
    return = (size_t) 0x1c

<- date
  -> libc.so.1:strftime() = 0x1c

-> date
  -> libc.so.1:int puts(const char * = 0x225c4
                        "Mon Nov 29 10:52:04 PST 2004")
    arg0 = (const char *) 0x225c4
    return = (int) 0x1d

<- date
  -> libc.so.1:puts() = 0x1d

** NR - The return value of a function call will not be traced.
Basic runtime support for apptrace is provided by the link auditing feature of the Solaris runtime linker (ld.so.1) and the apptrace command’s use of this facility relies on an auditing object (apptrace.so.1) kept in /usr/lib/abi.

In general, apptrace cannot trace calls to functions accepting variable argument lists. There has been some clever coding in several specific cases to work around this limitation, most notably in the printf and scanf families.

The apptrace utility cannot trace the return value of a function call whose return type is a struct or union.

Functions that attempt to probe the stack or otherwise extract information about the caller cannot be traced. Some examples are [gs]etcontext(), [sig]longjmp(), [sig]setjmp(), and vfork().

Functions such as exit(2) that do not return will not be traced for their return values.

For security reasons, only those processes with appropriate privileges can use apptrace to trace setuid/setgid programs.

Tracing functions whose usage requires the inclusion of <varargs.h>, such as vwprintw(3XCURSES) and vwscanf(3XCURSES), will not provide formatted printing of arguments.

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/apptrace (32-bit)</td>
</tr>
<tr>
<td></td>
<td>SUNWcstlx (64-bit)</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Uncommitted</td>
</tr>
</tbody>
</table>

See Also: ld.so.1(1), truss(1), vwprintw(3XCURSES), vwscanf(3XCURSES), attributes(5), fnmatch(5)

Linker and Libraries Guide
The `apropos` utility displays the manual page name, section number, subsection name, the `keyword`, and a short description for each manual page that contains `keyword`.

This information is contained in the index files that are either automatically created by an SMF service as described in `man(1)` and `man(5)`, or manually created using `catman(1M)` with `-w` option.

Each word is considered separately and the case of letters is ignored. Stemming on English words and section matching are also supported. Words which are part of other words are considered. For example, when looking for `compile`, `apropos` finds all instances of `compiler` as well.

As `apropos` is simply the `-k` option to the `man(1)` command, see `man(1)` for more details.

**EXAMPLE 1** Finding a Manual Page with a Name Line Containing `keyword`

Try
```bash
example% apropos password
```

and
```bash
example% apropos editor
```

If the line starts `filename(section) ...`, you can run
```bash
man -s section filename
```
to display the manual page for `filename`.

**EXAMPLE 2** Finding a Manual Page for the `printf()` Subroutine

Try
```bash
example% apropos format
```

and then
```bash
example% man -s 3s printf
```
to get the manual page on the subroutine `printf()`.
Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>text/doctools</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also man(1), whatis(1), catman(1M), attributes(5), man(5)
Name  ar – maintain portable archive or library

Synopsis  /usr/bin/ar -d [-SVv] archive file...
          /usr/bin/ar -m [-abiSVv] [posname] archive file...
          /usr/bin/ar -p [-SsVv] archive [file]...
          /usr/bin/ar -q [-cSVv] archive file...
          /usr/bin/ar -r [-abciuSVv] [posname] archive file...
          /usr/bin/ar -t [-SsVv] archive [file]...
          /usr/bin/ar -x [-CSsTVv] archive [file]...
          /usr/xpg4/bin/ar -d [-SVv] archive file...
          /usr/xpg4/bin/ar -m [-abiSVv] [posname] archive file...
          /usr/xpg4/bin/ar -p [-SsVv] archive [file]...
          /usr/xpg4/bin/ar -q [-cSVv] archive file...
          /usr/xpg4/bin/ar -r [-abciuSVv] [posname] archive file...
          /usr/xpg4/bin/ar -t [-SsVv] archive [file]...
          /usr/xpg4/bin/ar -x [-CSsTVv] archive [file]...

Description  The ar utility maintains groups of files combined into a single archive file. Its main use is to create and update library files. However, it can be used for any similar purpose. The magic string and the file headers used by ar consist of printable ASCII characters. If an archive is composed of printable files, the entire archive is printable.

When ar creates an archive, it creates headers in a format that is portable across all machines. The portable archive format and structure are described in detail in ar.h(3HEAD). The archive symbol table described there is used by the link editor ld(1) to effect multiple passes over libraries of object files in an efficient manner. An archive symbol table is only created and maintained by ar when there is at least one object file in the archive. The archive symbol table is in a specially named file that is always the first file in the archive. This file is never mentioned or accessible to the user. Whenever the ar command is used to create or update the contents of such an archive, the symbol table is rebuilt. The -s option described below forces the symbol table to be rebuilt.

Options  The following options are supported:

- a
  Positions new files in archive after the file named by the posname operand.

- b
  Positions new files in archive before the file named by the posname operand.
-c
 Suppresses the diagnostic message that is written to standard error by default when archive is created.

-C
 Prevents extracted files from replacing like-named files in the file system. This option is useful when -T is also used to prevent truncated file names from replacing files with the same prefix.

-d
 Deletes one or more files from archive.

-i
 Positions new files in archive before the file named by the posname operand. This option is equivalent to -b.

-m
 Moves files. If -a, -b, or -i with the posname operand are specified, the -m option moves files to the new position. Otherwise, -m moves files to the end of archive.

-p
 Prints the contents of files in archive to standard output. If no files are specified, the contents of all files in archive are written in the order of the archive.

-q
 Quickly appends files to the end of archive. Positioning options -a, -b, and -i are invalid. The command does not check whether the added files are already in archive. This option is useful to avoid quadratic behavior when creating a large archive piece-by-piece.

-r
 Replaces or adds files in archive. If archive does not exist, a new archive file is created and a diagnostic message is written to standard error, unless the -c option is specified. If no files are specified and the archive exists, the results are undefined. Files that replace existing files do not change the order of the archive. If the -u option is used with the -r option, only those files with dates of modification later than the archive files are replaced. If the -a, -b, or -i option is used, the posname argument must be present and specifies that new files are to be placed after (-a) or before (-b or -i) posname. Otherwise, the new files are placed at the end.

-s
 Forces the regeneration of the archive symbol table even if ar is not invoked with an option that will modify the archive contents. This command is useful to restore the archive symbol table after the strip(1) command has been used on the archive.

-S
 When building the archive symbol table, force the use of the 64–bit capable symbol table format. By default, the 32–bit format is used for all archives smaller than 4GB, and the larger format is used for larger archives that exceed the 32–bit limit.
Prints a table of contents of archive. The files specified by the file operands are included in the written list. If no file operands are specified, all files in archive are included in the order of the archive.

- T

Allows file name truncation of extracted files whose archive names are longer than the file system can support. By default, extracting a file with a name that is too long is an error. In that case, a diagnostic message is written and the file is not extracted.

-u

Updates older files. When used with the -r option, files within archive are replaced only if the corresponding file has a modification time that is at least as new as the modification time of the file within archive.

-v

Gives verbose output. When used with options -d, -r, or -x, the -v option writes a detailed file-by-file description of the archive creation and the constituent files, and maintenance activity. When used with -p, -v writes the name of the file to the standard output before writing the file itself to the standard output. When used with -t, -v includes a long listing of information about the files within the archive. When used with -x, -v prints the filename preceding each extraction. When writing to an archive, -v writes a message to the standard error.

-V

Prints its version number on standard error.

The following options are supported for /usr/xpg4/bin/ar:

- v  Same as the /usr/bin/ar version, except when writing to an archive, no message is written to the standard error.

- x  Extracts the files named by the file operands from archive. The contents of archive are not changed. If no file operands are given, all files in archive are extracted. If the file name of a file extracted from archive is longer than that supported in the directory to which it is being extracted, the results are undefined. The modification time of each file extracted is set to the time file is extracted from archive.

Operands  The following operands are supported:

archive    A path name of the archive file.

file       A path name. Only the last component is used when comparing against the names of files in the archive. If two or more file operands have the same last path name component (see basename(1)), the results are unspecified. The implementation’s archive format will not truncate valid file names of files added to or replaced in the archive.
posname  The name of a file in the archive file, used for relative positioning. See options -m and -r.

### Environment Variables

See `environ(5)` for descriptions of the following environment variables that affect the execution of `ar`: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, LC_TIME, and NLSPATH.

- **TMPDIR**  Determine the pathname that overrides the default directory for temporary files, if any.
- **TZ**  Determine the timezone used to calculate date and time strings written by `ar -tv`. If TZ is unset or null, an unspecified default timezone is used.

### Exit Status

The following exit values are returned:

- 0  Successful completion.
- >0  An error occurred.

### Attributes

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>/usr/bin/ar</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td></td>
<td>system/linker</td>
</tr>
<tr>
<td>Interface Stability</td>
<td></td>
<td>Committed</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>/usr/xpg4/bin/ar</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td></td>
<td>system/xopen/xcu4</td>
</tr>
<tr>
<td>Interface Stability</td>
<td></td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td></td>
<td>See <code>standards(5)</code></td>
</tr>
</tbody>
</table>

### See Also

`basename(1), cpio(1), elffile(1), file(1), ld(1), lorder(1), strip(1), tar(1), ar.h(3HEAD), a.out(4), attributes(5), environ(5), standards(5)`

### Notes

If the same file is mentioned twice in an argument list, it may be put in the archive twice.

By convention, archives are suffixed with ".a".

When inserting ELF objects into an archive file, `ar` might add \n characters to pad these objects to an 8-byte boundary. Such padding improves the efficiency with which `ld(1)` can access the archive. Only ELF object files are padded in this way. Other archive members are not altered. When an object with such padding is extracted from an archive, the padding is not included in the resulting output.

It is faster to create a new archive from scratch than to insert individual files into an existing archive via separate calls to `ar`. When possible, the recommended strategy is to remove the existing archive, and recreate it with a single `ar` invocation.
The overall size of an archive is allowed to exceed 4GB. However, the size of any individual file within an archive is limited to 4GB by the archive file format. See `ar.h(3HEAD)`.

The maximum user ID and group ID for an individual file within an archive are limited to 6 decimal digits by the archive file format. Any file with a user or group ID greater than 999999 is quietly set to user ID "nobody" (60001) or group ID "nobody" (6001). See `ar.h(3HEAD)`.
arch(1)

Name
arch – display the architecture of the current host

Synopsis
arch [-k | archname]

Description
The arch utility displays the application architecture of the current host system. Due to extensive historical use of this command without any options, all SunOS 5.x SPARC based systems will return "sun4" as their application architecture. Use of this command is discouraged. See NOTES section below.

Systems can be broadly classified by their architectures, which define what executables will run on which machines. A distinction can be made between kernel architecture and application architecture (or, commonly, just "architecture"). Machines that run different kernels due to underlying hardware differences may be able to run the same application programs.

Options
-k Displays the kernel architecture, such as sun4u. This defines which specific SunOS kernel will run on the machine, and has implications only for programs that depend on the kernel explicitly (for example, ps(1)).

Operands
The following operand is supported:
archname Use archname to determine whether the application binaries for this application architecture can run on the current host system. The archname must be a valid application architecture, such as sun4, i86pc, and so forth.

If application binaries for archname can run on the current host system, TRUE (0) is returned. Otherwise, FALSE (1) is returned.

Exit Status
The following exit values are returned:
0 Successful completion.
>0 An error occurred.

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also
mach(1), ps(1), uname(1), attributes(5)

Notes
This command is provided for compatibility with previous releases and its use is discouraged. Instead, the uname command is recommended. See uname(1) for usage information.
Name  as – assembler

Synopsis  SPARC

as [ -hwcap={1|0} ] [ -L ] [ -m ] [ -m32 ] [ -m64 ]
    [ -n ] [ -o outfile ] [ -ul ] [ -P ]
    [ -Dname ] [ -Dname=def ] [ -Ipath ]
    [ -Uname,... ] [ -O{y|n} ] [ -s ]
    [ -S{a|b|c|l|A|B|C|L} ] [ -V ] [ -xarch=v ]
    [ -xF ] [ -Y{m|c},path ] [ -YI,path ] filename...

x86

as [ -a32 ] [ -m ] [ -m32 ] [ -m64 ] [ -n ]
    [ -H ] [ -nH ] [ -o outfile ]
    [ -P ] [ -Dname ] [ -Dname=def ] [ -Ipath ]
    [ -Uname,... ]
    [ -KPIC ] [ -O{y|n} ] [ -s ] [ -S{a|b|c|l|A|B|C|L} ] [ -V ]
    [ -xF ] [ -xchip=v ] [ -xmodel=[a] ]
    [ -Y{m|d},path ] [ -YI,path ] filename...

Description  The as command creates object files from assembly language source files.

Options  This section is divided into three:

- Common Options (options common to both SPARC and x86)
- SPARC Options
- x86 Options

Common Options  

-Dname

-Dname=def

When the -P option is in effect, these options are passed to the cpp(1) preprocessor without interpretation by the as command; otherwise, they are ignored.

-I path

When the -P option is in effect, this option is passed to the cpp(1) preprocessor without interpretation by the as command; otherwise, it is ignored.

-i

Instructs as to ignore line-number information from the preprocessor.

-m

Run the m4(1) macro processor on the input to the assembler.

-m32| -m64

Generate 32-bit or 64-bit ELF format object code.

-n

Suppress all the warnings while assembling.
- o outfile
   Put the output of the assembly in outfile. By default, the output file name is formed by
   removing the .s suffix, if there is one, from the input file name and appending an .o suffix.

- P
   Run cpp(1), the C preprocessor, on the files being assembled. The preprocessor is run
   separately on each input file, not on their concatenation. The preprocessor output is
   passed to the assembler.

- Q[y|n]
   If the y option is specified, it produces the "assembler version" information in the comment
   section of the output object file. If the n option is specified, the information is suppressed.

- S[a|b|c|l|A|B|C|L]
   Produces a disassembly of the emitted code to the standard output. Adding each of the
   following characters to the - S option produces:
   
   a  Disassembling with address
   b  Disassembling with .bof
   c  Disassembling with comments
   l  Disassembling with line numbers.
   
   Capital letters switch the corresponding option off. The default is - Sc.

- s
   Place all stabs in the .stabs section. By default, stabs are placed in stabs .excl sections,
   which are stripped out by the static linker, ld(1), during final execution. When the - s
   option is used, stabs remain in the final executable because .stab sections are not stripped
   by the static linker.

- Uname
   When the - P option is in effect, this option is passed to the cpp(1) preprocessor without
   interpretation by the as command; otherwise, it is ignored.

- Ym.path
   Specify path to the version of m4 to use.

- YI.path
   Indicate path to search for #include header files.

SPARC Options

- hwcap={1|0}
   Enable (1) or suppress (0) the generation of the Hardware Capabilities section. Default is to
   generate the section.

- L
   Save all symbols, including temporary labels that are normally discarded to save space, in
   the ELF symbol table.
-ul
   Treat all undefined symbols as local.

-Yc,path
   Specify path to the version of cpp to use.

-xarch=sparc
   Enables the assembler to accept instructions defined in the SPARC-V9 architecture. The resulting object code is in ELF32 format when compiled with -m32, ELF64 format with -m64. It will not execute on an Oracle Solaris V8 system (a machine with a V8 processor). It will execute on a Oracle Solaris V8+ system.

-xarch=sparcvis
   Enables the assembler to accept instructions defined in the SPARC-V9 architecture plus the instructions in the Visual Instruction Set (VIS) version 1.0. The resulting object code is in V8+ ELF32 format when compiled with -m32, ELF64 format with -m64. It will not execute on a Oracle Solaris system with a V8 processor. It will execute on a Oracle Solaris system with a V8+ processor.

-xarch=sparcvis2
   Enables the assembler to accept instructions defined in the SPARC-V9 architecture, plus the instructions in the Visual Instruction Set (VIS) version 2.0, with UltraSPARC-III extensions. The resulting object code is in V8+ ELF32 format when compiled with -m32, ELF64 format with -m64.

-xarch=sparcvis3
   Accept instructions defined for the SPARC VIS version 3 of the SPARC-V9 ISA which are instructions from the SPARC-V9 instruction set, plus the UltraSPARC extensions, including the Visual Instruction Set (VIS) version 1.0, the UltraSPARC-III extensions, including the Visual Instruction Set (VIS) version 2.0, the fused multiply-add instructions, and the Visual Instruction Set (VIS) version 3.0.

-xarch=sparcfmaf
   Accept instructions defined for the sparcfmaf version of the SPARC-V9 ISA, plus the UltraSPARC extensions, including the Visual Instruction Set (VIS) version 1.0, the UltraSPARC-III extensions, including the Visual Instruction Set (VIS) version 2.0, and the SPARC64 VI extensions for floating-point multiply-add.

-xarch=sparcima
   Accept instructions defined for the sparcima version of the SPARC-V9 ISA which are instructions from the SPARC-V9 instruction set, plus the UltraSPARC extensions, including the Visual Instruction Set (VIS) version 1.0, the UltraSPARC-III extensions, including the Visual Instruction Set (VIS) version 2.0, the SPARC64 VI extensions for floating-point multiply-add, and the SPARC64 VII extensions for integer multiply-add.

-xarch=sparc4
   Accept instructions defined for the sparc4 version of the SPARC-V9 ISA, which are instructions from the SPARC-V9 instruction set, plus the extensions, which includes VIS.
1.0, the UltraSPARC-III extensions, which includes VIS 2.0, the fused floating-point multiply-add instructions, VIS 3.0, and SPARC4 instructions.

-xarch=v9
Equivalent to: -m64 -xarch=sparc

-xarch=v9a
Equivalent to: -m64 -xarch=sparcvis

-xarch=v9b
Equivalent to: -m64 -xarch=sparcvis2

-xF
Generates additional information for use by the Oracle Solaris Studio performance Analyzer. If the input file does not contain any stabs (debugging directives), then the assembler will generate the default stabs needed by the Oracle Solaris Studio analyzer. Also see the dbx(1) Oracle Sun Studio manual page.

The assembler accepts the instruction sets for the following recognized -xchip values:

generic  generic x86 instruction set.
native   this host processor.
core2    Intel Core2 processor.
nehalem  Intel Nehalem processor.
opteron  AMD Opteron processor.
penryn   Intel Penryn processor.
pentium  Intel Pentium architecture.
pentium_pro Intel Pentium Pro architecture.

User Commands 63
pentium3  Intel Pentium 3 style processor.
pentium4  Intel Pentium 4 style processor.
sandybridge  Intel Sandy Bridge processor.
westmere  Intel Westmere processor.
amdfam10  AMD FAM10 processor.
ivybridge  Intel Ivy Bridge processor.
haswell  Intel Haswell processor.

-xmodel=[small | medium | kernel]
For -m64 only, generate R_X86_64_32S relocatable type for data access under kernel.
Otherwise, generate R_X86_64_32 under small. SHN_AMD64_LCOMMON and .lbcomm support
added under medium. small is the default.

-Yd,path
Specify path to the version of cm4defs to use.

Environment
Variables
TMPDIR
as normally creates temporary files in the directory /tmp. You may specify another
directory by setting the environment variable TMPDIR to your chosen directory. (If TMPDIR
is not a valid directory, then as will use /tmp).

Files
By default, as creates its temporary files in /tmp.

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also
cpp(1), ld(1), m4(1), nm(1), strip(1), tmpnam(3C), a.out(4), attributes(5)

Notes
On SPARC platforms, the cpp symbol __sparc is set when the flag -P appears, as well as
__sparcv8 with the -m32 flag, and __sparcv9 with the -m64 flag.
On x86/x64, the symbol __i386 is set when the flag -P appears, as well as __amd64 with the
-m64 flag.
If the -m (invoke the m4(1) macro processor) option is used, keywords for m4 cannot be used as
symbols (variables, functions, labels) in the input file since m4 cannot determine which
keywords are assembler symbols and which keywords are real m4 macros.
Whenever possible, you should access the assembler through a compilation system interface
program such as the Oracle Solaris Studio C compiler, cc, to ensure proper library linking. See
the cc(1) Oracle Solaris Studio man page.
Name
asa – convert FORTRAN carriage-control output to printable form

Synopsis
asa [-f] [file]...

Description
The asa utility will write its input files to standard output, mapping carriage-control characters from the text files to line-printer control sequences.

The first character of every line will be removed from the input, and the following actions will be performed.

If the character removed is:
SPACE   The rest of the line will be output without change.
0       It is replaced by a NEWLINE control sequence followed by the rest of the input line.
1       It is replaced by a NEWPAGE control sequence followed by the rest of the input line.
+       It is replaced by a control sequence that causes printing to return to the first column of the previous line, where the rest of the input line is printed.

For any other character in the first column of an input line, asa skips the character and prints the rest of the line unchanged.

If asa is called without providing a filename, the standard input is used.

Options
The following option is supported:
- f       Start each file on a new page.

Operands
The following operand is supported:
file      A pathname of a text file used for input. If no file operands are specified, or is specified, the standard input will be used.

Environment Variables
See environ(5) for descriptions of the following environment variables that affect the execution of asa: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status
The following exit values are returned:
0       All input files were output successfully.
>0      An error occurred.

Attributes
See attributes(5) for descriptions of the following attributes:
<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also  attributes(5), environ(5), standards(5)
The at utility reads commands from standard input and groups them together as an at-job, to be executed at a later time.

The at-job is executed in a separate invocation of the shell, running in a separate process group with no controlling terminal, except that the environment variables, current working directory, file creation mask (see umask(1)), and system resource limits (for sh and ksh88 only, see ulimit(1)) in effect when the at utility is executed is retained and used when the at-job is executed.

When the at-job is submitted, the at_job_id and scheduled time are written to standard error. The at_job_id is an identifier that is a string consisting solely of alphanumeric characters and the period character. The at_job_id is assigned by the system when the job is scheduled such that it uniquely identifies a particular job.

User notification and the processing of the job’s standard output and standard error are described under the -m option.

Users are permitted to use at and batch (see below) if their name appears in the file /usr/lib/cron/at.allow. If that file does not exist, the file /usr/lib/cron/at.deny is checked to determine if the user should be denied access to at. If neither file exists, only a user with the solaris.jobs.user authorization is allowed to submit a job. If only at.deny exists and is empty, global usage is permitted. The at.allow and at.deny files consist of one user name per line.
cron and at jobs are not be executed if the user’s account is locked. Only accounts which are not locked as defined in shadow(4) will have their job or process executed.

**batch**  The **batch** utility reads commands to be executed at a later time.

Commands of the forms:

```
/usr/bin/batch [-p project]
/usr/xpg4/bin/batch [-p project]
```

are respectively equivalent to:

```
/usr/bin/at -q b [-p project] now
/usr/xpg4/bin/at -q b -m [-p project] now
```

where queue b is a special at queue, specifically for batch jobs. Batch jobs are submitted to the batch queue for immediate execution. Execution of submitted jobs can be delayed by limits on the number of jobs allowed to run concurrently. See queuedefs(4).

**Options**  If the -c, -k, or -s options are not specified, the SHELL environment variable by default determines which shell to use.

For `/usr/xpg4/bin/at` and `/usr/xpg4/bin/batch`, if SHELL is unset or NULL, `/usr/xpg4/bin/sh` is used.

For `/usr/bin/at` and `/usr/bin/batch`, if SHELL is unset or NULL, `/bin/sh` is used.

The following options are supported:

- `-c`  C shell. `csh(1)` is used to execute the at-job.
- `-k`  Korn shell. `/bin/ksh` is used to execute the at-job.
- `-s`  Bourne shell. `sh(1)` is used to execute the at-job.
- `-f file`  Specifies the path of a file to be used as the source of the at-job, instead of standard input.
- `-l`  (The letter ell.) Reports all jobs scheduled for the invoking user if no `at_job_id` operands are specified. If `at_job_ids` are specified, reports only information for these jobs.
- `-m`  Sends mail to the invoking user after the at-job has run, announcing its completion. Standard output and standard error produced by the at-job are mailed to the user as well, unless redirected elsewhere. Mail is sent even if the job produces no output.

If `-m` is not used, the job’s standard output and standard error is provided to the user by means of mail, unless they are redirected elsewhere; if there is no such output to provide, the user is not notified of the job’s completion.
-p project Specifies under which project the at or batch job is run. When used with the -l option, limits the search to that particular project. Values for project is interpreted first as a project name, and then as a possible project ID, if entirely numeric. By default, the user’s current project is used.

-q queuename Specifies in which queue to schedule a job for submission. When used with the -l option, limits the search to that particular queue. Values for queuename are limited to the lowercase letters a through z. By default, at-jobs are scheduled in queue a. In contrast, queue b is reserved for batch jobs. Since queue c is reserved for cron jobs, it can not be used with the -q option.

-r at_job_id Removes the jobs with the specified at_job_id operands that were previously scheduled by the at utility.

-t time Submits the job to be run at the time specified by the time option-argument, which must have the format as specified by the touch(1) utility.

Operands The following operands are supported:

at_job_id The name reported by a previous invocation of the at utility at the time the job was scheduled.

timespec Submit the job to be run at the date and time specified. All of the timespec operands are interpreted as if they were separated by space characters and concatenated. The date and time are interpreted as being in the timezone of the user (as determined by the TZ variable), unless a timezone name appears as part of time below.

In the C locale, the following describes the three parts of the time specification string. All of the values from the LC_TIME categories in the C locale are recognized in a case-insensitive manner.

time The time can be specified as one, two or four digits. One- and two-digit numbers are taken to be hours, four-digit numbers to be hours and minutes. The time can alternatively be specified as two numbers separated by a colon, meaning hour:minute. An AM/PM indication (one of the values from the am_pm keywords in the LC_TIME locale category) can follow the time; otherwise, a 24-hour clock time is understood. A timezone name of GMT, UCT, or ZULU (case insensitive) can follow to specify that the time is in Coordinated Universal Time. Other timezones can be specified using the TZ environment variable. The time field can also be one of the following tokens in the C locale:

midnight Indicates the time 12:00 am (00:00).
noon  Indicates the time 12:00 pm.
now   Indicate the current day and time. Invoking at now submits an at-job for potentially immediate execution (that is, subject only to unspecified scheduling delays).

date  An optional date can be specified as either a month name (one of the values from the mon or abmon keywords in the LC_TIME locale category) followed by a day number (and possibly year number preceded by a comma) or a day of the week (one of the values from the day or abday keywords in the LC_TIME locale category). Two special days are recognized in the C locale:

    today    Indicates the current day.
    tomorrow Indicates the day following the current day.

    If no date is given, today is assumed if the given time is greater than the current time, and tomorrow is assumed if it is less. If the given month is less than the current month (and no year is given), next year is assumed.

increment  The optional increment is a number preceded by a plus sign (+) and suffixed by one of the following: minutes, hours, days, weeks, months, or years. (The singular forms are also accepted.) The keyword next is equivalent to an increment number of +1.

For example, the following are equivalent commands:

    at 2pm + 1 week
    at 2pm next week

Usage  The format of the at command line shown here is guaranteed only for the C locale. Other locales are not supported for midnight, noon, now, mon, abmon, day, abday, today, tomorrow, minutes, hours, days, weeks, months, years, and next.

Since the commands run in a separate shell invocation, running in a separate process group with no controlling terminal, open file descriptors, traps and priority inherited from the invoking environment are lost.

Examples

at  EXAMPLE 1  Typical Sequence at a Terminal

This sequence can be used at a terminal:

    $ at -m 0730 tomorrow
    sort < file >outfile
    <EOB>
EXAMPLE 2 Redirecting Output

This sequence, which demonstrates redirecting standard error to a pipe, is useful in a command procedure (the sequence of output redirection specifications is significant):

```
$ at now + 1 hour <<!
diff file1 file2 2>&1 >outfile | mailx mygroup
```

EXAMPLE 3 Self-rescheduling a Job

To have a job reschedule itself, at can be invoked from within the at-job. For example, this daily-processing script named my.daily runs every day (although crontab is a more appropriate vehicle for such work):

```
# my.daily runs every day
at now tomorrow < my.daily
daily-processing
```

EXAMPLE 4 Various Time and Operand Presentations

The spacing of the three portions of the C locale timespec is quite flexible as long as there are no ambiguities. Examples of various times and operand presentations include:

```
at 0815am Jan 24
at 8:15am Jan 24
at now "+ 1day"
at 5 pm FRIday
at '17 utc+
   30 minutes'
```

EXAMPLE 5 Typical Sequence at a Terminal

This sequence can be used at a terminal:

```
$ batch
sort <file >outfile
<EOT>
```

EXAMPLE 6 Redirecting Output

This sequence, which demonstrates redirecting standard error to a pipe, is useful in a command procedure (the sequence of output redirection specifications is significant):

```
$ batch <<!
diff file1 file2 2>&1 >outfile | mailx mygroup
```

See environ(5) for descriptions of the following environment variables that affect the execution of at and batch: LANG, LC_ALL, LC_TYPE, LC_MESSAGES, NLSPATH, and LC_TIME.
If the environment variable `DATEMSK` is set, `at` uses its value as the full path name of a template file containing format strings. The strings consist of format specifiers and text characters that are used to provide a richer set of allowable date formats in different languages by appropriate settings of the environment variable `LANG` or `LC_TIME`. The list of allowable format specifiers is located in the `getdate(3C)` manual page. The formats described in the `OPERANDS` section for the `time` and `date` arguments, the special names `noon`, `midnight`, `now`, `next`, `today`, `tomorrow`, and the `increment` argument are not recognized when `DATEMSK` is set.

Determine a name of a command interpreter to be used to invoke the `at`-job. If the variable is unset or `NULL`, `sh` is used. If it is set to a value other than `sh`, the implementation uses that shell; a warning diagnostic is printed telling which shell will be used.

Determine the timezone. The job is submitted for execution at the time specified by `timespec` or `-t time` relative to the timezone specified by the `TZ` variable. If `timespec` specifies a timezone, it overrides `TZ`. If `timespec` does not specify a timezone and `TZ` is unset or `NULL`, an unspecified default timezone is used.

The following exit values are returned:

- `0` The `at` utility successfully submitted, removed or listed a job or jobs.
- `>0` An error occurred, and the job will not be scheduled.

**Files**

`/usr/lib/cron/at.allow` names of users, one per line, who are authorized access to the `at` and `batch` utilities

`/usr/lib/cron/at.deny` names of users, one per line, who are denied access to the `at` and `batch` utilities

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>/usr/bin/at</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td></td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td></td>
<td>Not enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td></td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td></td>
<td>See <code>standards(5)</code></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>/usr/xpg4/bin/at</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td></td>
<td>system/xopen/xcu4</td>
</tr>
</tbody>
</table>
ATTRIBUTETYPE ATTRIBUTE VALUE
CSI Not enabled
Interface Stability Standard

ATTRIBUTETYPE ATTRIBUTE VALUE
Availability system/core-os
CSI Enabled
Interface Stability Standard

ATTRIBUTETYPE ATTRIBUTE VALUE
Availability system/xopen/xcu4
CSI Enabled
Interface Stability Standard

See Also auths(1), crontab(1), csh(1), date(1), ksh88(1), sh(1), touch(1), ulimit(1), umask(1), cron(1M), getdate(3C), auth_attr(4), shadow(4), queuedefs(4), attributes(5), environ(5), standards(5)

Notes Regardless of queue used, cron(1M) has a limit of 100 jobs in execution at any time.
There can be delays in cron at job execution. In some cases, these delays can compound to the point that cron job processing appears to be hung. All jobs are executed eventually. When the delays are excessive, the only workaround is to kill and restart cron.
atq(1)

Name  atq – display the jobs queued to run at specified times

Synopsis  atq [-c] [-n] [username]...

Description  The atq utility displays the at jobs queued up for the current user. at(1) is a utility that allows users to execute commands at a later date. If invoked by a user with the solaris.jobs.admin authorization, atq will display all jobs in the queue.

If no options are given, the jobs are displayed in chronological order of execution.

When an authorized user invokes atq without specifying username, the entire queue is displayed; when a username is specified, only those jobs belonging to the named user are displayed.

Options  The following options are supported:

- c      Displays the queued jobs in the order they were created (that is, the time that the at command was given).
- n      Displays only the total number of jobs currently in the queue.

Files  /var/spool/cron/atjobs     spool area for at jobs.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  at(1), atrm(1), auths(1), cron(1M), auth_attr(4), attributes(5)
Name  atrm – remove jobs spooled by at or batch

Synopsis  atrm [-afi] [ job #] [user]...

Description  The atrm utility removes delayed-execution jobs that were created with the at(1) command, but have not yet executed. The list of these jobs and associated job numbers can be displayed by using atq(1).

atrm removes each job-number you specify, and/or all jobs belonging to the user you specify, provided that you own the indicated jobs.

You can only remove jobs belonging to other users if you have solaris.jobs.admin privileges.

Options  The following options are supported:

- a   All. Removes all unexecuted jobs that were created by the current user. If invoked by the privileged user, the entire queue is flushed.
- f   Force. All information regarding the removal of the specified jobs is suppressed.
- i   Interactive. atrm asks if a job should be removed. If the response is affirmative, the job is removed.

Files  /var/spool/cron/atjobs   Spool area for at jobs

Environment Variables  See environ(5) for descriptions of the following environment variables that affect the execution of atrm: LANG, LC_ALL, LC_COLLATE, LCCTYPE, LC_MESSAGES, and NLSPATH.

Affirmative responses are processed using the extended regular expression defined for the yessexpr keyword in the LC_MESSAGES category of the user’s locale. The locale specified in the LC_COLLATE category defines the behavior of ranges, equivalence classes, and multi-character collating elements used in the expression defined for yessexpr. The locale specified in LC_CTYPE determines the locale for interpretation of sequences of bytes of text data a characters, the behavior of character classes used in the expression defined for the yessexpr.

See locale(5)

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  at(1), atq(1), auths(1), cron(1M), auth_attr(4), attributes(5), environ(5), locale(5)
### Name
```
audioconvert - convert audio file formats
```

### Synopsis
```
audioconvert [-pF] [-f outfmt] [-o outfile] [ [-i infmt] [file] ... ]...
```

### Description
`audioconvert` converts audio data between a set of supported audio encodings and file formats. It can be used to compress and decompress audio data, to add audio file headers to raw audio data files, and to convert between standard data encodings, such as `law` and linear PCM.

If no filenames are present, `audioconvert` reads the data from the standard input stream and writes an audio file to the standard output. Otherwise, input files are processed in order, concatenated, and written to the output file.

Input files are expected to contain audio file headers that identify the audio data format. If the audio data does not contain a recognizable header, the format must be specified with the `-i` option, using the `rate`, `encoding`, and `channels` keywords to identify the input data format.

The output file format is derived by updating the format of the first input file with the format options in the `-f` specification. If `-p` is not specified, all subsequent input files are converted to this resulting format and concatenated together. The output file will contain an audio file header, unless `format=raw` is specified in the output format options.

Input files may be converted in place by using the `-p` option. When `-p` is in effect, the format of each input file is modified according to the `-f` option to determine the output format. The existing files are then overwritten with the converted data.

The `file(1)` command decodes and prints the audio data format of Sun audio files.

### Options
The following options are supported:

- `-p` **In Place**: The input files are individually converted to the format specified by the `-f` option and rewritten. If a target file is a symbolic link, the underlying file will be rewritten. The `-o` option may not be specified with `-p`.

- `-F` **Force**: This option forces `audioconvert` to ignore any file header for input files whose format is specified by the `-i` option. If `-F` is not specified, `audioconvert` ignores the `-i` option for input files that contain valid audio file headers.

- `-f outfmt` **Output Format**: This option is used to specify the file format and data encoding of the output file. Defaults for unspecified fields are derived from the input file format. Valid keywords and values are listed in the next section.

- `-o outfile` **Output File**: All input files are concatenated, converted to the output format, and written to the named output file. If `-o` and `-p` are not specified, the concatenated output is written to the standard output. The `-p` option may not be specified with `-o`. 
**Input Format:** This option is used to specify the data encoding of raw input files. Ordinarily, the input data format is derived from the audio file header. This option is required when converting audio data that is not preceded by a valid audio file header. If `-i` is specified for an input file that contains an audio file header, the input format string will be ignored, unless `-F` is present. The format specification syntax is the same as the `-f` output file format.

Multiple input formats may be specified. An input format describes all input files following that specification, until a new input format is specified.

**File Specification:** The named audio files are concatenated, converted to the output format, and written out. If no file name is present, or if the special file name `-' is specified, audio data is read from the standard input.

**Help:** Prints a command line usage message.

The syntax for the input and output format specification is:

```
keyword=value[,keyword=value ...]
```

with no intervening whitespace. Unambiguous values may be used without the preceding `keyword=`.

**rate**

The audio sampling rate is specified in samples per second. If a number is followed by the letter `k`, it is multiplied by 1000 (for example, `44.1k = 44100`). Standard of the commonly used sample rates are: 8k, 16k, 32k, 44.1k, and 48k.

**channels**

The number of interleaved channels is specified as an integer. The words `mono` and `stereo` may also be used to specify one and two channel data, respectively.

**encoding**

This option specifies the digital audio data representation. Encodings determine precision implicitly (ulaw implies 8-bit precision) or explicitly as part of the name (for example, `linear16`). Valid encoding values are:

- **ulaw**
  CCITT G.711 -law encoding. This is an 8-bit format primarily used for telephone quality speech.

- **alaw**
  CCITT G.711 A-law encoding. This is an 8-bit format primarily used for telephone quality speech in Europe.

- **linear8**, **linear16**, **linear32**
  Linear Pulse Code Modulation (PCM) encoding. The name identifies the number of bits of precision. `linear16` is typically used for high quality audio data.

- **pcm**
  Same as `linear16`.

---

User Commands 77
**g721**  CCITT G.721 compression format. This encoding uses Adaptive Delta Pulse Code Modulation (ADPCM) with 4-bit precision. It is primarily used for compressing -law voice data (achieving a 2:1 compression ratio).

**g723**  CCITT G.723 compression format. This encoding uses Adaptive Delta Pulse Code Modulation (ADPCM) with 3-bit precision. It is primarily used for compressing -law voice data (achieving an 8:3 compression ratio). The audio quality is similar to G.721, but may result in lower quality when used for non-speech data.

The following encoding values are also accepted as shorthand to set the sample rate, channels, and encoding:

- **voice**  Equivalent to encoding=ulaw, rate=8k, channels=mono.
- **cd**  Equivalent to encoding=linear16, rate=44.1k, channels=stereo.
- **dat**  Equivalent to encoding=linear16, rate=48k, channels=stereo.

**format**  This option specifies the audio file format. Valid formats are:

- **sun**  Sun compatible file format (the default).
- **raw**  Use this format when reading or writing raw audio data (with no audio header), or in conjunction with an offset to import a foreign audio file format.

**offset**  (*-i only*) Specifies a byte offset to locate the start of the audio data. This option may be used to import audio data that contains an unrecognized file header.

**Usage**  See largefile(5) for the description of the behavior of audioconvert when encountering files greater than or equal to 2 Gbyte (2^{31} bytes).

**Examples**

**EXAMPLE 1**  Recording and compressing voice data before storing it

Record voice data and compress it before storing it to a file:

```bash
example% audiorecord | audioconvert -f g721 > mydata.au
```

**EXAMPLE 2**  Concatenating two audio files

Concatenate two Sun format audio files, regardless of their data format, and output an 8-bit ulaw, 16 kHz, mono file:

```bash
example% audioconvert -f ulaw,rate=16k,mono -o outfile.au infile1 infile2
```

**EXAMPLE 3**  Converting a directory to Sun format

Convert a directory containing raw voice data files, in place, to Sun format (adds a file header to each file):

```bash
```
EXAMPLE 3   Converting a directory to Sun format   (Continued)

example% audioconvert -p -i voice -f sun *.au

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architecture</td>
<td>SPARC, x86</td>
</tr>
<tr>
<td>Availability</td>
<td>audio/audio-utilities</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  audioplay(1), audiorecord(1), file(1), attributes(5), largefile(5)

Notes  The algorithm used for converting multi-channel data to mono is implemented by simply summing the channels together. If the input data is perfectly in phase (as would be the case if a mono file is converted to stereo and back to mono), the resulting data may contain some distortion.
Name  audiocctl – audio mixer control command line application

Synopsis  audiocctl list-devices
     audiocctl show-device [-v] [-d device]
     audiocctl show-control [-v] [-d device] [control ...]
     audiocctl set-control [-v] [-d device] control value
     audiocctl save-controls [-d device] [-f] file
     audiocctl load-controls [-d device] file

Description  The audiocctl command is used to control various features of the audio mixer and to get information about the audio mixer and the audio device. The audiocctl command operates on the following data types:

- **device**: An audio device, such as audiohd#0. The subcommands that accept this do so as an argument to an option `-d`. If not supplied, the default audio device is assumed. Any device node associated with an audio device works as well, such as /dev/sound/0, /dev/dsp1, or /dev/audio.

- **control**: A mixer control name, such as volume.

- **value**: The value of a control. The specific format depends on the type of control. Monophonic values usually use a single whole number between 0 and 100, inclusive. Stereo values use a pair of such numbers, representing the right and left channels. Boolean values indicate either on or off. Enumerations take a single value of one or more names.

- **file**: An ASCII text file of control settings.

Options  Each subcommand has its own set of options that it takes. However, some subcommands support the special flag `-v`, which indicates a request for more verbose output.

Sub-commands  The following subcommands are supported:

- **audiocctl list-devices**
  List all the audio devices on the system.

- **audiocctl show-device [-v] [-d devices]**
  Display general information about a device.

- **audiocctl show-control [-v] [-d device] [control ...]**
  Display the control setting values for the device. The named controls are displayed. If no control names are provided, then all control values are displayed.

- **audiocctl set-control [-v] [-d device] control value**
  Changes the value of a control to the supplied value.
audioctl save-controls [-f] [-d device] file
Saves the current state of all mixer control values to the named file. The command aborts safely if the file already exists, unless -f is specified.

audioctl load-controls [-d device] file
Restores previously saved state in the named file for all mixer controls.

Environment Variables
AUDIODEV If the -d and -a options are not specified, the AUDIODEV environment variable is consulted. If set, AUDIODEV contains the full path name of the user's default audio device.

Files /dev/audioctl /dev/sound/{0...n}ctl

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architecture</td>
<td>SPARC, x86</td>
</tr>
<tr>
<td>Availability</td>
<td>system/io/audio</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>See below</td>
</tr>
</tbody>
</table>

The audioctl command and its subcommands are Committed. The human readable output is Not An Interface. The device names, control names, and values are Uncommitted. The format of the state files used by the save-controls and load-controls subcommands is Committed Private.

See Also audioconvert(1), audioplay(1), audiomix(1), open(2), attributes(5)
The `audioplay` utility copies the named audio files (or the standard input if no filenames are present) to the audio device. If no input file is specified and standard input is a tty, the program exits with an error message.

The input files must contain a valid audio file header. The encoding information in this header is matched against the capabilities of the audio device and, if the data formats are incompatible, an error message is printed and the file is skipped. Compressed ADPCM (G.721) monaural audio data is automatically uncompressed before playing.

Minor deviations in sampling frequency (that is, less than 1%) are ordinarily ignored. This allows, for instance, data sampled at 8012 Hz to be played on an audio device that only supports 8000 Hz. If the `-V` option is present, such deviations are flagged with warning messages.

The following options are supported:

- `-d dev`  *Device:* The `dev` argument specifies an alternate audio device to which output should be directed. If the `-d` option is not specified, the `AUDIODEV` environment variable is consulted (see below). Otherwise, `/dev/audio` is used as the default audio device.

- `-i`  *Immediate:* If the audio device is unavailable (that is, another process currently has write access), `audioplay` ordinarily waits until it can obtain access to the device. When the `-i` option is present, `audioplay` prints an error message and exits immediately if the device is busy.

- `-v vol`  *Volume:* The output volume is set to the specified value before playing begins, and is reset to its previous level when `audioplay` exits. The `vol` argument is an integer value between 0 and 100, inclusive. If this argument is not specified, the output volume remains at the level most recently set by any process.

- `-V`  *Verbose:* Prints messages on the standard error when waiting for access to the audio device or when sample rate deviations are detected.

- `\?`  *Help:* Prints a command line usage message.

**Operands**  *file*  *File Specification:* Audio files named on the command line are played sequentially. If no filenames are present, the standard input stream (if it is not a tty) is played (it, too, must contain an audio file header). The special filename — can be used to read the standard input stream instead of a file. If a relative path name is supplied, the `AUDIOPATH` environment variable is consulted (see below).

**Usage**  See `largefile(5)` for the description of the behavior of `audioplay` when encountering files greater than or equal to 2 Gbyte (2^31 bytes).
Environment Variables

AUDIODEV  The full path name of the audio device to write to, if no -d argument is supplied. If the AUDIODEV variable is not set, /dev/audio is used.

AUDIOPATH  A colon-separated list of directories in which to search for audio files whose names are given by relative pathnames. The current directory (.) can be specified explicitly in the search path. If the AUDIOPATH variable is not set, only the current directory is searched.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architecture</td>
<td>SPARC, x86</td>
</tr>
<tr>
<td>Availability</td>
<td>audio/audio-utilities</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  audioconvert(1), audiocctl(1), audiorecord(1), attributes(5), largefile(5), audio(7I)

Bugs  audioplay currently supports a limited set of audio format conversions. If the audio file is not in a format supported by the audio device, it must first be converted. For example, to convert to voice format on the fly, use the command:

```
example% audioconvert -f voice myfile | audioplay
```

The format conversion is not always be able to keep up with the audio output. If this is the case, you should convert to a temporary file before playing the data.
audiorecord(1)

Name  audiorecord – record an audio file

Synopsis  audiorecord [ -af ] [ -v vol ] [ -c channels ] [ -s rate ]
          [ -e encoding ] [ -t time ] [ -i info ] [ -d dev ]
          [ -T au | aif[f] | wav ] [ file[.au|.aif[f]] | .wav ]

Description  The audiorecord utility copies audio data from the audio device to a named audio file, or to the standard output if no filename is present. If no output file is specified and standard output is a tty, the program exits with an error message.

By default, monaural audio data is recorded at 8 kHz and encoded in ulaw format. If the audio device supports additional configurations, the -c, -s, and -e options may be used to specify the data format. The output file is prefixed by an audio file header that identifies the format of the data encoded in the file.

Recording begins immediately and continues until a SIGINT signal (for example, Control-c) is received. If the -t option is specified, audiorecord stops when the specified quantity of data has been recorded.

If the audio device is unavailable, that is, if another process currently has read access, audiorecord prints an error message and exits immediately.

Options  The following options are supported:

- \?  Help: Prints a command line usage message.

- a  Append: Appends the data on the end of the named audio file. The audio device must support the audio data format of the existing file.

- c channels  Channels: Specifies the number of audio channels (1 or 2). The value may be specified as an integer or as the string mono or stereo. The default value is mono.

- d dev  Device: The dev argument specifies an alternate audio device from which input should be taken. If the -d option is not specified, the AUDIODEV environment variable is consulted (see below). Otherwise, /dev/audio is used as the default audio device.

- e encoding  Encoding: Specifies the audio data encoding. This value may be one of ulaw, alaw, or linear. The default encoding is ulaw.

- f  Force: When the -a flag is specified, the sample rate of the audio device must match the sample rate at which the original file was recorded. If the -f flag is also specified, sample rate differences are ignored, with a warning message printed on the standard error.

- i info  Information: The ‘information’ field of the output file header is set to the string specified by the info argument. This option cannot be specified in conjunction with the -a argument.
-s rate

Sample Rate: Specifies the sample rate, in samples per second. If a number is followed by the letter k, it is multiplied by 1000 (for example, 44.1k = 44100). The default sample rate is 8 kHz.

-t time

Time: The time argument specifies the maximum length of time to record. Time can be specified as a floating-point value, indicating the number of seconds, or in the form: hh:mm:ss.dd, where the hour and minute specifications are optional.

-T au | aif[f] | wav

Specifies the audio file type to create. If the -a option is used, the file type must match the file to which it is being appended. Regardless of the file suffix, the type is set as specified in this option. If this option is not specified, the file suffix determines the type.

-v vol

Volume: The recording gain is set to the specified value before recording begins, and is reset to its previous level when audiorecord exits. The vol argument is an integer value between 0 and 100, inclusive. If this argument is not specified, the input volume remains at the level most recently set by any process.

Operands file [.au | aif[f] | wav]

File Specification: The named audio file is rewritten, or appended. If no filename is present, and standard output is not a tty, or if the special filename “−” is specified, output is directed to the standard output.

If the -T option is not specified, the file suffix determines the type of file. If the suffix is not recognized, the default is .au. If the -T option is specified, that file type is used regardless of the file suffix.

Usage See largefile(5) for the description of the behavior of audiorecord when encountering files greater than or equal to 2 Gbyte (2^31 bytes).

Environment Variables AUDIODEV The full path name of the audio device to record from, if no -d argument is supplied. If the AUDIODEV variable is not set, /dev/audio is used.

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architecture</td>
<td>SPARC, x86</td>
</tr>
<tr>
<td>Availability</td>
<td>audio/audio-utilities</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also audioconvert(1), audiocctl(1), audioplay(1), attributes(5), largefile(5), audio(7I)
Name  audiotest – test audio device
Synopsis  audiotest [-24571] [dev] ...
Description  The audiotest utility runs a test for the named audio device (or all audio devices found on the
system if none is given). The test includes playing an audio sample over each channel and
measuring the rate of playback for clock drift.
Options  The following options are supported:
  -1  Loop mode. The test is run in an infinite loop.
  -2  Stereo (2-channel) mode. This is the default mode. Playback assumes 2 channels are
      present.
  -4  Quadraphonic mode (4-channel surround). The test assumes that four surround
      channels are present.
  -5  Surround sound mode (5.1). The test checks the left, right, surround left, surround
      right, and center channels. The low frequency effects channel is not tested.
  -7  Surround sound mode (7.1). The test checks the left, right, surround left, surround
      right, back surround left, back surround right, and center channels. The low frequency
      effects channel is not tested.
Operands  dev  The path the device to test, for example, /dev/dsp0.
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architecture</td>
<td>SPARC, x86</td>
</tr>
<tr>
<td>Availability</td>
<td>audio/audio-utilities</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  audioconvert(1), audioctl(1), audiorecord(1), attributes(5), audio(7I)

Bugs  audiotest has no way to detect the number of actual audio channels supported by the
physical device.

audiotest does not test the low-frequency effects (LFE) channel.

There is no test for audio capture, volume controls, or other advanced device features.
The auths command prints on standard output the authorizations that you or the optionally-specified user or role have been granted. Authorizations are rights that are checked by certain privileged programs to determine whether a user may execute restricted functionality.

The command also creates and modifies an authorization and its properties in the auth_attr(4) database in the local files name service or LDAP name service. The auths command also prints on standard output the authorizations that you or the optionally specified user or role have been granted.

An administrator must be granted the Rights Management Profile to be able to manage the authorizations in the auth_attr(4) database with the add, modify, or remove subcommands.

Each user may have zero or more authorizations. Authorizations are represented by fully-qualified names, which identify the organization that created the authorization and the functionality that it controls. Following the Java convention, the hierarchical components of an authorization are separated by dots (.), starting with the reverse order Internet domain name of the creating organization, and ending with the specific function within a class of authorizations. Authorizations cannot end with a dot (.)

An asterisk (*) indicates all authorizations in a class.

A user’s authorizations are looked up in user_attr(4) and in the /etc/security/policy.conf file (see policy.conf(4)). Authorizations may be specified directly in user_attr(4) or indirectly through prof_attr(4). Authorizations may also be assigned to every user in the system directly as default authorizations or indirectly as default profiles in the /etc/security/policy.conf file.

### Subcommands

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>auths list</td>
<td>List authorizations.</td>
</tr>
<tr>
<td>auths info</td>
<td>Display information about an authorization.</td>
</tr>
<tr>
<td>auths check</td>
<td>Check authorizations.</td>
</tr>
<tr>
<td>auths add</td>
<td>Add a new authorization.</td>
</tr>
<tr>
<td>auths modify</td>
<td>Modify an existing authorization.</td>
</tr>
<tr>
<td>auths remove</td>
<td>Remove an authorization.</td>
</tr>
</tbody>
</table>

Add command:

```
auths add [-S repository] [-t description] [-h help_file_path] authorization
```

Create the specified authorization (`authorization`) in the specified name-service repository (`repository`).

If no repository option is specified, the authorization is created in the file's name-service.
check [-u user] authorization
Check if the specified authorization (authorization) has been granted to the specified
username (user) or the current user.

If the user has the proper authorization, auths exits with exit code 0. Otherwise, it returns
with exit code greater than 1.

info [-S repository] [-v] [authorization]
Check if the specified authorization (authorization) is present in the specified name-service
repository (repository) or looks up based on nsswitch.conf(4). If the specified authorization is present, it is listed and the auths exits with return code 0.

If no authorization is specified, auths prints all the authorizations present in the specified
name-service repository or based on nsswitch.conf(4).

list [-S repository] [-v] [-u user]
Lists all the authorizations that are assigned to the specified user (user) or current user, if no
username is specified, based on the name-service repository (repository).

If no repository is specified the information is looked up based on nsswitch.conf(4).

modify [-S repository] [-t description] [-h help_file_path]
Modify an existing authorization in the specified name-service repository. If no repository
is specified the authorization will be modified in the first name-service that it is found in
based on nsswitch.conf(4).

remove [-S repository] authorization
Remove an existing authorization (authorization) in the specified name-service repository
(repository).

If no repository is specified, the authorization is removed from the first name-service that it
is found in based on nsswitch.conf(4).

Options The auths subcommands support the following options:

- h help_file_path Set the location of the help file which contains information about the
  authorization.

- S repository Specify the name-service repository (repository) to be modified or
  searched. The supported repository options are files and ldap.

If this option is omitted, look up is based on nsswitch.conf(4).

- t description Specify the textual description of the authorization.

- u user Specify the username (user) for which to list or check authorization.

If this option is omitted, the current user is used.

- v Print the description for the authorization.
Examples

**EXAMPLE 1**  Using the auths Command

The output from the auths output looks as follows:

```
example% auths tester01 tester02
tester01 : solaris.system.date,solaris.jobs.admin
tester02 : solaris.system.*
example%
```

There is no space after the comma separating the authorization names in tester01.

The following command lists the authorizations that are assigned to user tester01.

```
example% auths list -u tester01
```

tester01:
solaris.jobs.admin
solaris.system.date

**EXAMPLE 2**  Listing Authorizations

The following command lists the authorizations assigned to user tester01 with descriptions.

```
example% auths list -v -u tester01
tester01:
solaris.jobs.admin
Manage All Jobs
solaris.system.date
Set Date & Time
```

**EXAMPLE 3**  Listing Authorizations

The following command lists the authorizations with descriptions in the name-service.

```
example% auths info -v solaris.user.manage
solaris.user.manage:
Manage user accounts
example%
```

**EXAMPLE 4**  Adding an Authorization

The following adds the authorization solaris.foo.manage with description manage foo and help file AuthFoo.html to the file's name-service repository.

```
example% auths add -t "manage foo"
-h /home/abc/AuthFoo.html solaris.foo.manage
```

**EXAMPLE 5**  Modifying an Authorization

The following example modifies the authorization solaris.foo.manage, sets the description to manage foo and bar, and sets the help file to AuthFooBar.html in LDAP.
EXAMPLE 5  Modifying an Authorization  

(Continued)

example% auths -S ldap modify -t "manage foo and bars"
 -h /home/abc/AuthFooBar.html solaris.foo.manage

Exit Status  The following exit values are returned:

  0  Successful completion.
  1  An error occurred.
  2  User not authorized.

Files  /etc/user_attr

/etc/security/auth_attr

/etc/security/policy.conf

/etc/security/prof_attr

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  profiles(1), roles(1), getauthattr(3C), auth_attr(4), policy.conf(4), prof_attr(4), user_attr(4), attributes(5)
auto_ef - auto encoding finder

**Synopsis**

```
/usr/bin/auto_ef [-e encoding_list] [-a] [-l level] [file ...]
```

```
/usr/bin/auto_ef -h
```

**Description**

The `auto_ef` utility identifies the encoding of a given file. The utility judges the encoding by using the `iconv` code conversion, determining whether a certain code conversion was successful with the file, and also by performing frequency analyses on the character sequences that appear in the file.

The `auto_ef` utility might produce unexpected output if the string is binary, a character table, a localized digit list, or a chronogram, or if the string or file is very small in size (for example, less than one 100 bytes).

<table>
<thead>
<tr>
<th>Name</th>
<th>Encoding</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASCII</td>
<td>JIS</td>
</tr>
<tr>
<td>ISO-2022-JP</td>
<td>JIS</td>
</tr>
<tr>
<td>eucJP</td>
<td>Japanese EUC</td>
</tr>
<tr>
<td>PCK</td>
<td>Japanese PC Kanji, CP932, Shift JIS</td>
</tr>
<tr>
<td>UTF-8</td>
<td>Korean EUC</td>
</tr>
<tr>
<td>ko_KR.euc</td>
<td>Unified Hangul</td>
</tr>
<tr>
<td>zh_CN.iso2022-CN</td>
<td>ISO-2022 CN/CN-EXT</td>
</tr>
<tr>
<td>zh_CN.euc</td>
<td>Simplified Chinese EUC, GB2312</td>
</tr>
<tr>
<td>GB18030</td>
<td>Simplified Chinese GB18030/GBK</td>
</tr>
<tr>
<td>zh_TW-big5</td>
<td>BIG5</td>
</tr>
<tr>
<td>zh_TW-euc</td>
<td>Traditional Chinese EUC</td>
</tr>
<tr>
<td>zh_TW.hkscs</td>
<td>Hong Kong BIG5</td>
</tr>
<tr>
<td>iso-8859-1</td>
<td>West European, and similar</td>
</tr>
<tr>
<td>iso-8859-2</td>
<td>East European, and similar</td>
</tr>
<tr>
<td>iso-8859-5</td>
<td>Cyrillic, and similar</td>
</tr>
<tr>
<td>iso-8859-6</td>
<td>Arabic</td>
</tr>
<tr>
<td>iso-8859-7</td>
<td>Greek</td>
</tr>
<tr>
<td>iso-8859-8</td>
<td>Hebrew</td>
</tr>
<tr>
<td>CP1250</td>
<td>windows-1250, corresponding to ISO-8859-2</td>
</tr>
</tbody>
</table>
CP1251  windows-1251, corresponding to ISO-8859-5
CP1252  windows-1252, corresponding to ISO-8859-1
CP1253  windows-1253, corresponding to ISO-8859-7
CP1255  windows-1255, corresponding to ISO-8859-8
koi8-r    corresponding to iso-8859-5

By default, auto_ef returns a single, most likely encoding for text in a specified file. To get all possible encodings for the file, use the -a option.

Also by default, auto_ef uses the fastest process to examine the file. For more accurate results, use the -l option.

To examine data with a limited set of encodings, use the -e option.

**Options**  The following options are supported:

- **-a**  Shows all possible encodings in order of possibility, with scores in the range between 0.0 and 1.0. A higher score means a higher possibility. For example,

  ```bash
  example% auto_ef -a test_file
  eucJP          0.89
  zh_CN.euc      0.04
  ko_KR.euc      0.01
  ```

  Without this option, only one encoding with the highest score is shown.

- **-e encoding_list**  Examines data only with specified encodings. For example, when `encoding_list` is specified as "ko_KR.euc:ko_KR.cp949", auto_ef examines text only with CP949 and ko_KR.euc. Without this option, auto_ef examines text with all encodings. Multiple encodings can be specified by separating the encodings using a colon (:).

- **-h**  Shows the usage message.

- **-l level**  Specifies the level of judgment. The value of `level` can be 0, 1, 2, or 3. Level 3 produces the best result but can be slow. Level 0 is fastest but results can be less accurate than in higher levels. The default is level 0.

**Operands**  The following operands are supported:

- **file**  File name to examine.

**Examples**  **EXAMPLE 1**  Examining encoding of a file

  ```bash
  example% auto_ef file_name
  ```
EXAMPLE 2  Examining encoding of a file at level 2.
example% auto_ef -l 2 file_name

EXAMPLE 3  Examining encoding of a file with only eucJP or ko_KR.euc
example% auto_ef -e "eucJP:ko_KR.euc" file_name

Exit Status  The following exit values are returned:
0    Successful completion
1    An error occurred.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>text/auto_ef</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  auto_ef(3EXT), libauto_ef(3LIB), attributes(5)

International Language Environments Guide
Name  awk – pattern scanning and processing language

Synopsis  
/usr/bin/awk [-f progfile] [-Fc] [ ’ prog ’ ] [parameters] 
[filename]... 

/usr/xpg4/bin/awk [-FcERE] [-v assignment]... ’program’ -f progfile... 
[argument]...

Description  The /usr/xpg4/bin/awk utility is described on the nawk(1) manual page. 

The /usr/bin/awk utility scans each input filename for lines that match any of a set of patterns specified in prog. The prog string must be enclosed in single quotes (' ') to protect it from the shell. For each pattern in prog there can be an associated action performed when a line of a filename matches the pattern. The set of pattern-action statements can appear literally as prog or in a file specified with the -f progfile option. Input files are read in order; if there are no files, the standard input is read. The file name '-' means the standard input.

Options  The following options are supported:

- f progfile  awk uses the set of patterns it reads from progfile.
- Fc  Uses the character c as the field separator (FS) character. See the discussion of FS below.

Usage  

Input Lines  Each input line is matched against the pattern portion of every pattern-action statement; the associated action is performed for each matched pattern. Any filename of the form var=value is treated as an assignment, not a filename, and is executed at the time it would have been opened if it were a filename. Variables assigned in this manner are not available inside a BEGIN rule, and are assigned after previously specified files have been read.

An input line is normally made up of fields separated by white spaces. (This default can be changed by using the FS built-in variable or the -Fc option.) The default is to ignore leading blanks and to separate fields by blanks and/or tab characters. However, if FS is assigned a value that does not include any of the white spaces, then leading blanks are not ignored. The fields are denoted $1, $2, ... ; $0 refers to the entire line.

Pattern-actionStatements  A pattern-action statement has the form:

pattern { action }

Either pattern or action can be omitted. If there is no action, the matching line is printed. If there is no pattern, the action is performed on every input line. Pattern-action statements are separated by newlines or semicolons.

Patterns are arbitrary Boolean combinations ( !, ||, &&, and parentheses) of relational expressions and regular expressions. A relational expression is one of the following:
expression relop expression
expression matchop regular_expression

where a relop is any of the six relational operators in C, and a matchop is either \( \sim \) (contains) or \(!\sim\) (does not contain). An expression is an arithmetic expression, a relational expression, the special expression

\( \text{var in array} \)

or a Boolean combination of these.

Regular expressions are as in `egrep(1)`. In patterns they must be surrounded by slashes. Isolated regular expressions in a pattern apply to the entire line. Regular expressions can also occur in relational expressions. A pattern can consist of two patterns separated by a comma; in this case, the action is performed for all lines between the occurrence of the first pattern to the occurrence of the second pattern.

The special patterns \texttt{BEGIN} and \texttt{END} can be used to capture control before the first input line has been read and after the last input line has been read respectively. These keywords do not combine with any other patterns.

### Built-in Variables

Built-in variables include:

- **FILENAME** name of the current input file
- **FS** input field separator regular expression (default blank and tab)
- **NF** number of fields in the current record
- **NR** ordinal number of the current record
- **OFMT** output format for numbers (default \%.6g)
- **OFS** output field separator (default blank)
- **ORS** output record separator (default new-line)
- **RS** input record separator (default new-line)

An action is a sequence of statements. A statement can be one of the following:

- `if (expression) statement [ else statement ]`
- `while (expression) statement`
- `do statement while (expression)`
- `for (expression; expression; expression) statement`
- `for (var in array) statement`
- `break`
- `continue`
- `{
  [ statement ] . . . }
```
- `expression # commonly variable = expression`
- `print [ expression-list ] [ >expression ]`
printf format [ , expression-list ] [ > expression ]
next  # skip remaining patterns on this input line
exit [ expr ]  # skip the rest of the input; exit status is expr

Statements are terminated by semicolons, newlines, or right braces. An empty expression-list stands for the whole input line. Expressions take on string or numeric values as appropriate, and are built using the operators +, −, *, /, % and concatenation (indicated by a blank). The operators ++, −−, +=, −=, *=, /=, %=, ^=, >, <, <=, ==, !=, and ?: are also available in expressions. Variables can be scalars, array elements (denoted x[i]), or fields. Variables are initialized to the null string or zero. Array subscripts can be any string, not necessarily numeric; this allows for a form of associative memory. String constants are quoted (""), with the usual C escapes recognized within.

The print statement prints its arguments on the standard output, or on a file if > expression is present, or on a pipe if ‘cmd’ is present. The output resulted from the print statement is terminated by the output record separator with each argument separated by the current output field separator. The printf statement formats its expression list according to the format (see printf(3C)).

Built-in Functions

The arithmetic functions are as follows:

cos(x)  Return cosine of x, where x is in radians. (In /usr/xpg4/bin/awk only. See nawk(1).)

sin(x)  Return sine of x, where x is in radians. (In /usr/xpg4/bin/awk only. See nawk(1).)

exp(x)  Return the exponential function of x.

log(x)  Return the natural logarithm of x.

sqrt(x)  Return the square root of x.

int(x)  Truncate its argument to an integer. It is truncated toward 0 when x > 0.

The string functions are as follows:

index(s, t)  Return the position in string s where string t first occurs, or 0 if it does not occur at all.

int(s)  truncates s to an integer value. If s is not specified, $0 is used.

length(s)  Return the length of its argument taken as a string, or of the whole line if there is no argument.

split(s, a, fs)  Split the string s into array elements a[1], a[2], ... a[n], and returns n. The separation is done with the regular expression fs or with the field separator FS if fs is not given.
sprintf(fmt, expr, expr, ...) Format the expressions according to the printf(3C) format given by fmt and returns the resulting string.

substr(s, m, n) returns the n-character substring of s that begins at position m.

The input/output function is as follows:

getline Set $0 to the next input record from the current input file. getline returns 1 for successful input, 0 for end of file, and −1 for an error.

Large File Behavior See largefile(5) for the description of the behavior of awk when encountering files greater than or equal to 2 Gbyte (2^31 bytes).

Examples

EXAMPLE 1 Printing Lines Longer Than 72 Characters

The following example is an awk script that can be executed by an awk -f examplescript style command. It prints lines longer than seventy two characters:

    length > 72

EXAMPLE 2 Printing Fields in Opposite Order

The following example is an awk script that can be executed by an awk -f examplescript style command. It prints the first two fields in opposite order:

    { print $2, $1 }

EXAMPLE 3 Printing Fields in Opposite Order with the Input Fields Separated

The following example is an awk script that can be executed by an awk -f examplescript style command. It prints the first two input fields in opposite order, separated by a comma, blanks or tabs:

    BEGIN { FS = ”,[ \\t]*|\\t*” }
    { print $2, $1 }

The example only works with /usr/xpg4/bin/awk.

EXAMPLE 4 Adding Up the First Column, Printing the Sum and Average

The following example is an awk script that can be executed by an awk -f examplescript style command. It adds up the first column, and prints the sum and average:

    { s += $1 }
    END { print ”sum is”, s, ” average is”, s/NR }

EXAMPLE 5 Printing Fields in Reverse Order

The following example is an awk script that can be executed by an awk -f examplescript style command. It prints fields in reverse order:
EXAMPLE 5  Printing Fields in Reverse Order  (Continued)

{ for (i = NF; i > 0; --i) print $i }

EXAMPLE 6  Printing All lines Between start/stop Pairs

The following example is an awk script that can be executed by an awk -f examplescript style command. It prints all lines between start/stop pairs.

/start/, /stop/

EXAMPLE 7  Printing All Lines Whose First Field is Different from the Previous One

The following example is an awk script that can be executed by an awk -f examplescript style command. It prints all lines whose first field is different from the previous one.

$1 != prev { print; prev = $1 }

EXAMPLE 8  Printing a File and Filling in Page numbers

The following example is an awk script that can be executed by an awk -f examplescript style command. It prints a file and fills in page numbers starting at 5:

/Page/  { $2 = n++; }
    { print }

EXAMPLE 9  Printing a File and Numbering Its Pages

Assuming this program is in a file named prog, the following example prints the file input numbering its pages starting at 5:

example% awk -f prog n=5 input

Environment Variables

See environ(5) for descriptions of the following environment variables that affect the execution of awk: LANG, LC_ALL, LC_COLLATE, LC_TYPE, LC_MESSAGES, NLSPATH, and PATH.

LC_NUMERIC  Determine the radix character used when interpreting numeric input, performing conversions between numeric and string values and formatting numeric output. Regardless of locale, the period character (the decimal-point character of the POSIX locale) is the decimal-point character recognized in processing awk programs (including assignments in command-line arguments).

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATtribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>
CSI Not Enabled
Availability system/xopen/xcu4
CSI Enabled
Interface Stability Committed
Standard See standards(5).

### See Also
egrep(1), grep(1), nawk(1), sed(1), printf(3C), attributes(5), environ(5), largefile(5), standards(5)

### Notes
Input whitespace is not preserved on output if fields are involved.

There are no explicit conversions between numbers and strings. To force an expression to be treated as a number, add `0` to it. To force an expression to be treated as a string, concatenate the null string ("") to it.
Name       banner – make posters
Synopsis    banner strings
Description banner prints its arguments (each up to 10 characters long) in large letters on the standard output.
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/extended-system-utilities</td>
</tr>
</tbody>
</table>

See Also       echo(1), attributes(5)
The `basename` utility deletes any prefix ending in `/` and the `suffix` (if present in `string`) from `string`, and prints the result on the standard output. It is normally used inside substitution marks (`'`) within shell procedures.

`/usr/bin` The `suffix` is a pattern defined on the `expr(1)` manual page.

`/usr/xpg4/bin` The `suffix` is a string with no special significance attached to any of the characters it contains. The `dirname` utility delivers all but the last level of the path name in `string`.

**Examples**

**EXAMPLE 1** Setting environment variables

The following example, invoked with the argument `/home/sms/personal/mail` sets the environment variable `NAME` to the file named `mail` and the environment variable `MYMAILPATH` to the string `/home/sms/personal`:

```
example% NAME='basename $HOME/personal/mail'
example% MYMAILPATH='dirname $HOME/personal/mail'
```

**EXAMPLE 2** Compiling a file and moving the output

This shell procedure, invoked with the argument `/usr/src/bin/cat.c`, compiles the named file and moves the output to `cat` in the current directory:

```
example% cc $1
example% mv a.out 'basename $1 .c'
```

**Environment Variables**

See `environ(5)` for descriptions of the following environment variables that affect the execution of `basename` and `dirname`: `LANG`, `LC_ALL`, `LC_CTYPE`, `LC_MESSAGES`, and `NLSPATH`.

**Exit Status**

The following exit values are returned:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful completion.</td>
</tr>
<tr>
<td>&gt;0</td>
<td>An error occurred.</td>
</tr>
</tbody>
</table>

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

```
<table>
<thead>
<tr>
<th>/usr/bin</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td></td>
<td>system/core-os</td>
</tr>
</tbody>
</table>
```
### basename(1)

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/xopen/xcu4</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See [standards(5)]</td>
</tr>
</tbody>
</table>

See Also: `expr(1), basename(3C), attributes(5), environ(5), standards(5)`
Name  basename – display portions of pathnames

Synopsis  /usr/ucb/basename string [suffix]

Description  The basename utility deletes any prefix ending in ‘/’ and the suffix, if present in string. It directs the result to the standard output, and is normally used inside substitution marks (‘’’) within shell procedures. The suffix is a string with no special significance attached to any of the characters it contains.

Examples  example  Using the basename command.

This shell procedure invoked with the argument /usr/src/bin/cat.c compiles the named file and moves the output to cat in the current directory:

```
example% cc $1
example% mv a.out `basename $1 .c`
```

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>

See Also  sh(1), attributes(5)
Name:  bc – arbitrary precision arithmetic language

Synopsis:  
```
/usr/bin/bc [-c] [-l] [file]...
/usr/xpg6/bin/bc [-c] [-l] [file]...
```

Description:  The bc utility implements an arbitrary precision calculator. It takes input from any files given, then reads from the standard input. If the standard input and standard output to bc are attached to a terminal, the invocation of bc is interactive, causing behavioral constraints described in the following sections. bc processes a language that resembles C and is a preprocessor for the desk calculator program dc, which it invokes automatically unless the -c option is specified. In this case the dc input is sent to the standard output instead.

Usage:  The syntax for bc programs is as follows:

- L  Means a letter a–z,
- E  Means an expression: a (mathematical or logical) value, an operand that takes a value, or a combination of operands and operators that evaluates to a value,
- S  Means a statement.

Comments: Enclosed in /* and */.

Names (Operands)  Simple variables: L.
Array elements: L[ E ] (up to BC_DIM_MAX dimensions). The words ibase, obase (limited to BC_BASE_MAX), and scale (limited to BC_SCALE_MAX).

Other Operands  Arbitrarily long numbers with optional sign and decimal point. Strings of fewer than BC_STRING_MAX characters, between double quotes ("), ( E )

- sqrt ( E )  Square root
- length ( E )  Number of significant decimal digits.
- scale ( E )  Number of digits right of decimal point.
- L ( E , . . . , E )

Operators  + − * / % ^  (% is remainder; ^ is power)
++ ---  (prefix and postfix; apply to names)
== <= >= ! = < >
= += -= *= /= %= =^

Statements  E
{ S ; . . . ; S }
if ( E ) S
while \((E)\) \(S\) 
for \((E; E; E)\) \(S\) 
null statement 
break 
quit 
.string 

Function Definitions 
\(\text{define } L \left( L, \ldots, L \right) \{\) 
\(\text{auto } L, \ldots, L \) 
\(S; \ldots S \) 
\(\text{return } (E) \) 
\} \)

Functions in -l Math Library 
\(s(x)\) sine 
\(c(x)\) cosine 
\(e(x)\) exponential 
\(l(x)\) log 
\(a(x)\) arctangent 
\(j(n, x)\) Bessel function 

All function arguments are passed by value.

The value of a statement that is an expression is printed unless the main operator is an assignment. Either semicolons or new-lines may separate statements. Assignment to \(\text{scale}\) influences the number of digits to be retained on arithmetic operations in the manner of \(\text{dc}\). Assignments to \(\text{ibase}\) or \(\text{obase}\) set the input and output number radix respectively.

The same letter may be used as an array, a function, and a simple variable simultaneously. All variables are global to the program. \(\text{auto}\) variables are stacked during function calls. When using arrays as function arguments or defining them as automatic variables, empty square brackets must follow the array name.

Options 
The following operands are supported:

- \(-c\) Compiles only. The output is \(\text{dc}\) commands that are sent to the standard output.
- \(-l\) Defines the math functions and initializes \(\text{scale}\) to 20, instead of the default zero.

Defines the math functions and initializes \(\text{scale}\) to 20, instead of the default zero. All math results have the scale of 20.
Operands  The following operands are supported:

  file  A pathname of a text file containing bc program statements. After all cases of file have been read, bc reads the standard input.

Examples  EXAMPLE 1  Setting the precision of a variable

In the shell, the following assigns an approximation of the first ten digits of \( n \) to the variable \( x \):

\[
x = \$(printf "%.10" 'scale = 10; 104348/33215' | bc)
\]

EXAMPLE 2  Defining a computing function

Defines a function to compute an approximate value of the exponential function:

\[
scale = 20
\]
\[
define e(x) {
    auto a, b, c, i, s
    a = 1
    b = 1
    s = 1
    for (i=1; i==1; i++) {
        a = a * x
        b = b * i
        c = a / b
        if (c == 0) return (s)
        s = s + c
    }
}
\]

EXAMPLE 3  Printing the approximate values of the function

Prints approximate values of the exponential function of the first ten integers:

\[
for (i=1; i<=10; i++) e(i)
\]

or

\[
for (i = 1; i <= 10; ++i) { e(i) }
\]

Environment Variables  See environ(5) for descriptions of the following environment variables that affect the execution of bc: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status  The following exit values are returned:

  0  All input files were processed successfully.

  unspecified  An error occurred.

Files  /usr/lib/lib.b  mathematical library

/usr/include/limits.h  to define BC_ parameters
Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also  dc(1), awk(1), attributes(5), environ(5), standards(5)

Notes  The bc command does not recognize the logical operators && and | |.

The for statement must have all three expressions (E's).
**bdiff(1)**

**Name**  
`bdiff` – big diff

**Synopsis**  
`bdiff filename1 filename2 [n] [-s]`

**Description**  
`bdiff` is used in a manner analogous to `diff` to find which lines in `filename1` and `filename2` must be changed to bring the files into agreement. Its purpose is to allow processing of files too large for `diff`. If `filename1 (filename2)` is −, the standard input is read.

`bdiff` ignores lines common to the beginning of both files, splits the remainder of each file into `n`-line segments, and invokes `diff` on corresponding segments. If both optional arguments are specified, they must appear in the order indicated above.

The output of `bdiff` is exactly that of `diff`, with line numbers adjusted to account for the segmenting of the files (that is, to make it look as if the files had been processed whole). Note: Because of the segmenting of the files, `bdiff` does not necessarily find a smallest sufficient set of file differences.

**Options**  
- `n` The number of line segments. The value of `n` is 3500 by default. If the optional third argument is given and it is numeric, it is used as the value for `n`. This is useful in those cases in which 3500-line segments are too large for `diff`, causing it to fail.
- `-s` Specifies that no diagnostics are to be printed by `bdiff` (silent option). Note: However, this does not suppress possible diagnostic messages from `diff`, which `bdiff` calls.

**Usage**  
See `largefile(5)` for the description of the behavior of `bdiff` when encountering files greater than or equal to 2 Gbyte (`2^{31}` bytes).

**Files**  
`/tmp/bd????`

**Attributes**  
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>enabled</td>
</tr>
</tbody>
</table>

**See Also**  
`diff(1), attributes(5), largefile(5)`

**Diagnostics**  
Use `help` for explanations.
### Name
bfs – big file scanner

### Synopsis
/usr/bin/bfs [-] filename

### Description
The bfs command is (almost) like ed(1) except that it is read-only and processes much larger files. Files can be up to 1024K bytes and 32K lines, with up to 512 characters, including new-line, per line (255 for 16-bit machines). bfs is usually more efficient than ed(1) for scanning a file, since the file is not copied to a buffer. It is most useful for identifying sections of a large file where csplit(1) can be used to divide it into more manageable pieces for editing.

Normally, the size of the file being scanned is printed, as is the size of any file written with the w (write) command. The optional − suppresses printing of sizes. Input is prompted with * if P and a carriage return are typed, as in ed(1). Prompting can be turned off again by inputting another P and carriage return. Note that messages are given in response to errors if prompting is turned on.

All address expressions described under ed(1) are supported. In addition, regular expressions may be surrounded with two symbols besides / and ?.

- > indicates downward search without wrap-around, and
- < indicates upward search without wrap-around.

There is a slight difference in mark names; that is, only the letters a through z may be used, and all 26 marks are remembered.

### bfs Commands
The e, g, v, k, p, q, w, =, !, and null commands operate as described under ed(1). Commands such as ——, ++++, +++=, −12, and +4p are accepted. Note that 1, 10p and 1, 10 will both print the first ten lines. The f command only prints the name of the file being scanned; there is no remembered file name. The w command is independent of output diversion, truncation, or crunching (see the xo, xt, and xc commands, below). The following additional commands are available:

- **xf file**
  Further commands are taken from the named file. When an end-of-file is reached, an interrupt signal is received or an error occurs, reading resumes with the file containing the xf. The xf commands may be nested to a depth of 10.

- **xn**
  List the marks currently in use (marks are set by the k command).

- **xo [file]**
  Further output from the p and null commands is diverted to the named file, which, if necessary, is created mode 666 (readable and writable by everyone), unless your umask setting (see umask(1)) dictates otherwise. If
file is missing, output is diverted to the standard output. Note that each diversion causes truncation or creation of the file.

'label'  This positions a label in a command file. The label is terminated by newline, and blanks between the : (colon) and the start of the label are ignored. This command may also be used to insert comments into a command file, since labels need not be referenced.

'()x/regular expression/label'  A jump (either upward or downward) is made to label if the command succeeds. It fails under any of the following conditions:

1. Either address is not between 1 and $.
2. The second address is less than the first.
3. The regular expression does not match at least one line in the specified range, including the first and last lines.

On success, . (dot) is set to the line matched and a jump is made to label. This command is the only one that does not issue an error message on bad addresses, so it may be used to test whether addresses are bad before other commands are executed. Note that the command, x/~/label, is an unconditional jump.

The xb command is allowed only if it is read from someplace other than a terminal. If it is read from a pipe, only a downward jump is possible.

'xt number'  Output from the p and null commands is truncated to, at most, number characters. The initial number is 255.

'xv [digit] [spaces] [value]'  The variable name is the specified digit following the xv. The commands xv$100 or xv 100 both assign the value 100 to the variable 5. The command xv61, 100p assigns the value 1, 100p to the variable 6. To reference a variable, put a % in front of the variable name. For example, using the above assignments for variables 5 and 6:

1, %5p
1, %5
%6

will all print the first 100 lines.
would globally search for the characters 100 and print each line containing a match. To escape the special meaning of %, a \ must precede it.

\g/\%/5%p

could be used to match and list %c, %d, or %s formats (for example, printf-like statements) of characters, decimal integers, or strings. Another feature of the \xv command is that the first line of output from a UNIX system command can be stored into a variable. The only requirement is that the first character of value be an !. For example:

.xw junk
.xv5!cat junk
!rm junk
!echo "%s"
xv6!expr %6 + 1

would put the current line into variable 35, print it, and increment the variable 36 by one. To escape the special meaning of ! as the first character of value, precede it with a \.

.xv7\!date

stores the value !date into variable 7.

These two commands will test the last saved return code from the execution of a UNIX system command (!command) or nonzero value, respectively, to the specified label. The two examples below both search for the next five lines containing the string size:

Example 1:

.xv55
: \n/size/
xv5!expr %5 - 1
!if 0%5 != 0 exit 2
.xbn \
Example 2:

```
xv45
  : l
  /size/
xv4!expr %4 - 1
  !if @%4 = 0 exit 2
  xbez l
```

xc [switch] If switch is 1, output from the p and null commands is crunched; if switch is 0, it is not. Without an argument, xc reverses switch. Initially, switch is set for no crunching. Crunched output has strings of tabs and blanks reduced to one blank and blank lines suppressed.

**Operands** The following operand is supported:

- `filename` Any file up to 1024K bytes and 32K lines, with up to 512 characters, including new-line, per line (255 for 16-bit machines). `filename` can be a section of a larger file which has been divided into more manageable sections for editing by the use of `csplit(1)`.

**Exit Status** The following exit values are returned:

- 0 Successful completion without any file or command errors.
- >0 An error occurred.

**Attributes** See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

**See Also** `csplit(1), ed(1), umask(1), attributes(5)`

**Diagnostics** Message is ? for errors in commands, if prompting is turned off. Self-explanatory error messages are displayed when prompting is on.
Name biff – give notice of incoming mail messages

Synopsis /usr/ucb/biff [y | n]

Description biff turns mail notification on or off for the terminal session. With no arguments, biff displays the current notification status for the terminal.

If notification is allowed, the terminal rings the bell and displays the header and the first few lines of each arriving mail message. biff operates asynchronously. For synchronized notices, use the MAIL variable of `sh(1)` or the mail variable of `csh(1)`.

A 'biff y' command can be included in your ~/.login or ~/.profile file for execution when you log in.

Options y  Allow mail notification for the terminal.
             n  Disable notification for the terminal.

Files ~/.login   User's login file
             ~/.profile User's profile file

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>

See Also csh(1), mail(1), sh(1), attributes(5)
Name  break, continue – shell built-in functions to escape from or advance within a controlling while, for, foreach, or until loop

Synopsis

sh  break [n]
    continue [n]

csh  break
    continue

ksh88  *break [n]
        *continue [n]

ksh  +break [n]
     +continue [n]

Description

sh  The break utility exits from the enclosing for or while loop, if any. If n is specified, break n levels.

The continue utility resumes the next iteration of the enclosing for or while loop. If n is specified, resume at the n-th enclosing loop.

csh  The break utility resumes execution after the end of the nearest enclosing foreach or while loop. The remaining commands on the current line are executed. This allows multilevel breaks to be written as a list of break commands, all on one line.

The continue utility continues execution of the next iteration of the nearest enclosing while or foreach loop.

ksh88  The break utility exits from the enclosed for, while, until, or select loop, if any. If n is specified, then break n levels. If n is greater than the number of enclosing loops, the outermost enclosing loop shall be exited.

The continue utility resumes the next iteration of the enclosed for, while, until, or select loop. If n is specified then resume at the n-th enclosed loop. If n is greater than the number of enclosing loops, the outermost enclosing loop shall be used.

On this manual page, ksh88(1) commands that are preceded by one or two * (asterisks) are treated specially in the following ways:

1. Variable assignment lists preceding the command remain in effect when the command completes.

2. I/O redirections are processed after variable assignments.

3. Errors cause a script that contains them to abort.
break is a shell special built-in that exits the smallest enclosing for, select, while, or until loop. It also exits the nth enclosing loop if n is specified. Execution continues at the command following the loop or loops.

If n is specified, it must be a positive integer ≥1. If n is larger than the number of enclosing loops, the last enclosing loop is exited.

continue is a shell special built-in that continues execution at the top of the smallest enclosing for, select, while, or until loop, if any; or of the top of the nth enclosing loop if n is specified.

If n is specified, it must be a positive integer ≥1. If n is larger than the number of enclosing loops, the last enclosing loop is used.

On this manual page, ksh(1) commands that are preceded by one or two + symbols are special built-in commands and are treated the following ways:

1. Variable assignment lists preceding the command remain in effect when the command completes.
2. I/O redirections are processed after variable assignments.
3. Errors cause a script that contains them to abort.
4. Built-in commands are not valid function names.
5. Words following a command preceded by ++ that are in the format of a variable assignment are expanded with rules as a variable assignment. This means that tilde substitution is performed after the = sign and field splitting and file name generation are not performed.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also csh(1), exit(1), ksh(1), ksh88(1), sh(1), attributes(5)
**Name**
builtin — ksh built-in function to add, delete, or display shell built-ins

**Synopsis**
builtin [-ds] [-f lib] [pathname ...]

**Description**
The `builtin` command adds, deletes, or displays built-in commands in the current shell environment. A built-in command executes in the current shell process and can have side effects in the current shell. On most systems, the invocation time for built-in commands is one or two orders of magnitude less than commands that create a separate process.

For each `pathname` specified, the basename of the pathname determines the name of the built-in. For each basename, the shell looks for a C level function in the current shell whose name is determined by pre-pending `b_` to the built-in name. If `pathname` contains a forward slash (`/`), the built-in is bound to `pathname`. A built-in bound to a pathname is only executed if `pathname` is the first executable found during a path search. Otherwise, built-ins are found prior to performing the path search.

If `pathname` is not specified, `builtin` displays the current list of built-ins, or just the special built-ins if the `-s` option is specified, on standard output. The full pathname for built-ins that are bound to pathnames are displayed.

Libraries containing built-ins can be specified with the `-f` option. If the library contains a function named `lib_init()`, this function is invoked with argument 0 when the library is loaded. The `lib_init()` function can load built-ins by invoking an appropriate C level function. In this case there is no restriction on the C level function name.

The C level function is invoked with three arguments. The first two are the same as `main()` and the third one is a pointer.

The `ksh builtin` command cannot be invoked from a restricted shell.

**Options**
The following options are supported:

- `-d`
  Delete each of the specified built-ins. Special built-ins cannot be deleted.

- `-f lib`
  On systems with dynamic linking, load and search for built-ins in the shared library, `lib`.

  Libraries are searched for in `$PATH` and system dependent library directories. The system dependent shared library prefix or suffix can be omitted. Once a library is loaded, its symbols become available for the current and subsequent invocations of `builtin`. Multiple libraries can be specified with separate invocations of `builtin`. Libraries are searched in the reverse order in which they are specified.

- `-s`
  Display only the special built-ins.

**Operands**
The following operands are supported:

- `pathname`
  Specifies the `pathname`. The basename of the pathname determines the name of the built-in.
Exit Status  The following exit values are returned:
   0      Successful completion.
   >0     An error occurred.

Examples  EXAMPLE 1  Loading a builtin Command
           The following example loads a builtin command mycmd from the library libfoo.so:
           example% builtin -f foo mycmd

Authors  David Korn, dgk@research.att.com

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Uncommitted</td>
</tr>
</tbody>
</table>

See Also  ksh(1), whence(1), attributes(5)
The `cal` utility writes a Gregorian calendar to standard output. If the `year` operand is specified, a calendar for that year is written. If no operands are specified, a calendar for the current month is written.

**Operands**

The following operands are supported:

- `month` Specify the month to be displayed, represented as a decimal integer from 1 (January) to 12 (December). The default is the current month.
- `year` Specify the year for which the calendar is displayed, represented as a decimal integer from 1 to 9999. The default is the current year.

**Environment Variables**

See `environ(5)` for descriptions of the following environment variables that affect the execution of `cal`: `LANG`, `LC_ALL`, `LC_CTYPE`, `LC_TIME`, `LC_MESSAGES`, and `NLSPATH`.

`TZ` Determine the timezone used to calculate the value of the current month.

**Exit Status**

The following exit values are returned:

- 0 Successful completion.
- >0 An error occurred.

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See <code>standards(5)</code></td>
</tr>
</tbody>
</table>

**See Also**

`calendar(1)`, `attributes(5)`, `environ(5)`, `standards(5)`

**Notes**

An unusual calendar is printed for September 1752. That is the month 11 days were skipped to make up for lack of leap year adjustments. To see this calendar, type:

```
cal 9 1752
```

The command `cal 83` refers to the year 83, not 1983.

The year is always considered to start in January.
calendar(1)

Name   calendar – reminder service

Synopsis calendar [-]

Description The calendar utility consults the file calendar in the current directory and writes lines that contain today's or tomorrow's date anywhere in the line to standard output. Most reasonable month-day dates such as Aug. 24, august 24, 8/24, and so forth, are recognized, but not 24 August or 24/8. On Fridays and weekends “tomorrow” extends through Monday. calendar can be invoked regularly by using the crontab(1) or at(1) commands.

When the optional argument - is present, calendar does its job for every user who has a file calendar in his or her login directory and sends them any positive results by mail(1). Normally this is done daily by facilities in the UNIX operating system (see cron(1M)).

If the environment variable DATEMSK is set, calendar will use its value as the full path name of a template file containing format strings. The strings consist of conversion specifications and text characters and are used to provide a richer set of allowable date formats in different languages by appropriate settings of the environment variable LANG or LC_TIME; see environ(5). See strftime(3C) for the list of allowable conversion specifications.

Examples  EXAMPLE 1 Possible contents of a template

The following example shows the possible contents of a template:

%B %eth of the year %Y

%B represents the full month name, %e the day of month and %Y the year (4 digits).

If DATEMSK is set to this template, the following calendar file would be valid:

March 7th of the year 1989 <Reminder>

See environ(5) for descriptions of the following environment variables that affect the execution of calendar: LC_CTYPE, LC_TIME, LC_MESSAGES, NLSPATH, and TZ.

Exit Status  0 Successful completion.
>0 An error occurred.

Files  /etc/passwd    system password file
/tmp/cal*    temporary files used by calendar
/usr/lib/calprog program used to determine dates for today and tomorrow

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>
See Also at(1), crontab(1), mail(1), cron(1M), ypbind(1M), strftime(3C), attributes(5), environ(5)

Notes

Appropriate lines beginning with white space will not be printed.

Your calendar must be public information for you to get reminder service.

calendar's extended idea of "tomorrow" does not account for holidays.

The - argument works only on calendar files that are local to the machine; calendar is intended not to work on calendar files that are mounted remotely with NFS. Thus, 'calendar -' should be run only on diskful machines where home directories exist; running it on a diskless client has no effect.

calendar is no longer in the default root crontab. Because of the network burden 'calendar -' can induce, it is inadvisable in an environment running ypbind(1M) with a large passwd.byname map. If, however, the usefulness of calendar outweighs the network impact, the super-user may run 'crontab -e' to edit the root crontab. Otherwise, individual users may wish to use 'crontab -e' to edit their own crontabs to have cron invoke calendar without the - argument, piping output to mail addressed to themselves.
The `cat` utility reads each file in sequence and writes it on the standard output. Thus:

Example:
```
example% cat file
```

prints file on your terminal, and:

```
example% cat file1 file2 >file3
```

concatenates file1 and file2, and writes the results in file3. If no input file is given, cat reads from the standard input file.

**Options**

The following options are supported by `/usr/bin/cat`:

- `-b` Number the lines, as `-n`, but omit the line numbers from blank lines.
- `-n` Precede each line output with its line number.
- `-s` cat is silent about non-existent files.
- `-u` The output is not buffered.

Buffered output is the default.

- `-v` Non-printing characters, with the exception of tabs, NEWLINEs and form feeds, are printed visibly. ASCII control characters (octal 000 – 037) are printed as ^n, where n is the corresponding ASCII character in the range octal 100 – 137 (@, A, B, C, ..., X, Y, Z, [, \, ], ^, and _); the DEL character (octal 0177) is printed ^?. Other non-printable characters are printed as M-x, where x is the ASCII character specified by the low-order seven bits.

When used with the `-v` option, the following options can be used:

- `-e` A $ character is printed at the end of each line, prior to the NEWLINE.
- `-t` Tabs are printed as ^I's and form feeds are printed as ^Ls.

The -e and -t options are ignored if the -v option is not specified.

**Operands**

The following operand is supported:

- `file` A path name of an input file. If no file is specified, the standard input is used. If file is `-`, cat reads from the standard input at that point in the sequence. cat does not close and reopen standard input when it is referenced in this way, but accepts multiple occurrences of `-` as file.

**Usage**

See `largefile(5)` for the description of the behavior of cat when encountering files greater than or equal to 2 Gbyte (2^31 bytes).
Examples

EXAMPLE 1  Concatenating a File

The following command writes the contents of the file myfile to standard output:

```bash
example% cat myfile
```

EXAMPLE 2  Concatenating Two files into One

The following command concatenates the files doc1 and doc2 and writes the result to doc.all.

```bash
example% cat doc1 doc2 > doc.all
```

EXAMPLE 3  Concatenating Two Arbitrary Pieces of Input with a Single Invocation

When standard input is a terminal, the following command gets two arbitrary pieces of input from the terminal with a single invocation of cat:

```bash
example% cat start - middle - end > file
```

When standard input is a terminal, gets two arbitrary pieces of input from the terminal with a single invocation of cat.

If standard input is a regular file,

```bash
example% cat start - middle - end > file
```

would be equivalent to the following command:

```bash
cat start - middle /dev/null end > file
```

because the entire contents of the file would be consumed by cat the first time − was used as a file operand and an end-of-file condition would be detected immediately when − was referenced the second time.

Environment Variables

See environ(5) for descriptions of the following environment variables that affect the execution of cat: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status

The following exit values are returned:

- 0  All input files were output successfully.

- >0  An error occurred.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
</tbody>
</table>
Redirecting the output of `cat` onto one of the files being read causes the loss of the data originally in the file being read. For example,

```bash
example% cat filename1 filename2 > filename1
```

causes the original data in `filename1` to be lost.

### See Also
- `touch(1)`, `attributes(5)`, `environ(5)`, `largefile(5)`, `standards(5)`

### Notes
- Redirecting the output of `cat` onto one of the files being read causes the loss of the data originally in the file being read. For example,

```bash
example% cat filename1 filename2 > filename1
```

causes the original data in `filename1` to be lost.
Name  cd, chdir, pushd, popd, dirs – change working directory

Synopsis  /usr/bin/cd [directory]

sh  cd [argument]
    chdir [argument]

csh  cd [dir]
    chdir [dir]
    pushd [+n | dir]
    popd [+n]
    dirs [-l]

ksh88, ksh  cd [-L] [-P] [arg]
            cd old new

Description  

The /usr/bin/cd utility changes the current directory in the context of the cd utility only. This is in contrast to the version built into the shell. /usr/bin/cd has no effect on the invoking process but can be used to determine whether or not a given directory can be set as the current directory.

sh  The Bourne shell built-in cd changes the current directory to argument. The shell parameter HOME is the default argument. The shell parameter CDPATH defines the search path for the directory containing argument. Alternative directory names are separated by a colon (:). The default path is <null> (specifying the current directory). The current directory is specified by a null path name, which can appear immediately after the equal sign or between the colon delimiters anywhere else in the path list. If argument begins with ‘/’, ‘.’, or ‘..’, the search path is not used. Otherwise, each directory in the path is searched for argument. cd must have execute (search) permission in argument. Because a new process is created to execute each command, cd would be ineffective if it were written as a normal command; therefore, it is recognized by and is internal to the shell. (See pwd(1), sh(1), and chdir(2)).

chdir is just another way to call cd.

Csh  If dir is not specified, the C shell built-in cd uses the value of shell parameter HOME as the new working directory. If dir specifies a complete path starting with ‘/’, ‘.’, or ‘..’, dir becomes the new working directory. If neither case applies, cd tries to find the designated directory relative to one of the paths specified by the CDPATH shell variable. CDPATH has the same syntax as, and similar semantics to, the PATH shell variable. cd must have execute (search) permission in dir. Because a new process is created to execute each command, cd would be ineffective if it were written as a normal command; therefore, it is recognized by and is internal to the C-shell. (See pwd(1), sh(1), and chdir(2)).
chdir changes the shell’s working directory to directory dir. If no argument is given, change to the home directory of the user. If dir is a relative pathname not found in the current directory, check for it in those directories listed in the cdpath variable. If dir is the name of a shell variable whose value starts with a /, change to the directory named by that value.

pushd pushes a directory onto the directory stack. With no arguments, exchange the top two elements.

+n Rotate the n’th entry to the top of the stack and cd to it.

dir Push the current working directory onto the stack and change to dir.

popd pops the directory stack and cd to the new top directory. The elements of the directory stack are numbered from 0 starting at the top.

+n Discard the n’th entry in the stack.

dirs prints the directory stack, most recent to the left; the first directory shown is the current directory. With the -l argument, produce an unabbreviated printout; use of the ~ notation is suppressed.

The Korn shell built-in cd command can be in either of two forms. In the first form it changes the current directory to arg. If arg is – the directory is changed to the previous directory. The shell variable HOME is the default arg. The environment variable PWD is set to the current directory. If the PWD is changed, the OLDPWD environment variable shall also be changed to the value of the old working directory, that is, the current working directory immediately prior to the call to change directory (cd). The shell variable CDPATH defines the search path for the directory containing arg. Alternative directory names are separated by a colon (:). The default path is null (specifying the current directory). The current directory is specified by a null path name, which can appear immediately after the equal sign or between the colon delimiters anywhere else in the path list. If arg begins with a ‘/’, ‘.’, or ‘..’, then the search path is not used. Otherwise, each directory in the path is searched for arg. If unsuccessful, cd attempts to change directories to the pathname formed by the concatenation of the value of PWD, a slash character, and arg.

-L Handles the operation dot-dot ( . . ) logically. Symbolic link components are not resolved before dot-dot components are processed.

-P Handles the operand dot-dot physically. Symbolic link components are resolved before dot-dot components are processed.

If both -L and -P options are specified, the last option to be invoked is used and the other is ignored. If neither -L nor -P is specified, the operand is handled dot-dot logically.

The second form of cd substitutes the string new for the string old in the current directory name, PWD and tries to change to this new directory.
The cd command cannot be executed by rksh. Because a new process is created to execute each command, cd would be ineffective if it were written as a normal command; therefore, it is recognized by and is internal to the Korn shell. (See \texttt{pwd(1)}, \texttt{sh(1)}, and \texttt{chdir(2)}).

**Operands**
The following operands are supported:

- \texttt{directory}
  An absolute or relative pathname of the directory that becomes the new working directory. The interpretation of a relative pathname by \texttt{cd} depends on the \texttt{CDPATH} environment variable.

**Output**
If a non-empty directory name from \texttt{CDPATH} is used, an absolute pathname of the new working directory is written to the standard output as follows:

\verb|"%s
<new directory>|\n
Otherwise, there is no output.

**Environment Variables**
See \texttt{environ(5)} for descriptions of the following environment variables that affect the execution of \texttt{cd}: \texttt{LANG}, \texttt{LC_ALL}, \texttt{LC_CTYPE}, \texttt{LC_MESSAGES}, and \texttt{NLSPATH}.

- \texttt{CDPATH}
  A colon-separated list of pathnames that refer to directories. If the \texttt{directory} operand does not begin with a slash (\texttt{/}) character, and the first component is not dot or dot-dot, \texttt{cd} searches for \texttt{directory} relative to each directory named in the \texttt{CDPATH} variable, in the order listed. The new working directory sets to the first matching directory found. An empty string in place of a directory pathname represents the current directory. If \texttt{CDPATH} is not set, it is treated as if it were an empty string.

- \texttt{HOME}
  The name of the home directory, used when no \texttt{directory} operand is specified.

- \texttt{OLDPWD}
  A pathname of the previous working directory, used by \texttt{cd-}.

- \texttt{PWD}
  A pathname of the current working directory, set by \texttt{cd} after it has changed to that directory.

**Exit Status**
The following exit values are returned by \texttt{cd}:

- \texttt{0}
  The directory was successfully changed.

- \texttt{>0}
  An error occurred.

**Attributes**
See \texttt{attributes(5)} for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>
### cd(1)

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

#### ksh

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Uncommitted</td>
</tr>
</tbody>
</table>

**See Also**  
`csh(1), ksh(1), ksh88(1), pwd(1), sh(1), chdir(2), attributes(5), environ(5), standards(5)`
The `cdrw` command provides the ability to create data and audio CDs. This command also provides the ability to extract audio tracks from an audio CD and to create data DVDs. The CD or DVD device must be MMC-compliant to create a CD or DVD with the `cdrw` command.

When more than one CD or DVD writer is connected to the system, use the `-d` option to indicate which device is desired. The device name can be specified in one of the following ways: `/dev/rdsk/cNtNdNsN, cNtNdNsN, cNtNdN`, or a name used by volume manager, such as `cdrom` or `cdrom1`. Using the `-l` option provides a list of CD or DVD writers.

For instructions on adding a USB-mass-storage-class-compliant CD-RW or DVD–RW device to your system, see `scsa2usb(7D)`.

### Creating Data CDs

When creating data CDs, `cdrw` uses the Track-At-Once mode of writing. Use the `-i` option to specify a file that contains the data to write on CD media. If you don’t specify this option, `cdrw` reads data from standard input.

In either case, the data is typically prepared by using the `mkisofs` command to convert the file and file information into the High Sierra format used on CDs. See the examples that include use of this command.

### Creating Data DVDs

`cdrw` can create single-session data DVDs on DVD+RW or DVD-RW devices using images generated from `mkisofs`. These disks can be mounted as HSFS file systems. When making data DVDs, `cdrw` uses Disk-At-Once (DAO) mode of writing, which closes the media when writing is completed and prevents any further sessions from being added. The image should be prepared in advance when writing an image to the DVD media since DAO mode requires that the size of the image be known in advance.
Creating Audio CDs

Use the -a option to create an audio CD. Single or multiple audio files can be specified with this option. All of the audio files should be in a supported audio format. Currently approved formats are:

- `s`un. au files with data in Red Book CDDA form
- `w`av. RIFF (.wav) files with data in Red Book CDDA form
- `c`da. `.cda` files having raw CD audio data (that is, 16 bit PCM stereo at 44.1 KHz sample rate in little-endian byte order)
- `a`ur. `.aur` files having raw CD data in big-endian byte order

If no audio format is specified, `cdrw` tries to identify the audio file format based on the file extension. The case of the characters in the extension is ignored. If a format is specified using the -T option, it is assumed to be the audio file type for all the files specified. Also, using the -c option closes the session after writing the audio tracks. Therefore, the tracks to be written should be specified in a single command line.

Extracting Audio

`cdrw` can also be used for extracting audio data from an audio CD with the -x option. The CD should have tracks in Red Book CDDA form. By default, the output format is based on the file extension. A user can specify a `s`un, `w`av, `c`da, or `a`ur output format with the -T option.

Copying CDs

`cdrw` can be used to copy single session data CD-ROMs and Red Book audio CDs. When copying a CD, `cdrw` looks for a specified source device. If no source device is specified when using the -c option, the current CD writer is assumed to be the source. `cdrw` extracts the track or tracks into a temporary file and looks for a blank writable CD-R/RW media in the current CD writer. If no media is found, insert a blank writable CD media in the current CD writer. If the default temporary directory does not have enough space, an alternate directory can be specified by using the -m option.

Erasing CD-RW or DVD-RW Media

Users have to erase the CD-RW media before it can be rewritten. With the -b option, the following flavors of erasing are currently supported:

- `s`ession. Erases the last session.
- `f`ast. Minimally erases the media.
- `a`ll. Erases the entire media.

If the session erasing type is used, `cdrw` erases the last session. If there is only one session recorded on the CD-RW (for example, a data or audio CD-RW created by this tool), then session erasing only erases the portion that is recorded, leaving behind a blank disk. This is faster than erasing the entire media. For DVD media, using the -b `s`ession erases the whole media.
The fast erasing type minimally erases the entire media by removing the PMA and TOC of the first session. It does not erase the user data and subsequent tracks on the media, but the media is treated as if it were a blank disk. If a complete erase is of the media is necessary, use the all option.

The all erasing type should be used if it is a multisession disk, the last session is not closed, or disk status is unknown, and you want to erase the disk. With this type of erasing, cdrw erases the entire disk.

DVD+RW media does not support erasing. To re-use DVD+RW media, simply write a new image onto the media. cdrw formats and overwrites the existing media automatically.

You can list a system’s CD or DVD writers by using the -l option. Also, for a particular media, you can get the blanking status and table of contents by using the -M option. The -M option also prints information about the last session’s start address and the next writable address. This information, along with the -0 option, can be used to create multisession CDs. Refer to the mkisofs(8) man page, (/usr/share/man/man8/mkisofs.8), in the SUNWfsman package for more information.

Options

The following options are supported:

- **-a** Creates an audio disk. At least one audio-file name must be specified. A CD can not have more than 99 audio tracks, so no more than 99 audio files can be specified.

- **-b** Blanks CD-RW or DVD-RW media. The type of erasing must be specified by the all, fast, or session argument. DVD+RW media does not support blanking, but can be rewritten without the need for blanking.

- **-c** Copies a CD. If no other argument is specified, the default CD writing device is assumed to be the source device as well. In this case, the copy operation reads the source media into a temporary directory and prompts you to place a blank media into the drive for the copy operation to proceed.

- **-c** This option is obsolete.

  This option used to cause cdrw to query the drive to determine media capacity. This is now the default behavior.

- **-d** Specifies the CD or DVD writing device.

- **-h** Help. Prints usage message.

- **-i** Specifies the image file for creating data CDs or DVDs. The file size should be less than what can be written on the media. Also, consider having the file locally available instead of having the file on an NFS-mounted file system. The CD writing process expects data to be available continuously without interruptions.

- **-l** Lists all the CD or DVD writers available on the system.
-L Closes the disk. If the media was left in an open state after the last write operation, it is closed to prevent any further writing. This operation can only be done on re-writable CD-RW media.

-m Uses an alternate temporary directory instead of the default temporary directory for storing track data while copying a CD or DVD. An alternate temporary directory might be required because the amount of data on a CD can be huge. For example, the amount of data can be as much as 800 Mbytes for an 80 minute audio CD and 4.7 Gbytes for a DVD. The default temporary directory might not have that much space available.

-M Reports media status. cdrw reports if the media is blank or not, its table of contents, the last session’s start address, and the next writable address if the disk is open. DVD+RW does not support erasing and always has some content on the media.

-O Keeps the disk open. cdrw closes the session, but it keeps the disk open so that another session can be added later on to create a multisession disk.

-p Sets the CD writing speed. For example, -p 4 sets the speed to 4X. If this option is not specified, cdrw uses the default speed of the CD writer. If this option is specified, cdrw tries to set the drive write speed to this value, but there is no guarantee of the actual speed that is used by the drive.

-s Specifies the source device for copying a CD or DVD.

-S Simulation mode. In this mode, cdrw operates with the drive laser turned off, so nothing is written to the media. Use this option to verify if the system can provide data at a rate good enough for CD writing.


-T Audio format to use for extracting audio files or for reading audio files for audio CD creation. The audio-type can be sun, wav, cda, or aur.

-v Verb mode.

-x Extracts audio data from an audio track.

Examples

**EXAMPLE 1** Creating a Data CD or DVD

```
example% cdrw -i /local/iso_image
```

**EXAMPLE 2** Creating a CD or DVD from a Directory

This example shows how to create a CD or DVD from the directory tree /home/foo.

```
example% mkisofs -r /home/foo 2>/dev/null | cdrw -i -p 1
```
EXAMPLE 3  Extracting an Audio Track Number
This example shows how to extract audio track number 1 to /home/foo/song1.wav.
example% cdrw -x -T wav 1 /home/foo/song1.wav

EXAMPLE 4  Using wav Files
This example shows how to create an audio CD from wav files on disk.
example% cdrw -a song1.wav song2.wav song3.wav song4.wav

EXAMPLE 5  Erasing CD-RW or DVD-RW Media
This example shows how to erase rewritable media.
example% cdrw -b all

EXAMPLE 6  Creating a Data CD or DVD with Multiple Drives
This example shows how to create a data CD or DVD on a system with multiple CD, DVD-R, or DVD-RW drives.
example% cdrw -d c1t6d0s2 -i /home/foo/iso-image

EXAMPLE 7  Checking Data Delivery Rate
This example shows how to verify that the system can provide data to a CD-RW or a DVD drive at a rate sufficient for the write operation.
example% cdrw -S -i /home/foo/iso-image

EXAMPLE 8  Running at a Higher Priority
This example shows how to run cdrw at a higher priority (for root user only).
example# priocntl -e -p 60 cdrw -i /home/foo/iso-image

EXAMPLE 9  Creating a Multi-session Disk
This examples shows how to create the first session image by using mkisofs and recording it onto the disk without closing the disk.
example% cdrw -O -i /home/foo/iso-image

Additional sessions can be added to an open disk by creating an image with mkisofs using the session start and next writable address reported by cdrw.
example% cdrw -M

<table>
<thead>
<tr>
<th>Track No.</th>
<th>Type</th>
<th>Start address</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Data</td>
<td>0</td>
</tr>
</tbody>
</table>
Creating a Multi-session Disk  (Continued)

Last session start address: 162140
Next writable address: 173464

example% mkisofs -o /tmp/image2 -r -C 0,173464 -M \
/dev/rdsk/c0t2d0s2 /home/foo

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>media/cdrw</td>
</tr>
</tbody>
</table>

See Also  audioconvert(1), priocntl(1), policy.conf(4), attributes(5), rbac(5), scsa2usb(7D), sd(7D)

mkisofs(8), (/usr/share/man/man8/mkisofs.8), in the SUNWfsman package

Oracle Solaris 11.1 Administration: Devices and File Systems

Notes  The CD writing process requires data to be supplied at a constant rate to the drive. Keep I/O activity to a minimum and shut down any related I/O applications while writing CDs.

When making copies or extracting audio tracks, use an MMC compliant source CD-ROM drive. The CD writer can be used for this purpose.

Before writing a CD, ensure that the media is blank by using the -M option. You can use the -S simulation mode to test the system to make sure it can provide data at the required rate. cdrw turns on buffer underrun protection for drives that support it and recovers from most stalls. If the system is not able to provide data at a constant rate or frequent stalling occurs, you can lower the speed by using the -p option. You can also try to run cdrw at a higher priority by using the priocntl(1) command.

If you know that the CD-R/RW drive can operate at different write speeds, use the -p option. Some commercially available drives handle the drive speed setting command differently, so use this option judiciously.

The cdrw command uses rbac(5) to control user access to the devices. By default, cdrw is accessible to all users but can be restricted to individual users. Refer to the Oracle Solaris 11.1 Administration: Devices and File Systems for more information.

To burn CDs as a non-root user hal must be enabled and the user must be on the console. hal, that is the svc:/system/hal SMF service, is enabled by default, therefore, typically this requires no special action.
The user must be logged onto the console. /dev/console is also correct. Previously, users could log in remotely, for example, by using telnet or ssh, and be able to burn CDs. This would work unless the administrator had changed the default configuration to deny solaris.device.cdrw authorization. See policy.conf(4).
Name
checknr – check nroff and troff input files; report possible errors

Synopsis
checknr [-fs] [-a . x1 . y1 . x2 . y2 ... .xn .yn]
        [-c . x1 . x2 . x3 ... .xn] [filename]...

Description
checknr checks a list of nroff(1) or troff(1) input files for certain kinds of errors involving mismatched opening and closing delimiters and unknown commands. If no files are specified, checknr checks the standard input. Delimiters checked are:

- Font changes using \f{x} \fP.
- Size changes using \s{x} \s0.
- Macros that come in open...close forms, for example, the .TS and .TE macros which must always come in pairs.

checknr knows about the ms(5) and me(5) macro packages.

checknr is intended to be used on documents that are prepared with checknr in mind. It expects a certain document writing style for \f and \s commands, in that each \f{x} must be terminated with \fP and each \s{x} must be terminated with \s0. While it will work to directly go into the next font or explicitly specify the original font or point size, and many existing documents actually do this, such a practice will produce complaints from checknr. Since it is probably better to use the \fP and \s0 forms anyway, you should think of this as a contribution to your document preparation style.

Options
- \f  Ignore \f font changes.
- \s  Ignore \s size changes.
- \a .x1 .y1... Add pairs of macros to the list. The pairs of macros are assumed to be those (such as .DS and .DE) that should be checked for balance. The \a option must be followed by groups of six characters, each group defining a pair of macros. The six characters are a period, the first macro name, another period, and the second macro name. For example, to define a pair .BS and .ES, use -a .BS .ES
- \c .x1... Define commands which checknr would otherwise complain about as undefined.

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>text/doctools</td>
</tr>
</tbody>
</table>

See Also
eqn(1), nroff(1), troff(1), attributes(5), me(5), ms(5)
Bugs  There is no way to define a one-character macro name using the -a option.
Name  
chgpr  - change file group ownership

Synopsis  
chgpr [-fhR]  group  file...

                   chgrp  -s [-fhR]  groupsid  file...
                   chgrp  -R  [f]  [-H |  -L  |  -P]  group  file...
                   chgrp  -s  -R  [f]  [-H  |  -L  |  -P]  groupsid  file...

Description  
The chgrp utility will set the group ID of the file named by each file operand to the group ID specified by the group operand.

For each file operand, it will perform actions equivalent to the chown(2) function, called with the following arguments:

- The file operand will be used as the path argument.
- The user ID of the file will be used as the owner argument.
- The specified group ID will be used as the group argument.

Unless chgrp is invoked by a process with appropriate privileges, the set-user-ID and set-group-ID bits of a regular file will be cleared upon successful completion; the set-user-ID and set-group-ID bits of other file types may be cleared.

The operating system has a configuration option _POSIX_CHOWN_RESTRICTED, to restrict ownership changes. When this option is in effect, the owner of the file may change the group of the file only to a group to which the owner belongs. Only the super-user can arbitrarily change owner IDs, whether or not this option is in effect. To set this configuration option, include the following line in /etc/system:

    set  rstchown  =  1

To disable this option, include the following line in /etc/system:

    set  rstchown  =  0

_POSIX_CHOWN_RESTRICTED is enabled by default. See system(4) and fpathconf(2).

Options  
The following options are supported.

/usr/bin/chgrp and  
/usr/xpg4/bin/chgrp

- h  If the file is a symbolic link, this option changes the group of the symbolic link. Without this option, the group of the file referenced by the symbolic link is changed.
- H  If the file specified on the command line is a symbolic link referencing a file of type directory, this option changes the group of the directory referenced by the symbolic link and all the files in the file hierarchy below it. If a symbolic link is encountered when traversing a file hierarchy, the group of the target file is changed, but no recursion takes place.
If the file is a symbolic link, this option changes the group of the file referenced by the symbolic link. If the file specified on the command line, or encountered during the traversal of the file hierarchy, is a symbolic link referencing a file of type directory, then this option changes the group of the directory referenced by the symbolic link and all files in the file hierarchy below it.

- L

If the file specified on the command line or encountered during the traversal of a file hierarchy is a symbolic link, this option changes the group of the symbolic link. This option does not follow the symbolic link to any other part of the file hierarchy.

- P

The specified group is Windows SID. This option requires a file system that supports storing SIDs, such as ZFS.

Specifying more than one of the mutually-exclusive options - H, - L, or - P is not considered an error. The last option specified determines the behavior of chgrp.

Operating System

chgrp(1)

Operands

The following operands are supported:

> group

A group name from the group database or a numeric group ID. Either specifies a group ID to be given to each file named by one of the file operands. If a numeric group operand exists in the group database as a group name, the group ID number associated with that group name is used as the group ID.

> file

A path name of a file whose group ID is to be modified.

Usage

See largefile(5) for the description of the behavior of chgrp when encountering files greater than or equal to 2 Gbyte (2^31 bytes).

Environment Variables

See environ(5) for descriptions of the following environment variables that affect the execution of chgrp: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status

The following exit values are returned:

> 0 The utility executed successfully and all requested changes were made.

> > 0 An error occurred.
Files  /etc/group  group file

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>/usr/bin/chgrp</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
<td></td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled. See NOTES.</td>
<td></td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>/usr/xpg4/bin/chgrp</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/xopen/xcu4</td>
<td></td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled. See NOTES.</td>
<td></td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
<td></td>
</tr>
</tbody>
</table>

See Also  chmod(1), chown(1), id(1M), chown(2), fpathconf(2), group(4), passwd(4), system(4), attributes(5), environ(5), largefile(5), standards(5)

Notes  chgrp is CSI-enabled except for the group name.
chkey

**Name**
chkey – change user's secure RPC key pair

**Synopsis**
chkey [-p] [-s nis | files | ldap]

[-m <mechanism>]

**Description**
chkey is used to change a user's secure RPC public key and secret key pair. chkey prompts for the old secure-rpc password and verifies that it is correct by decrypting the secret key. If the user has not already used keylogin(1) to decrypt and store the secret key with keyserv(1M), chkey registers the secret key with the local keyserv(1M) daemon. If the secure-rpc password does not match the login password, chkey prompts for the login password. chkey uses the login password to encrypt the user's secret Diffie-Hellman (192 bit) cryptographic key. chkey can also encrypt other Diffie-Hellman keys for authentication mechanisms configured.

chkey ensures that the login password and the secure-rpc password(s) are kept the same, thus enabling password shadowing. See shadow(4).

The key pair can be stored in the /etc/publickey file (see publickey(4)) or the NIS publickey map. If a new secret key is generated, it will be registered with the local keyserv(1M) daemon.

Keys for specific mechanisms can be changed or re-encrypted using the -m option followed by the authentication mechanism name. Multiple -m options can be used to change one or more keys.

If the source of the publickey is not specified with the -s option, chkey consults the publickey entry in the name service switch configuration file. See nsswitch.conf(4). If the publickey entry specifies one and only one source, then chkey will change the key in the specified name service. However, if multiple name services are listed, chkey can not decide which source to update and will display an error message. The user should specify the source explicitly with the -s option.

Non root users are not allowed to change their key pair in the files database.

**Options**
The following options are supported:

- `-p` Re-encrypt the existing secret key with the user's login password.
- `-s nis` Update the NIS database.
- `-s files` Update the files database.
- `-s ldap` Update the LDAP database.
- `-m <mechanism>` Changes or re-encrypt the secret key for the specified mechanism.

**Files**
/etc/nsswitch.conf
/etc/publickey
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  keylogin(1), keylogout(1), keyserv(1M), newkey(1M), nsswitch.conf(4), publickey(4), shadow(4), attributes(5)
The `chmod` utility changes or assigns the mode of a file.

`chmod` can also be used to modify Access Control Lists (ACLs) on files and directories, and to modify boolean read-write system attributes on regular files, directories, and opaque extended attribute files.

### Absolute Mode

An absolute mode command line has the following format:

```bash
chmod [options] absolute-mode file...
```

where `absolute-mode` is specified using octal numbers `nnnn` defined as follows:

- **n**: a number from 0 to 7. An absolute mode is constructed from the OR of any of the following modes:
  - **4000**: Set user ID on execution.
  - **200 # 0**: Set group ID on execution if # is 7, 5, 3, or 1.
    - Enable mandatory locking if # is 6, 4, 2, or 0.
      - For directories, files are created with BSD semantics for propagation of the group ID. With this option, files and subdirectories created in the directory inherit the group ID of the directory, rather than of the current process. For directories, the setgid bit can only be set or cleared by using symbolic mode.
  - **1000**: Turn on sticky bit. See `chmod(2)`.
  - **0400**: Allow read by owner.
  - **0200**: Allow write by owner.
  - **0100**: Allow execute (search in directory) by owner.
  - **0700**: Allow read, write, and execute (search) by owner.
Allow read by group.

0020
Allow write by group.

0010
Allow execute (search in directory) by group.

0070
Allow read, write, and execute (search) by group.

0004
Allow read by others.

0002
Allow write by others.

0001
Allow execute (search in directory) by others.

0007
Allow read, write, and execute (search) by others.

For directories, the set gid bit cannot be set (or cleared) in absolute mode; it must be set (or cleared) in symbolic mode using g+s (or g-s).

**Symbolic Mode**

A symbolic mode command line has the following format:

```chmod [options] symbolic-mode-list file ...```

where `symbolic-mode-list` is a comma-separated list (with no intervening white space) of symbolic mode expressions of the form:

`[who] operator [permissions]`

Operations are performed in the order given. Multiple `permissions` letters following a single operator cause the corresponding operations to be performed simultaneously.

**who**

zero or more of the characters `u`, `g`, `o`, and a specifying whose permissions are to be changed or assigned:

- `u` user's permissions
- `g` group's permissions
- `o` others' permissions
a

all permissions (user, group, and other)

If who is omitted, it defaults to a, but the setting of the file mode creation mask (see umask in sh(1) or csh(1) for more information) is taken into account. When who is omitted, chmod does not override the restrictions of your user mask.

operator

either +, −, or =, signifying how permissions are to be changed:

+ Add permissions.

If permissions are omitted, nothing is added.

If who is omitted, add the file mode bits represented by permissions, except for those with corresponding bits in the file mode creation mask.

If who is present, add the file mode bits represented by the permissions.

− Take away permissions.

If permissions are omitted, do nothing.

If who is omitted, clear the file mode bits represented by permissions, except for those with corresponding bits in the file mode creation mask.

If who is present, clear the file mode bits represented by permissions.

= Assign permissions absolutely.

If who is omitted, clear all file mode bits; if who is present, clear the file mode bits represented by who.

If permissions are omitted, do nothing else.

If who is omitted, add the file mode bits represented by permissions, except for those with corresponding bits in the file mode creation mask.

If who is present, add the file mode bits represented by permissions.

Unlike other symbolic operations, = has an absolute effect in that it resets all other bits represented by who. Omitting permissions is useful only with = to take away all permissions.

permission

any compatible combination of the following letters:

l mandatory locking
read permission

user or group set-ID

sticky bit

write permission

execute permission

execute permission if the file is a directory or if there is execute permission for one of the other user classes

indicate that permission is to be taken from the current user, group or other mode respectively.

Permissions to a file can vary depending on your user identification number (UID) or group identification number (GID). Permissions are described in three sequences each having three characters:

<table>
<thead>
<tr>
<th>User</th>
<th>Group</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>rwx</td>
<td>rwx</td>
<td>rwx</td>
</tr>
</tbody>
</table>

This example (user, group, and others all have permission to read, write, and execute a given file) demonstrates two categories for granting permissions: the access class and the permissions themselves.

The letter s is only meaningful with u or g, and t only works with u.

Mandatory file and record locking (1) refers to a file's ability to have its reading or writing permissions locked while a program is accessing that file.

In a directory which has the set-group-ID bit set (reflected as either ---s--- or ----l--- in the output of ‘ls -ld’), files and subdirectories are created with the group-ID of the parent directory—not that of current process.

It is not possible to permit group execution and enable a file to be locked on execution at the same time. In addition, it is not possible to turn on the set-group-ID bit and enable a file to be locked on execution at the same time. The following examples, therefore, are invalid and elicit error messages:
chmod(1)

    chmod g+x,+l file
    chmod g+s,+l file

Only the owner of a file or directory (or the super-user) can change that file's or directory's mode. Only the super-user can set the sticky bit on a non-directory file. If you are not super-user, chmod masks the sticky-bit but does not return an error. In order to turn on a file's set-group-ID bit, your own group ID must correspond to the file's and group execution must be set.

ACL Operation

An Access Control List (ACL) is a list of Access Control Entries (ACEs), each of which define access permissions for a particular class of user. The list of ACEs is numbered, starting from zero. The position of an ACE within an ACL is called an index. This index is used as an argument in many of the chmod commands described below. See Oracle Solaris 11.1 Administration: ZFS File Systems for further description of ACLs and ACEs.

Oracle Solaris utilities, including chmod, support both the NFSv4 and the newer POSIX-draft ACL specifications. These specifications spell out the syntax and semantics of the acl_specification field shown below. These two ACL specifications are described in their respective subsections, below.

An ACL Operation command line has the following format:

    chmod [options] A[index] {- | file ...
    chmod [options] A-acl_specification file ...
    chmod [options] A[index]{+=}acl_specification file ...

...where acl_specification is a comma-separated list (with no intervening whitespace) of the form:

A[index]+acl_specification

Prepends the access control entries (ACE) specified in acl_specification to the beginning of the file's ACL. Depending on the file system, the ACL can be reordered when applied to the file. If the optional index is specified, then new ACEs are inserted before specified index.

A-

Removes all ACEs for current ACL on file and replaces current ACL with new ACL that represents only the current mode of the file.

A[index]-

Removes ACE specified by index number.

A-acl_specification

Removes ACEs specified by acl_specification, if they exist in current file's ACL.

A=acl_specification

Replaces a file's entire ACL with acl_specification.

A[index]=acl_specification

Replaces ACEs starting at a specific index number in the current ACL on the file. If multiple ACEs are specified, then each subsequent ACE in acl_specification replaces the
corresponding ACE in the current ACL.

**POSIX-draft ACL Specification (as supported by UFS)**

POSIX-draft ACLs (as supported by UFS) are specified as colon (:) separated fields of the following.

- **user::perms**
  - File owner permissions.

- **user:username:perms**
  - Permissions for a specific user.

- **group::perms**
  - File group member permissions.

- **group:groupname:perms**
  - Permissions for a specific group.

- **other::perms**
  - Permissions for user other than the file owner or members of file group.

- **mask:perms**
  - The ACL mask. The mask entry specifies the maximum permissions allowed for user (other than that the owner) and for groups.

- **default:user::perms**
  - Default file owner permissions.

- **default:user:username:perms**
  - Default permissions for a specific user.

- **default:group::perms**
  - Default file group member permissions.

- **default:group:groupname:perms**
  - Default permissions for a specific group.

- **default:other:perms**
  - Default permissions for user other than the file owner or members of the file group.

- **default:mask:perms**
  - Default ACL mask.

The above specification allows for ACLs to be specified such as:

- **user:tom:rw-,mask:rwx,group:staff:r-x**

**NFSv4 ACL Specification (as supported by NFSv4 and ZFS)**

NFSv4 ACLs provide richer ACL semantics. They provide both allow and deny entries, finer-grained permissions, and enhanced inheritance control.

NFSv4 ACLs are specified as colon (:) separated fields of the following.
owner@:<perms>[:inheritance flags]:<allow|deny>
   Permissions for file owner.

group@:<perms>[:inheritance flags]:<allow|deny>
   Permissions for file group member.

everyone@:<perms>[:inheritance flags]:<allow|deny>
   Permissions for everyone, including file owner and group member.

user:<username>:<perms>[:inheritance flags]:<allow|deny>
   Permissions for a specific user.

usersid:<sid string>:<perms>[:inheritance flags]:<allow|deny>
   Permissions for a specific user, but user is specified by SID.

group:<groupname>:<perms>[:inheritance flags]:<allow|deny>
   Permissions for a specific group.

groupsid:<sid string>:<perms>[:inheritance flags]:<allow|deny>
   Permissions for a specific group, but group is specified by SID.

sid:<sid string>:<perms>[:inheritance flags]:<allow|deny>
   Permissions for a specific SID, but it doesn’t matter if it is a user or a group.

Permissions can be specified in three different chmod ACL formats: verbose, compact, or positional. The verbose format uses words to indicate that the permissions are separated with a forward slash (/) character. Compact format uses the permission letters and positional format uses the permission letters or the hyphen (-) to identify no permissions.

The permissions for verbose mode and their abbreviated form in parentheses for compact and positional mode are described as follows:

read_data (r)
   Permission to read the data of a file.

list_directory (r)
   Permission to list the contents of a directory.

write_data (w)
   Permission to modify a file’s data. anywhere in the file’s offset range.

add_file (w)
   Permission to add a new file to a directory.

append_data (p)
   The ability to modify a file’s data, but only starting at EOF.

   Currently, this permission is not supported.

add_subdirectory (p)
   Permission to create a subdirectory to a directory.
read_xattr (R)
   Ability to read the extended attributes of a file.

write_xattr (W)
   Ability to create extended attributes or write to the extended attribute directory.

execute (x)
   Permission to execute a file.

read_attributes (a)
   The ability to read basic attributes (non-ACLs) of a file.

write_attributes (A)
   Permission to change the times associated with a file or directory to an arbitrary value.

delete (d)
   Permission to delete a file.

   For more information about delete permission behavior, see the Oracle Solaris 11.1 Administration: ZFS File Systems.

delete_child (D)
   Permission to delete a file within a directory.

   For more information about delete permission behavior, see the Oracle Solaris 11.1 Administration: ZFS File Systems.

read_acl (c)
   Permission to read the ACL of a file.

write_acl (C)
   Permission to write the ACL of a file.

write_owner (o)
   Permission to change the owner of a file.

synchronize (s)
   Permission to access file locally at server with synchronize reads and writes.

   Currently, this permission is not supported.

Using the compact ACL format, permissions are specified by using 14 unique letters to indicate permissions.

Using the positional ACL format, permissions are specified as positional arguments similar to the `ls -V` format. The hyphen (`-`), which indicates that no permission is granted at that position, can be omitted and only the required letters have to be specified.

The letters above are listed in the order they would be specified in positional notation.

Permissions can be specified with these letters in the following way:
The hyphens can be removed to compact the string as follows:

rwxD

Several special permission sets or aliases are also supported. The following permission sets are used the same way that verbose permissions are specified.

**full set**
- All permissions.

**modify set**
- All permissions except `write_acl` and `write_owner`.

**read set**
- `read_data`, `read_acl`, `read_attributes`, and `read_xattr`.

**write set**
- `write_data`, `append_data`, `write_attributes`, and `write_xattr`.

The optional inheritance flags can be specified in the three formats. The first format uses words to indicate the various inheritance flags separated with a forward slash (/) character.

**file_inherit** (f)
- Inherit to all newly created files.

**dir_inherit** (d)
- Inherit to all newly created directories.

**inherit_only** (i)
- When placed on a directory, do not apply to the directory, only to newly created files and directories. This flag requires that either `file_inherit` or `dir_inherit` is also specified.

**no_propagate** (n)
- Indicates that ACL entries should be inherited to objects in a directory, but inheritance should stop after descending one level. This flag is dependent upon either `file_inherit` and or `dir_inherit` also being specified.

The inheritance flags listed can also be specified in the compact format or as positional arguments similar to the `ls -V` format. A hyphen character indicates that the inheritance flag at that position is not specified in the positional ACL format.

The inheritance flags can be specified with these letters in any of the following equivalent ways.

- `file_inherit/dir_inherit/no_propagate`
- `fd-n--`
- `fdn`
With this inheritance model, an ACL entry can be specified such as:

```
user:tom:read_data/write_data/read_attributes:file_inherit:allow
user:fred:read_data:file_inherit/dir_inherit:deny
user:bob:read_data:allow
```

**Attribute Operation**

An attribute operation command line has the following format:

```
chmod [options] attribute_specification_list file ... 
```

where `attribute_specification_list` is the character `S` followed by a comma-separated list of one or more `attribute_specifications`. Each `attribute_specification` is of the form:

```
[operator]attribute_specifier
```

An **operator** is one of the following:

- `+` Each attribute specified by the associated `attribute_specifier` is adjusted to match the value specified by the `attribute_specifier`.

- `-` Each attribute specified by the associated `attribute_specifier` is adjusted to match the inverse of the value specified by the `attribute_specifier`.

- `=` Each attribute specified by the associated `attribute_specifier` is adjusted to match the value specified by the `attribute_specifier`. Any boolean read-write extended system attributes associated with the current file that are not specified by `attribute_specifier` is cleared.

If an **operator** is not specified in an `attribute_specification`, `chmod` behaves as if `+` had been specified.

An **attribute_specifier** takes one of the following forms:

- `a` Set all boolean read-write extended system attributes associated with the current file.

- `c[compact_attribute_list]`
  ```
  c\{compact_attribute_list\}
  ```
  Set each boolean read-write extended system attribute identified by `compact_attribute_list`.

- `v[verbose_attribute_setting]`
  ```
  v\{verbose_attribute_setting\}
  ```
  Set each boolean read-write extended system attribute identified by `verbose_attribute_setting`.

A `compact_attribute_list` is a list of zero or more adjacent attribute abbreviation characters from list of `Attribute Names and Abbreviation Characters` later in this section. An arbitrary number of hyphen (`-`) characters can be included in a `compact_attribute_list`. These are ignored.
A verbose_attribute_setting is an attribute name from the list of Attribute Names and Abbreviation Characters later in this section, optionally, immediately preceded by no. If the attribute name is used without no, the attribute is set; otherwise the attribute is cleared.

A verbose_attribute_setting_list is zero or more comma-separated verbose_attribute_settings.

Multiple operations specified for a file are accumulated and are all set for a file operand as a single attribute setting operation. If an attribute is specified more than once in an attribute_specification_list, the last specified operation is applied.

The following is a list of Attribute Names and Abbreviation Characters:

<table>
<thead>
<tr>
<th>Attribute Name</th>
<th>Abbreviation Character</th>
</tr>
</thead>
<tbody>
<tr>
<td>hidden</td>
<td>H</td>
</tr>
<tr>
<td>sparse</td>
<td>s</td>
</tr>
<tr>
<td>system</td>
<td>S</td>
</tr>
<tr>
<td>readonly</td>
<td>R</td>
</tr>
<tr>
<td>archive</td>
<td>A</td>
</tr>
<tr>
<td>nounlink</td>
<td>u</td>
</tr>
<tr>
<td>immutable</td>
<td>i</td>
</tr>
<tr>
<td>appendonly</td>
<td>a</td>
</tr>
<tr>
<td>nodump</td>
<td>d</td>
</tr>
<tr>
<td>av_quarantined</td>
<td>q</td>
</tr>
<tr>
<td>av_modified</td>
<td>m</td>
</tr>
</tbody>
</table>

Options

The following options are supported:

- `f`
  Force. chmod does not complain if it fails to change the mode of a file.
-R
  Recursively descend through directory arguments, setting the mode for each file. When
  symbolic links are encountered, the mode of the target file is changed, but no recursion
  takes place.

-@ named_attribute
  Perform the attribute operation on the named extended attribute file of each file operand
  instead of the file operand itself. If multiple -@ operations are supplied, the attribute
  specification mode is applied to each of the named attribute files.

  A named attribute of * carries meaning to chmod, and is considered to mean all extended
  attribute files associated with a file operand. This does not refer to the special files . and ..

  A named attribute of . carries special meaning to chmod, and is considered to mean the file
  operand itself. This allows chmod, in a single call, to apply the attribute specification mode
  to the specified named attribute file of the file operand and the file operand itself.

Operands
  The following operands are supported:

  absolute-mode
  symbolic-mode-list
  Represents the change to be made to the file mode bits of each file named by one of the file
  operands. See Absolute Mode and Symbolic Mode in the DESCRIPTION section of this
  manual page for more information.

  acl_operation
  Represents the modification to be performed on the file’s ACL. See ACL Operation in the
  DESCRIPTION section for more information.

  acl_operation is one of the following:

  A[number] -
  A-acl_specification
  A[index]{+|=}acl_specification

  attribute_specification_list
  Represents the modification to performed on the file’s attributes. See Attribute Operation
  in the DESCRIPTION section of this manual page for more information.

  file
  A path name of a file whose file mode bits are to be modified.

Usage
  See largefile(5) for the description of the behavior of chmod when encountering files greater
  than or equal to 2 Gbyte (2^{31} bytes).

Examples
  EXAMPLE 1 Denying execute Permission
  The following example denies execute permission to everyone:

  % chmod a-x file
EXAMPLE 2  Allowing read-only Permission
The following example allows only read permission to everyone:

  % chmod 444 file

EXAMPLE 3  Making a File readable and writable
The following example makes a file readable and writable by the group and others:

  % chmod go+rw file
  % chmod 066 file

EXAMPLE 4  Locking a File From Access
The following example locks a file from access:

  $ chmod +l file

EXAMPLE 5  Granting read, write, execute, and set group-ID Permission on a File
The following example grants everyone read, write, and execute permissions on the file, and
turns on the set group-ID:

  $ chmod a=rwx,g+s file
  $ chmod 2777 file

EXAMPLE 6  Prepending a New ACL Entry on a ZFS File
The following example prepends a new ACL entry on a ZFS file.

First, display the current ACL:

  $ ls -v file.3
-rw-r--r--  1 marks staff  0 Oct  9 15:49 file.3
  0:owner@:execute:deny
  1:owner@:read_data/write_data/append_data/write_xattr/
      write_attributes/write_acl/write_owner:allow
  2:group@:write_data/append_data/execute:deny
  3:group@:read_data:allow
  4:everyone@:write_data/append_data/write_xattr/execute/
      write_attributes/write_acl/write_owner:deny
  5:everyone@:read_data/read_xattr/read_attributes/read_acl/
      synchronize:allow

Issue the following command:

  $ chmod A+user:lp:read_data:deny file.3

Display the new ACL:

  $ ls -v file.3
-rw-r--r--+  1 marks staff  0 Oct  9 15:49 file.3
  0:user:lp:read_data:deny
EXAMPLE 6  Prepending a New ACL Entry on a ZFS File  (Continued)

1:owner@:execute:deny
2:owner@:read_data/write_data/append_data/write_xattr/write_attributes/write_acl/write_owner:allow
3:group@:write_data/append_data/execute:deny
4:group@:read_data:allow
5:everyone@:write_data/append_data/write_xattr/execute/write_attributes/write_acl/write_owner:deny
6:everyone@:read_data/read_xattr/read_attributes/read_acl/synchronize:allow

EXAMPLE 7  Prepending a New POSIX-draft ACL Entry on a UFS File

The following example prepends a new POSIX-draft ACL entry on a UFS file.

First, display the current ACL:

$ ls -v file.2
-rw-r--r-- 1 marks staff 0 Oct 9 15:52 file.2
0:user::rw-
1:group::r-- #effective:r--
2:mask:r--
3:other:r--

Issue the following command:

$ chmod A+user:lp:-wx file.2

Display the new ACL:

$ ls -v file.2
-rw-r---+ 1 marks staff 0 Oct 9 15:52 file.2
0:user::rw-
1:user:lp:-wx #effective:---
2:group::r-- #effective:r--
3:mask:r--
4:other:r--

EXAMPLE 8  Inserting an ACL Entry in a Specific Position on a ZFS File

The following example inserts an ACL entry in a specific position on a ZFS file system. It also illustrates the compact ACL format.

First, display the ACL to pick a location to insert a new ACE.

% ls -V file.1
-rw-r--r--+ 1 root root 0 Oct 6 12:16 file.1
  user:lp:rw------------:--------:allow
  owner@:x------------:--------:deny
  owner@:rw-p---A-W-Co-:--------:allow
Next, insert a new entry in location 3. This causes the entries that are currently in position 3 - 6 to be pushed down.

Issue the following command:

$ chmod A3+user:marks:r:deny file.1

Display the new ACL:

$ ls -V file.1
-rw-r--r--+ 1 root staff 0 Feb 3 14:13 file.1
   user:lp:rw----------------:------:allow
   owner:---------------------:deny
   owner:rw-p----A-W-Co--------:allow
   user:marks:rw---------------:deny
   group@:wxp------------------:deny
   group@:r------------------:allow
   everyone@:wxp--A-W-Co--:------:deny
   everyone@:r-----a-R-c--s:------:allow

EXAMPLE 9 Inserting a POSIX-draft ACL in a Specific Position on a UFS File

The file system reorders ACLs when they are stored in the file system. The following example illustrates this behavior.

$ ls -v file.1
-rw-r--r--+ 1 root root 0 Sep 29 16:10 file.1
   0:user::rw-
   1:user:lp:rw- #effective:r--
   2:group::r-- #effective:r--
   3:mask:r--
   4:other:r--

Now, insert an entry at index position 3. The command works, but the file system reorders the ACL.

$ chmod A3+user:marks:rw- file.1
$ ls -v file.1
-rw-r--r--+ 1 root root 0 Sep 29 16:10 file.1
   0:user::rw-
   1:user:lp:rw- #effective:r--
   2:user:marks:rw- #effective:r--
   3:group::r-- #effective:r--
EXAMPLE 9  Inserting a POSIX-draft ACL in a Specific Position on a UFS File  (Continued)

4:mask:r--
5:other:r--

Rather than inserting the ACL entry in position 3 as requested, it actually ends up in position 2.

EXAMPLE 10  Removing an ACL Entry on a ZFS File

The following example removes the `lp` entry from an ACL:

$ ls -v file.3
-rw-r--r--+ 1 marks staff 0 Oct 9 15:49 file.3
0:user:lp:read_data:deny
 1:owner@:execute:deny
 2:owner@:read_data/write_data/append_data/write_xattr/
      write_attributes/write_ACL/write_owner:allow
 3:group@:write_data/append_data/execute:deny
 4:group@:read_data:allow
 5:everyone@:write_data/append_data/write_xattr/execute/
      write_attributes/write_ACL/write_owner:deny
 6:everyone@:read_data/read_xattr/read_attributes/read_acl/
      synchronize:allow

$ chmod A-user:lp:read_data:deny file.3
$ ls -v file.3
-rw-r--r-- 1 marks staff 0 Oct 9 15:49 file.3
0:owner@:execute:deny
 1:owner@:read_data/write_data/append_data/write_xattr/
      write_attributes/write_ACL/write_owner:allow
 2:group@:write_data/append_data/execute:deny
 3:group@:read_data:allow
 4:everyone@:write_data/append_data/write_xattr/execute/
      write_attributes/write_ACL/write_owner:deny
 5:everyone@:read_data/read_xattr/read_attributes/read_acl/
      synchronize:allow

EXAMPLE 11  Removing a POSIX-draft ACL on a UFS File

The following example removes the `lp` entry from an ACL:

$ ls -v file.2
-rw-r--r--+ 1 marks staff 0 Oct 9 15:52 file.2
0:user::rw-
 1:user:lp::wx #effective:---
 2:group::r-- #effective:r--
 3:mask:r--
 4:other:r--
EXAMPLE 11 Removing a POSIX-draft ACL on a UFS File  (Continued)

$ chmod A-user:lp:-wx file.2
$ ls -v file.2
-rw-r--r-- 1 marks staff 0 Oct 9 15:52 file.2
 0:user::rw-
 1:group::r-- #effective:r--
 2:mask:r--
 3:other:r--

EXAMPLE 12 Removing a Specific ACL Entry by Index Number on a ZFS File

Consider the following ACL:

$ ls -v file
 0:group:staff:read_data/write_data/execute/read_acl:allow
 1:user:bin:read_data:deny
 2:user:bin:read_data:allow
 3:owner::write_data/append_data:deny
 4:owner::read_data/write_xattr/execute/write_attributes/write_acl
   /write_owner:allow
 5:group::write_data/append_data:deny
 6:group::read_data/execute:allow
 7:everyone::write_data/append_data/write_xattr/write_attributes
   /write_acl/write_owner:deny
 8:everyone::read_data/read_xattr/execute/read_attributes/read_acl
   /synchronize:allow

Remove the second user entry for bin.

$ chmod A2- file
$ ls -v file
 0:group:staff:read_data/write_data/execute/read_acl:allow
 1:user:bin:read_data:deny
 2:user:bin:read_data:allow
 3:owner::write_data/append_data:deny
 4:owner::read_data/write_xattr/execute/write_attributes/write_acl
   /write_owner:allow
 5:group::write_data/append_data:deny
 6:group::read_data/execute:allow
 7:everyone::write_data/append_data/write_xattr/write_attributes
   /write_acl/write_owner:deny
 8:everyone::read_data/read_xattr/execute/read_attributes/read_acl
   /synchronize:allow

EXAMPLE 13 Removing a Specific POSIX-draft ACL Entry on a UFS File

The following example removes the lp entry by index number from the following ACL:

$ ls -v file.1
-rw-r--r-- 1 root root 0 Sep 29 16:10 file.1
 0:user::rw-
Removing a Specific POSIX-draft ACL Entry on a UFS File

(Continued)

```
1:user:lp:rw-          #effective:r--
2:group::r--          #effective:r--
3:mask:r--
4:other:r--

$ chmod A1- file.1
$ ls -v
-rw-r--r--+ 1 root root 0 Sep 29 16:10 file.1
0:user::rw-
1:group::r--        #effective:r--
2:mask:r--
3:other:r--
```

Removing All ACLs From a File

The following command works with either NFSv4/ZFS or POSIX-draft ACLs.

Consider the following ACL:

```
$ ls -v file.3
-rw-r--r--+ 1 marks staff 0 Oct  9 15:49 file.3
0:user:lp:read_data/write_data:allow
1:user:marks:read_acl:allow
2:owner:execute:deny
3:owner:read_data/write_data/append_data/write_xattr/
    write_attributes/write_acl/write_owner:allow
4:group:write_data/append_data/execute:deny
5:group:read_data:allow
6:everyone:write_data/append_data/write_xattr/execute/
    write_attributes/write_acl/write_owner:deny
7:everyone:read_data/read_xattr/read_attributes/read_acl/
    synchronize:allow
```

The existing ACL is effectively removed and is replaced with an ACL that represents the permission bits of the file.

```
$ chmod A- file.3
$ ls -v file.3
-rw-r--r-- 1 marks staff 0 Oct  9 15:49 file.3
0:owner:execute:deny
1:owner:read_data/write_data/append_data/write_xattr/
    write_attributes/write_acl/write_owner:allow
2:group:write_data/append_data/execute:deny
3:group:read_data:allow
4:everyone:write_data/append_data/write_xattr/execute/
    write_attributes/write_acl/write_owner:deny
5:everyone:read_data/read_xattr/read_attributes/read_acl/
    synchronize:allow
```
EXAMPLE 15  Replacing an Entire ACL Entry on a ZFS File

Use the following `chmod` syntax if you want to replace an ACL in its entirety:

```
$ chmod A=owner@:read_data/write_data:allow/group@:read_data/write_data:allow/user:lp:read_data:allow file.4
```

```
$ ls -v file.4  
-rw-rw----+ 1 marks staff  0 Oct 9 16:12 file.4  
   0:owner@:read_data/write_data:allow  
   1:group@:read_data/write_data:allow  
   2:user:lp:read_data:allow
```

EXAMPLE 16  Replacing an Entire POSIX-draft ACL on a UFS File

This operation is a little more complicated. The replacement ACL needs the necessary entries
to represent the file owner, file group owner, other, mask and any additional entries you wish
to set.

```
$ chmod A=user::rw-,group::rw-,other::--,mask:r--,user:lp:r-- file.3
```

```
$ ls -v file.3  
-rw-r----+ 1 root root  0 Oct 9 16:14 file.3  
   0:user::rw-  
   1:user:lp:r-- #effective:r--  
   2:group::rw- #effective:r--  
   3:mask:r--  
   4:other::--
```

EXAMPLE 17  Replacing a Specific Entry on a ZFS File

Consider the following ACL.

```
$ ls -v file.5  
-rw-r--r--+ 1 marks staff  0 Oct 9 16:18 file.5  
   0:user:marks:read_data:allow  
   1:owner@:execute:deny  
   2:owner@:read_data/write_data/append_data/write_xattr/write_attributes/write_acl/write_owner:allow  
   3:group@:read_data/append_data/execute:deny  
   4:group@:read_data:allow  
   5:everyone@:read_data/append_data/write_xattr/execute/write_attributes/write_acl/write_owner:deny  
   6:everyone@:read_data/read_xattr/read_attributes/read_acl/synchronize:allow
```

Now, change the allow access to a deny for user marks:

```
$ chmod A0=user:marks:read_data:deny file.5
```

```
$ ls -v file.5  
-rw-r--r--+ 1 marks staff  0 Aug 23 09:11 file.5  
   0:user:marks:read_data:deny
```
EXAMPLE 17  Replacing a Specific Entry on a ZFS File  (Continued)

1:owner@:read_data/write_data/append_data/write_xattr/write_attributes
   /write_acl/write_owner:allow
2:group@:write_data/append_data/execute:deny
3:group@:read_data:allow
4:everyone@:write_data/append_data/write_xattr/execute/write_attributes
   /write_acl/write_owner:deny
5:everyone@:read_data/read_xattr/read_attributes/read_acl/synchronize
   :allow

EXAMPLE 18  Replacing a Specific POSIX-draft ACL on a UFS File

Consider the following ACL.

$ ls -v file.4
-rw-r--r--+ 1 marks staff 0 Oct 9 16:21 file.4
0:user::rw-
1:user:lp:rwx  #effective:r--
2:group::r--  #effective:r--
3:mask:r--
4:other:r--

Now, change the permission on lp from rwx to r--:

$ chmod A1=user:lp:r-- file.4

$ ls -v file
-rw-r--r--+ 1 marks staff 0 Oct 9 16:21 file.4
0:user::rw-
1:user:lp:r--  #effective:r--
2:group::r--  #effective:r--
3:mask:r--
4:other:r--

EXAMPLE 19  Setting ACL Inheritance Flags on a ZFS File

You can only set inheritance flags on ZFS files. When setting ACLs on directories, several
inheritance flags can be optionally set.

Suppose you have an ACL entry for user lp that you want to be inherited to newly created files
in a directory. First, you need to create an inheritable ACL entry on the directory:

$ chmod A+user:lp:read_data:file_inherit:allow test.dir
$ ls -dv test.dir
drwxr-xr-x+ 2 marks staff 2 Aug 23 09:08 test.dir/
0:user:lp:read_data:file_inherit:allow
1:owner::deny
2:owner@:list_directory/read_data/add_file/write_data/add_subdirectory
   /append_data/write_xattr/execute/write_attributes/write_acl
EXAMPLE 19   Setting ACL Inheritance Flags on a ZFS File   (Continued)

/write_owner:allow
3:group@:add_file/write_data/add_subdirectory/append_data/deny
4:group@:list_directory/read_data/execute:allow
5:everyone@:add_file/write_data/add_subdirectory/append_data/write_xattr/write_attributes/write_acl/write_owner:deny
6:everyone@:list_directory/read_data/read_xattr/execute/read_attributes/write_acl/synchronize:allow

The lp entry is inherited to newly created files in the directory test.dir.

$ touch test.dir/file.test
$ ls -v test.dir/file.test
-rw-r---r-- 1 marks staff    0 Oct 9 16:29 test.dir/file.test
 0:user:lp::deny
 1:user:lp:read_data:allow
 2:owner@:execute:deny
 3:owner@:read_data/write_data/append_data/write_xattr/write_attributes/write_acl/write_owner:allow
 4:group@:read_data/execute:deny
 5:group@:read_data:allow
 6:everyone@:write_data/append_data/write_xattr/execute/write_attributes/write_acl/write_owner:deny
 7:everyone@:read_data/read_xattr/read_attributes/read_acl/synchronize:allow

The user lp entry is inherited to the newly created file. Multiple combinations of the inheritance flags can be specified. For example, if you wanted the lp entry to also be inherited to directories, then the following command can be used:

$ chmod A+user:lp:read_data:file_inherit/dir_inherit:allow test.dir

EXAMPLE 20   Replacing System Attributes of a ZFS File

The following examples replace system attributes of a ZFS file:

$ chmod S=v{archive,hidden,readonly,system,appendonly,nonodump,immutable,noav_modified,noav_quarantined,nounlink} file1

or

$ chmod S=c{AHRSa} file1

or

$ chmod S=c{AHRSa-i--u} file1

or
EXAMPLE 20  Replacing System Attributes of a ZFS File  (Continued)

$ chmod S=cAHRSau file1

or

$ chmod -@ '..' S=cAHRSau file1

Assuming appropriate privileges, this results in the following system attributes of file1 being set: archive, hidden, readonly, system, appendonly, immutable, and nounlink. Assuming appropriate privileges, the following system attributes of file1 are cleared: nodump, av_modified, and av_quarantined.

EXAMPLE 21  Clearing All System Attributes of a ZFS File

The following examples clears all system attributes of a ZFS file:

$ chmod S-a file1

or

$ chmod -@ '..' S-a file1

Assuming appropriate privileges, all boolean read-write system attributes are cleared on file1.

EXAMPLE 22  Setting a System Attribute of a Named Attribute File of a ZFS File

The following example sets a system attribute of a named attribute file of a ZFS file, but not of the file itself:

$ chmod -@ myattr S+vhidden file1

This results in the hidden system attribute being set for the named attribute file myattr of file1, but not the file itself.

EXAMPLE 23  Setting a System Attribute of All Named Attribute File of a ZFS File

The following example sets a system attribute of all named attribute files of a ZFS file, but not of the file itself:

$ chmod -@ '*' S+a file1

EXAMPLE 24  Setting a System Attribute of All Named Attribute Files of a ZFS File

The following example sets a system attribute of all named attribute files of a ZFS file, as well as of the file itself:

$ chmod -@ '..' -@ '*' S+vhidden file1

This results in the hidden system attribute being set for all named attribute files of file1, as well as the file itself.
EXAMPLE 25  Recursively Descending Through a Directory Hierarchy
The following example recursively descends through a directory hierarchy, and sets all system attributes of all named attribute files, the ZFS file operands, as well as of the directory itself:

$ chmod -R -@ './' -@ '*' S+* directory1

This results in the hidden system attribute being set for all named attribute files of all regular files and directories within the directory hierarchy of directory1, as well as of directory1 itself.

EXAMPLE 26  Setting the hidden and system System Attributes of a ZFS File
The following examples set the hidden and system system attributes of a ZFS file:

$ chmod S+chS file1

or

$ chmod S+vhidden,+vsystem file1

or

$ chmod S+v{hidden,system} file1

or

$ chmod S+c{-HS--------} file1

or

$ chmod S-v{nohidden,nosystem} file1

or

$ chmod S-v{hidden,system},+v{hidden,system} file1

EXAMPLE 27  Clearing All System Attributes of a ZFS File
The following example clears all system attributes of a ZFS file:

$ chmod S-a file1

or

$ chmod S=v{} file1

In the following two examples, the last attribute operation specified takes precedence.

In this example, the replacement attribute name list ({}), clears all system attributes for file1:

$ chmod S+chS,=v{} file1

In this example, the clear attributes operation (-a) clears all system attributes of file1:

$ chmod S+vhidden,+vsystem,-a file1
EXAMPLE 28  Setting the Values of All Boolean read-write System Attributes of a File

The following example sets the values of all boolean read-write system attributes of a file to the same as the boolean read-write system attributes of another file:

$ chmod $=v'ls -/v file1|sed '2s/.*{/{/p' file2

Assuming appropriate privileges and that file1 and file2 have the same supported system attributes, all system attributes of file1 that are set are also set on file2. All system attributes of file1 that are cleared are also cleared on file2.

Environment Variables

See environ(5) for descriptions of the following environment variables that affect the execution of chmod: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status

The following exit values are returned:

0  Successful completion.

>0  An error occurred.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also

getfacl(1), ls(1), setfacl(1), chmod(2), fgetattr(3C), acl(5), attributes(5), environ(5), fsattr(5), largefile(5), standards(5)

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Notes

Absolute changes do not work for the set-group-ID bit of a directory. You must use g+s or g-s.

chmod permits you to produce useless modes so long as they are not illegal (for instance, making a text file executable). chmod does not check the file type to see if mandatory locking is meaningful.

If the filesystem is mounted with the nosuid option, setuid execution is not allowed.

If you use chmod to change the file group owner permissions on a file with ACL entries, both the file group owner permissions and the ACL mask are changed to the new permissions. Be aware that the new ACL mask permissions can change the effective permissions for additional users and groups who have ACL entries on the file. Use the getfacl(1) or ls(1) command to make sure the appropriate permissions are set for all ACL entries.
The chown utility sets the user ID of the file named by each file to the user ID specified by owner, and, optionally, sets the group ID to that specified by group.

If chown is invoked by other than the super-user, the set-user-ID bit is cleared.

Only the owner of a file (or the super-user) can change the owner of that file.

The file system has a mountpoint option, restrictchown, to restrict ownership changes. When this option is in effect the owner of the file is prevented from changing the owner ID of the file. Only the super-user can arbitrarily change owner IDs, whether or not this option is in effect.

chown changes the ownership of each file to owner. owner can be specified as either a user name or a numeric user id. The group ownership of each file can also be changed to group by appending :group to the user name.

Options

The following options are supported:

- 
  
  -h If the file is a symbolic link, this option changes the owner of the symbolic link. Without this option, the owner of the file referenced by the symbolic link is changed.
  
  -H If the file specified on the command line is a symbolic link referencing a file of type directory, this option changes the owner of the directory referenced by the symbolic link and all the files in the file hierarchy below it. If a symbolic link is encountered when traversing a file hierarchy, the owner of the target file is changed, but no recursion takes place.
If the file is a symbolic link, this option changes the owner of the file referenced by the symbolic link. If the file specified on the command line, or encountered during the traversal of the file hierarchy, is a symbolic link referencing a file of type directory, then this option changes the owner of the directory referenced by the symbolic link and all files in the file hierarchy below it.

- P
If the file specified on the command line or encountered during the traversal of a file hierarchy is a symbolic link, this option changes the owner of the symbolic link. This option does not follow the symbolic link to any other part of the file hierarchy.

- s
The owner and/or group arguments are Windows SID strings. This option requires a file system that supports storing SIDs, such as ZFS.

Specifying more than one of the mutually-exclusive options -H, -L, or -P is not considered an error. The last option specified determines the behavior of chown.

The following options are supported:

- /usr/bin/chown
  The following options are supported:

  - R
    Recursive. chown descends through the directory, and any subdirectories, setting the specified ownership ID as it proceeds. When a symbolic link is encountered, the owner of the target file is changed, unless the -h or -P option is specified. However, no recursion takes place, unless the -H or -L option is specified.

- /usr/xpg4/bin/chown
  The following options are supported:

  - R
    Recursive. chown descends through the directory, and any subdirectories, setting the specified ownership ID as it proceeds. When a symbolic link is encountered, the owner of the target file is changed, unless the -h or -P option is specified. Unless the -H, -L, or -P option is specified, the -L option is used as the default mode.

Operands
The following operands are supported:

owner[:group]
A user ID and optional group ID to be assigned to file. The owner portion of this operand must be a user name from the user database or a numeric user ID. Either specifies a user ID to be given to each file named by file. If a numeric owner exists in the user database as a user name, the user ID number associated with that user name is used as the user ID. Similarly, if the group portion of this operand is present, it must be a group name from the group database or a numeric group ID. Either specifies a group ID to be given to each file. If a numeric group operand exists in the group database as a group name, the group ID number associated with that group name is used as the group ID.

file
A path name of a file whose user ID is to be modified.

Usage
See largefile(5) for the description of the behavior of chown when encountering files greater than or equal to 2 Gbyte (2³¹ bytes).
Examples

The following command changes ownership of all files in the hierarchy, including symbolic links, but not the targets of the links:

```bash
eexample% chown -R -h owner[:group] file...
```

Environment Variables

See `environ(5)` for descriptions of the following environment variables that affect the execution of `chown`: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status

The following exit values are returned:

- `0` The utility executed successfully and all requested changes were made.
- `>0` An error occurred.

Files

`/etc/passwd` System password file

Attributes

See `attributes(5)` for descriptions of the following attributes:

```
<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled. See NOTES.</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See <code>standards(5)</code>.</td>
</tr>
</tbody>
</table>
```

```
<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/xopen/scu4</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled. See NOTES.</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See <code>standards(5)</code>.</td>
</tr>
</tbody>
</table>
```

See Also

`chgrp(1), chmod(1), chown(2), fpathconf(2), passwd(4), system(4), attributes(5), environ(5), largefile(5), standards(5)`

Notes

`chown` is CSI-enabled except for the `owner` and `group` names.
chown – change owner

/chown [-fR] owner[.group] filename...

chown changes the owner of the filenames to owner. The owner can be either a decimal user ID (UID) or a login name found in the password file. An optional group can also be specified. The group can be either a decimal group ID (GID) or a group name found in the GID file.

In the default case, only the super-user of the machine where the file is physically located can change the owner. The system configuration option \{_POSIX_CHOWN_RESTRICTED\} and the privileges PRIV_FILE_CHOWN and PRIV_FILE_CHOWN_SELF also affect who can change the ownership of a file. See chown(2) and privileges(5).

Options

The following options are supported:

- \(-f\)
  Do not report errors.

- \(-R\)
  Recursively descend into directories setting the ownership of all files in each directory encountered. When symbolic links are encountered, their ownership is changed, but they are not traversed.

Usage

See largefile(5) for the description of the behavior of chown when encountering files greater than or equal to 2 Gbyte (2^{31} bytes).

Files

/etc/passwd Password file

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>

See Also chgrp(1), chown(2), group(4), passwd(4), attributes(5), largefile(5), privileges(5)
Name  ckd, errdate, helpdate, valdate – prompts for and validates a date

  [-e error] [-p prompt] [-k pid] [-s signal]
/usr/sadm/bin/errdate [-W width] [-e error] [-f format]
/usr/sadm/bin/helpdate [-W width] [-h help] [-f format]
/usr/sadm/bin/valdate [-f format] input

Description  The ckd utility prompts a user and validates the response. It defines, among other things, a  
  prompt message whose response should be a date, text for help and error messages, and a  
  default value (which will be returned if the user responds with a RETURN). The user response  
  must match the defined format for a date.

All messages are limited in length to 70 characters and are formatted automatically. Any white  
  space used in the definition (including newline) is stripped. The -w option cancels the  
  automatic formatting. When a tilde is placed at the beginning or end of a message definition,  
  the default text will be inserted at that point, allowing both custom text and the default text to  
  be displayed.

If the prompt, help or error message is not defined, the default message (as defined under  
  NOTES) will be displayed.

Three visual tool modules are linked to the ckd command. They are errdate (which  
  formats and displays an error message), helpdate (which formats and displays a help  
  message), and valdate (which validates a response). These modules should be used in  
  conjunction with FML objects. In this instance, the FML object defines the prompt. When  
  format is defined in the errdate and helpdate modules, the messages will describe the  
  expected format.

Options  The following options are supported:
  
  -d default  Defines the default value as default. The default does not have to meet the  
    format criteria.
  
  -e error  Defines the error message as error.
  
  -f format  Specifies the format against which the input will be verified. Possible formats  
    and their definitions are:

    %b = abbreviated month name (jan, feb, mar)
    %B = full month name %d = day of month (01 - 31)
    %D = date as %m/%d/%y (the default format)
    %e = day of month (1 - 31; single digits are preceded by a blank)
    %h = abbreviated month name, identical to %b
    %m = month number (01 - 12)
%y = year within century (for instance, 89)
%Y = year as CCYY (for instance, 1989)

-h help  Defines the help messages as help.
-k pid  Specifies that process ID pid is to be sent a signal if the user chooses to abort.
-p prompt  Defines the prompt message as prompt.
-Q  Specifies that quit will not be allowed as a valid response.
-s signal  Specifies that the process ID pid defined with the  -k option is to be sent signal
  when quit is chosen. If no signal is specified, SIGTERM is used.
-w width  Specifies that prompt, help and error messages will be formatted to a line length
  of width.

Operands  The following operand is supported:

input  Input to be verified against format criteria.

Exit Status  The following exit values are returned:

0  Successful execution.
1  EOF on input, or negative width on  -W option, or usage error.
3  User termination (quit).
4  Garbled format argument.

Attributes  See attributes(5) for descriptions of the following attributes:


<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  attributes(5)

Notes  The default prompt for ckdate is:

Enter the date [?,q]:

The default error message is:

ERROR - Please enter a date. Format is <format>.

The default help message is:

Please enter a date. Format is <format>.  

User Commands
When the quit option is chosen (and allowed), q is returned along with the return code 3. The validate module will not produce any output. It returns zero for success and non-zero for failure.
Name \texttt{ckgid}, \texttt{errgid}, \texttt{helpgid}, \texttt{valgid} – prompts for and validates a group id

Synopsis
\texttt{ckgid \{-Q\} \{-W\ width\} \{-m\} \{-d default\} \{-h help\} \{-e error\} \{-p prompt\} \{-k pid\} \{-s signal\}}
\texttt{/usr/sadm/bin/errgid \{-W\ width\} \{-e error\}}
\texttt{/usr/sadm/bin/helpgid \{-W\ width\} \{-m\} \{-h help\}}
\texttt{/usr/sadm/bin/valgid input}

Description \texttt{ckgid} prompts a user and validates the response. It defines, among other things, a prompt message whose response should be an existing group ID, text for help and error messages, and a default value (which will be returned if the user responds with a carriage return).

All messages are limited in length to 70 characters and are formatted automatically. Any white space used in the definition (including newline) is stripped. The \texttt{-W} option cancels the automatic formatting. When a tilde is placed at the beginning or end of a message definition, the default text will be inserted at that point, allowing both custom text and the default text to be displayed.

If the prompt, help or error message is not defined, the default message (as defined under \texttt{NOTES}) will be displayed.

Three visual tool modules are linked to the \texttt{ckgid} command. They are \texttt{errgid} (which formats and displays an error message), \texttt{helpgid} (which formats and displays a help message), and \texttt{valgid} (which validates a response). These modules should be used in conjunction with FML objects. In this instance, the FML object defines the prompt.

Options The following options are supported:

\texttt{-d default} Defines the default value as \texttt{default}. The default is not validated and so does not have to meet any criteria.

\texttt{-e error} Defines the error message as \texttt{error}.

\texttt{-h help} Defines the help messages as \texttt{help}.

\texttt{-k pid} Specifies that process ID \texttt{pid} is to be sent a signal if the user chooses to abort.

\texttt{-m} Displays a list of all groups when help is requested or when the user makes an error.

\texttt{-p prompt} Defines the prompt message as \texttt{prompt}.

\texttt{-Q} Specifies that quit will not be allowed as a valid response.

\texttt{-s signal} Specifies that the process ID \texttt{pid} defined with the \texttt{-k} option is to be sent signal \texttt{signal} when quit is chosen. If no signal is specified, \texttt{SIGTERM} is used.

\texttt{-W width} Specifies that prompt, help and error messages will be formatted to a line length of \texttt{width}.
The following operand is supported:

input  Input to be verified against /etc/group.

The following exit values are returned:

0   Successful execution.
1   EOF on input, or negative width on -W option, or usage error.
3   User termination (quit).

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

If the -m option of ckgid is used, a list of valid groups is displayed here.

If the -m option of ckgid is used, a list of valid groups is displayed here.

When the quit option is chosen (and allowed), q is returned along with the return code 3. The valgid module will not produce any output. It returns 0 for success and non-zero for failure.
ckint,errint,helpint,valint – display a prompt; verify and return an integer value

Synopsis

/usr/sadm/bin/errint [-W width] [-b base] [-e error]
/usr/sadm/bin/helpint [-W width] [-b base] [-h help]
/usr/sadm/bin/valint [-b base] input

Description

The ckint utility prompts a user, then validates the response. It defines, among other things, a prompt message whose response should be an integer, text for help and error messages, and a default value (which will be returned if the user responds with a carriage return).

All messages are limited in length to 70 characters and are formatted automatically. Any white space used in the definition (including newline) is stripped. The -W option cancels the automatic formatting. When a tilde is placed at the beginning or end of a message definition, the default text will be inserted at that point, allowing both custom text and the default text to be displayed.

If the prompt, help or error message is not defined, the default message (as defined under NOTES) will be displayed.

Three visual tool modules are linked to the ckint command. They are errint (which formats and displays an error message), helpint (which formats and displays a help message), and valint (which validates a response). These modules should be used in conjunction with FML objects. In this instance, the FML object defines the prompt. When base is defined in the errint and helpint modules, the messages will include the expected base of the input.

Options

The following options are supported:

- **-b base** Defines the base for input. Must be 2 to 36, default is 10.
- **-d default** Defines the default value as default. The default is not validated and so does not have to meet any criteria.
- **-e error** Defines the error message as error.
- **-h help** Defines the help messages as help.
- **-k pid** Specifies that process ID pid is to be sent a signal if the user chooses to abort.
- **-p prompt** Defines the prompt message as prompt.
- **-Q** Specifies that quit will not be allowed as a valid response.
- **-s signal** Specifies that the process ID pid defined with the -k option is to be sent signal signal when quit is chosen. If no signal is specified, SIGTERM is used.
- **-W width** Specifies that prompt, help and error messages will be formatted to a line length of width.
The following operand is supported:

input  Input to be verified against base criterion.

The following exit values are returned:

0  Successful execution.
1  EOF on input, or negative width on -W option, or usage error.
3  User termination (quit).

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

The default base 10 prompt for ckint is:

Enter an integer [?,q]:

The default base 10 error message is:

ERROR - Please enter an integer.

The default base 10 help message is:

Please enter an integer.

The messages are changed from "integer" to "base base integer" if the base is set to a number other than 10.

When the quit option is chosen (and allowed), q is returned along with the return code 3. The valint module will not produce any output. It returns 0 for success and non-zero for failure.
Name  ckitem, erritem, helpitem – build a menu; prompt for and return a menu item

        [-i invis] [,...] [-m max] [-d default] [-h help]
        [-e error] [-p prompt] [-k pid] [-s signal]
        [choice [,...]]

        /usr/sadm/bin/erritem [-W width] [-e error] [choice [,...]]
        /usr/sadm/bin/helpitem [-W width] [-h help] [choice [,...]]

Description  The ckitem utility builds a menu and prompts the user to choose one item from a menu of items. It then verifies the response. Options for this command define, among other things, a prompt message whose response will be a menu item, text for help and error messages, and a default value (which will be returned if the user responds with a carriage return).

By default, the menu is formatted so that each item is prepended by a number and is printed in columns across the terminal. Column length is determined by the longest choice. Items are alphabetized.

All messages are limited in length to 70 characters and are formatted automatically. Any white space used in the definition (including newline) is stripped. The -W option cancels the automatic formatting. When a tilde is placed at the beginning or end of a message definition, the default text will be inserted at that point, allowing both custom text and the default text to be displayed.

If the prompt, help or error message is not defined, the default message (as defined under NOTES) will be displayed.

Two visual tool modules are linked to the ckitem command. They are erritem (which formats and displays an error message) and helpitem (which formats and displays a help message). These modules should be used in conjunction with FML objects. In this instance, the FML object defines the prompt. When choice is defined in these modules, the messages will describe the available menu choice (or choices).

Options  The following options are supported:

- **-d default**  Define the default value as default. The default is not validated and so does not have to meet any criteria.

- **-e error**  Define the error message as error.

- **-f filename**  Define a file, filename, which contains a list of menu items to be displayed. (The format of this file is: token=tab=description. Lines beginning with a pound sign (#) are designated as comments and ignored.)

- **-h help**  Define the help messages as help.

- **-i invis**  Define invisible menu choices (those which will not be printed in the menu). (For example, “all” used as an invisible choice would mean it is a legal option
but does not appear in the menu. Any number of invisible choices may be defined.) Invisible choices should be made known to a user either in the prompt or in a help message.

- **k pid** Specify that the process ID `pid` is to be sent a signal if the user chooses to abort.
- **l label** Define a label, `label`, to print above the menu.
- **m max** Define the maximum number of menu choices that the user can choose. The default is 1.
- **n** Specify that menu items should not be displayed in alphabetical order.
- **o** Specify that only one menu token will be returned.
- **p prompt** Define the prompt message as `prompt`.
- **Q** Specify that quit will not be allowed as a valid response.
- **s signal** Specify that process ID `pid` defined with the `-k` option is to be sent signal `signal` when quit is chosen. If no signal is specified, SIGTERM is used.
- **u** Specify that menu items should be displayed as an unnumbered list.
- **w width** Specify that prompt, help and error messages will be formatted to a line length of `width`.

**Operands** The following operand is supported:

choice Define menu items. Items should be separated by white space or newline.

**Exit Status** The following exit values are returned:

0 Successful execution.
1 EOF on input, or negative width on `-w` option, or inability to open file on `-f` option, or usage error.
3 User termination (quit).
4 No choices from which to choose.

**Attributes** See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

**See Also** `attributes(5)`
The user may input the number of the menu item if choices are numbered or as much of the string required for a unique identification of the item. Long menus are paged with 10 items per page.

When menu entries are defined both in a file (by using the -f option) and also on the command line, they are usually combined alphabetically. However, if the -n option is used to suppress alphabetical ordering, then the entries defined in the file are shown first, followed by the options defined on the command line.

The default prompt for ckitem is:

Enter selection [?,??,q]:

One question mark will give a help message and then redisplay the prompt. Two question marks will give a help message and then redisplay the menu label, the menu and the prompt.

The default error message if you typed a number is:

ERROR: Bad numeric choice specification

The default error message if you typed a string is:

ERROR: Entry does not match available menu selection. Enter the number of the menu item you wish to select, the token which is associated with the menu item, or a partial string which uniquely identifies the token for the menu item. Enter ?? to reprint the menu.

The default help message is:

Enter the number of the menu item you wish to select, the token which is associated with the menu item, or a partial string which uniquely identifies the token for the menu item. Enter ? to reprint the menu.

When the quit option is chosen (and allowed), q is returned along with the return code 3.
ckkeywd(1)

Name ckkeywd – prompts for and validates a keyword


[-p prompt] [-k pid [-s signal]] keyword [...]

Description ckkeywd prompts a user and validates the response. It defines, among other things, a prompt message whose response should be one of a list of keywords, text for help and error messages, and a default value (which will be returned if the user responds with a carriage return). The answer returned from this command must match one of the defined list of keywords.

All messages are limited in length to 70 characters and are formatted automatically. Any white space used in the definition (including newline) is stripped. The -W option cancels the automatic formatting. When a tilde is placed at the beginning or end of a message definition, the default text will be inserted at that point, allowing both custom text and the default text to be displayed.

If the prompt, help or error message is not defined, the default message (as defined under NOTES) will be displayed.

Options The following options are supported:

- d default Defines the default value as default. The default is not validated and so does not have to meet any criteria.
- e error Defines the error message as error.
- h help Defines the help messages as help.
- k pid Specifies that process ID pid is to be sent a signal if the user chooses to abort.
- p prompt Defines the prompt message as prompt.
- Q Specifies that quit will not be allowed as a valid response.
- s signal Specifies that the process ID pid defined with the -k option is to be sent signal signal when quit is chosen. If no signal is specified, SIGTERM is used.
- W width Specifies that prompt, help and error messages will be formatted to a line length of width.

Operands The following operand is supported:

keyword Defines the keyword, or list of keywords, against which the answer will be verified.

Exit Status The following exit values are returned:

0 Successful execution.
1 EOF on input, or negative width on -W option, or no keywords from which to choose, or usage error.
3 User termination (quit).

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also attributes(5)

Notes

The default prompt for ckkeywd is:

Enter appropriate value [keyword,[ . . . ],?,q]:

The default error message is:

ERROR: Please enter one of the following keywords: keyword,[ . . . ],q

The default help message is:

keyword,[ . . . ],q

When the quit option is chosen (and allowed), q is returned along with the return code 3.
Name  ckpath, errpath, helppath, valpath – display a prompt; verify and return a pathname

Synopsis  ckpath [-Q] [-W width] [-a | l] [-b | c | f | y]
          [-n [o | z]] [-rtwx] [-d default] [-h help]
          [-e error] [-p prompt] [-k pid [-s signal]]
/usr/sadm/bin/errpath [-W width] [-a | l] [-b | c | f | y]
          [-n [o | z]] [-rtwx] [-e error]
/usr/sadm/bin/helppath [-W width] [-a | l] [-b | c | f | y]
          [-n [o | z]] [-rtwx] [-h help]
/usr/sadm/bin/valpath [-a | l] [-b | c | f | y]
          [-n [o | z]] [-rtwx] input

Description  The ckpath utility prompts a user and validates the response. It defines, among other things, a prompt message whose response should be a pathname, text for help and error messages, and a default value (which is returned if the user responds with a RETURN).

The pathname must obey the criteria specified by the first group of options. If no criteria is defined, the pathname must be for a normal file that does not yet exist. If neither -a (absolute) or -l (relative) is given, then either is assumed to be valid.

All messages are limited in length to 79 characters and are formatted automatically. Tabs and newlines are removed after a single white space character in a message definition, but spaces are not removed. When a tilde is placed at the beginning or end of a message definition, the default text is inserted at that point, allowing both custom text and the default text to be displayed.

If the prompt, help or error message is not defined, the default message (as defined under EXAMPLES) is displayed.

Three visual tool modules are linked to the ckpath command. They are errpath (which formats and displays an error message on the standard output), helppath (which formats and displays a help message on the standard output), and valpath (which validates a response).

Options  The following options are supported:

- -a  Pathname must be an absolute path.
- -b  Pathname must be a block special file.
- -c  Pathname must be a character special file.
- -d default  Defines the default value as default. The default is not validated and so does not have to meet any criteria.
- -e error  Defines the error message as error.
- -f  Pathname must be a regular file.
- -h help  Defines the help message as help.
ckpath(1)

-k pid  Specifies that process ID pid is to be sent a signal if the user chooses to quit.
-l     Pathname must be a relative path.
-n     Pathname must not exist (must be new).
-o     Pathname must exist (must be old).
-p prompt  Defines the prompt message as prompt.
-Q     Specifiesthatquitisnotallowedasavalidresponse.
-r     Pathname must be readable.
-s signal  Specifies that the process ID pid defined with the -k option is to be sent signal signal when quit is chosen. If no signal is specified, SIGTERM is used.
-t     Pathname must be creatable (touchable). Pathname will be created if it does not already exist.
-w     Pathname must be writable.
-w width  Specify that prompt, help and error messages be formatted to a line length of width.
-x     Pathname must be executable.
-y     Pathname must be a directory.
-z     Pathname must have a file having a size greater than zero bytes.

Operands  The following operand is supported:

input  Input to be verified against validation options.

Examples  The text of the default messages for ckpath depends upon the criteria options that have been used.

EXAMPLE 1  Default prompt
An example default prompt for ckpath (using the -a option) is:
example% ckpath -a
Enter an absolute pathname [?,q]

EXAMPLE 2  Default error message
An example default error message (using the -a option) is:
example% /usr/sadm/bin/errpath -a
ERROR: A pathname is a filename, optionally preceded by parent directories.
The pathname you enter: - must begin with a slash (/)
EXAMPLE 3  Default help message

An example default help message (using the -a option) is:

```
example% /usr/sadm/bin/helppath -a
A pathname is a filename, optionally preceded by parent directories.
The pathname you enter: - must begin with a slash (/)
```

EXAMPLE 4  The quit option

When the quit option is chosen (and allowed), q is returned along with the return code 3. Quit input gets a trailing newline.

EXAMPLE 5  Using the valpath module

The valpath module will produce a usage message on stderr. It returns 0 for success and non-zero for failure.

```
example% /usr/sadm/bin/valpath
usage: valpath [ -a[l][b[c|f|y][n][o|z]]rtwx ] input
   .
   .
```

Exit Status  The following exit values are returned:

0  Successful execution.
1  EOF on input, or negative width on -W option, or usage error.
2  Mutually exclusive options.
3  User termination (quit).
4  Mutually exclusive options.

Attributes  See attributes(5) for descriptions of the following attributes:

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<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  signal.h(3HEAD), attributes(5)
**Name**
ckrange, errange, helprange, valrange – prompts for and validates an integer

**Synopsis**
    [-d default] [-h help] [-e error] [-p prompt]
    [-k pid] [-s signal]
/usr/sadm/bin/errange [-W width] [-e error] [-l lower]
    [-u upper] [-b base]
/usr/sadm/bin/helprange [-W width] [-h help] [-l lower]
    [-u upper] [-b base]
/usr/sadm/bin/valrange [-l lower] [-u upper] [-b base] input

**Description**
The ckrange utility prompts a user for an integer between a specified range and determines whether this response is valid. It defines, among other things, a prompt message whose response should be an integer in the range specified, text for help and error messages, and a default value (which is returned if the user responds with a RETURN).

This command also defines a range for valid input. If either the lower or upper limit is left undefined, then the range is bounded on only one end.

All messages are limited in length to 79 characters and are formatted automatically. Tabs and newlines are removed after a single whitespace character in a message definition, but spaces are not removed. When a tilde is placed at the beginning or end of a message definition, the default text will be inserted at that point, allowing both custom text and the default text to be displayed.

If the prompt, help or error message is not defined, the default message (as defined under EXAMPLES) is displayed.

Three visual tool modules are linked to the ckrange command. They are errange (which formats and displays an error message on the standard output), helprange (which formats and displays a help message on the standard output), and valrange (which validates a response).

*Note: Negative “input” arguments confuse getopt in valrange. By inserting a "-" before the argument, getopt processing will stop. See getopt(1) and Intro(1) about getopt parameter handling. getopt is used to parse positional parameters and to check for legal options.*

**Options**
The following options are supported:

- **-b base** Defines the base for input. Must be 2 to 36, default is 10. Base conversion uses strtol(3C). Output is always base 10.
- **-d default** Defines the default value as default. default is converted using strtol(3C) in the desired base. Any characters invalid in the specified base will terminate the strtol conversion without error.
- **-e error** Defines the error message as error.
ckrange(1)

- h help   Defines the help message as help.
- k pid    Specifies that process ID pid is to be sent a signal if the user chooses to quit.
- l lower  Defines the lower limit of the range as lower. Default is the machine's largest negative long.
- p prompt Defines the prompt message as prompt.
- Q        Specifies that quit will not be allowed as a valid response.
- s signal Specifies that the process ID pid defined with the -k option is to be sent signal signal when quit is chosen. If no signal is specified, SIGTERM is used.
- u upper  Defines the upper limit of the range as upper. Default is the machine's largest positive long.
- W width  Specifies that prompt, help and error messages will be formatted to a line length of width.

Operands  The following operand is supported:
           input   Input to be verified against upper and lower limits and base.

Examples  EXAMPLE 1  Default base 10 prompt
           The default base 10 prompt for ckrange is:
           example% ckrange
           Enter an integer between lower_bound and upper_bound [lower_bound−upper_bound, ?, q]:

           EXAMPLE 2  Default base 10 error message
           The default base 10 error message is:
           example% /usr/sadm/bin/errange
           ERROR: Please enter an integer between lower_bound\n           and upper_bound.

           EXAMPLE 3  Default base 10 help message
           The default base 10 help message is:
           example% /usr/sadm/bin/helprange
           Please enter an integer between lower_bound and upper_bound.

           EXAMPLE 4  Changing messages for a base other than 10
           The messages are changed from “integer” to “base base integer” if the base is set to a number other than 10. For example,
           example% /usr/sadm/bin/helprange -b 36
EXAMPLE 5  Using the quit option
When the quit option is chosen (and allowed), q is returned along with the return code 3. Quit
input gets a trailing newline.

EXAMPLE 6  Using the valrange module
The valrange module will produce a usage message on stderr. It returns 0 for success and
non-zero for failure.

    example% /usr/sadm/bin/valrange
    usage: valrange [-l lower] [-u upper] [-b base] input

Exit Status  The following exit values are returned:
    0       Successful execution.
    1       EOF on input, or negative width on -W option, or usage error.
    2       Usage error.
    3       User termination (quit).

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  Intro(1), getopt(1), strtol(3C), attributes(5), signal.h(3HEAD)
Name
ckstr, errstr, helpstr, valstr - display a prompt; verify and return a string answer

Synopsis
[-k pid [-s signal]]
/usr/sadm/bin/errstr [-W width] [-e error] [-l length]
[-r regexp] [-...]
/usr/sadm/bin/helpstr [-W width] [-h help] [-l length]
[-r regexp] [-...]
/usr/sadm/bin/valstr [-l length] [-r regexp] [-...]

Description
The ckstr utility prompts a user and validates the response. It defines, among other things, a
prompt message whose response should be a string, text for help and error messages, and a
default value (which are returned if the user responds with a RETURN).

The answer returned from this command must match the defined regular expression and be
no longer than the length specified. If no regular expression is given, valid input must be a
string with a length less than or equal to the length defined with no internal, leading or trailing
white space. If no length is defined, the length is not checked.

All messages are limited in length to 79 characters and are formatted automatically. Tabs and
newlines are removed after a single white space character in a message definition, but spaces
are not removed. When a tilde is placed at the beginning or end of a message definition, the
default text will be inserted at that point, allowing both custom text and the default text to be
displayed.

If the prompt, help or error message is not defined, the default message (as defined under
EXAMPLES) is displayed.

Three visual tool modules are linked to the ckstr command. They are errstr (which formats
and displays an error message on the standard output), helpstr (which formats and displays a
help message on the standard output), and valstr (which validates a response).

Options
The following options are supported:

-d default Defines the default value as default. The default is not validated and so does not
have to meet any criteria.
-e error Defines the error message as error.
-h help Defines the help message as help.
-k pid Specifies that process ID pid is to be sent a signal if the user chooses to quit.
-l length Specifies the maximum length of the input.
-p prompt Defines the prompt message as prompt.
-Q Specifies that quit will not be allowed as a valid response.
-r regexp  Specifies a regular expression, regexp, against which the input should be validated. May include white space. If multiple expressions are defined, the answer need match only one of them.

-s signal  Specifies that the process ID pid defined with the -k option is to be sent signal signal when quit is chosen. If no signal is specified, SIGTERM is used.

-w width  Specifies that prompt, help and error messages will be formatted to a line length of width.

**Operands**  The following operand is supported:

`input`  Input to be verified against format length and/or regular expression criteria.

**Examples**  **EXAMPLE 1**  Default prompt

The default prompt for ckstr is:

```bash
example% ckstr
Enter an appropriate value [?,q]:
```

**EXAMPLE 2**  Default error message

The default error message is dependent upon the type of validation involved. The user will be told either that the length or the pattern matching failed. The default error message is:

```bash
example% /usr/sadm/bin/errstr
ERROR: Please enter a string which contains no embedded, leading or trailing spaces or tabs.
```

**EXAMPLE 3**  Default help message

The default help message is also dependent upon the type of validation involved. If a regular expression has been defined, the message is:

```bash
example% /usr/sadm/bin/helpstr -r regexp
Please enter a string which matches the following pattern:
regexp
```

Other messages define the length requirement and the definition of a string.

**EXAMPLE 4**  Using the quit option

When the quit option is chosen (and allowed), q is returned along with the return code 3. Quit input gets a trailing newline.

**EXAMPLE 5**  Using the valstr module

The valstr module will produce a usage message on stderr. It returns 0 for success and non-zero for failure.
EXAMPLE 5  Using the valstr module  (Continued)

example% /usr/sadm/bin/valstr
usage: valstr [-l length] [-r regexp] [ . . . ] input

Exit Status  The following exit values are returned:

0  Successful execution.
1  EOF on input, or negative width on -W option, or usage error.
2  Invalid regular expression.
3  User termination (quit).

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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</table>

See Also  signal.h(3HEAD), attributes(5)
The `cksum` command calculates and writes to standard output a cyclic redundancy check (CRC) for each input file, and also writes to standard output the number of octets in each file.

For each file processed successfully the `cksum` method writes in the following format:

```
"%u %d %s
<checksum>, <# of octets>, <path name>
```

If no file operand was specified, the path name and its leading space is omitted.

The CRC used is based on the polynomial used for CRC error checking in the referenced Ethernet standard.

The encoding for the CRC checksum is defined by the generating polynomial:

\[ G(x) = x^{32} + x^{26} + x^{23} + x^{22} + x^{16} + x^{12} + x^{11} + x^{10} + x^{8} + x^{7} + x^{5} + x^{4} + x^{2} + x + 1 \]

Mathematically, the CRC value corresponding to a given file is defined by the following procedure:

1. The \( n \) bits to be evaluated are considered to be the coefficients of a mod 2 polynomial \( M(x) \) of degree \( n - 1 \). These \( n \) bits are the bits from the file, with the most significant bit being the most significant bit of the first octet of the file and the last bit being the least significant bit of the last octet, padded with zero bits (if necessary) to achieve an integral number of octets, followed by one or more octets representing the length of the file as a binary value, least significant octet first. The smallest number of octets capable of representing this integer is used.

2. \( M(x) \) is multiplied by \( x^{32} \) (that is, shifted left 32 bits) and divided by \( G(x) \) using mod 2 division, producing a remainder \( R(x) \) of degree \( \leq 31 \).

3. The coefficients of \( R(x) \) are considered to be a 32-bit sequence.

4. The bit sequence is complemented and the result is the CRC.

The following operand is supported:

- `file` A path name of a file to be checked. If no `file` operands are specified, the standard input is used.

The `cksum` command is typically used to quickly compare a suspect file against a trusted version of the same, such as to ensure that files transmitted over noisy media arrive intact. However, this comparison cannot be considered cryptographically secure. The chances of a damaged file producing the same CRC as the original are astronomically small; deliberate deception is difficult, but probably not impossible.
Although input files to \texttt{cksum} can be any type, the results need not be what would be expected on character special device files. Since this document does not specify the block size used when doing input, checksums of character special files need not process all of the data in those files.

The algorithm is expressed in terms of a bitstream divided into octets. If a file is transmitted between two systems and undergoes any data transformation (such as moving 8-bit characters into 9-bit bytes or changing Little Endian byte ordering to Big Endian), identical CRC values cannot be expected. Implementations performing such transformations can extend \texttt{cksum} to handle such situations.

See \texttt{largefile(5)} for the description of the behavior of \texttt{cksum} when encountering files greater than or equal to 2 Gbyte ($2^{31}$ bytes).

\textbf{Environment Variables} See \texttt{environ(5)} for descriptions of the following environment variables that affect the execution of \texttt{cksum}: \texttt{LANG}, \texttt{LC\_ALL}, \texttt{LC\_CTYPE}, \texttt{LC\_MESSAGES}, and \texttt{NLSPATH}.

\textbf{Exit Status} The following exit values are returned:

- \texttt{0}  All files were processed successfully.
- \texttt{>0}  An error occurred.

\textbf{Attributes} See \texttt{attributes(5)} for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
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<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See \texttt{standards(5)}.</td>
</tr>
</tbody>
</table>

\textbf{See Also} \texttt{digest(1)}, \texttt{sum(1)}, \texttt{bart(1M)}, \texttt{attributes(5)}, \texttt{environ(5)}, \texttt{largefile(5)}, \texttt{standards(5)}
cktime, errtime, helptime, valtime – display a prompt; verify and return a time of day

**Name**
ccktime, errtime, helptime, valtime – display a prompt; verify and return a time of day

**Synopsis**
```
ccktime [-Q] [-W width] [-f format] [-d default] [-h help]
    [-e error] [-p prompt] [-k pid] [-s signal]
    /usr/sadm/bin/errtime [-W width] [-e error] [-f format]
    /usr/sadm/bin/helptime [-W width] [-h help] [-f format]
    /usr/sadm/bin/valtime [-f format] input
```

**Description**
The ccktime utility prompts a user and validates the response. It defines, among other things, a prompt message whose response should be a time, text for help and error messages, and a default value (which is returned if the user responds with a RETURN). The user response must match the defined format for the time of day.

All messages are limited in length to 70 characters and are formatted automatically. Any white space used in the definition (including NEWLINE) is stripped. The `-W` option cancels the automatic formatting. When a tilde is placed at the beginning or end of a message definition, the default text is inserted at that point, allowing both custom text and the default text to be displayed.

If the prompt, help or error message is not defined, the default message (as defined under NOTES) is displayed.

Three visual tool modules are linked to the ccktime command. They are errtime (which formats and displays an error message), helptime (which formats and displays a help message), and valtime (which validates a response). These modules should be used in conjunction with FML objects. In this instance, the FML object defines the prompt. When format is defined in the errtime and helptime modules, the messages will describe the expected format.

**Options**
The following options are supported:

- `-d default` Defines the default value as `default`. The default is not validated and so does not have to meet any criteria.

- `-e error` Defines the error message as `error`.

- `-f format` Specifies the format against which the input will be verified. Possible formats and their definitions are:

<table>
<thead>
<tr>
<th>Format</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>%H</code></td>
<td>hour (00 - 23)</td>
</tr>
<tr>
<td><code>%I</code></td>
<td>hour (00 - 12)</td>
</tr>
<tr>
<td><code>%M</code></td>
<td>minute (00 - 59)</td>
</tr>
<tr>
<td><code>%p</code></td>
<td>ante meridian or post meridian</td>
</tr>
<tr>
<td><code>%r</code></td>
<td>time as <code>%I:%M:%S %p</code></td>
</tr>
<tr>
<td><code>%R</code></td>
<td>time as <code>%H:%M</code> (the default format)</td>
</tr>
<tr>
<td><code>%S</code></td>
<td>seconds (00 - 59)</td>
</tr>
<tr>
<td><code>%T</code></td>
<td>time as <code>%H:%M:%S</code></td>
</tr>
</tbody>
</table>

- `-h help` Defines the help messages as `help`. 
-k pid Specifies that process ID pid is to be sent a signal if the user chooses to abort.
-p prompt Defines the prompt message as prompt.
-q Specifies that quit will not be allowed as a valid response.
-s signal Specifies that the process ID pid defined with the -k option is to be sent signal signal when quit is chosen. If no signal is specified, SIGTERM is used.
-W width Specifies that prompt, help and error messages will be formatted to a line length of width.

Operands The following operand is supported:

input Input to be verified against format criteria.

Exit Status The following exit values are returned:

0 Successful execution.
1 EOF on input, or negative width on -W option, or usage error.
3 User termination (quit).
4 Garbled format argument.

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also attributes(5)

Notes The default prompt for cktime is:

Enter a time of day [?,q]:

The default error message is:

ERROR: Please enter the time of day. Format is <format>.

The default help message is:

Please enter the time of day. Format is <format>.

When the quit option is chosen (and allowed), q is returned along with the return code 3. The valtime module will not produce any output. It returns 0 for success and non-zero for failure.
ckuid(1)

Name ckuid, erruid, helpuid, valuid – prompts for and validates a userID

Synopsis ckuid [-Q] [-W width] [-m] [-d default] [-h help]
               [-e error] [-p prompt] [-k pid] [-s signal]
/usr/sadm/bin/erruid [-W width] [-e error]
/usr/sadm/bin/helpuid [-W width] [-m] [-h help]
/usr/sadm/bin/valuid input

Description The ckuid utility prompts a user and validates the response. It defines, among other things, a prompt message whose response should be an existing userID, text for help and error messages, and a default value (which are returned if the user responds with a RETURN).

All messages are limited in length to 70 characters and are formatted automatically. Any white space used in the definition (including NEWLINE) is stripped. The -W option cancels the automatic formatting. When a tilde is placed at the beginning or end of a message definition, the default text is inserted at that point, allowing both custom text and the default text to be displayed.

If the prompt, help or error message is not defined, the default message (as defined under NOTES) is displayed.

Three visual tool modules are linked to the ckuid command. They are erruid (which formats and displays an error message), helpuid (which formats and displays a help message), and valuid (which validates a response). These modules should be used in conjunction with FML objects. In this instance, the FML object defines the prompt.

Options The following options are supported:

- `-d default` Defines the default value as `default`. The default is not validated and so does not have to meet any criteria.
- `-e error` Defines the error message as `error`.
- `-h help` Defines the help messages as `help`.
- `-k pid` Specifies that process ID `pid` is to be sent a signal if the user chooses to abort.
- `-m` Displays a list of all logins when help is requested or when the user makes an error.
- `-p prompt` Defines the prompt message as `prompt`.
- `-Q` Specifies that quit will not be allowed as a valid response.
- `-s signal` Specifies that the process ID `pid` defined with the -k option is to be sent signal `signal` when quit is chosen. If no signal is specified, SIGTERM is used.
- `-W width` Specifies that prompt, help and error messages will be formatted to a line length of `width`. 
Operands  The following operand is supported:

input    Input to be verified against /etc/passwd.

Exit Status  The following exit values are returned:

0    Successful execution.
1    EOF on input, or negative width on -W option, or usage error.
2    Usage error.
3    User termination (quit).

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  attributes(5)

Notes  The default prompt for ckuid is:

Enter the login name of an existing user [?,q]:

The default error message is:

ERROR - Please enter the login name of an existing user.

If the -m option is used, the default error message is:

ERROR: Please enter one of the following login names: <List>

The default help message is:

Please enter the login name of an existing user.

If the -m option is used, the default help message is:

Please enter one of the following login names: <List>

When the quit option is chosen (and allowed), q is returned along with the return code 3. The valuidd module will not produce any output. It returns 0 for success and non-zero for failure.
ckyorn, erryorn, helpyorn, valyorn – prompts for and validates yes/no

**Synopsis**

```bash
    [-p prompt] [-k pid [-s signal]]
/usr/sadm/bin/erryorn [-W width] [-e error]
/usr/sadm/bin/helpyorn [-W width] [-h help]
/usr/sadm/bin/valyorn input
```

**Description**

ckyorn prompts a user and validates the response. It defines, among other things, a prompt message for a yes or no answer, text for help and error messages, and a default value (which is returned if the user responds with a RETURN).

All messages are limited in length to 70 characters and are formatted automatically. Any white space used in the definition (including newline) is stripped. The `-W` option cancels the automatic formatting. When a tilde is placed at the beginning or end of a message definition, the default text is inserted at that point, allowing both custom text and the default text to be displayed.

If the prompt, help or error message is not defined, the default message (as defined under NOTES) is displayed.

Three visual tool modules are linked to the ckyorn command. They are erryorn (which formats and displays an error message), helpyorn (which formats and displays a help message), and valyorn (which validates a response).

**Options**

The following options are supported:

- `-d default` Defines the default value as `default`. The default is not validated and so does not have to meet any criteria.
- `-e error` Defines the error message as `error`.
- `-h help` Defines the help messages as `help`.
- `-k pid` Specifies that process ID `pid` is to be sent a signal if the user chooses to abort.
- `-p prompt` Defines the prompt message as `prompt`.
- `-Q` Specifies that quit will not be allowed as a valid response.
- `-s signal` Specifies that the process ID `pid` defined with the `-k` option is to be sent signal `signal` when quit is chosen. If no signal is specified, SIGTERM is used.
- `-W width` Specifies that prompt, help and error messages will be formatted to a line length of `width`.

**Operands**

The following operand is supported:

- `input` Input to be verified as y, yes, or n, no (in any combination of upper- and lower-case letters).
Exit Status The following exit values are returned:

0  Successful execution.
1  EOF on input, or negative width on -W option, or usage error.
2  Usage error.
3  User termination (quit).

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also attributes(5)

Notes The default prompt for ckyorn is:

Yes or No [y,n,?,q]:

The default error message is:

ERROR - Please enter yes or no.

The default help message is:

To respond in the affirmative, enter y, yes, Y, or YES.
To respond in the negative, enter n, no, N, or NO.

When the quit option is chosen (and allowed), q is returned along with the return code 3. The valyorn module will not produce any output. It returns 0 for success and non-zero for failure.
Name  clear – clear the terminal screen

Synopsis  clear [term]

Description  The clear utility clears the terminal screen if this is possible. It looks in the environment for the terminal type, if this is not already specified by the term operand, and then looks up the terminfo database to figure out how to clear the screen.

Operands  term  Indicates the type of terminal. Normally, this operand is unnecessary because the default is taken from the environment variable TERM.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  tput(1), attributes(5)
**cmp**

**Synopsis**
/usr/bin/cmp [-l | -s] file1 file2 [skip1] [skip2]

**Description**
cmp compares two files file1 and file2. cmp writes no output if the files are the same. By default, if the files differ, the byte and line number at which the first difference occurred are written to standard output. Bytes and lines are numbered beginning with 1.

skip1 and skip2 are initial byte offsets into file1 and file2 respectively, and can be either octal or decimal. A leading 0 denotes octal.

If either file1 or file2 is - , cmp uses standard input for that operand.

**Options**
The following options are supported:
- `-l` Write the decimal byte number and the differing bytes (in octal) for each difference.
- `-s` Write nothing for differing files. Return non-zero exit status only.

**Operands**
The following operands are supported:
- `file1` A path name of the first file to be compared. If file1 is --, the standard input is used.
- `file2` A path name of the second file to be compared. If file2 is --, the standard input is used.

If both file1 and file2 refer to standard input or refer to the same FIFO special, block special or character special file, an error results.

**Usage**
See largefile(5) for the description of the behavior of cmp when encountering files greater than or equal to 2 Gbyte (231 bytes).

**Examples**
**Example 1** Comparing Files Byte for Byte

The following example does a byte for byte comparison of file1 and file2:

```bash
example% cmp file1 file2 0 1024
```

It skips the first 1024 bytes in file2 before starting the comparison.

See environ(5) for descriptions of the following environment variables that affect the execution of cmp: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

**Exit Status**
The following error values are returned:
- `0` The files are identical.
- `1` The files are different. This includes the case where one file is identical to the first part of the other.
- `>1` An error occurred.
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also  comm(1), diff(1), attributes(5), environ(5), largefile(5), standards(5)
The `col` utility reads from the standard input and writes to the standard output. It performs the line overlays implied by reverse line-feeds, and by forward and reverse half-line-feeds. Unless `-x` is used, all blank characters in the input will be converted to tab characters wherever possible. `col` is particularly useful for filtering multi-column output made with the `.rt` command of `nroff(1)` and output resulting from use of the `tbl(1)` preprocessor.

The ASCII control characters SO and SI are assumed by `col` to start and end text in an alternative character set. The character set to which each input character belongs is remembered, and on output SI and SO characters are generated as appropriate to ensure that each character is written in the correct character set.

On input, the only control characters accepted are space, backspace, tab, carriage-return and newline characters, SI, SO, VT, reverse line-feed, forward half-line-feed and reverse half-line-feed. The VT character is an alternative form of full reverse line-feed, included for compatibility with some earlier programs of this type. The only other characters to be copied to the output are those that are printable.

The ASCII codes for the control functions and line-motion sequences mentioned above are as given in the table below. ESC stands for the ASCII escape character, with the octal code 033; ESC– means a sequence of two characters, ESC followed by the character x.

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>-b</code></td>
<td>Assume that the output device in use is not capable of backspacing. In this case, if two or more characters are to appear in the same place, only the last one read will be output.</td>
</tr>
<tr>
<td><code>-f</code></td>
<td>Although <code>col</code> accepts half-line motions in its input, it normally does not emit them on output. Instead, text that would appear between lines is moved to the next lower full-line boundary. This treatment can be suppressed by the <code>-f (fine)</code> option; in this case, the output from <code>col</code> may contain forward half-line-feeds (ESC-9), but will still never contain either kind of reverse line motion.</td>
</tr>
<tr>
<td><code>-p</code></td>
<td>Normally, <code>col</code> will ignore any escape sequences unknown to it that are found in its input; the <code>-p</code> option may be used to cause <code>col</code> to output these sequences as regular</td>
</tr>
</tbody>
</table>
characters, subject to overprinting from reverse line motions. The use of this option is
highly discouraged unless the user is fully aware of the textual position of the escape
sequences.

-x Prevent col from converting blank characters to tab characters on output wherever
possible. Tab stops are considered to be at each column position \( n \) such that \( n \) modulo
8 equals 1.

Environment Variables

See environ(5) for descriptions of the following environment variables that affect the
execution of col: LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status

The following error values are returned:

\( 0 \) Successful completion.

\( \geq 0 \) An error occurred.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>enabled</td>
</tr>
</tbody>
</table>

See Also

nroff(1), tbl(1), ascii(5), attributes(5), environ(5)

Notes

The input format accepted by col matches the output produced by nroff with either the -T37
or -Tlp options. Use -T37 (and the -f option of col) if the ultimate disposition of the output
of col will be a device that can interpret half-line motions, and -Tlp otherwise.

col cannot back up more than 128 lines or handle more than 800 characters per line.

Local vertical motions that would result in backing up over the first line of the document are
ignored. As a result, the first line must not have any superscripts.
Name  comm – select or reject lines common to two files

Synopsis  /usr/bin/comm [-options] file1 file2

Description  comm reads two files file1 and file2 which should be ordered in the collating sequence of the
current locale, and produces three text columns as output:

1  Lines only in file1.
2  Lines only in file2.
3  Lines in both files.

If lines in either file are not ordered according to the collating sequence of the current locale,
the results are not specified.

If either file1 or file2 is -, comm uses standard input starting at the current location.

Options  The following options are supported:

-1  Suppresses the output column of lines unique to file1.
-2  Suppresses the output column of lines unique to file2.
-3  Suppresses the output column of lines duplicated in file1 and file2.

Operands  The following operands are supported:

file1  A path name of the first file to be compared. If file1 is –, the standard input is used.
file2  A path name of the second file to be compared. If file2 is –, the standard input is used.

Usage  See largefile(5) for the description of the behavior of comm when encountering files greater
than or equal to 2 Gbyte (2^31 bytes).

Examples  EXAMPLE 1  Printing a list of utilities specified by files

If file1, file2, and file3 each contain a sorted list of utilities, the command

example% comm -23 file1 file2 | comm -23 - file3

prints a list of utilities in file1 not specified by either of the other files. The entry:

example% comm -12 file1 file2 | comm -12 - file3

prints a list of utilities specified by all three files. And the entry:

example% comm -12 file2 file3 | comm -23 -file1

prints a list of utilities specified by both file2 and file3, but not specified in file1.
Environment Variables
See environ(5) for descriptions of the following environment variables that affect the execution of comm: LANG, LC_ALL, LC_COLLATE, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status
The following exit values are returned:

   0    All input files were successfully output as specified.
   >0   An error occurred.

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also
cmp(1), diff(1), sort(1), uniq(1), attributes(5), environ(5), largefile(5), standards(5)
The command utility causes the shell to treat the arguments as a simple command, suppressing the shell function lookup.

If the \texttt{command\_name} is the same as the name of one of the special built-in utilities, the special properties do not occur. In every other respect, if \texttt{command\_name} is not the name of a function, the effect of \texttt{command} (with no options) are the same as omitting \texttt{command}.

The command utility also provides information concerning how a command name is interpreted by the shell. See \texttt{-v} and \texttt{-V}.

Without the \texttt{-v} or \texttt{-V} option, \texttt{command} executes \texttt{command\_name} with arguments specified by \texttt{argument}, suppressing the shell function lookup that normally occurs. In addition, if \texttt{command} is a special built-in command, the special properties are removed so that failures do not cause the script that executes it to terminate.

If the \texttt{-v} or \texttt{-V} options are specified, \texttt{command} is equivalent to \texttt{whence(1)}.

The following options are supported by \texttt{/usr/bin/command}:

\begin{itemize}
  \item \texttt{-p} Performs the command search using a default value for PATH that is guaranteed to find all of the standard utilities.
  \item \texttt{-v} Writes a string to standard output that indicates the path or command that is be used by the shell, in the current shell execution environment to invoke \texttt{command\_name}, but does not invoke \texttt{command\_name}.
    \begin{itemize}
      \item Utilities, regular built-in utilities, \texttt{command\_names} including a slash character, and any implementation-provided functions that are found using the PATH variable is written as absolute path names.
      \item Shell functions, special built-in utilities, regular built-in utilities not associated with a PATH search, and shell reserved words are written as just their names.
      \item An alias is written as a command line that represents its alias definition.
      \item Otherwise, no output is written and the exit status reflects that the name was not found.
    \end{itemize}
  \item \texttt{-V} Writes a string to standard output that indicates how the name specified in the \texttt{command\_name} operand is interpreted by the shell, in the current shell execution environment, but does not invoke \texttt{command\_name}. Although the format of this string is unspecified, it indicates in which of the following categories \texttt{command\_name} falls and include the information stated:
\end{itemize}
Utilities, regular built-in utilities, and any implementation-provided functions that are found using the PATH variable is identified as such and include the absolute path name in the string.

Other shell functions is identified as functions.

Aliases are identified as aliases and their definitions are included in the string.

Special built-in utilities are identified as special built-in utilities.

Regular built-in utilities not associated with a PATH search is identified as regular built-in utilities.

Shell reserved words are identified as reserved words.

The following options are supported by ksh command:

- `-p` Causes a default path to be searched rather than the one defined by the value of `PATH`.

- `-v` Equivalent to:
  
  `whence command [argument ...]`

- `-V` Equivalent to:
  
  `whence -v command [argument ...]`

- `-x` If command fails because there are too many arguments, it is invoked multiple times with a subset of the arguments on each invocation. Arguments that occur prior to the first word that expand to multiple arguments and arguments that occur after the last word that expands to multiple arguments are passed on each invocation. The exit status is the maximum invocation exit status.

The following operands are supported:

- `argument` One of the strings treated as an argument to `command_name`.

- `command_name` The name of a utility or a special built-in utility.

**Examples**

**EXAMPLE 1** Making a Version of cd That Always Prints Out the New Working Directory

The following example takes a version of cd that always prints out the new working directory exactly once:

```bash
cd() {
    command cd "$@" >/dev/null
    pwd
}
```

**EXAMPLE 2** Starting Off a secure shell script in Which the Script Avoids Being Spoofed by Its Parent

The following example starts off a secure shell script in which the script avoids being spoofed by its parent:
EXAMPLE 2  Starting Off a secure shell script in Which the Script Avoids Being Spoofed by Its Parent (Continued)

IFS='

# The preceding value should be <space><tab><newline>.
# Set IFS to its default value.
\unalias -a
# Unset all possible aliases.
# Note that unalias is escaped to prevent an alias
# being used for unalias.
unset -f command
# Ensure command is not a user function.
PATH="$\{command -p getconf _CS_PATH\}:\$PATH"
# Put on a reliable PATH prefix.
# ...

At this point, given correct permissions on the directories called by PATH, the script has the
ability to ensure that any utility it calls is the intended one. It is being very cautious because it
assumes that implementation extensions can be present that would allow user functions to
exist when it is invoked. This capability is not specified by this document, but it is not
prohibited as an extension. For example, the ENV variable precedes the invocation of the script
with a user startup script. Such a script could define functions to spoof the application.

Environment Variables
See environ(5) for descriptions of the following environment variables that affect the
execution of command: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

PATH      Determine the search path used during the command search, except as described
          under the -p option.

Exit Status

/usr/bin/command
When the -v or -V options are specified, the following exit values are returned:
0        Successful completion.
>0       The command_name could not be found or an error occurred.

Otherwise, the following exit values are returned:
126      The utility specified by command_name was found but could not be invoked.
127      An error occurred in the command utility or the utility specified by command_name
could not be found.

Otherwise, the exit status of command is that of the simple command specified by the
arguments to command.
If `command` is invoked, the exit status of command is that of `command`. Otherwise, it is one of the following:

- `0`  
  `command_name` completed successfully.
- `>0`  
  `-v` or `-V` has been specified and an error occurred.
- `126`  
  `command_name` was found but could not be invoked.
- `127`  
  `command_name` could not be found.

**Attributes**  
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See <code>standards(5)</code>.</td>
</tr>
</tbody>
</table>

**See Also**  
ksh(1), sh(1), type(1), whence(1), attributes(5), environ(5), standards(5)
The `compress` utility attempts to reduce the size of the named files by using adaptive Lempel-Ziv coding. Except when the output is to the standard output, each file is replaced by one with the extension `.Z`, while keeping the same ownership modes, change times and modification times, ACLs, and extended attributes. The compress utility also attempt to set the owner and group of `file`.z to the owner and group of file, but does not fail if this cannot be done. If appending the `.Z` to the file pathname would make the pathname exceed 1023 bytes, the command fails. If no files are specified, the standard input is compressed to the standard output.

The amount of compression obtained depends on the size of the input, the number of `bits` per code, and the distribution of common substrings. Typically, text such as source code or English is reduced by 50–60%. Compression is generally much better than that achieved by Huffman coding (as used in `pack(1)`) and it takes less time to compute. The `bits` parameter specified during compression is encoded within the compressed file, along with a magic number to ensure that neither decompression of random data nor recompression of compressed data is subsequently allowed.

The `uncompress` utility restores files to their original state after they have been compressed using the `compress` utility. If no files are specified, the standard input is uncompressed to the standard output.

This utility supports the uncompressing of any files produced by `compress`. For files produced by `compress` on other systems, `uncompress` supports 9- to 16-bit compression (see `-b`).

The `zcat` utility writes to standard output the uncompressed form of files that have been compressed using `compress`. It is the equivalent of `uncompress -c`. Input files are not affected.

`compress(1)`

**Options**

The following options are supported:

- `-b bits` Sets the upper limit (in bits) for common substring codes. `bits` must be between 9 and 16 (16 is the default). Lowering the number of bits result in larger, less compressed files.

- `-c` Writes to the standard output; no files are changed and no `.Z` files are created. The behavior of `zcat` is identical to that of `uncompress -c`.

- `-f` When compressing, forces compression of `file`, even if it does not actually reduce the size of the file, or if the corresponding `file`.Z file already exists.
If the `-f` option is not specified, and the process is not running in the background, prompts to verify whether an existing file should be overwritten. If the response is affirmative, the existing file is overwritten. When uncompressing, does not prompt for overwriting files. If the `-f` option is not specified, and the process is not running in the background, prompts to verify whether an existing file should be overwritten. If the standard input is not a terminal and `-f` is not specified, writes a diagnostic message to standard error and exits with a status greater than 0.

```-v```
Verbose. Writes to standard error messages concerning the percentage reduction or expansion of each file.

```-/```
When compressing or decompressing, copies any extended system attributes associated with the source file to the target file and copies any extended system attributes associated with extended attributes of the source file to the corresponding extended attributes associated with the target file. If any extended system attributes cannot be copied, the original file is retained, a diagnostic is written to stderr, and the final exit status is non-zero.

Operands
The following operand is supported:

``file``
A path name of a file to be compressed by `compress`, uncompressed by `uncompress`, or whose uncompressed form is written to standard out by `zcat`. If `file` is `−`, or if no `file` is specified, the standard input is used.

Usage
See `largefile(5)` for the description of the behavior of `compress`, `uncompress`, and `zcat` when encountering files greater than or equal to 2 Gbyte ($2^{31}$ bytes).

Environment Variables
See `environ(5)` for descriptions of the following environment variables that affect the execution of `compress`, `uncompress`, and `zcat`: `LANG`, `LC_ALL`, `LC_COLLATE`, `LC_CTYPE`, `LC_MESSAGES`, and `NLSPATH`.

Affirmative responses are processed using the extended regular expression defined for the `yesexpr` keyword in the `LC_MESSAGES` category of the user's locale. The locale specified in the `LC_COLLATE` category defines the behavior of ranges, equivalence classes, and multi-character collating elements used in the expression defined for `yesexpr`. The locale specified in `LC_CTYPE` determines the locale for interpretation of sequences of bytes of text data a characters, the behavior of character classes used in the expression defined for the `yesexpr`. See `locale(5)`.

Exit Status
The following error values are returned:

``0``
Successful completion.

``1``
An error occurred.

``2``
One or more files were not compressed because they would have increased in size (and the `-f` option was not specified).
An error occurred.

**Attributes**  See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See <code>standards(5)</code></td>
</tr>
</tbody>
</table>

**See Also**  `ln(1), pack(1), fgetattr(3C), fsetattr(3C), attributes(5), environ(5), largefile(5), locale(5), standards(5)`

**Diagnostics**  Usage: `compress [-fv] [-b bits] [file ...]`

`compress c [-fv] [-b bits] [file ...]`

Invalid options were specified on the command line.

Usage: `uncompress [-fv] [-c | -/] [file]...`

Invalid options were specified on the command line.

Missing maxbits

Maxbits must follow `-b`, or invalid maxbits, not a numeric value.

`file`: not in compressed format

The file specified to `uncompress` has not been compressed.

`file`: compressed with `x`xbits, can only handle `y`ybits

*file* was compressed by a program that could deal with more `bits` than the compress code on this machine. Recompress the file with smaller `bits`.

`file`: already has `.Z` suffix -- no change

The file is assumed to be already compressed. Rename the file and try again.

`file`: already exists; do you wish to overwrite (y or n)?

Respond *y* if you want the output file to be replaced; *n* if not.

`uncompress`: corrupt input

A SIGSEGV violation was detected, which usually means that the input file is corrupted.

**Compression:** xx.xx%

Percentage of the input saved by compression. (Relevant only for `-v`.)

– `-` not a regular file: unchanged
  When the input file is not a regular file, (such as a directory), it is left unaltered.

– `x` has `x` other links: unchanged
  The input file has links; it is left unchanged. See `ln(1)` for more information.
-- file unchanged
  No savings are achieved by compression. The input remains uncompressed.

-- filename too long to tack on .Z
  The path name is too long to append the .Z suffix.

-- cannot preserve extended attributes. file unchanged
  Extended system attributes could not be copied.

Notes  Although compressed files are compatible between machines with large memory, -b 12
        should be used for file transfer to architectures with a small process data space (64KB or less).

compress should be more flexible about the existence of the .Z suffix.
Name
cp – copy files

Synopsis
/usr/bin/cp [-fip/] source_file target_file

/usr/bin/cp [-fip/] source_file... target

/usr/bin/cp -r | -R [-H | -L | -P] [-fip/] source_dir... target

/usr/bin/cp -r | -R [-H | -L | -P] [-fip/] source_dir... target

/usr/xpg4/bin/cp [-fip/] source_file target_file

/usr/xpg4/bin/cp [-fip/] source_file... target

/usr/xpg4/bin/cp -r | -R [-H | -L | -P] [-fip/] source_dir... target

/usr/xpg4/bin/cp -r | -R [-H | -L | -P] [-fip/] source_dir... target

Description
In the first synopsis form, neither source_file nor target_file are directory files, nor can they have the same name. The cp utility copies the contents of source_file to the destination path named by target_file. If target_file exists, cp overwrites its contents, but the mode (and ACL if applicable), owner, and group associated with it are not changed. The last modification time of target_file and the last access time of source_file are set to the time the copy was made. If target_file does not exist, cp creates a new file named target_file that has the same mode as source_file except that the sticky bit is not set unless the user is super-user. In this case, the owner and group of target_file are those of the user, unless the setgid bit is set on the directory containing the newly created file. If the directory’s setgid bit is set, the newly created file has the group of the containing directory rather than of the creating user. If target_file is a link to another file, cp overwrites the link destination with the contents of source_file; the link(s) from target_file remains.

In the second synopsis form, one or more source_files are copied to the directory specified by target. It is an error if any source_file is a file of type directory, if target either does not exist or is not a directory.

In the third or fourth synopsis forms, one or more directories specified by source_dir are copied to the directory specified by target. Either the -r or -R must be specified. For each source_dir, cp copies all files and subdirectories.

Options
The following options are supported for both /usr/bin/cp and /usr/xpg4/bin/cp:

- f Unlink. If a file descriptor for a destination file cannot be obtained, this option attempts to unlink the destination file and proceed.

- H Takes actions based on the type and contents of the file referenced by any symbolic link specified as a source_file operand.

If the source_file operand is a symbolic link, then cp copies the file referenced by the symbolic link for the source_file operand. All other symbolic links encountered during traversal of a file hierarchy are preserved.
-i Interactive. cp prompts for confirmation whenever the copy would overwrite an existing target. This is done regardless of whether the input is coming from a terminal. If the prompt for confirmation fails, it is equivalent to the user answering in the negative. An affirmative response means that the copy should proceed. Any other answer prevents cp from overwriting target.

-L Takes actions based on the type and contents of the file referenced by any symbolic link specified as a source_file operand or any symbolic links encountered during traversal of a file hierarchy.

Copies files referenced by symbolic links. Symbolic links encountered during traversal of a file hierarchy are not preserved.

-p Preserve. The cp utility duplicates not only the contents of source_file, but also attempts to preserve its ACL, access and modification times, extended attributes, extended system attributes, file mode, and owner and group ids.

If cp is unable to preserve the access and modification times, extended attributes, or the file mode, cp does not consider it a failure. If cp is unable to preserve the owner and group id, the copy does not fail, but cp silently clears the S_ISUID and S_ISGID bits from the file mode of the target. The copy fails if cp is unable to clear these bits. If cp is unable to preserve the ACL or extended system attributes, the copy fails. If the copy fails, then a diagnostic message is written to stderr and (after processing any remaining operands) cp exits with a non-zero exit status.

-P Takes actions on any symbolic link specified as a source_file operand or any symbolic link encountered during traversal of a file hierarchy.

Copies symbolic links. Symbolic links encountered during traversal of a file hierarchy are preserved.

-r Recursive. cp copies the directory and all its files, including any subdirectories and their files to target. Unless the -H, -L, or -P option is specified, the -L option is used as the default mode.

-R Same as -r, except pipes are replicated, not read from.

-@ Preserves extended attributes. cp attempts to copy all of the source file's extended attributes along with the file data to the destination file.

-/ Preserves extended attributes and extended system attributes. Along with the file's data, the cp utility attempts to copy extended attributes and extended system attributes from each source file, and extended system attributes associated with extended attributes to the destination file. If cp is unable to copy extended attributes or extended system attributes, then a diagnostic message is written to stderr and (after processing any remaining operands) exits with a non-zero exit status.
Specifying more than one of the mutually-exclusive options -H, -L, and -P is not considered an error. The last option specified determines the behavior of the utility.

/usr/bin/cp If the -p option is specified with either the -@ option or the -/ option, /usr/bin/cp behaves as follows:

- When both -p and -@ are specified in any order, the copy fails if extended attributes cannot be copied.
- When both -p and -/ are specified in any order, the copy fails if extended system attributes cannot be copied.

/usr/xpg4/bin/cp If the -p option is specified with either the -@ option or the -/ option, /usr/xpg4/bin/cp behaves as follows:

- When both -p and -@ are specified, the last option specified determines whether the copy fails if extended attributes cannot be preserved.
- When both -p and -/ are specified, the last option specified determines whether the copy fails if extended system attributes cannot be preserved.

Operands The following operands are supported:

source_file A pathname of a regular file to be copied.

source_dir A pathname of a directory to be copied.

target_file A pathname of an existing or non-existing file, used for the output when a single file is copied.

target A pathname of a directory to contain the copied files.

Usage See largefile(5) for the description of the behavior of cp when encountering files greater than or equal to 2 Gbyte (2^31 bytes).

Examples

**EXAMPLE 1** Copying a File

The following example copies a file:

example% cp goodies goodies.old

eexample% ls goodies*
goodies goodies.old

**EXAMPLE 2** Copying a List of Files

The following example copies a list of files to a destination directory:

eexample% cp ~/src/* /tmp
EXAMPLE 3  Copying a Directory

The following example copies a directory, first to a new, and then to an existing destination directory

exampke% ls ~/bkup
/usr/example/fred/bkup not found

exampke% cp -r ~/src ~/bkup

exampke% ls -R ~/bkup
x.c y.c z.sh

exampke% cp -r ~/src ~/bkup

exampke% ls -R ~/bkup
src x.c y.c z.sh
src:
  x.c y.c z.s

EXAMPLE 4  Copying Extended File System Attributes

The following example copies extended file system attributes:

$ ls -/c file1
-rw-r--r-- 1 foo staff 0 Oct 29 20:04 file1
{AH------m--}

$ cp -/ file1 file2
$ ls -/c file2
-rw-r--r-- 1 foo staff 0 Oct 29 20:17 file2
{AH------m--}

EXAMPLE 5  Failing to Copy Extended System Attributes

The following example fails to copy extended system attributes:

$ ls -/c file1
-rw-r--r-- 1 foo staff 0 Oct 29 20:04 file1
{AH------m--}

$ cp -/ file1 /tmp
cp: Failed to copy extended system attributes from file1 to /tmp/file1

$ ls -/c /tmp/file1
-rw-r--r-- 1 foo staff 0 Oct 29 20:09 /tmp/file1
{}````
Environment Variables

See environ(5) for descriptions of the following environment variables that affect the execution of cp: LANG, LC_ALL, LC_COLLATE, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Affirmative responses are processed using the extended regular expression defined for the yesexpr keyword in the LC_MESSAGES category of the user's locale. The locale specified in the LC_COLLATE category defines the behavior of ranges, equivalence classes, and multi-character collating elements used in the expression defined for yesexpr. The locale specified in LC_CTYPE determines the locale for interpretation of sequences of bytes of text data a characters, the behavior of character classes used in the expression defined for the yesexpr. See locale(5).

Exit Status

The following exit values are returned:

- 0 All files were copied successfully.
- >0 An error occurred.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also

chmod(1), chown(1), setfacl(1), utime(2), fgetattr(3C), attributes(5), environ(5), fsattr(5), largefile(5), locale(5), standards(5)

Notes

The permission modes of the source file are preserved in the copy.

A - - permits the user to mark the end of any command line options explicitly, thus allowing cp to recognize filename arguments that begin with a -. 
The `cpio` command copies files into and out of a `cpio` archive. The `cpio` archive can span multiple volumes. The `-i`, `-o`, and `-p` options select the action to be performed. The following list describes each of the actions. These actions are mutually exclusive.

### Copy In Mode
`cpio -i` (copy in) extracts files from the standard input, which is assumed to be the product of a previous `cpio -o` command. Only files with names that match one of the `patterns` are selected. See `sh(1)` and OPERANDS for more information about `pattern`. Extracted files are conditionally copied into the current directory tree, based on the options described below. The permissions of the files are those of the previous `cpio -o` command. The owner and group are the same as those resulting from the previous `cpio -o` command. Notice that if `cpio -i` tries to create a file that already exists and the existing file is the same age or younger (newer), `cpio` outputs a warning message and does not replace the file. The `-u` option can be used to unconditionally overwrite the existing file.

### Copy Out Mode
`cpio -o` (copy out) reads a list of file path names from the standard input and copies those files to the standard output, together with path name and status information in the form of a `cpio` archive. Output is padded to an 8192-byte boundary by default or to the user-specified block size (with the `-B` or `-C` options) or to some device-dependent block size where necessary (as with the CTC tape).

### Pass Mode
`cpio -p` (pass) reads a list of file path names from the standard input and conditionally copies those files into the destination directory tree, based on the options described below.

If the underlying file system of the source file supports detection of holes as reported by `pathconf(2)`, the file is a sparse file, and the destination file is seekable, then holes in sparse files are preserved in pass mode, otherwise holes are filled with zeros.

`cpio` assumes four-byte words.

If, when writing to a character device (-o) or reading from a character device (-i), `cpio` reaches the end of a medium, and the `-0` and `-I` options are not used, `cpio` prints the following message:

To continue, type device/file name when ready.

To continue, you must replace the medium and type the character special device name and press RETURN.
Options

The following options are supported:

- **i**  
  (copy in) Reads an archive from the standard input and conditionally extracts the files contained in it and places them into the current directory tree.

- **o**  
  (copy out) Reads a list of file path names from the standard input and copies those files to the standard output in the form of a cpio archive.

- **p**  
  (pass) Reads a list of file path names from the standard input and conditionally copies those files into the destination directory tree.

The following options can be appended in any sequence to the `-i`, `-o`, or `-p` options:

- **0**  
  Reads a list of filenames terminated by a null character, instead of a NEWLINE, so that files whose names contain NEWLINESs can be archived. Using `find` with the `-print0` option is one way to produce such a list of filenames.

  This option may be used in copy-out and copy-pass modes.

- **a**  
  Resets access times of input files after they have been copied, making cpio's access invisible. Access times are not reset for linked files when `cpio -pla` is specified.

- **A**  
  Appends files to an archive. The `-A` option requires the `-0` option. Valid only with archives that are files or that are on hard disk partitions. The effect on files that are linked in the existing portion of the archive is unpredictable.

- **b**  
  Reverses the order of the bytes within each word. Use only with the `-i` option.

- **B**  
  Blocks input/output 5120 bytes to the record. The default buffer size is 8192 bytes when this and the `-C` options are not used. `-B` does not apply to the `-p` (pass) option.

- **c**  
  Reads or writes header information in ASCII character form for portability. There are no UID or GID restrictions associated with this header format. Use this option between SVR4-based machines, or the `-H odc` option between unknown machines. The `-c` option implies the use of expanded device numbers, which are only supported on SVR4-based systems. When transferring files between SunOS 4 or Interactive UNIX and the Solaris 2.6 Operating environment or compatible versions, use `-H odc`.

- **C bufsize**  
  Blocks input/output `bufsize` bytes to the record, where `bufsize` is replaced by a positive integer. The default buffer size is 8192 bytes when this and `-B` options are not used. `-C` does not apply to the `-p` (pass) option.

- **d**  
  Creates directories as needed.

- **E file**  
  Specifies an input file (file) that contains a list of filenames to be extracted from the archive (one filename per line).
-f  Copies in all files except those in patterns. See OPERANDS for a description of pattern.

- H header  Reads or writes header information in header format. Always use this option or the - c option when the origin and the destination machines are different types. This option is mutually exclusive with options - c and - 6.

Valid values for header are:

  bar  bar head and format. Used only with the - 1 option (read only).

  crc | CRC  ASCII header with expanded device numbers and an additional per-file checksum. There are no UID or GID restrictions associated with this header format.

  odc  ASCII header with small device numbers. This is the IEEE/P1003 Data Interchange Standard cpio header and format. It has the widest range of portability of any of the header formats. It is the official format for transferring files between POSIX-conforming systems (see standards(5)). Use this format to communicate with SunOS 4 and Interactive UNIX. This header format allows UIDs and GIDs up to 262143 to be stored in the header.

  tar | TAR  tar header and format. This is an older tar header format that allows UIDs and GIDs up to 2097151 to be stored in the header. It is provided for the reading of legacy archives only, that is, in conjunction with option - 1.

Specifying this archive format with option - o has the same effect as specifying the "ustar" format: the output archive is in ustar format, and must be read using - H ustar.

  ustar | USTAR  IEEE/P1003 Data Interchange Standard tar header and format. This header format allows UIDs and GIDs up to 2097151 to be stored in the header.

Files with UIDs and GIDs greater than the limit stated above are archived with the UID and GID of 60001. To transfer a large file (8 Gb — 1 byte), the header format can be tar | TAR, ustar | USTAR, or odc only.

- I file  Reads the contents of file as an input archive, instead of the standard input. If file is a character special device, and the current medium has been completely read, replace the medium and press RETURN to continue to the next medium. This option is used only with the - 1 option.
**-k**
Attempts to skip corrupted file headers and I/O errors that might be encountered. If you want to copy files from a medium that is corrupted or out of sequence, this option lets you read only those files with good headers. For cpio archives that contain other cpio archives, if an error is encountered, cpio can terminate prematurely. cpio finds the next good header, which can be one for a smaller archive, and terminate when the smaller archive’s trailer is encountered. Use only with the `-i` option.

**-l**
In pass mode, makes hard links between the source and destination whenever possible. If the `-L` option is also specified, the hard link is to the file referred to by the symbolic link. Otherwise, the hard link is to the symbolic link itself. Use only with the `-p` option.

**-L**
Follows symbolic links. If a symbolic link to a directory is encountered, archives the directory referred to by the link, using the name of the link. Otherwise, archives the file referred to by the link, using the name of the link.

**-m**
Retains previous file modification time. This option is ineffective on directories that are being copied.

**-M message**
Defines a message to use when switching media. When you use the `-O` or `-I` options and specify a character special device, you can use this option to define the message that is printed when you reach the end of the medium. One `%d` can be placed in `message` to print the sequence number of the next medium needed to continue.

**-O file**
Directs the output of cpio to `file`, instead of the standard output. If `file` is a character special device and the current medium is full, replace the medium and type a carriage return to continue to the next medium. Use only with the `-o` option.

**-P**
Preserves ACLs. If the option is used for output, existing ACLs are written along with other attributes, except for extended attributes, to the standard output. ACLs are created as special files with a special file type. If the option is used for input, existing ACLs are extracted along with other attributes from standard input. The option recognizes the special file type. Notice that errors occur if a cpio archive with ACLs is extracted by previous versions of cpio. This option should not be used with the `-c` option, as ACL support might not be present on all systems, and hence is not portable. Use ASCII headers for portability.

**-r**
Interactively renames files. If the user types a carriage return alone, the file is skipped. If the user types a “.”, the original pathname is retained. Not available with `cpio -p`.

**-R id**
Reassigns ownership and group information for each file to user ID. (ID must be a valid login ID from the `passwd` database.) This option is valid only when id is the invoking user or the super-user. See NOTES.
-s     Swaps bytes within each half word.
-sS    Swaps halfwords within each word.
-t     Prints a table of contents of the input. If any file in the table of contents has extended attributes, these are also listed. No files are created. -t and -V are mutually exclusive.
-u     Copies unconditionally. Normally, an older file is not replaced a newer file with the same name, although an older directory updates a newer directory.
-v     Verbose. Prints a list of file and extended attribute names. When used with the -t option, the table of contents looks like the output of an `ls -l` command (see `ls(1)`).
-V     Special verbose. Prints a dot for each file read or written. Useful to assure the user that cpio is working without printing out all file names.
-6     Processes a UNIX System Sixth Edition archive format file. Use only with the -i option. This option is mutually exclusive with -c and -H.
-@     Includes extended attributes in archive. By default, cpio does not place extended attributes in the archive. With this flag, cpio looks for extended attributes on the files to be placed in the archive and add them, as regular files, to the archive. The extended attribute files go in the archive as special files with special file types. When the -@ flag is used with -i or -p, it instructs cpio to restore extended attribute data along with the normal file data. Extended attribute files can only be extracted from an archive as part of a normal file extract. Attempts to explicitly extract attribute records are ignored.
-/     Includes extended system attributes in archive. By default, cpio does not place extended system attributes in the archive. With this flag, cpio looks for extended system attributes on the files to be placed in the archive and add them, as regular files, to the archive. The extended attribute files go in the archive as special files with special file types. When the -/ flag is used with -i or -p, it instructs cpio to restore extended system attribute data along with the normal file data. Extended system attribute files can only be extracted from an archive as part of a normal file extract. Attempts to explicitly extract attribute records are ignored.

**Operands** The following operands are supported:

directory A path name of an existing directory to be used as the target of cpio -p.

pattern Expressions making use of a pattern-matching notation similar to that used by the shell (see `sh(1)`) for filename pattern matching, and similar to regular expressions. The following metacharacters are defined:

* Matches any string, including the empty string.
Matches any single character.

\[ \ldots \] Matches any one of the enclosed characters. A pair of characters separated by ‘−’ matches any symbol between the pair (inclusive), as defined by the system default collating sequence. If the first character following the opening ‘[’ is a ‘!’ , the results are unspecified.

The ! (exclamation point) means not. For example, the !abc* pattern would exclude all files that begin with abc.

In pattern, metacharacters ?, *, and [ . . . ] match the slash (/) character, and backslash (\) is an escape character. Multiple cases of pattern can be specified and if no pattern is specified, the default for pattern is * (that is, select all files).

Each pattern must be enclosed in double quotes. Otherwise, the name of a file in the current directory might be used.

**Usage** See largefile(5) for the description of the behavior of cpio when encountering files greater than or equal to 2 Gbyte ( $2^{31}$ bytes).

**Examples** The following examples show three uses of cpio.

**EXAMPLE 1** Using standard input

```bash
eexample% ls | cpio -oc > ../newfile
```

When standard input is directed through a pipe to cpio -o, as in the example above, it groups the files so they can be directed (>) to a single file (../newfile). The -c option insures that the file is portable to other machines (as would the -H option). Instead of ls(1), you could use find(1), echo(1), cat(1), and so on, to pipe a list of names to cpio. You could direct the output to a device instead of a file.

**EXAMPLE 2** Extracting files into directories

```bash
eexample% cat newfile | cpio -icd "memo/a1" "memo/b*"
```

In this example, cpio -i uses the output file of cpio -o (directed through a pipe with cat), extracts those files that match the patterns (memo/a1, memo/b*), creates directories below the current directory as needed (-d option), and places the files in the appropriate directories. The -c option is used if the input file was created with a portable header. If no patterns were given, all files from newfile would be placed in the directory.

**EXAMPLE 3** Copying or linking files to another directory

```bash
eexample% find . -depth -print | cpio -pdlmv newdir
```

In this example, cpio -p takes the file names piped to it and copies or links (-l option) those files to another directory, newdir. The -d option says to create directories as needed. The -m option says to retain the modification time. (It is important to use the -depth option of
EXAMPLE 3  Copying or linking files to another directory  (Continued)

find(1) to generate path names for cpio. This eliminates problems that cpio could have trying to create files under read-only directories.) The destination directory, newdir, must exist.

Notice that when you use cpio in conjunction with find, if you use the -L option with cpio, you must use the -follow option with find and vice versa. Otherwise, there are undesirable results.

For multi-reel archives, dismount the old volume, mount the new one, and continue to the next tape by typing the name of the next device (probably the same as the first reel). To stop, type a RETURN and cpio ends.

Environment Variables  See environ(5) for descriptions of the following environment variables that affect the execution of cpio: LC_COLLATE, LC_CTYPE, LC_MESSAGES, LC_TIME, TZ, and NLSPATH.

TMPDIR  cpio creates its temporary file in /var/tmp by default. Otherwise, it uses the directory specified by TMPDIR.

Exit Status  The following exit values are returned:

0  Successful completion.

>0  An error occurred.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  ar(1), cat(1), echo(1), find(1), ls(1), pax(1), setfacl(1), sh(1), tar(1), chown(2), archives.h(3HEAD), attributes(5), environ(5), fsattr(5), largefile(5), standards(5)

Notes  The maximum path name length allowed in a cpio archive is determined by the header type involved. The following table shows the proper value for each supported archive header type.

<table>
<thead>
<tr>
<th>Header type</th>
<th>Command line options</th>
<th>Maximum path name length</th>
</tr>
</thead>
<tbody>
<tr>
<td>BINARY</td>
<td>“-o”</td>
<td>256</td>
</tr>
<tr>
<td>POSIX</td>
<td>“-oH odc”</td>
<td>256</td>
</tr>
</tbody>
</table>
When the command line options "-o -H tar" are specified, the archive created is of type USTAR. This means that it is an error to read this same archive using the command line options "-i -H tar". The archive should be read using the command line options "-i -H ustar". The options "-i -H tar" refer to an older tar archive format.

An error message is output for files whose UID or GID are too large to fit in the selected header format. Use -H crc or -c to create archives that allow all UID or GID values.

Only the super-user can copy special files.

Blocks are reported in 512-byte quantities.

If a file has 000 permissions, contains more than 0 characters of data, and the user is not root, the file is not saved or restored.

When cpio is invoked in Copy In or Pass Mode by a user with {PRIV_FILE_CHOWN_SELF} privilege, and in particular on a system where {_POSIX_CHOWN_RESTRICTED} is not in effect (effectively granting this privilege to all users where not overridden), extracted or copied files can end up with owners and groups determined by those of the original archived files, which can differ from the invoking user’s. This might not be what the user intended. The -R option can be used to retain file ownership, if desired, if you specify the user’s id.

The inode number stored in the header (/usr/include/archives.h) is an unsigned short, which is 2 bytes. This limits the range of inode numbers from 0 to 65535. Files which are hard linked must fall in this inode range. This could be a problem when moving cpio archives between different vendors’ machines.

You must use the same blocking factor when you retrieve or copy files from the tape to the hard disk as you did when you copied files from the hard disk to the tape. Therefore, you must specify the -B or -C option.

During -p and -o processing, cpio buffers the file list presented on stdin in a temporary file.

The new pax(1) format, with a command that supports it (for example, tar), should be used for large files. The cpio command is no longer part of the current POSIX standard and is deprecated in favor of pax.
cpp(1)

**Name**
cpp – the C language preprocessor

**Synopsis**
```
        [-Idirectory] [-Uname] [-Ydirectory]
[input-file  [output-file]]
```

**Description**
cpp is the C language preprocessor. cpp also used as a first-pass preprocessor for other Sun compilers.

Although cpp can be used as a macro processor, this is not normally recommended, as its output is geared toward that which would be acceptable as input to a compiler’s second pass. Thus, the preferred way to invoke cpp is through a compilation command. For general-purpose macro-processing, see m4(1).

cpp optionally accepts two filenames as arguments. *input-file* and *output-file* are, respectively, the input and output files for the preprocessor. They default to the standard input and the standard output.

**Options**
The following options are supported:

- **-B**
  Supports the C++ comment indicator / /. With this indicator, everything on the line after the / / is treated as a comment.

- **-C**
  Passes all comments (except those that appear on cpp directive lines) through the preprocessor. By default, cpp strips out C-style comments.

- **-H**
  Prints the pathnames of included files, one per line on the standard error.

- **-M**
  Generates a list of makefile dependencies and write them to the standard output. This list indicates that the object file which would be generated from the input file depends on the input file as well as the include files referenced.

- **-p**
  Uses only the first eight characters to distinguish preprocessor symbols, and issue a warning if extra tokens appear at the end of a line containing a directive.

- **-P**
  Preprocesses the input without producing the line control information used by the next pass of the C compiler.

- **-R**
  Allows recursive macros.

- **-T**
  Uses only the first eight characters for distinguishing different preprocessor names. This option is included for backward compatibility with systems which always use only the first eight characters.

- **-undef**
  Removes initial definitions for all predefined symbols.

- **-Dname**
  Defines *name* as 1 (one). This is the same as if a \-Dname=1 option appeared on the cpp command line, or as if a
  
  ```
  #define name 1
  ```
line appeared in the source file that cpp is processing.

-Dname=def
Defines name as if by a #define directive. This is the same as a
#define name def

line appeared in the source file that cpp is processing. The -D option has lower
precedence than the -U option. That is, if the same name is used in both a -U
option and a -D option, the name will be undefined regardless of the order of
the options.

-Idirectory
Inserts directory into the search path for #include files with names not
beginning with /.
directory is inserted ahead of the standard list of include
directories. Thus, #include files with names enclosed in double-quotes (")
are searched for first in the directory of the file with the #include line, then in
directories named with -I options, and lastly, in directories from the standard
list. For #include files with names enclosed in angle-brackets (< >), the
directory of the file with the #include line is not searched. See Details below
for exact details of this search order.

-Uname
Removes any initial definition of name, where name is a symbol that is
predefined by a particular preprocessor. Here is a partial list of symbols that
may be predefined, depending upon the architecture of the system:
Operating System: ibm, gcos, os, tss and unix
Hardware: interdata, u3b20d, ns32000, i386, sparc, and sun
UNIX system variant: RES, and RT
The lint command: lint

The symbols sun, sparc and unix are defined for all Sun systems.

-Ydirectory
Uses directory in place of the standard list of directories when searching for
#include files.

Usage

Directives
All cpp directives start with a hash symbol (#) as the first character on a line. White space
(SPACE or TAB characters) can appear after the initial # for proper indentation.

#define name token-string
Replace subsequent instances of name with token-string.

#define name( argument [ , argument] . . . ) token-string
There can be no space between name and the ‘(’. Replace subsequent instances of name,
followed by a parenthesized list of arguments, with token-string, where each occurrence of
an argument in the token-string is replaced by the corresponding token in the
comma-separated list. When a macro with arguments is expanded, the arguments are
placed into the expanded token-string unchanged. After the entire token-string has been expanded, cpp re-starts its scan for names to expand at the beginning of the newly created token-string.

`#undef name`
Remove any definition for the symbol name. No additional tokens are permitted on the directive line after name.

`#include "filename"`
`#include <filename>`
Read in the contents of filename at this location. This data is processed by cpp as if it were part of the current file. When the <filename> notation is used, filename is only searched for in the standard include directories. See the -I and -Y options above for more detail. No additional tokens are permitted on the directive line after the final " or >.

`#line integer-constant" filename"
Generate line control information for the next pass of the C compiler. integer-constant is interpreted as the line number of the next line and filename is interpreted as the file from where it comes. If "filename" is not given, the current filename is unchanged. No additional tokens are permitted on the directive line after the optional filename.

`#if constant-expression`
Subsequent lines up to the matching #else, #elif, or #endif directive, appear in the output only if constant-expression yields a nonzero value. All binary non-assignment C operators, including &&, | |, and ,, are legal in constant-expression. The ?: operator, and the unary −, †, and ~ operators, are also legal in constant-expression.

The precedence of these operators is the same as that for C. In addition, the unary operator defined, can be used in constant-expression in these two forms: 'defined ( name ) ' or 'defined name'. This allows the effect of #ifdef and #ifndef directives (described below) in the #if directive. Only these operators, integer constants, and names that are known by cpp should be used within constant-expression. In particular, the size of operator is not available.

`#ifdef name`
Subsequent lines up to the matching #else, #elif, or #endif appear in the output only if name has been defined, either with a define directive or a -D option, and in the absence of an intervening #undef directive. Additional tokens after name on the directive line will be silently ignored.

`#ifndef name`
Subsequent lines up to the matching #else, #elif, or #endif appear in the output only if name has not been defined, or if its definition has been removed with an #undef directive. No additional tokens are permitted on the directive line after name.
#elif constant-expression
Any number of #elif directives may appear between an #if, #ifdef, or #ifndef directive and a matching #else or #endif directive. The lines following the #elif directive appear in the output only if all of the following conditions hold:

- The constant-expression in the preceding #if directive evaluated to zero, the name in the preceding #ifdef is not defined, or the name in the preceding #ifndef directive was defined.
- The constant-expression in all intervening #elif directives evaluated to zero.
- The current constant-expression evaluates to non-zero.

If the constant-expression evaluates to non-zero, subsequent #elif and #else directives are ignored up to the matching #endif. Any constant-expression allowed in an #if directive is allowed in an #elif directive.

#else
This inverts the sense of the conditional directive otherwise in effect. If the preceding conditional would indicate that lines are to be included, then lines between the #else and the matching #endif are ignored. If the preceding conditional indicates that lines would be ignored, subsequent lines are included in the output. Conditional directives and corresponding #else directives can be nested.

#Endif
End a section of lines begun by one of the conditional directives #if, #ifdef, or #ifndef. Each such directive must have a matching #endif.

**Macros**

Formal parameters for macros are recognized in #define directive bodies, even when they occur inside character constants and quoted strings. For instance, the output from:

```c
#define abc(a)|'|a|
abc(xyz)
```

is:

```c
#1 ""
'|'|xyz |
```

The second line is a NEWLINE. The last seven characters are '|'|xyz | (vertical-bar, back quote, vertical-bar, x, y, z, vertical-bar). Macro names are not recognized within character constants or quoted strings during the regular scan. Thus:

```c
#define abc xyz
printf("abc");
```

does not expand abc in the second line, since it is inside a quoted string that is not part of a #define macro definition.

Macros are not expanded while processing a #define or #undef. Thus:
#define abc zingo
#define xyz abc
#undef abc
xyz

produces abc. The token appearing immediately after an #ifdef or #ifndef is not expanded.

Macros are not expanded during the scan which determines the actual parameters to another macro call.

#define reverse(first,second)second first
#define greeting hello
reverse(greeting,
#define greeting goodbye
)

produces
#define hello goodbye hello

Output consists of a copy of the input file, with modifications, plus lines of the form:
#define " filename" "level"
indicating the original source line number and filename of the following output line and whether this is the first such line after an include file has been entered (level=1), the first such line after an include file has been exited (level=2), or any other such line (level is empty).

Details This section contains usage details.

Directory Search #include files are searched for in the following order:
1. The directory of the file that contains the #include request (that is, #include is relative to the file being scanned when the request is made).
2. The directories specified by -I options, in left-to-right order.
3. The standard directory(s) (/usr/include on UNIX systems).

Special Names Two special names are understood by cpp. The name __LINE__ is defined as the current line number (a decimal integer) as known by cpp, and __FILE__ is defined as the current filename (a C string) as known by cpp. They can be used anywhere (including in macros) just as any other defined name.

Newline Characters A NEWLINE character terminates a character constant or quoted string. An escaped NEWLINE (that is, a backslash immediately followed by a NEWLINE) may be used in the body of a #define statement to continue the definition onto the next line. The escaped NEWLINE is not included in the macro value.
Comments: Comments are removed (unless the `-C` option is used on the command line). Comments are also ignored, except that a comment terminates a token.

Exit Status: The following exit values are returned:

- `0` Successful completion.
- non-zero An error occurred.

Attributes: See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/build/make</td>
</tr>
</tbody>
</table>

See Also: m4(1), attributes(5)

Diagnostics: The error messages produced by cpp are intended to be self-explanatory. The line number and filename where the error occurred are printed along with the diagnostic.

Notes: When NEWLINE characters were found in argument lists for macros to be expanded, some previous versions of cpp put out the NEWLINE characters as they were found and expanded. The current version of cpp replaces them with SPACE characters.

Because the standard directory for included files may be different in different environments, this form of `#include` directive:

```cpp
#include <file.h>
```

should be used, rather than one with an absolute path, like:

```cpp
#include "usr/include/file.h"
```

cpp warns about the use of the absolute pathname.

While the compiler allows 8-bit strings and comments, 8-bits are not allowed anywhere else.
### Name
Cputrack – monitor process and LWP behavior using CPU performance counters

### Synopsis
```
cputrack -c eventspec [-c eventspec]... [-efntvD]
    [-N count] [-o pathname] [-T interval] command [args]
```
```
cputrack -c eventspec [-c eventspec]... -p pid [-efntvD]
    [-N count] [-o pathname] [-T interval]
```
```
cputrack -h
```

### Description
The `cputrack` utility allows CPU performance counters to be used to monitor the behavior of a process or family of processes running on the system. If `interval` is specified with the `-T` option, `cputrack` samples activity every `interval` seconds, repeating forever. If a `count` is specified with the `-N` option, the statistics are repeated `count` times for each process tracked. If neither are specified, an interval of one second is used. If `command` and optional `args` are specified, `cputrack` runs the command with the arguments given while monitoring the specified CPU performance events. Alternatively, the process ID of an existing process can be specified using the `-p` option.

Because `cputrack` is an unprivileged program, it is subject to the same restrictions that apply to `truss(1)`. For example, `setuid(2)` executables cannot be tracked.

### Options
The following options are supported:

- `-c eventspec`
  Specifies a set of events for the CPU performance counters to monitor. The syntax of these event specifications is:
  ```
  [picn=]eventn[,attr[n]=val][,][picn=]eventn
      [,attr[n]=val][,],...
  ```
  You can use the `-h` option to obtain a list of available events and attributes. This causes generation of the usage message. You can omit an explicit counter assignment, in which case `cpustat` attempts to choose a capable counter automatically.

  Attribute values can be expressed in hexadecimal, octal, or decimal notation, in a format suitable for `strtoll(3C)`. An attribute present in the event specification without an explicit value receives a default value of 1. An attribute without a corresponding counter number is applied to all counters in the specification.

  The semantics of these event specifications can be determined by reading the CPU manufacturer’s documentation for the events.

  Multiple `-c` options can be specified, in which case `cputrack` cycles between the different event settings on each sample.

- `-D`
  Enables debug mode.

- `-e`
  Follows all `exec(2)`, or `execve(2)` system calls.
-f
Follows all children created by fork(2), fork1(2), or vfork(2) system calls.

-h
Prints an extended help message on how to use the utility, how to program the
processor-dependent counters, and where to look for more detailed information.

-n
Omits all header output (useful if cputrack is the beginning of a pipeline).

-N count
Specifies the maximum number of CPU performance counter samples to take before
exiting.

-o outfile
Specifies file to be used for the cputrack output.

-p pid
Interprets the argument as the process ID of an existing process to which process counter
context should be attached and monitored.

-t
Prints an additional column of processor cycle counts, if available on the current
architecture.

-T interval
Specifies the interval between CPU performance counter samples in seconds. Very small
intervals may cause some samples to be skipped. See WARNINGS.

-v
Enables more verbose output.

Usage
The operating system enforces certain restrictions on the tracing of processes. In particular, a
command whose object file cannot be read by a user cannot be tracked by that user; setuid and
setgid commands can only be tracked by a privileged user. Unless it is run by a privileged user,
cputrack loses control of any process that performs an exec() of a set-id or unreadable object
file. Such processes continue normally, though independently of cputrack, from the point of
the exec() .

The system may run out of per-user process slots when the -f option is used, since cputrack
runs one controlling process for each process being tracked.

The times printed by cputrack correspond to the wallclock time when the hardware counters
were actually sample. The time is derived from the same timebase as gethrtime(3C).

The cputrack utility attaches performance counter context to each process that it examines.
The presence of this context allows the performance counters to be multiplexed between
different processes on the system, but it cannot be used at the same time as the cpustat(1M)
utility.
Once an instance of the cpustat utility is running, further attempts to run cputrack will fail until all instances of cpustat terminate.

Sometimes cputrack provides sufficient flexibility and prints sufficient statistics to make adding the observation code to an application unnecessary. However, more control is occasionally desired. Because the same performance counter context is used by both the application itself and by the agent LWP injected into the application by cputrack, it is possible for an application to interact with the counter context to achieve some interesting capabilities. See cpc_enable(3CPC).

The processor cycle counts enabled by the -t option always apply to both user and system modes, regardless of the settings applied to the performance counter registers.

The output of cputrack is designed to be readily parseable by awk(1) and perl(1), thereby allowing performance tools to be composed by embedding cputrack in scripts. Alternatively, tools may be constructed directly using the same APIs that cputrack is built upon, using the facilities of libcpc(3LIB) and libpctx(3LIB). See cpc(3CPC).

Although cputrack uses performance counter context to maintain separate performance counter values for each LWP, some of the events that can be counted will inevitably be impacted by other activities occurring on the system, particularly for limited resources that are shared between processes (for example, cache miss rates). For such events, it may also be interesting to observe overall system behavior with cpustat(1M).

For the -T interval option, if interval is specified as zero, no periodic sampling is performed. The performance counters are only sampled when the process creates or destroys an LWP, or it invokes fork(2), exec(2), or exit(2).

**Examples**

**SPARC**

**EXAMPLE 1** Using Performance Counters to Count Clock Cycles

In this example, the utility is being used on a machine containing an UltraSPARC-III+ processor. The counters are set to count processor clock cycles and instructions dispatched in user mode while running the sleep(1) command.

```
example% cputrack -c pic0=Cycle_cnt,pic1=Instr_cnt sleep 10

<table>
<thead>
<tr>
<th>time</th>
<th>event</th>
<th>pic0</th>
<th>pic1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.007</td>
<td>tick</td>
<td>765308</td>
<td>219233</td>
</tr>
<tr>
<td>2.007</td>
<td>tick</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.017</td>
<td>tick</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6.007</td>
<td>tick</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8.007</td>
<td>tick</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10.007</td>
<td>tick</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10.017</td>
<td>exit</td>
<td>844703</td>
<td>228058</td>
</tr>
</tbody>
</table>
```

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EXAMPLE 2  Counting External Cache References and Misses
This example shows more verbose output while following the fork() and exec() of a simple
shell script on an UltraSPARC machine. The counters are measuring the number of external
cache references and external cache misses. Notice that the explicit pic0 and pic1 names can
be omitted where there are no ambiguities.

```cputrack –fev –c EC_ref,EC_hit /bin/ulimit –c
```

<table>
<thead>
<tr>
<th>time</th>
<th>pid</th>
<th>lwp</th>
<th>event</th>
<th>pic0</th>
<th>pic1</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.007</td>
<td>101142</td>
<td>1</td>
<td>init_lwp</td>
<td>805286</td>
<td>20023</td>
</tr>
<tr>
<td>0.023</td>
<td>101142</td>
<td>1</td>
<td>fork</td>
<td></td>
<td># 101143</td>
</tr>
<tr>
<td>0.026</td>
<td>101143</td>
<td>1</td>
<td>init_lwp</td>
<td>1015382</td>
<td>24461</td>
</tr>
<tr>
<td>0.029</td>
<td>101143</td>
<td>1</td>
<td>fini_lwp</td>
<td>1025546</td>
<td>25074</td>
</tr>
<tr>
<td>0.029</td>
<td>101143</td>
<td>1</td>
<td>exec</td>
<td>1025546</td>
<td>25074</td>
</tr>
<tr>
<td>0.000</td>
<td>101143</td>
<td>1</td>
<td>exec</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>\</td>
<td></td>
<td># '/usr/bin/sh /usr/bin/basename\</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>/bin/ulimit'</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.039</td>
<td>101143</td>
<td>1</td>
<td>init_lwp</td>
<td>1025546</td>
<td>25074</td>
</tr>
<tr>
<td>0.050</td>
<td>101143</td>
<td>1</td>
<td>fini_lwp</td>
<td>1140482</td>
<td>27806</td>
</tr>
<tr>
<td>0.050</td>
<td>101143</td>
<td>1</td>
<td>exec</td>
<td>1140482</td>
<td>27806</td>
</tr>
<tr>
<td>0.000</td>
<td>101143</td>
<td>1</td>
<td>exec</td>
<td></td>
<td># '/usr/bin/expr \</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>/bin/ulimit : (.<em>/)/**$ : .</em>(.<em>) : (.</em>)$</td>
<td>//bin/ulimit'</td>
<td></td>
</tr>
<tr>
<td>0.059</td>
<td>101143</td>
<td>1</td>
<td>init_lwp</td>
<td>1140482</td>
<td>27806</td>
</tr>
<tr>
<td>0.075</td>
<td>101143</td>
<td>1</td>
<td>fini_lwp</td>
<td>1237647</td>
<td>30207</td>
</tr>
<tr>
<td>0.075</td>
<td>101143</td>
<td>1</td>
<td>exit</td>
<td>1237647</td>
<td>30207</td>
</tr>
<tr>
<td>unlimited</td>
<td></td>
<td></td>
<td></td>
<td>953383</td>
<td>23814</td>
</tr>
<tr>
<td>0.081</td>
<td>101142</td>
<td>1</td>
<td>fini_lwp</td>
<td>953383</td>
<td>23814</td>
</tr>
<tr>
<td>0.081</td>
<td>101142</td>
<td>1</td>
<td>exit</td>
<td>953383</td>
<td>23814</td>
</tr>
</tbody>
</table>

x86  EXAMPLE 3  Counting Instructions
This example shows how many instructions were executed in the application and in the kernel
to print the date on a Pentium III machine:

```cputrack –c inst_retired,inst_retired,nouser1,sys1 date
```

<table>
<thead>
<tr>
<th>time</th>
<th>lwp</th>
<th>event</th>
<th>pic0</th>
<th>pic1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fri Aug 20 20:03:08 PDT 1999</td>
<td>0.072</td>
<td>1</td>
<td>exit</td>
<td>246725</td>
</tr>
</tbody>
</table>

EXAMPLE 4  Counting TLB Hits
This example shows how to use processor-specific attributes to count TLB hits on a Pentium 4
machine:

```cputrack -c ITLB_reference,emask=1 date
```

<table>
<thead>
<tr>
<th>time</th>
<th>lwp</th>
<th>event</th>
<th>pic0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fri Aug 20 20:03:08 PDT 1999</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
EXAMPLE 4  Counting TLB Hits  (Continued)

0.072  1  exit  246725

Warnings  By running any instance of the cpustat(1M) utility, all existing performance counter context is forcibly invalidated across the machine. This may in turn cause all invocations of the cputrack command to exit prematurely with unspecified errors.

If cpustat is invoked on a system that has CPU performance counters which are not supported by Solaris, the following message appears:

cputrack: cannot access performance counters - Operation not applicable

This error message implies that cpc_open() has failed and is documented in cpc_open(3CPC). Review this documentation for more information about the problem and possible solutions.

If a short interval is requested, cputrack may not be able to keep up with the desired sample rate. In this case, some samples may be dropped.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>diagnostic/cpu-counters</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  nawk(1), perl(1), proc(1), truss(1), prstat(1M), cpustat(1M), exec(2), exit(2), fork(2), setuid(2), vfork(2), gethrtime(3C), strtoll(3C), cpc(3CPC), cpc_bind_pctx(3CPC), cpc_enable(3CPC), cpc_open(3CPC), libcpc(3LIB), libpctx(3LIB), proc(4), attributes(5)
The `crle` utility provides for the creation and display of a runtime linking configuration file. The configuration file is read and interpreted by the runtime linker, `ld.so.1`, during process startup. The runtime linker attempts to read a default configuration file, `ld.so.1`, for all processes. For 32-bit processes, the default configuration file is `/var/ld/ld.config`. For 64-bit processes, the default configuration file is `/var/ld/64/ld.config`. Without any arguments, or with just the `-c` option, `crle` displays configuration information. This information includes the contents of a configuration file, any system defaults and the command-line required to regenerate the configuration file. When used with any other options, a new configuration file is created or updated.

The runtime linker can also be directed to an alternative configuration file by setting one of the `LD_CONFIG` family of environment variables. `LD_CONFIG` applies to both 32-bit and 64-bit programs. Since 32-bit and 64-bit configuration files differ, a single configuration file cannot be used for both class of object. Hence, `LD_CONFIG` can adversely affect program execution in cases where a program of one class executes a program of the other class. In particular, it is common practice for the 32-bit version of standard Solaris utilities to execute their 64-bit counterpart. `LD_CONFIG` cannot be successfully used in this case. Therefore, the use of the `LD_CONFIG_32` and `LD_CONFIG_64` environment variables, that precisely target the appropriate class of process, is recommended.

Creating an incorrect configuration file in the standard location, `/var/ld`, can prevent programs from running, and can therefore be difficult to recover from. To guard against this situation, it is recommended that new configuration files first be created in a temporary location. Then set the appropriate `LD_CONFIG` environment variable to this new configuration file. This setting causes the new configuration file to be used by the runtime linker instead of any default. After verification, the new configuration file can be moved to the default location if desired. At any time, the environment variable `LD_NOCONFIG` can be set to any value to instruct the runtime linker to ignore any configuration files. This setting can prove useful during experimentation.

A configuration file can contain the following information.

**Default Search Paths**

The runtime linker uses a prescribed search path for locating the dynamic dependencies of an object. This search path starts with the components of any `LD_LIBRARY_PATH` definition, followed by the components of an object's `runpath`. Finally, any default search paths specific to the object's class are used. This last component of the search path can be expressed within the configuration file. Typically, use of this facility should be augmented with any system default. See the `-l` and `-u` options.
Trusted Directories
When processing a secure application, the runtime linker restricts the use of
LD_LIBRARY_PATH searches, and $ORIGIN token expansion. See “Security” in Linker and
Libraries Guide. In addition, the directories from which preload and audit libraries can be
located are also restricted. The path names that are associated with preload and audit
libraries are restricted to known trusted directories. Trusted directories can be expressed
within the configuration file. Typically, use of this facility should be augmented with any
system defaults. See the -s and -u options.

Environment Variables
Any environment variable interpreted by the runtime linker can be specified within the
configuration file.

Directory Cache
The location of shared objects within defined directories can be maintained as a cache
within the configuration file. This directory cache can reduce the overhead of searching for
application dependencies.

Alternative Objects
In conjunction with the directory cache, shared objects can have alternative objects
specified for use at runtime. These alternate objects, can be supplied by the user.
Alternative objects can also be created by crle as copies of shared objects fixed to known
memory locations. These fixed alternative objects can require less processing at runtime
than their original shared object counterpart.

Defining additional default search paths, or additional trusted directories can be useful for
administrators who wish to install third party software in a central location, or otherwise alter
the search path of applications that might not have been coded with a suitable runpath.

The declaration of alternative objects provides a means of replacing dependencies other than
by using symbolic links or requiring LD_LIBRARY_PATH settings.

The declaration of environment variables that are interpreted by the runtime linker provides a
means of centralizing their definition for all applications.

The directory cache, and crle generated alternate objects, can provide a means of reducing
the runtime startup overhead of applications. Alternative objects can be useful for
applications that require many dependencies, or whose dependencies are expensive to
relocate. Shared objects that contain position-dependent code are often expensive to relocate.
Note, the system has many caching facilities that help mitigate expenses such as negative path
lookups, and thus employing crle to create a directory cache may have minimal effect other
than for some very specific cases.

When alternate objects that are generated by crle are specified within a configuration file, the
runtime linker performs some minimal consistency verification. The alternative objects are
verified against their originating objects. This verification is intended to avert application
failure should an applications configuration information become out-of-sync with the
underlying system components. When this situation arises the flexibility offered by dynamic linking system components can be compromised. This type of application failure can be very difficult to diagnose. No verification of directory cache information is performed. Any changes to the directory structure are not seen by a process until the cache is rebuilt.

System shared objects are often well tuned, and can show little benefit from being cached. The directory cache and alternative object features are typically applicable to user applications and shared objects, and may only show improvement in some very specific cases.

crle creates alternate objects for the shared objects that are discovered when using the -I and -G options, using dldump(3C). The alternate object is created in the directory specified by the preceding -o option, or defaults to the directory in which the configuration file is created. The flags used by dldump() are specified using the -f option, or default to RTLD_REL_RELATIVE.

Options

The following options are supported.

-64
Specify to process 64–bit objects, the default is 32–bit. Use -64 to create a 64–bit specific configuration file.

-a name
Create an alternative path name for name. The alternative path name is added to the configuration file.

The actual alternative file must be supplied by the user. Multiple occurrences of this option are permitted. If name is a directory, each shared object within the directory is added to the cache. If name does not exist, then name is marked in the cache as a nonexistent file.

Typically, this option is used with the -o option.

-A name
Create an optional alternative path name for name. This alternative path name is added to the configuration file.

This option mimics the -a option, except that if the alternative is unavailable at runtime, the original object name is used. This model mimics the use of auxiliary filters. See “Generating Auxiliary Filters” in Linker and Libraries Guide.

Typically, this option is used with the -o option.

-c conf
Specify to use the configuration filename conf. If this option is not supplied, the default configuration file is used.

-e env
Specify a replaceable environment variable, env. Only environment variables that are applicable to the runtime linker are meaningful. Multiple occurrences of this option are permitted. This option is similar to the -E option. However, the options differs in how configuration file definitions, and process environment definitions of the same name are resolved at runtime.
A definition established in a configuration file can be overridden by a process environment definition, or be suppressed by a null-value process environment definition.

In other words, these configuration file definitions can be replaced, or removed by the process environment at runtime.

-E env
Specify a permanent environment variable, env. Only environment variables that are applicable to the runtime linker are meaningful. Multiple occurrences of this option are permitted. This option is similar to the -e option. However, the option differs in how configuration file definitions, and process environment definitions of the same name are resolved at runtime.

Environment variable definitions that are meaningful to the runtime linker fall into one of two categories. Singular definitions are definitions such as LD_NOLAZYLOAD=1 and LD_DEBUG_OUTPUT=file. List definitions, which can take one or more values, are definitions such as LD_LIBRARY_PATH=path, and LD_DEBUG=files, details.

A singular definition that is established in a configuration file takes precedence over a process environment definition. A list definition that is established in a configuration file is appended to a process environment definition. Any definition that is established in a configuration file can not be suppressed by a null-value process environment definition.

In other words, these configuration file definitions can not be replaced, or removed by the process environment at runtime.

-f flags
Provide the symbolic flags argument to the dl_dump(3C) calls used to generate alternate objects. Any of the RTLD_REL flags that are defined in /usr/include/dlfcn.h can be used. Multiple flags can be or'ed together using the "|" character. In this case, the string should be quoted to avoid expansion by the shell. If no flags values are provided the default flag is RTLD_REL_RELATIVE.

-i name
Add an individual name to the configuration cache. Multiple occurrences of this option are permitted. name can be a shared object or a directory. If name is a directory, each shared object within the directory is added to the cache. If name does not exist, the name is marked in the cache as a nonexistent directory.

-I name
Mimic the -i, and in addition any shared object that is processed has an alternative created using dl_dump(3C). If the -f flag contains RTLD_REL_EXEC, then name can be a dynamic executable, for which an alternative is created. Only one dynamic executable can be specified in this manner, as the cache that is created is specific to this application.

-g name
Add the group name to the configuration cache. Each object is expanded to determine its dependencies. Multiple occurrences of this option are permitted. name can be a dynamic
executable, shared object or a directory. If *name* is a shared object, the shared object and its dependencies are added to the cache. If *name* is a directory, each shared object within the directory, and its dependencies, are added to the cache.

**-G name**
Mimic the `-g` option, and in addition any shared object that is processed has an alternative created using `dl_dump(3C)`. If *name* is a dynamic executable, and the `-f` flag contains `RTLD_REL_EXEC`, then an alternative for the dynamic executable is also created. Only one dynamic executable can be specified in this manner as the cache that is created is specific to this application.

**-l dir**
Specify a new default search directory *dir* for ELF objects. Multiple occurrences of this option are permitted.

The default search paths for 32–bit ELF objects are `/lib` followed by `/usr/lib`. For 64–bit ELF objects, the default search paths are `/lib/64` followed by `/usr/lib/64`.

Use of this option replaces the default search path. Therefore, a `-l` option is normally required to specify the original system default in relation to any new paths that are being applied. However, if the `-u` option is in effect, and a configuration file does not exist, the system defaults are added to the new configuration file. These defaults are added before the new paths specified with the `-l` option.

**-o dir**
When used with either the `-a` or `-A` options, specifies the directory *dir* in which any alternate objects exist. When alternative objects are created by `crle`, this option specified where the alternative are created. Without this option, alternate objects exist in the directory in which the configuration file is created. Multiple occurrences of this option are permitted, the directory *dir* being used to locate alternatives for any following command-line options. Alternative objects are not permitted to override their associated originals.

Typically, this option is used with the `-a` or `-A` options.

**-s dir**
Specify a new trusted directory *dir* for secure ELF objects. Multiple occurrences of this option are permitted.

See SECURITY in `ld.so.1(1)` for a definition of secure objects. See "Security" in Linker and Libraries Guide for a discussion of runtime restrictions imposed on secure applications.

The default trusted directories for secure 32–bit ELF objects are `/lib/secure` followed by `/usr/lib/secure`. For 64–bit secure ELF objects, the default trusted directories are `/lib/secure/64` followed by `/usr/lib/secure/64`.

Use of this option replaces the default trusted directories. Therefore, a `-s` option is normally required to specify the original system default in relation to any new directories.
that are being applied. However, if the -u option is in effect, and a configuration file does not exist, the system defaults are added to the new configuration file. These defaults are added before the new directories specified with the -l option.

-t
   Obsolete. See NOTES.

-u
   Request that a configuration file be updated, possibly with the addition of new information. Without other options, any existing configuration file is inspected and its contents recomputed. Additional arguments allow information to be appended to the recomputed contents. See NOTES.

If a configuration file does not exist, the configuration file is created as directed by the other arguments. In the case of the -l and -s options, any system defaults are first applied to the configuration file before the directories specified with these options.

The configuration file can be in the older format that lacks the system identification information that is normally written at the beginning of the file. In this case, crle does not place system identification information into the resulting file, preserving compatibility of the file with older versions of Solaris. See NOTES.

-v
   Specify verbose mode. When creating a configuration file, a trace of the files that are being processed is written to the standard out. When printing the contents of a configuration file, more extensive directory and file information is provided.

By default, the runtime linker attempts to read the configuration file /var/ld/ld.config for each 32–bit application processed. /var/ld/64/ld.config is read for each 64–bit application. When processing an alternative application, the runtime linker uses a $ORIGIN/ld.config.app-name configuration file if present. See NOTES. Applications can reference an alternative configuration file by setting the LD_CONFIG environment variable. An alternative configuration file can also be specified by recording the configuration file name in the application at the time the application is built. See the -c option of ld(1).

Examples

  EXAMPLE 1   Experimenting With a Temporary Configuration File

The following example creates a temporary configuration file with a new default search path for ELF objects. The environment variable LD_CONFIG_32 is used to instruct the runtime linker to use this configuration file for all 32–bit processes.

$ crle -c /tmp/ld.config -u -l /local/lib
$ crle -c /tmp/ld.config

Configuration file [version 4]: /tmp/ld.config
   Platform: 32-bit MSB SPARC
   Default Library Path (ELF): /lib:/usr/lib:/local/lib
   Trusted Directories (ELF): /lib/secure:/usr/lib/secure
EXAMPLE 1  Experimenting With a Temporary Configuration File  (Continued)

(system default)

Command line:
  crlc -c /tmp/ld.config -l /lib:/usr/lib:/local/lib

$ LD_CONFIG_32=/tmp/ld.config date
Thu May 29 17:42:00 PDT 2008

EXAMPLE 2  Updating and Displaying a New Default Search Path for ELF Objects

The following example updates and displays a new default search path for ELF objects.

# crlc -u -l /local/lib
# crlc

Configuration file [version 4]: /var/ld/ld.config
Platform: 32-bit MSB SPARC
Default Library Path (ELF): /lib:/usr/lib:/local/lib
Trusted Directories (ELF): /lib/secure:/usr/lib/secure
  (system default)

Command line:
  crlc -l /lib:/usr/lib:/local/lib

# crlc -u -l /ISV/lib
# crlc

Configuration file [version 4]: /var/ld/ld.config
Platform: 32-bit MSB SPARC
Default Library Path (ELF): /lib:/usr/lib:/local/lib:/ISV/lib
Trusted Directories (ELF): /lib/secure:/usr/lib/secure
  (system default)

Command line:
  crlc -l /lib:/usr/lib:/local/lib:/usr/local/lib

In this example, the default configuration file initially did not exist. Therefore, the new search path /local/lib is appended to the system default. The next update appends the search path /ISV/lib to those paths already established in the configuration file.

EXAMPLE 3  Recovering From a Bad Configuration File

The following example creates a bad configuration file in the default location. The file can be removed by instructing the runtime linker to ignore any configuration file with the LD_NOCONFIG environment variable. Note, it is recommended that temporary configuration files be created and the environment variable LD_CONFIG used to experiment with these files.
This configuration file does not include the system default search paths, and so the `date` utility is unable to locate the required system dependencies. In this case, the `-u` option should have been used.

**EXAMPLE 4** Creating and Displaying a New Default Search Path and New Trusted Directory for ELF Objects

The following example creates and displays a new default search path and new trusted directory for ELF objects.

```
# crle -l /local/lib -l /lib -l /usr/lib -s /local/lib
# crle

Configuration file [version 4]: /var/ld/ld.config
Platform: 32-bit MSB SPARC
Default Library Path (ELF): /local/lib:/lib:/usr/lib
Trusted Directories (ELF): /local/lib

Command line:
crle -l /local/lib:/lib:/usr/lib -s /local/lib

With this configuration file, third party applications could be installed in /local/bin and their associated dependencies in /local/lib. The default search path allows the applications to locate their dependencies without the need to set LD_LIBRARY_PATH. The default trusted directories have also been replaced with this example.

**EXAMPLE 5** Creating a Directory Cache for ELF Objects

The following example creates a directory cache for ELF objects.

```
$ crle -i /usr/dt/lib -i /usr/openwin/lib -i /lib -i /usr/lib \
    -c config
$ ldd -s ./main
```

```
    find object=libc.so.1; required by ./main
        search path=/usr/dt/lib:/usr/openwin/lib (RUNPATH/RPATH ./main)
        trying path=/usr/dt/lib/libc.so.1
        trying path=/usr/openwin/lib/libc.so.1
        search path=/lib (default)
        trying path=/lib/libc.so.1
```

EXAMPLE 5  Creating a Directory Cache for ELF Objects  (Continued)

    libc.so.1 => /lib/libc.so.1

$ LD_CONFIG=config ldd -s ./main
....
 find object=libc.so.1; required by ./main
 search path=/usr/dt/lib:/usr/openwin/lib (RUNPATH/RPATH ./main)
   search path=/lib (default)
 trying path=/lib/libc.so.1
     libc.so.1 => /lib/libc.so.1

With this configuration, the cache reflects that the system library libc.so.1 does not exist in the directories /usr/dt/lib or /usr/openwin/lib. Therefore, the search for this system file ignores these directories even though the application’s runpath indicates these paths should be searched.

EXAMPLE 6  Creating an Alternative Object Cache for an ELFExecutable

The following example creates an alternative object cache for an ELF executable.

$ crle -c /local/$HOST/.xterm/ld.config.xterm \       
        -f RTLD_REL_ALL -G /usr/openwin/bin/xterm
$ ln -s /local/$HOST/.xterm/xterm /local/$HOST/xterm
$ ldd /usr/local/$HOST/xterm
     libXaw.so.5 => /local/$HOST/.xterm/libWaw.so.5 (alternate)
     libXmu.so.4 => /local/$HOST/.xterm/libXmu.so.4 (alternate)
     ....
     libc.so.1 => /local/$HOST/.xterm/libc.so.1 (alternate)
     ....

With this configuration, a new xterm and its dependencies are created. These new objects are fully relocated to each other, and result in faster startup than the originating objects. The execution of this application uses its own specific configuration file. This model is generally more flexible than using the environment variable LD_CONFIG, as the configuration file can not be erroneously used by other applications such as ldd(1) or truss(1).

EXAMPLE 7  Creating an Alternative Object Cache to Replace an ELF Shared Object

The following example creates an alternative object cache to replace an ELF shared object.

$ ldd /usr/bin/vi
     libcurses.so.1 => /lib/libcurses.so.1
     ....

# crle -a /lib/libcurses.so.1 -o /usr/ucblib
# crle

Configuration file [version 4]: /var/ld/ld.config
EXAMPLE 7  Creating an Alternative Object Cache to Replace an ELF Shared Object  (Continued)

Platform: 32-bit MSB SPARC
Default Library Path (ELF): /lib:/usr/lib (system default)
Trusted Directories (ELF): /lib/secure:/usr/lib/secure \ (system default)
Directory: /lib
  libcurses.so.1 (alternate: /usr/ucblib/libcurses.so.1)
  ....

$ ldd /usr/bin/vi
  libcurses.so.1 => /usr/ucblib/libcurses.so.1 (alternate)
  ....

With this configuration, any dependency that would normally resolve to /usr/lib/libcurses.so.1 instead resolves to /usr/ucblib/libcurses.so.1.

EXAMPLE 8  Setting Replaceable and Permanent Environment Variables
The following example sets replaceable and permanent environment variables.

# crle -e LD_LIBRARY_PATH=/local/lib 
- E LD_PRELOAD=preload.so.1
# crle
  ....
Environment Variables:
  LD_LIBRARY_PATH=/local/lib (replaceable)
  LD_PRELOAD=preload.so.1 (permanent)
  ....

$ LD_DEBUG=files LD_PRELOAD=preload.so.2 ./main
  ....
  18764: file=preload.so.2; preloaded
  18764: file=/local/lib/preload.so.2 [ ELF ]; generating link map
  ....
  18764: file=preload.so.1; preloaded
  18764: file=/local/lib/preload.so.1 [ ELF ]; generating link map
  ....

With this configuration file, a replaceable search path has been specified together with a permanent preload object which becomes appended to the process environment definition.

Exit Status  The creation or display of a configuration file results in a 0 being returned. Otherwise, any error condition is accompanied with a diagnostic message and a non-zero value being returned.
The ability to tag an alternative application to use an application-specific configuration file, is possible if the original application contains one of the \texttt{.dynamic} tags \texttt{DT_FLAGS_1} or \texttt{DT_FEATURE_1}. Without these entries, a configuration file must be specified using the \texttt{LD_CONFIG} environment variable. Care should be exercised with this latter method as this environment variable is visible to any forked applications.

The use of the \texttt{-u} option requires at least version 2 of \texttt{crle}. This version level is evident from displaying the contents of a configuration file.

```bash
$ crle
Configuration file [2]: /var/ld/ld.config
      ...
```

With a version 2 configuration file, \texttt{crle} is capable of constructing the command-line arguments required to regenerate the configuration file. This command-line construction, provides full update capabilities using the \texttt{-u} option. Although a version 1 configuration file update is possible, the configuration file contents might be insufficient for \texttt{crle} to compute the entire update requirements.

Configuration files contain platform specific binary data. A given configuration file can only be interpreted by software with the same machine class and byte ordering. Configuration files have system identification information at the beginning of the file. This information is used by \texttt{crle} and the runtime to check their compatibility with configuration files. This information also allows the \texttt{file(1)} command to properly identify configuration files. For backward compatibility, older files that are missing this information are still accepted, although without the identification and error checking that would otherwise be possible. When processing an update (\texttt{-u}) operation for an older file that lacks system information, \texttt{crle} does not add system identification information to the result.

Oracle Solaris 11 discontinued support for SunOS 4.x AOUT executables on SPARC hardware. Prior to this change, the \texttt{-t} option provided a toggle for expressing the object type, ELF or AOUT, that affected any \texttt{-l} or \texttt{-s} options that followed. The \texttt{-t} option is now obsolete, and any AOUT specific directions are ignored with a warning to that effect. For the same reason, the use of \texttt{crle} to inspect old configuration files containing AOUT information produces a warning message that the information is obsolete.

**Files**

- `/var/ld/ld.config`
  Default configuration file for 32-bit applications.

- `/var/ld/64/ld.config`
  Default configuration file for 64-bit applications.

- `/var/tmp`
  Default location for temporary configuration file. See \texttt{tempnam(3C)}.

- `/usr/lib/lddstub`
  Stub application that is employed to \texttt{dlldump(3C)} 32-bit objects.
/usr/lib/64/lddstub
   Stub application that is employed to dldump(3C) 64–bit objects.

/usr/lib/libcrle.so.1
   Audit library that is employed to dldump(3C) 32–bit objects.

/usr/lib/64/libcrle.so.1
   Audit library that is employed to dldump(3C) 64–bit objects.

Environment Variables

There are no environment variables that are referenced by crle. However, several
environment variables affect the runtime linkers behavior in regard to the processing of
configuration files that are created by crle.

LD_CONFIG, LD_CONFIG_32 and LD_CONFIG_64
   Provide an alternative configuration file.

LD_NOCONFIG, LD_NOCONFIG_32 and LD_NOCONFIG_64
   Disable configuration file processing.

LD_NODIRCONFIG, LD_NODIRCONFIG_32 and LD_NODIRCONFIG_64
   Disable directory cache processing from a configuration file.

LD_NOENVCONFIG, LD_NOENVCONFIG_32 and LD_NOENVCONFIG_64
   Disable environment variable processing from a configuration file.

LD_NOOBJALTER, LD_NOOBJALTER_32 and LD_NOOBJALTER_64
   Disable alternative object processing from a configuration file.

Attributes

See attributes(5) for descriptions of the following attributes.

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/linker</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also

file(1), ld(1), ld.so.1(1), dldump(3C), tempnam(3C), attributes(5)

Linker and Libraries Guide
The `crontab` utility manages a user's access with `cron` (see `cron(1M)`) by copying, creating, listing, and removing `crontab` files. If invoked without options, `crontab` copies the specified file, or the standard input if no file is specified, into a directory that holds all users' `crontab` files.

If `crontab` is invoked with `filename`, this overwrites an existing `crontab` entry for the user that invokes it.

### Users: Access to `crontab` is allowed:
- if the user's name appears in `/etc/cron.d/cron.allow`.
- if `/etc/cron.d/cron.allow` does not exist and the user's name is not in `/etc/cron.d/cron.deny`.

### Users: Access to `crontab` is denied:
- if `/etc/cron.d/cron.allow` exists and the user's name is not in it.
- if `/etc/cron.d/cron.allow` does not exist and user's name is in `/etc/cron.d/cron.deny`.
- if neither file exists, only a user with the `solaris.jobs.user` authorization is allowed to submit a job.
- if Solaris Auditing is enabled, the user's shell is not audited and the user is not the `crontab` owner. This can occur if the user logs in by way of a program, such as some versions of SSH, which does not set audit parameters.

The rules for `allow` and `deny` apply to `root` only if the `allow/deny` files exist.

The `allow/deny` files consist of one user name per line.
A `crontab` file consists of lines of six fields each. The fields are separated by spaces or tabs. The first five are integer patterns that specify the following:

- minute (0–59),
- hour (0–23),
- day of the month (1–31),
- month of the year (1–12),
- day of the week (0–6 with 0=Sunday).

Each of these patterns can be either an asterisk (meaning all legal values) or a list of elements separated by commas. An element is either a number or two numbers separated by a minus sign (meaning an inclusive range). Time specified here is interpreted in the currently active timezone. At the top of the crontab file this is the timezone which is set system-wide in `/etc/default/init`. A user can add a line such as:

```plaintext
TZ=timezone
```

...and all subsequent entries will be interpreted using that timezone, until a new `TZ=timezone` line is encountered. The specification of days can be made by two fields (day of the month and day of the week). Both are adhered to if specified as a list of elements. See EXAMPLES.

The sixth field of a line in a `crontab` file is a string that is executed by the shell at the specified times. A percent character in this field (unless escaped by `\`) is translated to a NEWLINE character.

Only the first line (up to a ‘ % ’ or end of line) of the command field is executed by the shell. Other lines are made available to the command as standard input. Any blank line or line beginning with a ‘ # ’ is a comment and is ignored.

The shell is invoked from your `$HOME` directory. As with `$TZ`, both `$SHELL` and `$HOME` can be set by having a line such as:

```plaintext
SHELL=/usr/bin/someshell
```

...or:

```plaintext
HOME=somedirectory
```

...which will take precedence for all the remaining entries in the crontab or until there is another `HOME` or `SHELL` entry. It is invoked with an `arg0` of the basename of the `$SHELL` that is currently in effect. A user who wants to have his `.profile` or equivalent file executed must explicitly do so in the `crontab` file. `cron` supplies a default environment for every shell, defining `HOME`, `LOGNAME`, `SHELL`, `TZ`, and `PATH`. The default `PATH` for user `cron` jobs is `/usr/bin`; while root `cron` jobs default to `/usr/sbin:/usr/bin`. The default `PATH` can be set in `/etc/default/cron` (see `cron(1M)`). The `TZ`, `HOME`, and `SHELL` environment variables are set to match those that are in effect in the `crontab` file at the time.

If you do not redirect the standard output and standard error of your commands, any generated output or errors are mailed to you.
The following variables are supported:

**HOME**

Allows the user to choose and alternative directory for cron to change directory to prior to running the command. For example:

```sh
HOME=/var/tmp
```

**SHELL**

The name of the shell to use to run subsequent commands. For example:

```sh
SHELL=/usr/bin/ksh
```

**TZ**

Allows the user to choose the timezone in which the cron entries are run. This effects both the environment of the command that is run and the timing of the entry. For example, to have your entries run using the timezone for Iceland, use:

```sh
TZ=Iceland
```

Each of these variables affects all of the lines that follow it in the crontab file, until it is reset by a subsequent line resetting that variable. Hence, it is possible to have multiple timezones supported within a single crontab file.

The lines that are not setting these environment variables are the same as crontab entries that conform to the UNIX standard and are described elsewhere in this man page.

Setting cron Jobs Across Timezones

The default timezone of the cron daemon sets the system-wide timezone for cron entries. This, in turn, is by set by default system-wide using /etc/default/init.

If some form of daylight savings or summer/winter time is in effect, then jobs scheduled during the switchover period could be executed once, twice, or not at all.

Options

The following options are supported:

- `e`
  Edits a copy of the current user's crontab file, or creates an empty file to edit if crontab does not exist. When editing is complete, the file is installed as the user's crontab file.

  The environment variable EDITOR determines which editor is invoked with the `-e` option. All crontab jobs should be submitted using crontab. Do not add jobs by just editing the crontab file, because cron is not aware of changes made this way.

  If all lines in the crontab file are deleted, the old crontab file is restored. The correct way to delete all lines is to remove the crontab file using the `-r` option.

  If `username` is specified, the specified user's crontab file is edited, rather than the current user's crontab file. This can only be done by root or by a user with the `solaris.jobs.admin` authorization.
-l  Lists the crontab file for the invoking user. Only root or a user with the solaris.jobs.admin authorization can specify a username following the -l option to list the crontab file of the specified user.

-r  Removes a user's crontab from the crontab directory. Only root or a user with the solaris.jobs.admin authorization can specify a username following the -r option to remove the crontab file of the specified user.

**Examples**

**EXAMPLE 1** Cleaning up Core Files

This example cleans up core files every weekday morning at 3:15 am:

```
15 3 * * 1-5 find $HOME -name core 2>/dev/null | xargs rm -f
```

**EXAMPLE 2** Mailing a Birthday Greeting

This example mails a birthday greeting:

```
0 12 14 2 * mailx john%Happy Birthday!%Time for lunch.
```

**EXAMPLE 3** Specifying Days of the Month and Week

This example runs a command on the first and fifteenth of each month, as well as on every Monday:

```
0 0 1,15 * 1
```

To specify days by only one field, the other field should be set to *. For example:

```
0 0 * * 1
```

would run a command only on Mondays.

**EXAMPLE 4** Using Environment Variables

The following entries take advantage of crontab support for certain environment variables.

```
TZ=GMT
HOME=/local/home/user
SHELL=/usr/bin/ksh
0 0 * * * echo $(date) > midnight.GMT
TZ=US/Pacific
0 0 * * * echo $(date) > midnight.PST
TZ=US/Eastern
HOME=/local/home/myuser
SHELL=/bin/csh
```

The preceding entries allow two jobs to run. The first one would run at midnight in the GMT timezone and the second would run at midnight in the PST timezone. Both would be run in the directory /local/home/user using the Korn shell. The file concludes with TZ, HOME, and SHELL entries that return those variables to their default values.
**Environment Variables**

See `environ(5)` for descriptions of the following environment variables that affect the execution of `crontab`: `LANG`, `LC_ALL`, `LC_CTYPE`, `LC_MESSAGES`, and `NLSPATH`.

- **EDITOR**
  - Determines the editor to be invoked when the `-e` option is specified. This is overridden by the `VISUAL` environment variable. The default editor is `vi(1)`.

- **PATH**
  - The `PATH` in `crontab`'s environment specifies the search path used to find the editor.

- **VISUAL**
  - Determines the visual editor to be invoked when the `-e` option is specified. If `VISUAL` is not specified, then the environment variable `EDITOR` is used. If that is not set, the default is `vi(1)`.

- **EDITOR**
  - Determines the editor to be invoked when the `-e` option is specified. The default editor is `/usr/xpg4/bin/vi`.

  - Determines the editor to be invoked when the `-e` option is specified. The default editor is `/usr/xpg6/bin/vi`.

**Exit Status**

The following exit values are returned:

- `0` Successful completion.
- `>0` An error occurred.

**Files**

- `/etc/cron.d` main cron directory
- `/etc/cron.d/cron.allow` list of allowed users
- `/etc/default/cron` contains cron default settings
- `/etc/cron.d/cron.deny` list of denied users
- `/var/cron/log` accounting information
- `/var/spool/cron/crontabs` spool area for `crontab`

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>/usr/bin/crontab</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
<td></td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td>See <code>standards(5)</code></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>/usr/xpg4/bin/crontab</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/xopen/xcu4</td>
<td></td>
</tr>
</tbody>
</table>
If you inadvertently enter the `crontab` command with no arguments, do not attempt to get out with Control-d. This removes all entries in your `crontab` file. Instead, exit with Control-c.

When updating `cron`, check first for existing `crontab` entries that can be scheduled close to the time of the update. Such entries can be lost if the update process completes after the scheduled event. This can happen because, when `cron` is notified by `crontab` to update the internal view of a user's `crontab` file, it first removes the user's existing internal `crontab` and any internal scheduled events. Then it reads the new `crontab` file and rebuilds the internal `crontab` and events. This last step takes time, especially with a large `crontab` file, and can complete after an existing `crontab` entry is scheduled to run if it is scheduled too close to the update. To be safe, start a new job at least 60 seconds after the current date and time.

Simultaneous modifications of the same `crontab` file may lead to unexpected results.

Care should be taken when adding `TZ`, `SHELL` and `HOME` variables to the `crontab` file when the `crontab` file could be shared with applications that do not expect those variables to be changed from the default. Resetting the values to their defaults at the bottom of the file will minimize the risk of problems.

---

**See Also**

`atq(1)`, `atrm(1)`, `auths(1)`, `ed(1)`, `sh(1)`, `vi(1)`, `cron(1M)`, `su(1M)`, `auth_attr(4)`, `attributes(5)`, `environ(5)`, `standards(5)`

**Notes**

If you inadvertently enter the `crontab` command with no arguments, do not attempt to get out with Control-d. This removes all entries in your `crontab` file. Instead, exit with Control-c.

When updating `cron`, check first for existing `crontab` entries that can be scheduled close to the time of the update. Such entries can be lost if the update process completes after the scheduled event. This can happen because, when `cron` is notified by `crontab` to update the internal view of a user's `crontab` file, it first removes the user's existing internal `crontab` and any internal scheduled events. Then it reads the new `crontab` file and rebuilds the internal `crontab` and events. This last step takes time, especially with a large `crontab` file, and can complete after an existing `crontab` entry is scheduled to run if it is scheduled too close to the update. To be safe, start a new job at least 60 seconds after the current date and time.

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**csh(1)**

<table>
<thead>
<tr>
<th>Name</th>
<th>csh – shell command interpreter with a C-like syntax</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synopsis</td>
<td>csh [-bcefinstvXx] [argument]…</td>
</tr>
<tr>
<td>Description</td>
<td>csh, the C shell, is a command interpreter with a syntax reminiscent of the C language. It provides a number of convenient features for interactive use that are not available with the Bourne shell, including filename completion, command aliasing, history substitution, job control, and a number of built-in commands. As with the Bourne shell, the C shell provides variable, command and filename substitution.</td>
</tr>
<tr>
<td>Initialization and Termination</td>
<td>When first started, the C shell normally performs commands from the .cshrc file in your home directory, provided that it is readable and you either own it or your real group ID matches its group ID. If the shell is invoked with a name that starts with '−', as when started by <code>login(1)</code>, the shell runs as a login shell. If the shell is a login shell, this is the sequence of invocations: First, commands in /etc/.login are executed. Next, commands from the .cshrc file your home directory are executed. Then the shell executes commands from the .login file in your home directory; the same permission checks as those for .cshrc are applied to this file. Typically, the .login file contains commands to specify the terminal type and environment. (For an explanation of file interpreters, see <code>Command Execution</code> and <code>exec(2)</code>.) As a login shell terminates, it performs commands from the .logout file in your home directory; the same permission checks as those for .cshrc are applied to this file.</td>
</tr>
<tr>
<td>Interactive Operation</td>
<td>After startup processing is complete, an interactive C shell begins reading commands from the terminal, prompting with <code>hostname%</code> (or <code>hostname#</code> for the privileged user). The shell then repeatedly performs the following actions: a line of command input is read and broken into words. This sequence of words is placed on the history list and then parsed, as described under <code>USAGE</code>. Finally, the shell executes each command in the current line.</td>
</tr>
<tr>
<td>Noninteractive Operation</td>
<td>When running noninteractively, the shell does not prompt for input from the terminal. A noninteractive C shell can execute a command supplied as an <code>argument</code> on its command line, or interpret commands from a file, also known as a script.</td>
</tr>
<tr>
<td>Options</td>
<td>The following options are supported:</td>
</tr>
<tr>
<td></td>
<td><code>-b</code> Forced a “break” from option processing. Subsequent command line arguments are not interpreted as C shell options. This allows the passing of options to a script without confusion. The shell does not run set-user-ID or set-group-ID scripts unless this option is present.</td>
</tr>
<tr>
<td></td>
<td><code>-c</code> Executes the first <code>argument</code>, which must be present. Remaining arguments are placed in <code>argv</code>, the argument-list variable, and passed directly to <code>csh</code>.</td>
</tr>
<tr>
<td></td>
<td><code>-e</code> Exits if a command terminates abnormally or yields a nonzero exit status.</td>
</tr>
<tr>
<td></td>
<td><code>-f</code> Fast start. Reads neither the .cshrc file, nor the .login file (if a login shell) upon startup.</td>
</tr>
</tbody>
</table>
-i Forced interactive. Prompts for command line input, even if the standard input does not appear to be a terminal (character-special device).

-n Parses (interprets), but does not execute commands. This option can be used to check C shell scripts for syntax errors.

-s Takes commands from the standard input.

-t Reads and executes a single command line. A `\' (backslash) can be used to escape each newline for continuation of the command line onto subsequent input lines.

-v Verbose. Sets the verbose predefined variable. Command input is echoed after history substitution, but before other substitutions and before execution.

-V Sets verbose before reading .cshrc.

-x Echo. Sets the echo variable. Echoes commands after all substitutions and just before execution.

-X Sets echo before reading .cshrc.

Except with the options -c, -i, -s, or -t, the first nonoption argument is taken to be the name of a command or script. It is passed as argument zero, and subsequent arguments are added to the argument list for that command or script.

Usage

Filename Completion
When enabled by setting the variable filec, an interactive C shell can complete a partially typed filename or user name. When an unambiguous partial filename is followed by an ESC character on the terminal input line, the shell fills in the remaining characters of a matching filename from the working directory.

If a partial filename is followed by the EOF character (usually typed as Control-d), the shell lists all filenames that match. It then prompts once again, supplying the incomplete command line typed in so far.

When the last (partial) word begins with a tilde (~), the shell attempts completion with a user name, rather than a file in the working directory.

The terminal bell signals errors or multiple matches. This bell signal can be inhibited by setting the variable nobeep. You can exclude files with certain suffixes by listing those suffixes in the variable fignore. If, however, the only possible completion includes a suffix in the list, it is not ignored. fignore does not affect the listing of filenames by the EOF character.

Lexical Structure
The shell splits input lines into words at space and tab characters, except as noted below. The characters &|, ;<, >, (, and ) form separate words; if paired, the pairs form single words. These shell metacharacters can be made part of other words, and their special meaning can be suppressed by preceding them with a `\' (backslash). A newline preceded by a \ is equivalent to a space character.
In addition, a string enclosed in matched pairs of single-quotes (‘), double-quotes ("), or backquotes (!), forms a partial word. Metacharacters in such a string, including any space or tab characters, do not form separate words. Within pairs of backquote (‘) or double-quote (") characters, a newline preceded by a \ (backslash) gives a true newline character. Additional functions of each type of quote are described, below, under Variable Substitution, Command Substitution, and Filename Substitution.

When the shell's input is not a terminal, the character # introduces a comment that continues to the end of the input line. Its special meaning is suppressed when preceded by a \ or enclosed in matching quotes.

Command Line Parsing

A *simple command* is composed of a sequence of words. The first word (that is not part of an I/O redirection) specifies the command to be executed. A simple command, or a set of simple commands separated by | or | & characters, forms a *pipeline*. With |, the standard output of the preceding command is redirected to the standard input of the command that follows. With | & both the standard error and the standard output are redirected through the pipeline.

Pipelines can be separated by semicolons (;), in which case they are executed sequentially. Pipelines that are separated by & & or | | form conditional sequences in which the execution of pipelines on the right depends upon the success or failure, respectively, of the pipeline on the left.

A pipeline or sequence can be enclosed within parentheses (’) to form a simple command that can be a component in a pipeline or sequence.

A sequence of pipelines can be executed asynchronously or “in the background” by appending an ’ &; rather than waiting for the sequence to finish before issuing a prompt, the shell displays the job number (see Job Control, below) and associated process IDs and prompts immediately.

History Substitution

History substitution allows you to use words from previous command lines in the command line you are typing. This simplifies spelling corrections and the repetition of complicated commands or arguments. Command lines are saved in the history list, the size of which is controlled by the history variable. The most recent command is retained in any case. A history substitution begins with a ! (although you can change this with the histchars variable) and occurs anywhere on the command line; history substitutions do not nest. The ! can be escaped with \ to suppress its special meaning.

Input lines containing history substitutions are echoed on the terminal after being expanded, but before any other substitutions take place or the command gets executed.

Event Designators

An event designator is a reference to a command line entry in the history list.

! Start a history substitution, except when followed by a space character, tab, newline, = or .
!! Refer to the previous command. By itself, this substitution repeats the previous command.

!n Refer to command line n.

! - n Refer to the current command line minus n.

!str Refer to the most recent command starting with str.

!?str? Refer to the most recent command containing str.

!?str? additional Refer to the most recent command containing str and append additional to that referenced command.

!{command} additional Refer to the most recent command beginning with command and append additional to that referenced command.

^previous_word*replacement^ Repeat the previous command line replacing the string previous_word with the string replacement. This is equivalent to the history substitution:

!:s/previous_word/replacement/.

To re-execute a specific previous command AND make such a substitution, say, re-executing command #6,

!:6s/previous_word/replacement/.

Word Designators A ‘:’ (colon) separates the event specification from the word designator. It can be omitted if the word designator begins with a ^, $, *, – or %. If the word is to be selected from the previous command, the second ! character can be omitted from the event specification. For instance, !:1 and !:1 both refer to the first word of the previous command, while !!!$ and !$ both refer to the last word in the previous command. Word designators include:

# The entire command line typed so far.

0 The first input word (command).

n The n'th argument.

^ The first argument, that is, 1.

$ The last argument.

% The word matched by the ?s search.

x–y A range of words; –y abbreviates 0–y.

* All the arguments, or a null value if there is just one word in the event.

x* Abbreviates x–$.

x– Like x* but omitting word $.
After the optional word designator, you can add one of the following modifiers, preceded by a :
h  Remove a trailing pathname component, leaving the head.
r  Remove a trailing suffix of the form ‘.xxx’, leaving the basename.
e  Remove all but the suffix, leaving the Extension.
s/l/r/s  Substitute r for l.
t  Remove all leading pathname components, leaving the tail.
&  Repeat the previous substitution.
g  Apply the change to the first occurrence of a match in each word, by prefixing the above (for example, 9&).
p  Print the new command but do not execute it.
q  Quote the substituted words, escaping further substitutions.
x  Like q, but break into words at each space character, tab or newline.

Unless preceded by a g, the modification is applied only to the first string that matches l; an error results if no string matches.

The left-hand side of substitutions are not regular expressions, but character strings. Any character can be used as the delimiter in place of /. A backslash quotes the delimiter character. The character & in the right hand side, is replaced by the text from the left-hand-side. The & can be quoted with a backslash. A null l uses the previous string either from a l or from a contextual scan string s from !?s. You can omit the rightmost delimiter if a newline immediately follows r; the rightmost ? in a context scan can similarly be omitted.

Without an event specification, a history reference refers either to the previous command, or to a previous history reference on the command line (if any).

This is equivalent to the history substitution:
!:s/l/r/

The C shell maintains a list of aliases that you can create, display, and modify using the alias and unalias commands. The shell checks the first word in each command to see if it matches the name of an existing alias. If it does, the command is reprocessed with the alias definition replacing its name; the history substitution mechanism is made available as though that command were the previous input line. This allows history substitutions, escaped with a backslash in the definition, to be replaced with actual command line arguments when the alias is used. If no history substitution is called for, the arguments remain unchanged.
Aliases can be nested. That is, an alias definition can contain the name of another alias. Nested aliases are expanded before any history substitutions is applied. This is useful in pipelines such as

```
alias lm 'ls -l \!* | more'
```

which when called, pipes the output of `ls(1)` through `more(1)`.

Except for the first word, the name of the alias cannot appear in its definition, nor in any alias referred to by its definition. Such loops are detected, and cause an error message.

### I/O Redirection

The following metacharacters indicate that the subsequent word is the name of a file to which the command’s standard input, standard output, or standard error is redirected; this word is variable, command, and filename expanded separately from the rest of the command.

- `<` Redirect the standard input.
- `<< word` Read the standard input, up to a line that is identical with `word`, and place the resulting lines in a temporary file. Unless `word` is escaped or quoted, variable and command substitutions are performed on these lines. Then, the pipeline is invoked with the temporary file as its standard input. `word` is not subjected to variable, filename, or command substitution, and each line is compared to it before any substitutions are performed by the shell.
- `>> !> &> & !` Redirect the standard output to a file. If the file does not exist, it is created. If it does exist, it is overwritten; its previous contents are lost. When set, the variable `noclobber` prevents destruction of existing files. It also prevents redirection to terminals and `/dev/null`, unless one of the `!` forms is used. The `&` forms redirect both standard output and the standard error (diagnostic output) to the file.
- `>> >> & >> ! >> & !` Append the standard output. Like `>`, but places output at the end of the file rather than overwriting it. If `noclobber` is set, it is an error for the file not to exist, unless one of the `!` forms is used. The `&` forms append both the standard error and standard output to the file.

### Variable Substitution

The C shell maintains a set of variables, each of which is composed of a `name` and a `value`. A variable name consists of up to 128 letters and digits, and starts with a letter. An underscore `_` is considered a letter. A variable’s value is a space-separated list of zero or more words. If the shell supports a variable name up to 128 characters the variable `SUNW_VARLEN` is defined. If a variable name of up to 128 characters is not supported, then an older version of the shell is being used, and the shell variable name length has a maximum length of 20.

To refer to a variable’s value, precede its name with a ‘$’. Certain references (described below) can be used to select specific words from the value, or to display other information about the variable. Braces can be used to insulate the reference from other characters in an input-line word.
Variable substitution takes place after the input line is analyzed, aliases are resolved, and I/O redirections are applied. Exceptions to this are variable references in I/O redirections (substituted at the time the redirection is made), and backquoted strings (see Command Substitution).

Variable substitution can be suppressed by preceding the $ with a \, except within double-quotes where it always occurs. Variable substitution is suppressed inside of single-quotes. A $ is escaped if followed by a space character, tab or newline.

Variables can be created, displayed, or destroyed using the set and unset commands. Some variables are maintained or used by the shell. For instance, the argv variable contains an image of the shell’s argument list. Of the variables used by the shell, a number are toggles; the shell does not care what their value is, only whether they are set or not.

Numerical values can be operated on as numbers (as with the @ built-in command). With numeric operations, an empty value is considered to be zero. The second and subsequent words of multiverse values are ignored. For instance, when the verbose variable is set to any value (including an empty value), command input is echoed on the terminal.

Command and filename substitution is subsequently applied to the words that result from the variable substitution, except when suppressed by double-quotes, when noglob is set (suppressing filename substitution), or when the reference is quoted with the :q modifier. Within double-quotes, a reference is expanded to form (a portion of) a quoted string; multiword values are expanded to a string with embedded space characters. When the :q modifier is applied to the reference, it is expanded to a list of space-separated words, each of which is quoted to prevent subsequent command or filename substitutions.

Except as noted below, it is an error to refer to a variable that is not set.

$var
${var} These are replaced by words from the value of var, each separated by a space character. If var is an environment variable, its value is returned (but ‘:’ modifiers and the other forms given below are not available).

$var[index]
${var[index]} These select only the indicated words from the value of var. Variable substitution is applied to index, which can consist of (or result in) a either single number, two numbers separated by a ‘−’, or an asterisk. Words are indexed starting from 1; a ‘*’ selects all words. If the first number of a range is omitted (as with $argv [−2]), it defaults to 1. If the last number of a range is omitted (as with $argv[1−]), it defaults to $#var the word count). It is not an error for a range to be empty if the second argument is omitted (or within range).

#$name
${#name} These give the number of words in the variable.
This substitutes the name of the file from which command input is being read except for setuid shell scripts. An error occurs if the name is not known.

$\{n\}$ Equivalent to $\text{argv}\[n\]$.  

$\ast$ Equivalent to $\text{argv}\[\ast\]$.  

The modifiers :e, :h, :q, :r, :t, and :x can be applied (see History Substitution), as can :gh, :gt, and :gr. If { } (braces) are used, then the modifiers must appear within the braces. The current implementation allows only one such modifier per expansion.

The following references cannot be modified with : modifiers.

$\?\ var$ 

$\{?\ var\}$ Substitutes the string 1 if \textit{var} is set or 0 if it is not set.

$\?\ 0$ Substitutes 1 if the current input filename is known or 0 if it is not.

$\$$ Substitutes the process number of the (parent) shell.

$\< $ Substitutes a line from the standard input, with no further interpretation thereafter. It can be used to read from the keyboard in a C shell script.

### Command and Filename Substitutions

Command and filename substitutions are applied selectively to the arguments of built-in commands. Portions of expressions that are not evaluated are not expanded. For non-built-in commands, filename expansion of the command name is done separately from that of the argument list; expansion occurs in a subshell, after I/O redirection is performed.

A command enclosed by backquotes (‘...’) is performed by a subshell. Its standard output is broken into separate words at each space character, tab and newline; null words are discarded. This text replaces the backquoted string on the current command line. Within double-quotes, only newline characters force new words; space and tab characters are preserved. However, a final newline is ignored. It is therefore possible for a command substitution to yield a partial word.

Unquoted words containing any of the characters *, ?, [ or {, or that begin with ~, are expanded (also known as globbing) to an alphabetically sorted list of filenames, as follows:

* Match any (zero or more) characters.

? Match any single character.

[... ] Match any single character in the enclosed list(s) or range(s). A list is a string of characters. A range is two characters separated by a dash (−), and includes all the characters in between in the ASCII collating sequence (see ascii(5)).
\{str, str, \ldots\} Expand to each string (or filename-matching pattern) in the comma-separated list. Unlike the pattern-matching expressions above, the expansion of this construct is not sorted. For instance, \{b, a\} expands to ‘b’ ‘a’, (not ‘a’ ‘b’). As special cases, the characters \{ and \}, along with the string \{ \}, are passed undisturbed.

\sim\{user\} Your home directory, as indicated by the value of the variable home, or that of user, as indicated by the password entry for user.

Only the patterns *, ?, and [...] imply pattern matching; an error results if no filename matches a pattern that contains them. The ‘.’ (dot character), when it is the first character in a filename or pathname component, must be matched explicitly. The / (slash) must also be matched explicitly.

Expressions and Operators

A number of C shell built-in commands accept expressions, in which the operators are similar to those of C and have the same precedence. These expressions typically appear in the @, exit, if, set and while commands, and are often used to regulate the flow of control for executing commands. Components of an expression are separated by white space.

Null or missing values are considered \0. The result of all expressions is a string, which can represent decimal numbers.

The following C shell operators are grouped in order of precedence:

\((\ldots)\) grouping

\(\sim\) one’s complement

! logical negation

* / % multiplication, division, remainder. These are right associative, which can lead to unexpected results. Combinations should be grouped explicitly with parentheses.

\(+ -\) addition, subtraction (also right associative)

\(< < > >\) bitwise shift left, bitwise shift right

\(< > <= >=\) less than, greater than, less than or equal to, greater than or equal to

\(= = != =~ !~\) equal to, not equal to, filename-substitution pattern match (described below), filename-substitution pattern mismatch

& bitwise AND

^ bitwise XOR (exclusive or)

| bitwise inclusive OR

&& logical AND
The operators: ==, !==, and !~- compare their arguments as strings; other operators use numbers. The operators =~ and !~ each check whether or not a string to the left matches a filename substitution pattern on the right. This reduces the need for switch statements when pattern-matching between strings is all that is required.

Also available are file inquiries:

- `r filename` Return true, or 1 if the user has read access. Otherwise it returns false, or 0.
- `w filename` True if the user has write access.
- `x filename` True if the user has execute permission (or search permission on a directory).
- `e filename` True if `filename` exists.
- `o filename` True if the user owns `filename`.
- `z filename` True if `filename` is of zero length (empty).
- `f filename` True if `filename` is a plain file.
- `d filename` True if `filename` is a directory.

If `filename` does not exist or is inaccessible, then all inquiries return false.

An inquiry as to the success of a command is also available:

```
{ command }
```

If command runs successfully, the expression evaluates to true, 1. Otherwise, it evaluates to false, 0. Note: Conversely, command itself typically returns 0 when it runs successfully, or some other value if it encounters a problem. If you want to get at the status directly, use the value of the status variable rather than this expression.

The shell contains a number of commands to regulate the flow of control in scripts and within limits, from the terminal. These commands operate by forcing the shell either to reread input (to loop), or to skip input under certain conditions (to branch).

Each occurrence of a foreach, switch, while, if...then and else built-in command must appear as the first word on its own input line.

If the shell’s input is not seekable and a loop is being read, that input is buffered. The shell performs seeks within the internal buffer to accomplish the rereading implied by the loop. (To the extent that this allows, backward goto commands succeeds on nonseekable inputs.)

If the command is a C shell built-in command, the shell executes it directly. Otherwise, the shell searches for a file by that name with execute access. If the command name contains a /, the shell takes it as a pathname, and searches for it. If the command name does not contain a /, the shell attempts to resolve it to a pathname, searching each directory in the path variable for
the command. To speed the search, the shell uses its hash table (see the rehash built-in command) to eliminate directories that have no applicable files. This hashing can be disabled with the -c or -t, options, or the unhash built-in command.

As a special case, if there is no / in the name of the script and there is an alias for the word shell, the expansion of the shell alias is prepended (without modification) to the command line. The system attempts to execute the first word of this special (late-occurring) alias, which should be a full pathname. Remaining words of the alias’s definition, along with the text of the input line, are treated as arguments.

When a pathname is found that has proper execute permissions, the shell forks a new process and passes it, along with its arguments, to the kernel using the execve( ) system call (see exec(2)). The kernel then attempts to overlay the new process with the desired program. If the file is an executable binary (in a.out(4) format) the kernel succeeds and begins executing the new process. If the file is a text file and the first line begins with #!, the next word is taken to be the pathname of a shell (or command) to interpret that script. Subsequent words on the first line are taken as options for that shell. The kernel invokes (overlays) the indicated shell, using the name of the script as an argument.

If neither of the above conditions holds, the kernel cannot overlay the file and the execve( ) call fails (see exec(2)). The C shell then attempts to execute the file by spawning a new shell, as follows:

- If the first character of the file is a #, a C shell is invoked.
- Otherwise, a Bourne shell is invoked.

Signal Handling

The shell normally ignores QUIT signals. Background jobs are immune to signals generated from the keyboard, including hangups (HUP). Other signals have the values that the C shell inherited from its environment. The shell’s handling of interrupt and terminate signals within scripts can be controlled by the onintr built-in command. Login shells catch the TERM signal. Otherwise, this signal is passed on to child processes. In no case are interrupts allowed when a login shell is reading the .logout file.

Job Control

The shell associates a numbered job with each command sequence to keep track of those commands that are running in the background or have been stopped with TSTP signals (typically Control-z). When a command or command sequence (semicolon separated list) is started in the background using the & metacharacter, the shell displays a line with the job number in brackets and a list of associated process numbers:


To see the current list of jobs, use the jobs built-in command. The job most recently stopped (or put into the background if none are stopped) is referred to as the current job and is indicated with a ‘+’. The previous job is indicated with a ‘−’. When the current job is terminated or moved to the foreground, this job takes its place (becomes the new current job).
To manipulate jobs, refer to the bg, fg, kill, stop, and % built-in commands.

A reference to a job begins with a ‘%’. By itself, the percent-sign refers to the current job.

%  %+  %%  %—  The current job.
%j  Refer to job j as in: ‘kill -9 %j’. j can be a job number, or a string that uniquely specifies the command line by which it was started; ‘fg %vi’ might bring a stopped vi job to the foreground, for instance.

%?string  Specify the job for which the command line uniquely contains string.

A job running in the background stops when it attempts to read from the terminal. Background jobs can normally produce output, but this can be suppressed using the ‘stty tostop’ command.

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A job running in the background stops when it attempts to read from the terminal. Background jobs can normally produce output, but this can be suppressed using the ‘stty tostop’ command.

Status Reporting  While running interactively, the shell tracks the status of each job and reports whenever the job finishes or becomes blocked. It normally displays a message to this effect as it issues a prompt, in order to avoid disturbing the appearance of your input. When set, the notify variable indicates that the shell is to report status changes immediately. By default, the notify command marks the current process; after starting a background job, type notify to mark it.

Commands  Built-in commands are executed within the C shell. If a built-in command occurs as any component of a pipeline except the last, it is executed in a subshell.

:  Null command. This command is interpreted, but performs no action.

alias [ name [ def ] ]  Assign def to the alias name. def is a list of words that can contain escaped history-substitution metasyntax. name is not allowed to be alias or unalias. If def is omitted, the current definition for the alias name is displayed. If both name and def are omitted, all aliases are displayed with their definitions.

bg [ %job ... ]  Run the current or specified jobs in the background.

break  Resume execution after the end of the nearest enclosing foreach or while loop. The remaining commands on the current line are executed. This allows multilevel breaks to be written as a list of break commands, all on one line.

breaksw  Break from a switch, resuming after the endsw.

case label:  A label in a switch statement.

cd [ dir ]

chdir [ dir ]  Change the shell's working directory to directory dir. If no argument is given, change to the home directory of the user. If dir is a relative
pathname not found in the current directory, check for it in those directories listed in the cdpath variable. If dir is the name of a shell variable whose value starts with a /, change to the directory named by that value.

continue

Continue execution of the next iteration of the nearest enclosing while or foreach loop.

default:

Labels the default case in a switch statement. The default should come after all case labels. Any remaining commands on the command line are first executed.

dirs [-l]

Print the directory stack, most recent to the left. The first directory shown is the current directory. With the -l argument, produce an unabbreviated printout; use of the ~ notation is suppressed.

echo [-n] list

The words in list are written to the shell’s standard output, separated by space characters. The output is terminated with a newline unless the -n option is used. csh, by default, invokes its built-in echo, if echo is called without the full pathname of a Unix command, regardless of the configuration of your PATH (see echo(1)).

eval argument . . .

Reads the arguments as input to the shell and executes the resulting command(s). This is usually used to execute commands generated as the result of command or variable substitution. See tset(1B) for an example of how to use eval.

exec command

Execute command in place of the current shell, which terminates.

exit [(expr)]

The calling shell or shell script exits, either with the value of the status variable or with the value specified by the expression expr.

fg [sjob ]

Bring the current or specified job into the foreground.

foreach var(wordlist)

The variable var is successively set to each member of wordlist. The sequence of commands between this command and the matching end is executed for each new value of var. Both foreach and end must appear alone on separate lines.

The built-in command continue can be used to terminate the execution of the current iteration of the loop and the built-in command break can be used to terminate execution of the foreach command. When this command is read from the terminal, the loop is read once prompting with ? before any statements in the loop are executed.
glob wordlist

Perform filename expansion on wordlist. Like echo, but no \ escapes are recognized. Words are delimited by NULL characters in the output.

gotolabel

The specified label is a filename and a command expanded to yield a label. The shell rewinds its input as much as possible and searches for a line of the form label: possibly preceded by space or tab characters. Execution continues after the indicated line. It is an error to jump to a label that occurs between a while or for built-in command and its corresponding end.

hashstat

Print a statistics line indicating how effective the internal hash table for the path variable has been at locating commands (and avoiding execs). An exec is attempted for each component of the path where the hash function indicates a possible hit and in each component that does not begin with a `'/'. These statistics only reflect the effectiveness of the path variable, not the cdpath variable.

history[-hr][n]

Display the history list; if n is given, display only the n most recent events.

- r Reverse the order of printout to be most recent first rather than oldest first.

- h Display the history list without leading numbers. This is used to produce files suitable for sourcing using the -h option to source.

if (expr )command

If the specified expression evaluates to true, the single command with arguments is executed. Variable substitution on command happens early, at the same time it does for the rest of the if command. command must be a simple command, not a pipeline, a command list, or a parenthesized command list. Note: I/O redirection occurs even if expr is false, when command is not executed (this is a bug).

if (expr) then
 ...
else if (expr2) then
 ...
else
 ...
endif

If expr is true, commands up to the first else are executed. Otherwise, if expr2 is true, the commands
between the \texttt{else if} and the second \texttt{else} are executed. Otherwise, commands between the \texttt{else} and the \texttt{endif} are executed. Any number of \texttt{else if} pairs are allowed, but only one \texttt{else}. Only one \texttt{endif} is needed, but it is required. The words \texttt{else} and \texttt{endif} must be the first nonwhite characters on a line. The \texttt{if} must appear alone on its input line or after an \texttt{else}.

\begin{verbatim}
jobs [-l]
\end{verbatim}

List the active jobs under job control.

\begin{verbatim}
- l List process IDs, in addition to the normal information.
\end{verbatim}

\begin{verbatim}
kill [sig] [pid] [ %job ]
\end{verbatim}

Send the \texttt{TERM} (terminate) signal, by default, or the signal specified, to the specified process ID, the \texttt{job} indicated, or the current \texttt{job}. Signals are either given by number or by name. There is no default. Typing \texttt{kill} does not send a signal to the current job. If the signal being sent is \texttt{TERM} (terminate) or \texttt{HUP} (hangup), then the \texttt{job} or process is sent a \texttt{CONT} (continue) signal as well.

\begin{verbatim}
- l List the signal names that can be sent.
\end{verbatim}

\begin{verbatim}
limit [-h] [resource [max-use]]
\end{verbatim}

Limit the consumption by the current process or any process it spawns, each not to exceed \texttt{max-use} on the specified \texttt{resource}. The string \texttt{unlimited} requests that the current limit, if any, be removed. If \texttt{max-use} is omitted, print the current limit. If \texttt{resource} is omitted, display all limits. Run the \texttt{sysdef(1M)} command to obtain the maximum possible limits for your system. The values reported by \texttt{sysdef} are in hexadecimal, but can be translated into decimal numbers using the \texttt{bc(1)} command.

\begin{verbatim}
- h Use hard limits instead of the current limits. Hard limits impose a ceiling on the values of the current limits. Only the privileged user can raise the hard limits.
\end{verbatim}

\textit{resource} is one of:

\begin{verbatim}
cputime Maximum CPU seconds per process.
\end{verbatim}
filesize  Largest single file allowed. Limited by the size and capabilities of the filesystem. See df(1M).

datasize (heapsize) Maximum data size (including stack) for the process. This is the size of your virtual memory. See swap(1M).

stacksize Maximum stack size for the process. The default stack size is 2^64 bytes. You can use limit(1) to change this default within a shell.

coredumpsize Maximum size of a core dump (file). This limited to the size of the filesystem.

descriptors Maximum number of file descriptors. Run sysdef(1M).

memorysize Maximum size of virtual memory.

max-use is a number, with an optional scaling factor, as follows:


Example of limit: To limit the size of a core file dump to 0 Megabytes, type the following:

```
limit coredumpsize 0M
```

```
login [username | -p ]
```

Terminate a login shell and invoke login(1). The .logout file is not processed. If username is omitted, login prompts for the name of a user.

```
-p
```

Preserve the current environment (variables).

```
logout
```

Terminate a login shell.
nice [\(+n\) \([-n]\) \([\text{command}]\)]

Increment the process priority value for the shell or for `command` by \(n\). The higher the priority value, the lower the priority of a process, and the slower it runs. When given, `command` is always run in a subshell, and the restrictions placed on commands in simple `if` commands apply. If `command` is omitted, `nice` increments the value for the current shell. If no increment is specified, `nice` sets the process priority value to 4. The range of process priority values is from \(-20\) to 20. Values of \(n\) outside this range set the value to the lower, or to the higher boundary, respectively.

\(\text{+n}\) Increment the process priority value by \(n\).

\(\text{-n}\) Decrement by \(n\). This argument can be used only by the privileged user.

nohup [\(\text{command}\)]

Run `command` with HUPs ignored. With no arguments, ignore HUPs throughout the remainder of a script. When given, `command` is always run in a subshell, and the restrictions placed on commands in simple `if` statements apply. All processes detached with `&` are effectively nohup’ed.

notify [%\(\text{job}\)]...

Notify the user asynchronously when the status of the current job or specified jobs changes.

onintr [\(-\) \(\text{label}\)]

Control the action of the shell on interrupts. With no arguments, `onintr` restores the default action of the shell on interrupts. (The shell terminates shell scripts and returns to the terminal command input level). With the `-` argument, the shell ignores all interrupts. With a `label` argument, the shell executes a `goto label` when an interrupt is received or a child process terminates because it was interrupted.

popd [+\(n\)]

Pop the directory stack and `cd` to the new top directory. The elements of the directory stack are numbered from 0 starting at the top.

\(\text{+n}\) Discard the \(n\)'th entry in the stack.

pushd [+\(n\) \([\text{dir}]\)]

Push a directory onto the directory stack. With no arguments, exchange the top two elements.

\(\text{+n}\) Rotate the \(n\)'th entry to the top of the stack and `cd` to it.
dir     Push the current working directory onto the stack and change to dir.

rehash  Recompute the internal hash table of the contents of directories listed in the path variable to account for new commands added. Recompute the internal hash table of the contents of directories listed in the cdpath variable to account for new directories added.

repeat count command Repeat command count times. command is subject to the same restrictions as with the one-line if statement.

set [var [= value ] ]
set var[n] = word

With no arguments, set displays the values of all shell variables. Multiword values are displayed as a parenthesized list. With the var argument alone, set assigns an empty (null) value to the variable var. With arguments of the form var = value set assigns value to var, where value is one of:

word       A single word (or quoted string).
(wordlist) A space-separated list of words enclosed in parentheses.

Values are command and filename expanded before being assigned. The form set var[n] = word replaces the n'th word in a multiword value with word.

setenv [VAR [word ] ]

With no arguments, setenv displays all environment variables. With the VAR argument, setenv sets the environment variable VAR to have an empty (null) value. (By convention, environment variables are normally given upper-case names.) With both VAR and word arguments, setenv sets the environment variable NAME to the value word, which must be either a single word or a quoted string. The most commonly used environment variables, USER, TERM, and PATH, are automatically imported to and exported from the csh variables user, term, and path. There is no need to use setenv for these. In addition, the shell sets the PWD environment variable from the csh variable cwd whenever the latter changes.

The environment variables LC_TYPE, LC_MESSAGES, LC_TIME, LC_COLLATE, LC_NUMERIC, and LC_MONETARY take immediate effect when changed within the C shell.
If any of the LC_* variables (LC_CTYPE, LC_MESSAGES, LC_TIME, LC_COLLATE, LC_NUMERIC, and LC_MONETARY) (see environ(5)) are not set in the environment, the operational behavior of csh for each corresponding locale category is determined by the value of the LANG environment variable. If LC_ALL is set, its contents are used to override both the LANG and the other LC_* variables. If none of the above variables is set in the environment, the “C” (U.S. style) locale determines how csh behaves.

LC_CTYPE Determines how csh handles characters. When LC_CTYPE is set to a valid value, csh can display and handle text and filenames containing valid characters for that locale.

LC_MESSAGES Determines how diagnostic and informative messages are presented. This includes the language and style of the messages and the correct form of affirmative and negative responses. In the “C” locale, the messages are presented in the default form found in the program itself (in most cases, U.S./English).

LC_NUMERIC Determines the value of the radix character, decimal point, (.) in the “C” locale) and thousand separator, empty string (“”) in the “C” locale).

shift [variable ] The components of argv, or variable, if supplied, are shifted to the left, discarding the first component. It is an error for the variable not to be set or to have a null value.

source [-h] name Reads commands from name. source commands can be nested, but if they are nested too deeply the shell can run out of file descriptors. An error in a sourced file at any level terminates all nested source commands.

- h Place commands from the file name on the history list without executing them.

stop %jobid... Stop the current or specified background job.

stop pid... Stop the specified process, pid. (see ps(1)).
suspend

Stop the shell in its tracks, much as if it had been sent a stop signal with ^Z. This is most often used to stop shells started by su.

switch (string)
case label:
  ...
breaksw
  ...
default:
  ...
breaksw
endsw

Each label is successively matched, against the specified string, which is first command and filename expanded. The file metacharacters *, ?, and [...] can be used in the case labels, which are variable expanded. If none of the labels match before a “default” label is found, execution begins after the default label. Each case statement and the default statement must appear at the beginning of a line. The command breaksw continues execution after the endsw. Otherwise control falls through subsequent case and default statements as with C. If no label matches and there is no default, execution continues after the endsw.

time [command]

With no argument, print a summary of time used by this C shell and its children. With an optional command, execute command and print a summary of the time it uses. As of this writing, the time built-in command does NOT compute the last 6 fields of output, rendering the output to erroneously report the value 0 for these fields.

example %time ls -R
  9.0u 11.0s 3:32 10% 0+0k 0+0io 0pf+0w

(See the Environment Variables and Predefined Shell Variables sub-section on the time variable.)

umask [value]

Display the file creation mask. With value, set the file creation mask. With value given in octal, the user can turn off any bits, but cannot turn on bits to allow new permissions. Common values include 077, restricting all permissions from everyone else; 002, giving complete access to the group, and read (and directory search) access to others; or 022, giving read (and directory search) but not write permission to the group and others.
unalias pattern
Discard aliases that match (filename substitution) pattern. All aliases are removed by 'unalias *'.

unhash
Disable the internal hash tables for the path and cdpath variables.

unlimit [-h] [resource]
Remove a limitation on resource. If no resource is specified, then all resource limitations are removed. See the description of the limit command for the list of resource names.

- h Remove corresponding hard limits. Only the privileged user can do this.

unset pattern
Remove variables whose names match (filename substitution) pattern. All variables are removed by 'unset *'; this has noticeably distasteful side effects.

unsetenv variable
Remove variable from the environment. As with unset, pattern matching is not performed.

wait
Wait for background jobs to finish (or for an interrupt) before prompting.

while (expr)
...
end
While expr is true (evaluates to nonzero), repeat commands between the while and the matching end statement. break and continue can be used to terminate or continue the loop prematurely. The while and end must appear alone on their input lines. If the shell's input is a terminal, it prompts for commands with a question-mark until the end command is entered and then performs the commands in the loop.

% [job] [&]
Bring the current or indicated job to the foreground. With the ampersand, continue running job in the background.

@[var = expr]
@ [var[n]=expr]
With no arguments, display the values for all shell variables. With arguments, set the variable var, or the n'th word in the value of var, to the value that expr evaluates to. (If [n] is supplied, both var and its n'th component must already exist.)
If the expression contains the characters >, <, &, or |, then at least this part of \textit{expr} must be placed within parentheses.

The operators *=, +=, and so forth, are available as in C. The space separating the name from the assignment operator is optional. Spaces are, however, mandatory in separating components of \textit{expr} that would otherwise be single words.

Special postfix operators, + + and − −, increment or decrement \textit{name}, respectively.

Unlike the Bourne shell, the C shell maintains a distinction between environment variables, which are automatically exported to processes it invokes, and shell variables, which are not. Both types of variables are treated similarly under variable substitution. The shell sets the variables \texttt{argv}, \texttt{cwd}, \texttt{home}, \texttt{path}, \texttt{prompt}, \texttt{shell}, and \texttt{status} upon initialization. The shell copies the environment variable \texttt{USER} into the shell variable \texttt{user}, \texttt{TERM} into \texttt{term}, and \texttt{HOME} into \texttt{home}, and copies each back into the respective environment variable whenever the shell variables are reset. \texttt{PATH} and \texttt{path} are similarly handled. You need only set \texttt{path} once in the \texttt{.cshrc} or \texttt{.login} file. The environment variable \texttt{PWD} is set from \texttt{cwd} whenever the latter changes. The following shell variables have predefined meanings:

- \texttt{argv}: Argument list. Contains the list of command line arguments supplied to the current invocation of the shell. This variable determines the value of the positional parameters $1$, $2$, and so on.
- \texttt{cdpath}: Contains a list of directories to be searched by the \texttt{cd}, \texttt{chdir}, and \texttt{popd} commands, if the directory argument each accepts is not a subdirectory of the current directory.
- \texttt{cwd}: The full pathname of the current directory.
- \texttt{echo}: Echo commands (after substitutions) just before execution.
- \texttt{fignore}: A list of filename suffixes to ignore when attempting filename completion. Typically the single word `.o`.
- \texttt{flecc}: Enable filename completion, in which case the Control-d character \texttt{EOT} and the \texttt{ESC} character have special significance when typed in at the end of a terminal input line:
  - \texttt{EOT}: Print a list of all filenames that start with the preceding string.
  - \texttt{ESC}: Replace the preceding string with the longest unambiguous extension.
- \texttt{hardpaths}: If set, pathnames in the directory stack are resolved to contain no symbolic-link components.
histchars  A two-character string. The first character replaces \! as the
directory substitution character. The second replaces the carat (^) for quick
substitutions.

history  The number of lines saved in the history list. A very large number can use up
all of the C shell's memory. If not set, the C shell saves only the most recent
command.

home  The user's home directory. The filename expansion of ~ refers to the value of
this variable.

ignoreeof  If set, the shell ignores EOF from terminals. This protects against accidentally
killing a C shell by typing a Control-d.

mail  A list of files where the C shell checks for mail. If the first word of the value is a
number, it specifies a mail checking interval in seconds (default 5 minutes).

nobeep  Suppress the bell during command completion when asking the C shell to
extend an ambiguous filename.

clobber  Restrict output redirection so that existing files are not destroyed by accident.
> redirections can only be made to new files. >> redirections can only be made
to existing files.

noglob  Inhibit filename substitution. This is most useful in shell scripts once filenames
(if any) are obtained and no further expansion is desired.

nonomatch  Return the filename substitution pattern, rather than an error, if the pattern is
not matched. Malformed patterns still result in errors.

notify  If set, the shell notifies you immediately as jobs are completed, rather than
waiting until just before issuing a prompt.

path  The list of directories in which to search for commands. path is initialized
from the environment variable PATH, which the C shell updates whenever path
changes. A null word ("") specifies the current directory. The default is typically
(\!/usr/bin .). One can override this initial search path upon csh start-up by
setting it in .cshrc or .login (for login shells only). If path becomes unset,
only full pathnames execute. An interactive C shell normally hashes the
contents of the directories listed after reading .cshrc, and whenever path is
reset. If new commands are added, use the rehash command to update the
table.

prompt  The string an interactive C shell prompts with. Noninteractive shells leave the
prompt variable unset. Aliases and other commands in the .cshrc file that are
only useful interactively, can be placed after the following test: 'if ($?prompt
== 0) exit', to reduce startup time for noninteractive shells. A ! in the prompt
string is replaced by the current event number. The default prompt is
hostname% for mere mortals, or hostname# for the privileged user.
The setting of `$prompt` has three meanings:

- $prompt not set: non-interactive shell, test `$prompt`.
- $prompt set but `== ""`: .cshrc called by the `which(1)` command.
- $prompt set and `!= ""`: normal interactive shell.

**savehist**
The number of lines from the history list that are saved in `~/.history` when the user logs out. Large values for `savehist` slow down the C shell during startup.

**shell**
The file in which the C shell resides. This is used in forking shells to interpret files that have execute bits set, but that are not executable by the system.

**status**
The status returned by the most recent command. If that command terminated abnormally, 0200 is added to the status. Built-in commands that fail return exit status 1; all other built-in commands set status to 0.

**time**
Control automatic timing of commands. Can be supplied with one or two values. The first is the reporting threshold in CPU seconds. The second is a string of tags and text indicating which resources to report on. A tag is a percent sign (%) followed by a single upper-case letter (unrecognized tags print as text):

- `%D`: Average amount of unshared data space used in Kilobytes.
- `%E`: Elapsed (wallclock) time for the command.
- `%F`: Page faults.
- `%I`: Number of block input operations.
- `%K`: Average amount of unshared stack space used in Kilobytes.
- `%M`: Maximum real memory used during execution of the process.
- `%O`: Number of block output operations.
- `%P`: Total CPU time — U (user) plus S (system) — as a percentage of E (elapsed) time.
- `%S`: Number of seconds of CPU time consumed by the kernel on behalf of the user’s process.
- `%U`: Number of seconds of CPU time devoted to the user’s process.
- `%W`: Number of swaps.
- `%X`: Average amount of shared memory used in Kilobytes.

The default summary display outputs from the `%U`, `%S`, `%E`, `%P`, `%X`, `%D`, `%I`, `%O`, `%F`, and `%W` tags, in that order.

**verbose**
Display each command after history substitution takes place.
Large File Behavior

See largefile(5) for the description of the behavior of csh when encountering files greater than or equal to 2 Gbyte ($2^{31}$ bytes).

Files

<table>
<thead>
<tr>
<th>File Path</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>~/.cshrc</td>
<td>Read at beginning of execution by each shell.</td>
</tr>
<tr>
<td>~/.login</td>
<td>Read by login shells after .cshrc at login.</td>
</tr>
<tr>
<td>~/.logout</td>
<td>Read by login shells at logout.</td>
</tr>
<tr>
<td>~/.history</td>
<td>Saved history for use at next login.</td>
</tr>
<tr>
<td>/usr/bin/sh</td>
<td>The Bourne shell, for shell scripts not starting with a '#'</td>
</tr>
<tr>
<td>/tmp/sh*</td>
<td>Temporary file for <code>&lt;&lt;</code>.</td>
</tr>
<tr>
<td>/etc/passwd</td>
<td>Source of home directories for <code>~name</code>.</td>
</tr>
</tbody>
</table>

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

See Also

bc(1), echo(1), limit(1), login(1), ls(1), more(1), pfcsh(1), pfexec(1), ps(1), sh(1),
shell builtins(1), tset(1B), which(1), df(1M), swap(1M), sysdef(1M), access(2),
exec(2), fork(2), pipe(2), a.out(4), ascii(5), attributes(5), environ(5), largefile(5),
termio(71)

Diagnostics

You have stopped jobs.
You attempted to exit the C shell with stopped jobs under job control. An immediate second attempt to exit succeeds, terminating the stopped jobs.

Warnings

The use of setuid shell scripts is strongly discouraged.

Notes

Words can be no longer than 1024 bytes. The system limits argument lists to 1,048,576 bytes. However, the maximum number of arguments to a command for which filename expansion applies is 1706. Command substitutions can expand to no more characters than are allowed in the argument list. To detect looping, the shell restricts the number of alias substitutions on a single line to 20.

When a command is restarted from a stop, the shell prints the directory it started in if this is different from the current directory; this can be misleading (that is, wrong) as the job might have changed directories internally.

Shell built-in functions are not stoppable/restartable. Command sequences of the form $a b c$ are also not handled gracefully when stopping is attempted. If you suspend $b$, the shell never
executes c. This is especially noticeable if the expansion results from an alias. It can be avoided by placing the sequence in parentheses to force it into a subshell.

Commands within loops, prompted for by ?, are not placed in the history list.

Control structures should be parsed rather than being recognized as built-in commands. This would allow control commands to be placed anywhere, to be combined with |, and to be used with & and ; metasyntax.

It should be possible to use the : modifiers on the output of command substitutions. There are two problems with : modifier usage on variable substitutions: not all of the modifiers are available, and only one modifier per substitution is allowed.

The g (global) flag in history substitutions applies only to the first match in each word, rather than all matches in all words. The common text editors consistently do the latter when given the g flag in a substitution command.

Quoting conventions are confusing. Overriding the escape character to force variable substitutions within double quotes is counterintuitive and inconsistent with the Bourne shell.

Symbolic links can fool the shell. Setting the hardpaths variable alleviates this.

It is up to the user to manually remove all duplicate pathnames accrued from using built-in commands more than once, as shown below:

```
set path = pathnames
setenv PATH = pathnames
```

These often occur because a shell script or a .cshrc file does something like
‘set path=/usr/local /usr/hosts $path’

to ensure that the named directories are in the pathname list.

The only way to direct the standard output and standard error separately is by invoking a subshell, as follows:

```
command > outfile 2> errorfile
```

Although robust enough for general use, adventures into the esoteric periphery of the C shell can reveal unexpected quirks.

If you start csh as a login shell and you do not have a .login in your home directory, then the csh reads in the /etc/.login.

When the shell executes a shell script that attempts to execute a non-existent command interpreter, the shell returns an erroneous diagnostic message that the shell script file does not exist.
Bugs  As of this writing, the `time` built-in command does not compute the last 6 fields of output, rendering the output to erroneously report the value 0 for these fields:

example `%time ls -R
   9.0u 11.0s 3:32 10% 0+0k 0+0io 0pf+0w
**csplit** – split files based on context

**Synopsis**
```
csplit [-ks] [-f prefix] [-n number] file arg1... argn
```

**Description**
The `csplit` utility reads the file named by the `file` operand, writes all or part of that file into other files as directed by the `arg` operands, and writes the sizes of the files.

**Options**
The following options are supported:

- `-f prefix` Names the created files `prefix00`, `prefix01`, ..., `prefixn`. The default is `xx00` ... `xxn`. If the `prefix` argument would create a file name exceeding 14 bytes, an error results. In that case, `csplit` exits with a diagnostic message and no files are created.

- `-k` Leaves previously created files intact. By default, `csplit` removes created files if an error occurs.

- `-n number` Uses `number` decimal digits to form filenames for the file pieces. The default is 2.

- `-s` Suppresses the output of file size messages.

**Operands**
The following operands are supported:

- `file` The path name of a text file to be split. If `file` is `-`, the standard input will be used.

The operands `arg1 ... argn` can be a combination of the following:

- `/rexp\[\{num\}\]` Create a file using the content of the lines from the current line up to, but not including, the line that results from the evaluation of the regular expression with `offset`, if any, applied. The regular expression `rexp` must follow the rules for basic regular expressions. Regular expressions can include the use of `\` and `\%`. These forms must be properly quoted with single quotes, since "\" is special to the shell. The optional `offset` must be a positive or negative integer value representing a number of lines. The integer value must be preceded by `+` or `−`. If the selection of lines from an offset expression of this type would create a file with zero lines, or one with greater than the number of lines left in the input file, the results are unspecified. After the section is created, the current line will be set to the line that results from the evaluation of the regular expression with any offset applied. The pattern match of `rexp` always is applied from the current line to the end of the file.

- `%rexp%\{num\}` This operand is the same as `/rexp\[\{num\}\]`, except that no file will be created for the selected section of the input file.

- `line_no` Create a file from the current line up to (but not including) the line number `line_no`. Lines in the file will be numbered starting at one. The current line becomes `line_no`.

- `{num}` Repeat operand. This operand can follow any of the operands described previously. If it follows a `rexp` type operand, that operand will be applied `num` more times. If it follows a `line_no` operand, the file will be split every
line_no lines, num times, from that point.

An error will be reported if an operand does not reference a line between the current position and the end of the file.

Usage  See largefile(5) for the description of the behavior of csplit when encountering files greater than or equal to 2 Gbyte ($2^{31}$ bytes).

Examples  EXAMPLE 1  Splitting and combining files
This example creates four files, cobol00...cobol03.

```
example% csplit -f cobol filename \
       '/procedure division/' /par5./ /par16./
```

After editing the split files, they can be recombined as follows:

```
example% cat cobol[0-3] > filename
```

This example overwrites the original file.

EXAMPLE 2  Splitting a file into equal parts
This example splits the file at every 100 lines, up to 10,000 lines. The -k option causes the created files to be retained if there are less than 10,000 lines; however, an error message would still be printed.

```
example% csplit -k filename 100 {99}
```

EXAMPLE 3  Creating a file for separate C routines
If prog.c follows the normal C coding convention (the last line of a routine consists only of a } in the first character position), this example creates a file for each separate C routine (up to 21) in prog.c.

```
example% csplit -k prog.c '%main(\' "/"}/+1' {20}
```

Environment Variables  See environ(5) for descriptions of the following environment variables that affect the execution of csplit: LANG, LC_ALL, LC_COLLATE, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status  The following exit values are returned:

- 0  Successful completion.
- >0  An error occurred.

Attributes  See attributes(5) for descriptions of the following attributes:
<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

**See Also**  
`sed(1), split(1), attributes(5), environ(5), largefile(5), standards(5)`

**Diagnostics**  
The diagnostic messages are self-explanatory, except for the following:

- `arg – out of range`  
  The given argument did not reference a line between the current position and the end of the file.
ct utility dials the telephone number of a modem that is attached to a terminal and spawns a login process to that terminal. The telno is a telephone number, with equal signs for secondary dial tones and minus signs for delays at appropriate places. (The set of legal characters for telno is 0 through 9, . , =, *, and #. The maximum length telno is 31 characters.) If more than one telephone number is specified, ct will try each in succession until one answers; this is useful for specifying alternate dialing paths.

ct will try each line listed in the file /etc/uucp/Devices until it finds an available line with appropriate attributes, or runs out of entries.

After the user on the destination terminal logs out, there are two things that could occur depending on what type of port monitor is monitoring the port. In the case of no port monitor, ct prompts: Reconnect? If the response begins with the letter n, the line will be dropped; otherwise, ttypmon will be started again and the login: prompt will be printed. In the second case, where a port monitor is monitoring the port, the port monitor reissues the login: prompt.

The user should log out properly before disconnecting.

Options The following options are supported:

- **h** Normally, ct will hang up the current line so that it can be used to answer the incoming call. The -h option will prevent this action. The -h option will also wait for the termination of the specified ct process before returning control to the user's terminal.

- **-sspeed** The data rate may be set with the -s option. speed is expressed in baud rates. The default baud rate is 1200.

- **v** If the -v (verbose) option is used, ct will send a running narrative to the standard error output stream.

- **wn** If there are no free lines ct will ask if it should wait, and for how many minutes, before it gives up. ct will continue to try to open the dialers at one-minute intervals until the specified limit is exceeded. This dialogue may be overridden by specifying the -wn option. n is the maximum number of minutes that ct is to wait for a line.

- **xn** This option is used for debugging; it produces a detailed output of the program execution on stderr. n is a single number between 0 and 9. As n increases to 9, more detailed debugging information is given.
Files
/etc/uucp/Devices
/var/adm/ctlog

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/uucp</td>
</tr>
</tbody>
</table>

See Also cu(1C), login(1), uucp(1C), ttymon(1M), attributes(5)

Notes The ct program will not work with a DATAKIT Multiplex interface.

For a shared port, one used for both dial-in and dial-out, the ttymon program running on the line must have the -r and -b options specified (see ttymon(1M)).
ctags(1)

Name
ctags—create a tags file for use with ex and vi

Synopsis
/usr/bin/ctags [-aBFuvwx] [-f tagsfile] file...
/usr/xpg4/bin/ctags [-aBFuvwx] [-f tagsfile] file...

description
The ctags utility makes a tags file for ex(1) from the specified C, C++, Pascal, FORTRAN, yacc(1), and lex(1) sources. A tags file gives the locations of specified objects (in this case functions and typedefs) in a group of files. Each line of the tags file contains the object name, the file in which it is defined, and an address specification for the object definition. Functions are searched with a pattern, typedefs with a line number. Specifiers are given in separate fields on the line, separated by SPACE or TAB characters. Using the tags file, ex can quickly find these objects’ definitions.

Normally, ctags places the tag descriptions in a file called tags; this may be overridden with the -f option.

Files with names ending in .c or .h are assumed to be either C or C++ source files and are searched for C/C++ routine and macro definitions. Files with names ending in .cc, .C, or .cxx, are assumed to be C++ source files. Files with names ending in .y are assumed to be yacc source files. Files with names ending in .l are assumed to be lex files. Others are first examined to see if they contain any Pascal or FORTRAN routine definitions; if not, they are processed again looking for C definitions.

The tag main is treated specially in C or C++ programs. The tag formed is created by prepending M to file, with a trailing .c, .cc .C, or .cxx removed, if any, and leading path name components also removed. This makes use of ctags practical in directories with more than one program.

Options
The precedence of the options that pertain to printing is -x, -v, then the remaining options. The following options are supported:

-a Appends output to an existing tags file.
-B Uses backward searching patterns (?...?).
-f tagsfile Places the tag descriptions in a file called tagsfile instead of tags.
-F Uses forward searching patterns (/.../) (default).
-t Creates tags for typedefs. /usr/xpg4/bin/ctags creates tags for typedefs by default.
-u Updates the specified files in tags, that is, all references to them are deleted, and the new values are appended to the file. Beware: this option is implemented in a way that is rather slow; it is usually faster to simply rebuild the tags file.
-v Produces on the standard output an index listing the function name, file name, and page number (assuming 64 line pages). Since the output will be sorted into lexicographic order, it may be desired to run the output through sort -f.
Suppresses warning diagnostics.

-x Produces a list of object names, the line number and file name on which each is defined, as well as the text of that line and prints this on the standard output. This is a simple index which can be printed out as an off-line readable function index.

Operands The following file operands are supported:

- file.c Files with basenames ending with the .c suffix are treated as C-language source code.
- file.h Files with basenames ending with the .h suffix are treated as C-language source code.
- file.f Files with basenames ending with the .f suffix are treated as FORTRAN-language source code.

Usage The -v option is mainly used with vgrind which will be part of the optional BSD Compatibility Package.

Examples 1 Producing entries in alphabetical order

Using ctags with the -v option produces entries in an order which may not always be appropriate for vgrind. To produce results in alphabetical order, you may want to run the output through sort -f.

```bash
example% ctags -v filename.c filename.h | sort -f > index
exmaple% vgrind -x index
```

EXAMPLE 2 Building a tags file

To build a tags file for C sources in a directory hierarchy rooted at sourcedir, first create an empty tags file, and then run find(1)

```bash
example% cd sourcedir ; rm -f tags ; touch tags
example% find . -name SCCS -prune -name \n"*.c" -o -name "*.h" \) -exec ctags -u {} \;
```

Notice that spaces must be entered exactly as shown.

Environment Variables See environ(5) for descriptions of the following environment variables that affect the execution of ctags: LANG, LC_ALL, LC_COLLATE, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status The following exit values are returned:

- 0 Successful completion.
- >0 An error occurred.
ctags(1)

Files  tags  output tags file

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>/usr/bin/ctags</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/base-developer-utilities</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>/usr/xpg4/bin/ctags</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/xopen/xcu4</td>
<td></td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5)</td>
<td></td>
</tr>
</tbody>
</table>

See Also  ex(1), lex(1), vgrind(1), vi(1), yacc(1), attributes(5), environ(5), standards(5)

Notes  Recognition of functions, subroutines, and procedures for FORTRAN and Pascal is done in a very simple-minded way. No attempt is made to deal with block structure; if you have two Pascal procedures in different blocks with the same name, you lose.

The method of deciding whether to look for C or Pascal and FORTRAN functions is a hack.

The ctags utility does not know about #ifdefs.

The ctags utility should know about Pascal types. Relies on the input being well formed to detect typedefs. Use of -tx shows only the last line of typedefs.
Name  ctrun – execute command in a process contract

Synopsis  /usr/bin/ctrun [options] command [ argument]...

Description  The ctrun utility starts a command in a newly created process contract. ctrun holds the contract and can be instructed to output or respond to events that occur within the contract.

For additional information about process contracts, see contract(4) and process(4).

Options  The following options are supported:

-A aux  Sets the process contract creator’s auxiliary field.
-1 event,[event ...]  Sets the informative and fatal events, respectively.
-ť event,[event ...]  Sets the informative and fatal events, respectively.

The following are valid events:

core  A member process dumped core.
    core events are informative by default.

empty  The last member of the process contract exited.

exit  A member process exited.

fork  A process was added to the process contract.

hwerr  A member process encountered a hardware error.
    hwerr events are fatal by default.

signal  A member process received a fatal signal from a process in a different process contract.

Only core, hwerr, and signal events can be made fatal.

More events can be delivered than requested if ctrun requires them for its own purposes. For example, empty messages are always requested if a lifetime of contract is specified. See -lı.

-F fmri  Sets the process contract service FMRI field. To set this field the caller is required to have the {PRIV_CONTRACT_IDENTIT} in its effective set.

-lı lifetime  The following valid lifetime values are supported:

child  ctrun exits when the command exits, regardless of whether the contract is empty.

contract  ctrun exits only when the contract exits. This is the default.
none ctrun exits immediately, orphaning the contract.

-o option,[option ...] The following options are supported:

noorphan Kills all processes in the contract if the holder ctrun exits.

This option is invalid when a lifetime of none is specified.

pgrponly If a fatal error occurs, kills at most the process group of which the errant process is a member.

regent The contract inherits inheritable contracts when abandoned by member processes.

-r count If the contract encounters a fault, this option attempts to restart the command count times. If count is 0, the attempt to restart continues indefinitely. By default, ctrun does not attempt to restart the command.

This option is invalid if a lifetime other than contract is specified or if the pgrponly option is used.

-t If the contract created by ctrun inherited subcontracts from its member processes, attempts to transfer them to the new contract when restarting.

This option is invalid unless -r is also specified.

-v Displays contract events and ctrun actions as they occur.

-V Displays verbose contract events, as are displayed by the -v option of ctwatch. Implies -v.

Operands The following operands are supported:

argument One of the strings treated as an argument to command.

command The command to be passed to execvp(2). See exec(2).

Examples EXAMPLE 1 Running a Shell in a New Process Contract

The following example runs a shell in a new process contract:

eexample% ctrun -l child -o pgrponly ksh

The -l child option argument is specified so that ctrun won't wait until all children of the shell have exited. -o pgrponly is specified because an interactive ksh puts each job in a new process group, and an error in one job is unlikely to affect the others.
EXAMPLE 2  Running a Simple Server

The following example runs a simple server:

example% ctrun -r 0 -t -f hwerr,core,signal server

The -r 0 and -t options are specified to indicate that if the server encounters a fatal error, ctrun should try to restart it. The -f option makes "hwerr", "core", and "signal" fatal events.

Exit Status  If command is specified and successfully invoked (see exec(2)), the exit status of ctrun is the exit status of command. Otherwise, ctrun exits with one of the following values:

- 123  The child process exited abnormally.
- 124  ctrun encountered an internal error.
- 125  Invalid arguments were provided to ctrun.
- 126  command was found but could not be invoked.
- 127  command could not be found.

Files  /system/contract/process/*

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>See below.</td>
</tr>
</tbody>
</table>

Human Readable Output is Uncommitted. Invocation is Committed.

See Also  ctstat(1), ctwatch(1), exec(2), contract(4), process(4), attributes(5)
ctstat(1)

Name  ctstat – display active system contracts

Synopsis  
/usr/bin/ctstat [-a] [-i contractid...] [-t type...] [-v]
    [-T u | d] [interval [count]]

Description  The ctstat utility allows a user to observe the contracts active on a system.

   Unless you specify the -i or -t option, ctstat displays statistics on all contracts in the system.

Options  The following options are supported:

   -a
   Display all contracts regardless of state. By default, only those contracts which are in the
   owned, inherited, or orphan states are displayed.

   -i contractid...
   Request status on the specified contracts, identified by their numeric contract identifier
   (contract_id).

   This option accepts lists as arguments. Items in the list can be separated by commas, or
   enclosed in quotes and separated by commas or spaces.

   -T u | d
   Display a time stamp.

   Specify u for a printed representation of the internal representation of time. See time(2).
   Specify d for standard date format. See date(1).

   -t type...
   Request status on contracts of the specified type (type).

   This option accepts lists as arguments. Items in the list can be separated by commas, or
   enclosed in quotes and separated by commas or spaces.

   The following types are supported:
   process
      Process contracts

   -v
   Verbose output.

Operands  The following operands are supported:

   interval
      Report once each interval seconds.

   count
      Print only count reports.
Output  The following list defines the column headings and the meanings of a ctstat report:

CTID  The contract ID of the contract.

ZONEID  The zone ID of the contract's creator.

TYPE  The contract type.

STATE  The state of the contract:

owned  Contract is owned by a process.

inherited  The contract owner has exited abnormally and the contract has been inherited by the owner's process contract.

orphan  The contract owner has abandoned the contract, the contract owner exited abnormally and the contract was not inherited by the owner's process contract, or the process contract which had inherited the contract was abandoned by its owner.

dead  The contract is no longer active. It is removed from the system automatically when all references to it (open file descriptors, contract templates, and events) have been released.

HOLDER  If the contract is in the owned state, the pid of the process that owns the contract. If the contract is in the inherited state, the id of the regent process contract.

EVENTS  The number of unacknowledged critical events pending.

QTIME  The time until quantum ends, or - if no negotiation is in progress.

NTIME  The time until negotiation ends, or - if no negotiation is in progress.

Examples  EXAMPLE 1  Reporting on all Contracts in the System

The following example reports on all contracts in the system:

example% ctstat -a

<table>
<thead>
<tr>
<th>CTID</th>
<th>TYPE</th>
<th>STATE</th>
<th>HOLDER</th>
<th>EVENTS</th>
<th>QTIME</th>
<th>NTIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>process</td>
<td>owned</td>
<td>100579</td>
<td>0</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
EXAMPLE 1 Reporting on all Contracts in the System (Continued)

2 process dead - 1 - -
3 process inherit 1 3 - -
4 process orphan - 0 - -

EXAMPLE 2 Obtaining a Verbose Report of All Contracts in the System

The following example obtains a verbose report of all contracts in the system:

dir example% ctstat -av

<table>
<thead>
<tr>
<th>CTID</th>
<th>TYPE</th>
<th>STATE</th>
<th>HOLDER</th>
<th>EVENTS</th>
<th>QTIME</th>
<th>NTIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>process owned</td>
<td>100579</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>informative event set: none</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>critical event set: hwerr core</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>fatal event set: hwerr</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>parameter set: none</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>member processes: 100600 100601</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>inherited ctids: none</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>service fmri: svc:/system/init:default</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>svc_fmri ctid: 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>creator: sched</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>aux:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2 process dead - 1 - -
informative event set: none
critical event set: none
fatal event set: hwerr core
parameter set: pgrponly
member processes: none
inherited ctids: none
service fmri: svc:/system/power:default
svc_fmri ctid: 19
creator: svc.startd
aux: start

Exit Status The following exit values are returned:

0
  Successful completion.
1
  An error occurred.
2
  Invalid arguments.
Files /system/contract/*

Attributes

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>See below.</td>
</tr>
</tbody>
</table>

The human readable output is Uncommitted. The invocation is Committed.

See Also ctrun(1), ctwatch(1), contract(4), process(4), attributes(5)
ctwatch – watch events in a contract or group of contracts

Synopsis
/usr/bin/ctwatch [-f] [-r] [-v] contract-type... | contract-id...

Description
The ctwatch utility allows a user to observe the events occurring within a set of contracts or contract types. By default, ctwatch watches all contracts.

Options
The following options are supported:

- **-f** Report events starting at the front of the event queue. Normally, ctwatch reports only events which occur after it has been invoked. With the -f option, any events that still exist in the contracts’ event queues when ctwatch is invoked (for example, unacknowledged critical events) are also reported.

- **-r** Reliably watches all messages. Normally, the system may drop informative events and acknowledged critical events at any time, so ctwatch isn’t guaranteed to see them all. This option may only be used if the ctwatch is invoked with the (PRIV_CONTRACT_EVENT) privilege asserted in its effective set.

- **-v** Request verbose event descriptions.

Operands
The following operands are supported:

- **contract-type** Valid contract types are:
  - process Process contracts.

- **contract-id** A valid contract id.

Output
The following list defines the column headings and the meanings of a ctwatch report:

<table>
<thead>
<tr>
<th>CTID</th>
<th>EVID</th>
<th>CRIT</th>
<th>ACK</th>
<th>CTTYPE</th>
<th>SUMMARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>crit</td>
<td>no</td>
<td>process</td>
<td>pid 100569 was created</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>info</td>
<td>no</td>
<td>process</td>
<td>pid 100569 encountered hardware error</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>info</td>
<td>no</td>
<td>process</td>
<td>pid 100568 exited</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>info</td>
<td>no</td>
<td>process</td>
<td>pid 100569 exited</td>
</tr>
</tbody>
</table>

Examples
**Example 1** Watching a process contract

eexample% ctwatch -r 1

<table>
<thead>
<tr>
<th>CTID</th>
<th>EVID</th>
<th>CRIT</th>
<th>ACK</th>
<th>CTTYPE</th>
<th>SUMMARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>crit</td>
<td>no</td>
<td>process</td>
<td>pid 100569 was created</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>info</td>
<td>no</td>
<td>process</td>
<td>pid 100569 encountered hardware error</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>info</td>
<td>no</td>
<td>process</td>
<td>pid 100568 exited</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>info</td>
<td>no</td>
<td>process</td>
<td>pid 100569 exited</td>
</tr>
</tbody>
</table>
EXAMPLE 1  Watching a process contract  (Continued)

1  6  crit no process contract empty

Exit Status  The following exit values are returned:
0  Successful completion.
1  An error occurred.
2  Invalid arguments.

Files  /system/contract/*

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>See below.</td>
</tr>
</tbody>
</table>

Human Readable Output is Uncommitted. Invocation is Committed.

See Also  ctron(1), ctstat(1), contract(4), process(4), attributes(5), privileges(5)

Notes  Ordering of events is only guaranteed within a single contract, or within a single type when a type is specified.

ctwatch can only observe those events which are generated by contracts owned or authored by processes with the same effective user ID as ctwatch, unless the {PRIV_CONTRACT_OBSERVER} privilege is asserted in its effective set.
Name  cu – call another UNIX system

Synopsis  cu [-c device | -l line] [-s speed] [-b bits] [-h] [-n]
[ local-cmd]

Description  The command cu calls up another UNIX system, a terminal, or possibly a non-UNIX system. It manages an interactive conversation with possible transfers of files. It is convenient to think of cu as operating in two phases. The first phase is the connection phase in which the connection is established. cu then enters the conversation phase. The -d option is the only one that applies to both phases.

Options  cu accepts many options. The -c, -l, and -s options play a part in selecting the medium. The remaining options are used in configuring the line.

- b bits  Forces bits to be the number of bits processed on the line. bits is either 7 or 8. This allows connection between systems with different character sizes. By default, the character size of the line is set to the same value as the current local terminal, but the character size setting is affected by LC_CTYPE also.

- c device  Forces cu to use only entries in the "Type" field (the first field in the /etc/uucp/Devices file) that match the user specified device, usually the name of a local area network.

- C  Runs the local-cmd specified at the end of the command line instead of entering interactive mode. The stdin and stdout of the command that is run refer to the remote connection.

- d  Prints diagnostic traces.

- e  Sets an EVEN data parity. This option designates that EVEN parity is to be generated for data sent to the remote system.

- h  Sets communication mode to half-duplex. This option emulates local echo in order to support calls to other computer systems that expect terminals to be set to half-duplex mode.

- H  Ignores one hangup. This allows the user to remain in cu while the remote machine disconnects and places a call back to the local machine. This option should be used when connecting to systems with callback or dialback modems. Once the callback occurs subsequent hangups will cause cu to terminate. This option can be specified more than once. For more information about dialback configuration, see remote(4) and System Administration Guide: IP Services

- l line  Specifies a device name to use as the communication line. This can be used to override the search that would otherwise take place for the first available line having the right speed. When the -l option is used without the -s option, the speed of a line is taken from the /etc/uucp/Devices file record in which line matches the second field (the Line field). When the -l and -s options are both
cu(1C)

used together, cu will search the /etc/uucp/Devices file to check if the requested speed for the requested line is available. If so, the connection will be made at the requested speed, otherwise, an error message will be printed and the call will not be made. In the general case where a specified device is a directly connected asynchronous line (for instance, /dev/term/a), a telephone number (telno) is not required. The specified device need not be in the /dev directory. If the specified device is associated with an auto dialer, a telephone number must be provided.

-L       Goes through the login chat sequence specified in the /etc/uucp/Systems file. For more information about the chat sequence, see System Administration Guide: IP Services

-n       Requests user prompt for telephone number. For added security, this option will prompt the user to provide the telephone number to be dialed, rather than taking it from the command line.

-o       Sets an ODD data parity. This option designates that ODD parity is to be generated for data sent to the remote system.

-s speed Specifies the transmission speed (300, 1200, 2400, 4800, 9600, 19200, 38400). The default value is "Any" speed which will depend on the order of the lines in the /etc/uucp/Devices file.

-t       Dials a terminal which has been set to auto answer. Appropriate mapping of carriage-return to carriage-return-line-feed pairs is set.

Operands     The following operands are supported:

telno       When using an automatic dialler, specifies the telephone number with equal signs for secondary dial tone or minus signs placed appropriately for delays of 4 seconds.

systemname  Specifies a uucp system name, which can be used rather than a telephone number; in this case, cu will obtain an appropriate direct line or telephone number from a system file.

Usage

Connection Phase cu uses the same mechanism that uucp(1C) does to establish a connection. This means that it will use the uucp control files /etc/uucp/Devices and /etc/uucp/Systems. This gives cu the ability to choose from several different media to establish the connection. The possible media include telephone lines, direct connections, and local area networks (LAN). The /etc/uucp/Devices file contains a list of media that are available on your system. The /etc/uucp/Systems file contains information for connecting to remote systems, but it is not generally readable.
Note: cu determines which /etc/uucp/Systems and /etc/uucp/Devices files to use based upon the name used to invoke cu. In the simple case, this name will be "cu", but you could also have created a link to cu with another name, such as "pppcu", in which case cu would then look for a "service=pppcu" entry in the /etc/uucp/Sysfiles file to determine which /etc/uucp/Systems file to use.

The telno or systemname parameter from the command line is used to tell cu what system you wish to connect to. This parameter can be blank, a telephone number, a system name, or a LAN specific address.

- **telephone number**: A telephone number is a string consisting of the tone dial characters (the digits 0 through 9, *, and #) plus the special characters = and −. The equal sign designates a secondary dial tone and the minus sign creates a 4 second delay.

- **system name**: A system name is the name of any computer that uucp can call; the uname(1C) command prints a list of these names.

- **LAN address**: The documentation for your LAN will show the form of the LAN specific address.

If cu's default behavior is invoked (not using the -c or -l options), cu will use the telno or systemname parameter to determine which medium to use. If a telephone number is specified, cu will assume that you wish to use a telephone line and it will select an automatic call unit (ACU). Otherwise, cu will assume that it is a system name. cu will follow the uucp calling mechanism and use the /etc/uucp/Systems and /etc/uucp/Devices files to obtain the best available connection. Since cu will choose a speed that is appropriate for the medium that it selects, you may not use the -s option when this parameter is a system name.

The -c and -l options modify this default behavior. -c is most often used to select a LAN by specifying a Type field from the /etc/uucp/Devices file. You must include either a telno or systemname value when using the -c option. If the connection to systemname fails, a connection will be attempted using systemname as a LAN specific address. The -l option is used to specify a device associated with a direct connection. If the connection is truly a direct connection to the remote machine, then there is no need to specify a systemname. This is the only case where a telno or systemname parameter is unnecessary. On the other hand, there may be cases in which the specified device connects to a dialer, so it is valid to specify a telephone number. The -c and -l options should not be specified on the same command line.

After making the connection, cu runs as two processes. The transmit process reads data from the standard input and, except for lines beginning with ~, passes it to the remote system. The receive process accepts data from the remote system and, except for lines beginning with ~, passes it to the standard output. Normally, an automatic DC3/DC1 protocol is used to control input from the remote so the buffer is not overrun. Lines beginning with ~ have special meanings.
The *transmit* process interprets the following user initiated commands:

- \(~.~\) Terminates the conversation.
- \(\sim!\) Escapes to an interactive shell on the local system.
- \(\sim!\text{cmd} \ldots\) Runs *cmd* on the local system (via *sh -c*).
- \(\sim$c\text{md} \ldots\) Runs *cmd* locally and send its output to the remote system.
- \(\sim%\text{cd}\) Changes the directory on the local system. Note: \(\sim!\text{cd}\) will cause the command to be run by a sub-shell, probably not what was intended.
- \(\sim%\text{take from [ to ]}\) Copies file *from* (on the remote system) to file *to* on the local system. If *to* is omitted, the *from* argument is used in both places.
- \(\sim%\text{put from [ to ]}\) Copies file *from* (on local system) to file *to* on remote system. If *to* is omitted, the *from* argument is used in both places.
- \(\sim\text{line}\) Sends the line \(\sim\text{line}\) to the remote system.
- \(\sim%\text{break}\) Transmits a BREAK to the remote system (which can also be specified as \(\sim%\text{b}\)).
- \(\sim%\text{debug}\) Toggles the -d debugging option on or off (which can also be specified as \(\sim%\text{d}\)).
- \(\sim\text{t}\) Prints the values of the termio structure variables for the user’s terminal (useful for debugging).
- \(\sim\text{l}\) Prints the values of the termio structure variables for the remote communication line (useful for debugging).
- \(\sim%\text{ifc}\) Toggles between DC3/DC1 input control protocol and no input control. This is useful when the remote system does not respond properly to the DC3 and DC1 characters (can also be specified as \(\sim%\text{nostop}\)).
- \(\sim%\text{ofc}\) Toggles the output flow control setting. When enabled, outgoing data may be flow controlled by the remote host (can also be specified as \(\sim%\text{nostop}\)).
- \(\sim%\text{divert}\) Allows/disallows unsolicited diversions. That is, diversions not specified by \(\sim%\text{take}\).
- \(\sim%\text{old}\) Allows/disallows old style syntax for received diversions.
- \(\sim%\text{nostop}\) Same as \(\sim%\text{ifc}\).

The *receive* process normally copies data from the remote system to the standard output of the local system. It may also direct the output to local files.
The use of ~%put requires `stty(1)` and `cat(1)` on the remote side. It also requires that the current erase and kill characters on the remote system be identical to these current control characters on the local system. Backslashes are inserted at appropriate places.

The use of ~%take requires the existence of `echo(1)` and `cat(1)` on the remote system, and that the remote system must be using the Bourne shell, `sh`. Also, tabs mode (see `stty(1)`) should be set on the remote system if tabs are to be copied without expansion to spaces.

When `cu` is used on system X to connect to system Y and subsequently used on system Y to connect to system Z, commands on system Y can be executed by using ~ ~. Executing a tilde command reminds the user of the local system `uname`. For example, `uname` can be executed on Z, X, and Y as follows:

```plaintext
uname
Z
~[X]!uname
X
~~[Y]!uname
Y
```

In general, ~ causes the command to be executed on the original machine. ~ ~ causes the command to be executed on the next machine in the chain.

**Examples**

**EXAMPLE 1**  Dialling a system

To dial a system whose telephone number is 9 1 201 555 1234 using 1200 baud (where dialtone is expected after the 9):

```plaintext
example% cu -s 1200 9=12015551234
```

If the speed is not specified, "Any" is the default value.

**EXAMPLE 2**  Logging into a system on a direct line

To login to a system connected by a direct line:

```plaintext
example% cu -l /dev/term/b
```

or

```plaintext
example% cu -l term/b
```

**EXAMPLE 3**  Dialling a system with specific line and speed

To dial a system with a specific line and speed:

```plaintext
example% cu -s 1200 -l term/b
```
EXAMPLE 4  Using a system name
To use a system name:

example% cu systemname

Environment Variables
See environ(5) for descriptions of the following environment variables that affect the execution of cu: LC_TYPE, LC_MESSAGES, and NLSPATH.

Exit Status
The following exit values are returned:

  0    Successful completion.
  >0   An error occurred.

Files
/etc/uucp/Devices   device file
/etc/uucp/Sysfiles  system file
/etc/uucp/Systems   system file
/var/spool/locks/*  lock file

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/uucp</td>
</tr>
</tbody>
</table>

See Also
cat(1), echo(1), stty(1), tip(1), uname(1), ct(1C), uuname(1C), uucp(1C), remote(4), attributes(5), environ(5)

System Administration Guide: IP Services

Notes
The cu utility takes the default action upon receipt of signals, with the exception of:

SIGHUP    Close the connection and terminate.
SIGINT    Forward to the remote system.
SIGQUIT   Forward to the remote system.
SIGUSR1   Terminate the cu process without the normal connection closing sequence.

The cu command does not do any integrity checking on data it transfers. Data fields with special cu characters may not be transmitted properly. Depending on the interconnection hardware, it may be necessary to use a ~. to terminate the conversion, even if stty 0 has been used. Non-printing characters are not dependably transmitted using either the ~%put or ~%take commands. ~%put and ~%take cannot be used over multiple links. Files must be moved one link at a time.
There is an artificial slowing of transmission by `cu` during the `~%put` operation so that loss of data is unlikely. Files transferred using `~%take` or `~%put` must contain a trailing newline, otherwise, the operation will hang. Entering a Control-D command usually clears the hang condition.
Name  cut – cut out selected fields of each line of a file

Synopsis  

```
/usr/bin/cut -b [ -n ] [file]...
/usr/bin/cut -c [list] [file]...
/usr/bin/cut -f [ -d delim ] [ -s ] [file]...
```

Description  cut cuts bytes, characters, or character-delimited fields from one or more files, and concatenates them on standard output.

The `option` argument list is a comma-separated or blank-separated list of positive numbers and ranges. Ranges can be of three forms. The first is two positive integers separated by a hyphen (low-high), which represents all fields from low to high. The second is a positive number preceded by a hyphen (-high), which represents all fields from field 1 to high. The last is a positive number followed by a hyphen (low-), which represents all fields from low to the last field, inclusive. Elements in the list can be repeated, can overlap, and can appear in any order. The order of the output is that of the input.

One and only one of `-b`, `-c`, or `-f` options must be specified.

If no file is given, or if the file is `-`, cut cuts from standard input. The start of the file is defined as the current offset.

Options  The following options are supported:

- `-b list`
  The `list` following `-b` specifies byte positions (for instance, `-b1-72` would pass the first 72 bytes of each line). When `-b` and `-n` are used together, `list` is adjusted so that no multi-byte character is split.

- `-c list`
  The `list` following `-c` specifies character positions (for instance, `-c1-72` would pass the first 72 characters of each line).

- `-d delim`
  The character following `-d` is the field delimiter (`-f` option only). The default is TAB. Space or other characters with special meaning to the shell must be quoted. `delim` can be a multi-byte character.

- `-f list`
  The `list` following `-f` is a list of fields assumed to be separated in the file by a delimiter character (see `-d`); for instance, `-f1,7` copies the first and seventh field only. Lines with no field delimiters are passed through intact (useful for table subheadings), unless `-s` is specified.

- `-n`
  Do not split characters. When `-b` list and `-n` are used together, `list` is adjusted so that no multi-byte character is split.
-5
  Suppresses lines with no delimiter characters in case of -f option. Unless specified, lines with no delimiters is passed through untouched.

**Operands**
The following operands are supported:

*file*  A path name of an input file. If no file operands are specified, or if a file operand is -, the standard input is used.

**Usage**
See *largefile(5)* for the description of the behavior of cut when encountering files greater than or equal to 2 Gbyte ($2^{31}$ bytes).

**Examples**

**EXAMPLE 1**  Mapping user IDs

A mapping of userID to names follows:

```
example% cut -d: -f1,5 /etc/passwd
```

**EXAMPLE 2**  Setting the Current login name

To set name to current login name:

```
example$ name=$(who am i | cut -f1 -d' ')
```

**Environment Variables**
See *environ(5)* for descriptions of the following environment variables that affect the execution of cut: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

**Exit Status**
The following exit values are returned:

0  All input files were output successfully.

>0  An error occurred.

**Attributes**
See *attributes(5)* for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

**See Also**  *grep(1), paste(1), attributes(5), environ(5), largefile(5), standards(5)*
**Name**  
date – write the date and time

**Synopsis**  
/usr/bin/date [-u] [+format]

/usr/bin/date [-a [-] sss.fff]

/usr/bin/date [-u] [ [mmdd] HHMM | mmddHHMM [cc] yy] [.SS]

/usr/xpg4/bin/date [-u] [+format]

/usr/xpg4/bin/date [-a [-] sss.fff]

/usr/xpg4/bin/date [-u] [ [mmdd] HHMM | mmddHHMM [cc] yy] [.SS]

**Description**  
The `date` utility writes the date and time to standard output or attempts to set the system date and time. By default, the current date and time is written.

Specifications of native language translations of month and weekday names are supported. The month and weekday names used for a language are based on the locale specified by the environment variable `LC_TIME`. See `environ(5)`.

The following is the default form for the C locale:

%a %b %e %T %Z %Y

For example,

Fri Dec 23 10:10:42 EST 1988

**Options**  
The following options are supported:

- `-a [-] sss.fff`  
  Slowly adjust the time by `sss.fff` seconds (`fff` represents fractions of a second). This adjustment can be positive or negative. The system’s clock is sped up or slowed down until it has drifted by the number of seconds specified. Only the super-user may adjust the time.

- `-u`  
  Display (or set) the date in Greenwich Mean Time (GMT—universal time), bypassing the normal conversion to (or from) local time.

**Operands**  
The following operands are supported:

- `+format`  
  If the argument begins with +, the output of `date` is the result of passing `format` and the current time to `strftime()`. `date` uses the conversion specifications listed on the `strftime(3C)` manual page, with the conversion specification for `%C` determined by whether `/usr/bin/date` or `/usr/xpg4/bin/date` is used:

  - `/usr/bin/date`  
    Locale’s date and time representation. This is the default output for `date`.

  - `/usr/xpg4/bin/date`  
    Century (a year divided by 100 and truncated to an integer) as a decimal number [00-99].
Additionally, date supports `%N` which represents nanosecond portion of the current time since Epoch (00:00:00 UTC, January 1, 1970) as a decimal number [000000000-999999999]. The conversion specification accepts an optional flag character, an optional field width, or both as specified in `strftime()` with a difference that, if a field width specified is less than nine, the actual date output contains only the specified amount of digits of the nanoseconds from left.

The string is always terminated with a NEWLINE. An argument containing blanks must be quoted; see the EXAMPLES section.

- **mm**  
  Month number
- **dd**  
  Day number in the month
- **HH**  
  Hour number (24 hour system)
- **MM**  
  Minute number
- **SS**  
  Second number
- **cc**  
  Century (a year divided by 100 and truncated to an integer) as a decimal number [00-99]. For example, `cc` is 19 for the year 1988 and 20 for the year 2007.
- **yy**  
  Last two digits of the year number. If century (`cc`) is not specified, then values in the range 69–99 shall refer to years 1969 to 1999 inclusive, and values in the range 00–68 shall refer to years 2000 to 2068, inclusive.

The month, day, year number, and century may be omitted; the current values are applied as defaults. For example, the following entry:

```
example% date 10080045
```

sets the date to Oct 8, 12:45 a.m. The current year is the default because no year is supplied. The system operates in GMT. `date` takes care of the conversion to and from local standard and daylight time. Only the super-user may change the date. After successfully setting the date and time, `date` displays the new date according to the default format. The `date` command uses `TZ` to determine the correct time zone information; see `environ(5)`.

**Examples**

**EXAMPLE 1 Generating Output**

The following command:

```
example% date '+DATE: %m/%d/%y%nTIME:%H:%M:%S'
```

generates as output

```
DATE: 08/01/76
TIME: 14:45:05
```
EXAMPLE 2  Setting the Current Time
The following command sets the current time to 12:34:56:

example# date 1234.56

EXAMPLE 3  Setting Another Time and Date in Greenwich Mean Time
The following command sets the date to January 1st, 12:30 am, 2000:

example# date -u 010100302000

This is displayed as:
Thu Jan 01 00:30:00 GMT 2000

Environment
Variables
See environ(5) for descriptions of the following environment variables that affect
the execution of date: LANG, LC_ALL, LC_CTYPE, LC_TIME, LC_MESSAGES, and NLSPATH.

TZ    Determine the timezone in which the time and date are written, unless the -u option
       is specified. If the TZ variable is not set and the -u is not specified, the system default
       timezone is used.

Exit Status
The following exit values are returned:

  0    Successful completion.
  >0   An error occurred.

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

See Also
strftime(3C), attributes(5), environ(5), standards(5)

Diagnostics
no permission    You are not the super-user and you tried to change the date.
bad conversion   The date set is syntactically incorrect.
Notes  If you attempt to set the current date to one of the dates that the standard and alternate time zones change (for example, the date that daylight time is starting or ending), and you attempt to set the time to a time in the interval between the end of standard time and the beginning of the alternate time (or the end of the alternate time and the beginning of standard time), the results are unpredictable.

Using the `date` command from within windowing environments to change the date can lead to unpredictable results and is unsafe. It can also be unsafe in the multi-user mode, that is, outside of a windowing system, if the date is changed rapidly back and forth. The recommended method of changing the date is `date -a`.

Setting the system time or allowing the system time to progress beyond 03:14:07 UTC Jan 19, 2038 is not supported on Solaris.
dc is an arbitrary precision arithmetic package. Ordinarily it operates on decimal integers, but one may specify an input base, output base, and a number of fractional digits to be maintained. The overall structure of dc is a stacking (reverse Polish) calculator. If an argument is given, input is taken from that file until its end, then from the standard input.

bc is a preprocessor for dc that provides infix notation and a C-like syntax that implements functions. bc also provides reasonable control structures for programs. See bc(1).

The following constructions are recognized under both /usr/bin/dc and /usr/xpg6/bin/dc:

- **number**: The value of the number is pushed on the stack. A number is an unbroken string of the digits 0–9. It may be preceded by an underscore (_) to input a negative number. Numbers may contain decimal points.
- **sx**: The top of the stack is popped and stored into a register named x, where x may be any character. If the s is capitalized, x is treated as a stack and the value is pushed on it.
- **lx**: The value in register x is pushed on the stack. The register x is not altered. All registers start with zero value. If the l is capitalized, register x is treated as a stack and its top value is popped onto the main stack.
- **d**: The top value on the stack is duplicated.
- **p**: The top value on the stack is printed. The top value remains unchanged.
- **P**: Interprets the top of the stack as an ASCII string, removes it, and prints it.
- **f**: All values on the stack are printed.
- **q**: Exits the program. If executing a string, the recursion level is popped by two.
- **Q**: Exits the program. The top value on the stack is popped and the string execution level is popped by that value.
- **x**: Treats the top element of the stack as a character string and executes it as a string of dc commands.
- **X**: Replaces the number on the top of the stack with its scale factor.
- **[ . . . ]**: Puts the bracketed ASCII string onto the top of the stack.
- **<x>x=x**: The top two elements of the stack are popped and compared. Register x is evaluated if they obey the stated relation.
v Replaces the top element on the stack by its square root. Any existing fractional part of the argument is taken into account, but otherwise the scale factor is ignored.

! Interprets the rest of the line as a shell command.

c All values on the stack are popped.

i The top value on the stack is popped and used as the number radix for further input.

I Pushes the input base on the top of the stack.

o The top value on the stack is popped and used as the number radix for further output.

O Pushes the output base on the top of the stack.

k The top of the stack is popped, and that value is used as a non-negative scale factor: the appropriate number of places are printed on output, and maintained during multiplication, division, and exponentiation. The interaction of scale factor, input base, and output base will be reasonable if all are changed together.

K Pushes the current scale factor on the top of the stack.

z The stack level is pushed onto the stack.

Z Replaces the number on the top of the stack with its length.

? A line of input is taken from the input source (usually the terminal) and executed.

Y Displays dc debugging information.

; : Used by bc(1) for array operations.

The following construction is recognized under /usr/bin/dc, using the scale of whatever the result is.

+ − / * % ^ The top two values on the stack are added (+), subtracted (−), multiplied (∗), divided (/), remaindered (%), or exponentiated (^). The two entries are popped off the stack; the result is pushed on the stack in their place. Any fractional part of an exponent is ignored.

The following construction is recognized under /usr/xpg6/bin/dc. The results of division are forced to be a scale of 20.

+ − / * % ^ The top two values on the stack are added (+), subtracted (−), multiplied (∗), divided (/), remaindered (%), or exponentiated (^). The two entries are popped off the stack. The result is pushed on the stack in their place. Any fractional part of an exponent is ignored.
Ensures that the scale set prior to division is the scale of the result.

**Examples**

**EXAMPLE 1** Printing the first ten values of $n!$

This example prints the first ten values of $n!$:

```
[lal+dsa*pla10>y]sy
0sa1
\yx
```

**Attributes**

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

**See Also**

bc(1), attributes(5)

**Diagnostics**

- *x is unimplemented* $x$ is an octal number.
- *out of space* The free list is exhausted (too many digits).
- *out of stack space* Too many pushes onto the stack (stack overflow).
- *empty stack* Too many pops from the stack (stack underflow).
- *nesting depth* Too many levels of nested execution.
- *divide by 0* Division by zero.
- *sqrt of neg number* Square root of a negative number is not defined (no imaginary numbers).
- *exp not an integer* $dc$ only processes integer exponentiation.
- *exp too big* The largest exponent allowed is 999.
- *input base is too large* The input base $x$: $2 \leq x \leq 16$.
- *input base is too small* The input base $x$: $2 \leq x \leq 16$.
- *output base is too large* The output base must be no larger than $\text{BC\_BASE\_MAX}$.
- *invalid scale factor* Scale factor cannot be less than 1.
- *scale factor is too large* A scale factor cannot be larger than $\text{BC\_SCALE\_MAX}$.
- *symbol table overflow* Too many variables have been specified.
- *invalid index* Index cannot be less than 1.
- *index is too large* An index cannot be larger than $\text{BC\_DIM\_MAX}$.
The `deallocate` command frees an allocated device. It resets the ownership and permissions on all device special files associated with the device, disabling access to that device. `deallocate` runs the device cleaning program for that device as specified in `device_allocate(4)`.

The default `deallocate` operation deallocates devices allocated to the user.

### Options

The following options are supported:

- `-c dev-class`
  Deallocates all devices of the specified device class.

- `-F device`
  Forces deallocation of the device associated with the file specified by `device`. Only a user with the `solaris.device.revoke` authorization is permitted to use this option.

- `-I`
  Forces deallocation of all allocatable devices. Only a user with the `solaris.device.revoke` authorization is permitted to use this option. This option should only be used at system initialization.

- `-s`
  Silent. Suppresses any diagnostic output.

The following options are supported when the system is configured with Trusted Extensions:

- `-g dev-type`
  Deallocates a device of device type matching `dev-type`.

- `-w`
  Runs the device cleaning program in a windowing environment. If a windowing version of the program exists, it is used. Otherwise, the standard version is run in a terminal window.

- `-z zonename`
  Deallocates device from the zone specified by `zonename`.

### Operands

The following operands are supported:

- `device`
  Deallocates the specified `device`.

### Exit Status

The following exit values are returned:

- `0`
  Successful completion.

- `20`
  No entry for the specified device.

- `other value`
  An error occurred.
Files
/etc/security/device_allocate
/etc/security/device_maps
/etc/security/dev/*
/etc/security/lib/*

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>See below.</td>
</tr>
</tbody>
</table>

The invocation is Uncommitted. The options are Uncommitted. The output is Not-an-Interface.

See Also
allocate(1), list_devices(1), device_allocate(1M), dminfo(1M), mkdevalloc(1M), mkdevmaps(1M), device_allocate(4), device_maps(4), attributes(5)

Controlling Access to Devices

Notes

The functionality described in this man page is available only if Solaris Auditing has been enabled.

The functionality described in this man page is available only if the device_allocate(1M) service is enabled.

On systems configured with Trusted Extensions, the functionality is enabled by default.

/etc/security/dev, mkdevalloc(1M), and mkdevmaps(1M) might not be supported in a future release of the Solaris Operating Environment.
**Name**
deroff – remove nroff/troff, tbl, and eqn constructs

**Synopsis**
deroff [-m [m | s | l]] [-w] [-i] [filename...]

**Description**
deroff reads each of the filenames in sequence and removes all troff(1) requests, macro calls, backslash constructs, eqn(1) constructs (between .EQ and .EN lines, and between delimiters), and tbl(1) descriptions, perhaps replacing them with white space (blanks and blank lines), and writes the remainder of the file on the standard output. deroff follows chains of included files (.so and .nx troff commands); if a file has already been included, a .so naming that file is ignored and a .nx naming that file terminates execution. If no input file is given, deroff reads the standard input.

**Options**
- **m** The -m option may be followed by an m, s, or l. The -mm option causes the macros to be interpreted so that only running text is output (that is, no text from macro lines.) The -ml option forces the -mm option and also causes deletion of lists associated with the mm macros.

- **w** If the -w option is given, the output is a word list, one “word” per line, with all other characters deleted. Otherwise, the output follows the original, with the deletions mentioned above. In text, a “word” is any string that contains at least two letters and is composed of letters, digits, ampersands (&), and apostrophes (’); in a macro call, however, a “word” is a string that begins with at least two letters and contains a total of at least three letters. Delimiters are any characters other than letters, digits, apostrophes, and ampersands. Trailing apostrophes and ampersands are removed from “words.”

- **i** The -i option causes deroff to ignore .so and .nx commands.

**Attributes**
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>text/doctools</td>
</tr>
</tbody>
</table>

**See Also**
eqn(1), nroff(1), tbl(1), troff(1), attributes(5)

**Notes**
deroff is not a complete troff interpreter, so it can be confused by subtle constructs. Most such errors result in too much rather than too little output.

The -ml option does not handle nested lists correctly.
df – display status of disk space on file systems

**Synopsis**

```
/usr/ucb/df [-a] [-i] [-t type] [filesystem...] [filename...]
```

**Description**

The `df` utility displays the amount of disk space occupied by currently mounted file systems, the amount of used and available space, and how much of the file system’s total capacity has been used.

If arguments to `df` are path names, `df` produces a report on the file system containing the named file. Thus ‘`df .`’ shows the amount of space on the file system containing the current directory.

**Options**

The following options are supported:

- `-a`
  Report on all filesystems including the uninteresting ones which have zero total blocks (that is, auto-mounter).

- `-i`
  Report the number of used and free inodes. Print ‘`*`’ if no information is available.

- `-t type`
  Report on filesystems of a given type (for example, nfs or ufs).

**Examples**

**Example 1** Using `df`

A sample of output for `df` looks like:

```
example% df
Filesystem     kbytes  used  avail capacity Mounted on
sparky:/        7445   4714   1986    70% /  
sparky:/usr    42277  35291  2758   93% /usr
```

Note that `used+avail` is less than the amount of space in the file system (kbytes); this is because the system reserves a fraction of the space in the file system to allow its file system allocation routines to work well. The amount reserved is typically about 10%; this can be adjusted using `tunefs` (see `tunefs(1M)`). When all the space on a file system except for this reserve is in use, only the super-user can allocate new files and data blocks to existing files. When a file system is overallocated in this way, `df` can report that the file system is more than 100% utilized.

**Files**

- `/etc/mnttab` List of file systems currently mounted
- `/etc/vfstab` List of default parameters for each file system

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>
See Also  du(1), quot(1M), tunefs(1M), mnttab(4), attributes(5)
**Name**
dhcpinfo – display values of parameters received through DHCP

**Synopsis**


**Description**
The dhcpinfo utility prints the DHCP–supplied value(s) of the parameter requested on the command line. The parameter can be identified either by its numeric code in the DHCP specification, or by its mnemonic identifier, as listed in `dhcp_inittab(4)`. This command is intended to be used in command substitutions in the shell scripts invoked by `init(1M)` at system boot. It first contacts the DHCP client daemon at system boot or in event scripts as described in `dhcpagent(1M)`. It first contacts the DHCP client daemon `dhcpagent(1M)` to verify that DHCP has successfully completed on the requested interface. If DHCP has successfully completed on the requested interface, `dhcpinfo` retrieves the values for the requested parameter. Parameter values echoed by `dhcpinfo` should not be used without checking its exit status. See `exit(1)`. See `dhcp_inittab(4)` for the list of mnemonic identifier codes for all DHCP parameters. See `RFC 2132, DHCP Options and BOOTP Vendor Extensions` for more details on DHCPv4 parameters, and RFC 3315, Dynamic Host Configuration Protocol for IPv6 (DHCPv6), for more details on DHCPv6 parameters.

**Output Format**
The output from `dhcpinfo` consists of one or more lines of ASCII text; the format of the output depends upon the requested parameter. The number of values returned per line and the total number of lines output for a given parameter are determined by the parameter's granularity and maximum values, respectively, as defined by `dhcp_inittab(4)`.

The format of each individual value is determined by the data type of the option, as determined by `dhcp_inittab(4)`. The possible data types and their formats are listed below:

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Format</th>
<th>dhcp_inittab(4) type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unsigned Number</td>
<td>One or more decimal digits</td>
<td>UNUMBER8, UNUMBER16, UNUMBER32, UNUMBER64</td>
</tr>
<tr>
<td>Signed Number</td>
<td>One or more decimal digits, optionally preceded by a minus sign</td>
<td>SNUMBER8, SNUMBER16, SNUMBER32, SNUMBER64</td>
</tr>
<tr>
<td>IP Address</td>
<td>Dotted-decimal notation</td>
<td>IP</td>
</tr>
<tr>
<td>IPv6 Address</td>
<td>Colon-separated notation</td>
<td>IPv6</td>
</tr>
<tr>
<td>Octet</td>
<td>The string 0x followed by a two-digit hexadecimal value</td>
<td>OCTET</td>
</tr>
<tr>
<td>String</td>
<td>Zero or more ASCII characters</td>
<td>ASCII</td>
</tr>
<tr>
<td>DUID</td>
<td>DHCP Unique Identifier text</td>
<td>DUID</td>
</tr>
</tbody>
</table>
The following options are supported:

- `c` Displays the output in a canonical format. This format is identical to the OCTET format with a granularity of 1.

- `i interface` Specifies the interface to retrieve values for DHCP parameters from. If this option is not specified, the primary interface is used.

If a primary interface has not been selected for the system by `ifconfig(1M)` or for this command by `-i`, the system automatically selects an interface to consider as primary for the current command invocation. The selection chooses the interface whose name sorts lexically first, and that has DHCP parameters attached. This selection does not affect system state. Use `ifconfig(1M)` to set a primary interface.

The recommended practice in the `dhcpagent(1M)` eventhook scripts is to specify the desired interface with `-i`, rather than relying on primary selection.

For DHCPv6, the interface name used should be the name of the physical interface, not one of the logical interfaces created by `dhcpagent`.

- `n limit` Limits the list of values displayed to `limit` lines.

- `v 4 | 6` Specifies the DHCP version to query. Use `-v4` for DHCPv4 and `-v6` for DHCPv6.

The following operands are supported:

- `code` Numeric code for the requested DHCP parameter, as defined by the DHCP specification. Vendor options are specified by adding 256 to the actual vendor code for DHCPv4, and 65536 for DHCPv6.

- `identifier` Mnemonic symbol for the requested DHCP parameter, as listed in `dhcp_inittab(4)`.

The following exit values are returned:

- `0` Successful operation.

- `2` The operation was not successful. The DHCP client daemon might not be running, the interface might have failed to configure, or no satisfactory DHCP responses were received.

- `3` Bad arguments.

- `4` The operation timed out.
6 System error (should never occur).

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also dhcpagent(1M), ifconfig(1M), init(1M), dhcp_inittab(4), attributes(5)


Name  
diff – compare two files

Synopsis  
diff [-bitw] [-c | -e | -f | -h | -n | -u] file1 file2

diff [-bitw] [-C number | -U number] file1 file2

diff [-bitw] [-D string] file1 file2

[-S name] directory1 directory2

Description  
The diff utility compares the contents of file1 and file2 and write to standard output a list of changes necessary to convert file1 into file2. This list should be minimal. Except in rare circumstances, diff finds a smallest sufficient set of file differences. No output is produced if the files are identical.

The normal output contains lines of these forms:

- n1 a n3,n4
- n1,n2 d n3
- n1,n2 c n3,n4

where n1 and n2 represent lines file1 and n3 and n4 represent lines in file2. These lines resemble ed(1) commands to convert file1 to file2. By exchanging a for d and reading backward, file2 can be converted to file1. As in ed, identical pairs, where n1=n2 or n3=n4, are abbreviated as a single number.

Following each of these lines come all the lines that are affected in the first file flagged by ‘<’, then all the lines that are affected in the second file flagged by ‘>’.

Options  
The following options are supported:

- b  Ignores trailing blanks (spaces and tabs) and treats other strings of blanks as equivalent.

- i  Ignores the case of letters. For example, ‘A’ compares equal to ‘a’.

- t  Expands TAB characters in output lines. Normal or -c output adds character(s) to the front of each line that can adversely affect the indentation of the original source lines and make the output lines difficult to interpret. This option preserves the original source’s indentation.

- w  Ignores all blanks (SPACE and TAB characters) and treats all other strings of blanks as equivalent. For example, ‘if ( a = = b )’ compares equal to ‘if (a= =b)’.

The following options are mutually exclusive:

- c  Produces a listing of differences with three lines of context. With this option, output format is modified slightly. That is, output begins with identification of the files involved and their creation dates, then each change is separated by a line with a dozen ‘*’s. The lines removed from file1 are marked with ‘—’. The lines added to file2 are marked ‘+’. Lines that are changed from one file to the other are marked in both files with ‘!’.
-C number Produces a listing of differences identical to that produced by -c with number lines of context.

-D string Creates a merged version of file1 and file2 with C preprocessor controls included so that a compilation of the result without defining string is equivalent to compiling file1, while defining string yields file2.

-e Produces a script of only a, c, and d commands for the editor ed, which recreates file2 from file1. In connection with the -e option, the following shell program can help maintain multiple versions of a file. Only an ancestral file ($1) and a chain of version-to-version ed scripts ($2,$3,...) made by diff need be on hand. A "latest version" appears on the standard output.

(shift; cat $*; echo 1,sp) | ed - $1

-f Produces a similar script, not useful with ed, in the opposite order.

-h Does a fast, uninspired job.

This option only works when changed stretches are short and well-separated. It does work on files of unlimited length.

Only --b is available with -h.

diff does not descend into directories with this option.

-n Produces a script similar to -e, but in the opposite order and with a count of changed lines on each insert or delete command.

-u Produces a listing of differences with three lines of context. The output is similar to that of the -c option, except that the context is "unified". Removed and changed lines in file1 are marked by a '-' while lines added or changed in file2 are marked by a '+'. Both versions of changed lines appear in the output, while added, removed, and context lines appear only once. The identification of file1 and file2 is different, with "——" and "+++" being printed where "***" and "——" would appear with the -c option. Each change is separated by a line of the form

@@ -n1,n2 +n3,n4 @@

-U number Produces a listing of differences identical to that produced by -u with number lines of context.

The following options are used for comparing directories:

-l Produces output in long format. Before the diff, each text file is piped through pr(1) to paginate it. Other differences are remembered and summarized after all text file differences are reported.

-r Applies diff recursively to common subdirectories encountered.
-s Reports files that are identical. These identical files would not otherwise be mentioned.

-S name Starts a directory diff in the middle, beginning with the file name.

Operands The following operands are supported:

file1 file2 A path name of a file or directory to be compared. If either file1 or file2 is -, the standard input is used in its place.

directory1 directory2 A path name of a directory to be compared.

If only one of file1 and file2 is a directory, diff is applied to the non-directory file and the file contained in the directory file with a filename that is the same as the last component of the non-directory file.

Usage See largefile(5) for the description of the behavior of diff when encountering files greater than or equal to 2 Gbyte (2^31 bytes).

Examples EXAMPLE 1 Using the diff Command

In the following command, dir1 is a directory containing a directory named x, dir2 is a directory containing a directory named x, dir1/x and dir2/x both contain files named date.out, and dir2/x contains a file named y:

eexample% diff -r dir1 dir2
Common subdirectories: dir1/x and dir2/x

Only in dir2/x: y

diff -r dir1/x/date.out dir2/x/date.out

1c1
< Mon Jul  2 13:12:16 PDT 1990
...

> Tue Jun 19 21:41:39 PDT 1990

Environment Variables See environ(5) for descriptions of the following environment variables that affect the execution of diff: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, LC_TIME, and NLSPATH.

TZ Determines the locale for affecting the timezone used for calculating file timestamps written with the -C and -c options.
The following exit values are returned:

0  No differences were found.
1  Differences were found.
>1  An error occurred.

**Files**  /tmp/d?????    Temporary file used for comparison
            /usr/lib/diffh    Executable file for the -h option

**Attributes**  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

**See Also**  bdiff(1), cmp(1), comm(1), dircmp(1), ed(1), pr(1), sdiff(1), attributes(5), environ(5), largefile(5), standards(5)

**Notes**  Editing scripts produced under the -e or -f options are naive about creating lines consisting of a single period (.).

Missing NEWLINE at end of file indicates that the last line of the file in question did not have a NEWLINE. If the lines are different, they are flagged and output, although the output seems to indicate they are the same.
diff3(1)

Name
diff3 – 3-way differential file comparison

Synopsis
diff3 [-eEX3] filename1 filename2 filename3

Description
diff3 compares three versions of a file. It publishes disagreeing ranges of text flagged with the following codes:

==== all three files differ
====1 filename1 is different
====2 filename2 is different
====3 filename3 is different

The type of change suffered in converting a given range of a given file to some other is indicated in one of the following ways:

f : n1 a Text is to be appended after line number n1 in file f, where f = 1, 2, or 3.

f : n1 , n2 c Text is to be changed in the range line n1 to line n2. If n1 = n2, the range can be abbreviated to n1.

The original contents of the range follows immediately after a c indication. When the contents of two files are identical, the contents of the lower-numbered file is suppressed.

The following command applies the resulting script to filename1.

( cat script; echo ` 1,`$`p) | ed - filename1

Options

The following options are supported:

- e Produce a script for the ed(1) editor that incorporates into filename1 all changes between filename2 and filename3 (that is, the changes that normally would be flagged ==== and ====3).

Text lines that consist of a single dot (. defeat the - e option.

- E Produce a script that incorporates all changes between filename2 and filename3, but treat overlapping changes (that is, changes that would be flagged with ==== in the normal listing) differently. The overlapping lines from both files are inserted by the edit script, bracketed by <<<<< and >>>>> lines.

- x Produce a script to incorporate only changes flagged ====.

- X Produce a script that incorporates only changes flagged ====, but treat these changes in the manner of the - E option.

- 3 Produce a script to incorporate only changes flagged ====3.
Usage  See `largefile(5)` for the description of the behavior of diff3 when encountering files greater than or equal to 2 Gbyte ($2^{31}$ bytes).

Files  
/tmp/d3*
/usr/lib/diff3prog

Exit Status  The following exit values are returned:
0  Successful completion.
1  An error occurred. A difference was found or there was a fatal error.
>1  A fatal error occurred.

Return values do not work the same as `diff(1)` or other vendor's versions of `diff3`.

Attributes  See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

See Also  `diff(1), attributes(5), largefile(5)`

Notes  Files longer than 64 Kbytes do not work.
diffmk – mark differences between versions of a troff input file

Synopsis
diffmk oldfile newfile markedfile

Description
diffmk compares two versions of a file and creates a third version that includes “change mark” (.mc) commands for nroff(1) and troff(1). oldfile and newfile are the old and new versions of the file. diffmk generates markedfile, which, contains the text from newfile with troff(1) “change mark” requests (.mc) inserted where newfile differs from oldfile. When markedfile is formatted, changed or inserted text is shown by | at the right margin of each line. The position of deleted text is shown by a single *.

Usage
See largefile(5) for the description of the behavior of diffmk when encountering files greater than or equal to 2 Gbyte (2^31 bytes).

Examples

**EXAMPLE 1**

An example of the diffmk command.

diffmk can also be used in conjunction with the proper troff requests to produce program listings with marked changes. In the following command line:

e.example% diffmk old.c new.c marked.c ; nroff reqs marked.c | pr

the file reqs contains the following troff requests:

```
.pl 1
.ll 77
.nf
.eo
.nh
```

which eliminate page breaks, adjust the line length, set no-fill mode, ignore escape characters, and turn off hyphenation, respectively.

If the characters | and * are inappropriate, you might run markedfile through sed(1) to globally change them.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>text/doc tools</td>
</tr>
</tbody>
</table>

See Also
diff(1), nroff(1), sed(1), troff(1), attributes(5), largefile(5)

Bugs

Aesthetic considerations may dictate manual adjustment of some output. File differences involving only formatting requests may produce undesirable output, that is, replacing .sp by .sp 2 will produce a “change mark” on the preceding or following line of output.
digest(1)

Name
digest – calculate a message digest

Synopsis
/usr/bin/digest -l | [-v] -a algorithm [file]...

Description
The digest utility calculates the message digest of the given files or stdin using the algorithm specified. If more than one file is given, each line of output is the digest of a single file.

Options
The following options are supported:

- a algorithm
  Specifies the name of the algorithm to use during the encryption or decryption process. See USAGE, Algorithms, for details.

- l
  Displays list of algorithms available on the system. This list can change depending on the configuration of the cryptographic framework.

- v
  Verbose output. Includes the algorithm name and filename in the output.

Usage

Algorithms
These algorithms are provided by the Cryptographic Framework. Each algorithm supported by the command is an alias of the PKCS #11 mechanism for easier access. For example, sha1 is an alias to CKM_SHA_1.

These aliases are used with the -a option and are case-sensitive.

Examples

EXAMPLE 1 Simulating Output
The following example simulates output of the common md5sum program:

eexample$ digest -v -a md5 /usr/bin/vi
md5 (/usr/bin/vi) = e4e3588c5212903847c66d36b1a828a5

EXAMPLE 2 Digesting a File
The following example generates the sha1 digest of the file /etc/motd:

eexample$ digest -a sha1 /etc/motd
9498a4f5303d056ad3ecae826b59f41448d63790

EXAMPLE 3 Generating a Directory Manifest
The following example generates a directory manifest with sha1:

eexample$ digest -v -a sha1 /usr/lib/inet/*
sha1 (/usr/lib/inet/certdb) = f6d43e6e395d50db24d34e4af4828598c8918b16
sha1 (/usr/lib/inet/certlocal) = 7f74ba4a019b809c7023212b4bda10d9485e071d
sha1 (/usr/lib/inet/certlrdb) = 1f845d30b8d02066647de04311e74549049852ed
sha1 (/usr/lib/inet/dhcp) = e3db5e4ff0a69d13f2497254526c2015d2c37b3
sha1 (/usr/lib/inet/dsvclockd) = b61aad7ed6a0f82145c3c26a6c613a4a1f032e
sha1 (/usr/lib/inet/in.dhcpd) = 382210180c826fbb2e747236c480062bac8cc30b
sha1 (/usr/lib/inet/in.iked) = be6061fad725d37256e773d85f8bd5248649463
sha1 (/usr/lib/inet/in.mpathd) = 5bd6bf0340fd5c4cc0c53f2df158302a0e85f9d0
EXAMPLE 3  Generating a Directory Manifest  (Continued)

    sha1 (/usr/lib/inet/in.ndpd) = fdb768aebe7e5eb4465e1c1bb5e679b496f5c5c6
    sha1 (/usr/lib/inet/in.ripngd) = 4f56a0df2d4a252f581a73c2e84143b920db66b
    sha1 (/usr/lib/inet/ncaconfd) = 7219542b5585a8d1104d7ce4a2ced07d8a260ea3
    sha1 (/usr/lib/inet/ppp) = c96ee458549871a6ffdf2674a888b01d0c9e9740
    sha1 (/usr/lib/inet/pppoec) = 5f022498d79dacac9d47cddadc64f171822e3dee
    sha1 (/usr/lib/inet/pppoed) = 252bd2f0863d8bc1b05ffae72821a2a95609b8d
    sha1 (/usr/lib/inet/slpd) = dfa24cc0f05f790546d4f09484a9094f7889027
    sha1 (/usr/lib/inet/wanboot) = a8b8c51c389c774d0be2ae43c85d1b1439484ae
    sha1 (/usr/lib/inet/ntpd) = 5b4aff0f2372cea801e7d08acde9655f8c81f07c

EXAMPLE 4  Displaying a List of Available Algorithms

The following example displays a list of available algorithms to digest:

    example$ digest -l
    sha1
    md5
    sha224
    sha256
    sha384
    sha512

Exit Status  The following exit values are returned:

    0        Successful completion.
    >0       An error occurred.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  cksum(1), encrypt(1), mac(1), bart(1M), cryptoadm(1M), libpkcs11(3LIB), attributes(5), pkcs11_softtoken(5)
The `dircmp` command examines `dir1` and `dir2` and generates various tabulated information about the contents of the directories. Listings of files that are unique to each directory are generated for all the options. If no option is entered, a list is output indicating whether the file names common to both directories have the same contents.

The following options are supported:

- `-d` Compares the contents of files with the same name in both directories and outputs a list telling what must be changed in the two files to bring them into agreement. The list format is described in `diff(1)`.
- `-s` Suppresses messages about identical files.
- `-w n` Changes the width of the output line to `n` characters. The default width is 72.

The following operands are supported:

- `dir1` A path name of a directory to be compared.
- `dir2` A path name of a directory to be compared.

See `largefile(5)` for the description of the behavior of `dircmp` when encountering files greater than or equal to 2 Gbyte (2^{31} bytes).

See `environ(5)` for descriptions of the following environment variables that affect the execution of `dircmp`: `LC_COLLATE`, `LC_CTYPE`, `LC_MESSAGES`, and `NLSPATH`.

The following exit values are returned:

- `0` Successful completion.
- `>0` An error occurred. (Differences in directory contents are not considered errors.)

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also `cmp(1), diff(1), attributes(5), environ(5), largefile(5)`
The `dis` command produces an assembly language listing of `file`, which can be an object file or an archive of object files. The listing includes assembly statements and an octal or hexadecimal representation of the binary that produced those statements.

Options are interpreted by the disassembler and can be specified in any order.

The following options are supported:

- `-C` Displays demangled C++ symbol names in the disassembly.
- `-d sec` Disassembles the named section as data, printing the offset of the data from the beginning of the section.
- `-D sec` Disassembles the named section as data, printing the actual address of the data.
- `-F function` Disassembles only the named function in each object file specified on the command line. The `-F` option can be specified multiple times on the command line.
- `-l string` Disassembles the archive file specified by `string`. For example, one would issue the command `dis -l x -l z` to disassemble `libx.a` and `libz.a`, which are assumed to be in `LIBDIR`.

This option is obsolete and might be removed in a future release of Solaris.

- `-L` Invokes a lookup of C-language source labels in the symbol table for subsequent writing to standard output.

This option is obsolete and might be removed in a future release of Solaris.

- `-n` Displays all addresses numerically. Addresses are displayed using symbolic names by default.
- `-o` Prints numbers in octal. The default is hexadecimal.
- `-q` Quiet mode. Does not print any headers or function entry labels.
- `-t sec` Disassembles the named section as text.
- `-V` Prints, on standard error, the version number of the disassembler being executed.

This option is obsolete and might be removed in a future release of Solaris.

If the `-d`, `-D`, or `-t` options are specified, only those named sections from each user-supplied file is disassembled. Otherwise, all sections containing text is disassembled.
On output, a number enclosed in brackets at the beginning of a line, such as [5], indicates that the break-pointable line number starts with the following instruction. These line numbers is printed only if the file was compiled with additional debugging information.

**Operands**  The following operand is supported:

```
file     A path name of an object file or an archive (see ar(1)) of object files.
```

**Environment Variables**  See environ(5) for descriptions of the following environment variables that affect the execution of dis: LC_CTYPE, LC_MESSAGES, and NLSPATH.

```
LIBDIR     If this environment variable contains a value, use this as the path to search for the library. If the variable contains a null value, or is not set, it defaults to searching for the library under /usr/lib.
```

**Exit Status**  The following exit values are returned:

```
0         Successful completion.
>0        An error occurred.
```

**Files**  /usr/lib    default LIBDIR

**Attributes**  See attributes(5) for descriptions of the following attributes:

```
+--------------------------------+-------------------------------+
| ATTRIBUTE TYPE | ATTRIBUTE VALUE                |
|----------------+-------------------------------|
| Availability   | developer/base-developer-utilities |
| Interface Stability | See below.                   |
+--------------------------------+-------------------------------+
```

The human readable output is Uncommitted. The command line options are Committed.

**See Also**  ar(1), as(1), ld(1), a.out(4), attributes(5), environ(5)

**Diagnostics**  The self-explanatory diagnostics indicate errors in the command line or problems encountered with the specified files.
**Name**

disown – ksh built-in function to disassociate a job with the current shell

**Synopsis**

```
disown [job ...]
```

**Description**

The ksh `disown` command prevents the current shell from sending a `HUP` signal to each of the specified jobs when the current shell terminates a login session.

If `job` is omitted, `disown` sends the `HUP` signal to the most recently started or stopped background job.

**Operands**

The following operands are supported:

- `job` Specifies the job or jobs on which `disown` operates.
  
  Specify `job` as one of the following:
  
  - `number` Refers to a process ID.
  - `-number` Refers to a process group ID.
  - `%number` Refers to a job number.
  - `%string` Refers to a job whose name begins with `string`.
  - `%?string` Refers to a job whose name contains `string`.
  - `%+` or `%` Refers to the current job.
  - `%-` Refers to the previous job.

**Exit Status**

- **0** Successful completion.
- **>0** One or more specified jobs does not exist.

**Examples**

**EXAmple 1** Disowning a Job

The following example disowns job 1:

```
example% disown %1
```

**Authors**

David Korn, dgk@research.att.com

**Attributes**

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Uncommitted</td>
</tr>
</tbody>
</table>

**See Also**

`bg(1), jobs(1), ksh(1), wait(1), attributes(5)`
**Name**

dispgid – displays a list of all valid group names

**Synopsis**
dispgid

**Description**
dispgid displays a list of all group names on the system (one group per line).

**Exit Status**
The following exit values are returned:

- 0  Successful execution.
- 1  Cannot read the group file.

**Attributes**
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

**See Also**
attributes(5)
dispuid(1)

Name  dispuid – displays a list of all valid user names
Synopsis  dispuid
Description  dispuid displays a list of all user names on the system (one line per name).
Exit Status  The following exit values are returned:
0     Successful execution.
1     Cannot read the password file.
Attributes  See attributes(5) for descriptions of the following attributes:

```
<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>
```

See Also  attributes(5)
Name  dos2unix – convert text file from DOS format to ISO format

Synopsis  dos2unix [-ascii] [-iso] [-7]
           [-437 | -850 | -860 | -863 | -865] originalfile convertedfile

Description  The dos2unix utility converts characters in the DOS extended character set to the
             corresponding ISO standard characters.

             This command can be invoked from either DOS or SunOS. However, the filenames must
             conform to the conventions of the environment in which the command is invoked.

             If the original file and the converted file are the same, dos2unix will rewrite the original file
             after converting it.

Options  The following options are supported:

-ascii  Removes extra carriage returns and converts end of file characters in DOS format
         text files to conform to SunOS requirements.

-iso  This is the default. It converts characters in the DOS extended character set to the
       corresponding ISO standard characters.

-7  Converts 8 bit DOS graphics characters to 7 bit space characters so that SunOS
     can read the file.

     On non-i386 systems, dos2unix will attempt to obtain the keyboard type to determine which
     code page to use. Otherwise, the default is US. The user may override the code page with one
     of the following options:

-437  Use US code page
-850  Use multilingual code page
-860  Use Portuguese code page
-863  Use French Canadian code page
-865  Use Danish code page

Operands  The following operands are required:

originalfile  The original file in DOS format that is being converted to ISO format.

convertedfile  The new file in ISO format that has been converted from the original DOS
                file format.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>
File filename not found, or no read permission
The input file you specified does not exist, or you do not have read permission. Check with the SunOS command, ls -l (see ls(1)).

Bad output filename filename, or no write permission
The output file you specified is either invalid, or you do not have write permission for that file or the directory that contains it. Check also that the drive is not write-protected.

Error while writing to temporary file
An error occurred while converting your file, possibly because there is not enough space on the current drive. Check the amount of space on the current drive using the DIR command. Also be certain that the default drive is write-enabled (not write-protected). Notice that when this error occurs, the original file remains intact.

Translated temporary file name = filename.
Could not rename temporary file to filename.
The program could not perform the final step in converting your file. Your converted file is stored under the name indicated on the second line of this message.

See Also  unix2dos(1), ls(1), attributes(5)
**Name**
dpost – troff postprocessor for PostScript printers

**Synopsis**
dpost [-c num] [-e num] [-m num] [-n num] [-o list]
   [-w num] [-x num] [-y num] [-F dir] [-H dir]
   [-L file] [-O] [-T name] [file]...

/usr/lib/lp/postscript/dpost

**Description**
dpost translates files created by troff(1) into PostScript and writes the results on the standard output. If no files are specified, or if – is one of the input files, the standard input is read.

The files should be prepared by troff. The default font files in /usr/lib/font/devpost produce the best and most efficient output. They assume a resolution of 720 dpi, and can be used to format files by adding the -Tpost option to the troff call. Older versions of the eqn and pic preprocessors need to know the resolution that troff will be using to format the files. If those are the versions installed on your system, use the -r720 option with eqn and -T720 with pic.

dpost makes no assumptions about resolutions. The first x res command sets the resolution used to translate the input files, the DESC.out file, usually /usr/lib/font/devpost/DESC.out, defines the resolution used in the binary font files, and the PostScript prologue is responsible for setting up an appropriate user coordinate system.

**Options**
- **-c num** Print num copies of each page. By default only one copy is printed.
- **-e num** Sets the text encoding level to num. The recognized choices are 0, 1, and 2. The size of the output file and print time should decrease as num increases. Level 2 encoding will typically be about 20 percent faster than level 0, which is the default and produces output essentially identical to previous versions of dpost.
- **-m num** Magnify each logical page by the factor num. Pages are scaled uniformly about the origin, which is located near the upper left corner of each page. The default magnification is 1.0.
- **-n num** Print num logical pages on each piece of paper, where num can be any positive integer. By default, num is set to 1.
- **-o list** Print those pages for which numbers are given in the comma-separated list. The list contains single numbers N and ranges N1–N2. A missing N1 means the lowest numbered page, a missing N2 means the highest. The page range is an expression of logical pages rather than physical sheets of paper. For example, if you are printing two logical pages to a sheet, and you specified a range of 4, then two sheets of paper would print, containing four page layouts. If you specified a page range of 3-4, when requesting two logical pages to a sheet; then only page 3 and page 4 layouts would print, and they would appear on one physical sheet of paper.
- **-p mode** Print files in either portrait or landscape mode. Only the first character of mode is significant. The default mode is portrait.
-w num  Set the line width used to implement troff graphics commands to num points, where a point is approximately 1/72 of an inch. By default, num is set to 0.3 points.

-x num  Translate the origin num inches along the positive x axis. The default coordinate system has the origin fixed near the upper left corner of the page, with positive x to the right and positive y down the page. Positive num moves everything right. The default offset is 0 inches.

-y num  Translate the origin num inches along the positive y axis. Positive num moves text up the page. The default offset is 0.

-F dir  Use dir as the font directory. The default dir is /usr/lib/font, and dpost reads binary font files from directory /usr/lib/font/devpost.

-H dir  Use dir as the host resident font directory. Files in this directory should be complete PostScript font descriptions, and must be assigned a name that corresponds to the appropriate two-character troff font name. Each font file is copied to the output file only when needed and at most once during each job. There is no default directory.

-L file Use file as the PostScript prologue which, by default, is /usr/lib/lp/postscript/dpost.ps.

-O Disables PostScript picture inclusion. A recommended option when dpost is run by a spooler in a networked environment.

-T name Use font files for device name as the best description of available PostScript fonts. By default, name is set to post and dpost reads binary files from /usr/lib/font/devpost.

Examples  EXAMPLE 1  Using the dpost Command
If the old versions of eqn and pic are installed on your system, you can obtain the best possible looking output by issuing a command line such as the following:

example% pic -T720 file | tbl | eqn -r720 | troff -mm -Tpost | dpost

Otherwise,

example% pic file | tbl | eqn | troff -mm -Tpost | dpost

should give the best results.

Exit Status  The following exit values are returned:

0        Successful completion.
non-zero An error occurred.
Files
/usr/lib/font/devpost/*.out
/usr/lib/font/devpost/charlib/*
/usr/lib/lp/postscript/color.ps
/usr/lib/lp/postscript/draw.ps
/usr/lib/lp/postscript/forms.ps
/usr/lib/lp/postscript/ps.requests
/usr/lib/macros/pictures
/usr/lib/macros/color

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>print/lp/filter/postscript-lp-filter</td>
</tr>
</tbody>
</table>

See Also
troff(1), attributes(5)

Notes
Output files often do not conform to Adobe's file structuring conventions.

Although dpost can handle files formatted for any device, emulation is expensive and can easily double the print time and the size of the output file. No attempt has been made to implement the character sets or fonts available on all devices supported by troff. Missing characters will be replaced by white space, and unrecognized fonts will usually default to one of the Times fonts (that is, R, I, B, or BI).

An x res command must precede the first x init command, and all the input files should have been prepared for the same output device.

Use of the -T option is not encouraged. Its only purpose is to enable the use of other PostScript font and device description files, that perhaps use different resolutions, character sets, or fonts.

Although level 0 encoding is the only scheme that has been thoroughly tested, level 2 is fast and may be worth a try.
du – summarize disk usage

**Synopsis**

```
/usr/bin/du [-dorx] [-a | -s] [-h | -k | -m] [-H | -L] [file ...]
```

```
/usr/xpg4/bin/du [-dorx] [-a | -s] [-h | -k | -m] [-H | -L] [file ...]
```

**Description**

The `du` utility writes to standard output the size of the file space allocated to, and the size of the file space allocated to each subdirectory of, the file hierarchy rooted in each of the specified files. The size of the file space allocated to a file of type directory is defined as the sum total of space allocated to all files in the file hierarchy rooted in the directory plus the space allocated to the directory itself. This sum will include the space allocated to any extended attributes encountered.

Files with multiple links will be counted and written for only one entry. The directory entry that is selected in the report is unspecified. By default, file sizes are written in 512-byte units, rounded up to the next 512-byte unit.

**Options**

The following options are supported for `/usr/bin/du` and `/usr/xpg4/bin/du`:

- `-a` In addition to the default output, report the size of each file not of type directory in the file hierarchy rooted in the specified file. Regardless of the presence of the `-a` option, non-directories given as `file` operands will always be listed.

- `-d` Do not cross filesystem boundaries. For example, the command, `du -d /` reports usage only on the root partition.

- `-h` All sizes are scaled to a human readable format, for example, `14K`, `234M`, `2.7G`, or `3.0T`. Scaling is done by repetitively dividing by 1024.

- `-H` If a symbolic link to a directory is specified on the command line, process the symbolic link by using the directory which the symbolic link references, rather than the link itself.

- `-k` Write the files sizes in units of 1024 bytes, rather than the default 512-byte units.

- `-L` Process symbolic links by using the file or directory which the symbolic link references, rather than the link itself.

- `-m` Write the files sizes in units of megabytes, rather than the default 512-byte units.

- `-o` Do not add child directories’ usage to a parent’s total. Without this option, the usage listed for a particular directory is the space taken by the files in that directory, as well as the files in all directories beneath it. This option does nothing if `-s` is used.

The following options are supported specifically for `/usr/xpg4/bin/du`:

- `-d` Do not cross filesystem boundaries. For example, the command, `du -d /` reports usage only on the root partition.

When `du` cannot obtain file attributes or read directories (see `stat(2)`), it will report an error condition and the final exit status will be affected.
-r Generate diagnostic messages about unreadable directories and files whose status cannot be obtained. /usr/bin/du is silent if these conditions arise and -r is not specified. /usr/xpg4/bin/du acts as though -r is always specified.

-s Instead of the default output, report only the total sum for each of the specified files.

-x When evaluating file sizes, evaluate only those files that have the same device as the file specified by the file operand.

Specifying more than one of the options in the mutually exclusive pair, -H and -L, is not considered an error. The last option specified determines the output format.

Specifying more than one of the options in the mutually exclusive set of options -h, -k, and -m is not considered an error. The last option specified determines the output format.

Operands The following operand is supported:

file The path name of a file whose size is to be written. If no file is specified, the current directory is used.

Output The output from du consists of the amount of the space allocated to a file and the name of the file.

Usage See largefile(5) for the description of the behavior of du when encountering files greater than or equal to 2 Gbyte (2^{31} bytes).

Environment Variables See environ(5) for descriptions of the following environment variables that affect the execution of du: LANG, LC_ALL, LC_TYPE, LC_MESSAGES, and NLSPATH.

Exit Status The following exit values are returned:

0 Successful completion.

>0 An error occurred.

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>/usr/bin/du</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
<td></td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
<td></td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>/usr/xpg4/bin/du</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/xopen/xcu4</td>
<td></td>
</tr>
</tbody>
</table>
A file with two or more links is counted only once. If, however, there are links between files in different directories where the directories are on separate branches of the file system hierarchy, `du` will count the excess files more than once.

Files containing holes will result in an incorrect block count.
<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>du – display the number of disk blocks used per directory or file</td>
<td></td>
</tr>
</tbody>
</table>

**Synopsis**

```
/usr/ucb/du [-adkLr] [ -o | -s] [filename]
```

**Description**

The `du` utility gives the number of kilobytes contained in all files and, recursively, directories within each specified directory or file `filename`. If `filename` is missing, `.`(the current directory) is used.

A file that has multiple links to it is only counted once.

**Options**

The following options are supported:

- `-a` Generates an entry for each file.
- `-d` Does not cross file system boundaries. For example, `du -d /` reports usage only on the root partition.
- `-k` Writes the files sizes in units of 1024 bytes, rather than the default 512-byte units.
- `-L` Processes symbolic links by using the file or directory that the symbolic link references, rather than the link itself.
- `-o` Does not add child directories' usage to a parent's total. Without this option, the usage listed for a particular directory is the space taken by the files in that directory, as well as the files in all directories beneath it. This option does nothing if the `-s` option is used.
- `-r` Generates messages about directories that cannot be read, files that cannot be opened, and so forth, rather than being silent (the default).
- `-s` Only displays the grand total for each of the specified filenames.

Entries are generated only for each directory in the absence of options.

**Examples**

**EXAMPLE 1**

Showing usage of all subdirectories in a directory

This example uses `du` in a directory. The `pwd(1)` command was used to identify the directory, then `du` was used to show the usage of all the subdirectories in that directory. The grand total for the directory is the last entry in the display:

```
example% pwd  
/usr/ralph/misc
example% du  
5 ./jokes  
33 ./squash
44 ./tech.papers/lpr.document  
217 ./tech.papers/new.manager  
401 ./tech.papers   
144 ./memos
80 ./letters
388 ./window
93 ./messages
```
EXAMPLE 1  Showing usage of all subdirectories in a directory  (Continued)

15  ./useful.news
1211  .

Environment Variables

If any of the LC_* variables, that is, LC_CTYPE, LC_MESSAGES, LC_TIME, LC_COLLATE, LC_NUMERIC, and LC_MONETARY (see environ(5)), are not set in the environment, the operational behavior of du for each corresponding locale category is determined by the value of the LANG environment variable. If LC_ALL is set, its contents are used to override both the LANG and the other LC_* variables. If none of the above variables is set in the environment, the "C" (U.S. style) locale determines how du behaves.

LC_CTYPE  Determines how du handles characters. When LC_CTYPE is set to a valid value, du can display and handle text and filenames containing valid characters for that locale. du can display and handle Extended Unix Code (EUC) characters where any individual character can be 1, 2, or 3 bytes wide. du can also handle EUC characters of 1, 2, or more column widths. In the "C" locale, only characters from ISO 8859-1 are valid.

LC_MESSAGES  Determines how diagnostic and informative messages are presented. This includes the language and style of the messages, and the correct form of affirmative and negative responses. In the "C" locale, the messages are presented in the default form found in the program itself (in most cases, U.S. English).

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>

See Also  pwd(1), df(1M), du(1), quot(1M), attributes(5), environ(5)

Notes  Filename arguments that are not directory names are ignored, unless you use -a.

If there are too many distinct linked files, du will count the excess files more than once.
dump(1)

Name
dump – dump selected parts of an object file

Synopsis
dump [-aCcfghLorstV [-p]] [-T index [, indexn]] filename...
dump [-afhorstL [-p] [v]] filename...
dump [-hsr [-p] [-d number [, numbern]]] filename...
dump [-hsrt [-p] [-n name]] filename...

Description
The dump utility dumps selected parts of each of its object file arguments.

The dump utility is best suited for use in shell scripts, whereas the elfdump(1) command is recommended for more human-readable output.

Options
This utility accepts both object files and archives of object files. It processes each file argument according to one or more of the following options:

- a                    Dumps the archive header of each member of an archive.
- c                    Dumps the string table(s).
- C                    Dumps decoded C++ symbol table names.
- f                    Dumps each file header.
- g                    Dumps the global symbols in the symbol table of an archive.
- h                    Dumps the section headers.
- L                    Dumps dynamic linking information and static shared library information, if available.
- o                    Dumps each program execution header.
- r                    Dumps relocation information.
- s                    Dumps section contents in hexadecimal.
- t                    Dumps symbol table entries.
- T index
- T index1,index2     Dumps only the indexed symbol table entry defined by index or a range of entries defined by index1, index2.
- V                    Prints version information.

The following modifiers are used in conjunction with the options listed above to modify their capabilities.

- d number
- d number1,number2   Dumps the section number indicated by number or the range of sections starting at number1 and ending at number2. This modifier can be used with -h, -s, and -r. When -d is used with -h or -s, the
argument is treated as the number of a section or range of sections. When `-d` is used with `-r`, the argument is treated as the number of the section or range of sections to which the relocation applies. For example, to print out all relocation entries associated with the `.text` section, specify the number of the section as the argument to `-d`. If `.text` is section number 2 in the file, `dump -r -d 2` prints all associated entries. To print out a specific relocation section, use `dump -s -n name` for raw data output, or `dump -sv -n name` for interpreted output.

- `-n name` Dumps information pertaining only to the named entity. This modifier can be used with `-h`, `-s`, `-r`, and `-t`. When `-n` is used with `-h` or `-s`, the argument is treated as the name of a section. When `-n` is used with `-t` or `-r`, the argument is treated as the name of a symbol. For example, `dump -t -n .text` dumps the symbol table entry associated with the symbol whose name is `.text`, where `dump -h -n .text` dumps the section header information for the `.text` section.

- `-p` Suppresses printing of the headings.

- `-v` Dumps information in symbolic representation rather than numeric. This modifier can be used with

  - `-a` (date, user id, group id)
  - `-f` (class, data, type, machine, version, flags)
  - `-h` (type, flags)
  - `-L` (value)
  - `-o` (type, flags)
  - `-r` (name, type)
  - `-s` (interpret section contents wherever possible)
  - `-t` (type, bind)

When `-v` is used with `-s`, all sections that can be interpreted, such as the string table or symbol table, is interpreted. For example, `dump -sv -n .symtab filename...` produces the same formatted output as `dump -tv filename...`, but `dump -s -n .symtab filename...` prints raw data in hexadecimal. Without additional modifiers, `dump -sv filename...` dumps all sections in the files, interpreting all those that it can and dumping the rest (such as `.text` or `.data`) as raw data.
The `dump` utility attempts to format the information it dumps in a meaningful way, printing certain information in character, hexadecimal, octal, or decimal representation as appropriate.

**Attributes**  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/base-developer-utilities</td>
</tr>
</tbody>
</table>

**See Also**  elfdump(1), elffile(1), file(1), nm(1), ar.h(3HEAD), a.out(4), attributes(5)
dumpcs(1)

Name
dumpcs – show codeset table for the current locale

Synopsis
dumpcs [-0123vw]

dumpcs shows a list of printable characters for the user’s current locale, along with their hexadecimal code values. The display device is assumed to be capable of displaying characters for a given locale. With no option, dumps displays the entire list of printable characters for the current locale.

With one or more numeric options specified, it shows EUC codeset(s) for the current locale according to the numbers specified, and in order of codeset number. Each non-printable character is represented by an asterisk “*” and enough ASCII space character(s) to fill that codeset’s column width.

Options
-0    Show ASCII (or EUC primary) codeset.
-1    Show EUC codeset 1, if used for the current locale.
-2    Show EUC codeset 2, if used for the current locale.
-3    Show EUC codeset 3, if used for the current locale.
-v    "Verbose". Normally, ranges of non-printable characters are collapsed into a single line. This option produces one line for each non-printable character.
-w    Replace code values with corresponding wide character values (process codes).

Environment Variables
The environment variables LC_CTYPE and LANG control the character classification throughout dumpcs. On entry to dumpcs, these environment variables are checked in that order. This implies that a new setting for LANG does not override the setting of LC_CTYPE. When none of the values is valid, the character classification defaults to the POSIX.1 “C” locale.

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also
localedef(1), attributes(5)

Notes
dumpcs can only handle EUC locales.
Name  echo – echo arguments

Synopsis /usr/bin/echo [string]...

Description The echo utility writes its arguments, separated by BLANKs and terminated by a NEWLINE, to the standard output. If there are no arguments, only the NEWLINE character is written.

echo is useful for producing diagnostics in command files, for sending known data into a pipe, and for displaying the contents of environment variables.

The C shell, the Korn shell, and the Bourne shell all have echo built-in commands, which, by default, is invoked if the user calls echo without a full pathname. See shell_builtins(1). sh's echo, ksh88's echo, ksh's echo, and /usr/bin/echo understand the back-slashed escape characters, except that sh's echo does not understand \a as the alert character. In addition, ksh88's and ksh's echo does not have an -n option. csh's echo and /usr/ucb/echo, on the other hand, have an -n option, but do not understand the back-slashed escape characters. sh and ksh88 determine whether /usr/ucb/echo is found first in the PATH and, if so, they adapt the behavior of the echo builtin to match /usr/ucb/echo.

Operands The following operand is supported:

string A string to be written to standard output. If any operand is "-n", it is treated as a string, not an option. The following character sequences is recognized within any of the arguments:

\a Alert character.
\b Backspace.
\c Print line without new-line. All characters following the \c in the argument are ignored.
\f Form-feed.
\n New-line.
\r Carriage return.
\t Tab.
\v Vertical tab.
\\ Backslash.
\0n Where n is the 8-bit character whose ASCII code is the 1-, 2- or 3-digit octal number representing that character.

Usage Portable applications should not use -n (as the first argument) or escape sequences.

The printf(1) utility can be used portably to emulate any of the traditional behaviors of the echo utility as follows:
The Solaris 2.6 operating environment or compatible version's /usr/bin/echo is equivalent to:

```
printf "%b\n" "$*"
```

The /usr/ucb/echo is equivalent to:

```
if [ "X$1" = "X-n" ]
then
    shift
    printf "%s" "$*
else
    printf "%s\n" "$*
fi
```

New applications are encouraged to use printf instead of echo.

**Examples**

**Example 1** Finding how far below root your current directory is located

You can use echo to determine how many subdirectories below the root directory (/) is your current directory, as follows:

- Echo your current-working-directory's full pathname.
- Pipe the output through tr to translate the path's embedded slash-characters into space-characters.
- Pipe that output through wc -w for a count of the names in your path.

```
example% /usr/bin/echo $PWD | tr '/'' ' | wc -w
```

See tr(1) and wc(1) for their functionality.

Below are the different flavors for echoing a string without a NEWLINE:

**Example 2** /usr/bin/echo

```
example% /usr/bin/echo "$USER's current directory is $PWD\c"
```

**Example 3** sh/ksh88 shells

```
example$ echo "$USER's current directory is $PWD\c"
```

**Example 4** csh shell

```
example% echo -n "$USER's current directory is $PWD"
```
EXAMPLES  /usr/ucb/echo
example% /usr/ucb/echo -n "$USER's current directory is $PWD"

Environment Variables  See environ(5) for descriptions of the following environment variables that affect the execution of uname: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status  The following error values are returned:

    0    Successful completion.
    >0   An error occurred.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also  ksh(1), printf(1), shell_builtins(1), tr(1), wc(1), echo(1B), ascii(5), attributes(5), environ(5), standards(5)

Notes  When representing an 8-bit character by using the escape convention \
0n, the n must always be preceded by the digit zero (0).

For example, typing: echo ‘WARNING:\ 07’ prints the phrase WARNING: and sounds the “bell” on your terminal. The use of single (or double) quotes (or two backslashes) is required to protect the “\” that precedes the “07”.

Following the \0, up to three digits are used in constructing the octal output character. If, following the \0n, you want to echo additional digits that are not part of the octal representation, you must use the full 3-digit n. For example, if you want to echo “ESC 7” you must use the three digits “033” rather than just the two digits “33” after the \ 0.

- 2 digits Incorrect: echo "\037" | od -xc produces: df0a 337 (hex) (ascii)
- 3 digits Correct: echo "\00337" | od -xc produces: lb37 0a00 033 7 (hex) (ascii)

For the octal equivalents of each character, see ascii(5).
echo is useful for producing diagnostics in command files and for sending known data into a pipe, and for displaying the contents of environment variables.

For example, you can use echo to determine how many subdirectories below the root directory (/) is your current directory, as follows:

- echo your current-working-directory's full pathname
- pipe the output through tr to translate the path’s embedded slash-characters into space-characters
- pipe that output through wc -w for a count of the names in your path.

```
example% /usr/bin/echo "echo $PWD | tr '//' ' ' | wc -w"
```

See tr(1) and wc(1) for their functionality.

The shells csh(1), ksh(1), and sh(1), each have an echo built-in command, which, by default, will have precedence, and will be invoked if the user calls echo without a full pathname. /usr/ucb/echo and csh’s echo() have an -n option, but do not understand back-slashed escape characters. sh’s echo(), ksh’s echo(), and /usr/bin/echo, on the other hand, understand the black-slashed escape characters, and ksh’s echo() also understands \a as the audible bell character; however, these commands do not have an -n option.

**Options**
- **-n**  Do not add the NEWLINE to the output.

**Attributes**
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>

**See Also**
csh(1), echo(1), ksh(1), sh(1), tr(1), wc(1), attributes(5)

**Notes**
The -n option is a transition aid for BSD applications, and may not be supported in future releases.
The ed utility is the standard text editor. If file is specified, ed simulates an e command (see below) on the named file. That is, the file is read into ed's buffer so that it can be edited.

The ed utility operates on a copy of the file it is editing. Changes made to the copy have no effect on the file until a w (write) command is given. The copy of the text being edited resides in a temporary file called the buffer. There is only one buffer.

The red utility is a restricted version of ed. It will only allow editing of files in the current directory. red prohibits executing shell commands via !shell command. Attempts to bypass these restrictions result in an error message (restricted shell).

Both ed and red support the fspec(4) formatting capability. The default terminal mode is either stty -tabs or stty tab3, where tab stops are set at eight columns (see stty(1)). If, however, the first line of file contains a format specification, that specification will override the default mode. For example, tab stops would be set at 5, 10, and 15, and a maximum line length of 72 would be imposed if the first line of file contains

```
<t5,10,15 s72:>
```

Commands to ed have a simple and regular structure: zero, one, or two addresses followed by a single-character command, possibly followed by parameters to that command. These addresses specify one or more lines in the buffer. Every command that requires addresses has default addresses, so that the addresses can very often be omitted.

In general, only one command may appear on a line. Certain commands allow the input of text. This text is placed in the appropriate place in the buffer. While ed is accepting text, it is said to be in input mode. In this mode, no commands are recognized; all input is merely collected. Leave input mode by typing a period (.) at the beginning of a line, followed immediately by a carriage return.

If ed executes commands with arguments, it uses the default shell /usr/bin/sh (see sh(1)).

If ed executes commands with arguments, it uses /usr/xpg4/bin/sh (see ksh88(1)).

Regular Expressions

The ed utility supports a limited form of regular expression notation. Regular expressions are used in addresses to specify lines and in some commands (for example, s) to specify portions of a line that are to be substituted. To understand addressing in ed, it is necessary to know that at any time there is a current line. Generally speaking, the current line is the last line affected by a command. The exact effect on the current line is discussed under the description of each command.
Internationalized Basic Regular Expressions are used for all system-supplied locales. See regex(5).

ed Commands

Commands may require zero, one, or two addresses. Commands that require no addresses regard the presence of an address as an error. Commands that accept one or two addresses assume default addresses when an insufficient number of addresses is given; if more addresses are given than such a command requires, the last one(s) are used.

Typically, addresses are separated from each other by a comma (,). They may also be separated by a semicolon (;). In the latter case, the first address is calculated, the current line (.) is set to that value, and then the second address is calculated. This feature can be used to determine the starting line for forward and backward searches (see Rules 5 and 6, above). The second address of any two-address sequence must correspond to a line in the buffer that follows the line corresponding to the first address.

For /usr/xpg6/gbin/ed, the address can be omitted on either side of the comma or semicolon separator, in which case the resulting address pairs are as follows:

<table>
<thead>
<tr>
<th>Specified</th>
<th>Resulting</th>
</tr>
</thead>
<tbody>
<tr>
<td>,</td>
<td>1, $</td>
</tr>
<tr>
<td>, addr</td>
<td>1, addr</td>
</tr>
<tr>
<td>addr ,</td>
<td>addr , addr</td>
</tr>
<tr>
<td>;</td>
<td>1; $</td>
</tr>
<tr>
<td>; addr</td>
<td>1; addr</td>
</tr>
<tr>
<td>addr ;</td>
<td>addr ; addr</td>
</tr>
</tbody>
</table>

Any <blank>s included between addresses, address separators, or address offsets are ignored.

In the following list of ed commands, the parentheses shown prior to the command are not part of the address. Rather, the parentheses show the default address(es) for the command.

Each address component can be preceded by zero or more blank characters. The command letter can be preceded by zero or more blank characters. If a suffix letter (l, n, or p) is given, it must immediately follow the command.

The e, E, f, r, and w commands take an optional file parameter, separated from the command letter by one or more blank characters.

If changes have been made in the buffer since the last w command that wrote the entire buffer, ed warns the user if an attempt is made to destroy the editor buffer via the e or q commands.

The ed utility writes the string:

"?q\n"
ed(1)

User Commands 359

(followed by an explanatory message if help mode has been enabled via the H command) to
standard output and continues in command mode with the current line number unchanged.
If the e or q command is repeated with no intervening command, ed takes effect.

If an end-of-file is detected on standard input when a command is expected, the ed utility acts
as if a q command had been entered.

It is generally illegal for more than one command to appear on a line. However, any command
(except e, f, r, or w) may be suffixed by l, n, or p in which case the current line is either listed,
numbered or written, respectively, as discussed below under the l, n, and p commands.

( . ) a
<text>.

The append command accepts zero or more lines of text and appends it after the
addressed line in the buffer. The current line ( . ) is left at the last inserted line, or, if there were none, at the addressed line. Address 0 is legal for this command: it
causes the appended text to be placed at the beginning of the buffer. The maximum
number of characters that may be entered from a terminal is 256 per line
(including the new-line character).

( . , ) c
<text>.

The change command deletes the addressed lines from the buffer, then accepts
zero or more lines of text that replaces these lines in the buffer. The current line ( . )
is left at the last line input, or, if there were none, at the first line that was not
deleted. If the lines deleted were originally at the end of the buffer, the current line
number will be set to the address of the new last line. If no lines remain in the
buffer, the current line number will be set to 0.

/usr/xpg4/bin/ed Address 0 is not legal for this command.
/usr/xpg6/bin/ed Address 0 is valid for this command. It is interpreted as if
the address 1 were specified.

( . , ) d

The delete command deletes the addressed lines from the buffer. The line after the
last line deleted becomes the current line. If the lines deleted were originally at the
end of the buffer, the new last line becomes the current line. If no lines remain in
the buffer, the current line number will be set to 0.

e file

The edit command deletes the entire contents of the buffer and then reads the
contents of file into the buffer. The current line ( . ) is set to the last line of the buffer.
If file is not given, the currently remembered file name, if any, is used (see the f
command). The number of bytes read will be written to standard output, unless the
-s option was specified, in the following format:

"%d\n" <number of bytes read>
file is remembered for possible use as a default file name in subsequent e, E, r, and w commands. If file is replaced by !, the rest of the line is taken to be a shell (sh(1)) command whose output is to be read. Such a shell command is not remembered as the current file name. See also DIAGNOSTICS below. All marks are discarded upon the completion of a successful e command. If the buffer has changed since the last time the entire buffer was written, the user is warned, as described previously.

E file

The Edit command is like e, except that the editor does not check to see if any changes have been made to the buffer since the last w command.

f file

If file is given, the f command changes the currently remembered path name to file. Whether the name is changed or not, the f command then writes the (possibly new) currently remembered path name to the standard output in the following format:

"%s
pathname"

The current line number is unchanged.

(1, $)g/RE/command list

In the global command, the first step is to mark every line that matches the given RE. Then, for every such line, the given command list is executed with the current line (. ) initially set to that line. When the g command completes, the current line number has the value assigned by the last command in the command list. If there were no matching lines, the current line number is not changed. A single command or the first of a list of commands appears on the same line as the global command. All lines of a multi-line list except the last line must be ended with a backslash (\); a, i, and c commands and associated input are permitted. The . terminating input mode may be omitted if it would be the last line of the command list. An empty command list is equivalent to the p command. The g, G, v, V, and ! commands are not permitted in the command list. See also the NOTES and the last paragraph before FILES below. Any character other than space or newline can be used instead of a slash to delimit the RE. Within the RE, the RE delimiter itself can be used as a literal character if it is preceded by a backslash.

(1, $)G/RE/

In the interactive Global command, the first step is to mark every line that matches the given RE. Then, for every such line, that line is written to standard output, the current line (. ) is changed to that line, and any one command (other than one of the a, c, i, g, G, v, and V commands) may be input and is executed. After the execution of that command, the next marked line is written, and so on. A new-line acts as a null
command. An & causes the re-execution of the most recent non-null command executed within the current invocation of ed. Note: The commands input as part of the execution of the G command may address and affect any lines in the buffer. The final value of the current line number is the value set by the last command successfully executed. (Notice that the last command successfully executed is the G command itself if a command fails or the null command is specified.) If there were no matching lines, the current line number is not changed. The G command can be terminated by a SIGINT signal. The G command can be terminated by an interrupt signal (ASCII DEL or BREAK). Any character other than space or newline can be used instead of a slash to delimit the RE. Within the RE, the RE delimiter itself can be used as a literal character if it is preceded by a backslash.

h

The help command gives a short error message that explains the reason for the most recent ? diagnostic. The current line number is unchanged.

H

The Help command causes ed to enter a mode in which error messages are written for all subsequent ? diagnostics. It also explains the previous ? if there was one. The H command alternately turns this mode on and off; it is initially off. The current line number is unchanged.

(. , )i
<text>
.

The insert command accepts zero or more lines of text and inserts it before the addressed line in the buffer. The current line (.) is left at the last inserted line, or, if there were none, at the addressed line. This command differs from the a command only in the placement of the input text. The maximum number of characters that may be entered from a terminal is 256 per line (including the new-line character).

/usr/xpg4/bin/ed
Address 0 is not legal for this command.

/usr/xpg6/bin/ed
Address 0 is valid for this command. It is interpreted as if the address 1 were specified.

(., +1)j

The join command joins contiguous lines by removing the appropriate new-line characters. If exactly one address is given, this command does nothing. If lines are joined, the current line
number is set to the address of the joined line. Otherwise, the current line number is unchanged.

\[ . \]k\text{\textit{x}}

The mark command marks the addressed line with name \textit{x}, which must be an ASCII lower-case letter (a-z). The address \texttt{\textbackslash x} then addresses this line. The current line (.) is unchanged.

\[ . . \]l

The \text{\texttt{l}} command writes to standard output the addressed lines in a visually unambiguous form. The characters (\texttt{\textbackslash \textbackslash, \textbackslash a, \textbackslash b, \textbackslash f, \textbackslash r, \textbackslash t, \textbackslash v}) are written as the corresponding escape sequence. The \texttt{\textbackslash n} in that table is not applicable. Non-printable characters not in the table are written as one three-digit octal number (with a preceding backslash character) for each byte in the character, with the most significant byte first.

Long lines are folded, with the point of folding indicated by writing backslash/newline character. The length at which folding occurs is unspecified, but should be appropriate for the output device. The end of each line is marked with a \$. When using the \texttt{/usr/xpg6/bin/ed} command, the end of each line is marked with a \$ due to folding, and \$ characters within the text are written with a preceding backslash. An \texttt{\textbackslash l} command can be appended to any other command other than \texttt{e, E, f, q, Q, r, w, or !}. The current line number is set to the address of the last line written.

\[ . . \]ma

The move command repositions the addressed line(s) after the line addressed by \textit{a}. Address 0 is legal for \textit{a} and causes the addressed line(s) to be moved to the beginning of the file. It is an error if address \textit{a} falls within the range of moved lines. The current line (.) is left at the last line moved.

\[ . . \]n

The number command writes the addressed lines, preceding each line by its line number and a tab character. The current line (.) is left at the last line written. The \text{\texttt{n}} command may be appended to any command other than \texttt{e, E, f, q, Q, r, w, or !}.

\[ . . \]p

The print command writes the addressed lines to standard output. The current line (.) is left at the last line written. The \text{\texttt{p}} command may be appended to any command other than \texttt{e, E, f, q, Q, r, w, or !}. For example, dp deletes the current line and writes the new current line.

\text{\texttt{P}}

The \text{\texttt{P}} command causes \texttt{ed} to prompt with an asterisk (*). (or \textit{string}, if -p is specified) for all subsequent commands. The \text{\texttt{P}}
command alternatively turns this mode on and off; it is initially on if the -p option is specified, otherwise off. The current line is unchanged.

q

The quit command causes ed to exit. If the buffer has changed since the last time the entire buffer was written, the user is warned. See DIAGNOSTICS.

Q

The editor exits without checking if changes have been made in the buffer since the last w command.

($) r file

The read command reads the contents of file into the buffer. If file is not given, the currently remembered file name, if any, is used (see the e and f commands). The currently remembered file name is not changed unless file is the very first file name mentioned since ed was invoked. Address 0 is legal for r and causes the file to be read in at the beginning of the buffer. If the read is successful and the -s option was not specified, the number of characters read is written to standard output in the following format:

\%d
, <number of bytes read>

The current line (.) is set to the last line read. If file is replaced by !, the rest of the line is taken to be a shell command (see sh(1)) whose output is to be read. For example, $r ! ls appends the current directory to the end of the file being edited. Such a shell command is not remembered as the current file name.

(.,.)s/RE/replacement/
(.,.)s/RE/replacement/count, count=[1-2047]
(.,.)s/RE/replacement/g
(.,.)s/RE/replacement/l
(.,.)s/RE/replacement/n
(.,.)s/RE/replacement/p

The substitute command searches each addressed line for an occurrence of the specified RE. Zero or more substitution commands can be specified. In each line in which a match is found, all (non-overlapped) matched strings are replaced by the replacement if the global replacement indicator g appears after the command. If the global indicator does not appear, only the first occurrence of the matched string is replaced. If a number count appears after the command, only the count-th
occurrence of the matched string on each addressed line is replaced. It is an error if the substitution fails on all addressed lines. Any character other than space or new-line may be used instead of the slash (/) to delimit the RE and the replacement. The current line (.) is left at the last line on which a substitution occurred. Within the RE, the RE delimiter itself can be used as a literal character if it is preceded by a backslash. See also the last paragraph before FILES below.

An ampersand (&) appearing in the replacement is replaced by the string matching the RE on the current line. The special meaning of & in this context may be suppressed by preceding it by \. As a more general feature, the characters \n, where n is a digit, are replaced by the text matched by the n-th regular subexpression of the specified RE enclosed between \ and \). When nested parenthesized subexpressions are present, n is determined by counting occurrences of \ starting from the left. When the character % is the only character in the replacement, the replacement used in the most recent substitute command is used as the replacement in the current substitute command. If there was no previous substitute command, the use of % in this manner is an error. The % loses its special meaning when it is in a replacement string of more than one character or is preceded by a \. For each backslash (\) encountered in scanning replacement from beginning to end, the following character loses its special meaning (if any). It is unspecified what special meaning is given to any character other than &, \, %, or digits.
A line may be split by substituting a new-line character into it. The new-line in the replacement must be escaped by preceding it by \. Such substitution cannot be done as part of a g or v command list. The current line number is set to the address of the last line on which a substitution is performed. If no substitution is performed, the current line number is unchanged. If a line is split, a substitution is considered to have been performed on each of the new lines for the purpose of determining the new current line number. A substitution is considered to have been performed even if the replacement string is identical to the string that it replaces.

The substitute command supports the following indicators:

- **count**: Substitute for the countth occurrence only of the RE found on each addressed line. count must be between 1-2047.
- **g**: Globally substitute for all non-overlapping instances of the RE rather than just the first one. If both g and count are specified, the results are unspecified.
- **l**: Write to standard output the final line in which a substitution was made. The line is written in the format specified for the l command.
- **n**: Write to standard output the final line in which a substitution was made. The line is written in the format specified for the n command.
p Write to standard output the final line in which a substitution was made. The line will be written in the format specified for the p command.

( . , ) ta This command acts just like the m command, except that a copy of the addressed lines is placed after address a (which may be 0). The current line (.) is left at the last line copied.

u The undo command nullifies the effect of the most recent command that modified anything in the buffer, namely the most recent a, c, d, g, 1, j, m, r, s, t, u, v, G, or V command. All changes made to the buffer by a g, G, v, or V global command is undone as a single change. If no changes were made by the global command (such as with g/ RE/p), the u command has no effect. The current line number is set to the value it had immediately before the command being undone started.

(1, $)v/RE/command list This command is the same as the global command g, except that the lines marked during the first step are those that do not match the RE.

(1, $)V/RE/ This command is the same as the interactive global command G, except that the lines that are marked during the first step are those that do not match the RE.

(1, $)w file The write command writes the addressed lines into file. If file does not exist, it is created with mode 666 (readable and writable by everyone), unless your file creation mask dictates otherwise. See the description of the umask special command on sh(1). The currently remembered file name is not changed.
unless file is the very first file name mentioned since ed was invoked. If no file name is given, the currently remembered file name, if any, is used (see the e and f commands). The current line (.) is unchanged. If the command is successful, the number of characters written is printed, unless the -s option is specified in the following format:

"%d\n<number of bytes written>

If file is replaced by !, the rest of the line is taken to be a shell (see sh(1)) command whose standard input is the addressed lines. Such a shell command is not remembered as the current path name. This usage of the write command with ! is to be considered as a "last w command that wrote the entire buffer".

(1, $)W file

This command is the same as the write command above, except that it appends the addressed lines to the end of file if it exists. If file does not exist, it is created as described above for the w command.

($) =

The line number of the addressed line is written to standard output in the following format:

"%d\n<line number>

The current line number is unchanged by this command.

! shell command

The remainder of the line after the ! is sent to the UNIX system shell (see sh(1)) to be interpreted as a command. Within the text of that command, the unescaped character % is replaced with the remembered file name. If a ! appears as the first character of the shell command, it is replaced with the text of the previous shell command. Thus, !! repeats the last shell command. If any replacements of % or ! are performed, the modified line is written to the standard output before command is executed. The ! command will write:

"!\n"

to standard output upon completion, unless the -s option is specified. The current line number is unchanged.
An address alone on a line causes the addressed line to be written. A new-line alone is equivalent to .+1p. It is useful for stepping forward through the buffer. The current line number will be set to the address of the written line.

If an interrupt signal (ASCII DEL or BREAK) is sent, ed writes a "?\n" and returns to its command level.

The ed utility takes the standard action for all signals with the following exceptions:

**SIGINT**  The ed utility interrupts its current activity, writes the string "?\n" to standard output, and returns to command mode.

**SIGHUP**  If the buffer is not empty and has changed since the last write, the ed utility attempts to write a copy of the buffer in a file. First, the file named ed.hup in the current directory is used. If that fails, the file named ed.hup in the directory named by the HOME environment variable is used. In any case, the ed utility exits without returning to command mode.

Some size limitations are in effect: 512 characters in a line, 256 characters in a global command list, and 255 characters in the path name of a file (counting slashes). The limit on the number of lines depends on the amount of user memory. Each line takes 1 word.

When reading a file, ed discards ASCII and NUL characters.

If a file is not terminated by a new-line character, ed adds one and puts out a message explaining what it did.

If the closing delimiter of an RE or of a replacement string (for example, /) would be the last character before a new-line, that delimiter may be omitted, in which case the addressed line is written. The following pairs of commands are equivalent:

\[ s/s1/s2 \quad s/s1/s2/p \]
\[ g/s1 \quad g/s1/p \]
\[ ?s1 \quad ?s1? \]

If an invalid command is entered, ed writes the string:

"?\n"

(followed by an explanatory message if help mode has been enabled by the H command) to standard output and continues in command mode with the current line number unchanged.

**Options**

- **-pstring**  Allows the user to specify a prompt string. By default, there is no prompt string.

- **-s | ;**  Suppresses the writing of character counts by e, r, and w commands, of diagnostics from e and q commands, and of the ! prompt after a !shell command.
The following operand is supported:

file    If file is specified, ed simulates an e command on the file named by the path name file before accepting commands from the standard input.

Usage   See largefile(5) for the description of the behavior of ed and red when encountering files greater than or equal to 2 Gbyte (2^{31} bytes).

Environment Variables   See environ(5) for descriptions of the following environment variables that affect the execution of ed: HOME, LANG, LC_ALL, LC_CTYPE, LC_COLLATE, LC_MESSAGES, and NLSPATH.

Exit Status   The following exit values are returned:

0    Successful completion without any file or command errors.

>0    An error occurred.

Files   $TMPDIR    If this environment variable is not NULL, its value is used in place of /var/tmp as the directory name for the temporary work file.

/var/tmp    If /var/tmp exists, it is used as the directory name for the temporary work file.

/tmp    If the environment variable TMPDIR does not exist or is NULL, and if /var/tmp does not exist, then /tmp is used as the directory name for the temporary work file.

ed . hup    Work is saved here if the terminal is hung up.

Attributes   See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>/usr/bin/ed, /usr/bin/red</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATTRIBUTE TYPE</td>
</tr>
<tr>
<td>Availability</td>
</tr>
<tr>
<td>CSI</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>/usr/xpg4/bin/ed</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
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</tr>
<tr>
<td>CSI</td>
</tr>
<tr>
<td>Interface Stability</td>
</tr>
<tr>
<td>Standard</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>/usr/xpg6/bin/ed</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATTRIBUTE TYPE</td>
</tr>
<tr>
<td>Availability</td>
</tr>
</tbody>
</table>
CSI Enabled
Interface Stability Standard

See Also bfs(1), edit(1), ex(1), grep(1), ksh88(1), sed(1), sh(1), stty(1), umask(1), vi(1), fspec(4), attributes(5), environ(5), largefile(5), regex(5), standards(5)

Diagnostics ? for command errors.

?file for an inaccessible file. Use the help and Help commands for detailed explanations.

If changes have been made in the buffer since the last w command that wrote the entire buffer, ed warns the user if an attempt is made to destroy ed’s buffer via the e or q commands. It writes ? and allows one to continue editing. A second e or q command at this point will take effect. The -s command-line option inhibits this feature.

Notes The - option, although it continues to be supported, has been replaced in the documentation by the -s option that follows the Command Syntax Standard (see Intro(1)).

A ! command cannot be subject to a g or a v command.

The ! command and the ! escape from the e, r, and w commands cannot be used if the editor is invoked from a restricted shell (see sh(1)).

The sequence \n in an RE does not match a new-line character.

If the editor input is coming from a command file (for example, ed file < ed_cmd_file), the editor exits at the first failure.

Loading an alternate malloc() library using the environment variable LD_PRELOAD can cause problems for /usr/bin/ed.
The edit utility is a variant of the text editor ex recommended for new or casual users who wish to use a command-oriented editor. It operates precisely as ex with the following options automatically set:

- novice: ON
- report: ON
- showmode: ON
- magic: OFF

The following brief introduction should help you get started with edit. If you are using a CRT terminal you might want to learn about the display editor vi.

To edit the contents of an existing file you begin with the command `edit name` to the shell. edit makes a copy of the file that you can then edit, and tells you how many lines and characters are in the file. To create a new file, you also begin with the command `edit` with a filename: `edit name`; the editor tells you it is a [New File].

The edit command prompt is the colon (:) which you should see after starting the editor. If you are editing an existing file, then you have some lines in edit's buffer (its name for the copy of the file you are editing). When you start editing, edit makes the last line of the file the current line. Most commands to edit use the current line if you do not tell them which line to use. Thus if you say `print` (which can be abbreviated `p`) and type carriage return (as you should after all edit commands), the current line is printed. If you delete (d) the current line, edit prints the new current line, which is usually the next line in the file. If you delete the last line, then the new last line becomes the current one.

If you start with an empty file or wish to add some new lines, then the append (a) command can be used. After you execute this command (typing a carriage return after the word append), edit reads lines from your terminal until you type a line consisting of just a dot (.), it places these lines after the current line. The last line you type then becomes the current line. The insert (i) command is like append, but places the lines you type before, rather than after, the current line.
The `edit` utility numbers the lines in the buffer, with the first line having number 1. If you execute the command 1, then `edit` types the first line of the buffer. If you then execute the command d, `edit` deletes the first line, line 2 becomes line 1, and `edit` prints the current line (the new line 1) so you can see where you are. In general, the current line is always the last line affected by a command.

You can make a change to some text within the current line by using the `substitute` command: `s/old/new/` where `old` is the string of characters you want to replace and `new` is the string of characters you want to replace `old` with.

The `filename` command tells you how many lines there are in the buffer you are editing and says [Modified] if you have changed the buffer. After modifying a file, you can save the contents of the file by executing a `write` command. You can leave the editor by issuing a `quit` command. If you run `edit` on a file, but do not change it, it is not necessary (but does no harm) to write the file back. If you try to quit from `edit` after modifying the buffer without writing it out, you receive the message `No write since last change (:quit! overrides)`, and `edit` waits for another command. If you do not want to write the buffer out, issue the `quit` command followed by an exclamation point (`q!`). The buffer is then irretrievably discarded and you return to the shell.

By using the `d` and `a` commands and giving line numbers to see lines in the file, you can make any changes you want. You should learn at least a few more things, however, if you use `edit` more than a few times.

The `change` command changes the current line to a sequence of lines you supply (as in `append`, you type lines up to a line consisting of only a dot (.)). You can tell change to change more than one line by giving the line numbers of the lines you want to change, that is, 3, 5c. You can print lines this way too: `1, 23p` prints the first 23 lines of the file.

The `undo` command reverses the effect of the last command you executed that changed the buffer. Thus if you execute a `substitute` command that does not do what you want, type `u` and the old contents of the line are restored. You can also `undo` an `undo` command. `edit` gives you a warning message when a command affects more than one line of the buffer. Note that commands such as `write` and `quit` cannot be undone.

To look at the next line in the buffer, type carriage return. To look at a number of lines, type `^D` (while holding down the control key, press d) rather than carriage return. This shows you a half-screen of lines on a CRT or 12 lines on a hardcopy terminal. You can look at nearby text by executing the `z` command. The current line appears in the middle of the text displayed, and the last line displayed becomes the current line; you can get back to the line where you were before you executed the `z` command by typing `'`. The `z` command has other options: `z−` prints a screen of text (or 24 lines) ending where you are; `z+` prints the next screenful. If you want less than a screenful of lines, type `z .11` to display five lines before and five lines after the current line. (Typing `z .n`, when n is an odd number, displays a total of n lines, centered about the current line; when n is an even number, it displays n-1 lines, so that the lines displayed are
centered around the current line.) You can give counts after other commands; for example, you can delete 5 lines starting with the current line with the command \texttt{d5}.

To find things in the file, you can use line numbers if you happen to know them; since the line numbers change when you insert and delete lines this is somewhat unreliable. You can search backwards and forwards in the file for strings by giving commands of the form /text/ to search forward for text or ?text? to search backward for text. If a search reaches the end of the file without finding text, it wraps around and continues to search back to the line where you are. A useful feature here is a search of the form /\text{^text}/ which searches for text at the beginning of a line. Similarly /\text{text}$/ searches for text at the end of a line. You can leave off the trailing / or ? in these commands.

The current line has the symbolic name dot (.), this is most useful in a range of lines as in . , $p which prints the current line plus the rest of the lines in the file. To move to the last line in the file, you can refer to it by its symbolic name $. Thus the command $d deletes the last line in the file, no matter what the current line is. Arithmetic with line references is also possible. Thus the line $-5$ is the fifth before the last and $.+20$ is 20 lines after the current line.

You can find out the current line by typing ‘=.='. This is useful if you wish to move or copy a section of text within a file or between files. Find the first and last line numbers you wish to copy or move. To move lines 10 through 20, type 10,20d a to delete these lines from the file and place them in a buffer named a. \texttt{edit} has 26 such buffers named a through z. To put the contents of buffer a after the current line, type put a. If you want to move or copy these lines to another file, execute an edit (e) command after copying the lines; following the e command with the name of the other file you wish to edit, that is, \texttt{edit chapter2}. To copy lines without deleting them, use yank (y) in place of d. If the text you wish to move or copy is all within one file, it is not necessary to use named buffers. For example, to move lines 10 through 20 to the end of the file, type 10,20m $.

**Options**

These options can be turned on or off using the \texttt{set} command in \texttt{ex(1)}.

- \texttt{C} Encryption option; same as the -x option, except that vi simulates the C command of \texttt{ex}. The C command is like the X command of \texttt{ex}, except that all text read in is assumed to have been encrypted.

- \texttt{I} Set up for editing LISP programs.

- \texttt{L} List the name of all files saved as the result of an editor or system crash.

- \texttt{R} Read only mode; the readonly flag is set, preventing accidental overwriting of the file.

- \texttt{r filename} Edit \texttt{filename} after an editor or system crash. (Recovers the version of \texttt{filename} that was in the buffer when the crash occurred.)
- t tag        Edit the file containing the tag and position the editor at its definition.
- v            Start up in display editing state using vi. You can achieve the same effect by simply typing the vi command itself.
- V            Verbose. When ex commands are read by means of standard input, the input is echoed to standard error. This can be useful when processing ex commands within shell scripts.
- x            Encryption option; when used, edit simulates the X command of ex and prompts the user for a key. This key is used to encrypt and decrypt text using the algorithm of the crypt command. The X command makes an educated guess to determine whether text read in is encrypted or not. The temporary buffer file is encrypted also, using a transformed version of the key typed in for the - x option.
- wn           Set the default window size to n. This is useful when using the editor over a slow speed line.
+command | -c command     Begin editing by executing the specified editor command (usually a search or positioning command).
- | - s            Suppress all interactive user feedback. This is useful when processing editor scripts.

The filename argument indicates one or more files to be edited.

Attributes  See attributes(5) for descriptions of the following attributes:

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</tr>
<tr>
<td>Availability</td>
</tr>
</tbody>
</table>
```
The encryption options are provided with the Security Administration Utilities package, which is available only in the United States.

See Also  ed(1), ex(1), vi(1), attributes(5), XPG4(5)

Notes  The encryption options are provided with the Security Administration Utilities package, which is available only in the United States.
### egrep(1)

**Name**  
egrep – search a file for a pattern using full regular expressions

**Synopsis**  
```
/usr/bin/egrep [-bchilnsv] -e pattern_list [file...]
/usr/bin/egrep [-bchilnsv] -f file [file...]
/usr/bin/egrep [-bchilnsv] pattern [file...]
/usr/xpg4/bin/egrep [-bchilnqsvx] -e pattern_list [-f file] [file...]
/usr/xpg4/bin/egrep [-bchilnqsvx] [-e pattern_list] -f file [file...]
/usr/xpg4/bin/egrep [-bchilnqsvx] pattern [file...]
```

**Description**  
The `egrep` (expression grep) utility searches files for a pattern of characters and prints all lines that contain that pattern. `egrep` uses full regular expressions (expressions that have string values that use the full set of alphanumeric and special characters) to match the patterns. It uses a fast deterministic algorithm that sometimes needs exponential space.

If no files are specified, `egrep` assumes standard input. Normally, each line found is copied to the standard output. The file name is printed before each line found if there is more than one input file.

`/usr/bin/egrep`  
The `/usr/bin/egrep` utility accepts full regular expressions as described on the `regexp(5)` manual page, except for \( ( \text{ and } \backslash ) \), \( ( \text{ and } \backslash ) \), \( ( \text{ and } \backslash ) \), \< and \>, and \n, and with the addition of:

1. A full regular expression followed by + that matches one or more occurrences of the full regular expression.
2. A full regular expression followed by ? that matches 0 or 1 occurrences of the full regular expression.
3. Full regular expressions separated by | or by a NEWLINE that match strings that are matched by any of the expressions.
4. A full regular expression that can be enclosed in parentheses () for grouping.

Be careful using the characters $, *, [^, ], , (, ) and \ in full regular expression, because they are also meaningful to the shell. It is safest to enclose the entire full regular expression in single quotes (’ ’).

The order of precedence of operators is [ ], then * ? +, then concatenation, then | and NEWLINE.

`/usr/xpg4/bin/egrep`  
The `/usr/xpg4/bin/egrep` utility uses the regular expressions described in the EXTENDED REGULAR EXPRESSIONS section of the `regex(5)` manual page.
The following options are supported for both /usr/bin/egrep and /usr/xpg4/bin/egrep:

- **b**  
  Precede each line by the block number on which it was found. This can be useful in locating block numbers by context (first block is 0).

- **c**  
  Print only a count of the lines that contain the pattern.

- **e** pattern_list  
  Search for a pattern_list (full regular expression that begins with a −).

- **f** file  
  Take the list of full regular expressions from file.

- **h**  
  Suppress printing of filenames when searching multiple files.

- **i**  
  Ignore upper/lower case distinction during comparisons.

- **l**  
  Print the names of files with matching lines once, separated by NEWLINEs. Does not repeat the names of files when the pattern is found more than once.

- **n**  
  Precede each line by its line number in the file (first line is 1).

- **s**  
  Work silently, that is, display nothing except error messages. This is useful for checking the error status.

- **v**  
  Print all lines except those that contain the pattern.

The following options are supported for /usr/xpg4/bin/egrep only:

- **q**  
  Quiet. Does not write anything to the standard output, regardless of matching lines. Exits with zero status if an input line is selected.

- **x**  
  Consider only input lines that use all characters in the line to match an entire fixed string or regular expression to be matching lines.

The following operands are supported:

- **file**  
  A path name of a file to be searched for the patterns. If no file operands are specified, the standard input is used.

- **pattern**  
  Specify a pattern to be used during the search for input.

- **pattern**  
  Specify one or more patterns to be used during the search for input. This operand is treated as if it were specified as -e pattern_list.

**Usage**  
See largefile(5) for the description of the behavior of egrep when encountering files greater than or equal to 2 Gbyte ($2^{31}$ bytes).

**Environment Variables**  
See environ(5) for descriptions of the following environment variables that affect the execution of egrep: LC_COLLATE, LC_CTYPE, LC_MESSAGES, and NLSPATH.

**Exit Status**  
The following exit values are returned:

- **0**  
  If any matches are found.
1 If no matches are found.
2 For syntax errors or inaccessible files (even if matches were found).

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Not Enabled</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/xopen/xcu4</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

See Also fgrep(1), grep(1), sed(1), sh(1), attributes(5), environ(5), largefile(5), regex(5), regexp(5), XPG4(5)

Notes Ideally there should be only one grep command, but there is not a single algorithm that spans a wide enough range of space-time trade-offs.

Lines are limited only by the size of the available virtual memory.

Portable applicationsshould use /usr/xpg4/bin/grep -E. See grep(1).
eject – eject media such as CD-ROM from drive

Synopsis  eject [-dflqt] [ [device | nickname]]

Description  The eject utility is used for those removable media devices that do not have a manual eject button, or for those that might be locked due to, for instance, being mounted. The device may be specified by its name or by a nickname. If no device is specified, the default device is used.

Only devices that support eject under program control respond to this command.

When eject is used on media that can only be ejected manually, it does everything except remove the media, including unmounting the file system if it is mounted. In this case, eject displays a message that the media can now be manually ejected.

Do not physically eject media from a device that contains mounted file systems. eject automatically searches for any mounted file systems that reside on the device, and attempts to unmount them prior to ejecting the media. See mount(1M). If the unmount operation fails, eject prints a warning message and exits. The -f option can be used to specify an eject even if the device contains mounted partitions.

Pressing the physical media eject button located on some drives’ front panel has the same effect as invoking eject for the respective drive. Not all drives have this capability.

Options  The following options are supported:

- d   Display the name of the default device to be ejected.
- f   Force the device to eject even if it is busy.
- l   Display paths and nicknames of ejectable devices.
- q   Query to see if the media is present.
- t   Issues the drive a CD-ROM tray close command.

Not all devices support this command.

Operands  The following operands are supported:

device   Specifies which device to eject, by the name it appears in the directory /dev.

nickname Specifies which device to eject, by its nickname as known to this command.

Volume label or device type (for example, cdrom) can be used as a nickname.

Examples  EXAMPLE 1  Ejecting Media

The following example ejects media by its volume label:

example> eject 'My Pictures'
The following exit codes are returned:

0  The operation was successful or, with the -q option, the media is in the drive.
1  The operation was unsuccessful or, with the -q option, the media is not in the drive.
2  Invalid options were specified.
3  An ioctl() request failed.
4  Manually ejectable media is now okay to remove.

Files   /dev/sr0       default CD-ROM file (deprecated)

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  volcheck(1), mount(1M), rmmount(1M), ioctl(2), attributes(5)
elfdump – dumps selected parts of an object file

Synopsis

elfdump [-cCdegHiklmnPrsSuvy] [-p | -w file] [-I index-expr]
         [-N name] [-0 osabi] [-T type] filename...

Description

The elfdump utility symbolically dumps selected parts of the specified object file(s). The
options allow specific portions of the file to be displayed.

The elfdump utility is similar in function to the dump(1) utility. The dump utility offers an older
and less user-friendly interface than elfdump, although dump might be more appropriate for
certain uses such as in shell scripts.

Archive files, produced by ar(1), can also be inspected with elfdump. In this case, each object
within the archive is processed using the options supplied.

elfdump can display the ELF header, program header array, and section header array for any
ELF object. It is also able to display the data found in the following types of sections:

<table>
<thead>
<tr>
<th>Category</th>
<th>Option</th>
<th>ELF Section Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic</td>
<td>-d</td>
<td>SHT_DYNAMIC</td>
</tr>
<tr>
<td>Global Offset Table (GOT)</td>
<td>-G</td>
<td>Special. See below.</td>
</tr>
<tr>
<td>Group</td>
<td>-g</td>
<td>SHT_GROUP</td>
</tr>
<tr>
<td>Capabilities</td>
<td>-H</td>
<td>SHT_SUNW_cap</td>
</tr>
<tr>
<td>Hash Table</td>
<td>-h</td>
<td>SHT_HASH</td>
</tr>
<tr>
<td>Interpreter</td>
<td>-i</td>
<td>Special, see below.</td>
</tr>
<tr>
<td>Move</td>
<td>-m</td>
<td>SHT_SUNW_move</td>
</tr>
<tr>
<td>Note</td>
<td>-n</td>
<td>SHT_NOTE</td>
</tr>
<tr>
<td>Relocation</td>
<td>-r</td>
<td>SHT_RELA</td>
</tr>
<tr>
<td>Stack Unwind/Exceptions</td>
<td>-u</td>
<td>Special. See below.</td>
</tr>
<tr>
<td>Syminfo</td>
<td>-y</td>
<td>SHT_SUNW_syminfo</td>
</tr>
<tr>
<td>Symbol Sort</td>
<td>-S</td>
<td>SHT_SUNW_sorted</td>
</tr>
<tr>
<td>Symbol Table</td>
<td>-s</td>
<td>SHT_SYMTAB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SHT_DYNSYM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SHT_SUNW_LDYSYM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SHT_SUNW_versym</td>
</tr>
<tr>
<td>Versioning</td>
<td>-v</td>
<td>SHT_SUNW_verdef</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SHT_SUNW_verneed</td>
</tr>
</tbody>
</table>

Interpreter and global offset table sections do not have a special ELF section type, but are
instead implemented as SHT_PROGBITS sections with well known names (.interp and .got
respectively). elfdump is able to recognize and display these special sections.

Sections used for stack unwinding and exception handling can have the ELF section type
SHT_PROGBITS, or SHT_AMD64_UNWIND, depending on the compiler and platform involved.
These sections are recognized by name: .eh_frame, .eh_frame_hdr, and .exception_ranges.

When run without options to narrow the information displayed, elfdump displays all available
information for each object.
For a complete description of the displayed information, refer to the *Linker and Libraries Guide*.

**Options** The following options are supported:

- **-c**
  Dumps section header information.

- **-C**
  Demangles C++ symbol names.

- **-d**
  Dumps the contents of the `.dynamic` section.

- **-e**
  Dumps the ELF header.

- **-g**
  Dumps the contents of the `.group` section.

- **-G**
  Dumps the contents of the `.got` section.

- **-h**
  Dumps the contents of the `.hash` section.

- **-H**
  Dumps the contents of the `.SUNW_cap` capabilities section.

- **-i**
  Dumps the contents of the `.interp` section.

- **-I index-expr**
  Qualifies the sections or program headers to examine with a specific index or index range. For example, the third section header in a file can be displayed using:

  ```
  example% elfdump -c -I 3 filename
  ```

  An *index-expr* can be a single non-negative integer value that specifies a specific item, as shown in the previous example. Alternatively, an *index-expr* can consist of two such values separated by a colon (:), indicating a range of items. The following example displays the third, fourth, and fifth program headers in a file:

  ```
  example% elfdump -p -I 3:5 filename
  ```

  When specifying an index range, the second value can be omitted to indicate the final item in the file. For example, the following statement lists all section headers from the tenth to the end:

  ```
  example% elfdump -c -I 10: filename
  ```

  See Matching Options for additional information about the matching options (-I, -N, -T).
-k
Calculates the ELF checksum. See `getf_checksum(3ELF)`.

-1
Displays long section names without truncation.

-m
Dumps the contents of the `.SUNW_move` section.

-n
Dumps the contents of `.note` sections. By default, `elfdump` displays this data without interpretation in hexadecimal form. Core files are an exception. A subset of the core file notes described in `core(4)` are interpreted by `elfdump` and displayed in a high level format: `NT_PRSTATUS`, `NT_PRPSINFO`, `NT_PLATFORM`, `NT_AUXV`, `NT_ASRS`, `NT_PSTATUS`, `NT_PPSINFO`, `NT_PRCRED`, `NT_UTSNAME`, `NT_LWPSTATUS`, `NT_LWPSINFO`, `NT_PRPRIV`, `NT_PRPRIVINFO`, `NT_CONTENT`, and `NT_ZONENAME`.

-N name
Qualifies the sections or program headers to examine with a specific name. For example, in a file that contains more than one symbol table, the `.dynsym` symbol table can be displayed by itself using:

```
example% elfdump -N .dynsym filename
```

ELF program headers do not have names. If the `-p` option is specified, `name` refers to the program header type, and the behavior of the `-N` option is identical to that of the `-T` option. For example, the program header that identifies an interpreter can be displayed using:

```
example% elfdump -p -N PT_INTERP filename
```

See Matching Options for additional information about the matching options (`-I`, `-N`, `-T`).

-O osabi
Specifies the Operating System ABI to apply when interpreting the object. `osabi` can be the name or value of any of the `ELFOSABI_` constants found in `/usr/include/sys/elf.h`. For convenience, the `ELFOSABI_` prefix may be omitted from these names. Two `osabi` values are fully supported: `solaris` is the native ABI of the Solaris operating system. `none` is the generic ELF ABI. Support for other operating system ABIs may be incomplete or missing. Items for which strings are unavailable are displayed in numeric form.

If `-O` is not used, and the object ELF header specifies a non-generic ABI, the ABI specified by the object is used. If the object specifies the generic ELF ABI, `elfdump` searches for a `.note.ABI-tag` section, and if found, identifies the object as having the `linux` ABI. Otherwise, an object that specifies the generic ELF ABI is assumed to conform to the `solaris` ABI.

-p
Dumps the program headers. Individual program headers can be specified using the matching options (`-I`, `-N`, `-T`). See Matching Options for additional information.
The -p and -w options are mutually exclusive. Only one of these options can be used in a given elfdump invocation.

-p
Generate and use alternative section header information based on the information from the program headers, ignoring any section header information contained in the file. If the file has no section headers a warning message is printed and this option is automatically selected. Section headers are not used by the system to execute a program. As such, a malicious program can have its section headers stripped or altered to provide misleading information. In contrast the program headers must be accurate for the program to be runnable. The use of synthetic section header information derived from the program headers allows files with altered section headers to be examined.

-r
Dumps the contents of the .rel[a] relocation sections.

-s
Dumps the contents of the .SUNW ldynsym, .dynsym, and .symtab symbol table sections. For archives, the archive symbol table is also dumped. Individual sections can be specified with the matching options (-I, -N, -T). An archive symbol table can be specified using the special section name -N ARSYM.

In the case of core files, the shndx field has the value “unknown” since the field does not contain the valid values.

In addition to the standard symbol table information, the version definition index of the symbol is also provided under the ver heading.

See Matching Options for additional information about the matching options (-I, -N, -T).

-T type
Qualifies the sections or program headers to examine with a specific type. For example, in a file that contains more than one symbol table, the .dynsym symbol table can be displayed by itself using:

example% elfdump -T SHT_DYNSYM filename

The value of type can be a numeric value, or any of the SHT_ symbolic names defined in /usr/include/sys/elf.h. The SHT_ prefix is optional, and type is case insensitive. Therefore, the above example can also be written as:

example% elfdump -T dynsym filename
If the `-p` option is specified, `type` refers to the program header type, which allows for the display of specific program headers. For example, the program header that identifies an interpreter can be displayed using:

```
example% elfdump -p -T PT_INTERP filename
```

The value of `type` can be a numeric value, or any of the `PT_` symbolic names defined in `/usr/include/sys/elf.h`. The `PT_` prefix is optional, and `type` is case insensitive. Therefore, the above example can also be written as:

```
example% elfdump -p -T interp filename
```

See Matching Options for additional information about the matching options (`-I`, `-N`, `-T`).

```
-u
```

- Dumps the contents of sections used for stack frame unwinding and exception processing.

```
-v
```

- Dumps the contents of the `.SUNW_version` version sections.

```
-w file
```

- Writes the contents of sections which are specified with the matching options (`-I`, `-N`, `-T`) to the named file. For example, extracting the `.text` section of a file can be carried out with:

```
example% elfdump -w text.out -N .text filename
```

See Matching Options for additional information about the matching options (`-I`, `-N`, `-T`).

The `-p` and `-w` options are mutually exclusive. Only one of these options can be used in a given `elfdump` invocation.

```
-y
```

- Dumps the contents of the `.SUNW_syminfo` section. Symbol attributes are conveyed by character tokens.

```
A
```

- Symbol definition acts as an auxiliary filter.

```
B
```

- Assigned with D, symbol reference should be directly bound to the associated dependency definition.

```
C
```

- Symbol definition is the result of a copy-relocation.

```
D
```

- Symbol reference has a direct association to a dependency containing the definition.

```
F
```

- Symbol definition acts as a standard filter.

```
I
```

- Symbol definition acts as an interposer.

```
L
```

- Symbol reference is to a dependency that should be lazily loaded.

```
N
```

- External references cannot directly bind to this symbol definition.

```
P
```

- Symbol is associated with deferred (postponed) dependency.
Symbol associated with capabilities.

**Operands** The following operand is supported:

*filename* The name of the specified object file.

**Usage**

**Matching Options** The options `{-I, -N, and -T}` are collectively referred to as the matching options. These options are used to narrow the range of program headers or sections to examine, by index, name, or type.

The exact interpretation of the matching options depends on the other options used:

- When used with the `-p` option, the matching options reference program headers. `-I` refers to program header indexes. `-T` refers to program header types. As program headers do not have names, the `-N` option behaves identically to `-T` for program headers.
- The matching options are used to select sections by index, name, or type when used with any of the options `{-c, -g, -m, -n, -r, -s, -S, -u, or -w}`.
- If matching options are used alone without any of the options `{-c, -g, -m, -n, -p, -r, -s, -S, -u, or -w}`, then `elfdump` examines each object, and displays the contents of any sections matched.

Any number and type of matching option can be mixed in a given invocation of `elfdump`. In this case, `elfdump` displays the superset of all items matched by any of the matching options used. This feature allows for the selection of complex groupings of items using the most convenient form for specifying each item.

**Files** `liblddbg.so` linker debugging library

**Attributes** See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/linker</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

**See Also** `ar(1), dump(1), elffile(1), file(1), nm(1), pvs(1), elf(3ELF), core(4), attributes(5)`

*Linker and Libraries Guide*
elfedit(1)

Name  elfedit – examine or edit ELF files

Synopsis  elfedit [-adr] [-e cmd] [-L path]
          [-o default | simple | num] [infile] [outfile]

Description  elfedit is a tool for examining or modifying the contents of an existing ELF object. Specifically, elfedit is used to modify the ELF metadata contained in the object. Access is provided to most of the ELF data contained in an object, including the ELF header, section header table, program header table, dynamic section, hardware and software capabilities, string tables, and symbol tables.

Syntax  elfedit processes commands from the command line (-e option) or from standard input. If standard input is a terminal, elfedit provides terminal editing capabilities, as well as extensive command completion. ELF uses many standard symbolic names for special integer values and bit masks. elfedit is aware of most possible completions for such names. You can press TAB at any point while entering an elfedit command to cause elfedit to display a usage message and any known completions for the text at the current cursor.

elfedit functionality is organized in the form of modules. Each module delivers a set of commands, focused on related functionality. A command is specified by combining the module and command names with a colon (:) delimiter, with no intervening white space. For example, dyn:runpath refers to the runpath command provided by the dyn module. Module names must be unique. The command names within a given module are unique within that module, but the same command names can be used in more than one module.

Some modules designate one of their commands to be the default command for that module. This command is run when the user specifies only a module name. Most elfedit modules supply a command named dump, which produces the same information displayed by the elfdump utility for the part of the ELF file covered by the module. It is common for a module to specify dump as its default command.

The syntax used to execute an elfedit command is intended to be familiar to anyone who uses UNIX command line utilities. It consists of white space delimited tokens. The first token is the command name. Options, which are arguments that start with the hyphen (-) character follow the command. Plain arguments (operands) follow the options. There can be 0 or more options and operands for a given command, but if they are present, options always precede plain arguments. The special option, --, (two hyphens) can be used to delimit the end of the options. When it is encountered, any remaining arguments are considered to be plain arguments even if they start with a -.

The interpretation of the characters in an elfedit token depends on the style of quoting used:

Unquoted
Outside of single (') or double (") quotes, backslash (\) acts as an escape character. When a backslash character is seen, elfedit ignores it, and treats the character following it literally (even if the following character is itself a backslash). This feature can be used to insert a
white space character into a string argument to a command without having it split the string into two separate tokens. Similarly, it can be used to insert a quote or backslash as a literal character.

**Single Quotes**

Within single quotes ('), white space characters do not delimit tokens, and are interpreted as literal characters within the token. Double quote (") and backslash (\) characters are interpreted as literal characters, and have no special meaning.

**Double Quotes**

Within double quotes ("), white space characters do not delimit tokens. Single quote characters are interpreted literally and do not have a quoting function. Backslash (\) is an escape character which operates similarly to the way it is used in the C programming language within a string literal:

- \a alert (bell)
- \b backspace
- \f form feed
- \n newline
- \r return
- \t horizontal tab
- \v vertical tab
- \\ backslash
- \' single quote
- \" double quote
- \ooo An octal constant, where ooo is one to three octal digits (0...7)

Any other character following a backslash is an error.

The core commands belong to an internal module named `sys`. All other modules are packaged as dynamically loadable sharable objects. `elfedit` loads modules on demand, when a command that requires it is executed, or as the result of executing the `sys:load` command. Due to its special built in status, and because its commands are used heavily, `elfedit` allows you to specify commands from the `sys` module without including the `sys:` prefix, for example, `load` rather than `sys:load`. To access a command from any other module, you must specify the full `module:cmd` form.

`elfedit` is delivered with the following standard modules:

- cap  Capabilities Section
- dyn  Dynamic Section
Status And Command Documentation

The `status(sys:status)` command displays information about the current `elfedit` session:

- Input and output files
- Option setting
- Module search path
- Modules loaded

Included with every `elfedit` module is extensive online documentation for every command, in a format similar to UNIX manual pages. The `help(sys:help)` command is used to display this information. To learn more about `elfedit`, start `elfedit` and use the help command without arguments:

```
% elfedit
> help
```

`elfedit` displays a welcome message with more information about `elfedit`, and on how to use the help system.

To obtain summary information for a module:

```
> help module
```

To obtain the full documentation for a specific command provided by a module:

```
> help module:command
```

Using the `dyn module` and `dyn:runpath` commands as examples:

```
> help dyn
> help dyn:runpath
```

`help(sys:help)` can be used to obtain help on itself:

```
> help help
```
elfedit modules are implemented as sharable objects which are loaded on demand. When a
module is required, elfedit searches a module path in order to locate the sharable object that
implements the module. The path is a sequence of directory names delimited by colon (:) characters. In addition to normal characters, the path can also contain any of the following
tokens:

%i  Expands to the current instruction set architecture (ISA) name (sparc,sparcv9,i386,
amd64).
%I  Expands to the 64-bit ISA. This is the same thing as %i for 64-bit versions of elfedit,
    but expands to the empty string for 32-bit versions.
&o  Expands to the old value of the path being modified. This is useful for appending or
    prepending directories to the default path.
%r  Root of file system tree holding the elfedit program, assuming that elfedit is
    installed as $usr/bin/elfedit within the tree. On a standard system, this is simply the
    standard system root directory (/). On a development system, where the copy of
    elfedit can be installed elsewhere, the use of %r can be used to ensure that the
    matching set of modules are used.
%%  Expands to a single % character

The default module search path for elfedit is:

%r/usr/lib/elfedit/%I

Expanding the tokens, this is:

/usr/lib/elfedit  32-bit elfedit
/usr/lib/elfedit/sparcv9  64-bit elfedit (sparc)
/usr/lib/elfedit/amd64  64-bit elfedit (x86)

The default search path can be changed by setting the ELFEDIT_PATH environment variable, or
by using the -L command line option. If you specify both, the -L option supersedes the
environment variable.

Options

The following options are supported:

-a
   Enable autoprint mode. When autoprint is enabled, elfedit prints the modified values
   that result when the ELF file is modified. This output is shown in the current output style,
   which can be changed using the -o option. The default output style is the style used by the
   elfdump(1) utility. autoprint mode is the default when elfedit is used interactively
   (when stdin and stdout are terminals). Therefore, the -a option only has meaning when
   elfedit is used in non-interactive contexts. To disable autoprint in an interactive session,
   use the elfedit command:
-d
If set, this option causes elfedit to issue informational messages describing its internal operations and details of the ELF object being processed. This can be useful when a deep understanding of the operation being carried out is desired.

-e cmd
Specifies an edit command. Multiple -e options can be specified. If edit commands are present on the command line, elfedit operates in batch mode. After opening the file, elfedit executes each command in the order given, after which the modified file is saved and elfedit exits. Batch mode is useful for performing simple operations from shell scripts and makefiles.

-L path
Sets default path for locating elfedit modules. Modules are described in Module Search Path section of this manual page..

-o default|simple|num
The style used to display ELF data. This option establishes the current style for the session. It can be changed from within the elfedit session by using the set (sys:set) command, or by providing -o options to the individual commands executed within the session.

default The default style is to display output in a format intended for human viewing. This style is similar to that used by the elfdump utility.

num Integer values are always shown in integer form. Strings are shown as the integer offset into the containing string table.

simple When displaying strings from within the ELF file, only the string is displayed. Integer values are displayed as symbolic constants if possible, and in integer form otherwise. No titles, headers, or other supplemental output is shown.

-r
Read-only mode. The input file is opened for read-only access, and the results of the edit session are not saved. elfedit does not allow the outfile argument when -r is specified. Read-only mode is highly recommended when there is no intention to modify the file. In addition to providing extra protection against accidental modification, it allows for the examination of files for which the user does not have write permission.

Operands
The following operands are supported:

infile
Input file containing an ELF object to process.

This can be an executable (ET_EXEC), shared object (ET_DYN), or relocatable object file, (ET_REL). Archives are not directly supported. To edit an object in an archive, you must extract the object, edit the copy, and then insert it back into the archive.
If no `infile` is present, `elfedit` runs in a limited mode that only allows executing commands from the `sys:` module. This mode is primarily to allow access to the command documentation available from the help (`sys:help`) command.

If `infile` is present, and no `outfile` is given, `elfedit` edits the file in place, and writes the results into the same file, causing the original file contents to be overwritten. It is usually recommended that `elfedit` not be used in this mode, and that an output file be specified. Once the resulting file has been tested and validated, it can be moved into the place of the original file.

The `-r` option can be used to open `infile` for read-only access. This can be useful for examining an existing file that you do not wish to modify.

`outfile`

Output file. If both `infile` and `outfile` are present, `infile` is opened for read-only access, and the modified object contents are written to `outfile`.

**Usage**

When supported by the system, `elfedit` runs as a 64-bit application, capable of processing files greater than or equal to 2 Gbytes (2^31 bytes).

At startup, `elfedit` uses `libelf` to open the input file and cache a copy of its contents in memory for editing. It can then execute one or more commands. A session finishes by optionally writing the modified object to the output file, and then exiting.

If no `infile` is present, `elfedit` runs in a limited mode that only allows executing commands from the `sys:` module. This mode is primarily to allow access to the command documentation available from the help (`sys:help`) command.

If one or more `-e` options are specified, the commands they supply are executed in the order given. `elfedit` adds implicit calls to `write` (`sys:write`) and `quit` (`sys:quit`) immediately following the given commands, causing the output file to be written and the `elfedit` process to exit. This form of use is convenient in shell scripts and makefiles.

If no `-e` options are specified, `elfedit` reads commands from `stdin` and executes them in the order given. The caller must explicitly issue the `write` (`sys:write`) and `quit` (`sys:quit`) commands to save their work and exit when running in this mode.

**Exit Status**

The following exit values are returned:

0  Successful completion.
1  A fatal error occurred.
2  Invalid command line options were specified.

**Examples**

In the following examples, interactive use of `elfedit` is shown with the shell prompt (%) and the `elfedit` prompt (>). Neither of these characters should be entered by the user.
EXAMPLE 1  Changing the Runpath of an Executable

The following example presupposes an executable named prog, installed in a bin directory that has an adjacent lib directory for sharable objects. The following command sets the runpath of that executable to the lib directory:

```bash
elfedit -e 'dyn:runpath $ORIGIN/../lib'
```

The use of single quotes with the argument to the -e option is necessary to ensure that the shell passes the entire command as a single argument to elfedit.

Alternatively, the same operation can be done using elfedit in its non-batch mode:

```bash
% elfedit prog
> dyn:runpath $ORIGIN/../lib
  index  tag   value
    [30] RUNPATH 0x3e6 $ORIGIN/../lib
> write
> quit
```

The addition or modification of elements such as runpath or needed entries might only be achievable when padding exists within the objects. See Notes.

EXAMPLE 2  Removing a Hardware Capability Bit

Objects that require optional hardware support to run are built with a capability section that contains a mask of bits specifying which capabilities they need. The runtime linker (ld.so.1) checks this mask against the attributes of the running system to determine whether a given object is able to be run by the current system. Programs that require abilities not available on the system are prevented from running.

This check prevents a naive program that does not explicitly check for the hardware support it requires from crashing in a confusing manner. However, it can be inconvenient for a program that is written to explicitly check the system capabilities at runtime. Such a program might have optimized code to use when the hardware supports it while providing a generic fallback version that can be run, albeit more slowly, otherwise. In this case, the hardware compatibility mask prevents such a program from running on the older hardware. In such a case, removing the relevant bit from the mask allows the program to run.

The following example removes the AV_386_SSE3 hardware capability from an x86 binary that uses the SSE3 CPU extension. This transfers responsibility for validating the ability to use SSE3 from the runtime linker to the program itself:

```bash
elfedit -e 'cap:hw1 -and -cmp sse3' prog
```

EXAMPLE 3  Reading Information From an Object

elfedit can be used to extract specific targeted information from an object. The following shell command reads the number of section headers contained in the file /usr/bin/ls:

```bash
elfedit(1)
```
% SHNUM=`elfedit -r -onum -e 'ehdr:e_shnum' /usr/bin/ls`
% echo $SHNUM
29

You might get a different value, depending on the version of Solaris and type of machine that you are using. The -r option causes the file to be opened read-only, allowing a user with ordinary access permissions to open the file, and protecting against accidental damage to an important system executable. The num output style is used in order to obtain only the desired value, without any extraneous text.

Similarly, the following extracts the symbol type of the symbol unlink from the C runtime library:

% TYPE=`elfedit -r -osimple -e 'sym:st_type unlink' /lib/libc.so`
% echo $TYPE
STT_FUNC

EXAMPLE 4 Specifying ASLR Settings For An Executable

The default Address Space Layout Randomization (ASLR) behavior for an executable is specified with the DT_SUNW_ASLR dynamic section entry. The following demonstrates how to enable or disable ASLR for the specified program.

% elfedit prog
> dyn:sunw_aslr enable
  index tag value
  [40] SUNW_ASLR 0x2 ENABLE
> dyn:sunw_aslr disable
  index tag value
  [40] SUNW_ASLR 0x1 DISABLE

Environment Variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELFEDIT_PATH</td>
<td>Alters the default module search path. Module search paths are discussed in</td>
</tr>
<tr>
<td></td>
<td>the Module Search Path section of this manual page.</td>
</tr>
<tr>
<td>LD_NOEXEC_64</td>
<td>Suppresses the automatic execution of the 64-bit elfedit. By default, the 64-</td>
</tr>
<tr>
<td></td>
<td>bit version of elfedit runs if the system is 64-bit capable.</td>
</tr>
<tr>
<td>PAGER</td>
<td>Interactively delivers output from elfedit to the screen. If not set, more</td>
</tr>
<tr>
<td></td>
<td>is used. See more(1).</td>
</tr>
</tbody>
</table>

Files

<table>
<thead>
<tr>
<th>DIR</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>/usr/lib/elfedit</td>
<td>Default directory for elfedit modules that are loaded on demand to supply</td>
</tr>
<tr>
<td></td>
<td>editing commands.</td>
</tr>
<tr>
<td>~/.teclarc</td>
<td>Personal tecl customizations file for command line editing. See tecla(5).</td>
</tr>
</tbody>
</table>
### Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/linker</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

### See Also
dump(1), elfdump(1), ld.so.1(1), more(1), nm(1), pvs(1), sxadm(1M), elf(3ELF), libelf(3LIB), tecla(5), attributes(5)

### Linker and Libraries Guide

### Warnings
elfedit is designed to be a tool for testing and development of the ELF system. It offers the ability to examine and change nearly every piece of ELF metadata in the object. It quietly allows edits that can produce an invalid or unusable ELF file. The user is expected to have knowledge of the ELF format and of the rules and conventions that govern them. The Linker and Libraries Guide can be helpful when using elfedit.

elfedit allows the user to alter the ELF metadata in an object, but cannot understand or alter the code of the actual program. Setting ELF attributes such as types, sizes, alignments, and so forth in a manner that does not agree with the actual contents of the file is therefore likely to yield a broken and unusable output object. Such changes might be useful for testing of linker components, but should be avoided otherwise.

Higher level operations, such as the use of the dyn:runpath command to change the runpath of an object, are safe, and can be carried out without the sort of risk detailed in this section.

### Notes
Not every ELF operation supported by elfedit can be successfully carried out on every ELF object. elfedit is constrained by the existing sections found in the file.

One area of particular interest is that elfedit might not be able to modify the runpath of a given object. To modify a runpath, the following must be true:

1. The desired string must already exist in the dynamic string table, or there must be enough reserved space within this section for the new string to be added. If your object has a string table reservation area, the value of the .dynamic DT_SUNW_STRPAD element indicates the size of the area. The following elfedit command can be used to check this:
   ```bash
   % elfedit -r -e 'dyn:tag DT_SUNW_STRPAD' file
   ```
2. The dynamic section must already have a runpath element, or there must be an unused dynamic slot available where one can be inserted. To test for the presence of an existing runpath:
   ```bash
   % elfedit -r -e 'dyn:runpath' file
   ```
   A dynamic section uses an element of type DT_NULL to terminate the array found in that section. The final DT_NULL cannot be changed, but if there are more than one of these, elfedit can convert one of them into a runpath element. To test for extra dynamic slots:
Older objects do not have the extra space necessary to complete such operations. The space necessary to do so was introduced in the Solaris Express Community Edition release.

When an operation fails, the detailed information printed using the -d (debug) option can be very helpful in uncovering the reason why.

**elfedit** modules follow a convention by which commands that directly manipulate a field in an ELF structure have the same name as the field, while commands that implement higher level concepts do not. For instance, the command to manipulate the eflags field in the ELF header is named `ehdr:e_flags`. Therefore, you generally find the command to modify ELF fields by identifying the module and looking for a command with the name of the field.

```bash
% elfedit -r -e 'dyn:tag DT_NULL' file
```
The elffile utility is a specialized variant of the file command that is intended for use with ELF objects and related file types. elffile can identify files of the following types:

- **Archives**
  - In addition to the information provided by file, elffile identifies the types of the archive members.

- **ELF Objects / Runtime Linker Configuration files**
  - elffile provides the same output as file

Files of any other type are reported as non-ELF. No attempt to further classify such files is made. The file utility is recommended for general purpose file identification.

The following options are supported:

- `-s basic | detail | summary`
  - Specify the style of output to be provided
    - **basic**
      - Produce a one-line description in the same format used by file.
    - **detail**
      - For non-archives, summary output is the same as basic. When processing archives, the basic output line is followed by one line of output for each archive member.
    - **summary**
      - For non-archives, summary output is the same as basic. When processing archives, a summary description of the archive contents is added to the end of the basic output. If the `-s` option is not specified, elffile uses the summary style by default.

The output produced for archives when using the summary style depends on the contents of the archive. If the archive contains a homogeneous collection of objects for the same platform, the platform details are shown in the same format used for a single object. Otherwise, a summary description is produced. The detail style can be used to obtain more specific information about individual archive members.

The summary and detail styles require examination of every member of an archive. Speed of execution is proportional to the number of archive members, and can be slow for extremely large archives.

**Examples**

**Example 1**  Displaying Summary Output for Archives

The following example displays the summary output from elffile for archives with differing content. The following archives are used.

```plaintext
same_elf.a
  ELF objects for a single platform.
```
EXAMPLE 1  Displaying Summary Output for Archives

mixed_elf.a
  ELF objects for more than one platform.

mixed.a
  ELF objects and non-ELF files.

not_elf.a
  Non-ELF files.

The summary output for archives depends on the types of the archive members.

```bash
elexample% elffile same_elf.a mixed_elf.a mixed.a not_elf.a
same_elf.a: current ar archive, 32-bit symbol table,
  ELF 64-bit LSB relocatable AMD64 Version 1
mixed_elf.a: current ar archive, 32-bit symbol table,
  mixed ELF content
mixed.a: current ar archive, 32-bit symbol table,
  mixed ELF and non-ELF content
not_elf.a: current ar archive, non-ELF content
```

EXAMPLE 2  Filtering Detailed Output for Archives

The detailed output from elffile produces one line of output for the archive, followed by one line of output per archive member. This output can be easily filtered in order to present the information in various forms. The following example demonstrates this using the archive, libCstd.a which contains relocatable objects for a 64-bit x86 system. The unfiltered detailed elffile output for this archive is as follows.

```bash
elexample% elffile -s detail libCstd.a
libCstd.a: current ar archive, 32-bit symbol table
libCstd.a(bitset.o): ELF 64-bit LSB relocatable AMD64 Version 1 [CMOV]
libCstd.a(complex.o): ELF 64-bit LSB relocatable AMD64 Version 1 [SSE2 SSE CMOV FPU]
libCstd.a( dtoinit.o): ELF 64-bit LSB relocatable AMD64 Version 1 [SSE2 SSE FPU]
libCstd.a(stdexcept.o): ELF 64-bit LSB relocatable AMD64 Version 1 [SSE CMOV]
...```

This output shows that each object is tagged with the hardware capabilities it requires to run. These capability tags vary depending on the code found in each object. The following command filters the output from elffile to identify each unique capability mask, and to count the number of objects containing each mask within the archive. The sed command is used to remove the archive member name from the output, with the result that the output for every archive member with the same capability mask will be identical. The sort command is used to group these identical lines together, and the uniq command is used to replace each unique group with a single line from the group, preceded with a count of how many times that line occurred within the group.
example% elffile -s detail libCstd.a | sed 's,(.*),,' | sort -f | uniq -c
 1 libCstd.a: current ar archive, 32-bit symbol table
 777 libCstd.a: ELF 64-bit LSB relocatable AMD64 Version 1
  1 libCstd.a: ELF 64-bit LSB relocatable AMD64 Version 1 [CMOV FPU]
 126 libCstd.a: ELF 64-bit LSB relocatable AMD64 Version 1 [CMOV]
  12 libCstd.a: ELF 64-bit LSB relocatable AMD64 Version 1 [FPU]
  69 libCstd.a: ELF 64-bit LSB relocatable AMD64 Version 1 [SSE CMOV]
   2 libCstd.a: ELF 64-bit LSB relocatable AMD64 Version 1 [SSE2 CMOV]
   3 libCstd.a: ELF 64-bit LSB relocatable AMD64 Version 1 [SSE2 SSE CMOV FPU]
   3 libCstd.a: ELF 64-bit LSB relocatable AMD64 Version 1 [SSE2 SSE CMOV]
  1 libCstd.a: ELF 64-bit LSB relocatable AMD64 Version 1 [SSE2 SSE FPU]
   2 libCstd.a: ELF 64-bit LSB relocatable AMD64 Version 1 [SSE2 SSE]
  20 libCstd.a: ELF 64-bit LSB relocatable AMD64 Version 1 [SSE2]
  4 libCstd.a: ELF 64-bit LSB relocatable AMD64 Version 1 [SSE]

Exit Status  The following exit values are returned:

0       Successful completion
>0      An error occurred

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/linker</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  ar(1), dump(1), elfdump(1), file(1)

Linker and Libraries Guide
elfsign(1)

Name  elfsign – sign binaries

Synopsis  /usr/bin/elfsign sign [-v] -k private_key -c certificate_file
         -e elf_object [-F format] [file]...

/usr/bin/elfsign sign [-v] -c certificate_file
         -e elf_object -T token_label [-P pin_file] [-F format] [file]...

/usr/bin/elfsign verify [-c certificate_file]
         [-v] -e elf_object [file]...

/usr/bin/elfsign request -r certificate_request_file
         {-k private_key | -T token_label}

/usr/bin/elfsign list -f field -c certificate_file

/usr/bin/elfsign list -f field -e elf_object

Description  list  Lists on standard output information from a single certificate file or signed elf object. The selected field appears on a single line. If the field specified does not apply to the named file, the command terminates with no standard output. This output of this subcommand is intended for use in scripts and by other commands.

request  Generates a private key and a PKCS#10 certificate request. The PKCS#10 certificate request for use with the Solaris Cryptographic Framework. If the private key is to be created in a token device, elfsign prompts for the PIN required to update the token device. The PKCS#10 certificate request should be sent to the email address solaris-crypto-req_ww@oracle.com to obtain a Certificate.

Users of elfsign must first generate a certificate request and obtain a certificate before signing binaries for use with the Solaris Cryptographic Framework.

sign  Signs the elf object, using the given private key and certificate file.

verify  Verifies an existing signed object. Uses the certificate given or searches for an appropriate certificate in /etc/crypto/certs if -c is not given.

Options  The following options are supported:

- c certificate_file  Specifies the path to an X.509 certificate in PEM/PKCS#7 or ASN.1 BER format.

- e elf_object  Specifies the path to the object to be signed or verified.

The -e option can be specified multiple times for signing or verifying multiple objects.

- F format  For the sign subcommand, specifies the format of the signature. The valid format options are
rsa_md5_sha1  Default format Solaris 10 and updates. The rsa_md5_sha1 format is Obsolete.

rsa_sha1  Default format for this release.

Formats other than rsa_md5_sha1 include an informational timestamp with the signature indicating when the signature was applied. This timestamp is not cryptographically secure, nor is it used as part of verification.

-\f field

For the list subcommand, specifies what field should appear in the output.

The valid field specifiers for a certificate file are:

subject  Subject DN (Distinguished Name)
issuer  Issuer DN

The valid field specifiers for an elf object are:

format  Format of the signature
signer  Subject DN of the certificate used to sign the object
time  Time the signature was applied, in the locale's default format

-k private_key

Specifies the location of the private key file when not using a PKCS#11 token. This file is an RSA Private key file in a Solaris specific format. When used with the request subcommand, this is the output file for the newly generated key.

It is an error to specify both the -k and -T options.

-P pin_file

Specifies the file which holds the PIN for accessing the token device. If the PIN is not provided in a pin_file, elfsign prompts for the PIN.

It is an error to specify the -P option without the -T option.

-r certificate_request_file

Specifies the path to the certificate request file, which is in PKCS#10 format.

-T token_label

Specifies the label of the PKCS#11 token device, as provided by pktool, which holds the private key.

It is an error to specify both the -T and -k options.

-v

Requests more detailed information. The additional output includes the signer and, if the signature format contains it, the
time the object was signed. This is not stable parseable output.

Operands

The following operand is supported:

file One or more elf objects to be signed or verified. At least one elf object must be specified either via the -e option or after all other options.

Examples

EXAMPLE 1 Signing an ELF Object Using a Key/Certificate in a File

```
example$ elfsign sign -k myprivatekey -c mycert -e lib/libmylib.so.1
```

EXAMPLE 2 Verifying an elf Object's Signature

```
example$ elfsign verify -c mycert -e lib/libmylib.so.1
elfsign: verification of lib/libmylib.so.1 passed
```

EXAMPLE 3 Generating a Certificate Request

```
exmple$ elfsign request -k mykey -r req.pkcs10
Enter Company Name / Stock Symbol or some other globally unique identifier.
This will be the prefix of the Certificate DN: SUNW
```

EXAMPLE 4 Determining Information About an Object

```
exmple$ elfsign list -f format -e lib/libmylib.so.1 rsa_md5_sha1
```
```
exmple$ elfsign list -f signer -e lib/libmylib.so.1
CN=VENDOR, OU=Software Development, O=Vendor Inc.
```

Exit Status

The following exit values are returned:

<table>
<thead>
<tr>
<th>VALUE</th>
<th>MEANING</th>
<th>SUB-COMMAND</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Operation successful</td>
<td>sign/verify/request</td>
</tr>
<tr>
<td>1</td>
<td>Invalid arguments</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Failed to verify ELF object</td>
<td>verify</td>
</tr>
<tr>
<td>3</td>
<td>Unable to open ELF object</td>
<td>sign/verify</td>
</tr>
<tr>
<td>4</td>
<td>Unable to load or invalid certificate</td>
<td>sign/verify</td>
</tr>
<tr>
<td>5</td>
<td>Unable to load private key, private key is invalid, or token label is invalid</td>
<td>sign</td>
</tr>
<tr>
<td>6</td>
<td>Failed to add signature</td>
<td>sign</td>
</tr>
<tr>
<td>VALUE</td>
<td>MEANING</td>
<td>SUB-COMMAND</td>
</tr>
<tr>
<td>-------</td>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>7</td>
<td>Attempt to verify unsigned object or object not an ELF file</td>
<td>verify</td>
</tr>
</tbody>
</table>

Files
/etc/crypto/certs  Directory searched for the verify subcommand if the -c flag is not used

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/base-developer-utilities</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>See below.</td>
</tr>
</tbody>
</table>

The elfsign command and subcommands are Committed. While applications should not depend on the output format of elfsign, the output format of the list subcommand is Committed.

See Also
date(1), pktool(1), cryptoadm(1M), libpkcs11(3LIB), attributes(5)
elfwrap(1)

**Name**
elfwrap – wrap data in an ELF file

**Synopsis**

```
elfwrap [-64] [-o relobj-file] [-z target=sparc | x86] data-file ...
```

**Description**
The `elfwrap` utility creates an ELF relocatable object file from one or more data files. The relocatable object encapsulates each data file within an individual section, together with symbols that can be used to reference the section. The relocatable object is appropriate for inclusion with a subsequent link-edit. Users can reference the encapsulated data using the associated symbols.

By default, a 32–bit ELF relocatable object is created that is appropriate for the machine on which `elfwrap` is executed. The `-64` option can be used to create a 64–bit ELF relocatable object. The `-z target` option can be used to create a relocatable object for a specific machine type.

**Note** – Any data encapsulated with `elfwrap` must be in a format appropriate for the destination target.

By default, the relocatable object `a_wrap.o` is created. The `-o` option can be used to specify an alternative relocatable object name.

The `basename(1)` of each data file is used to create various pieces of ELF information. For example, if the input data file is `ISV/isv-data`, the following ELF information is created within the relocatable object.

- **An ELF section named `.isv-data`**
  This section contains the entire contents of the input data file.

- **An ELF symbol named `isv-data_start`**
  This symbol reflects the starting address of the `.isv-data` section.

- **An ELF symbol named `isv-data_end`**
  This symbol reflects the address of the first location after the `.isv-data` section.

**Options**
The following options are supported:

- **-64**
  Create a 64–bit ELF relocatable object.

- **-o relobj-file**
  Produce a relocatable object that is named `relobj-file`.

- **-z target=sparc | x86**
  Specifies the machine type for the output relocatable object. Supported targets are `sparc` and `x86`. The 32–bit machine type for the specified target is used unless the `-64` option is also present, in which case the corresponding 64–bit machine type is used. By default, the relocatable object that is generated is 32–bit for the machine one which `elfwrap` is executed.
**Examples**  The following example encapsulates the system passwd file and the system group file within a relocatable object passgroup.o.

```
example% elfwrap -o passgroup.o /etc/passwd /etc/group
example% elfdump -s passgroup.o | egrep "passwd|group"
[2] 0x00000000 0x00000000 SECT LOCL D 0 .passwd
[3] 0x00000000 0x00000000 SECT LOCL D 0 .group
[7] 0x00000000 0x000002f0 OBJT GLOB D 0 .passwd passwd_start
[8] 0x000002f0 0x00000000 OBJT GLOB D 0 .passwd passwd_end
[9] 0x00000000 0x00000121 OBJT GLOB D 0 .group group_start
[10] 0x00000121 0x00000000 OBJT GLOB D 0 .group group_end
example% strings -N.passwd passgroup.o | head -1
root:x:0:0:Super-User:/:/usr/sbin/sh
example% strings -N.group passgroup.o | head -1
root::0:
```

This relocatable object can be referenced from the following user code.

```
example% cat main.c
#include <stdio.h>
extern char passwd_start, passwd_end;

void main()
{
    char *pstart = &passwd_start, *pend = &passwd_end;
    char *str, *lstr;
    for (lstr = str = pstart; str < pend; str++) {
        if ((*str == '
') && (str != (pend - 1))) {
            (void) printf("%.*s", (++str - lstr), lstr);
            lstr = str;
        }
    }
example% cc -o main main.c passgroup.o
example% ./main
root:x:0:0:Super-User:/:/usr/sbin/sh
....
nobody4:x:65534:65534:SunOS 4.x NFS Anonymous Access User:/::
```

**Files**  `a.wrap.o`  The default relocatable object file created.

**Attributes**  See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/base-developer-utilities</td>
</tr>
</tbody>
</table>
elfwrap(1)

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  elfdump(1), ld(1), strings(1), elf(3ELF), attributes(5), ddi_modopen(9F)

Lexer and Libraries Guide
encrypt, decrypt – encrypt or decrypt files

Synopsis
/usr/bin/encrypt -l
/usr/bin/encrypt -a algorithm [-v]
    [-k key_file | -K key_label [-T token_spec]]
    [-i input_file] [-o output_file]

/usr/bin/decrypt -l
/usr/bin/decrypt -a algorithm [-v]
    [-k key_file | -K key_label [-T token_spec]]
    [-i input_file] [-o output_file]

Description
This utility encrypts or decrypts the given file or stdin using the algorithm specified. If no output file is specified, output is to standard out. If the cryptoadm -i and -o options specify the same file, the encrypted output is written to a temporary work file in the same file system and then used to replace the original file.

Upon decryption, if the cryptoadm -i and -o options specify the same file, the cleartext replaces the ciphertext file.

The output file of encrypt and the input file for decrypt contains the following information:

- Output format version number, 4 bytes in network byte order. The current version is 1.
- Iterations used in key generation function, 4 bytes in network byte order.
- IV (ivlen bytes)[1]. iv data is generated by random bytes equal to one block size.
- Salt data used in key generation (16 bytes).
- Cipher text data.

Options
The following options are supported:

- **-a algorithm** Specify the name of the algorithm to use during the encryption or decryption process. See USAGE, Algorithms for details.

- **-i input_file** Specify the input file. Default is stdin if input_file is not specified.

- **-k key_file** Specify the file containing the key value for the encryption algorithm. Each algorithm has specific key material requirements, as stated in the PKCS#11 specification. If -k is not specified, encrypt prompts for key material using getpassphrase(3C). The size of the key file determines the key length, and passphrases set from the terminal are always used to generate 128 bit long keys for ciphers with a variable key length.

For information on generating a key file, see the genkey subcommand in pktool(1). Alternatively, dd(1M) can be used.

- **-K key_label** Specify the label of a symmetric token key in a PKCS#11 token.
-l Display the list of algorithms available on the system. This list can change depending on the configuration of the cryptographic framework. The keysizes are displayed in bits.

-o output_file Specify output file. Default is stdout if output_file is not specified. If stdout is used without redirecting to a file, the terminal window can appear to hang because the raw encrypted or decrypted data has disrupted the terminal emulation, much like viewing a binary file can do at times.

-T token_spec Specify a PKCS#11 token other than the default soft token object store when the -K is specified.

_token_spec has the format of:

token_name [:manuf_id [:serial_no]]

When a token label contains trailing spaces, this option does not require them to be typed as a convenience to the user.

Colon separates token identification string. If any of the parts have a literal colon (:) character, it must be escaped by a backslash (\). If a colon (:) is not found, the entire string (up to 32 characters) is taken as the token label. If only one colon (:) is found, the string is the token label and the manufacturer.

-v Display verbose information. See Verbose.

Usage

Algorithms
The supported algorithms are displayed with their minimum and maximum key sizes in the -l option. These algorithms are provided by the cryptographic framework. Each supported algorithm is an alias of the PKCS #11 mechanism that is the most commonly used and least restricted version of a particular algorithm type. For example, des is an alias to CKM_DES_CBC_PAD and arcfour is an alias to CKM_RC4. Algorithm variants with no padding or ECB are not supported.

These aliases are used with the -a option and are case-sensitive.

Passphrase
When the -k option is not used during encryption and decryption tasks, the user is prompted for a passphrase. The passphrase is manipulated into a more secure key using the PBKDF2 algorithm specified in PKCS #5.

When a passphrase is used with encrypt and decrypt, the user entered passphrase is turned into an encryption key using the PBKDF2 algorithm as defined defined in http://www.rsasecurity.com, PKCS #5 v2.0.
If an input file is provided to the command, a progress bar spans the screen. The progress bar denotes every 25% completed with a pipe sign (|). If the input is from standard input, a period (.) is displayed each time 40KB is read. Upon completion of both input methods, Done is printed.

**Examples**

**EXAMPLE 1** Listing Available Algorithms

The following example lists available algorithms:

```bash
example$ encrypt -l
Algorithm     Keysize: Min Max
-----------------------------------
aes            128 128
arcfour        8 128
des            64 64
3des           192 192
```

**EXAMPLE 2** Encrypting Using AES

The following example encrypts using AES and prompts for the encryption key:

```bash
example$ encrypt -a aes -i myfile.txt -o secretstuff
```

**EXAMPLE 3** Encrypting Using AES with a Key File

The following example encrypts using AES after the key file has been created:

```bash
example$ pktool genkey keystore=file keytype=aes keylen=128 \
          outkey=key
example$ encrypt -a aes -k key -i myfile.txt -o secretstuff
```

**EXAMPLE 4** Using an In Pipe to Provide Encrypted Tape Backup

The following example uses an in pipe to provide encrypted tape backup:

```bash
example$ ufsdump 0f - /var | encrypt -a arcfour \
          -k /etc/mykeys/backup.k | dd of=/dev/rmt/0
```

**EXAMPLE 5** Using an In Pipe to Restore Tape Backup

The following example uses and in pipe to restore a tape backup:

```bash
example$ decrypt -a arcfour -k /etc/mykeys/backup.k \
          -i /dev/rmt/0 | ufsrestore xvf -
```

**EXAMPLE 6** Encrypting an Input File Using the 3DES Algorithm

The following example encrypts the input file with the 192-bit key stored in the des3key file:

```bash
example$ encrypt -a 3des -k des3key -i inputfile -o outputfile
```
EXAMPLE 7  Encrypting an Input File with a DES token key

The following example encrypts the input file file with a DES token key in the soft token
keystore. The DES token key can be generated with pktool(1):

```
example$ encrypt -a des -K mydeskey \ 
   -T "Sun Software PKCS#11 softtoken" -i inputfile \ 
   -o outputfile
```

Exit Status  The following exit values are returned:

0       Successful completion.
>0      An error occurred.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  digest(1), pktool(1), mac(1), dd(1M), getpassphrase(3C), libpkcs11(3LIB),
attributes(5), pkcs11_softtoken(5)

Oracle Solaris 11.1 Administration: Security Services

RSA PKCS#11 v2.11: http://www.rsasecurity.com
RSA PKCS#5 v2.0: http://www.rsasecurity.com
The `enhance` program provides enhanced command-line editing facilities to users of third party applications, to which one doesn’t have any source code. It does this by placing a pseudo-terminal between the application and the real terminal. It uses the `tecla` command-line editing library to read input from the real terminal, then forwards each just completed input line to the application via the pseudo-terminal. All output from the application is forwarded back unchanged to the real terminal.

Whenever the application stops generating output for more than a tenth of a second, the `enhance` program treats the latest incomplete output line as the prompt, and re-displays any incompleted input line that the user has typed after it. The small delay, which is imperceptible to the user, isn’t necessary for correct operation of the program. It is just an optimization, designed to stop the input line from being re-displayed so often that it slows down output.

The user-level command-line editing facilities provided by the `Tecla` library are documented in the `tecla(5)` man page.

The one major problem that hasn’t been solved yet, is how to deal with applications that change whether typed input is echoed by their controlling terminal. For example, programs that ask for a password, such as `ftp` and `telnet`, temporarily tell their controlling terminal not to echo what the user types. Since this request goes to the application side of the pseudo terminal, the `enhance` program has no way of knowing that this has happened, and continues to echo typed input to its controlling terminal, while the user types their password.

Furthermore, before executing the host application, the `enhance` program initially sets the pseudo terminal to `noecho` mode, so that everything that it sends to the program doesn’t get redundantly echoed. If a program that switches to `noecho` mode explicitly restores echoing afterwards, rather than restoring the terminal modes that were previously in force, then subsequently, every time that you enter a new input line, a duplicate copy will be displayed on the next line.

### Files
- `/usr/lib/libtecla.so` tecla library
- `~/.teclarc` tecla personal customization file.

### Attributes
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>library/libtecla</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>
See Also  libtecla(3LIB), attributes(5), tecla(5)
Name  

env – set environment for command invocation

Synopsis

/usr/bin/env [-i | -] [name=value]... [utility [arg...]]
/usr/xpg4/bin/env [-i | -] [name=value]...
               [utility [arg...]]

Description

The env utility obtains the current environment, modifies it according to its arguments, then invokes the utility named by the utility operand with the modified environment.

Optional arguments are passed to utility. If no utility operand is specified, the resulting environment is written to the standard output, with one name=value pair per line.

/usr/bin  If env executes commands with arguments, it uses the default shell /usr/bin/sh (see sh(1)).
/usr/xpg4/bin  If env executes commands with arguments, it uses /usr/xpg4/bin/sh (see ksh88(1)).

Options

The following options are supported:

- i | –  Ignores the environment that would otherwise be inherited from the current shell.
  Restrictions the environment for utility to that specified by the arguments.

Operands

The following operands are supported:

name=value  Arguments of the form name=value modify the execution environment, and are placed into the inherited environment before utility is invoked.

utility  The name of the utility to be invoked. If utility names any of the special shell built-in utilities, the results are undefined.

arg  A string to pass as an argument for the invoked utility.

Examples

Example 1  Invoking utilities with new PATH values

The following utility:

e example% env -i PATH=/mybin mygrep xyz myfile

invokes the utility mygrep with a new PATH value as the only entry in its environment. In this case, PATH is used to locate mygrep, which then must reside in /mybin.

Environment Variables

See environ(5) for descriptions of the following environment variables that affect the execution of env: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

PATH  Determine the location of the utility. If PATH is specified as a name=value operand to env, the value given shall be used in the search for utility.

Exit Status

If utility is invoked, the exit status of env is the exit status of utility. Otherwise, the env utility returns one of the following exit values:

0  Successful completion.
1-125  An error occurred.
utility was found but could not be invoked.
utility could not be found.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>/usr/bin</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ATTRIBUTE TYPE</td>
<td>ATTRIBUTE VALUE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Availability</td>
<td>system/core-os</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSI</td>
<td>enabled</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>/usr/xpg4/bin</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ATTRIBUTE TYPE</td>
<td>ATTRIBUTE VALUE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Availability</td>
<td>system/xopen/xcu4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSI</td>
<td>enabled</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

See Also

ksh88(1), sh(1), exec(2), profile(4), attributes(5), environ(5), standards(5)
Name eqn, neqn, checkeq – typeset mathematics test

Synopsis eqn [-d xy] [-f n] [-p n] [-s n] [file]...

neqn [file]...

checkeq [file]...

Description eqn and neqn are language processors to assist in describing equations. eqn is a preprocessor for troff(1) and is intended for devices that can print troff's output. neqn is a preprocessor for nroff(1) and is intended for use with terminals. Usage is almost always:

example% eqn file ... | troff
example% neqn file ... | nroff

If no files are specified, eqn and neqn read from the standard input. A line beginning with .EQ marks the start of an equation. The end of an equation is marked by a line beginning with .EN. Neither of these lines is altered, so they may be defined in macro packages to get centering, numbering, and so on. It is also possible to set two characters as "delimiters"; subsequent text between delimiters is also treated as eqn input.

checkeq reports missing or unbalanced delimiters and .EQ/.EN pairs.

Options The following options are supported:

-dxy Sets equation delimiters set to characters x and y with the command-line argument. The more common way to do this is with delim xy between .EQ and .EN. The left and right delimiters may be identical. Delimiters are turned off by delim off appearing in the text. All text that is neither between delimiters nor between .EQ and .EN is passed through untouched.

-fn Changes font to n globally in the document. The font can also be changed globally in the body of the document by using the gfont n directive, where n is the font specification.

-pn Reduces subscripts and superscripts by n point sizes from the previous size. In the absence of the -p option, subscripts and superscripts are reduced by 3 point sizes from the previous size.

-sn Changes point size to n globally in the document. The point size can also be changed globally in the body of the document by using the gsize n directive, where n is the point size.

Operands The following operands are supported:

file The nroff or troff file processed by eqn or neqn.

Eqn Language The nroff version of this description depicts the output of neqn to the terminal screen exactly as neqn is able to display it. To see an accurate depiction of the output, view the printed version of this page.
Tokens within eqn are separated by braces, double quotes, tildes, circumflexes, SPACE, TAB, or NEWLINE characters. Braces { } are used for grouping. Generally speaking, anywhere a single character like $x$ could appear, a complicated construction enclosed in braces may be used instead. A tilde (~) represents a full SPACE in the output; a circumflex (\^) half as much.

Subscripts and superscripts:
These are produced with the keywords sub and sup.

\begin{align*}
x \text{ sub } i & \quad \text{makes } x_i \\
a \text{ sub } i \text{ sup } 2 & \quad \text{produces } a_i^2 \\
e \text{ sup } \{ \text{x sup } 2 + \text{y sup } 2 \} & \quad \text{gives } e^{x^2+y^2}
\end{align*}

Fractions:
Fractions are made with over.

\begin{align*}
a \text{ over } b & \quad \text{yields } \frac{a}{b}
\end{align*}

Square Roots:
These are made with sqrt

\begin{align*}
1 \text{ over } \sqrt{\{ ax \text{ sup } 2 + bx + c \}} & \quad \text{results in } \frac{1}{\sqrt{ax^2+bx+c}}
\end{align*}

Limits:
The keywords from and to introduce lower and upper limits on arbitrary things:

\begin{align*}
\lim_{n \to \infty} \sum_{0}^{n} x_i & \quad \text{makes } \lim_{n \to \infty} \sum_{0}^{n} x_i \\
\text{left } [ \text{x sup } 2 + \text{y sup } 2 \text{ over } \alpha \text{ right } ] & \quad \text{produces } \left[ \frac{x^2+y^2}{\alpha} \right] = 1
\end{align*}

The right clause is optional. Legal characters after left and right are braces, brackets, bars, c and f for ceiling and floor, and ** for nothing at all (useful for a right-side-only
Vertical piles:

Vertical piles of things are made with \texttt{pile}, \texttt{lpile}, \texttt{cpile}, and \texttt{rpile}.

\texttt{pile \{ a above b above c \}}

\begin{equation*}
\begin{array}{c}
\text{a} \\
\text{b} \\
\text{c}
\end{array}
\end{equation*}

produces \( c \)

There can be an arbitrary number of elements in a pile. \texttt{lpile} left-justifies, \texttt{pile} and \texttt{cpile} center, with different vertical spacing, and \texttt{rpile} right-justifies.

Matrices:

Matrices are made with \texttt{matrix}.

\texttt{matrix \{ lcol \{ x sub i above y sub 2 \} ccol \{ 1 above 2 \} \}}

\begin{equation*}
\begin{array}{c}
\text{x}_i \\
\text{1}
\end{array}
\end{equation*}

produces \( y_2 \ 2 \)

In addition, there is \texttt{rcol} for a right-justified column.

Diacritical marks:

Diacritical marks are made with \texttt{dot}, \texttt{dotdot}, \texttt{hat}, \texttt{tilde}, \texttt{bar}, \texttt{vec}, \texttt{dyad}, and \texttt{under}.

\begin{equation*}
\begin{aligned}
\text{x dot} &= \text{f(t) bar} \\
\text{y dotdot bar} &= \text{n under}
\end{aligned}
\end{equation*}

\begin{equation*}
\begin{aligned}
\text{\( \dot{x} = f(t) \)} \\
\text{\( \ddot{y} = n \)}
\end{aligned}
\end{equation*}

\begin{equation*}
\begin{aligned}
\text{\( \vec{x} = \hat{y} \)}
\end{aligned}
\end{equation*}

Sizes and Fonts:

Sizes and font can be changed with \texttt{size n} or \texttt{size zn}, \texttt{roman}, \texttt{italic}, \texttt{bold}, and \texttt{font n}.

Size and fonts can be changed globally in a document by \texttt{gsise n} and \texttt{gfont n}, or by the command-line arguments \texttt{-s n} and \texttt{-f n}.

Successive display arguments:

Successive display arguments can be lined up. Place \texttt{mark} before the desired lineup point in the first equation; place \texttt{lineup} at the place that is to line up vertically in subsequent equations.

Shorthands:

Shorthands may be defined or existing keywords redefined with \texttt{define}:
define thing % replacement %  Defines a new token called thing which will be replaced
by replacement whenever it appears thereafter. The %
may be any character that does not occur in replacement.

Keywords and Shorthands:
Keywords like sum int inf and shorthands like >= → and != are recognized.

Greek letters:
Greek letters are spelled out in the desired case, as in alpha or GAMMA.

Mathematical words:
Mathematical words like sin, cos, and log are made Roman automatically.

troff(1) four-character escapes like \(bu\) can be used anywhere. Strings enclosed in double
quotes "..." are passed through untouched; this permits keywords to be entered as text, and
can be used to communicate with troff when all else fails.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>text/doctools</td>
</tr>
</tbody>
</table>

See Also  nroff(1), tbl(1), troff(1), attributes(5), ms(5)

Bugs  To embolden characters such as digits and parentheses, it is necessary to quote them, as in
"bold "12.3". 
**Name**  
error – insert compiler error messages at right source lines

**Synopsis**  
[filename]

**Description**  
error analyzes error messages produced by a number of compilers and language processors. It replaces the painful, traditional methods of scribbling abbreviations of errors on paper, and permits error messages and source code to be viewed simultaneously.

error looks at error messages, either from the specified file filename or from the standard input, and:

- Determines which language processor produced each error message.
- Determines the file name and line number of the erroneous line.
- Inserts the error message into the source file immediately preceding the erroneous line.

Error messages that can’t be categorized by language processor or content are not inserted into any file, but are sent to the standard output. error touches source files only after all input has been read.

error is intended to be run with its standard input connected with a pipe to the error message source. Some language processors put error messages on their standard error file; others put their messages on the standard output. Hence, both error sources should be piped together into error. For example, when using the csh syntax, the following command analyzes all the error messages produced by whatever programs make(1S) runs when making lint:

```
example% make -s lint | & error -q -v
```

error knows about the error messages produced by: as(1), cpp(1), ld(1), make(1S) and other compilers. For all languages except Pascal, error messages are restricted to one line. Some error messages refer to more than one line in more than one file, in which case error duplicates the error message and inserts it in all the appropriate places.

**Options**

- **-n**  
  Do not touch any files; all error messages are sent to the standard output.

- **-q**  
  error asks whether the file should be touched. A ‘y’ or ‘n’ to the question is necessary to continue. Absence of the -q option implies that all referenced files (except those referring to discarded error messages) are to be touched.

- **-s**  
  Print out statistics regarding the error categorization.

- **-v**  
  After all files have been touched, overlay the visual editor vi with it set up to edit all files touched, and positioned in the first touched file at the first error. If vi(1) can’t be found, try ex(1) or ed(1) from standard places.

- **-t suffixlist**  
  Take the following argument as a suffix list. Files whose suffices do not appear in the suffix list are not touched. The suffix list is dot separated, and ‘*’ wildcards work. Thus the suffix list:

  `.c .y .f* .h`
allows error to touch files ending with '.c', '.y', '.f*' and '.h'.

error catches interrupt and terminate signals, and terminates in an orderly fashion.

**Examples**

**EXAMPLE 1** Using the error Command

In the following C shell (/usr/bin/csh) example, error takes its input from the FORTRAN compiler:

```
example% f77 -c any.f |& error options
```

Here is the same example using the Korn shell (/usr/bin/ksh):

```
example% f77 -c any.f 2>&1 | error options
```

**Usage**

error does one of six things with error messages.

- **synchronize** Some language processors produce short errors describing which file they are processing. error uses these to determine the file name for languages that do not include the file name in each error message. These synchronization messages are consumed entirely by error.

- **discard** Error messages from lint that refer to one of the two lint libraries, /usr/lib/lint/llib-1c and /usr/lib/lint/llib-port are discarded, to prevent accidentally touching these libraries. Again, these error messages are consumed entirely by error.

- **nullify** Error messages from lint can be nullified if they refer to a specific function, which is known to generate diagnostics which are not interesting. Nullified error messages are not inserted into the source file, but are written to the standard output. The names of functions to ignore are taken from either the file named .errorrc in the user's home directory, or from the file named by the -I option. If the file does not exist, no error messages are nullified. If the file does exist, there must be one function name per line.

- **not file specific** Error messages that can't be intuited are grouped together, and written to the standard output before any files are touched. They are not inserted into any source file.

- **file specific** Error messages that refer to a specific file but to no specific line are written to the standard output when that file is touched.

- **true errors** Error messages that can be intuited are candidates for insertion into the file to which they refer.

Only true error messages are inserted into source files. Other error messages are consumed entirely by error or are written to the standard output. error inserts the error messages into the source file on the line preceding the line number in the error message. Each error message
is turned into a one line comment for the language, and is internally flagged with the string
### at the beginning of the error, and %% at the end of the error. This makes pattern searching
for errors easier with an editor, and allows the messages to be easily removed. In addition,
each error message contains the source line number for the line the message refers to. A
reasonably formatted source program can be recompiled with the error messages still in it,
without having the error messages themselves cause future errors. For poorly formatted
source programs in free format languages, such as C or Pascal, it is possible to insert a
comment into another comment, which can wreak havoc with a future compilation. To avoid
this, format the source program so there are no language statements on the same line as the
end of a comment.

Files

```
~/.errorrc   function names to ignore for lint error messages
/dev/tty      user’s teletype
```

Attributes See attributes(5) for descriptions of the following attributes:

```
<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/base-developer-utilities</td>
</tr>
</tbody>
</table>
```

See Also as(1), cpp(1), csh(1), ed(1), ex(1), make(1S), ld(1), vi(1), attributes(5)

Bugs Opens the tty-device directly for user input.

Source files with links make a new copy of the file with only one link to it.

Changing a language processor’s error message format may cause error to not understand the
error message.

error, since it is purely mechanical, will not filter out subsequent errors caused by
“floodgating” initiated by one syntactically trivial error. Humans are still much better at
discarding these related errors.

Pascal error messages belong after the lines affected, error puts them before. The alignment of
the ‘| ’ marking the point of error is also disturbed by error.

error was designed for work on CRT’s at reasonably high speed. It is less pleasant on slow
speed terminals, and was not designed for use on hardcopy terminals.
**ex(1)**

**Name**
ex – text editor

**Synopsis**
/usr/bin/ex [-| -s] [-l] [-L] [-R] [-r [file]] [-t tag]
[-v] [-V] [-wn] [+command | -c command] file...

[-t tag] [-v] [-V] [-wn]
[+command | -c command] file...

[-t tag] [-v] [-V] [-wn]
[+command | -c command] file...

**Description**
The ex utility is the root of a family of editors: ex and vi. ex is a superset of ed(1), with the most notable extension being a display editing facility. Display based editing is the focus of vi.

If you have a CRT terminal, you can wish to use a display based editor; in this case see vi(1), which is a command which focuses on the display-editing portion of ex.

If you have used ed you find that, in addition to having all of the ed commands available, ex has a number of additional features useful on CRT terminals. Intelligent terminals and high speed terminals are very pleasant to use with vi. Generally, the ex editor uses far more of the capabilities of terminals than ed does, and uses the terminal capability data base (see terminfo(4)) and the type of the terminal you are using from the environment variable TERM to determine how to drive your terminal efficiently. The editor makes use of features such as insert and delete character and line in its visual command (which can be abbreviated vi) and which is the central mode of editing when using the vi command.

The ex utility contains a number of features for easily viewing the text of the file. The z command gives easy access to windows of text. Typing "^D" (CTRL-D) causes the editor to scroll a half-window of text and is more useful for quickly stepping through a file than just typing return. Of course, the screen-oriented viual mode gives constant access to editing context.

The ex utility gives you help when you make mistakes. The undo (u) command allows you to reverse any single change which goes astray. ex gives you a lot of feedback, normally printing changed lines, and indicates when more than a few lines are affected by a command so that it is easy to detect when a command has affected more lines than it should have.

The editor also normally prevents overwriting existing files, unless you edited them, so that you do not accidentally overwrite a file other than the one you are editing. If the system (or editor) crashes, or you accidentally hang up the telephone, you can use the editor recover command (or -r file option) to retrieve your work. This gets you back to within a few lines of where you left off.

The ex utility has several features for dealing with more than one file at a time. You can give it a list of files on the command line and use the next (n) command to deal with each in turn. The next command can also be given a list of file names, or a pattern as used by the shell to
specify a new set of files to be dealt with. In general, file names in the editor can be formed with full shell metasyntax. The metacharacter ‘%’ is also available in forming file names and is replaced by the name of the current file.

The editor has a group of buffers whose names are the ASCII lower-case letters (a-z). You can place text in these named buffers where it is available to be inserted elsewhere in the file. The contents of these buffers remain available when you begin editing a new file using the edit (e) command.

There is a command & in ex which repeats the last substitute command. In addition, there is a confirmed substitute command. You give a range of substitutions to be done and the editor interactively asks whether each substitution is desired.

It is possible to ignore the case of letters in searches and substitutions. ex also allows regular expressions which match words to be constructed. This is convenient, for example, in searching for the word “edit” if your document also contains the word “editor.”

ex has a set of options which you can set to tailor it to your liking. One option which is very useful is the autoindent option that allows the editor to supply leading white space to align text automatically. You can then use ^D as a backtab and space or tab to move forward to align new code easily.

Miscellaneous useful features include an intelligent join (j) command that supplies white space between joined lines automatically, commands < and > which shift groups of lines, and the ability to filter portions of the buffer through commands such as sort.

**Options**

The following options are supported:

- `-s` Suppresses all interactive user feedback. This is useful when processing editor scripts.
- `-l` Sets up for editing LISP programs.
- `-L` Lists the name of all files saved as the result of an editor or system crash.
- `-R` Readonly mode. The readonly flag is set, preventing accidental overwriting of the file.
- `-r file` Edits file after an editor or system crash. (Recovers the version of file that was in the buffer when the crash occurred.)
- `-t tag` Edits the file containing the tag and positions the editor at its definition. It is an error to specify more than one -t option.
- `-v` Starts up in display editing state, using vi. You can achieve the same effect by typing the vi command itself.
-V  Verbose. When ex commands are read by means of standard input, the input is echoed to standard error. This can be useful when processing ex commands within shell scripts.

-wm  Sets the default window size to n. This is useful when using the editor over a slow speed line.

+command | -c command  Begins editing by executing the specified editor command (usually a search or positioning command).

Operands  The following operand is supported:

file  A path name of a file to be edited.

Usage  This section defines the ex states, commands, initializing options, and scanning pattern formations.

ex States  Command Normal and initial state. Input prompted for by “:”. The line kill character cancels a partial command.

Insert  Entered by a, i, or c. Arbitrary text can be entered. Insert state normally is terminated by a line having only ”. ” on it, or, abnormally, with an interrupt.

Visual  Entered by typing vi. Terminated by typing Q or ^ (Control-").

<table>
<thead>
<tr>
<th>ex Command Names and Abbreviations</th>
<th>Command Name</th>
<th>Abbreviation</th>
<th>Command Name</th>
<th>Abbreviation</th>
<th>Command Name</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>abbrev</td>
<td>ab</td>
<td>map</td>
<td>set</td>
<td>se</td>
<td></td>
<td></td>
</tr>
<tr>
<td>append</td>
<td>a</td>
<td>mark</td>
<td>ma</td>
<td>shell</td>
<td>sh</td>
<td></td>
</tr>
<tr>
<td>args</td>
<td>ar</td>
<td>move</td>
<td>m</td>
<td>source</td>
<td>so</td>
<td></td>
</tr>
<tr>
<td>change</td>
<td>c</td>
<td>next</td>
<td>n</td>
<td>substitute</td>
<td>s</td>
<td></td>
</tr>
<tr>
<td>copy</td>
<td>co</td>
<td>number</td>
<td>nu</td>
<td>unabbrev</td>
<td>unab</td>
<td></td>
</tr>
<tr>
<td>delete</td>
<td>d</td>
<td>preserve</td>
<td>pre</td>
<td>undo</td>
<td>u</td>
<td></td>
</tr>
<tr>
<td>edit</td>
<td>e</td>
<td>print</td>
<td>p</td>
<td>unmap</td>
<td>unm</td>
<td></td>
</tr>
<tr>
<td>file</td>
<td>f</td>
<td>put</td>
<td>pu</td>
<td>version</td>
<td>ve</td>
<td></td>
</tr>
<tr>
<td>global</td>
<td>g</td>
<td>quit</td>
<td>q</td>
<td>visual</td>
<td>vi</td>
<td></td>
</tr>
</tbody>
</table>
Join Command
Arguments

Join [range] j [join] [!] [count] [flags]

If count is specified:

/usr/bin/ex, /usr/xpg6/bin/ex
If no address is specified, the join command behaves as if 2addr were the current line and the current line plus count (., ., + count). If one address is specified, the join command behaves as if 2addr were the specified address and the specified address plus count (addr, addr + count).

/usr/xpg4/bin/ex
If no address is specified, the join command behaves as if 2addr were the current line and the current line plus count - 1 (., ., + count - 1). If one address is specified, the join command behaves as if 2addr were the specified address and the specified address plus count - 1 (addr, addr + count - 1).

/usr/bin/ex, /usr/xpg4/bin/ex, /usr/xpg6/bin/ex
If two or more addresses are specified, the join command behaves as if an additional address, equal to the last address plus count - 1 (addr1, ., lastaddr, lastaddr + count - 1), was specified. If this results in a second address greater than the last line of the edit buffer, it is corrected to be equal to the last line of the edit buffer.

If no count is specified:

/usr/bin/ex, /usr/xpg4/bin/ex, /usr/xpg6/bin/ex
If no address is specified, the join command behaves as if 2addr were the current line and the next line (., ., +1). If one address is specified, the join command behaves as if 2addr were the specified address and the next line (addr, addr +1).

Additional ex Command Arguments

/usr/bin/ex, /usr/xpg6/bin/ex
For the following ex commands, if count is specified, it is equivalent to specifying an additional address to the command. The additional address is equal to the last address specified to the command (either explicitly or by default) plus count - 1. If this results in an address greater than the last line of the edit buffer, it is corrected to equal the last line of the edit buffer.

/usr/xpg4/bin/ex
For the following ex commands, if both a count and a range are specified for a command that uses them, the number of lines affected is taken from the count value rather than the range. The starting line for the
The command is taken to be the first line addressed by the range.

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abbreviate</td>
<td>ab[brev] word rhs</td>
</tr>
<tr>
<td>Append</td>
<td>[line]a[ppend][!]</td>
</tr>
<tr>
<td>Arguments</td>
<td>ar[gs]</td>
</tr>
<tr>
<td>Change</td>
<td>[range] c[change][!] [count]</td>
</tr>
<tr>
<td>Change Directory</td>
<td>chd[ir][!] [directory]; cd[!] [directory]</td>
</tr>
<tr>
<td>Copy</td>
<td>[range] co[py] line [flags]; [range] t line [flags]</td>
</tr>
<tr>
<td>Delete</td>
<td>[range] d[elete] [buffer] [count] [flags]</td>
</tr>
<tr>
<td>Edit</td>
<td>e[dit][!] [+line][file]; ex[!] [+line] [file]</td>
</tr>
<tr>
<td>File</td>
<td>f[ile] [file]</td>
</tr>
<tr>
<td>Global</td>
<td>[range] g[lobal]/pattern/ [commands]; [range] v/pattern/ [commands]</td>
</tr>
<tr>
<td>Insert</td>
<td>[line] i[nsert][!]</td>
</tr>
<tr>
<td>List</td>
<td>[range] l[ist] [count] [flags]</td>
</tr>
<tr>
<td>Map</td>
<td>map[!] [x rhs]</td>
</tr>
<tr>
<td>Mark</td>
<td>[line] ma[rk] x; [line] k x</td>
</tr>
<tr>
<td>Move</td>
<td>[range] m[ove] line</td>
</tr>
<tr>
<td>Next</td>
<td>n[ext][!] [file ...]</td>
</tr>
<tr>
<td>Open</td>
<td>[line] o[pen]/pattern/ [flags]</td>
</tr>
<tr>
<td>Preserve</td>
<td>pre[serve]</td>
</tr>
<tr>
<td>Put</td>
<td>[line] pu[t] [buffer]</td>
</tr>
<tr>
<td>Quit</td>
<td>q[uit][!]</td>
</tr>
<tr>
<td>Read</td>
<td>[line] r[ead][!] [file]</td>
</tr>
<tr>
<td>Recover</td>
<td>rec[over] file</td>
</tr>
<tr>
<td>Rewind</td>
<td>rew[ind][!]</td>
</tr>
<tr>
<td>Set</td>
<td>se[t] [option=[value]...][!] [nooption...] [option?] [all]</td>
</tr>
<tr>
<td>Shell</td>
<td>sh[ell]</td>
</tr>
<tr>
<td>Source</td>
<td>so[urce] file</td>
</tr>
<tr>
<td>Suspend</td>
<td>su[spend][!]; st[op][!]</td>
</tr>
</tbody>
</table>
Tag \[tag][!] tagstring
Unabbreviate \[unabbrev][word
Undo \[undo][x
Unmap \[unmap][!] x
Visual \[line][visual][type][count][flags]
Write \[range][write][!] [>>][file];\[range][write][!] [file];\[range][wq][!] [>>][file]
Write and Exit \[range][x[it][!] [file]
Yank \[range][yank][buffer][count]
Adjust Window \[line][z][type][count][flags]
Escape ! command [range][!][command]
Scroll EOF
Write Line Number \[line][=][flags]
Execute @ buffer; * buffer

/\usr/bin/ex, /\usr/xpg4/bin/ex, /\usr/xpg6/bin/ex
For the following ex commands, if count is specified, it is equivalent to specifying an additional address to the command. The additional address is equal to the last address specified to the command (either explicitly or by default) plus count - 1. If this results in an address greater than the last line of the edit buffer, it is corrected to equal the last line of the edit buffer.

Number \[range][number][count][flags];\[range][#][count][flags]
Print \[range][print][count][flags]
Substitute \[range][substitute][/pattern/repl[/options]][count][flags]
Shift Left \[range]<[count][flags]
Shift Right \[range]>[count][flags]
Resubstitute \[range][&][options][count][flags];\[range][substitute][options][count][flags];\[range]~[options][count][flags]
resubst
print next
rshift

User Commands
### ex Command Addresses

- `<`  
  - lshift
- `^D`  
  - scroll
- `z`  
  - window
- `!`  
  - shell escape

### Initializing Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>EXINIT</code></td>
<td>place set's here in environment variable</td>
</tr>
<tr>
<td><code>$HOME/.exrc</code></td>
<td>editor initialization file</td>
</tr>
<tr>
<td><code>./.exrc</code></td>
<td>editor initialization file</td>
</tr>
<tr>
<td><code>set x</code></td>
<td>enable option x</td>
</tr>
<tr>
<td><code>set nox</code></td>
<td>disable option x</td>
</tr>
<tr>
<td><code>set x=val</code></td>
<td>give value val to option x</td>
</tr>
<tr>
<td><code>set</code></td>
<td>show changed options</td>
</tr>
<tr>
<td><code>set all</code></td>
<td>show all options</td>
</tr>
<tr>
<td><code>set x?</code></td>
<td>show value of option x</td>
</tr>
</tbody>
</table>
### Useful Options and Abbreviations

<table>
<thead>
<tr>
<th>Option</th>
<th>Abbrev</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>autoindent</td>
<td>ai</td>
<td>supply indent</td>
</tr>
<tr>
<td>autowrite</td>
<td>aw</td>
<td>write before changing files</td>
</tr>
<tr>
<td>directory</td>
<td></td>
<td>pathname of directory for temporary work files</td>
</tr>
<tr>
<td>exc</td>
<td>ex</td>
<td>allow vi/ex to read the .exrc in the current directory. This option is set in the EXINIT shell variable or in the .exrc file in the $HOME directory.</td>
</tr>
<tr>
<td>ignorecase</td>
<td>ic</td>
<td>ignore case of letters in scanning</td>
</tr>
<tr>
<td>list</td>
<td></td>
<td>print ^I for tab, $ at end</td>
</tr>
<tr>
<td>magic</td>
<td></td>
<td>treat . [ * special in patterns</td>
</tr>
<tr>
<td>modelines</td>
<td>para</td>
<td>first five lines and last five lines executed as vi/ex commands if they are of the form ex:command: or vi:command:</td>
</tr>
<tr>
<td>number</td>
<td>nu</td>
<td>number lines</td>
</tr>
<tr>
<td>paragraphs</td>
<td>para</td>
<td>macro names that start paragraphs</td>
</tr>
<tr>
<td>redraw</td>
<td></td>
<td>simulate smart terminal</td>
</tr>
<tr>
<td>report</td>
<td></td>
<td>informs you if the number of lines modified by the last command is greater than the value of the report variable</td>
</tr>
<tr>
<td>scroll</td>
<td></td>
<td>command mode lines</td>
</tr>
<tr>
<td>sections</td>
<td>sect</td>
<td>macro names that start sections</td>
</tr>
<tr>
<td>shiftwidth</td>
<td>sw</td>
<td>for &lt; &gt;, and input ^D</td>
</tr>
<tr>
<td>showmatch</td>
<td>sm</td>
<td>to ) and } as typed</td>
</tr>
<tr>
<td>showmode</td>
<td>smod</td>
<td>show insert mode in vi</td>
</tr>
<tr>
<td>slowopen</td>
<td>slow</td>
<td>stop updates during insert</td>
</tr>
<tr>
<td>term</td>
<td></td>
<td>specifies to vi the type of terminal being used (the default is the value of the environment variable TERM)</td>
</tr>
<tr>
<td>window</td>
<td></td>
<td>visual mode lines</td>
</tr>
<tr>
<td>wrapmargin</td>
<td>wm</td>
<td>automatic line splitting</td>
</tr>
<tr>
<td>wrapscan</td>
<td>ws</td>
<td>search around end (or beginning) of buffer</td>
</tr>
</tbody>
</table>

### Scanning Pattern Formation

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>^</td>
<td>beginning of line</td>
</tr>
<tr>
<td>$</td>
<td>end of line</td>
</tr>
<tr>
<td>.</td>
<td>any character</td>
</tr>
</tbody>
</table>
See `environ(5)` for descriptions of the following environment variables that affect the execution of `ex`: HOME, LANG, LC_ALL, LC_COLLATE, LC_CTYPE, LC_MESSAGES, NLSPATH, PATH, SHELL, and TERM.

**Environment Variables**

- **COLUMNS**: Override the system-selected horizontal screen size.
- **EXINIT**: Determine a list of `ex` commands that are executed on editor start-up, before reading the first file. The list can contain multiple commands by separating them using a vertical-line (|) character.
- **LINES**: Override the system-selected vertical screen size, used as the number of lines in a screenful and the vertical screen size in visual mode.

**Exit Status**

The following exit values are returned:

- **0**: Successful completion.
- **>0**: An error occurred.

**Files**

- `/var/tmp/Exnnnnn`: editor temporary
- `/var/tmp/Rxnnnnn`: named buffer temporary
- `/usr/lib/expreserve`: preserve command
- `/usr/lib/exrecover`: recover command
- `/usr/lib/exstrings`: error messages
- `/usr/share/lib/terminfo/*`: describes capabilities of terminals
- `/var/preserve/login`: preservation directory (where `login` is the user's login)
- `$HOME/.exrc`: editor startup file
- `./.exrc`: editor startup file

**Attributes**

See `attributes(5)` for descriptions of the following attributes:
The vi and ex utilities are based on software developed by The University of California, Berkeley California, Computer Science Division, Department of Electrical Engineering and Computer Science.

Notes Several options, although they continue to be supported, have been replaced in the documentation by options that follow the Command Syntax Standard (see Intro(1)). The – option has been replaced by -s, a -r option that is not followed with an option-argument has been replaced by -L, and +command has been replaced by -c command.

The message file too large to recover with -r option, which is seen when a file is loaded, indicates that the file can be edited and saved successfully, but if the editing session is lost, recovery of the file with the -r option is not possible.

The z command prints the number of logical rather than physical lines. More than a screen full of output can result if long lines are present.

File input/output errors do not print a name if the command line -s option is used.
The editing environment defaults to certain configuration options. When an editing session is initiated, `ex` attempts to read the EXINIT environment variable. If it exists, the editor uses the values defined in EXINIT, otherwise the values set in `$HOME/.exrc` are used. If `$HOME/.exrc` does not exist, the default values are used.

To use a copy of `.exrc` located in the current directory other than `$HOME`, set the `exrc` option in EXINIT or `$HOME/.exrc`. Options set in EXINIT can be turned off in a local `.exrc` only if `exrc` is set in EXINIT or `$HOME/.exrc`. In order to be used, `.exrc` in `$HOME` or the current directory must fulfill these conditions:

- It must exist.
- It must be owned by the same userid as the real userid of the process, or the process has appropriate privileges.
- It is not writable by anyone other than the owner.

There is no easy way to do a single scan ignoring case.

The editor does not warn if text is placed in named buffers and not used before exiting the editor.

Null characters are discarded in input files and cannot appear in resultant files.
**Name**  exec, eval, source – shell built-in functions to execute other commands

**Synopsis**

- **sh**
  ```
  exec [argument]...
  eval [argument]...
  ```

- **csh**
  ```
  exec command
  eval argument...
  source [-h] name
  ```

- **ksh88**
  ```
  *exec [argument]...
  *eval [argument]...
  +exec [-c] [-a name] [command [argument ... ]]
  +eval [argument]...
  ```

**Description**

- **sh** The `exec` command specified by the arguments is executed in place of this shell without creating a new process. Input/output arguments and appear and, if no other arguments are specified, cause the shell input/output to be modified.

  The *arguments* to the `eval` built-in are read as input to the shell and the resulting command(s) executed.

- **csh** `exec` executes `command` in place of the current shell, which terminates.

  `eval` reads its *arguments* as input to the shell and executes the resulting command(s). This is usually used to execute commands generated as the result of command or variable substitution.

  `source` reads commands from `name`. `source` commands can be nested, but if they are nested too deeply the shell can run out of file descriptors. An error in a sourced file at any level terminates all nested `source` commands.

  `-h` Place commands from the file `name` on the history list without executing them.

- **ksh88** With the `exec` built-in, if `arg` is specified, the command specified by the arguments is executed in place of this shell without creating a new process. Input/output arguments can appear and affect the current process. If no arguments are specified the effect of this command is to modify file descriptors as prescribed by the input/output redirection list. In this case, any file descriptor numbers greater than 2 that are opened with this mechanism are closed when invoking another program.

  The arguments to `eval` are read as input to the shell and the resulting command(s) executed.
On this man page, **ksh88(1)** commands that are preceded by one or two * (asterisks) are treated specially in the following ways:

1. Variable assignment lists preceding the command remain in effect when the command completes.
2. I/O redirections are processed after variable assignments.
3. Errors cause a script that contains them to abort.
4. Words, following a command preceded by ** that are in the format of a variable assignment, are expanded with the same rules as a variable assignment. This means that tilde substitution is performed after the = sign and word splitting and file name generation are not performed.

**exec** is a special built-in command that can be used to manipulate file descriptors or to replace the current shell with a new command.

If *command* is specified, then the current shell process is replaced by *command* rather than running *command* and waiting for it to complete. There is no need to use **exec** to enhance performance since the shell implicitly uses the **exec** mechanism internally whenever possible.

If no operands are specified, **exec** can be used to open or close files, or to manipulate file descriptors from 0 to 9 in the current shell environment using the standard redirection mechanism available with all commands. The close-on-exec flags is set on file descriptor numbers greater than 2 that are opened this way so that they are closed when another program is invoked.

Because **exec** is a special command, any failure causes the script that invokes it to exit. This can be prevented by invoking **exec** from the command utility.

**exec** cannot be invoked from a restricted shell to create files or to open a file for writing or appending.

**eval** is a shell special built-in command that constructs a command by concatenating the *arguments* together, separating each with a space. The resulting string is taken as input to the shell and evaluated in the current environment. Command words are expanded twice, once to construct *argument*, and again when the shell executes the constructed command. It is not an error if *argument* is not specified.

On this manual page, **ksh** commands that are preceded by one or two + symbols are special built-in commands and are treated specially in the following ways:

1. Variable assignment lists preceding the command remain in effect when the command completes.
2. I/O redirections are processed after variable assignments.
3. Errors cause a script that contains them to abort.
4. They are not valid function names.
5. Words following a command preceded by ++ that are in the format of a variable assignment are expanded with the same rules as a variable assignment. This means that tilde substitution is performed after the = sign and field splitting and file name generation are not performed.

Options

ksh The following options are supported by ksh exec:

- a name argv[0] is set to name for command.
- c Clear all environment variables before executions except variable assignments that are part of the current exec command.

Exit Status

ksh88 The following exit values are returned by exec:

0 Successful completion.
1-125 A redirection error occurred.
127 command was not found.
126 command was found, but it is not an executable utility.

ksh The following exit values are returned by exec. If command is specified, exec does not return.

0 Successful completion. All I/O redirections were successful.
>0 An error occurred.

The following exit values are returned by eval:

If argument is not specified, the exit status is 0. Otherwise, it is the exit status of the command defined by the argument operands.

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also csh(1), ksh(1), ksh88(1), sh(1), attributes(5)
exit, return, goto – shell built-in functions to enable the execution of the shell to advance beyond its sequence of steps

**Synopsis**

- `sh`:
  - `exit [n]`
  - `return [n]`
- `csh`:
  - `exit [{ expr }]`
  - `goto label`
- `ksh88`:
  - `*exit [n]`
  - `*return [n]`
- `ksh`:
  - `+exit [n]`
  - `+return [n]`

**Description**

- `sh`:
  - `exit` causes the calling shell or shell script to exit with the exit status specified by `n`. If `n` is omitted the exit status is that of the last command executed (an EOF also causes the shell to exit.)
  - `return` causes a function to exit with the return value specified by `n`. If `n` is omitted, the return status is that of the last command executed.

- `csh`:
  - `exit` causes the calling shell or shell script to exit, either with the value of the status variable or with the value specified by the expression `expr`.
  - The `goto` built-in uses a specified `label` as a search string amongst commands. The shell rewinds its input as much as possible and searches for a line of the form `label:` possibly preceded by space or tab characters. Execution continues after the indicated line. It is an error to jump to a label that occurs between a `while` or `for` built-in command and its corresponding `end`.

- `ksh88`:
  - `exit` causes the calling shell or shell script to exit with the exit status specified by `n`. The value is the least significant 8 bits of the specified status. If `n` is omitted then the exit status is that of the last command executed. When `exit` occurs when executing a trap, the last command refers to the command that executed before the trap was invoked. An end-of-file also causes the shell to exit except for a shell which has the `ignoreeof` option (See set below) turned on.
  - `return` causes a shell function or `.` script to return to the invoking script with the return status specified by `n`. The value is the least significant 8 bits of the specified status. If `n` is omitted then the return status is that of the last command executed. If `return` is invoked while not in a function or a `.` script, then it is the same as an `exit`.

- `ksh`:
  - `+exit [n]`
  - `+return [n]`

On this man page, `ksh88(1)` commands that are preceded by one or two `*` (asterisks) are treated specially in the following ways:
1. Variable assignment lists preceding the command remain in effect when the command completes.
2. I/O redirections are processed after variable assignments.
3. Errors cause a script that contains them to abort.
4. Words, following a command preceded by ** that are in the format of a variable assignment, are expanded with the same rules as a variable assignment. This means that tilde substitution is performed after the = sign and word splitting and file name generation are not performed.

**exit** is shell special built-in that causes the shell that invokes it to exit. Before exiting the shell, if the EXIT trap is set, it is invoked.

If *n* is specified, it is used to set the exit status.

*return* is a shell special built-in that causes the function or dot script that invokes it to exit. If *return* is invoked outside of a function or dot script it is equivalent to *exit*.

If *return* is invoked inside a function defined with the function reserved word syntax, then any EXIT trap set within the function is invoked in the context of the caller before the function returns.

If *n* is specified, it is used to set the exit status.

On this manual page, ksh commands that are preceded by one or two + symbols are special built-in commands and are treated specially in the following ways:

1. Variable assignment lists preceding the command remain in effect when the command completes.
2. I/O redirections are processed after variable assignments.
3. Errors cause a script that contains them to abort.
4. They are not valid function names.
5. Words following a command preceded by ++ that are in the format of a variable assignment are expanded with the same rules as a variable assignment. This means that tilde substitution is performed after the = sign and field splitting and file name generation are not performed.

**Exit Status**

If *n* is specified for **exit**, the exit status is the least significant eight bits of the value of *n*. Otherwise, the exit status is the exit status of preceding command. When invoked inside a trap, the preceding command means the command that invoked the trap.

If *n* is specified for *return*, the exit status is the least significant eight bits of the value of *n*. Otherwise, the exit status is the exit status of preceding command.
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  break(1), csh(1), ksh(1), ksh88(1), sh(1), attributes(5)
Name  
expand, unexpand – expand TAB characters to SPACE characters, and vice versa

Synopsis 
expand [-t tablist] [file]...
expand [-tabstop] [-tab1, tab2,..., tabn] [file]...
unexpand [-a] [-t tablist] [file]...

Description 
The expand utility copies files (or the standard input) to the standard output, with TAB characters expanded to SPACE characters. BACKSPACE characters are preserved into the output and decrement the column count for TAB calculations. expand is useful for pre-processing character files (before sorting, looking at specific columns, and so forth) that contain TAB characters.

unexpand copies files (or the standard input) to the standard output, putting TAB characters back into the data. By default, only leading SPACE and TAB characters are converted to strings of tabs, but this can be overridden by the -a option (see the OPTIONS section below).

Options 
The following options are supported for expand:
- **-t tablist**
  Specifies the tab stops. The argument tablist must consist of a single positive decimal integer or multiple positive decimal integers, separated by blank characters or commas, in ascending order. If a single number is given, tabs will be set tablist column positions apart instead of the default 8. If multiple numbers are given, the tabs will be set at those specific column positions.

  Each tab-stop position $N$ must be an integer value greater than zero, and the list must be in strictly ascending order. This is taken to mean that, from the start of a line of output, tabbing to position $N$ causes the next character output to be in the $(N+1)$th column position on that line.

  In the event of expand having to process a tab character at a position beyond the last of those specified in a multiple tab-stop list, the tab character is replaced by a single space character in the output.

- **-tabstop**
  Specifies as a single argument, sets TAB characters tabstop SPACE characters apart instead of the default 8.

- **-tab1, tab2,..., tabn**
  Sets TAB characters at the columns specified by -tab1,tab2,..., tabn

The following options are supported for unexpand:
- **-a**
  Inserts TAB characters when replacing a run of two or more SPACE characters would produce a smaller output file.

- **-t tablist**
  Specifies the tab stops. The option-argument tablist must be a single argument consisting of a single positive decimal integer or multiple positive decimal integers, separated by blank characters or commas, in ascending order. If a
single number is given, tabs will be set tablist column positions apart instead of
the default 8. If multiple numbers are given, the tabs will be set at those specific
column positions. Each tab-stop position N must be an integer value greater
than zero, and the list must be in strictly ascending order. This is taken to mean
that, from the start of a line of output, tabbing to position N will cause the next
character output to be in the (N+1)th column position on that line. When the -t
option is not specified, the default is the equivalent of specifying -t 8 (except for
the interaction with -a, described below).

No space-to-tab character conversions occur for characters at positions beyond
the last of those specified in a multiple tab-stop list.

When -t is specified, the presence or absence of the -a option is ignored;
conversion will not be limited to the processing of leading blank characters.

Operands  The following operand is supported for expand and unexpand:

   file     The path name of a text file to be used as input.

Environment Variables  See environ(5) for descriptions of the following environment variables that affect the
execution of expand and unexpand: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status  The following exit values are returned:

   0  Successful completion
   >0  An error occurred.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also  tabs(1), attributes(5), environ(5), standards(5)
**Name**
exportfs – translates exportfs options to share/unshare commands

**Synopsis**
/usr/sbin/exportfs [-aiuv] [-o options] [pathname]

**Description**
exportfs translates SunOS 4.x exportfs options to the corresponding share/unshare options and invokes share/unshare with the translated options.

With no options or arguments, exportfs invokes share to print out the list of all currently shared NFS filesystems.

exportfs is the BSD/Compatibility Package command of share(1M) and unshare(1M). Use share(1M)/unshare(1M) whenever possible.

**Options**
- `-a` Invokes shareall(1M), or if `-u` is specified, invokes unshareall(1M).
- `-i` Ignore options in /etc/dfs/dfstab.
- `-u` Invokes unshare(1M) on pathname.
- `-v` Verbose.
- `-o options` Specify a comma-separated list of optional characteristics for the filesystems being exported. exportfs translates options to share-equivalent options. (see share(1M) for information about individual options).

**Attributes**
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/file-system/nfs</td>
</tr>
</tbody>
</table>

**See Also**
share(1M), shareall(1M), unshare(1M), unshareall(1M), attributes(5)
expr(1)

Name  expr – evaluate arguments as an expression

Synopsis  
/usr/bin/expr argument...
/usr/xpg4/bin/expr argument...
/usr/xpg6/bin/expr argument...

Description  
The expr utility evaluates the expression and writes the result to standard output. The character 0 is written to indicate a zero value and nothing is written to indicate a null string.

The expr utility evaluates the expression and writes the result to standard output followed by a NEWLINE. If there is no result from expr processing, a NEWLINE is written to standard output.

Operands  The argument operand is evaluated as an expression. Terms of the expression must be separated by blanks. Characters special to the shell must be escaped (see sh(1)). Strings containing blanks or other special characters should be quoted. The length of the expression is limited to LINE_MAX (2048 characters).

The operators and keywords are listed below. The list is in order of increasing precedence, with equal precedence operators grouped within { } symbols. All of the operators are left-associative.

expr \| expr  Returns the evaluation of the first expr if it is neither NULL nor 0; otherwise, returns the evaluation of the second expr if it is not NULL; otherwise, 0.

expr \& expr  Returns the first expr if neither expr is NULL or 0, otherwise returns 0.

expr[ =, !>, , , !, ] expr  Returns the result of an integer comparison if both arguments are integers, otherwise returns the result of a string comparison using the locale-specific coalition sequence. The result of each comparison is 1 if the specified relationship is TRUE, 0 if the relationship is FALSE.

expr[ +, ] expr  Addition or subtraction of integer-valued arguments.

expr[ *, /, ] expr  Multiplication, division, or remainder of the integer-valued arguments.

expr : expr  The matching operator : (colon) compares the first argument with the second argument, which must be an internationalized basic regular expression (BRE), except that all patterns are anchored to the beginning of the string. That is, only sequences starting at the first...
character of a string are matched by the regular expression. See regex(5) and NOTES. Normally, the 
/usr/bin/expr matching operator returns the number of bytes matched and the /usr/xpg4/bin/expr 
matching operator returns the number of characters matched (0 on failure). If the second argument contains 
at least one BRE sub-expression [\(...\)], the matching 
operator returns the string corresponding to \1.

integer
An argument consisting only of an (optional) unary 
minus followed by digits.

string
A string argument that cannot be identified as an integer 
argument or as one of the expression operator symbols.

The following four operators: index, length, match, and substr, are all at the same 
precedence:

index string character-list
Report the first byte in string (counting from one) where 
a byte from character-list matches a byte from string. If no 
bytes in character-list appear in string, a 0 is returned.

length string
Return the length (that is, the number of bytes) of string. 
The terminating null character is not included in that 
count.

match string regular-expression
Synonymous with the expr : expr matching operator.

substr string integer-1 integer-2
Extract the sequence of bytes from string (counting from 
one) starting at position integer-1 and of length integer-2 
bytes. If integer-1 has a value greater than the number of 
bytes in string, expr returns a null string. If you try to 
extract more bytes than there are in string, expr returns 
all the remaining bytes from string. Results are 
unspecified if either integer-1 or integer-2 is a negative 
value.

Examples
EXAMPLE 1 Adding an integer to a shell variable
Add 1 to the shell variable a:
examples a='expr $a + 1'

EXAMPLE 2 Returning a path name segment
The following example emulates basename(1), returning the last segment of the path name $a. 
For $a equal to either /usr/abc/file or just file, the example returns file. (Watch out for / 
alone as an argument: expr takes it as the division operator. See NOTES below.)
EXAMPLE 2  Returning a path name segment  (Continued)

example$ expr $a : '.*/\(.*\)' \| $a

EXAMPLE 3  Using // characters to simplify the expression
Here is a better version of the previous example. The addition of the // characters eliminates
any ambiguity about the division operator and simplifies the whole expression.
example$ expr //a : '.*/\(.*\)'  

EXAMPLE 4  Returning the number of bytes in a variable
example$ expr "$VAR" : '.*'

EXAMPLE 5  Returning the number of characters in a variable
example$ expr "$VAR" : '.*'

Environment Variables  See environ(5) for descriptions of the following environment variables that affect the
execution of expr: LANG, LC_ALL, LC_COLLATE, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status  As a side effect of expression evaluation, expr returns the following exit values:
0    If the expression is neither NULL nor 0.
1    If the expression is either NULL or 0.
2    For invalid expressions.
>2   An error occurred.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled. See Notes.</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>See below.</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

The match, substr, length, and index operators are Uncommitted. Everything else is
Committed.

See Also  basename(1), ed(1), sh(1), Intro(3), attributes(5), environ(5), regex(5), standards(5)
**Diagnostics**

- **syntax error**    Operator and operand errors.
- **non-numeric argument**    Arithmetic is attempted on such a string.

**Notes**

The following three operators are not CSI enabled. They are also not available in 
`/usr/xpg4/bin/expr` and `/usr/xpg6/bin/expr`:

- `index string character-list`
- `length string`
- `substr string integer-1 integer-2`

After argument processing by the shell, `expr` cannot tell the difference between an operator and an operand except by the value. If `$a` is an `=`, the command:

```
example$ expr $a = '='
```

looks like:

```
example$ expr $a = =
```

as the arguments are passed to `expr` (and they are all taken as the `=` operator). The following works:

```
example$ expr X$a = X=
```

**Regular Expressions**

Unlike some previous versions, `expr` uses Internationalized Basic Regular Expressions for all system-provided locales. Internationalized Regular Expressions are explained on the `regex(5)` manual page.
expr(1B)

Name expr – evaluate arguments as a logical, arithmetic, or string expression

Synopsis /usr/ucb/expr argument...

Description The expr utility evaluates expressions as specified by its arguments. After evaluation, the result is written on the standard output. Each token of the expression is a separate argument, so terms of the expression must be separated by blanks. Characters special to the shell must be escaped. Note: 0 is returned to indicate a zero value, rather than the null string. Strings containing blanks or other special characters should be quoted. Integer-valued arguments may be preceded by a unary minus sign. Internally, integers are treated as 32-bit, two's-complement numbers.

The operators and keywords are listed below. Characters that need to be escaped are preceded by '\'. The list is in order of increasing precedence, with equal precedence operators grouped within { } symbols.

\| expr \| expr

Returns the evaluation of the first expr if it is neither NULL nor 0; otherwise, returns the evaluation of the second expr if it is not NULL; otherwise, 0.

\& expr \& expr

Returns the first expr if neither expr is NULL or 0, otherwise returns 0.

{ =, \, \, , \, <, \, <=, \, != } expr

Returns the result of an integer comparison if both arguments are integers, otherwise returns the result of a lexical comparison.

{ +, - } expr

Addition or subtraction of integer-valued arguments.

{ \, /, \% } expr

Multiplication, division, or remainder of the integer-valued arguments.

string : regular-expression

match string regular-expression

The two forms of the matching operator above are synonymous. The matching operators : and match compare the first argument with the second argument which must be a regular expression. Regular expression syntax is the same as that of regexp(5), except that all patterns are “anchored” (treated as if they begin with ^) and therefore ^ is not a special character, in that context. Normally, the matching operator returns the number of characters matched (0 on failure). Alternatively, the \ . . . \ pattern symbols can be used to return a portion of the first argument.

substr string integer-1 integer-2

Extracts the substring of string starting at position integer-1 and of length integer-2 characters. If integer-1 has a value greater than the length of string, expr returns
null string. If you try to extract more characters than there are in `string`, `expr` returns all the remaining characters from `string`. Beware of using negative values for either `integer-1` or `integer-2` as `expr` tends to run forever in these cases.

```plaintext
index string character-list
```

Reports the first position in `string` at which any one of the characters in `character-list` matches a character in `string`.

```plaintext
length string
```

Returns the length (that is, the number of characters) of `string`.

```plaintext
(expr)
```

Parentheses may be used for grouping.

### Examples

**EXAMPLE 1**  Adding an integer to a shell variable

Add 1 to the shell variable `a`.

```
a='expr $a + 1'
```

**EXAMPLE 2**  Returning a path name segment

Return the last segment of a path name (that is, the filename part). Watch out for `/` alone as an argument: `expr` will take it as the division operator (see **BUGS** below).

```
# 'For $a equal to either "/usr/abc/file" or just "file"
expr $a : '.*/\ $a
```

**EXAMPLE 3**  Using `//` characters to simplify the expression

The addition of the `//` characters eliminates any ambiguity about the division operator and simplifies the whole expression.

```
# A better representation of example 2.
expr \$a : './*/\ $a
```

**EXAMPLE 4**  Returning the value of a variable

Returns the number of characters in `$VAR`.

```
expr $VAR : '.*/
```

### Exit Status

`expr` returns the following exit codes:

- 0  If the expression is neither `NULL` nor 0.
- 1  If the expression is `NULL` or 0.
- 2  For invalid expressions.
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTETYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>

See Also  sh(1), test(1), attributes(5), regexp(5)

Diagnostics  syntax error  for operator/operand errors
  non-numeric argument  if arithmetic is attempted on such a string
  division by zero  if an attempt to divide by zero is made

Bugs  After argument processing by the shell, expr cannot tell the difference between an operator and an operand except by the value. If $a$ is an $=$, the command:

```sh
expr $a = '
'
```

looks like:

```sh
expr = = =
```

as the arguments are passed to expr (and they will all be taken as the $=$ operator). The following works:

```sh
expr X$a = X=
```

Note: the match, substr, length, and index operators cannot themselves be used as ordinary strings. That is, the expression:

```sh
example% expr index expurgatorious length
```

syntax error

example%

generates the 'syntax error' message as shown instead of the value 1 as you might expect.
**Name**  
exstr – extract strings from source files

**Synopsis**  
exstr filename...
exstr -e filename...
exstr -r [-d] filename...

**Description**  
The `exstr` utility is used to extract strings from C-language source files and replace them by calls to the message retrieval function (see `gettext(3C)`). This utility will extract all character strings surrounded by double quotes, not just strings used as arguments to the `printf` command or the `printf` routine. In the first form, `exstr` finds all strings in the source files and writes them on the standard output. Each string is preceded by the source file name and a colon (:`).

The first step is to use `exstr -e` to extract a list of strings and save it in a file. Next, examine this list and determine which strings can be translated and subsequently retrieved by the message retrieval function. Then, modify this file by deleting lines that can’t be translated and, for lines that can be translated, by adding the message file names and the message numbers as the fourth (`msgfile`) and fifth (`msgnum`) entries on a line. The message files named must have been created by `mkmsgs(1)` and exist in `/usr/lib/locale/locale/LC_MESSAGES`. (The directory `locale` corresponds to the language in which the text strings are written; see `setlocale(3C)`.) The message numbers used must correspond to the sequence numbers of strings in the message files.

Now use this modified file as input to `exstr -r` to produce a new version of the original C-language source file in which the strings have been replaced by calls to the message retrieval function `gettext()`. The `msgfile` and `msgnum` fields are used to construct the first argument to `gettext()`. The second argument to `gettext()` is printed if the message retrieval fails at run-time. This argument is the null string, unless the `-d` option is used.

This utility cannot replace strings in all instances. For example, a static initialized character string cannot be replaced by a function call. A second example is that a string could be in a form of an escape sequence which could not be translated. In order not to break existing code, the files created by invoking `exstr -e` must be examined and lines containing strings not replaceable by function calls must be deleted. In some cases the code may require modifications so that strings can be extracted and replaced by calls to the message retrieval function.

**Options**  
The following options are supported:

- `-e` Extract a list of strings from the named C-language source files, with positional information. This list is produced on standard output in the following format:

```
file:line:position:msgfile:msgnum:string
```

where

```
file the name of a C-language source file
```
Normally you would redirect this output into a file. Then you would edit this file to add the values you want to use for msgfile and msgnum:

```
msgfile  the file that contains the text strings that will replace string. A file with this name must be created and installed in the appropriate place by the mkmsgs(1) utility.

msgnum  the sequence number of the string in msgfile.
```

The next step is to use `exstr -r` to replace strings in file.

```
-exstr -r
```

Replace strings in a C-language source file with function calls to the message retrieval function `gettext()`.

```
-d
```

This option is used together with the `-r` option. If the message retrieval fails when `gettext()` is invoked at run-time, then the extracted string is printed. You would use the capability provided by `exstr` on an application program that needs to run in an international environment and have messages print in more than one language. `exstr` replaces text strings with function calls that point at strings in a message database. The database used depends on the run-time value of the `LC_MESSAGES` environment variable (see `environ(5)`).

**Examples**

**EXAMPLE 1** The following examples show uses of `exstr`

Assume that the file `example.c` contains two strings:

```
main()
{
    printf("This is an example\n");
    printf("Hello world!\n");
}
```

The `exstr` utility, invoked with the argument `example.c` extracts strings from the named file and prints them on the standard output.

```
example% exstr example.c
```
EXAMPLE 1  The following examples show uses of exstr  (Continued)

produces the following output:

example.c:This is an example
example.c:Hello world!

The exstr utility, invoked with the -e option and the argument example.c, and redirecting output to the file example.stringsout

example% exstr -e example.c > example.stringsout

produces the following output in the file example.stringsout

example.c:3:8:::This is an example
example.c:4:8:::Hello world!

You must edit example.stringsout to add the values you want to use for the msgfile and msgnum fields before these strings can be replaced by calls to the retrieval function. If UX is the name of the message file, and the numbers 1 and 2 represent the sequence number of the strings in the file, here is what example.stringsout looks like after you add this information:

example.c:3:8:UX:1:This is an example
example.c:4:8:UX:2:Hello world!

The exstr utility can now be invoked with the -r option to replace the strings in the source file by calls to the message retrieval function gettxt().

example% exstr -r example.c <example.stringsout >intlexample.c

produces the following output:

extern char *gettxt();

main()
{
    printf(gettxt("UX:1", "");
    printf(gettxt("UX:2", "");
}

The following example:

example% exstr -rd example.c <example.stringsout >intlexample.c

uses the extracted strings as a second argument to gettxt():
The following examples show uses of `exstr` (Continued)

```c
extern char *gettxt();
main()
{
    printf(gettxt("UX:1", "This is an example\n"));
    printf(gettxt("UX:2", "Hello world!\n"));
}
```

Files 
/usr/lib/locale/locale/LC_MESSAGES/* files created by `mkmsgs(1)`

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>text/locale</td>
</tr>
</tbody>
</table>

See Also 
`gettext(1), mkmsgs(1), printf(1), srchtxt(1), gettext(3C), printf(3C), setlocale(3C), attributes(5), environ(5)`

Diagnostics The error messages produced by `exstr` are intended to be self-explanatory. They indicate errors in the command line or format errors encountered within the input file.
Name  factor – obtain the prime factors of a number

Synopsis  factor [integer]

Description  factor writes to standard input all prime factors for any positive integer less than or equal to 10^{14}. The prime factors are written the proper number of times.

If factor is used without an argument, it waits for an integer to be entered. After entry of the integer, it factors it, writes its prime factors the proper number of times, and then waits for another integer. factor exits if a 0 or any non-numeric character is entered.

If factor is invoked with an argument (integer), it writes the integer, factors it and writes all the prime factors as described above, and then exits. If the argument is 0 or non-numeric, factor writes a 0 and then exits.

The maximum time to factor an integer is proportional to sqrt(n), where \( n \) is the integer which is entered. factor will take this time when \( n \) is prime or the square of a prime.

Operands  integer     Any positive integer less than or equal to 10^{14}.

Exit Status  0     Successful completion.

1     An error occurred.

Diagnostics  factor prints the error message Ouch! for input out of range or for garbage input.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/extended-system-utilities</td>
</tr>
</tbody>
</table>

See Also  attributes(5)
Name  fastboot, fasthalt – reboot/halt the system without checking the disks

Synopsis  /usr/ucb/fastboot [boot-options]
           /usr/ucb/fasthalt [halt-options]

Description  fastboot and fasthalt are shell scripts that invoke reboot and halt with the proper arguments.

These commands are provided for compatibility only.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>

See Also  fsck(1M), halt(1M), init(1M), reboot(1M), init.d(4), attributes(5)
The `fgrep` (fixed grep) utility searches files for a character string and prints all lines that contain that string. `fgrep` is different from `grep(1)` and from `egrep(1)` because it searches for a string, instead of searching for a pattern that matches an expression.

The characters $, *, [, ^, |, (, ), and \ are interpreted literally by `fgrep`, that is, `fgrep` does not recognize full regular expressions as does `egrep`. These characters have special meaning to the shell. Therefore, to be safe, enclose the entire `string` within single quotes (`'`).

If no files are specified, `fgrep` assumes standard input. Normally, each line that is found is copied to the standard output. The file name is printed before each line that is found if there is more than one input file.

The following options are supported for both `/usr/bin/fgrep` and `/usr/xpg4/bin/fgrep`:

- `-b` Precedes each line by the block number on which the line was found. This can be useful in locating block numbers by context. The first block is 0.
- `-c` Prints only a count of the lines that contain the pattern.
- `-e pattern_list` Searches for a `string` in `pattern_list`. This is useful when the `string` begins with a `-`.
- `-f pattern-file` Takes the list of patterns from `pattern-file`.
- `-h` Suppresses printing of files when searching multiple files.
- `-i` Ignores upper/lower case distinction during comparisons.
- `-l` Prints the names of files with matching lines once, separated by new-lines. Does not repeat the names of files when the pattern is found more than once.
- `-n` Precedes each line by its line number in the file. The first line is 1.
- `-s` Works silently, that is, displays nothing except error messages. This is useful for checking the error status.
- `-v` Prints all lines except those that contain the pattern.
The following options are supported for `/usr/xpg4/bin/fgrep` only:

- `q` Quiet. Does not write anything to the standard output, regardless of matching lines. Exits with zero status if an input line is selected.

### Operands

The following operands are supported:

- `file` Specifies a path name of a file to be searched for the patterns. If no `file` operands are specified, the standard input will be used.

- `pattern` Specifies a pattern to be used during the search for input.

- `pattern_list` Specifies one or more patterns to be used during the search for input. This operand is treated as if it were specified as `-e pattern_list`

### Usage

See `largefile(5)` for the description of the behavior of `fgrep` when encountering files greater than or equal to 2 Gbyte (2^{31} bytes).

### Environment Variables

See `environ(5)` for descriptions of the following environment variables that affect the execution of `fgrep`: `LC_COLLATE`, `LC_CTYPE`, `LC_MESSAGES`, and `NLSPATH`.

### Exit Status

The following exit values are returned:

- `0` If any matches are found
- `1` If no matches are found
- `2` For syntax errors or inaccessible files, even if matches were found.

### Attributes

See `attributes(5)` for descriptions of the following attributes:

#### /usr/bin/fgrep

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

#### /usr/xpg4/bin/fgrep

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/xopen/xcu4</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

### See Also

`ed(1), egrep(1), grep(1), sed(1), sh(1), attributes(5), environ(5), largefile(5), XPG4(5)`

### Notes

Ideally, there should be only one `grep` command, but there is not a single algorithm that spans a wide enough range of space-time tradeoffs.

Lines are limited only by the size of the available virtual memory.
The /usr/xpg4/bin/fgrep utility is identical to /usr/xpg4/bin/grep -F (see grep(1)). Portable applications should use /usr/xpg4/bin/grep -F.
The `file` utility performs a series of tests on each file supplied by `file` and, optionally, on each file listed in `ffile` in an attempt to classify it. If the file is not a regular file, its file type is identified. The file types directory, FIFO, block special, and character special are identified as such. If the file is a regular file and the file is zero-length, it is identified as an empty file.

If `file` appears to be a text file, `file` examines the first 512 bytes and tries to determine its programming language. If `file` is a symbolic link, by default the link is followed and `file` tests the file to which the symbolic link refers.

If `file` is a relocatable object, executable, or shared object, `file` prints out information about the file’s execution requirements. This information includes the machine class, byte-ordering, static/dynamic linkage, and any software or hardware capability requirements. If `file` is a runtime linking configuration file, `file` prints information about the target platform, including the machine class and byte-ordering.

By default, `file` will try to use the localized magic file

```
/usr/lib/locale/locale/LC_MESSAGES/magic
```

if it exists, to identify files that have a magic number. For example, in the Japanese locale, `file` will try to use

```
/usr/lib/locale/ja/LC_MESSAGES/magic
```

If a localized magic file does not exist, `file` will utilize `/etc/magic`. A magic number is a numeric or string constant that indicates the file type. See `magic(4)` for an explanation of the format of `/etc/magic`.

If `file` does not exist, cannot be read, or its file status could not be determined, it is not considered an error that affects the exit status. The output will indicate that the file was processed, but that its type could not be determined.

### Options

The following options are supported:

- `-c` Checks the magic file for format errors. For reasons of efficiency, this validation is normally not carried out.
Applies any position-sensitive and context-sensitive default system tests to the file.

-ffile  ffile contains a list of the files to be examined.

-h  When a symbolic link is encountered, this option identifies the file as a symbolic link. If -h is not specified and file is a symbolic link that refers to a non-existent file, the file utility identifies the file as a symbolic link, as if -h had been specified.

-i  If a file is a regular file, this option does not attempt to classify the type of file further, but identifies the file as a "regular file".

-m mfile  /usr/bin/file   Uses mfile as an alternate magic file, instead of /etc/magic.

/usr/xpg4/bin/file   Specifies the name of a file containing position-sensitive tests that are applied to a file in order to classify it (see magic(4)). If the -m option is specified without specifying the -d option or the -M option, position-sensitive default system tests are applied after the position-sensitive tests specified by the -m option.

-M Mfile  Specifies the name of a file containing position-sensitive tests that are applied to a file in order to classify it (see magic(4)). No position-sensitive default system tests nor context-sensitive default system tests are applied unless the -d option is also specified.

If the -M option is specified with the -d option, the -m option, or both, or if the -m option is specified with the -d option, the concatenation of the position-sensitive tests specified by these options is applied in the order specified by the appearance of these options.

Operands  The following operands are supported:

file  A path name of a file to be tested.

Usage  See largefile(5) for the description of the behavior of file when encountering files greater than or equal to 2 Gbyte (2^31 bytes).

Examples  EXAMPLE 1  Determining if an Argument is a Binary Executable Files

The following example determine if an argument is a binary executable file:

file "$1" | grep −Fq executable && printf "%s is executable.\n" "$1"

Environment Variables  See environ(5) for descriptions of the following environment variables that affect the execution of file: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.
Exit Status  The following exit values are returned:

0    Successful completion.

>0   An error occurred.

Files  /etc/magic       file's magic number file

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also  crle(1), elfdump(1), elffile(1), ls(1), magic(4), attributes(5), environ(5), largefile(5), standards(5)

Notes  The file utility cannot examine archive members unless they are first extracted from the archive into a separate file. The elffile utility can examine archive members in place, and is recommended for use with ELF objects and archives.
Name  file – determine the type of a file by examining its contents

Synopsis  /usr/ucb/file  [-f  file] [-cl] [-m  mfile] filename...

Description  file performs a series of tests on each filename in an attempt to determine what it contains. If
the contents of a file appear to be ASCII text, file examines the first 512 bytes and tries to
guess its language.

file uses the file /etc/magic to identify files that have some sort of magic number, that is, any
file containing a numeric or string constant that indicates its type.

Options  
- c        Check for format errors in the magic number file. For reasons of efficiency, this
validation is not normally carried out. No file type-checking is done under - c.

- f  file   Get a list of filenames to identify from  file.

- L        If a file is a symbolic link, test the file the link references rather than the link itself.

- m  mfile  Use  mfile as the name of an alternate magic number file.

Examples  
EXAMPLE 1  Using  file on all the files in a specific user’s directory.
This example illustrates the use of  file on all the files in a specific user’s directory:

example%  pwd
/usr/blort/misc
example% /usr/ucb/file  *

code:               mc68020 demand paged executable
code.c:              c program text
counts:              ascii text
doc:                 roff,nroff, or eqn input text
empty.file:          empty
libz:                archive random library
memos:               directory
project:             symbolic link to /usr/project
script:              executable shell script
titles:              ascii text
ss5.stuff:           cpio archive

example%

Environment Variables  The environment variables LC_CTYPE, LANG, and LC_default control the character
classification throughout  file. On entry to  file, these environment variables are checked in
the following order: LC_CTYPE, LANG, and LC_default. When a valid value is found, remaining
environment variables for character classification are ignored. For example, a new setting for
LANG does not override the current valid character classification rules of LC_CTYPE. When
none of the values is valid, the shell character classification defaults to the POSIX.1 “C” locale.
Files /etc/magic

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>

See Also magic(4), attributes(5)

Bugs file often makes mistakes. In particular, it often suggests that command files are C programs. file does not recognize Pascal or LISP.
Name  filebench – framework of workloads to measure and compare filesystem performance

Synopsis  
/usr/benchmarks/filebench/bin/filebench profile
/usr/benchmarks/filebench/bin/filebench -c stats_dir...

Description  filebench runs workloads to measure and compare filesystem performance.

Full documentation can be found at the performance community at: http://hub.opensolaris.org/bin/view/Main/

Options  The following options are supported:

-\c stats_dir... Generates a HTML file (index.html) that is a comparison of the specified directories. stats_dir specifies the directory or directories in which the results are stored.

Operands  The following operands are supported:

profile Specifies the name of the configuration file ending in .prof. The configuration file specifies:
- what workloads to run,
- what parameters to run,
- the directory path on which to operate, and
- the directory path in which to store the results.

Exit Status  The following exit values are returned:

0  Successful completion.
1  An error occurred.
2  Invalid command line options were specified.

Examples  EXAMPLE 1  Running the Multi-stream Sequential Read Workload

The following example runs the workloads described in the configuration file named sqread.prof:

# filebench sqread

EXAMPLE 2  Comparing Multiple Runs

The following example compares the results of two previous runs.

This example assumes that the results from the two previous filebench runs were located in the directories: /stats/wombat-zfs-noel-Jun_27_2007-15h_45m_33s and /stats/wombat-ufs-noel-Jun_27_2007-15h_52m_11s.

This example generates a HTML file named index.html in your current working directory.
Example 2  Comparing Multiple Runs  (Continued)

`# filebench -c /stats/wombat-zfs-noel-Jun_27_2007-15h_45m_33s \
   /stats/wombat-ufs-noel-Jun_27_2007-15h_52m_11s`

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>benchmark/filebench</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Uncommitted</td>
</tr>
</tbody>
</table>

See Also  attributes(5)
filesync - synchronize ordinary, directory or special files

filesync [-aehmnqvy] [-o src | dst]
           [-f src | dst | old | new] [-r directory]...

filesync [-aehmnqvy] -s source-dir -d dest-dir filename...

Description
The filesync utility synchronizes files between multiple computer systems, typically a server and a portable computer. filesync synchronizes ordinary, directory or special files. Although intended for use on nomadic systems, filesync is useful for backup and file replication on more permanently connected systems.

If files are synchronized between systems, the corresponding files on each of the systems are identical. Changing a file on one or both of the systems causes the files to become different (not synchronized). In order to make the files identical again, the differences between the files must be reconciled. See Reconciling and Synchronizing Files for specific details about how filesync reconciles and synchronizes files.

There are two forms of the filesync command. The first form of filesync is invoked without file arguments. This form of filesync reconciles differences between the files and systems specified in the $HOME/.packingrules file. $HOME/.packingrules is a packing rules list for filesync and contains a list of files to be kept synchronized. See packingrules(4).

The second form of filesync copies specific files from a directory on the source system to a directory on the destination system. In addition, this form of filesync adds the file or files specified as arguments (filename) to $HOME/.packingrules. See -s and -d for information about specifying directories on source and destination systems. See OPERANDS for details about specifying file (filename) arguments.

Multiple filesync commands are cumulative (that is, the specified files are added to the already existing packing rules file list). See Multiple filesync Commands.

Reconciling and Synchronizing Files
filesync synchronizes files between computer systems by performing the following two tasks:

1. filesync examines the directories and files specified in the packing rules file on both systems, and determines whether or not they are identical. Any file that differs requires reconciliation.

filesync also maintains a baseline summary in the $HOME/filesync-base file for all of the files that are being monitored. This file lists the names, types, and sizes of all files as of the last reconciliation.

2. Based on the information contained in the baseline file and the specified options (see Resolving filesync Conflicts), filesync determines which of the various copies is the correct one, and makes the corresponding changes to the other system. Once this has been done, the two copies are, again, identical (synchronized).
If a source file has changed and the destination file has not, the changes on the source system are propagated to the destination system. If a destination file has changed and the corresponding source file has not, the changes on the destination file are propagated to the source system. If both systems have changed (and the files are not still identical) a warning message will be printed out, asking the user to resolve the conflict manually. See Resolving filesync Conflicts.

In cases where files on both sides have changed, filesync attempts to determine which version should be chosen. If filesync cannot automatically determine which version should be selected, it prints out a warning message and leaves the two incompatible versions of the file unreconciled. In these cases, you must either resolve the differences manually, or tell filesync how to choose which file should win. Use the -o and -f options to tell filesync how to resolve conflicts (see OPTIONS).

Alternatively, for each conflicting file, you can examine the two versions, determine which one should be kept, and manually bring the two versions into agreement (by copying, deleting, or changing the ownership or protection to be correct). You can then re-run filesync to see whether or not any other conflicts remain.

The packing rules file $HOME/.packingrules contains a list of files to be kept synchronized. The syntax of this file is described in packingrules(4).

The $HOME/.packingrules file is automatically created if users invoke filesync with filename arguments. By using filesync options, users can augment the packing rules in $HOME/.packingrules.

Many users choose to create the packing rules file manually and edit it by hand. Users can edit $HOME/.packingrules (using any editor) to permanently change the $HOME/.packingrules file, or to gain access to more powerful options that are not available from the command line (such as IGNORE commands). It is much easier to enter complex wildcard expressions by editing the $HOME/.packingrules file.

$HOME/.filesync-base is the filesync baseline summary file. filesync uses the information in $HOME/.filesync-base to identify the differences between files during the reconciliation and synchronization process. Users do not create or edit the baseline file. It is created automatically by filesync and records the last known state of agreement between all of the files being maintained.

Over a period of time, the set of files you want to keep synchronized can change. It is common, for instance, to want to keep files pertaining to only a few active projects on your notebook. If you continue to keep files associated with every project you have ever worked on synchronized, your notebook's disk will fill up with old files. Each filesync command will waste a lot of time updating files you no longer care about.
If you delete the files from your notebook, filesync will want to perform the corresponding deletes on the server, which would not be what you wanted. Rather, you would like a way to tell filesync to stop synchronizing some of the files. There are two ways to do this:

1. Edit $HOME/.packingrules. Delete the rules for the files that you want to delete.
2. Delete $HOME/.packingrules. Use the filesync command to specify the files that you want synchronized.

Either way works, and you can choose the one that seems easiest to you. For minor changes, it is probably easier to just edit $HOME/.packingrules. For major changes it is probably easier to start from scratch.

Once filesync is no longer synchronizing a set of files, you can delete them from your notebook without having any effect on the server.

Nomadic Machines

When using filesync to keep files synchronized between nomadic machines and a server, store the packing rules and baseline files on the nomadic machines, not the server. If, when logged into your notebook, the HOME environment variable does not normally point to a directory on your notebook, you can use the FILESYNC environment variable to specify an alternate location for the packing rules and baseline files.

Each nomadic machine should carry its own packing rules and baseline file. Incorrect file synchronization can result if a server carries a baseline file and multiple nomadic machines attempt to reconcile against the server’s baseline file. In this case, a nomadic machine could be using a baseline file that does not accurately describe the state of its files. This might result in incorrect reconciliations.

To safeguard against the dangers associated with a single baseline file being shared by more than two machines, filesync adds a default rule to each new packing rules file. This default rule prevents the packing rules and baseline files from being copied.

Options

The following options are supported:

-a
Force the checking of Access Control Lists (ACLs) and attempt to make them agree for all new and changed files. If it is not possible to set the ACL for a particular file, filesync stops ACL synchronization for that file.

Some file systems do not support ACLs. It is not possible to synchronize ACLs between file systems that support ACLs and those that do not; attempting to do so will result in numerous error messages.

-d dest-dir
Specify the directory on the destination system into which filename is to be copied. Use with the -s source-dir option and the filename operand. See -s and OPERANDS.
-e
Flag all differences. It may not be possible to resolve all conflicts involving modes and ownership (unless filesync is being run with root privileges). If you cannot change the ownership or protections on a file, filesync will normally ignore conflicts in ownership and protection. If you specify the -e (everything must agree) flag, however, filesync will flag these differences.

-f src | dst | old | new
The -f option tells filesync how to resolve conflicting changes. If a file has been changed on both systems, and an -f option has been specified, filesync will retain the changes made on the favored system and discard the changes made on the unfavored system.

Specify -f src to favor the source-system file. Specify -f dst to favor the destination-system file. Specify -f old to favor the older version of the file. Specify -f new to favor the newer version of the file.

It is possible to specify the -f and -o options in combination if they both specify the same preference (src and dst). If -f and -o conflict, the -f option is ignored. See the -o option description.

-h
Halt on error. Normally, if filesync encounters a read or write error while copying files, it notes the error and the program continues, in an attempt to reconcile other files. If the -h option is specified, filesync will immediately halt when one of these errors occurs and will not try to process any more files.

-m
Ensure that both copies of the file have the same modification time. The modification time for newly copied files is set to the time of reconciliation by default. File changes are ordered by increasing modification times so that the propagated files have the same relative modification time ordering as the original changes. Users should be warned that there is usually some time skew between any two systems, and transferring modification times from one system to another can occasionally produce strange results.

There are instances in which using filesync to update some (but not all) files in a directory will confuse the make program. If, for instance, filesync is keeping .c files synchronized, but ignoring .o files, a changed .c file may show up with a modification time prior to a .o file that was built from a prior version of the .c file.

-n
Do not really make the changes. If the -n option is specified, filesync determines what changes have been made to files, and what reconciliations are required and displays this information on the standard output. No changes are made to files, including the packing rules file.

Specifying both the -n and -o options causes filesync to analyze the prevailing system and report the changes that have been made on that system.
filesync(1)

combination is useful if your machine is disconnected (and you cannot access the server) but you want to know what changes have been made on the local machine. See the -o option description.

**-o src | dst**

The -o option forces a one-way reconciliation, favoring either the source system (src) or destination system (dst).

Specify **-o src** to propagate changes only from the source system to the destination system. Changes made on the destination system are ignored. filesync aborts if it cannot access a source or destination directory.

Specify **-o dst** to propagate changes only from the destination system to the source system. Changes made on the source system are ignored. filesync aborts if it cannot access a source or destination directory.

Specifying **-n** with the -o option causes filesync to analyze the prevailing system and reports on what changes have been made on that system. Using -n and -o in combination is useful if a machine is disconnected (and there is no access to the server), but you want to know what changes have been made on the local machine. See the -n option description.

It is possible to specify the -o and -f options in combination if they both specify the same preference (src or dst). If -o and -f options conflict, the -f option will be ignored. See the -f option description.

**-q**

Suppress the standard filesync messages that describe each reconciliation action as it is performed.

The standard filesync message describes each reconciliation action in the form of a UNIX shell command (for example, mv, ln, cp, rm, chmod, chown, chgrp, setfacl, and so forth).

**-r directory**

Limit the reconciliation to directory. Specify multiple directories with multiple -r specifications.

**-s source-dir**

Specify the directory on the source system from which the filename to be copied is located. Use with the -d dest-dir option and the filename operand. See the -d option description and OPERANDS.

**-v**

Display additional information about each file comparison as it is made on the standard output.

**-y**

Bypass safety check prompts. Nomadic machines occasionally move between domains, and many of the files on which filesync operates are expected to be accessed by NFS. There is a danger that someday filesync will be asked to reconcile local changes against the wrong
filesystem or server. This could result in a large number of inappropriate copies and deletions. To prevent such a mishap, filesync performs a few safety checks prior to reconciliation. If large numbers of files are likely to be deleted, or if high level directories have changed their I-node numbers, filesync prompts for a confirmation before reconciliation. If you know that this is likely, and do not want to be prompted, use the -y (yes) option to automatically confirm these prompts.

**Operands**  The following operands are supported:

*filename*  The name of the ordinary file, directory, symbolic link, or special file in the specified source directory (*source-dir*) to be synchronized. Specify multiple files by separating each filename by spaces. Use the *filename* operand with the -s and -d options. See OPTIONS.

If *filename* is an ordinary file, that ordinary file will be replicated (with the same *filename*) in the specified destination directory (*dest-dir*).

If *filename* is a directory, that directory and all of the files and subdirectories under it will be replicated (recursively) in the specified destination directory (*dest-dir*).

If *filename* is a symbolic link, a copy of that symbolic link will be replicated in the specified destination directory (*dest-dir*).

If *filename* is a special file, a special file with the same major or minor device numbers will be replicated in the specified destination directory (*dest-dir*). Only super-users can use filesync to create special files.

Files created in the destination directory (*dest-dir*) will have the same owner, group and other permissions as the files in the source directory.

If *filename* contains escaped shell wildcard characters, the wildcard characters are stored in $HOME/.packingrules and evaluated each time filesync is run.

For example, the following would make sure that the two specified files, currently in $RHOME, were replicated in $HOME:

```
filesync -s $RHOME -d $HOME a.c  b.c
```

The following example would ensure that all of the *.c* files in $RHOME were replicated in $HOME, even if those files were not created until later.

```
filesync -s $RHOME -d $HOME '*.c'
```

If any of the destination files already exist, filesync ensures that they are identical and issues warnings if they are not.

Once files have been copied, the distinction between the source and destination is a relatively arbitrary one (except for its use in the -o and -f switches).
FILESYNC

Specifies the default location of the filesync packing rules and baseline files. The default value for this variable is $HOME. The suffixes .packingrules and .filesync-base will be appended to form the names of the packing rules and baseline files.

LC_MESSAGES

Determines how diagnostic and informative messages are presented. In the C locale, the messages are presented in the default form found in the program itself (in most cases, U.S. English).

Exit Status

Normally, if all files are already up-to-date, or if all files were successfully reconciled, filesync will exit with a status of 0. However, if either the -n option was specified or any errors occurred, the exit status will be the logical OR of the following:

0    No conflicts, all files up to date.
1    Some resolvable conflicts.
2    Some conflicts requiring manual resolution.
4    Some specified files did not exist.
8    Insufficient permission for some files.
16   Errors accessing packing rules or baseline file.
32   Invalid arguments.
64   Unable to access either or both of the specified src or dst directories.
128  Miscellaneous other failures.

Files

$HOME/.packingrules    list of files to be kept synchronized
$HOME/.filesync-base    baseline summary file

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/network-clients</td>
</tr>
</tbody>
</table>

See Also

packingrules(4), attributes(5)
find – find files

/usr/bin/find [-H | -L] path... expression
/usr/xpg4/bin/find [-H | -L] path... expression

The `find` utility recursively descends the directory hierarchy for each `path` seeking files that match a Boolean `expression` written in the primaries specified below.

`find` is able to descend to arbitrary depths in a file hierarchy and does not fail due to path length limitations (unless a `path` operand specified by the application exceeds `PATH_MAX` requirements).

`find` detects infinite loops; that is, entering a previously visited directory that is an ancestor of the last file encountered.

Options

The following options are supported:

- `-H` Causes the file information and file type evaluated for each symbolic link encountered on the command line to be those of the file referenced by the link, and not the link itself. If the referenced file does not exist, the file information and type is for the link itself. File information for all symbolic links not on the command line is that of the link itself.

- `-L` Causes the file information and file type evaluated for each symbolic link to be those of the file referenced by the link, and not the link itself. See NOTES.

Specifying more than one of the mutually-exclusive options `-H` and `-L` is not considered an error. The last option specified determines the behavior of the utility.

Operands

The following operands are supported:

- `path` A pathname of a starting point in the directory hierarchy.
- `expression` The first argument that starts with a `~`, or is a `!` or a `(`, and all subsequent arguments are interpreted as an `expression` made up of the following primaries and operators. In the descriptions, wherever `n` is used as a primary argument, it is interpreted as a decimal integer optionally preceded by a plus (`+`) or minus (`-`) sign, as follows:
  
  - `+n` more than `n`
  - `n` exactly `n`
  - `-n` less than `n`

Expressions

Valid expressions are:

- `-acl` True if the file have additional ACLs defined.
- `-amin n` File was last accessed `n` minutes ago.

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-atime n  True if the file was accessed n days ago. The access time of directories in path is changed by find itself.
-cmin n  File's status was last changed n minutes ago.
-cpio device  Always true. Writes the current file on device in cpio format (5120-byte records).
-ctime n  True if the file's status was changed n days ago.
-depth  Always true. Causes descent of the directory hierarchy to be done so that all entries in a directory are acted on before the directory itself. This can be useful when find is used with cpio(1) to transfer files that are contained in directories without write permission.
-exec command  True if the executed command returns a zero value as exit status. The end of command must be punctuated by an escaped semicolon (;). A command argument {} is replaced by the current pathname. If the last argument to -exec is {} and you specify + rather than the semicolon (;), the command is invoked fewer times, with {} replaced by groups of pathnames. If any invocation of the command returns a non-zero value as exit status, find returns a non-zero exit status.
-follow  Always true and always evaluated no matter where it appears in expression. The behavior is unspecified if -follow is used when the find command is invoked with either the -H or the -L option. Causes symbolic links to be followed. When following symbolic links, find keeps track of the directories visited so that it can detect infinite loops. For example, such a loop would occur if a symbolic link pointed to an ancestor. This expression should not be used with the find-type l expression. See NOTES.
-fstype type  True if the filesystem to which the file belongs is of type type.
-group gname  True if the file belongs to the group gname. If gname is numeric and does not appear in the group(4) database, it is taken as a group ID.
-iname pattern  Similar to -name, but the match between the pattern and the base name of the current file name is case insensitive. (See EXAMPLES). Unlike the -name option, there is no special treatment in leading period and wildcard file name generation characters can match file names beginning with a . for both /usr/bin/find and /usr/xpg4/bin/find.
-inum n  True if the file has inode number n.
-links n  True if the file has n links.
-local  True if the file system type is not a remote file system type as defined in the /etc/dfs/fstypes file. nfs is used as the default remote filesystem type if the /etc/dfs/fstypes file is not present. The -local option descends the
hierarchy of non-local directories. See EXAMPLES for an example of how to search for local files without descending.

- `ls` Always true. Prints current pathname together with its associated statistics. These include (respectively):
  - inode number
  - size in kilobytes (1024 bytes)
  - protection mode
  - number of hard links
  - user
  - group
  - size in bytes
  - modification time.

If the file is a special file, the size field instead contains the major and minor device numbers.

If the file is a symbolic link, the pathname of the linked-to file is printed preceded by ‘→’. The format is identical to that of `ls -gilds` (see `ls(1B)`).

Formatting is done internally, without executing the `ls` program.

- `mmin n` File's data was last modified $n$ minutes ago.
- `mount` Always true. Restricts the search to the file system containing the directory specified. Does not list mount points to other file systems.
- `mtime n` True if the file's data was modified $n$ days ago.
- `name pattern` True if `pattern` matches the basename of the current file name. Normal shell file name generation characters (see `sh(1)`) can be used. A backslash (`\`) is used as an escape character within the pattern. The pattern should be escaped or quoted when `find` is invoked from the shell.

Unless the character ‘.’ is explicitly specified in the beginning of `pattern`, a current file name beginning with ‘.’ does not match `pattern` when using `/usr/bin/find`. `/usr/xpg4/bin/find` does not make this distinction; wildcard file name generation characters can match file names beginning with ‘.’.

- `ncpio device` Always true. Writes the current file on `device` in `cpio -c` format (5120 byte records).
- `newer file` True if the current file has been modified more recently than the argument `file`.
- `nogroup` True if the file belongs to a group not in the `group(4)` database.
- `nouser` True if the file belongs to a user not in the `passwd(4)` database.
-ok command  Like -exec, except that the generated command line is printed with a question mark first, and is executed only if the response is affirmative.

-perm [-]mode  The mode argument is used to represent file mode bits. It is identical in format to the symbolic mode operand, symbolic_mode_list, described in chmod(1), and is interpreted as follows. To start, a template is assumed with all file mode bits cleared. An op symbol of:

+  Set the appropriate mode bits in the template
–  Clear the appropriate bits
=  Set the appropriate mode bits, without regard to the contents of the file mode creation mask of the process

The op symbol of – cannot be the first character of mode, to avoid ambiguity with the optional leading hyphen. Since the initial mode is all bits off, there are no symbolic modes that need to use – as the first character.

If the hyphen is omitted, the primary evaluates as true when the file permission bits exactly match the value of the resulting template.

Otherwise, if mode is prefixed by a hyphen, the primary evaluates as true if at least all the bits in the resulting template are set in the file permission bits.

-perm [-]onum  True if the file permission flags exactly match the octal number onum (see chmod(1)). If onum is prefixed by a minus sign (−), only the bits that are set in onum are compared with the file permission flags, and the expression evaluates true if they match.

-print  Always true. Causes the current pathname to be printed.
-print0  Always true. Causes the current pathname to be printed followed by a null character, rather than the NEWLINE character that -print uses.

This allows file names that contain NEWLINEs or other types of white space to be correctly interpreted by programs that process the find output. This option corresponds to the -0 option of cpio and xargs.

-prune  Always yields true. Does not examine any directories or files in the directory structure below the pattern just matched. (See EXAMPLES). If -depth is specified, -prune has no effect.

-size n[c]  True if the file is n blocks long (512 bytes per block). If n is followed by a c, the size is in bytes.
- `type c` True if the type of the file is c, where c is b, c, d, f, l, p, or s for block special file, character special file, directory, door, plain file, symbolic link, fifo (named pipe), or socket, respectively.

- `-user uname` True if the file belongs to the user `uname`. If `uname` is numeric and does not appear as a login name in the `passwd(4)` database, it is taken as a user ID.

- `-xdev` Same as the `-mount` primary.

- `-xattr` True if the file has extended attributes.

### Complex Expressions

The primaries can be combined using the following operators (in order of decreasing precedence):

1) `(expression)` True if the parenthesized expression is true (parentheses are special to the shell and must be escaped).

2) `! expression` The negation of a primary (`!` is the unary `not` operator).

3) `expression [-a] expression` Concatenation of primaries (the `and` operation is implied by the juxtaposition of two primaries).

4) `expression -o expression` Alternation of primaries (`-o` is the `or` operator).

When you use `find` in conjunction with `cpio`, if you use the `-L` option with `cpio`, you must use the `-L` option or the `-follow` primitive with `find` and vice versa. Otherwise the results are unspecified.

If no `expression` is present, `-print` is used as the expression. Otherwise, if the specified expression does not contain any of the primaries `-exec`, `-ok`, `-ls`, or `-print`, the specified expression is effectively replaced by:

`(-specified) -print`

The `-user`, `-group`, and `-newer` primaries each evaluate their respective arguments only once. Invocation of `command` specified by `-exec` or `-ok` does not affect subsequent primaries on the same file.

### Usage

See `largefile(5)` for the description of the behavior of `find` when encountering files greater than or equal to 2 Gbyte ($2^{31}$ bytes).

### Examples

**EXAMPLE 1** Writing Out the Hierarchy Directory

The following commands are equivalent:

```
example% find .
exa mple% find . -print
```

They both write out the entire directory hierarchy from the current directory.
EXAMPLE 2  Removing Files
The following command removes all files in your home directory named a.out or *.o that have not been accessed for a week:

```bash
eexample% find $HOME \( -name a.out -o -name '*.o' \) \ -atime +7 -exec rm {} \;
```

EXAMPLE 3  Printing All File Names But Skipping SCCS Directories
The following command recursively print all file names in the current directory and below, but skipping SCCS directories:

```bash
eexample% find . -name SCCS -prune -o -print
```

EXAMPLE 4  Printing all filenames and the SCCS directory name
Recursively print all file names in the current directory and below, skipping the contents of SCCS directories, but printing out the SCCS directory name:

```bash
eexample% find . -print -name SCCS -prune
```

EXAMPLE 5  Testing for the Newer File
The following command is basically equivalent to the -nt extension to `test(1)`:

```bash
eexample$ if [ -n "$(find file1 -prune -newer file2)" ]; then
  printf %s\n "file1 is newer than file2"
```

EXAMPLE 6  Selecting a File Using 24-hour Mode
The descriptions of -atime, -ctime, and -mtime use the terminology n “24-hour periods”. For example, a file accessed at 23:59 is selected by:

```bash
eexample% find . -atime -1 -print
```

at 00:01 the next day (less than 24 hours later, not more than one day ago). The midnight boundary between days has no effect on the 24-hour calculation.

EXAMPLE 7  Printing Files Matching a User’s Permission Mode
The following command recursively print all file names whose permission mode exactly matches read, write, and execute access for user, and read and execute access for group and other:

```bash
eexample% find . -perm u=rwx,g=rx,o=rx
```

The above could alternatively be specified as follows:

```bash
eexample% find . -perm a=rwx,g-w,o-w
```
The following command recursively print all file names whose permission includes, but is not limited to, write access for other:

```
example% find . -perm -o+w
```

**EXAMPLE 9** Printing Local Files without Descending Non-local Directories

```
example% find . ! -local -prune -o -print
```

**EXAMPLE 10** Printing the Files in the Name Space Possessing Extended Attributes

```
example% find . -xattr
```

**EXAMPLE 11** Printing all PDF Filenames Regardless of Case

The following example finds all file names with an extension of .pdf, .PDF, .Pdf, and so forth.

```
example% find . -iname '*.pdf'
```

### Environment Variables

See `environ(5)` for descriptions of the following environment variables that affect the execution of `find`: LANG, LC_ALL, LC_COLLATE, LC_CTYPE, LC_MESSAGES, and NLSPATH.

**PATH**

Determine the location of the `utility_name` for the `-exec` and `-ok` primaries.

Affirmative responses are processed using the extended regular expression defined for the `yesexpr` keyword in the `LC_MESSAGES` category of the user’s locale. The locale specified in the `LC_COLLATE` category defines the behavior of ranges, equivalence classes, and multi-character collating elements used in the expression defined for `yesexpr`. The locale specified in `LC_CTYPE` determines the locale for interpretation of sequences of bytes of text data as characters, the behavior of character classes used in the expression defined for the `yesexpr`. See `locale(5)`.

### Exit Status

The following exit values are returned:

0 All path operands were traversed successfully.

>0 An error occurred.

### Files

- `/etc/passwd` Password file
- `/etc/group` Group file
- `/etc/dfs/fstypes` File that registers distributed file system packages

### Attributes

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>
### find(1)

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

#### See Also

#### Warnings
The following options are obsolete and will not be supported in future releases:

- **-cpio device**  
  Always true. Writes the current file on device in cpio format (5120-byte records).

- **-ncpio device**  
  Always true. Writes the current file on device in cpio -c format (5120-byte records).

#### Notes
When using `find` to determine files modified within a range of time, use the `-mtime` argument before the `-print` argument. Otherwise, `find` gives all files.

Some files that might be under the Solaris root file system are actually mount points for virtual file systems, such as mntfs or namefs. When comparing against a ufs file system, such files are not selected if `-mount` or `-xdev` is specified in the `find` expression.

Using the `-L` or `-follow` option is not recommended when descending a file-system hierarchy that is under the control of other users. In particular, when using `-exec`, symbolic links can lead the `find` command out of the hierarchy in which it started. Using `-type` is not sufficient to restrict the type of files on which the `-exec` command operates, because there is an inherent race condition between the type-check performed by the `find` command and the time the executed command operates on the file argument.
finger – display information about local and remote users

Synopsis

finger [-bfhilmpqsw] [username]...

finger [-l] [username] [hostname 1 [hostname 2 ... ] ]...

finger [-l] [hostname 1 [hostname 2 ... ] ]...

Description

By default, the finger command displays in multi-column format the following information about each logged-in user:

- user name
- user’s full name
- terminal name (prepended with an '*' (asterisk) if write-permission is denied)
- idle time
- login time
- host name, if logged in remotely

Idle time is in minutes if it is a single integer, in hours and minutes if a ':' (colon) is present, or in days and hours if a 'd' is present.

When one or more username arguments are given, more detailed information is given for each username specified, whether they are logged in or not. username must be that of a local user, and may be a first or last name, or an account name. Information is presented in multi-line format as follows:

- the user name and the user’s full name
- the user’s home directory and login shell
- time the user logged in if currently logged in, or the time the user last logged in; and the terminal or host from which the user logged in
- last time the user received mail, and the last time the user read mail
- the first line of the $HOME/.project file, if it exists
- the contents of the $HOME/.plan file, if it exists

Note: when the comment (GECOS) field in /etc/passwd includes a comma, finger does not display the information following the comma.

If the arguments username@hostname1[@hostname2 ... ] or @hostname1[@hostname2 ... ] are used, the request is sent first to hostname and forwarded through each hostname-1 to hostname1. The program uses the finger user information protocol (see RFC 1288) to query that remote host for information about the named user (if username is specified), or about each logged-in user. The information displayed is server dependent.
As required by RFC 1288, finger passes only printable, 7-bit ASCII data. This behavior may be modified by a system administrator by using the PASS option in /etc/default/finger. Specifying PASS=low allows all characters less than decimal 32 ASCII. Specifying PASS=high allows all characters greater than decimal 126 ASCII. PASS=low, high or PASS=high, low allows both characters less than 32 and greater than 126 to pass through.

Options
The following options are supported, except that the username@hostname form supports only the -l option:

- Suppresses printing the user's home directory and shell in a long format printout.
- $ Suppresses printing the header that is normally printed in a non-long format printout.
- h Suppresses printing of the .project file in a long format printout.
- i Forces "idle" output format, which is similar to short format except that only the login name, terminal, login time, and idle time are printed.
- l Forces long output format.
- m Matches arguments only on user name (not first or last name).
- p Suppresses printing of the .plan file in a long format printout.
- q Forces quick output format, which is similar to short format except that only the login name, terminal, and login time are printed.
- s Forces short output format.
- w Suppresses printing the full name in a short format printout.

Files

$HOME/.plan user's plan
$HOME/.project user's projects
/etc/default/finger finger options file
/etc/passwd password file
/var/adm/lastlog time of last login
/var/adm/utmpx accounting

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/network-servers</td>
</tr>
</tbody>
</table>

See Also
passw(1), who(1), whois(1), passwd(4), attributes(5)

**Notes**  The *finger user information protocol* limits the options that may be used with the remote form of this command.
fmt(1)

Name  fmt – simple text formatters

Synopsis  fmt [-cs] [-w width | -width] [inputfile]...

Description  fmt is a simple text formatter that fills and joins lines to produce output lines of (up to) the number of characters specified in the `-w width` option. The default `width` is 72. fmt concatenates the `inputfiles` listed as arguments. If none are given, fmt formats text from the standard input.

Blank lines are preserved in the output, as is the spacing between words. fmt does not fill nor split lines beginning with a `.' (dot), for compatibility with nroff(1). Nor does it fill or split a set of contiguous non-blank lines which is determined to be a mail header, the first line of which must begin with “From”.

Indentation is preserved in the output, and input lines with differing indentation are not joined (unless `-c` is used).

fmt can also be used as an in-line text filter for vi(1). The vi command:

```vi
!}fmt
```

reformats the text between the cursor location and the end of the paragraph.

Options  `-c`  Crown margin mode. Preserve the indentation of the first two lines within a paragraph, and align the left margin of each subsequent line with that of the second line. This is useful for tagged paragraphs.

`-s`  Split lines only. Do not join short lines to form longer ones. This prevents sample lines of code, and other such formatted text, from being unduly combined.

`-w width | -width`  Fill output lines to up to `width` columns.

Operands  `inputfile`  Input file.

Environment Variables  See environ(5) for a description of the LC_CTYPE environment variable that affects the execution of fmt.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  nroff(1), vi(1), attributes(5), environ(5)

Notes  The `-width` option is acceptable for BSD compatibility, but it may go away in future releases.
Based on a message's classification component, the `fmtmsg` utility either writes a formatted message to `stderr` or writes a formatted message to the console.

A formatted message consists of up to five standard components (see environment variable `MSGVERB` in the ENVIRONMENT VARIABLES section of this page). The classification and subclass components are not displayed as part of the standard message, but rather define the source of the message and direct the display of the formatted message.

**Options**

The following options are supported:

- **-c class** Describes the source of the message. Valid keywords are:
  - hard: The source of the condition is hardware.
  - soft: The source of the condition is software.
  - firm: The source of the condition is firmware.

- **-u subclass** A list of keywords (separated by commas) that further defines the message and directs the display of the message. Valid keywords are:
  - appl: The condition originated in an application. This keyword should not be used in combination with either `util` or `opsys`.
  - util: The condition originated in a utility. This keyword should not be used in combination with either `appl` or `opsys`.
  - opsys: The message originated in the kernel. This keyword should not be used in combination with either `appl` or `util`.
  - recov: The application will recover from the condition. This keyword should not be used in combination with `nrecov`.
  - nrecov: The application will not recover from the condition. This keyword should not be used in combination with `recov`.
  - print: Print the message to the standard error stream `stderr`.
  - console: Write the message to the system console. `print`, `console`, or both may be used.

- **-l label** Identifies the source of the message.

- **-s severity** Indicates the seriousness of the error. The keywords and definitions of the standard levels of severity are:
  - halt: The application has encountered a severe fault and is halting.
error  The application has detected a fault.
warn  The application has detected a condition that is out of the ordinary
      and might be a problem.
info  The application is providing information about a condition that is
      not in error.

-t tag  The string containing an identifier for the message.
-a action  A text string describing the first step in the error recovery process. This string
            must be written so that the entire action argument is interpreted as a single
            argument. fmtmsg precedes each action string with the TO FIX: prefix.

Examples

EXAMPLE 1  Standard message format
The following example of fmtmsg produces a complete message in the standard message
format and displays it to the standard error stream.

eexample% fmtmsg -c soft -u recov,print,appl -l UX:cat \
-s error -t UX:cat:001 -a "refer to manual" "invalid syntax"

produces:
UX:cat: ERROR: invalid syntax
TO FIX: refer to manual  UX:cat:138

EXAMPLE 2  Using MSGVERB
When the environment variable MSGVERB is set as follows:

MSGVERB=severity:text:action

and Example 1 is used, fmtmsg produces:

ERROR: invalid syntax
TO FIX: refer to manual

EXAMPLE 3  Using SEV_LEVEL
When the environment variable SEV_LEVEL is set as follows:

SEV_LEVEL=note,5,NOTE

the following fmtmsg command:

eexample% fmtmsg -c soft -u print -l UX:cat -s note \
-a "refer to manual" "invalid syntax"

produces:
EXAMPLE 3 Using SEV_LEVEL (Continued)

NOTE: invalid syntax
TO FIX: refer to manual

and displays the message on stderr.

**Environment Variables**

The environment variables MSGVERB and SEV_LEVEL control the behavior of *fmtmsg*. MSGVERB is set by the administrator in the `/etc/profile` for the system. Users can override the value of MSGVERB set by the system by resetting MSGVERB in their own `.profile` files or by changing the value in their current shell session. SEV_LEVEL can be used in shell scripts.

MSGVERB tells *fmtmsg* which message components to select when writing messages to stderr. The value of MSGVERB is a colon-separated list of optional keywords. MSGVERB can be set as follows:

```
MSGVERB=[keyword[:keyword[:...]]]
```

Valid *keywords* are: `label`, `severity`, `text`, `action`, and `tag`. If MSGVERB contains a keyword for a component and the component's value is not the component's null value, *fmtmsg* includes that component in the message when writing the message to stderr. If MSGVERB does not include a keyword for a message component, that component is not included in the display of the message. The keywords may appear in any order. If MSGVERB is not defined, if its value is the null string, if its value is not of the correct format, or if it contains keywords other than the valid ones listed above, *fmtmsg* selects all components.

MSGVERB affects only which message components are selected for display. All message components are included in console messages.

SEV_LEVEL defines severity levels and associates print strings with them for use by *fmtmsg*. The standard severity levels shown below cannot be modified. Additional severity levels can be defined, redefined, and removed.

<table>
<thead>
<tr>
<th>SEV_LEVEL</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(no severity is used)</td>
</tr>
<tr>
<td>1</td>
<td>HALT</td>
</tr>
<tr>
<td>2</td>
<td>ERROR</td>
</tr>
<tr>
<td>3</td>
<td>WARNING</td>
</tr>
<tr>
<td>4</td>
<td>INFO</td>
</tr>
</tbody>
</table>

SEV_LEVEL is set as follows:

```
description is a comma-separated list containing three fields:
```
SEV_LEVEL= [description[ : description [...] ]]

export SEV_LEVEL

description= severity_keyword, level, printstring

severity_keyword is a character string used as the keyword with the -s severity option to fmtmsg.

level is a character string that evaluates to a positive integer (other than 0, 1, 2, 3, or 4, which are reserved for the standard severity levels). If the keyword severity_keyword is used, level is the severity value passed on to fmtmsg(3C).

printstring is the character string used by fmtmsg in the standard message format whenever the severity value level is used.

If SEV_LEVEL is not defined, or if its value is null, no severity levels other than the defaults are available. If a description in the colon separated list is not a comma separated list containing three fields, or if the second field of a comma separated list does not evaluate to a positive integer, that description in the colon separated list is ignored.

Exit Status  The following exit values are returned:

0   All the requested functions were executed successfully.
1   The command contains a syntax error, an invalid option, or an invalid argument to an option.
2   The function executed with partial success, however the message was not displayed on stderr.
4   The function executed with partial success; however, the message was not displayed on the system console.
32  No requested functions were executed successfully.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  addseverity(3C), fmtmsg(3C), attributes(5)
fold(1)

Name    fold – filter for folding lines

Synopsis    fold [ -bs ] [ -w width ] [ -width ] [file] ...

Description    The fold utility is a filter that folds lines from its input files, breaking the lines to have a maximum of width column positions (or bytes, if the -b option is specified). Lines are broken by the insertion of a NEWLINE character such that each output line (referred to later in this section as a segment) is the maximum width possible that does not exceed the specified number of column positions (or bytes). A line is not broken in the middle of a character. The behavior is undefined if width is less than the number of columns any single character in the input would occupy.

If the CARRIAGE-RETURN, BACKSPACE, or TAB characters are encountered in the input, and the -b option is not specified, they are treated specially:

BACKSPACE    The current count of line width is decremented by one, although the count never becomes negative. fold does not insert a NEWLINE character immediately before or after any BACKSPACE character.

CARRIAGE-RETURN    The current count of line width is set to 0. fold does not insert a NEWLINE character immediately before or after any CARRIAGE-RETURN character.

TAB    Each TAB character encountered advances the column position pointer to the next tab stop. Tab stops are at each column position n such that n modulo 8 equals 1.

Options    The following options are supported:

- b    Counts width in bytes rather than column positions.

- s    If a segment of a line contains a blank character within the first width column positions (or bytes), breaks the line after the last such blank character meeting the width constraints. If there is no blank character meeting the requirements, the -s option has no effect for that output segment of the input line.

- w width | -width    Specifies the maximum line length, in column positions (or bytes if -b is specified). If width is not a positive decimal number, an error is returned. The default value is 80.

Operands    The following operand is supported:

file    A path name of a text file to be folded. If no file operands are specified, the standard input is used.
Environment Variables

See environ(5) for descriptions of the following environment variables that affect the execution of fold: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status

The following exit values are returned:

0  All input files were processed successfully.

>0  An error occurred.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also

cut(1), pr(1), attributes(5), environ(5), standards(5)

Notes

fold and cut(1) can be used to create text files out of files with arbitrary line lengths. fold should be used when the contents of long lines need to be kept contiguous. cut should be used when the number of lines (or records) needs to remain constant.

fold is frequently used to send text files to line printers that truncate, rather than fold, lines wider than the printer is able to print (usually 80 or 132 column positions).

fold might not work correctly if underlining is present.
from – display the sender and date of newly-arrived mail messages

**Synopsis**

/usr/ucb/from [-s sender] [username]

**Description**
The `from` utility prints out the mail header lines in your mailbox file to show you who your mail is from. If `username` is specified, `username`'s mailbox is examined instead of your own.

**Options**
The following option is supported:
- `-s sender` Only display headers for mail sent by `sender`.

**Usage**
See `largefile(5)` for the description of the behavior of `from` when encountering files greater than or equal to 2 Gbyte (`2^{31}` bytes).

**Files**
/var/mail/*

**Attributes**
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>

**See Also**
`biff(1B), mail(1B), attributes(5), largefile(5)`
**ftp(1)**

**Name**  
ftp – file transfer program

**Synopsis**  
ftp [-adfginpstvx] [-m GSS Mech] [-T timeout]  
[hostname [port]]

**Description**  
The `ftp` command is the user interface to the Internet standard File Transfer Protocol (FTP). `ftp` transfers files to and from a remote network site.

The host and optional port with which `ftp` is to communicate can be specified on the command line. If this is done, `ftp` immediately attempts to establish a connection to an FTP server on that host. Otherwise, `ftp` enters its command interpreter and awaits instructions from the user. When `ftp` is awaiting commands from the user, it displays the prompt `ftp>`.

**Options**  
The following options can be specified at the command line, or to the command interpreter:

- `-a`  
  Uses GSSAPI authentication *only*. If the authentication fails, this option closes the connection.

- `-d`  
  Enables debugging.

- `-f`  
  Forwards local security credentials to the remote server.

- `-g`  
  Disables filename “globbing”.

- `-i`  
  Turns off interactive prompting during multiple file transfers.

- `-m`  
  Specifies the GSS-API mechanism to use. The default is to use the kerberos_v5 mechanism. Supported alternatives are defined in `/etc/gss/mech` (see `mech(4)`).

- `-n`  
  Does not attempt “auto-login” upon initial connection. If auto-login is not disabled, `ftp` checks the `.netrc` file in the user’s home directory for an entry describing an account on the remote machine. If no entry exists, `ftp` prompts for the login name of the account on the remote machine (the default is the login name on the local machine), and, if necessary, prompts for a password and an account with which to login.

- `-p`  
  Enables passive mode for data transfers. This command is useful when connecting to a remote host from behind a connection filtering firewall.

- `-s`  
  Skips the SYST command that is sent by default to all remote servers upon connection. The system command is what enables the automatic use of binary mode rather than the protocol default ascii mode.

As some older servers cannot handle the `ftp` command, this directive is provided to allow inter-operability with these servers.

- `-t`  
  Enables packet tracing (unimplemented).

- `-T timeout`  
  Enables global connection timer, specified in seconds (decimal). There is a timer for the control connection that is reset when anything is sent to the
server and disabled while the client is prompting for user input. Another independent timer is used to monitor incoming or outgoing data connections.

-v Shows all responses from the remote server, as well as report on data transfer statistics. This is turned on by default if ftp is running interactively with its input coming from the user’s terminal.

-x Attempts to use GSSAPI for authentication and encryption. Data and Command channel protection is set to “private”.

The following commands can be specified to the command interpreter:

! [ command ] Runs command as a shell command on the local machine. If no command is given, invokes an interactive shell.

$ macro-name [ args ] Executes the macro macro-name that was defined with the makdef command. Arguments are passed to the macro unglobbed.

account [ passwd ] Supplies a supplemental password required by a remote system for access to resources once a login has been successfully completed. If no argument is included, the user is prompted for an account password in a non-echoing input mode.

append local-file [ remote-file ] Appends a local file to a file on the remote machine. If remote-file is not specified, the local file name is used, subject to alteration by any tran or nmap settings. File transfer uses the current settings for “representation type”, “file structure”, and “transfer mode”.

ascii Sets the “representation type” to “network ASCII”. This is the default type.

bell Sounds a bell after each file transfer command is completed.

binary Sets the “representation type” to “image”.

bye Terminates the FTP session with the remote server and exit ftp. An EOF also terminates the session and exit.

case Toggles remote computer file name case mapping during mget commands. When case is on (default is off), remote computer file names with all letters in upper case are written in the local directory with the letters mapped to lower case.
<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>cd remote-directory</td>
<td>Changes the working directory on the remote machine to <code>remote-directory</code>.</td>
</tr>
<tr>
<td>cdup</td>
<td>Changes the remote machine working directory to the parent of the current remote machine working directory.</td>
</tr>
<tr>
<td>clear</td>
<td>Sets the protection level on data transfers to “clear”. If no ADAT command succeeded, then this is the default protection level.</td>
</tr>
<tr>
<td>close</td>
<td>Terminates the FTP session with the remote server, and return to the command interpreter. Any defined macros are erased.</td>
</tr>
<tr>
<td>cr</td>
<td>Toggles RETURN stripping during “network ASCII” type file retrieval. Records are denoted by a RETURN/LINEFEED sequence during “network ASCII” type file transfer. When cr is on (the default), RETURN characters are stripped from this sequence to conform with the UNIX system single LINEFEED record delimiter. Records on non-UNIX-system remote hosts can contain single LINEFEED characters; when an “network ASCII” type transfer is made, these LINEFEED characters can be distinguished from a record delimiter only when cr is off.</td>
</tr>
<tr>
<td>delete remote-file</td>
<td>Deletes the file <code>remote-file</code> on the remote machine.</td>
</tr>
<tr>
<td>debug</td>
<td>Toggles debugging mode. When debugging is on, ftp prints each command sent to the remote machine, preceded by the string --&gt;.</td>
</tr>
<tr>
<td>dir [ remote-directory [ local-file ]]</td>
<td>Prints a listing of the directory contents in the directory, <code>remote-directory</code>, and, optionally, placing the output in <code>local-file</code>. If no directory is specified, the current working directory on the remote machine is used. If no local file is specified, or <code>local-file</code> is --, output is sent to the terminal.</td>
</tr>
<tr>
<td>disconnect</td>
<td>A synonym for close.</td>
</tr>
<tr>
<td>form [format-name]</td>
<td>Sets the carriage control format subtype of the “representation type” to <code>format-name</code>. The only valid <code>format-name</code> is non-print, which corresponds to the default “non-print” subtype.</td>
</tr>
</tbody>
</table>
**get remote-file [local-file]**

Retrieves the *remote-file* and store it on the local machine. If the local file name is not specified, it is given the same name it has on the remote machine, subject to alteration by the current case, ntr ans, and nmap settings. The current settings for “representation type”, “file structure”, and “transfer mode” are used while transferring the file.

**glob**

Toggles filename expansion, or “globbing”, for `mdelete`, `mget` and `mput`. If globbing is turned off, filenames are taken literally.

Globbing for `mput` is done as in `sh(1)`. For `mdelete` and `mget`, each remote file name is expanded separately on the remote machine, and the lists are not merged.

Expansion of a directory name is likely to be radically different from expansion of the name of an ordinary file: the exact result depends on the remote operating system and FTP server, and can be previewed with the command, `mls remote-files`.

`mget` and `mput` are not meant to transfer entire directory subtrees of files. You can do this by transferring a `tar(1)` archive of the subtree (using a “representation type” of “image” as set by the `binary` command).

**hash**

Toggles hash-sign (#) printing for each data block transferred. The size of a data block is 8192 bytes.

**help [command]**

Prints an informative message about the meaning of *command*. If no argument is given, `ftp` prints a list of the known commands.

**lcd [directory]**

Changes the working directory on the local machine. If no *directory* is specified, the user’s home directory is used.

**ls [ -al ] remote-directory [local-file]**

By default, prints an abbreviated listing of the contents of a directory on the remote machine. This default behavior can be changed to make `ls` a synonym of the `dir` command. This change can be achieved by setting `FTP_LS SENDS_NLST` to ’no’ in `/etc/default/ftp` or in the environment. See `ftp(4)` for details.
The -a option lists all entries, including those that begin with a dot (.), which are normally not listed. The -l option lists files in long format, giving mode, number of links, owner, group, size in bytes, and time of last modification for each file. If the file is a special file, the size field instead contains the major and minor device numbers rather than a size. If the file is a symbolic link, the filename is printed followed by "→" and the pathname of the referenced file.

If remote-directory is left unspecified, the current working directory is used.

If no local file is specified, or if local-file is --, the output is sent to the terminal.

macdef macro-name

Defines a macro. Subsequent lines are stored as the macro macro-name. A null line (consecutive NEWLINE characters in a file or RETURN characters from the terminal) terminates macro input mode. There is a limit of 16 macros and 4096 total characters in all defined macros. Macros remain defined until a close command is executed.

The macro processor interprets $ and \ as special characters. A $ followed by a number (or numbers) is replaced by the corresponding argument on the macro invocation command line. A $ followed by an i signals that macro processor that the executing macro is to be looped. On the first pass, $i is replaced by the first argument on the macro invocation command line; on the second pass, it is replaced by the second argument, and so on. A \ followed by any character is replaced by that character. Use the \ to prevent special treatment of the $.

mdelete remote-files

Deletes the remote-files on the remote machine.

mdir remote-files local-file

Like dir, except multiple remote files can be specified. If interactive prompting is on, ftp prompts the user to verify that the last argument is indeed the target local file for receiving mdir output.
### mget remote-files
Expands the `remote-files` on the remote machine and do a `get` for each file name thus produced. See `glob` for details on the filename expansion. Resulting file names are processed according to `case`, `ntrans`, and `nmap` settings. Files are transferred into the local working directory, which can be changed with `lcd directory`. New local directories can be created with `mkdir directory`.

### mkdir directory-name
Makes a directory on the remote machine.

### mls remote-files local-file
Like `ls(1)`, except multiple remote files can be specified. If interactive prompting is on, `ftp` prompts the user to verify that the last argument is indeed the target local file for receiving `mls` output.

### mode [ mode-name ]
Sets the “transfer mode” to `mode-name`. The only valid `mode-name` is `stream`, which corresponds to the default “stream” mode. This implementation only supports `stream`, and requires that it be specified.

### mput local-files
Expands wild cards in the list of local files given as arguments and do a `put` for each file in the resulting list. See `glob` for details of filename expansion. Resulting file names are processed according to `ntrans` and `nmap` settings.

### nlist [-al] remote-directory [ local-file ]
Prints an abbreviated listing of the contents of a directory on the remote machine, listing only those files that can be retrieved by the `get` command, unless the `-a` or `-l` option is used. If `remote-directory` is left unspecified, the current working directory is used.

The `-a` option lists all entries, including those that begin with a dot (.), which are normally not listed. The `-l` option lists files in long format the same way it does when used with the `ls` command.

### nmap [ input-pattern output-pattern ]
Sets or unsets the filename mapping mechanism. If no arguments are specified, the filename mapping mechanism is unset. If arguments are specified, remote filenames are
mapped during mput commands and put commands issued without a specified remote target filename. If arguments are specified, local filenames are mapped during mget commands and get commands issued without a specified local target filename.

This command is useful when connecting to a non-UNIX-system remote host with different file naming conventions or practices. The mapping follows the pattern set by inpattern and outpattern. inpattern is a template for incoming filenames (which can have already been processed according to the ntrans and case settings). Variable templating is accomplished by including the sequences $1, $2, ..., $9 in inpattern. Use \ to prevent this special treatment of the $ character. All other characters are treated literally, and are used to determine the nmap inpattern variable values.

For example, given inpattern $1.$2 and the remote file name mydata.data, $1 would have the value mydata, and $2 would have the value data.

The outpattern determines the resulting mapped filename. The sequences $1, $2, ..., $9 are replaced by any value resulting from the inpattern template. The sequence $0 is replaced by the original filename. Additionally, the sequence [ seq1, seq2 ] is replaced by seq1 if seq1 is not a null string; otherwise it is replaced by seq2.

For example, the command nmap $1.$2.$3 [$1,$2].[$2, file] would yield the output filename myfile.data for input filenames myfile.data and myfile.data.old, myfile.file for the input filename myfile, and myfile.myfile for the input filename .myfile. SPACE characters can be included in outpattern, as in the example nmap $1 | sed
"s/ *$//" > $1. Use the \ character to prevent special treatment of the $, [, ], and , characters.

**ntrans [ inchars [ outchars ]]**

Sets or unsets the filename character translation mechanism. If no arguments are specified, the filename character translation mechanism is unset. If arguments are specified, characters in remote filenames are translated during `put` commands and `put` commands issued without a specified remote target filename, and characters in local filenames are translated during `get` commands and `get` commands issued without a specified local target filename.

This command is useful when connecting to a non-UNIX-system remote host with different file naming conventions or practices. Characters in a filename matching a character in `inchars` are replaced with the corresponding character in `outchars`. If the character’s position in `inchars` is longer than the length of `outchars`, the character is deleted from the file name.

Only 16 characters can be translated when using the `ntrans` command under `ftp`. Use case (described above) if needing to convert the entire alphabet.

**open host [ port ]**

Establishes a connection to the specified host FTP server. An optional port number can be supplied, in which case, `ftp` attempts to contact an FTP server at that port. If the `auto-login` option is on (default setting), `ftp` also attempts to automatically log the user in to the FTP server.

**passive**

Toggles passive mode. When passive mode is turned on, the `ftp` client sends the `PASV` command requesting that the FTP server open a port for the data connection and return the address of that port. The remote server listens on that port and the client connects to it. When passive mode is turned off, the `ftp` client sends
the PORT command to the server specifying an address for the remote server to connect back to. Passive mode is useful when the connections to the ftp client are controlled, for example, when behind a firewall. When connecting to an IPv6-enabled FTP server, EPSV can be used in place of PASV and EPRT in place of PORT.

**private**

Sets the protection level on data transfers to "private". Data transmissions are confidentiality- and integrity—protected by encryption. If no ADAT command succeeded, then the only possible level is "clear".

**prompt**

Toggles interactive prompting. Interactive prompting occurs during multiple file transfers to allow the user to selectively retrieve or store files. By default, prompting is turned on. If prompting is turned off, any `mget` or `mput` transfers all files, and any `mdelete` deletes all files.

**protect protection-level**

Sets the protection level on data transfers to `protection-level`. The valid protection levels are "clear" for unprotected data transmissions, "safe" for data transmissions that are integrity-protected by cryptographic checksum, and "private" for data transmissions that are confidentiality— and integrity—protected by encryption. If no ADAT command succeeded, then the only possible level is "clear". If no level is specified, the current level is printed. The default protection level is "clear".

**proxy ftp-command**

Executes an FTP command on a secondary control connection. This command allows simultaneous connection to two remote FTP servers for transferring files between the two servers. The first `proxy` command should be an open, to establish the secondary control connection. Enter the command `proxy ?` to see other FTP commands executable on the secondary connection.
The following commands behave differently when prefaced by `proxy`: `open` does not define new macros during the auto-login process, `close` does not erase existing macro definitions, `get` and `mget` transfer files from the host on the primary control connection to the host on the secondary control connection, and `put`, `mput`, and `append` transfer files from the host on the secondary control connection to the host on the primary control connection.

Third party file transfers depend upon support of the `PASV` command by the server on the secondary control connection.

`put local-file [ remote-file ]` Stores a local file on the remote machine. If `remote-file` is left unspecified, the local file name is used after processing according to any `ntrans` or `nmmap` settings in naming the remote file. File transfer uses the current settings for “representation type”, “file structure”, and “transfer mode”.

`pwd` Prints the name of the current working directory on the remote machine.

`quit` A synonym for `bye`.

`quote arg1 arg2 ...` Sends the arguments specified, verbatim, to the remote FTP server. A single FTP reply code is expected in return. (The `remotehelp` command displays a list of valid arguments.) `quote` should be used only by experienced users who are familiar with the FTP protocol.


`reget remote-file [ local-file ]` The `reget` command acts like `get`, except that if `local-file` exists and is smaller than `remote-file`, `local-file` is presumed to be a partially transferred copy of `remote-file` and the transfer is continued from the apparent point of failure. This command is useful when transferring large files over networks that are prone to dropping connections.
remotehelp [command-name] Requests help from the remote FTP server. If a
command-name is specified it is supplied to the
server as well.

rename from to Renames the file from on the remote machine
to have the name to.

reset Clears reply queue. This command
re-synchronizes command/reply sequencing
with the remote FTP server.
Resynchronization can be necessary following
a violation of the FTP protocol by the remote
server.

restart [marker] Restarts the immediately following get or put
at the indicated marker. On UNIX systems,
marker is usually a byte offset into the file.
When followed by an mget, the restart
applies to the first get performed. Specifying a
marker of 0 clears the restart marker. If no
argument is specified, the current restart status
is displayed.

rmdir directory-name Deletes a directory on the remote machine.

runique Toggles storing of files on the local system with
unique filenames. If a file already exists with a
name equal to the target local filename for a
get or mget command, a .1 is appended to the
name. If the resulting name matches another
existing file, a .2 is appended to the original
name. If this process continues up to .99, an
error message is printed, and the transfer does
not take place. The generated unique filename
is reported. runique does not affect local files
generated from a shell command. The default
value is off.

safe Sets the protection level on data transfers to
"safe". Data transmissions are
integrity-protected by cryptographic
checksum. If no ADAT command succeeded,
then the only possible level is "clear".

sendport Toggles the use of PORT commands. By default, ftp attempts to use a PORT command when establishing a connection for each data transfer. The use of PORT commands can prevent delays when performing multiple file transfers. If the PORT command fails, ftp uses the default data port. When the use of PORT commands is disabled, no attempt is made to use PORT commands for each data transfer. This is useful when connected to certain FTP implementations that ignore PORT commands but incorrectly indicate they have been accepted.

site arg1 [arg2]... Sends the arguments specified, verbatim, to the remote FTP server as a SITE command.

status Show the current status of ftp.

struct [struct-name] Sets the file structure to struct-name. The only valid struct-name is file, which corresponds to the default “file” structure. The implementation only supports file, and requires that it be specified.

unique Toggles storing of files on remote machine under unique file names. The remote FTP server must support the STOU command for successful completion. The remote server reports the unique name. Default value is off.

tcpwindow [size] Sets the TCP window size to be used for data connections. Specifying a size of 0 stops the explicit setting of the TCP window size on data connections. If no argument is specified, the current setting is displayed.

tenex Sets the “representation type” to that needed to talk to TENEX machines.

trace Toggles packet tracing (unimplemented).

type [type-name] Sets the “representation type” to type-name. The valid type-names are ascii for “network ASCII”, binary or image for “image”, and tenex for “local byte size” with a byte size of 8 (used to talk to TENEX machines). If no type is
If any command argument which is not indicated as being optional is not specified, ftp prompts for that argument.

Command arguments which have embedded spaces can be quoted with quote (") marks.

verbose

Toggles verbose mode. In verbose mode, all responses from the FTP server are displayed to the user. In addition, if verbose mode is on, when a file transfer completes, statistics regarding the efficiency of the transfer are reported. By default, verbose mode is on if ftp's commands are coming from a terminal, and off otherwise.

? [ command ]

A synonym for help.

Abort File Transfer

To abort a file transfer, use the terminal interrupt key. Sending transfers is immediately halted. Receiving transfers are halted by sending an FTP protocol ABOR command to the remote server, and discarding any further data received. The speed at which this is accomplished depends upon the remote server's support for ABOR processing. If the remote server does not support the ABOR command, an ftp> prompt does not appear until the remote server has completed sending the requested file.

The terminal interrupt key sequence is ignored when ftp has completed any local processing and is awaiting a reply from the remote server. A long delay in this mode can result from the ABOR processing described above, or from unexpected behavior by the remote server, including violations of the ftp protocol. If the delay results from unexpected remote server behavior, the local ftp program must be killed by hand.
Local files specified as arguments to `ftp` commands are processed according to the following rules.

1) If the file name is specified, the standard input (for reading) or standard output (for writing) is used.

2) If the first character of the file name is |, the remainder of the argument is interpreted as a shell command. `ftp` then forks a shell, using `popen(3C)` with the argument supplied, and reads (writes) from the standard output (standard input) of that shell. If the shell command includes SPACE characters, the argument must be quoted; for example, `| ls -lt`. A particularly useful example of this mechanism is: "dir | more".

3) Failing the above checks, if globbing is enabled, local file names are expanded according to the rules used in the `sh(1)`; see the `glob` command. If the `ftp` command expects a single local file (for example, `put`), only the first filename generated by the globbing operation is used.

4) For `mget` commands and `get` commands with unspecified local file names, the local filename is the remote filename, which can be altered by a case, `ntrans`, or `nmap` setting. The resulting filename can then be altered if `runique` is on.

5) For `mput` commands and `put` commands with unspecified remote file names, the remote filename is the local filename, which can be altered by a `ntrans` or `nmap` setting. The resulting filename can then be altered by the remote server if `sunique` is on.

The FTP specification specifies many parameters which can affect a file transfer.

The "representation type" can be one of "network ASCII", "EBCDIC", "image", or "local byte size" with a specified byte size (for PDP-10's and PDP-20's mostly). The "network ASCII" and "EBCDIC" types have a further subtype which specifies whether vertical format control (NEWLINE characters, form feeds, and so on) are to be passed through ("non-print"), provided in TELNET format ("TELNET format controls"), or provided in ASA (FORTRAN) ("carriage control (ASA)") format. `ftp` supports the "network ASCII" (subtype "non-print" only) and "image" types, plus "local byte size" with a byte size of 8 for communicating with TENEX machines.

The "file structure" can be one of `file` (no record structure), `record`, or `page`. `ftp` supports only the default value, which is `file`.

The "transfer mode" can be one of `stream`, `block`, or `compressed`. `ftp` supports only the default value, which is `stream`.

Usage

See `largefile(5)` for the description of the behavior of `ftp` when encountering files greater than or equal to 2 Gbyte (\(2^{31}\) bytes).

The `ftp` command is IPv6-enabled. See `ip6(7P)`.
`ftp(1)`

### Files
~/.netrc

### Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>network/ftp</td>
</tr>
<tr>
<td>CSI</td>
<td>enabled</td>
</tr>
</tbody>
</table>

### See Also
ls(1), rcp(1), sh(1), tar(1), popen(3C), ftp(4), ftpusers(4), mech(4), netrc(4), attributes(5), largefile(5), ip6(7P)


### Notes
Failure to log in can arise from an explicit denial by the remote FTP server because the account is listed in /etc/ftpusers. See ftpusers(4).

Correct execution of many commands depends upon proper behavior by the remote server.

An error in the treatment of carriage returns in the 4.2 BSD code handling transfers with a "representation type" of "network ASCII" has been corrected. This correction can result in incorrect transfers of binary files to and from 4.2 BSD servers using a "representation type" of "network ASCII". Avoid this problem by using the "image" type.
Name  gcore – get core images of running processes

Synopsis  gcore [-pgF] [-o filename] [-c content] process-id...

Description  The gcore utility creates a core image of each specified process. By default, the name of the core image file for the process whose process ID is process-id is core.process-id.

Options  The following options are supported:

- c content  Produces core image files with the specified content. The content description uses the same tokens as in coreadm(1M). The -c option does not apply to cores produced due to the -p or -g flags.
- F  Force. Grabs the target process even if another process has control.
- g  Produces core image files in the global core filerepository with the global content as configured by coreadm(1M). The command fails if the user does not have permissions to the global core filerepository.
- o filename  Substitutes filename in place of core as the first part of the name of the core image files. filename can contain the same tokens to be expanded as the paths in coreadm(1M).
- p  Produces a core image file in the process-specific location with the process-specific content for each process as configured by coreadm(1M). The command fails if the user does not have permissions to the per-process core filerepository.

Operands  The following operand is supported:

process-id  process ID

Usage  Caution should be exercised when using the -F flag. Imposing two controlling processes on one victim process can lead to chaos. Safety is assured only if the primary controlling process, typically a debugger, has stopped the victim process and the primary controlling process is doing nothing at the moment of application of the proc tool in question.

Exit Status  The following exit values are returned:

0  On success.
non-zero  On failure, such as non-existent process ID.

Files  core.process-id  core images

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>
The command syntax is Committed. The Output Formats are Uncommitted.

See Also  
kill(1), coreadm(1M), setrlimit(2), core(4), proc(4), attributes(5)

Notes  
gcore is unaffected by the setrlimit(2) system call using the RLIMIT_CORE value.
The `gencat` command merges the message text source file(s) `msgfile` into a formatted message database `catfile`. The database `catfile` is created if it does not already exist. If `catfile` does exist, its messages are included in the new `catfile`. If set and message numbers collide, the new message-text defined in `msgfile` replaces the old message text currently contained in `catfile`. The message text source file (or set of files) input to `gencat` can contain either set and message numbers or simply message numbers, in which case the set `NL_SETD` (see `nl_types.h`) is assumed.

The format of a message text source file is defined as follows. Note that the fields of a message text source line are separated by a single ASCII space or tab character. Any other ASCII spaces or tabs are considered as part of the subsequent field.

- **$set n comment**
  Where `n` specifies the set identifier of the following messages until the next `$set`, `$del set`, or end-of-file appears. `n` must be a number in the range (1–`NL_SETMAX`). Set identifiers within a single source file need not be contiguous. Any string following the set identifier is treated as a comment. If no `$set` directive is specified in a message text source file, all messages are located in the default message set `NL_SETD`.

- **$del set n comment**
  Deletes message set `n` from an existing message catalog. Any string following the set number is treated as a comment. *(Note: if `n` is not a valid set it is ignored.)*

- **$comment**
  A line beginning with a dollar symbol `$` followed by an ASCII space or tab character is treated as a comment.

- **m message-text**
  The `m` denotes the message identifier, a number in the range (1–`NL_MSGMAX`). The `message-text` is stored in the message catalog with the set identifier specified by the last `$set` directive, and with message identifier `m`. If the `message-text` is empty, and an ASCII space or tab field separator is present, an empty string is stored in the message catalog. If a message source line has a message number, but neither a field separator nor `message-text`, the existing message with that number (if any) is deleted from the catalog. Message identifiers need not be contiguous. The length of `message-text` must be in the range (0–`NL_TEXTMAX`).

- **$quote c**
  This line specifies an optional quote character `c`, which can be used to surround `message-text` so that trailing spaces or null (empty) messages are visible in a message source line. By default, or if an empty `$quote` directive is supplied, no quoting of `message-text` will be recognized.
Empty lines in a message text source file are ignored.

Text strings can contain the special characters and escape sequences defined in the following table:

<table>
<thead>
<tr>
<th>Description</th>
<th>Symbol</th>
<th>Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>newline</td>
<td>NL(LF)</td>
<td>\n</td>
</tr>
<tr>
<td>horizontal tab</td>
<td>HT</td>
<td>\t</td>
</tr>
<tr>
<td>vertical tab</td>
<td>VT</td>
<td>\v</td>
</tr>
<tr>
<td>backspace</td>
<td>BS</td>
<td>\b</td>
</tr>
<tr>
<td>carriage return</td>
<td>CR</td>
<td>\r</td>
</tr>
<tr>
<td>form feed</td>
<td>FF</td>
<td>\f</td>
</tr>
<tr>
<td>backslash</td>
<td>\</td>
<td>\</td>
</tr>
<tr>
<td>bit pattern</td>
<td>ddd</td>
<td>\ddd</td>
</tr>
</tbody>
</table>

The escape sequence \ddd consists of backslash followed by 1, 2 or 3 octal digits, which are taken to specify the value of the desired character. If the character following a backslash is not one of those specified, the backslash is ignored.

Backslash followed by an ASCII newline character is also used to continue a string on the following line. Thus, the following two lines describe a single message string:

```
1 This line continues \n to the next line
```

which is equivalent to:

```
1 This line continues to the next line
```

Operands

The following operands are supported:

- **catfile** A path name of the formatted message catalog. If - is specified, standard output is used.
- **msgfile** A path name of a message text source file. If - is specified for an instance of msgfile, standard input is used. The format of message text source files is defined in Message Text Source File Format.

Environment Variables

See environ(5) for descriptions of the following environment variables that affect the execution of gencat: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.
Exit Status  The following exit values are returned:

0      Successful completion.
>0     An error occurred.

Attributes  See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>text/locale</td>
</tr>
<tr>
<td>CSI</td>
<td>enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See <code>standards(5)</code>.</td>
</tr>
</tbody>
</table>

See Also  `mkmsgs(1), catgets(3C), catopen(3C), gettxt(3C), nl_types.h(3HEAD), attributes(5), environ(5), standards(5)`
### Name
`geniconvtbl` – generate `iconv` code conversion tables

### Synopsis
```
    [-D name=value] [-I directory] [-U name] [infile]...
```

### Description
The `geniconvtbl` utility accepts code conversion rules defined in flat text file(s) and writes code conversion binary table file(s) that can be used to support user-defined `iconv` code conversions (see `iconv(1)` and `iconv(3C)` for more detail on the `iconv` code conversion).

### Options
The following options are supported:

- `-f`  
  Overwrites output file if the output file exists.

- `-n`  
  Does not generate an output file. This is useful to check the contents of the input file.

- `-p preprocessor`  
  Uses specified `preprocessor` instead of the default preprocessor, `/usr/lib/cpp`.

- `-q`  
  Quiet option. It suppresses warning and error messages.

- `-W arg`  
  Passes the argument `arg` to the preprocessor. If this option is specified more than once, all arguments are passed to the preprocessor.

- `-D name`  
  `geniconvtbl` recognizes these options and passes them and their arguments to the preprocessor.

### Operands
The following operand is supported:

- `infile`  
  A path name of an input file. If no input file is specified, `geniconvtbl` reads from the standard input stream. The user can specify more than one input file if necessary.

### Output
If input is from the standard input stream, `geniconvtbl` writes output to the standard output stream. If one or more input files are specified, `geniconvtbl` reads from each input file and writes to a corresponding output file. Each of the output file names will be the same as the corresponding input file with `.bt` appended.

The generated output files must be moved to the following directory prior to using the code conversions at `iconv(1)` and `iconv(3C)`:

```
/usr/lib/iconv/geniconvtbl/binarytables/
```

The output file name should start with one or more printable ASCII characters as the ‘fromcode’ name followed by a percentage character (%), followed by one or more printable ASCII characters as the ‘tocode’ name, followed by the suffix ‘.bt’. The ‘fromcode’ and ‘tocode’ names are used to identify the `iconv` code conversion at `iconv(1)` and
iconv_open(3C)). The properly named output file should be placed in the directory, /usr/lib/iconv/geniconvtbl/binarytables/.

Examples

EXAMPLE 1  Generating an iconv code conversion binary table

The following example generates a code conversion binary table with output file name convertA2B.bt:

example% geniconvtbl convertA2B

EXAMPLE 2  Generating multiple iconv code conversion binary tables

The following example generates two code conversion binary tables with output files test1.bt and test2.bt:

example% geniconvtbl test1 test2

EXAMPLE 3  Using another preprocessor

The following example generates a code conversion binary table once the specified preprocessor has processed the input file:

example% geniconvtbl -p /opt/SUNWspro/bin/cc -W -E convertA2B

EXAMPLE 4  Placing a binary table

To use the binary table created in the first example above as the engine of the conversion 'fromcode' ABC to 'tocode' DEF, become super-user and then rename it and place it like this:

example# mv convertA2B.bt \
/usr/lib/iconv/geniconvtbl/binarytables/ABC%DEF.bt

EXAMPLE 5  Providing modified ISO8859-1 to UTF-8 code conversion

Write a geniconvtbl source file that defines the code conversion. For instance, you can copy over /usr/lib/iconv/geniconvtbl/srcs/ISO8859-1_to_UTF-8.src into your directory and make necessary changes at the source file. Once the modifications are done, generate the binary table:

example% geniconvtbl ISO8859-1_to_UTF-8.src

As super-user, place the generated binary table with a unique name at the system directory where iconv_open(3C) can find the binary table:

example% su
Password:
example% cp ISO8859-1_to_UTF-8.bt \
/usr/lib/iconv/geniconvtbl/binarytables/my-iso-8859-1%utf-8.bt

After that, you can do the iconv code conversion. For instance:

example% iconv -f my-iso-8859-1 -t utf-8 testfile.txt
**Environment Variables**

See `environ(5)` for descriptions of the following environment variables that affect the execution of `geniconvtbl`: LANG and LC_TYPE.

**Exit Status**

The following exit values are returned:

- **0**  
  No errors occurred and the output files were successfully created.

- **1**  
  Command line options are not correctly used or an unknown command line option was specified.

- **2**  
  Invalid input or output file was specified.

- **3**  
  Conversion rules in input files are not correctly defined.

- **4**  
  Conversion rule limit of input files has been reached. See NOTES section of `geniconvtbl(4)`.

- **5**  
  No more system resource error.

- **6**  
  Internal error.

**Files**

- `/usr/lib/iconv/geniconvtbl/binarytables/*`  
  conversion binary tables

- `/usr/lib/iconv/geniconvtbl/srcs/*`  
  conversion source files for user reference

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

**See Also**

`cpp(1), iconv(1), iconv(3C), iconv_close(3C), iconv_open(3C), geniconvtbl(4), attributes(5), environ(5), iconv(5)`

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**Notes**

The generated and correctly placed output files, `/usr/lib/iconv/geniconvtbl/binarytables/*`, are used in both 32-bit and 64-bit environments.
**Name**
genmsg – generate a message source file by extracting messages from source files

**Synopsis**
genmsg [-a -b -d -f -r -n -t -x] [-c message-tag] [-g project-file]
   [-l project-file] [-m prefix] [-M suffix]
   [-o message-file] [-p preprocessor] [-s set-tags] file...

**Description**
The genmsg utility extracts message strings with calls to `catgets(3C)` from source files and writes them in a format suitable for input to `gencat(1)`.

**Invocation**
genmsg reads one or more input files and, by default, generates a message source file whose name is composed of the first input file name with`.msg`. If the `-o` option is specified, genmsg uses the option argument for its output file.

<table>
<thead>
<tr>
<th>Command</th>
<th>Output File</th>
</tr>
</thead>
<tbody>
<tr>
<td>genmsg prog.c</td>
<td>prog.c.msg</td>
</tr>
<tr>
<td>genmsg main.c util.c tool.c</td>
<td>main.c.msg</td>
</tr>
<tr>
<td>genmsg -o prog.msg mail.c util.c</td>
<td>prog.msg</td>
</tr>
</tbody>
</table>

genmsg also allows you to invoke a preprocessor to solve the dependencies of macros and define statements for the `catgets(3C)` calls.

**Auto Message Numbering**
genmsg replaces message numbers with the calculated numbers based upon the project file if the message numbers are `-1`, and it generates copies of the input files with the new message numbers and a copy of the project file with the new maximum message numbers.

A project file is a database that stores a list of set numbers with their maximum message numbers. Each line in a project file is composed of a set number and its maximum message number:

```
Set_number   Maximum_message_number
```

In a project file, a line beginning with a number sign (#) or an ASCII space is considered as a comment and ignored.

genmsg also has the reverse operation to replace all message numbers with `-1`.

**Comment Extraction**
genmsg allows you to comment about messages and set numbers to inform the translator how the messages should be translated. It extracts the comment, which is surrounded with the comment indicators and has the specified tag inside the comment, from the input file and writes it with a dollar ($) prefix in the output file. genmsg supports the C and C++ comment indicators, `/*`, `*/`, and `''`. 
Testing

`genmsg` generates two kinds of messages for testing, prefixed messages and long messages. Prefixed messages allow you to check that your program is retrieving the messages from the message catalog. Long messages allow you to check the appearance of your window program's initial size and position.

Options

The following options are supported:

- **-a** Append the output into the message file `message-file` that is specified by the `-o` option. If two different messages that have the same set and message number are found, the message in the specified message file is kept and the other message in the input file is discarded.

- **-b** Place the extracted comment after the corresponding message in the output file. This option changes the placement behavior of the `-s` or `-c` option.

- **-c message-tag** Extract message comments having `message-tag` inside them from the input files and write them with a `'$'` prefix as a comment in the output file.

- **-d** Include an original text of a message as a comment to be preserved along with its translations. With this option, the translator can see the original messages even after they are replaced with their translations.

- **-f** Overwrite the input files and the project file when used with the `-l` or `-r` option. With the `-r` option, `genmsg` overwrites only the input files.

- **-g project-file** Generate `project-file` that has a list of set numbers and their maximum message numbers in the input files.

- **-l project-file** Replace message numbers with the calculated numbers based upon `project-file` if the message numbers are `-1` in the input files, and then generate copies of the input files with the new message numbers and a copy of `project-file` with the new maximum message numbers. If `project-file` is not found, `genmsg` uses the maximum message number in the input file as a base number and generates `project-file`.

- **-m prefix** Fill in the message with `prefix`. This option is useful for testing.

- **-M suffix** Fill in the message with `suffix`. This option is useful for testing.

- **-n** Add comment lines to the output file indicating the file name and line number in the input files where each extracted string is encountered.

- **-o message-file** Write the output to `message-file`.

- **-p preprocessor** Invoke `preprocessor` to preprocess macros and define statements for the `catgets(3C)` calls. `genmsg` first invokes the option argument as a preprocessor and then starts the normal process against the output from the preprocessor. `genmsg` initiates this process for all the input files.
-r Replaces message numbers with -1. This is the reverse operation of the -l option.

-s set-tag Extract set number comments having set-tag inside them from the input files and write them with a $ prefix as a comment in the output file. If multiple comments are specified for one set number, the first one is extracted and the rest of them are discarded.

-t Generates a message that is three times as long as the original message. This option is useful for testing.

-x Suppresses warning messages about message and set number range checks and conflicts.

Operands

file An input source file.

Examples

**EXAMPLE 1** Assigning Message Numbers and Generating New Files

Suppose that you have the following source and project files:

```bash
example% cat test.c
printf(catgets(catfd, 1, -1, "line too long
"));
printf(catgets(catfd, 2, -1, "invalid code
"));
```

```bash
example% cat proj
1 10
2 20
```

The command

```bash
example% genmsg -l proj test.c
```

would assign the calculated message numbers based upon proj and generate the following files:

- **test.c.msg** Message file
- **proj.new** Updated project file
- **test.c.new** New source file

```bash
example% cat test.c.msg
$quote "$set 1
11 "line too long"
$set 2
21 "invalid code"
```

```bash
example% cat proj.new
1 11
2 21
```
EXAMPLE 1  Assigning Message Numbers and Generating New Files  (Continued)

example% cat test.c.new
printf(catgets(catfd, 1, 11, "line too long\n"));
printf(catgets(catfd, 2, 21, "invalid code\n"));

EXAMPLE 2  Extracting Comments Into a File
The command
example% genmsg -s SET -c MSG test.c
example% cat test.c
/* SET: tar messages */
/* MSG: don't translate "tar". */
catgets(catfd, 1, 1, "tar: tape write error");
// MSG: don't translate "tar" and ":I".
catgets(catfd, 1, 2, "tar: missing argument for -I flag");

would extract the comments and write them in the following output file:

example% cat test.c.msg
$ /* SET: tar messages */
$set 1
$ /* MSG: don't translate "tar". */
1  "tar: tape write error"
$ // MSG: don't translate "tar" and ":I".
2  "tar: missing argument for -I flag"

EXAMPLE 3  Generating Test Messages
The following command:
example% genmsg -m PRE: -M :FIX test.c

might generate the following messages for testing:

example% cat test.c.msg
1  "PRE:OK:FIX"
2  "PRE:Cancel:FIX"

EXAMPLE 4  Parsing a Macro and Writing the Extracted Messages
Given the following input:
example% cat example.c
#include <nl_types.h>
#define MSG1  "message1"
#define MSG2  "message2"
#define MSG3  "message3"
#define MSG(n) catgets(catfd, 1, n, MSG ## n)
EXAMPLE 4 Parsing a Macro and Writing the Extracted Messages

(Continued)

```c
void
main(int argc, char **argv)
{
  nl_catd catd = catopen(argv[0], NL_CAT_LOCALE);
  (void) printf("%s
, MSG(1));
  (void) printf("%s
, MSG(2));
  (void) printf("%s
, MSG(3));
  (void) catclose(catd);
}
```

The following command:

```
example% genmsg -p "cc -E" -o example.msg example.c
```

would parse the MSG macros and write the extracted messages in example.msg.

EXAMPLE 5 Assigning Calculated Message Numbers

Suppose that you have the following header, source, and project files:

```
example% cat ../inc/msg.h
#define WARN_SET 1
#define ERR_SET 2
#define WARN_MSG(id, msg) catgets(catd, WARN_SET, (id), (msg))
#define ERR_MSG(id, msg) catgets(catd, ERR_SET, (id), (msg))
```

```
example% example.c
#include "msg.h"
printf("%s, WARN_MSG(-1, "Warning error");
printf("%s, ERR_MSG(-1, "Fatal error");
```

```
example % proj
1 10
2 10
```

The command

```
example% genmsg -f -p "cc -E -I../inc" -l proj \
   -o example.msg example.c
```

would assign each of the -1 message numbers a calculated number based upon proj and
would overwrite the results to example.c and proj. Also, this command writes the extracted
messages in example.msg.

**Environment Variables** See `environ(5)` for descriptions of the following environment variables that affect the
execution of genmsg: `LC_MESSAGES` and `NLSPATH`. 
The following exit values are returned:
0 Successful completion.
>0 An error occurred.

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>text/locale</td>
</tr>
</tbody>
</table>

See Also
gencat(1), catgets(3C), catopen(3C), attributes(5), environ(5)

Notes
genmsg does not handle pointers or variables in the catgets(3C) call. For example:

```c
const int set_num = 1;
extern int msg_num(const char *);
const char *msg = "Hello";
catgets(catd, set_num, msg_num(msg), msg);

When the auto message numbering is turned on with a preprocessor, if there are multiple -1's in the catgets(3C) line, genmsg replaces all of the -1's in the line with a calculated number. For example, given the input:

#define MSG(id, msg) catgets(catd, 1, (id), (msg))
if (ret == -1) printf("%s, MSG(-1, "Failed")");

the command

genmsg -l proj -p "cc -E"

would produce:

#define MSG(id, msg) catgets(catd, 1, (id), (msg))
if (ret == 1) printf("%s, MSG(1, "Failed")");

The workaround would be to split it into two lines as follows:

if (ret == -1)
    printf("%s, MSG(-1, "Failed")");
getconf(1)

Name
getconf – get configuration values

Synopsis
/usr/bin/getconf [-v specification] system_var
/usr/bin/getconf [-v specification] path_var path_name
/usr/bin/getconf -a
/usr/xpg4/bin/getconf [-v specification] system_var
/usr/xpg4/bin/getconf [-v specification] path_var path_name
/usr/xpg4/bin/getconf -a
/usr/xpg6/bin/getconf [-v specification] system_var
/usr/xpg6/bin/getconf [-v specification] path_var path_name
/usr/xpg6/bin/getconf -a

Description
In the first synopsis form, the getconf utility writes to the standard output the value of the variable specified by system_var, in accordance with specification if the -v option is used.

In the second synopsis form, getconf writes to the standard output the value of the variable specified by path_var for the path specified by path_name, in accordance with specification if the -v option is used.

In the third synopsis form, config writes to the standard output the names of the current system configuration variables.

The value of each configuration variable is determined as if it were obtained by calling the function from which it is defined to be available. The value reflects conditions in the current operating environment.

Options
The following options are supported:
-a
  Writes the names of the current system configuration variables to the standard output.
-v specification
  Gives the specification which governs the selection of values for configuration variables.

Operands
The following operands are supported:

path_var
  A name of a configuration variable whose value is available from the pathconf(2) function. All of the values in the following table are supported:

<table>
<thead>
<tr>
<th>Link Max</th>
<th>Name Max</th>
<th>Posix Chown Restricted</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAX_CANON</td>
<td>PATH_MAX</td>
<td>POSIX_NO_TRUNC</td>
</tr>
<tr>
<td>MAX_INPUT</td>
<td>PIPE_BUF</td>
<td>POSIX_VDISABLE</td>
</tr>
</tbody>
</table>
**pathname**  
A path name for which the variable specified by `path_var` is to be determined.

**system_var**  
A name of a configuration variable whose value is available from `confstr(3C)` or `sysconf(3C)`. All of the values in the following table are supported:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARG_MAX</td>
<td>BC_BASE_MAX</td>
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<tr>
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<td>BC_SCALE_MAX</td>
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<tr>
<td>BC_STRING_MAX</td>
<td>CHAR_BIT</td>
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<td>CHARCLASS_NAME_MAX</td>
<td>CHAR_MAX</td>
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<td>CHAR_MIN</td>
<td>CHILD_MAX</td>
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<td>COLI_WEIGHTS_MAX</td>
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<td>CS_PATH</td>
<td>EXPR_NEST_MAX</td>
</tr>
<tr>
<td>HOST_NAME_MAX</td>
<td>INT_MAX</td>
</tr>
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<td>INT_MIN</td>
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<tr>
<td>LFS64_LDFLAGS</td>
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<tr>
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</tr>
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<td>MB_LEN_MAX</td>
</tr>
<tr>
<td>NGROUPS_MAX</td>
<td>NL_ARGMAX</td>
</tr>
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<td>NL_LANGMAX</td>
<td>NL_MSGMAX</td>
</tr>
<tr>
<td>NL_NMAX</td>
<td>NL_SETMAX</td>
</tr>
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<td>NL_TEXTMAX</td>
<td>NZERO</td>
</tr>
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<td>Environment Variable</td>
<td>Description</td>
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<td>-----------------------------------------------</td>
<td>------------------------------</td>
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<td>_POSIX_AIO_LISTIO_MAX _POSIX_AIO_MAX</td>
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</tr>
</tbody>
</table>

**getconf(1)**

The `getconf` command is used to display various system configuration settings that are related to the system's architecture and operating environment. These settings are defined by POSIX standards and are typically used for debugging, testing, or configuring applications that need to be aware of the system's capabilities. The command outputs a list of environment variables that are defined, along with their values. For example, `SYMLOOP_MAX` is a variable that might be relevant for applications that need to know the maximum number of symbols in a loop. Other variables like `POSIX2_LOCALEDEF` and `POSIX2_RE_DUP_MAX` refer to specific settings that are defined by different POSIX standards, indicating the maximum number of characters in a locale or the maximum number of methods that can be used for replication, respectively.
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
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```plaintext
<p>| | |</p>
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<td>_XOPEN_IOV_MAX</td>
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```
The symbol PATH also is recognized, yielding the same value as the confstr() name value CS_PATH.

**Usage**  See *largefile(5)* for the description of the behavior of /usr/bin/getconf when encountering files greater than or equal to 2 Gbyte (2^{31} bytes).

**Examples**

**EXAMPLE 1**  Writing the Value of a Variable
This example illustrates the value of \{NGROUPS_MAX\}:

```
example% getconf NGROUPS_MAX
```

**EXAMPLE 2**  Writing the Value of a Variable for a Specific Directory
This example illustrates the value of \{NAME_MAX\} for a specific directory:

```
example% getconf NAME_MAX /usr
```

**EXAMPLE 3**  Dealing with Unspecified Results
This example shows how to deal more carefully with results that might be unspecified:

```
if value=$(getconf PATH_MAX /usr); then
    if [ "$value" = "undefined" ]; then
        echo PATH_MAX in /usr is infinite.
    else
        echo PATH_MAX in /usr is $value.
    fi
else
    echo Error in getconf.
fi
```

For example:

```
sysconf(_SC_POSIX_C_BIND);
```

and

```
system("getconf POSIX2_C_BIND");
```

in a C program could give different answers. The sysconf call supplies a value that corresponds to the conditions when the program was either compiled or executed, depending on the implementation. The system call to getconf always supplies a value corresponding to
EXAMPLE 3  Dealing with Unspecified Results  (Continued)

conditions when the program is executed.

Environment Variables  See environ(5) for descriptions of the following environment variables that affect the
execution of getconf: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status  The following exit values are returned:

0  The specified variable is valid and information about its current state was written
   successfully.

>0  An error occurred.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also  sh(1), pathconf(2), sysinfo(2), confstr(3C), sysconf(3C), attributes(5), environ(5),
largefile(5), standards(5)
**Name**
getfacl – display discretionary file information

**Synopsis**
getfacl [-ad] file...

**Description**
For each argument that is a regular file, special file, or named pipe, the `getfacl` utility displays the owner, the group, and the Access Control List (ACL). For each directory argument, `getfacl` displays the owner, the group, and the ACL and/or the default ACL. Only directories contain default ACLs.

The `getfacl` utility may be executed on a file system that does not support ACLs. It reports the ACL based on the base permission bits.

With no options specified, `getfacl` displays the filename, the file owner, the file group owner, and both the ACL and the default ACL, if it exists.

**Options**
The following options are supported:

- `-a` Displays the filename, the file owner, the file group owner, and the ACL of the file.
- `-d` Displays the filename, the file owner, the file group owner, and the default ACL of the file, if it exists.

**Operands**
The following operands are supported:

- `file` The path name of a regular file, special file, or named pipe.

**Output**
The format for ACL output is as follows:

```
# file: filename
# owner: uid
# group: gid
user::perm
user:uid:perm
group::perm
group:gid:perm
mask:perm
other:perm
default:user::perm
default:user:uid:perm
default:group::perm
default:group:gid:perm
default:mask:perm
default:other:perm
```

When multiple files are specified on the command line, a blank line separates the ACLs for each file.

The ACL entries are displayed in the order in which they are evaluated when an access check is performed. The default ACL entries that may exist on a directory have no effect on access checks.
The first three lines display the filename, the file owner, and the file group owner. Notice that when only the `-d` option is specified and the file has no default ACL, only these three lines are displayed.

The `user` entry without a user ID indicates the permissions that are granted to the file owner. One or more additional user entries indicate the permissions that are granted to the specified users.

The `group` entry without a group ID indicates the permissions that are granted to the file group owner. One or more additional group entries indicate the permissions that are granted to the specified groups.

The `mask` entry indicates the ACL mask permissions. These are the maximum permissions allowed to any user entries except the file owner, and to any group entries, including the file group owner. These permissions restrict the permissions specified in other entries.

The `other` entry indicates the permissions that are granted to others.

The `default` entries may exist only for directories. These entries indicate the default entries that are added to a file created within the directory.

The `uid` is a login name or a user ID if there is no entry for the `uid` in the system password file, `/etc/passwd`. The `gid` is a group name or a group ID if there is no entry for the `gid` in the system group file, `/etc/group`. The `perm` is a three character string composed of the letters representing the separate discretionary access rights: `r` (read), `w` (write), `x` (execute/search), or the placeholder character `−`. The `perm` is displayed in the following order: `rwx`. If a permission is not granted by an ACL entry, the placeholder character appears.

If you use the `chmod(1)` command to change the file group owner permissions on a file with ACL entries, both the file group owner permissions and the ACL mask are changed to the new permissions. Be aware that the new ACL mask permissions may change the effective permissions for additional users and groups who have ACL entries on the file.

In order to indicate that the ACL mask restricts an ACL entry, `getfacl` displays an additional tab character, pound sign (`#`), and the actual permissions granted, following the entry.

**Examples**

**EXAMPLE 1**  Displaying file information

Given file `foo`, with an ACL six entries long, the command

```bash
host% getfacl foo
```

would print:

```
# file: foo
# owner: shea
# group: staff
user::rwx
```
EXAMPLE 1  Displaying file information  (Continued)

user:spy:  ---
user:mookie:r  --
group:  r  --
mask:  rw  --
other:  ---

EXAMPLE 2  Displaying information after chmod command

Continue with the above example, after chmod 700 foo was issued:

host% getfacl foo

would print:

# file: foo
# owner: shea
# group: staff
user::rwx
user:spy:  ---
user:mookie:r  --  #effective:  ---
group:  ---
mask:  ---
other:  ---

EXAMPLE 3  Displaying information when ACL contains default entries

Given directory doo, with an ACL containing default entries, the command

host% getfacl -d doo

would print:

# file: doo
# owner: shea
# group: staff
default:user::rwx
default:user:spy:  ---
default:user:mookie:r  --
default:group:  r  --
default:mask:  ---
default:other:  ---

Files  /etc/passwd  system password file
       /etc/group  group file
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTETYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  chmod(1), ls(1), setfacl(1), acl(2), aclsort(3SEC), group(4), passwd(4), attributes(5)

Notes  The output from getfacl is in the correct format for input to the setfacl -f command. If the output from getfacl is redirected to a file, the file may be used as input to setfacl. In this way, a user may easily assign one file's ACL to another file.
getlabel(1)

Name  getlabel – display the label of files

Synopsis  /usr/bin/getlabel  [-sS]  filename ...

Description  getlabel displays the label that is associated with each filename. When options are not
specified, the output format of the label is displayed in default format.

Options  -s  Display the label that is associated with filename in short form.
-s  Display the label that is associated with filename in long form.

Exit Status  getlabel exits with one of the following values:
  0    Successful completion.
  1    Unsuccessful completion due to usage error.
  2    Unable to translate label.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/trusted</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>See below.</td>
</tr>
</tbody>
</table>

The command line is Committed. The output is Not-an-Interface.

See Also  setlabel(1), m_label(3TSOL), label_encodings(4), attributes(5)

Notes  The functionality described on this manual page is available only if the system is configured with Trusted Extensions.
**Name**
getopt – parse command options

**Synopsis**
set -- 'getopt optstring $*' 

**Description**
The `getopts` command supersedes `getopt`. For more information, see NOTES below.

`getopt` is used to break up options in command lines for easy parsing by shell procedures and to check for legal options. `optstring` is a string of recognized option letters; see `getopt(3C)`. If a letter is followed by a colon (:), the option is expected to have an argument which may or may not be separated from it by white space. The special option – is used to delimit the end of the options. If it is used explicitly, `getopt` recognizes it; otherwise, `getopt` generates it; in either case, `getopt` places it at the end of the options. The positional parameters ($1 $2 ... ) of the shell are reset so that each option is preceded by a – and is in its own positional parameter; each option argument is also parsed into its own positional parameter.

**Examples**

**EXAMPLE 1**  Processing the arguments for a command

The following code fragment shows how one might process the arguments for a command that can take the options -a or -b, as well as the option -o, which requires an argument:

```bash
set -- 'getopt abo: $*' 
if [ $? != 0 ]
then
    echo $USAGE
    exit 2
fi 
for i in $*
do
    case $i in
        -a | -b)
            FLAG=$i; shift;
            esac
    done
```

This code accepts any of the following as equivalent:

- `cmd -aoarg filename1 filename2`
- `cmd -a -o arg filename1 filename2`
- `cmd -oarg -a filename1 filename2`
- `cmd -a -oarg -- filename1 filename2`

**Attributes**
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTETYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>enabled</td>
</tr>
</tbody>
</table>
getopt prints an error message on the standard error when it encounters an option letter not included in `optstring`.

getopt will not be supported in the next major release. For this release a conversion tool has been provided, namely, `getoptcvt`. For more information, see `getopts(1)` and `getoptcvt(1)`.

Reset `optind` to 1 when rescanning the options.

getopt does not support the part of Rule 8 of the command syntax standard (see `Intro(1)`) that permits groups of option-arguments following an option to be separated by white space and quoted. For example,

```
cmd -a -b -o "xxx z yy" filename
```

is not handled correctly. To correct this deficiency, use the `getopts` command in place of `getopt`.

If an option that takes an option-argument is followed by a value that is the same as one of the options listed in `optstring` (referring to the earlier EXAMPLES section, but using the following command line:

```
cmd -o -a filename
```

getopt always treats it as an option-argument to `-o`; it never recognizes `-a` as an option. For this case, the `for` loop in the example shifts past the `filename` argument.
**getoptcvt**

**Name**
getoptcvt – convert to getopt to parse command options

**Synopsis**
```
/usr/lib/getoptcvt [-b] filename
```

**Description**
`/usr/lib/getoptcvt` reads the shell script in `filename`, converts it to use `getopts` instead of `getopt`, and writes the results on the standard output.

`getopts` is a built-in Bourne shell command used to parse positional parameters and to check for valid options. See `sh(1)`. It supports all applicable rules of the command syntax standard (see Rules 3-10, `Intro(1)`). It should be used in place of the `getopt` command. (See the NOTES section below.) The syntax for the shell's built-in `getopts` command is:

```
getopts optstring name [ argument . . . ]
```

`optstring` must contain the option letters the command using `getopts` will recognize; if a letter is followed by a colon (:), the option is expected to have an argument, or group of arguments, which must be separated from it by white space.

Each time it is invoked, `getopts` places the next option in the shell variable `name` and the index of the next argument to be processed in the shell variable `OPTIND`. Whenever the shell or a shell script is invoked, `OPTIND` is initialized to 1.

When an option requires an option-argument, `getopts` places it in the shell variable `OPTARG`.

If an illegal option is encountered, `?` will be placed in `name`.

When the end of options is encountered, `getopts` exits with a non-zero exit status. The special option — may be used to delimit the end of the options.

By default, `getopts` parses the positional parameters. If extra arguments (`argument . . .`) are given on the `getopts` command line, `getopts` parses them instead.

So that all new commands will adhere to the command syntax standard described in `Intro(1)`, they should use `getopts` or `getopt` to parse positional parameters and check for options that are valid for that command (see the NOTES section below).

**Options**
The following option is supported:

- `-b` Makes the converted script portable to earlier releases of the UNIX system. `#/usr/lib/getoptcvt` modifies the shell script in `filename` so that when the resulting shell script is executed, it determines at run time whether to invoke `getopts` or `getopt`.

**Examples**

**EXAMPLE 1** Processing the arguments for a command

The following fragment of a shell program shows how one might process the arguments for a command that can take the options `-a` or `-b`, as well as the option `-o`, which requires an option-argument:
EXAMPLE 1  Processing the arguments for a command  (Continued)

while getopts abo: c
do
  case $c in
    a | b) FLAG=$c;;
o) OARG=$OPTARG;;
   ?) echo $USAGE
      exit 2;;
   esac
done
shift 'expr $OPTIND − 1'

EXAMPLE 2  Equivalent code expressions

This code accepts any of the following as equivalent:

cmd -a -b -o "xxx z yy" filename

cmd -a -b -o "xxx z yy" -filename

cmd -ab -o xxx,z,yy filename

cmd -ab -o "xxx z yy" filename

cmd -o xxx,z,yy b a filename

Environment
Variables

See environ(5) for descriptions of the following environment variables that affect the
execution of getopts: LC_CTYPE, LC_MESSAGES, and NLSPATH.

OPTIND  This variable is used by getoptcvt as the index of the next argument to be
        processed.

OPTARG  This variable is used by getoptcvt to store the argument if an option is using
        arguments.

Exit Status  The following exit values are returned:

    0    An option, specified or unspecified by optstring, was found.
   >0    The end of options was encountered or an error occurred.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
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</tr>
<tr>
<td>CSI</td>
<td>enabled</td>
</tr>
</tbody>
</table>

See Also  Intro(1), getopts(1), sh(1), shell_builtins(1), getop(3C), attributes(5)
Diagnostics  getopt prints an error message on the standard error when it encounters an option letter not included in optstring.

Notes  Although the following command syntax rule (see Intro(1)) relaxations are permitted under the current implementation, they should not be used because they may not be supported in future releases of the system. As in the EXAMPLES section above, -a and -b are options, and the option -o requires an option-argument. The following example violates Rule 5: options with option-arguments must not be grouped with other options:

```bash
example% cmd -aboxxx filename
```

The following example violates Rule 6: there must be white space after an option that takes an option-argument:

```bash
example% cmd -ab oxxx filename
```

Changing the value of the shell variable OPTIND or parsing different sets of arguments may lead to unexpected results.
**Name**
getopts – parse utility options

**Synopsis**
/usr/bin/getopts optstring name [arg...]

sh
gopts optstring name [argument]...

ksh88
gopts optstring name [arg]...

ksh
gopts [-a name] optstring name [arg]...

**Description**

The **getopts** utility can be used to retrieve options and option-arguments from a list of parameters.

Each time it is invoked, the **getopts** utility places the value of the next option in the shell variable specified by the `name` operand and the index of the next argument to be processed in the shell variable `OPTIND`. Whenever the shell is invoked, `OPTIND` is initialized to 1.

When the option requires an option-argument, the **getopts** utility places it in the shell variable `OPTARG`. If no option was found, or if the option that was found does not have an option-argument, `OPTARG` is unset.

If an option character not contained in the `optstring` operand is found where an option character is expected, the shell variable specified by `name` is set to the question-mark (`?`) character. In this case, if the first character in `optstring` is a colon (`:`), the shell variable `OPTARG` is set to the option character found, but no output is written to standard error; otherwise, the shell variable `OPTARG` is unset and a diagnostic message is written to standard error. This condition is considered to be an error detected in the way arguments were presented to the invoking application, but is not an error in **getopts** processing.

If an option-argument is missing:
- If the first character of `optstring` is a colon, the shell variable specified by `name` is set to the colon character and the shell variable `OPTARG` is set to the option character found.
- Otherwise, the shell variable specified by `name` is set to the question-mark character (`?`), the shell variable `OPTARG` is unset, and a diagnostic message is written to standard error. This condition is considered to be an error detected in the way arguments were presented to the invoking application, but is not an error in **getopts** processing; a diagnostic message is written as stated, but the exit status is zero.

When the end of options is encountered, the **getopts** utility exits with a return value greater than zero; the shell variable `OPTIND` is set to the index of the first non-option-argument, where the first `−−` argument is considered to be an option-argument if there are no other non-option-arguments appearing before it, or the value `$# + 1` if there are no non-option-arguments; the `name` variable is set to the question-mark character. Any of the following identifies the end of options: the special option `−−`, finding an argument that does not begin with a `−`, or encountering an error.
getopts(1)

The shell variables OPTIND and OPTARG are local to the caller of getopts and are not exported by default.

The shell variable specified by the name operand, OPTIND and OPTARG affect the current shell execution environment.

If the application sets OPTIND to the value 1, a new set of parameters can be used: either the current positional parameters or new arg values. Any other attempt to invoke getopts multiple times in a single shell execution environment with parameters (positional parameters or arg operands) that are not the same in all invocations, or with an OPTIND value modified to be a value other than 1, produces unspecified results.

getopts is a built-in Bourne shell command used to parse positional parameters and to check for valid options. See sh(1). It supports all applicable rules of the command syntax standard (see Rules 3-10, Intro(1)). It should be used in place of the getopt command.

optstring must contain the option letters the command using getopts recognizes. If a letter is followed by a colon, the option is expected to have an argument, or group of arguments, which must be separated from it by white space.

Each time it is invoked, getopts places the next option in the shell variable name and the index of the next argument to be processed in the shell variable OPTIND. Whenever the shell or a shell script is invoked, OPTIND is initialized to 1.

When an option requires an option-argument, getopts places it in the shell variable OPTARG.

If an illegal option is encountered, ? is placed in name.

When the end of options is encountered, getopts exits with a non-zero exit status. The special option – can be used to delimit the end of the options.

By default, getopts parses the positional parameters. If extra arguments (argument ...) are specified on the getopts command line, getopts parses them instead.

/usr/lib/getoptcvt reads the shell script in filename, converts it to use getopts instead of getopt, and writes the results on the standard output.

So that all new commands adhere to the command syntax standard described in Intro(1), they should use getopts or getopt to parse positional parameters and check for options that are valid for that command.

getopts prints an error message on the standard error when it encounters an option letter not included in optstring.

Although the following command syntax rule (see Intro(1)) relaxations are permitted under the current implementation, they should not be used because they can not be supported in future releases of the system. As in the EXAMPLES section below, -a and -b are options, and the option -o requires an option-argument.
The following example violates Rule 5: options with option-arguments must not be grouped with other options:

```
example% cmd -aboxxx filename
```

The following example violates Rule 6: there must be white space after an option that takes an option-argument:

```
example% cmd -ab oxxx filename
```

Changing the value of the shell variable `OPTIND` or parsing different sets of arguments can lead to unexpected results.

Ksh88 checks `arg` for legal options. If `arg` is omitted, the positional parameters are used. An option argument begins with a `+` or a `−`. An option not beginning with `+` or `−` or the argument `−` ends the options. `optstring` contains the letters that `getopts` recognizes. If a letter is followed by a `:`, that option is expected to have an argument. The options can be separated from the argument by blanks.

`getopts` places the next option letter it finds inside variable `name` each time it is invoked with a `+` prepended when `arg` begins with a `+`. The index of the next `arg` is stored in `OPTIND`. The option argument, if any, gets stored in `OPTARG`.

A leading `:` in `optstring` causes `getopts` to store the letter of an invalid option in `OPTARG`, and to set `name` to `?` for an unknown option and to `:` when a required option is missing. Otherwise, `getopts` prints an error message. The exit status is non-zero when there are no more options.

`getopts` supports both traditional single-character short options and long options defined by Sun’s Command Line Interface Paradigm (CLIP).

Each long option is an alias for a short option and is specified in parentheses following its equivalent short option. For example, you can specify the long option `file` as an alias for the short option `f` using the following script line:

```
getopts "f(file)" opt
```

Precede long options on the command line with `--` or `++`. In the example above, `--file` on the command line would be the equivalent of `-f`, and `++file` on the command line would be the equivalent of `+f`.

Each short option can have multiple long option equivalents, although this is in violation of the CLIP specification and should be used with caution. You must enclose each long option equivalent parentheses, as follows:

```
getopts "f:(file)(input-file)o:(output-file)"
```

In the above example, both `--file` and `--input-file` are the equivalent of `-f`, and `--output-file` is the equivalent of `-o`. 
The variable name is always set to a short option. When a long option is specified on the command line, name is set to the short-option equivalent.

For a further discussion of the Korn shell’s `getopts` built-in command, see the previous discussion in the Bourne shell (sh) section of this manpage.

The `getopts` utility can be used to retrieve options and arguments from a list of arguments specified by `args` or the positional parameters if `arg` is omitted. It can also generate usage messages and a manual page for the command based on the information in `optstring`.

Each time it is invoked, the `getopts` utility places the value of the next option in the shell variable specified by the `name` operand and the index of the next argument to be processed in the shell variable `OPTIND`. When the shell is invoked `OPTIND` is initialized to 1. When an option requires or permits an option argument, `getopts` places the option argument in the shell variable `OPTARG`. Otherwise `OPTARG` is set to 1 when the option is set and 0 when the option is unset.

The `optstring` string consists of alphanumeric characters, the special characters `+`, `?`, `:)`, and `SPACE` or character groups enclosed in `[...]`. Character groups can be nested in `{...}`. Outside of a `[...]` group, a single `NEWLINE` followed by zero or more blanks is ignored. One or more blank lines separate the options from the command argument synopsis.

Each `[...]` group consists of an optional label, optional attributes separated by `:`, and an optional description string following `?`. The characters from the `?` to the end of the next `]` are ignored for option parsing and short usage messages. They are used for generating verbose help or man pages. The `:` character can not appear in the label. The `?` character must be specified as `??` in the label and the `]` character must be specified as `]` in the description string. Text between two `\b` (backspace) characters indicates that the text should be emboldened when displayed. Text between two `\a` (bell) characters indicates that the text should be emphasized or italicized when displayed. Text between two `\v` (vertical tab) characters indicates that the text should displayed in a fixed-width font. Text between two `\f` (form feed) characters is replaced by the output from the shell function whose name is that of the enclosed text.

All output from this interface is written to the standard error.

There are several group types:

- A group of the form

  ```
  [- [version] [flag[number]] ... [?text]]
  ```

  which appears as the first group enables the extended interface.

  `version` specifies the interface version, currently 1. The latest version is assumed if version is omitted. Future enhancements can increment `version`, but all versions are supported.

  `text` typically specifies an SCCS or CVS identification string. Zero or more flags with optional number values can be specified to control option parsing. The flags are:
c  Cache this optstring for multiple passes. Used to optimize built-ins that can be called many times within the same process.

i  Ignore this optstring when generating help. Used when combining optstring values from multiple passes.

l  Display only long option names in help messages.

o  The - option character prefix is optional. This supports the obsolete ps(1) option syntax.

p  The number specifies the number of - characters that must prefix long option names. The default is 2. 0, 1 or 2 are accepted, for example p0 for dd(1M) and p1 for find(1).

s  The number specifies the manual page section number, 1 by default.

- An option specification of the form [option[!][=number] [:longname] [?text]]. In this case the first field is the option character, which is the value returned in the name operand when the option is matched. If there is no option character then a two or more digit number should be specified. This number is returned as the value of the name operand if the long option is matched. If option is followed by a ! then the option character sense is the inverse of the longname sense. For options that do not take values OPTARG is set to 0 for ! inverted option characters and 1 otherwise. =number optionally specifies a number to be returned in the name operand instead of the option character. A longname is specified by --longname and is matched by the shortest non-ambiguous prefix of all long options. An * in the longname field indicates that only characters up to that point need to match, provided any additional characters match exactly. The enclosing [ and ] can be omitted for an option that does not have a longname or descriptive text.

- An option argument specification. Options that take arguments can be followed by :, indicating a string value or #, indicating a numeric value, and an option argument specification. An option argument specification consists of the option argument name as field 1. The remaining : separated fields are a type name and zero or more of the special attribute words listof, oneof, and ignorecase. A default option value can be specified in the final field as :=default. The option argument specification can be followed by a list of option value descriptions enclosed in braces. A long option that takes an argument is specified as --longname=value. If the : or # is followed by ?, the option argument is optional. If only the option character form is specified then the optional argument value is not set if the next argument starts with - or +.

- An option value description.

- An argument specification. A list of valid option argument values can be specified by enclosing them inside a { ... } following the option argument specification. Each of the permitted values can be specified with a [ ... ] containing the value followed by a description.

- A group of the form [+\n... ] displays the characters representing ... in fixed-width font without adding line breaks.
A group of the form [+name?text] specifies a section name with descriptive text. If name is omitted, text is placed in a new paragraph.

A group of the form [-name?text] specifies entries for the IMPLEMENTATION section.

If the leading character of optstring is +, arguments beginning with + are also be considered options.

A leading : character or a : following a leading + in optstring affects the way errors are handled. If an option character or a long name argument not specified in optstring is encountered when processing options, the shell variable whose name is name is set to the ? character. The shell variable OPTARG is set to the character found. If an option argument is missing or has an invalid value, then name is set to the : character and the shell variable OPTARG is set to the option character found. Without the leading :, name is set to the ? character, OPTARG is unset, and an error message is written to standard error when errors are encountered.

The end of options occurs when:
1. The special argument -- is encountered.
2. An argument that does not begin with a - is encountered.
3. A help argument is specified.
4. An error is encountered.

If OPTIND is set to the value 1, a new set of arguments can be used.

getopts can also be used to generate help messages containing command usage and detailed descriptions. Specify args as:

- ? Use this to generate a usage synopsis.
- ?? Use this to generate a verbose usage message.
- ??man Use this to generate a formatted manual page.
- ??api Use this to generate an easy to parse usage message.
- ??html Use this to generate a man page in html format.
- ??nroff Use this to generate a man page in nroff format.
- ??usage Use this to list the current optstring.
- ??name Use this to list version=n, where n is greater than 0, if the option name is recognized by getopts.

When the end of options is encountered, getopts exits with a non-zero return value and the variable OPTIND is set to the index of the first non-option argument.

Options
ksh  The following options are supported by ksh:

-  *name*  Use *name* instead of the command name in usage messages.

**Operands**  The following operands are supported:

*optstring*  A string containing the option characters recognised by the utility invoking `getopts`. If a character is followed by a colon, the option is expected to have an argument, which should be supplied as a separate argument. Applications should specify an option character and its option-argument as separate arguments, but `getopts` interprets the characters following an option character requiring arguments as an argument whether or not this is done. An explicit null option-argument need not be recognised if it is not supplied as a separate argument when `getopts` is invoked; see `getopt(3C)`. The characters question-mark (?) and colon (:) must not be used as option characters by an application. The use of other option characters that are not alphanumeric produces unspecified results. If the option-argument is not supplied as a separate argument from the option character, the value in `OPTARG` is stripped of the option character and the −. The first character in `optstring` determines how `getopts` behaves if an option character is not known or an option-argument is missing.

*name*  The name of a shell variable that is set by the `getopts` utility to the option character that was found.

The `getopts` utility by default parses positional parameters passed to the invoking shell procedure. If `args` are specified, they are parsed instead of the positional parameters.

**Usage**  Since `getopts` affects the current shell execution environment, it is generally provided as a shell regular built-in. If it is called in a subshell or separate utility execution environment, such as one of the following:

```
(getopts abc value "$@")
nohup getopts ...
find . -exec getopts ... 
```

it does not affect the shell variables in the caller's environment.

Notice that shell functions share `OPTIND` with the calling shell even though the positional parameters are changed. Functions that want to use `getopts` to parse their arguments usually want to save the value of `OPTIND` on entry and restore it before returning. However, there are cases when a function wants to change `OPTIND` for the calling shell.

**Examples**  **EXAMPLE 1**  Parsing and Displaying Arguments

The following example script parses and displays its arguments:

```bash
aflag=
bflag=
```
EXAMPLE 1  Parsing and Displaying Arguments  (Continued)

while getopts ab: name
do        case $name in
  a)       aflag=1;;
  b)       bflag=1
            bval="$OPTARG";;
?        printf "Usage: %s: [-a] [-b value] args\n" $0
            exit 2;;
esac
done
if [ ! -z "$aflag" ]; then
  printf "Option -a specified\n"
fi
if [ ! -z "$bflag" ]; then
  printf "Option -b ""$bval" specified\n"
fi
shift $(($OPTIND - 1))
printf "Remaining arguments are: %s\n" "$*

EXAMPLE 2  Processing Arguments for a Command with Options

The following fragment of a shell program processes the arguments for a command that can
take the options -a or -b. It also processes the option -o, which requires an option-argument:

while getopts abo: c
do        case $c in
  a | b)  FLAG=$c;;
  o)     OARG=$OPTARG;;
  \?)    echo SUSAGE
            exit 2;;
esac
done
shift 'expr $OPTIND - 1'

EXAMPLE 3  Equivalent Code Expressions

This code example accepts any of the following as equivalent:

cmd -a -b -o "xxx z yy" filename
cmd -a -b -o "xxx z yy" -- filename
cmd -ab -o xxx,z,yy filename
cmd -ab -o "xxx z yy" filename
cmd -o xxx,z,yy -b -a filename
**Environment Variables**

See `environ(5)` for descriptions of the following environment variables that affect the execution of `getopts`: `LANG`, `LC_ALL`, `LC_CTYPE`, `LC_MESSAGES`, and `NLSPATH`.

- **OPTIND**
  This variable is used by `getopts` as the index of the next argument to be processed.

- **OPTARG**
  This variable is used by `getopts` to store the argument if an option is using arguments.

**Exit Status**

The following exit values are returned:

- **0**
  An option, specified or unspecified by `optstring`, was found.

- **>0**
  The end of options was encountered or an error occurred.

**ksh**

The following exit values are returned by `ksh`:

- **0**
  A specified option was found.

- **1**
  An end of options was encountered.

- **2**
  A usage or information message was generated.

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

```
ATTRIBUTETYPE ATTRIBUTEVALUE
Availability system/core-os
Interface Stability Committed
Standard See standards(5).
```

```
ATTRIBUTETYPE ATTRIBUTEVALUE
Availability system/core-os
Interface Stability Uncommitted
```

**See Also**

`Intro(1)`, `getoptcvt(1)`, `ksh(1)`, `ksh88(1)`, `ps(1)`, `sh(1)`, `getopt(3C)`, `attributes(5)`, `environ(5)`, `standards(5)`

**Diagnostics**

Whenever an error is detected and the first character in the `optstring` operand is not a colon (:), a diagnostic message is written to standard error with the following information in an unspecified format:

- The invoking program name is identified in the message. The invoking program name is the value of the shell special parameter `0` at the time the `getopts` utility is invoked. A name equivalent to `basename "$0"` can be used.

User Commands
- If an option is found that was not specified in `optstring`, this error is identified and the invalid option character is identified in the message.
- If an option requiring an option-argument is found, but an option-argument is not found, this error is identified and the invalid option character is identified in the message.
**gettext(1)**

**Name**
gettext – retrieve text string from message database

**Synopsis**
gettext [-d textdomain | --domain=textdomain]

[textdomain] msgid

ggettext [-s [-e] [-n]

[-d textdomain | --domain=textdomain] msgid...

**Description**
The gettext utility retrieves a translated text string corresponding to string msgid from a message object generated with msgfmt(1). The message object name is derived from the optional argument textdomain if present, otherwise from the TEXTDOMAIN environment. If no domain is specified, or if a corresponding string cannot be found, gettext prints msgid.

Ordinarily, gettext looks for its message object in /usr/lib/locale/lang/LC_MESSAGES where lang is the locale name. If present, the TEXTDOMAINDIR environment variable replaces the pathname component up to lang.

This command interprets C escape sequences such as \t for tab. Use \\ to print a backslash. To produce a message on a line of its own, either enter \n at the end of msgid, or use this command in conjunction with printf(1).

When used with the -s option, gettext behaves like echo(1). But it does not simply copy its arguments to standard output. Instead, those messages found in the selected catalog are translated.

**Options**
The following options are supported:

- `d textdomain`
  - `--domain=textdomain`
  Retrieves translated messages from the domain textdomain, if textdomain is not specified as an operand.

- `e`
  Enables expansion of some escape sequences if used with the -s option.

- `n`
  Suppresses trailing newline if used with the -s option.

- `s`
  Behaves like echo(1) (see DESCRIPTION above). If the -s option is specified, no expansion of C escape sequences is performed and a newline character is appended to the output, by default.

**Operands**
The following operands are supported:

- `textdomain`
  A domain name used to retrieve the messages. This overrides the specification by the -d or --domain options, if present.

- `msgid`
  A key to retrieve the localized message.

**Environment Variables**

- `LANG`
  Specifies locale name.

- `LC_MESSAGES`
  Specifies messaging locale, and if present overrides LANG for messages.
Specifiesthetextdomainname,whichisidenticaltothemessageobject
filenamewithout.mo suffix.

TEXTDOMAINVALIDIR Specifysthepathname tothemessage database. If present, replaces
/usr/lib/locale.

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTETYPE</th>
<th>ATTRIBUTEVALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also echo(1), msgfmt(1), printf(1), gettext(3C), setlocale(3C), attributes(5)

Notes Thisistheshellequivalentofthelibraryroutine gettext(3C).
**Name**

gettxt – retrieve a text string from a message database

**Synopsis**

gettxt  msgfile : msgnum  [dflt_msg]

**Description**

gettxt retrieves a text string from a message file in the directory

```
/usr/lib/locale/locale/LC_MESSAGES
```

The directory name `locale` corresponds to the language in which the text strings are written; see `setlocale(3C)`.

- **msgfile**
  
  Name of the file in the directory `/usr/lib/locale/locale/LC_MESSAGES` to retrieve `msgnum` from. The name of `msgfile` can be up to 14 characters in length, but may not contain either `\0` (null) or the ASCII code for `/` (slash) or `:` (colon).

- **msgnum**
  
  Sequence number of the string to retrieve from `msgfile`. The strings in `msgfile` are numbered sequentially from 1 to `n`, where `n` is the number of strings in the file.

- **dflt_msg**
  
  Default string to be displayed if `gettxt` fails to retrieve `msgnum` from `msgfile`. Nongraphic characters must be represented as alphabetic escape sequences.

The text string to be retrieved is in the file `msgfile`, created by the `mksys(1)` utility and installed under the directory `/usr/lib/locale/locale/LC_MESSAGES`. You control which directory is searched by setting the environment variable `LC_MESSAGES`. If `LC_MESSAGES` is not set, the environment variable `LANG` will be used. If `LANG` is not set, the files containing the strings are under the directory `/usr/lib/locale/C/LC_MESSAGES`.

If `gettxt` fails to retrieve a message in the requested language, it will try to retrieve the same message from `/usr/lib/locale/C/LC_MESSAGES/msgfile`. If this also fails, and if `dflt_msg` is present and non-null, then it will display the value of `dflt_msg`; if `dflt_msg` is not present or is null, then it will display the string "Message not found!!".

**Examples**

**EXAMPLE 1**  The environment variables `LANG` and `LC_MESSAGES`.

If the environment variables `LANG` or `LC_MESSAGES` have not been set to other than their default values, the following example:

```
example% gettxt UX:10 "hello world\n"
```

will try to retrieve the 10th message from `/usr/lib/locale/C/UX/msgfile`. If the retrieval fails, the message "hello world," followed by a newline, will be displayed.

**Environment Variables**

See `environ(5)` for descriptions of the following environment variables that affect the execution of `gettxt`: `LC_CTYPE` and `LC_MESSAGES`.

- **LC_CTYPE**
  
  Determines how `gettxt` handles characters. When `LC_CTYPE` is set to a valid value, `gettxt` can display and handle text and filenames containing valid characters for that locale. `gettxt` can display and handle Extended Unix Code (EUC) characters where any individual character can be 1, 2, or 3 bytes wide. `gettxt` can also handle EUC characters of 1, 2, or more column widths. In the "C" locale, only characters from ISO 8859-1 are valid.
LC_MESSAGES  Determines how diagnostic and informative messages are presented. This includes the language and style of the messages, and the correct form of affirmative and negative responses. In the "C" locale, the messages are presented in the default form found in the program itself (in most cases, U.S. English).

Files  

/usr/lib/locale/C/LCMESSAGES/*  default message files created by mkmsgs(1)
/usr/lib/locale/locale/LCMESSAGES/*  message files for different languages created by mkmsgs(1)

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>text/locale</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

See Also  extr(1), mkmsgs(1), srchtxt(1), gettext(3C), setlocale(3C), attributes(5), environ(5)
**Name**
getzonepath – display root path of the zone corresponding to the specified label

**Synopsis**
/usr/bin/getzonepath  (sensitivity-label)

**Description**
getzonepath displays the root path name of the running labeled zone that corresponds to the specified sensitivity label. The returned path name is relative to the caller’s root path name, and has the specified sensitivity label.

If the caller is in the global zone, the returned path name is not traversable unless the caller’s processes have the file_dac_search privilege.

If the caller is in a labeled zone, the caller’s label must dominate the specified label. Access to files under the returned path name is restricted to read-only operations.

**Attributes**
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/trusted</td>
</tr>
<tr>
<td>Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

**Diagnostics**
getzonepath exits with one of the following values:

0  Success
1  Usage error
2  Failure; error message is the system error number from getzoneroottylabel(3TSOL)

**See Also**
getzoneroottylabel(3TSOL), attributes(5)

“Acquiring a Sensitivity Label” in Trusted Extensions Developer’s Guide

**Notes**
The functionality described on this manual page is available only if the system is configured with Trusted Extensions.
Name  glob – shell built-in function to expand a word list

Synopsis

csh  glob  wordlist

Description

csh  glob performs filename expansion on wordlist. Like echo(1), but no \ escapes are recognized. Words are delimited by null characters in the output.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  csh(1), echo(1), attributes(5)
The `gprof` utility produces an execution profile of a program. The effect of called routines is incorporated in the profile of each caller. The profile data is taken from the call graph profile file that is created by programs compiled with the `-xpg` option of `cc(1)`, or by the `-pg` option with other compilers, or by setting the `LD_PROFILE` environment variable for shared objects. See `ld.so.1(1)`. These compiler options also link in versions of the library routines which are compiled for profiling. The symbol table in the executable image file `image-file` (a.out by default) is read and correlated with the call graph profile file `profile-file` (gmon.out by default).

First, execution times for each routine are propagated along the edges of the call graph. Cycles are discovered, and calls into a cycle are made to share the time of the cycle. The first listing shows the functions sorted according to the time they represent, including the time of their call graph descendants. Below each function entry is shown its (direct) call-graph children and how their times are propagated to this function. A similar display above the function shows how this function's time and the time of its descendants are propagated to its (direct) call-graph parents.

Cycles are also shown, with an entry for the cycle as a whole and a listing of the members of the cycle and their contributions to the time and call counts of the cycle.

Next, a flat profile is given, similar to that provided by `prof(1)`. This listing gives the total execution times and call counts for each of the functions in the program, sorted by decreasing time. Finally, an index is given, which shows the correspondence between function names and call-graph profile index numbers.

A single function may be split into subfunctions for profiling by means of the `MARK` macro. See `prof(5)`. Beware of quantization errors. The granularity of the sampling is shown, but remains statistical at best. It is assumed that the time for each execution of a function can be expressed by the total time for the function divided by the number of times the function is called. Thus the time propagated along the call-graph arcs to parents of that function is directly proportional to the number of times that arc is traversed.

The profiled program must call `exit(2)` or return normally for the profiling information to be saved in the `gmon.out` file.

**Options**

The following options are supported:

- `-a` Suppress printing statically declared functions. If this option is given, all relevant information about the static function (for instance, time samples, calls to other functions, calls from other functions) belongs to the function loaded just before the static function in the a.out file.
-b  Brief. Suppress descriptions of each field in the profile.

-c  Discover the static call-graph of the program by a heuristic which
examinesthetextspaceoftheobjectfile. Static-only parents or children
are indicated with call counts of 0. Note that for dynamically linked
executables, the linked shared objects’ text segments are not examined.

-C  Demangle C++ symbol names before printing them out.

-D  Produce a profile file gmon . sum that represents the difference of the
profile information in all specified profile files. This summary profile file
may be given to subsequent executions of gprof (also with -D) to
summarize profile data across several runs of an a.out file. See also the
-s option.

As an example, suppose function A calls function B n times in profile file
 gmon . sum, and m times in profile file gmon . out. With -D, a new gmon . sum
file will be created showing the number of calls from A to B as n - m.

-evfunction-name  Suppress printing the graph profile entry for routine function-name and
all its descendants (unless they have other ancestors that are not
suppressed). More than one -e option may be given. Only one
function-name may be given with each -e option.

-Efunction-name  Suppress printing the graph profile entry for routine function-name
(and its descendants) as -e, below, and also exclude the time spent in
function-name (and its descendants) from the total and percentage time
computations. More than one -E option may be given. For example:

-E mcount -E mcleanup

is the default.

-ffunction-name  Print the graph profile entry only for routine function-name and its
descendants. More than one -f option may be given. Only one
function-name may be given with each -f option.

-Ffunction-name  Print the graph profile entry only for routine function-name and its
descendants (as -f, below) and also use only the times of the printed
routines in total time and percentage computations. More than one -F
option may be given. Only one function-name may be given with each
-F option. The -F option overrides the -E option.

-l  Suppress the reporting of graph profile entries for all local symbols. This
option would be the equivalent of placing all of the local symbols for the
specified executable image on the -E exclusion list.

-n  Limits the size of flat and graph profile listings to the top n offending
functions.
Produce a profile file `gmon.sum` which represents the sum of the
profile information in all of the specified profile files. This summary
profile file may be given to subsequent executions of `gprof` (also with
`-s`) to accumulate profile data across several runs of an `a.out` file. See also the
`-D` option.

Display routines which have zero usage (as indicated by call counts and
accumulated time). This is useful in conjunction with the `-c` option for
discovering which routines were never called. Note that this has
restricted use for dynamically linked executables, since shared object
text space will not be examined by the `-c` option.

If this environment variable contains a value, place profiling output within that
directory, in a file named `pid. programname`. `pid` is the process ID and
`programname` is the name of the program being profiled, as determined by
removing any path prefix from the `argv[0]` with which the program was called.
If the variable contains a null value, no profiling output is produced. Otherwise,
profiling output is placed in the file `gmon.out`.

Executable file containing namelist
Dynamic call-graph and profile
Summarized dynamic call-graph and profile

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/base-developer-utilities</td>
</tr>
</tbody>
</table>

See Also `cc(1), ld.so.1(1), prof(1), exit(2), pcsample(2), profil(2), malloc(3C),
malloc(3MALLOC), monitor(3C), attributes(5), prof(5)`

Graham, S.L., Kessler, P.B., McKusick, M.K., `gprof: A Call Graph Execution Profiler
Proceedings of the SIGPLAN '82 Symposium on Compiler Construction, SIGPLAN Notices,
Vol. 17, No. 6, pp. 120-126, June 1982.`

If the executable image has been stripped and does not have the `.symtab` symbol table, `gprof`
reads the global dynamic symbol tables `.dynsym` and `.SUNW_ldynsym`, if present. The symbols
in the dynamic symbol tables are a subset of the symbols that are found in `.symtab`. The
`.dynsym` symbol table contains the global symbols used by the runtime linker. `.SUNW_ldynsym`
augments the information in `.dynsym` with local function symbols. In the case where `.dynsym`

is found and .SUNW_ldynsym is not, only the information for the global symbols is available. Without local symbols, the behavior is as described for the -a option.

LD_LIBRARY_PATH must not contain /usr/lib as a component when compiling a program for profiling. If LD_LIBRARY_PATH contains /usr/lib, the program will not be linked correctly with the profiling versions of the system libraries in /usr/lib/libp.

The times reported in successive identical runs may show variances because of varying cache-hit ratios that result from sharing the cache with other processes. Even if a program seems to be the only one using the machine, hidden background or asynchronous processes may blur the data. In rare cases, the clock ticks initiating recording of the program counter may beat with loops in a program, grossly distorting measurements. Call counts are always recorded precisely, however.

Only programs that call exit or return from main are guaranteed to produce a profile file, unless a final call to monitor is explicitly coded.

Functions such as mcount(), _mcount(), moncontrol(), _moncontrol(), monitor(), and _monitor() may appear in the gprof report. These functions are part of the profiling implementation and thus account for some amount of the runtime overhead. Since these functions are not present in an unprofiled application, time accumulated and call counts for these functions may be ignored when evaluating the performance of an application.

64–bit profiling

64–bit profiling may be used freely with dynamically linked executables, and profiling information is collected for the shared objects if the objects are compiled for profiling. Care must be applied to interpret the profile output, since it is possible for symbols from different shared objects to have the same name. If name duplication occurs in the profile output, the module id prefix before the symbol name in the symbol index listing can be used to identify the appropriate module for the symbol.

When using the -s or -D option to sum multiple profile files, care must be taken not to mix 32–bit profile files with 64–bit profile files.

32–bit profiling

32–bit profiling may be used with dynamically linked executables, but care must be applied. In 32–bit profiling, shared objects cannot be profiled with gprof. Thus, when a profiled, dynamically linked program is executed, only the main portion of the image is sampled. This means that all time spent outside of the main object, that is, time spent in a shared object, will not be included in the profile summary; the total time reported for the program may be less than the total time used by the program.

Because the time spent in a shared object cannot be accounted for, the use of shared objects should be minimized whenever a program is profiled with gprof. If desired, the program should be linked to the profiled version of a library (or to the standard archive version if no profiling version is available), instead of the shared object to get profile information on the functions of a library. Versions of profiled libraries may be supplied with the system in the /usr/lib/libp directory. Refer to compiler driver documentation on profiling.
Consider an extreme case. A profiled program dynamically linked with the shared C library spends 100 units of time in some libc routine, say, `malloc()`. Suppose `malloc()` is called only from routine B and B consumes only 1 unit of time. Suppose further that routine A consumes 10 units of time, more than any other routine in the main (profiled) portion of the image. In this case, `gprof` will conclude that most of the time is being spent in A and almost no time is being spent in B. From this it will be almost impossible to tell that the greatest improvement can be made by looking at routine B and not routine A. The value of the profiler in this case is severely degraded; the solution is to use archives as much as possible for profiling.

**Bugs**

Parents which are not themselves profiled will have the time of their profiled children propagated to them, but they will appear to be spontaneously invoked in the call-graph listing, and will not have their time propagated further. Similarly, signal catchers, even though profiled, will appear to be spontaneous (although for more obscure reasons). Any profiled children of signal catchers should have their times propagated properly, unless the signal catcher was invoked during the execution of the profiling routine, in which case all is lost.
grep(1)

Name  grep – search a file for a pattern

Synopsis  /usr/bin/grep [-c | -l | -q] [-bhi ] limited-regular-expression
          [filename]...

          /usr/xpg4/bin/grep [-E | -F] [-c | -l | -q] [-bhi ] -e pattern_list...
          [-f pattern_file]... [file]...

          /usr/xpg4/bin/grep [-E | -F] [-c | -l | -q] [-bhi ]
          [-e pattern_list]... [-f pattern_file]... [file]...

          /usr/xpg4/bin/grep [-E | -F] [-c | -l | -q] [-bhi ] pattern
          [file]...

Description  The grep utility searches text files for a pattern and prints all lines that contain that pattern. It uses a compact non-deterministic algorithm.

Be careful using the characters $, *, [, ^, ], (, ), and \ in the pattern_list because they are also meaningful to the shell. It is safest to enclose the entire pattern_list in single quotes ‘...’.

If no files are specified, grep assumes standard input. Normally, each line found is copied to standard output. The file name is printed before each line found if there is more than one input file.

/usr/bin/grep  The /usr/bin/grep utility uses limited regular expressions like those described on the regexp(5) manual page to match the patterns.

/usr/xpg4/bin/grep  The options -E and -F affect the way /usr/xpg4/bin/grep interprets pattern_list. If -E is specified, /usr/xpg4/bin/grep interprets pattern_list as a full regular expression (see -E for description). If -F is specified, grep interprets pattern_list as a fixed string. If neither are specified, grep interprets pattern_list as a basic regular expression as described on regexp(5) manual page.

Options  The following options are supported for both /usr/bin/grep and /usr/xpg4/bin/grep:

- b  Precedes each line by the block number on which it was found. This can be useful in locating block numbers by context (first block is 0).

- c  Prints only a count of the lines that contain the pattern.

- h  Prevents the name of the file containing the matching line from being prepended to that line. Used when searching multiple files.

- i  Ignores upper/lower case distinction during comparisons.

- l  Prints only the names of files with matching lines, separated by NEWLINE characters. Does not repeat the names of files when the pattern is found more than once.

- n  Precedes each line by its line number in the file (first line is 1).

- q  Quiet. Does not write anything to the standard output, regardless of matching lines. Exits with zero status if an input line is selected.
-s Suppresses error messages about nonexistent or unreadable files.
-v Prints all lines except those that contain the pattern.
-w Searches for the expression as a word as if surrounded by \< and \\>.

The following options are supported for /usr/xpg4/bin/grep only:

- **e pattern_list** Specifies one or more patterns to be used during the search for input. Patterns in pattern_list must be separated by a NEWLINE character. A null pattern can be specified by two adjacent newline characters in pattern_list. Unless the -E or -F option is also specified, each pattern is treated as a basic regular expression. Multiple -e and -f options are accepted by grep. All of the specified patterns are used when matching lines, but the order of evaluation is unspecified.

- **E** Matches using full regular expressions. Treats each pattern specified as a full regular expression. If any entire full regular expression pattern matches an input line, the line is matched. A null full regular expression matches every line. Each pattern is interpreted as a full regular expression as described on the regex(5) manual page, except for \( and \), and including:

1. A full regular expression followed by + that matches one or more occurrences of the full regular expression.
2. A full regular expression followed by ? that matches 0 or 1 occurrences of the full regular expression.
3. Full regular expressions separated by | or by a new-line that match strings that are matched by any of the expressions.
4. A full regular expression that is enclosed in parentheses () for grouping.

The order of precedence of operators is [ ], then * ?, +, then concatenation, then | and new-line.

- **f pattern_file** Reads one or more patterns from the file named by the path name pattern_file. Patterns in pattern_file are terminated by a NEWLINE character. A null pattern can be specified by an empty line in pattern_file. Unless the -E or -F option is also specified, each pattern is treated as a basic regular expression.

- **F** Matches using fixed strings. Treats each pattern specified as a string instead of a regular expression. If an input line contains any of the patterns as a contiguous sequence of bytes, the line is matched. A null string matches every line. See fgrep(1) for more information.
considers only input lines that use all characters in the line to match an entire fixed string or regular expression to be matching lines.

Operands

file

A path name of a file to be searched for the patterns. If no file operands are specified, the standard input is used.

pattern

Specifies a pattern to be used during the search for input.

pattern_list

Specifies one or more patterns to be used during the search for input. This operand is treated as if it were specified as -e pattern_list.

The -c, -l and -q options are mutually exclusive. If specified together -q overrides -c which overrides -l.

The -e pattern_list option has the same effect as the pattern_list operand, but is useful when pattern_list begins with the hyphen delimiter. It is also useful when it is more convenient to provide multiple patterns as separate arguments.

Multiple -e and -f options are accepted and grep uses all of the patterns it is given while matching input text lines. Notice that the order of evaluation is not specified. If an implementation finds a null string as a pattern, it is allowed to use that pattern first, matching every line, and effectively ignore any other patterns.

The -q option provides a means of easily determining whether or not a pattern (or string) exists in a group of files. When searching several files, it provides a performance improvement (because it can quit as soon as it finds the first match) and requires less care by the user in choosing the set of files to supply as arguments (because it exits zero if it finds a match even if grep detected an access or read error on earlier file operands).

Large File Behavior

See largefile(5) for the description of the behavior of grep when encountering files greater than or equal to 2 Gbyte (2^{31} bytes).

Examples

EXAMPLE 1 Finding All Uses of a Word

To find all uses of the word "Posix" (in any case) in the file text.mm, and write with line numbers:

```
example% /usr/bin/grep -i -n posix text.mm
```

EXAMPLE 2 Finding All Empty Lines

To find all empty lines in the standard input:

```
example% /usr/bin/grep ^$
```

or

```
example% /usr/bin/grep -v .
```
EXAMPLE 3  Finding Lines Containing Strings

All of the following commands print all lines containing strings abc or def or both:

```
example% /usr/xpg4/bin/grep 'abc
def'
exemple% /usr/xpg4/bin/grep -e 'abc
def'
exemple% /usr/xpg4/bin/grep -e 'abc' -e 'def'
exemple% /usr/xpg4/bin/grep -E 'abc|def'
exemple% /usr/xpg4/bin/grep -E -e 'abc|def'
exemple% /usr/xpg4/bin/grep -E -e 'abc' -e 'def'
exemple% /usr/xpg4/bin/grep -E 'abc
def'
exemple% /usr/xpg4/bin/grep -E -e 'abc
def'
exemple% /usr/xpg4/bin/grep -F -e 'abc' -e 'def'
exemple% /usr/xpg4/bin/grep -F 'abc
def'
exemple% /usr/xpg4/bin/grep -F -e 'abc
def'
```

EXAMPLE 4  Finding Lines with Matching Strings

Both of the following commands print all lines matching exactly abc or def:

```
exemple% /usr/xpg4/bin/grep -E '^abc$ ^def$'
exemple% /usr/xpg4/bin/grep -F -e 'abc' -e 'def'
```

Environment Variables  See `environ(5)` for descriptions of the following environment variables that affect the execution of `grep`: LANG, LC_ALL, LC_COLLATE, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status  The following exit values are returned:

<table>
<thead>
<tr>
<th>Exit Status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>One or more matches were found.</td>
</tr>
<tr>
<td>1</td>
<td>No matches were found.</td>
</tr>
<tr>
<td>2</td>
<td>Syntax errors or inaccessible files (even if matches were found).</td>
</tr>
</tbody>
</table>

Attributes  See `attributes(5)` for descriptions of the following attributes:

```
<table>
<thead>
<tr>
<th>Attribute</th>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
<td></td>
</tr>
</tbody>
</table>
```

`/usr/bin/grep`
### grep(1)

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/xopen/xcu4</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

**See Also**  

**Notes**  

**/usr/bin/grep**  
Lines are limited only by the size of the available virtual memory. If there is a line with embedded nulls, grep only matches up to the first null. If the line matches, the entire line is printed.

**/usr/xpg4/bin/grep**  
The results are unspecified if input files contain lines longer than LINE_MAX bytes or contain binary data. LINE_MAX is defined in /usr/include/limits.h.
Name  groups – print group membership of user

Synopsis  groups [user]...

Description  The command groups prints on standard output the groups to which you or the optionally specified user belong. Each user belongs to a group specified in /etc/passwd and possibly to other groups as specified in /etc/group. Note that /etc/passwd specifies the numerical ID (gid) of the group. The groups command converts gid to the group name in the output.

Examples  The output takes the following form:

```bash
example% groups tester01 tester02
tester01 : staff
tester02 : staff
example%
```

Files  /etc/passwd

/etc/group

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  group(4), passwd(4), attributes(5)
groups(1B)

Name  groups – display a user's group memberships

Synopsis  /usr/ucb/groups [user]...

Description  With no arguments, groups displays the groups to which you belong; else it displays the groups to which the user belongs. Each user belongs to a group specified in the password file /etc/passwd and possibly to other groups as specified in the file /etc/group. If you do not own a file but belong to the group which it is owned by then you are granted group access to the file.

Files  /etc/passwd
       /etc/group

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>

See Also  getgroups(2), attributes(5)

Notes  This command is obsolete.
Name  grpck – check group database entries

Synopsis  /usr/sbin/grpck [filename]

Description  The grpck utility checks that a file in group(4) does not contain any errors; it checks the /etc/group file by default.

Files  /etc/group

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  groups(1), group(4), passwd(4), attributes(5)

Diagnostics  Too many/few fields  An entry in the group file does not have the proper number of fields.
No group name  The group name field of an entry is empty.
Bad character(s) in group name  The group name in an entry contains characters other than lower-case letters and digits.
Invalid GID  The group ID field in an entry is not numeric or is greater than 65535.
Null login name  A login name in the list of login names in an entry is null.
Logname not found in password file  A login name in the list of login names in an entry is not in the password file.
Line too long  A line (including the NEWLINE character) in the group file exceeds the maximum length of 512 characters.
Duplicate logname entry  A login name appears more than once in the list of login names for a group file entry.
Out of memory  The program cannot allocate memory in order to continue.
Maximum groups exceeded for logname  A login name’s group membership exceeds the maximum, NGROUPS_MAX.
hash(1)

Name  hash, rehash, unhash, hashstat – evaluate the internal hash table of the contents of directories

Synopsis  
/usr/bin/hash [utility]  
/usr/bin/hash [-r]  
sh  hash [-r] [name]...  
csh  rehash  
unhash  
hashstat  
ksh88  hash [name]...  
hash [-r]

Description

/usr/bin/hash  The /usr/bin/hash utility affects the way the current shell environment remembers the locations of utilities found. Depending on the arguments specified, it adds utility locations to its list of remembered locations or it purges the contents of the list. When no arguments are specified, it reports on the contents of the list. The -r option causes the shell to forget all remembered locations.

Utilities provided as built-ins to the shell are not reported by hash.

sh  For each name, the location in the search path of the command specified by name is determined and remembered by the shell. The -r option to the hash built-in causes the shell to forget all remembered commands. If no arguments are given, hash provides information about remembered commands. The Hits column of output is the number of times a command has been invoked by the shell process. The Cost column of output is a measure of the work required to locate a command in the search path. If a command is found in a "relative" directory in the search path, after changing to that directory, the stored location of that command is recalculated. Commands for which this will be done are indicated by an asterisk (*) adjacent to the Hits information. Cost will be incremented when the recalculation is done.

csh  rehash recomputes the internal hash table of the contents of directories listed in the path environmental variable to account for new commands added.

unhash disables the internal hash table.

hashstat prints a statistics line indicating how effective the internal hash table has been at locating commands (and avoiding execs). An exec is attempted for each component of the path where the hash function indicates a possible hit and in each component that does not begin with a '/'.
For each `name`, the location in the search path of the command specified by `name` is determined and remembered by the shell. The `-r` option to the `hash` built-in causes the shell to forget all remembered locations. If no arguments are given, `hash` provides information about remembered commands.

**Operands**

The following operand is supported by `hash`:

- `utility` The name of a utility to be searched for and added to the list of remembered locations.

**Output**

The standard output of `hash` is used when no arguments are specified. Its format is unspecified, but includes the pathname of each utility in the list of remembered locations for the current shell environment. This list consists of those utilities named in previous `hash` invocations that have been invoked, and may contain those invoked and found through the normal command search process.

**Environment Variables**

See `environ(5)` for descriptions of the following environment variables that affect the execution of `hash`: `LANG`, `LC_ALL`, `LC_CTYPE`, `LC_MESSAGES`, and `NLSPATH`.

- `PATH` Determine the location of `utility`.

**Exit Status**

The following exit values are returned by `hash`:

- `0` Successful completion.
- `>0` An error occurred.

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See <code>standards(5)</code>.</td>
</tr>
</tbody>
</table>

**See Also**

`csh(1)`, `ksh88(1)`, `sh(1)`, `attributes(5)`, `environ(5)`, `standards(5)`
head(1)

**Name**  head – display first few lines of files

**Synopsis**  

```
/usr/bin/head [-number | -n number] [filename]...
```

**Description**  The `head` utility copies the first `number` of lines of each `filename` to the standard output. If no `filename` is given, `head` copies lines from the standard input. The default value of `number` is 10 lines.

When more than one file is specified, the start of each file looks like:

```
==> filename <==
```

Thus, a common way to display a set of short files, identifying each one, is:

```
example% head -9999 filename1 filename2 ...
```

**Options**  The following options are supported:

- `-n number`  The first `number` lines of each input file is copied to standard output. The `number` option-argument must be a positive decimal integer.

- `-number`  The `number` argument is a positive decimal integer with the same effect as the `-n number` option.

If no options are specified, `head` acts as if `-n 10` had been specified.

**Operands**  The following operand is supported:

- `filename`  A path name of an input file. If no file operands are specified, the standard input is used.

**Usage**  See `largefile(5)` for the description of the behavior of `head` when encountering files greater than or equal to 2 Gbyte ($2^{31}$ bytes).

**Examples**  **EXAMPLE 1**  Writing the First Ten Lines of All Files

The following example writes the first ten lines of all files, except those with a leading period, in the directory:

```
example% head *
```

**Environment Variables**  See `environ(5)` for descriptions of the following environment variables that affect the execution of `head`: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

**Exit Status**  The following exit values are returned:

- `0`  Successful completion.

- `>0`  An error occurred.
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also  cat(1), more(1), pg(1), tail(1), attributes(5), environ(5), largefile(5), standards(5)
The `fc` utility lists or edits and reexecutes, commands previously entered to an interactive `sh`.

The command history list references commands by number. The first number in the list is selected arbitrarily. The relationship of a number to its command does not change except when the user logs in and no other process is accessing the list, at which time the system can reset the numbering to start the oldest retained command at another number (usually 1). When the number reaches the value in `HISTSIZE` or 32767 (whichever is greater), the shell can wrap the numbers, starting the next command with a lower number (usually 1). However, despite this optional wrapping of numbers, `fc` maintains the time-ordering sequence of the commands. For example, if four commands in sequence are given the numbers 32766, 32767, 1 (wrapped), and 2 as they are executed, command 32767 is considered the command previous to 1, even though its number is higher.

When commands are edited (when the `-l` option is not specified), the resulting lines are entered at the end of the history list and then reexecuted by `sh`. The `fc` command that caused the editing is not entered into the history list. If the editor returns a non-zero exit status, this suppresses the entry into the history list and the command reexecution. Any command-line variable assignments or redirection operators used with `fc` affects both the `fc` command itself as well as the command that results, for example:

```
f -s -- -l 2>/dev/null
```

reinvokes the previous command, suppressing standard error for both `fc` and the previous command.

**Description**

**csh** Display the history list. If `n` is given, display only the `n` most recent events.

- `r` Reverse the order of printout to be most recent first rather than oldest first.

- `h` Display the history list without leading numbers. This is used to produce files suitable for sourcing using the `-h` option to the `csh` built-in command, `source(1)`.

**History Substitution:**
History substitution allows you to use words from previous command lines in the command line you are typing. This simplifies spelling corrections and the repetition of complicated commands or arguments. Command lines are saved in the history list, the size of which is controlled by the `history` variable. The `history` shell variable can be set to the maximum number of command lines that is saved in the history file, that is:

```
set history = 200
```

allows the history list to keep track of the most recent 200 command lines. If not set, the C shell saves only the most recent command.

A history substitution begins with a `!` (although you can change this with the `histchars` variable) and can occur anywhere on the command line; history substitutions do not nest. The `!` can be escaped with `\` to suppress its special meaning.

Input lines containing history substitutions are echoed on the terminal after being expanded, but before any other substitutions take place or the command gets executed.

**Event Designators:**

An event designator is a reference to a command line entry in the history list.

- `!` Start a history substitution, except when followed by a space character, tab, newline, = or .
- `!!` Refer to the previous command. By itself, this substitution repeats the previous command.
- `!n` Refer to command line `n`.
- `!-n` Refer to the current command line minus `n`.
- `!str` Refer to the most recent command starting with `str`.
- `!?str?` Refer to the most recent command containing `str`.
- `!?str? additional` Refer to the most recent command containing `str` and append `additional` to that referenced command.
- `{command} additional` Refer to the most recent command beginning with `command` and append `additional` to that referenced command.

\[\text{^previous\_word*replacement^}\] Repeat the previous command line replacing the string `previous_word` with the string `replacement`. This is equivalent to the history substitution:

```
Repeat the previous command line replacing the string `previous_word` with the string `replacement`. This is equivalent to the history substitution:
```

User Commands 571
To re-execute a specific previous command and make such a substitution, say, re-executing command #6:

`:6s/previous_word/replacement/ .`

**Word Designators:**

A `'` (colon) separates the event specification from the word designator. It can be omitted if the word designator begins with a `^`, `$`, `*`, `−` or `%`. If the word is to be selected from the previous command, the second `!` character can be omitted from the event specification. For instance, `!!:1` and `!:1` both refer to the first word of the previous command, while `!!$` and `!$` both refer to the last word in the previous command. Word designators include:

- `#` The entire command line typed so far.
- `0` The first input word (command).
- `n` The n'th argument.
- `^` The first argument, that is, 1.
- `$` The last argument.
- `%` The word matched by (the most recent) `?s` search.
- `x−y` A range of words; `−y` abbreviates `0−y`.
- `*` All the arguments, or a null value if there is just one word in the event.
- `x*` Abbreviates `x−$`.
- `x−` Like `x*` but omitting word `$`.

**Modifiers:**

After the optional word designator, you can add a sequence of one or more of the following modifiers, each preceded by a `:`.

- `h` Remove a trailing pathname component, leaving the head.
- `r` Remove a trailing suffix of the form `’..xxx’`, leaving the basename.
- `e` Remove all but the suffix, leaving the extension.
- `s/oldchars/replacements/` Substitute `replacements` for `oldchars`. `oldchars` is a string that can contain embedded blank spaces, whereas `previous_word` in the event designator can not.
- `^oldchars^replacements^`
- `t` Remove all leading pathname components, leaving the tail.
&  Repeat the previous substitution.

\textit{g}  Apply the change to the first occurrence of a match in each word, by prefixing the above (for example, g&).

p  Print the new command but do not execute it.

q  Quote the substituted words, escaping further substitutions.

x  Like q, but break into words at each space character, tab or newline.

Unless preceded by a \textit{g}, the modification is applied only to the first string that matches \textit{oldchars}. An error results if no string matches.

The left-hand side of substitutions are not regular expressions, but character strings. Any character can be used as the delimiter in place of /. A backslash quotes the delimiter character. The character \& in the right hand side, is replaced by the text from the left-hand-side. The & can be quoted with a backslash. A null \textit{oldchars} uses the previous string either from a \textit{oldchars} or from a contextual scan string \textit{s} from !?s. You can omit the rightmost delimiter if a newline immediately follows \textit{replacements}; the rightmost ? in a context scan can similarly be omitted.

Without an event specification, a history reference refers either to the previous command, or to a previous history reference on the command line (if any).

\texttt{ksh88} Using \texttt{fc}, in the form of

\begin{verbatim}
fc -e [old=\textit{new}] [\textit{command}],
\end{verbatim}

or

\begin{verbatim}
fc -s [old=\textit{new}] [\textit{command}],
\end{verbatim}

the \textit{command} is re-executed after the substitution \textit{old=\textit{new}} is performed. If there is not a \textit{command} argument, the most recent command typed at this terminal is executed.

Using \texttt{fc} in the form of

\begin{verbatim}
fc [-e \textit{ename}] [-nlr] [first [last]],
\end{verbatim}

a range of commands from \textit{first} to \textit{last} is selected from the last HISTSIZE commands that were typed at the terminal. The arguments \textit{first} and \textit{last} can be specified as a number or as a string. A string is used to locate the most recent command starting with the given string. A negative number is used as an offset to the current command number. If the -l flag is selected, the commands are listed on standard output. Otherwise, the editor program \texttt{-e \textit{name}} is invoked on a file containing these keyboard commands. If \texttt{ename} is not supplied, then the value of the variable \texttt{FCEDIT} (default \texttt{/bin/ed}) is used as the editor. When editing is complete, the edited command(s) is executed. If \texttt{last} is not specified, it is set to \textit{first}. If \textit{first} is not specified, the
default is the previous command for editing and –16 for listing. The flag - r reverses the order of the commands and the flag - n suppresses command numbers when listing. (See ksh88(1) for more about command line editing.)

**HISTFILE**
If this variable is set when the shell is invoked, then the value is the pathname of the file that is used to store the command history.

**HISTSIZE**
If this variable is set when the shell is invoked, then the number of previously entered commands that are accessible by this shell is greater than or equal to this number. The default is 128.

### Command Re-entry:

The text of the last HISTSIZE (default 128) commands entered from a terminal device is saved in a history file. The file $HOME/.sh_history is used if the HISTFILE variable is not set or if the file it names is not writable. A shell can access the commands of all interactive shells which use the same named HISTFILE. The special command fc is used to list or edit a portion of this file. The portion of the file to be edited or listed can be selected by number or by giving the first character or characters of the command. A single command or range of commands can be specified. If you do not specify an editor program as an argument to fc then the value of the variable FCEDIT is used. If FCEDIT is not defined then /bin/ed is used. The edited command(s) is printed and re-executed upon leaving the editor. The editor name – is used to skip the editing phase and to re-execute the command. In this case a substitution parameter of the form old=new can be used to modify the command before execution. For example, if r is aliased to ‘fc - e – then typing 'r bad=good c' re-executes the most recent command which starts with the letter c, replacing the first occurrence of the string bad with the string good.

Using the fc built-in command within a compound command causes the whole command to disappear from the history file.

**hist** lists, edits, or re-executes commands previously entered into the current shell environment.

The command history list references commands by number. The first number in the list is selected arbitrarily. The relationship of a number to its command does not change during a login session. When the number reaches 32767 the number wraps around to 1 but maintains the ordering.

When the 1 option is not specified, and commands are edited, the resulting lines are entered at the end of the history list and then re-executed by the current shell. The hist command that caused the editing is not entered into the history list. If the editor returns a non-zero exit status, this suppresses the entry into the history list and the command re-execution. Command line variable assignments and redirections affect both the hist command and the commands that are re-executed.

*first* and *last* define the range of commands. Specify *first* and *last* as one of the following:
number A positive number representing a command number. A + sign can precede number.

- number A negative number representing a command that was executed number commands previously. For example, -1 is the previous command.

string string indicates the most recently entered command that begins with string. string should not contain an =.

If first is omitted, the previous command is used, unless -l is specified, in which case it defaults to -16 and last defaults to -1.

If first is specified and last is omitted, then last defaults to first unless -l is specified in which case it defaults to -1.

If no editor is specified, then the editor specified by the HISTEDIT variable is used if set, or the FCEDIT variable is used if set, otherwise, ed is used.

Options The following options are supported:

- e editor Uses the editor named by editor to edit the commands. The editor string is a utility name, subject to search via the PATH variable. The value in the FCEDIT variable is used as a default when -e is not specified. If FCEDIT is null or unset, ed is used as the editor.

- l (The letter ell.) Lists the commands rather than invoking an editor on them. The commands are written in the sequence indicated by the first and last operands, as affected by -r, with each command preceded by the command number.

- n Suppresses command numbers when listing with -l.

- r Reverses the order of the commands listed (with -l) or edited (with neither -l nor -s).

- s Re-executes the command without invoking an editor.

ksh ksh supports the following options:

- e editor Specify the editor to use to edit the history command. A value of - for editor is equivalent to specifying the -s option.

- l List the commands rather than editing and re-executing them.

- N num Start at num commands back.

- n Suppress the command numbers when the commands are listed.

- p Write the result of history expansion for each operand to standard output. All other options are ignored.

- r Reverse the order of the commands.
-s Re-execute the command without invoking an editor. In this case an operand of the form old=new can be specified to change the first occurrence of the string old in the command to new before re-executing the command.

Operands

The following operands are supported:

**first**
Selects the commands to list or edit. The number of previous commands that can be accessed is determined by the value of the HISTSIZE variable. The value of first or last or both is one of the following:

```
[+]+number A positive number representing a command number. Command numbers can be displayed with the -l option.
```

```
–number A negative decimal number representing the command that was executed number of commands previously. For example, –1 is the immediately previous command.
```

```
string A string indicating the most recently entered command that begins with that string. If the old=new operand is not also specified with -s, the string form of the first operand cannot contain an embedded equal sign.
```

When the synopsis form with -s is used, if first is omitted, the previous command is used.

For the synopsis forms without -s:

- If last is omitted, last defaults to the previous command when -l is specified; otherwise, it defaults to first.
- If first and last are both omitted, the previous 16 commands is listed or the previous single command is edited (based on the -l option).
- If first and last are both present, all of the commands from first to last is edited (without -l ) or listed (with -l). Editing multiple commands is accomplished by presenting to the editor all of the commands at one time, each command starting on a new line. If first represents a newer command than last, the commands is listed or edited in reverse sequence, equivalent to using -r. For example, the following commands on the first line are equivalent to the corresponding commands on the second:

```
f c - r 10 20 f c 30 40
f c 20 10 f c - r 40 30
```
When a range of commands is used, it is not be an error to specify first or last values that are not in the history list. `fc` substitutes the value representing the oldest or newest command in the list, as appropriate. For example, if there are only ten commands in the history list, numbered 1 to 10:

```
fc -l
fc 1 99
```

lists and edits, respectively, all ten commands.

```
old=new
```

Replace the first occurrence of string `old` in the commands to be reexecuted by the string `new`.

**Output** When the `-l` option is used to list commands, the format of each command in the list is as follows:

```
"%d\t%s\n", <line number>, <command>
```

If both the `-l` and `-n` options are specified, the format of each command is:

```
"%s\n", <command>
```

If the `command` consists of more than one line, the lines after the first are displayed as:

```
"%s\n", <continued-command>
```

**Examples**

**EXAMPLE 1** Using history and `fc`

```csh
% history
1 cd /etc 1 cd /etc
2 vi passwd 2 vi passwd
3 date 3 date
4 cd 4 cd
5 du . 5 du .
6 ls -t 6 ls -t
7 history 7 fc -l

% !d
    $ fc -e - d
    du .
    262 ./SCCS 262 ./SCCS
    336 .

% !da
Thu Jul 21 17:29:56 PDT 1994
Thu Jul 21 17:29:56 PDT 1994

% $ alias \
`fc -e -`
```

**User Commands**
EXAMPLE 1  Using history and fc  (Continued)

% ! !                                    $ !
    date                                     alias = 'fc -e -'
Thu Jul 21 17:29:56 PDT 1994

Environment Variables

See environ(5) for descriptions of the following environment variables that affect the execution of fc: LC_CTYPE, LC_MESSAGES, and NLSPATH.

FCEDIT       This variable, when expanded by the shell, determines the default value for the -e editor option's editor option-argument. If FCEDIT is null or unset, ed(1) is used as the editor.

HISTFILE     Determine a pathname naming a command history file. If the HISTFILE variable is not set, the shell can attempt to access or create a file .sh_history in the user's home directory. If the shell cannot obtain both read and write access to, or create, the history file, it uses an unspecified mechanism that allows the history to operate properly. (References to history "file" in this section are understood to mean this unspecified mechanism in such cases.) fc can choose to access this variable only when initializing the history file; this initialization occurs when fc or sh first attempt to retrieve entries from, or add entries to, the file, as the result of commands issued by the user, the file named by the ENV variable, or a system startup file such as /etc/profile. (The initialization process for the history file can be dependent on the system startup files, in that they can contain commands that effectively preempts the user's settings of HISTFILE and HISTSIZE. For example, function definition commands are recorded in the history file, unless the set -o noclobber option is set. If the system administrator includes function definitions in some system startup file called before the ENV file, the history file is initialized before the user gets a chance to influence its characteristics.) The variable HISTFILE is accessed initially when the shell is invoked. Any changes to HISTFILE does not take effect until another shell is invoked.

HISTSIZE     Determine a decimal number representing the limit to the number of previous commands that are accessible. If this variable is unset, an unspecified default greater than or equal to 128 are used. The variable HISTSIZE is accessed initially when the shell is invoked. Any changes to HISTSIZE does not take effect until another shell is invoked.

Exit Status The following exit values are returned:

0  Successful completion of the listing.

>0  An error occurred.

Otherwise, the exit status is that of the commands executed by fc or hist.
Attributes  See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  `csh(1), ed(1), ksh(1), ksh88(1), set(1), sh(1), source(1), attributes(5), environ(5)`
The `hostid` command prints the identifier of the current host in hexadecimal. If it is executed within a non-global zone that emulates a host identifier, the emulated host identifier is printed. This numeric value is likely to differ when `hostid` is run on a different machine.

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

**See Also**

`sysinfo(2), gethostid(3C), attributes(5), zones(5)"
Name  hostname – set or print name of current host system

Synopsis  /usr/bin/hostname  [-t]  name-of-host

Description  The hostname command prints the name of the current host, as given before the login prompt. The super-user can set the hostname by giving an argument. The change of the hostname is permanent unless the -t option is specified.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  uname(1), nodename(4), attributes(5)
Name  iconv – code set conversion utility

Synopsis  iconv [-cs] [-f frommap -t tomap] [file]...

iconv -f fromcode [-cs] [-t tocode] [file]...

iconv -t tocode [-cs] [-f fromcode] [file]...

iconv -l

Description  The iconv utility converts the characters or sequences of characters in file from one code set to another and writes the results to standard output. If no conversion exists for a particular character, an implementation-defined conversion is performed on this character.

The list of supported conversions and the locations of the associated conversion tables are provided in the iconv(5) manual page.

Options  The following options are supported:

- c  Omits any characters that are invalid in the codeset of the input file from the output. When -c is not used, the results of encountering invalid characters in the input stream depend on the specified codesets for the conversion. Invalid characters can be either those that are not valid characters in the codeset of the input file or those that have no corresponding character in the codeset of the output file. The presence or absence of -c does not affect the exit status of iconv. When fromcode is specified for the fromcodeset of the -f option or tocode is specified for the tocodeset of the -t option, the specification of -c may be ignored.

- f fromcodeset  Identifies the code set of the input file. The following two forms of the fromcodeset option-argument are recognized:

fromcode  The fromcode option-argument must not contain a slash (/) character. It is interpreted as the name of one of the codeset descriptions.

frommap  The frommap option-argument must contain a slash character. It is interpreted as the pathname of a charmap file as defined in charmap(5). If the pathname does not represent a valid, readable charmap file, the results are undefined.

If this option is omitted, the codeset of the current locale is used.

- l  Writes all supported fromcode and tocode values to standard output.

- s  Suppresses any messages written to standard error concerning invalid characters. When -s is not used, the results of encountering invalid characters in the input stream depend on the specified codesets for the conversion. Invalid characters can be either those that are not valid characters in the codeset of the input file or those that have no
corresponding character in the codeset of the output file. The presence or
absence of -s does not affect the exit status of iconv. When fromcode is
specified for the fromcodeset of the -f option or tocode is specified for the
tocodeset of the -t option, the specification of -s may be ignored.

- t tocodeset

Identifies the code set used for the output file. The following two forms of
the tocodeset option-argument are recognized:

tocode The tocode option-argument must not contain a slash (/)
character. It is interpreted as the name of one of the codeset
descriptions.

tomap The tomap option-argument must contain a slash character. It
is interpreted as the pathname of a charmap file as defined in
charmap(5). If the pathname does not represent a valid,
readable charmap file, the results are undefined.

If this option is omitted, the codeset of the current locale is used.

If either -f or -t represents a charmap file but the other does not, or is omitted, or if both -f
and - t are omitted, iconv fails as an error.

Operands

The following operands are supported:

file A path name of an input file. If no file operands are specified, or if a file operand is ‘-‘,
the standard input is used.

Examples

EXAMPLE 1 Converting and storing files

The following example converts the contents of file mail1 from code set 8859 to 646fr and
stores the results in file mail.local:

example% iconv -f 8859 -t 646fr mail1 > mail.local

Environment

Variables

See environ(5) for descriptions of the following environment variables that affect the
execution of iconv: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status

The following exit values are returned:

0 Successful completion.

1 An error has occurred.

Files /usr/lib/iconv/iconv_data list of conversions supported by conversion tables

Attributes

See attributes(5) for descriptions of the following attributes:
<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also  iconv(3C), iconv_open(3C), attributes(5), charmap(5), environ(5), iconv(5), iconv_unicode(5), standards(5)

Notes  Make sure that both charmap files use the same symbolic names for characters the two codesets have in common.

The output format of the -l option is unspecified. The -l option is not intended for shell script usage.

When fromcode or tocode is specified for the codeset conversion, iconv uses the iconv_open(3C) function. If iconv_open(3C) fails to open the specified codeset conversion, iconv searches for an appropriate conversion table. As for the supported codeset conversion by iconv_open(3C), please refer to iconv(5) and iconv_locale(5).
Name  indxbib – create an inverted index to a bibliographic database

Synopsis  indxbib database-file...

Description  indxbib makes an inverted index to the named database-file (which must reside within the current directory), typically for use by lookbib(1) and refer(1). A database contains bibliographic references (or other kinds of information) separated by blank lines.

A bibliographic reference is a set of lines, constituting fields of bibliographic information. Each field starts on a line beginning with a '%' followed by a key-letter, then a blank, and finally the contents of the field, which may continue until the next line starting with '%'.

indxbib is a shell script that calls two programs: /usr/lib/refer/mkey and /usr/lib/refer/inv. mkey truncates words to 6 characters, and maps uppercase to lowercase. It also discards words shorter than 3 characters, words among the 100 most common English words, and numbers (dates) < 1000 or > 2099. These parameters can be changed.

indxbib creates an entry file (with a .ia suffix), a posting file (.ib), and a tag file (.ic), in the working directory.

Files  /usr/lib/refer/mkey
       /usr/lib/refer/inv
       x.ia   entry file
       x.ib   posting file
       x.ic   tag file
       x.ig   reference file

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>text/doctools</td>
</tr>
</tbody>
</table>

See Also  addbib(1), lookbib(1), refer(1), roffbib(1), sortbib(1), attributes(5)

Bugs  All dates should probably be indexed, since many disciplines refer to literature written in the 1800s or earlier.

indxbib does not recognize pathnames.
install – install files

**Synopsis**

```
/usr/ucb/install [-cs] [-g group] [-m mode] [-o owner] filename1 filename2
```

```
/usr/ucb/install [-cs] [-g group] [-m mode] [-o owner] filename... directory
```

```
/usr/ucb/install -d [-g group] [-m mode] [-o owner] directory
```

**Description**

`install` is used within makefiles to copy new versions of files into a destination directory and to create the destination directory itself.

The first two forms are similar to the `cp(1)` command with the addition that executable files can be stripped during the copy and the owner, group, and mode of the installed file(s) can be given.

The third form can be used to create a destination directory with the required owner, group and permissions.

Note: `install` uses no special privileges to copy files from one place to another. The implications of this are:

- You must have permission to read the files to be installed.
- You must have permission to copy into the destination file or directory.
- You must have permission to change the modes on the final copy of the file if you want to use the `-m` option to change modes.
- You must be superuser if you want to specify the ownership of the installed file with `-o`. If you are not the super-user, or if `-o` is not in effect, the installed file will be owned by you, regardless of who owns the original.

**Options**

- `c` Copy files. In fact `install` always copies files, but the `-c` option is retained for backwards compatibility with old shell scripts that might otherwise break.
- `d` Create a directory. Missing parent directories are created as required as in `mkdir -p`. If the directory already exists, the owner, group and mode will be set to the values given on the command line.
- `s` Strip executable files as they are copied.
- `g group` Set the group ownership of the installed file or directory. (staff by default.)
- `m mode` Set the mode for the installed file or directory. (0755 by default.)
- `o owner` If run as root, set the ownership of the installed file to the user-ID of `owner`. 

---

**Synopsis**

```
manpages section 1: User Commands • Last Revised 14 Sep 1992
```

586
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>

See Also  chgrp(1), chmod(1), chown(1), cp(1), mkdir(1), strip(1), install(1M), attributes(5)
ipcrm – remove a message queue, semaphore set, or shared memory ID

Synopsis

ipcrm [-z zone] [-m shmid] [-q msqid] [-s semid]
    [-M shmkey] [-Q msgkey] [-S semkey]

Description

ipcrm removes one or more messages, semaphores, or shared memory identifiers.

Options

The following option is supported:

- z zone    Keys specified by other options refer to facilities in the specified zone (see zones(5)). The default is the zone in which the command is executing. This option is only useful when the command is executed in the global zone.

The identifiers are specified by the following options:

- m shmid     Removes the shared memory identifier shmid from the system. The shared memory segment and data structure associated with it are destroyed after the last detach.

- q msqid     Removes the message queue identifier msqid from the system and destroys the message queue and data structure associated with it.

- s semid     Removes the semaphore identifier semid from the system and destroys the set of semaphores and data structure associated with it.

- M shmkey    Removes the shared memory identifier, created with key shmkey, from the system. The shared memory segment and data structure associated with it are destroyed after the last detach.

- Q msgkey    Removes the message queue identifier, created with key msgkey, from the system and destroys the message queue and data structure associated with it.

- S semkey    Removes the semaphore identifier, created with key semkey, from the system and destroys the set of semaphores and data structure associated with it.

The details of the removes are described in msgctl(2), shmctl(2), and semctl(2). Use the ipcs command to find the identifiers and keys.

Environment Variables

See environ(5) for descriptions of the following environment variables that affect the execution of ipcrm: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>
See Also  ipcs(1), msgctl(2), msgget(2), msgsnd(2), semctl(2), semget(2), semop(2),
shmctl(2), shmget(2), shmov(2), attributes(5), environ(5), standards(5), zones(5)
**ipcs**

**Synopsis**

```
ipcs [-aAbciJmopqstZ] [-D mtype] [-z zone]
```

**Description**

The **ipcs** utility prints information about active inter-process communication facilities. The information that is displayed is controlled by the options supplied. Without options, information is printed in short format for message queues, shared memory, and semaphores that are currently active in the system.

**Options**

The following options are supported:

- `-m`
  - Prints information about active shared memory segments.

- `-q`
  - Prints information about active message queues.

- `-s`
  - Prints information about active semaphores.

If `-m`, `-q`, or `-s` are specified, information about only those indicated is printed. If none of these three is specified, information about all three is printed subject to these options:

- `-a`
  - Uses all XCU5 print options. (This is a shorthand notation for `-b`, `-c`, `-o`, `-p`, and `-t`.)

- `-A`
  - Uses all print options. (This is a shorthand notation for `-b`, `-c`, `-i`, `-J`, `-o`, `-p`, and `-t`.)

- `-b`
  - Prints information on biggest allowable size: maximum number of bytes in messages on queue for message queues, size of segments for shared memory, and number of semaphores in each set for semaphores. See below for meaning of columns in a listing.

- `-c`
  - Prints creator's login name and group name. See below.

- `-D mtype`
  - Displays, in hexadecimal and ASCII, the contents of all messages of type `mtype` found on any message queue that the user invoking **ipcs** has permission to read. If `mtype` is 0, all messages are displayed. If `mtype` is negative, all messages with type less than or equal to the absolute value of `mtype` are displayed. (See `msgrcv(2)` and `msgsnap(2)`.)

- `-i`
  - Prints number of ISM attaches to shared memory segments.

- `-J`
  - Prints the creator's project.

- `-o`
  - Prints information on outstanding usage: number of messages on queue and total number of bytes in messages on queue for message queues and number of processes attached to shared memory segments.

- `-p`
  - Prints process number information: process ID of last process to send a message, process ID of last process to receive a message on message queues, process ID of creating process, and process ID of last process to attach or detach on shared memory segments. See below.
- **t**  Prints time information: time of the last control operation that changed the access permissions for all facilities, time of last `msgsnd(2)` and last `msgrcv(2)` on message queues, time of last `shmat(2)` and last `shmdt(2)` on shared memory (see `shmop(2)`), time of last `semop(2)` on semaphores. See below.

- **z zone**  Prints information about facilities associated with the specified zone (see `zones(5)`). The zone can be specified as either a name or a numeric id. The default is to display information about the zone in which the command is executing. Notice that this option is only useful when executing in the global zone.

- **Z**  When executing in the global zone, prints information about all zones. Otherwise, prints information about the zone in which the command is executing. The output includes the zone associated with each facility.

The column headings and the meaning of the columns in an `ipcs` listing are given below. The letters in parentheses indicate the options that cause the corresponding heading to appear and “all” means that the heading always appears. Note: These options only determine what information is provided for each facility; they do not determine which facilities are listed.

<table>
<thead>
<tr>
<th><strong>T (all)</strong></th>
<th>Type of the facility:</th>
</tr>
</thead>
<tbody>
<tr>
<td>q</td>
<td>message queue</td>
</tr>
<tr>
<td>m</td>
<td>shared memory segment</td>
</tr>
<tr>
<td>s</td>
<td>semaphore</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>ID (all)</strong></th>
<th>The identifier for the facility entry.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>KEY (all)</strong></th>
<th>The key used as an argument to <code>msgget(2), semget(2), or shmget(2)</code> to create the facility entry. (Note: The key of a shared memory segment is changed to IPC_PRIVATE when the segment has been removed until all processes attached to the segment detach it.)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>MODE (all)</strong></th>
<th>The facility access modes and flags: The mode consists of 11 characters that are interpreted as follows. The first two characters are:</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>A process is waiting on a <code>msgrcv(2)</code>.</td>
</tr>
<tr>
<td>S</td>
<td>A process is waiting on a <code>msgsnd(2)</code>.</td>
</tr>
<tr>
<td>-</td>
<td>The corresponding special flag is not set.</td>
</tr>
</tbody>
</table>

The next nine characters are interpreted as three sets of three bits each. The first set refers to the owner’s permissions; the next to permissions of others in the user-group of the facility entry; and the last to all others. Within each set, the first character indicates permission to read, the second character indicates permission to write or alter the facility entry, and the last character is currently unused.
The permissions are indicated as follows:

- r  Read permission is granted.
- w  Write permission is granted.
- a  Alter permission is granted.
-  The indicated permission is not granted.

**OWNER (all)**
The login name of the owner of the facility entry.

**GROUP (all)**
The group name of the group of the owner of the facility entry.

**CREATOR (a,A,c)**
The login name of the creator of the facility entry.

**CGROUP (a,A,c)**
The group name of the group of the creator of the facility entry.

**CBYTES (a,A,o)**
The number of bytes in messages currently outstanding on the associated message queue.

**QNUM (a,A,o)**
The number of messages currently outstanding on the associated message queue.

**QBYTES (a,A,b)**
The maximum number of bytes allowed in messages outstanding on the associated message queue.

**LSPID (a,A,p)**
The process ID of the last process to send a message to the associated queue.

**LRPID (a,A,p)**
The process ID of the last process to receive a message from the associated queue.

**STIME (a,A,t)**
The time the last message was sent to the associated queue.

**RTIME (a,A,t)**
The time the last message was received from the associated queue.

**CTIME (a,A,t)**
The time when the associated entry was created or changed.

**ISMATTCH (a,i)**
The number of ISM attaches to the associated shared memory segments.

**NATTCH (a,A,o)**
The number of processes attached to the associated shared memory segment.

**SEGSZ (a,A,b)**
The size of the associated shared memory segment.

**CPID (a,A,p)**
The process ID of the creator of the shared memory entry.

**LPID (a,A,p)**
The process ID of the last process to attach or detach the shared memory segment.

**ATIME (a,A,t)**
The time the last attach was completed to the associated shared memory segment.
DTIME (a,A,t)  The time the last detach was completed on the associated shared memory segment.

NSEMS (a,A,b)  The number of semaphores in the set associated with the semaphore entry.

OTIME (a,A,t)  The time the last semaphore operation was completed on the set associated with the semaphore entry.

PROJECT (J,A)  The project name of the creator of the facility entry.

ZONE (Z)  The zone with which the facility is associated.

Environment Variables  See environ(5) for descriptions of the following environment variables that affect the execution of ipcs: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

TZ  Determine the timezone for the time strings written by ipcs.

Files  /etc/group  group names
       /etc/passwd  user names

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also  ipcrm(1), msgget(2), msgsends(2), msgsnd(2), msgrcv(2), semget(2), semids(2), semop(2), shmat(2), shmat(2), shmdt(2), shmhalt(2), shmstat(2), shmget(2), shmids(2), shmmount(2), attributes(5), environ(5), standards(5), zones(5)

Notes  Things can change while ipcs is running. The information it gives is guaranteed to be accurate only when it was retrieved.
Name  
isainfo – describe instruction set architectures

Synopsis  
isainfo [ [-v] [-b | -n | -k] | [-x]]

Description  
The isainfo utility is used to identify various attributes of the instruction set architectures supported on the currently running system. Among the questions it can answer are whether 64-bit applications are supported, or whether the running kernel uses 32-bit or 64-bit device drivers.

When invoked with no options, isainfo prints the names of the native instruction sets for applications supported by the current version of the operating system. These are a subset of the list returned by isalist(1). The subset corresponds to the basic applications environments supported by the currently running system.

Options  
The following options are supported:

- \( -b \)  Prints the number of bits in the address space of the native instruction set.
- \( -k \)  Prints the name of the instruction set(s) used by the operating system kernel components such as device drivers and STREAMS modules.
- \( -n \)  Prints the name of the native instruction set used by portable applications supported by the current version of the operating system.
- \( -v \)  When used with the \( -b \), \( -k \) or \( -n \) options, prints more detailed information.
- \( -x \)  Prints instruction extensions to the native ABI which are supported by the platform.

Examples  
**EXAMPLE 1**  Invoking isainfo on a 32-bit x86 Platform

The following example invokes isainfo on a 32-bit x86 platform:

```
example% isainfo -v
32-bit i386 applications
example% isainfo -k
i386
```

**EXAMPLE 2**  Invoking isainfo on a System Running the 64-bit Operating System on a 64-bit SPARC Processor

The following example invokes isainfo on a system running the 64-bit operating system on a 64-bit SPARC processor:

```
example% isainfo
sparcv9 sparc
example% isainfo -n
sparcv9
example% isainfo -v
64-bit sparcv9 applications
32-bit sparc applications
example% isainfo -vk
```
EXAMPLE 2 Invoking `isainfo` on a System Running the 64-bit Operating System on a 64-bit SPARC Processor (Continued)

64-bit sparcv9 kernel modules

EXAMPLE 3 Invoking `isainfo -x` on an AMD Opteron CPU

The following example invokes `isainfo` with the `-x` option on an AMD Opteron CPU:

```bash
example% isainfo -x
i386: fpu tsc cx8 sep cmov mmx ammx a3dnow a3dnowx fxsr sse sse2 pause
```

Exit Status

Non-zero Options are not specified correctly, or the command is unable to recognize attributes of the system on which it is running. An error message is printed to stderr.

Attributes

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also `isalist(1), uname(1), psrinfo(1M), getisax(2), sysinfo(2), attributes(5), isalist(5)`
isalist(1)

**Name**
isalist – display the native instruction sets executable on this platform

**Synopsis**
isalist

**Description**
isalist prints the names of the native instruction sets executable on this platform on the standard output, as returned by the SI_ISALIST command of `sysinfo(2)`.

The names are space-separated and are ordered in the sense of best performance. That is, earlier-named instruction sets might contain more instructions than later-named instruction sets; a program that is compiled for an earlier-named instruction sets will most likely run faster on this machine than the same program compiled for a later-named instruction set.

Programs compiled for instruction sets that do not appear in the list will most likely experience performance degradation or not run at all on this machine.

The instruction set names known to the system are listed in `isalist(5)`. These names might or might not match predefined names or compiler options in the C language compilation system.

This command is obsolete and may be removed in a future version of Solaris. See `isainfo(1)` for a better way to handle instruction set extensions.

**Attributes**
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

**See Also**
isainfo(1), optisa(1), uname(1), sysinfo(2), attributes(5), isalist(5)
Name  jobs, fg, bg, stop, notify – control process execution

Synopsis

sh  jobs [-p | -l] [% job_id...
    jobs -x command [arguments]
    fg [% job_id...
    bg [% job_id...
    stop % job_id...
    stop pid...

csh  jobs [-l]
    fg [% job_id]
    bg [% job_id]...
    notify [% job_id]....
    stop % job_id...
    stop pid...

ksh88  jobs [-lp] [% job_id...
    fg [% job_id...
    bg [% job_id...
    stop % job_id...
    stop pid...

ksh  jobs [-lp] [job_id...
    fg [job_id...
    bg [job_id...

Description

    sh  When Job Control is enabled, the Bourne shell built-in jobs reports all jobs that are stopped or executing in the background. If %job_id is omitted, all jobs that are stopped or running in the background is reported. The following options modify or enhance the output of jobs:
        -l  Reports the process group ID and working directory of the jobs.
        -p  Reports only the process group ID of the jobs.
        -x  Replaces any job_id found in command or arguments with the corresponding process group ID, and then executes command passing it arguments.
When the shell is invoked as `jsh`, Job Control is enabled in addition to all of the functionality described previously for `sh`. Typically Job Control is enabled for the interactive shell only. Non-interactive shells typically do not benefit from the added functionality of Job Control.

With Job Control enabled every command or pipeline the user enters at the terminal is called a `job_id`. All jobs exist in one of the following states: foreground, background or stopped. These terms are defined as follows:

1. A job in the **foreground** has read and write access to the controlling terminal.
2. A job in the **background** is denied read access and has conditional write access to the controlling terminal (see `stty(1)`).
3. A **stopped job** is a job that has been placed in a suspended state, usually as a result of a `SIGTSTP` signal (see `signal.h(3HEAD)`).

Every job that the shell starts is assigned a positive integer, called a `job_id number` which is tracked by the shell and are used as an identifier to indicate a specific job. Additionally, the shell keeps track of the current and previous jobs. The current job is the most recent job to be started or restarted. The previous job is the first non-current job.

The acceptable syntax for a Job Identifier is of the form:

```sh
%<job_id>
```

where `job_id` can be specified in any of the following formats:

- `%` or `+` for the current job
- `−` for the previous job
- `?<string>` specify the job which the command line uniquely contains `string`.
- `n` for job number `n`, where `n` is a job number
- `pref` where `pref` is a unique prefix of the command name (for example, if the command `ls -l name` were running in the background, it could be referred to as `%ls); `pref` cannot contain blanks unless it is quoted.

When Job Control is enabled, `fg` resumes the execution of a stopped job in the foreground, also moves an executing background job into the foreground. If `%<job_id>` is omitted the current job is assumed.

When Job Control is enabled, `bg` resumes the execution of a stopped job in the background. If `%<job_id>` is omitted the current job is assumed.

`stop` stops the execution of a background job(s) by using its `job_id`, or of any process by using its `pid`; see `ps(1)`.
The C shell built-in, `jobs`, without an argument, lists the active jobs under job control.

- `-l` List process IDs, in addition to the normal information.

The shell associates a numbered `job_id` with each command sequence to keep track of those commands that are running in the background or have been stopped with TSTP signals (typically Control-Z). When a command or command sequence (semicolon-separated list) is started in the background using the `&` metacharacter, the shell displays a line with the job number in brackets and a list of associated process numbers:

```
[1] 1234
```

To see the current list of jobs, use the `jobs` built-in command. The job most recently stopped (or put into the background if none are stopped) is referred to as the current job and is indicated with a `+`. The previous job is indicated with a `-`; when the current job is terminated or moved to the foreground, this job takes its place (becomes the new current job).

To manipulate jobs, refer to the `bg`, `fg`, `kill`, `stop`, and `%` built-in commands.

A reference to a job begins with a `%`. By itself, the percent sign refers to the current job.

- `%+` The current job.
- `%−` The previous job.
- `%j` Refer to job `j` as in: `kill -9 %j`. `j` can be a job number, or a string that uniquely specifies the command line by which it was started; `fg %vi` might bring a stopped `vi` job to the foreground, for instance.
- `%?string` Specify the job for which the command line uniquely contains `string`.

A job running in the background stops when it attempts to read from the terminal. Background jobs can normally produce output, but this can be suppressed using the `stty tostop` command.

- `fg` brings the current or specified `job_id` into the foreground.
- `bg` runs the current or specified jobs in the background.
- `stop` stops the execution of a background job(s) by using its `job_id`, or of any process by using its `pid`; see `ps(1)`.
- `notify` notifies the user asynchronously when the status of the current job or specified jobs changes.

`jobs` displays the status of the jobs that were started in the current shell environment. When `jobs` reports the termination status of a job, the shell removes its process ID from the list of those known in the current shell execution environment.
job_id specifies the jobs for which the status is to be displayed. If no job_id is specified, the status information for all jobs are displayed.

The following options modify or enhance the output of jobs:

- \l (The letter ell.) Provides more information about each job listed. This information includes the job number, current job, process group ID, state and the command that formed the job.
- \n Displays only jobs that have stopped or exited since last notified.
- \p Displays only the process IDs for the process group leaders of the selected jobs.

By default, jobs displays the status of all the stopped jobs, running background jobs, and all jobs whose status has changed and have not been reported by the shell.

If the \monitor option of the set command is turned on, an interactive shell associates a job with each pipeline. It keeps a table of current jobs, printed by the jobs command, and assigns them small integer numbers. When a job is started asynchronously with & the shell prints a line which looks like:

```
[1] 1234
```

indicating that the job, which was started asynchronously, was job number 1 and had one (top-level) process, whose process id was 1234.

If you are running a job and wish to do something else you can hit the key \^Z (Control-Z) which sends a STOP signal to the current job. The shell then normally indicates that the job has been "Stopped" (see OUTPUT below), and print another prompt. You can then manipulate the state of this job, putting it in the background with the bg command, or run some other commands and then eventually bring the job back into the foreground with the foreground command fg. A \^Z takes effect immediately and is like an interrupt, in that pending output and unread input are discarded when it is typed.

There are several ways to refer to jobs in the shell. A job can be referred to by the process id of any process of the job or by one of the following:

- \%number The job with the specified number.
- \%string Any job whose command line begins with string; works only in the interactive mode when the history file is active.
- \?string Any job whose command line contains string; works only in the interactive mode when the history file is active.
- \% Current job.
- \%+ Equivalent to \%.
- \% Previous job.
The shell learns immediately whenever a process changes state. It normally informs you whenever a job becomes blocked so that no further progress is possible, but only just before it prints a prompt. This is done so that it does not otherwise disturb your work. When the monitor mode is on, each background job that completes triggers any trap set for CHLD. When you try to leave the shell while jobs are running or stopped, you are warned that 'You have stopped (running) jobs.' You can use the Jobs command to see what they are. If you do this or immediately try to exit again, the shell does not warn you a second time, and the stopped jobs are terminated.

fg moves a background job from the current environment into the foreground. Using fg to place a job in the foreground removes its process ID from the list of those known in the current shell execution environment. The fg command is available only on systems that support job control. If job_id is not specified, the current job is brought into the foreground.

bg resumes suspended jobs from the current environment by running them as background jobs. If the job specified by job_id is already a running background job, bg has no effect and exits successfully. Using bg to place a job into the background causes its process ID to become 'known in the current shell execution environment, as if it had been started as an asynchronous list. The bg command is available only on systems that support job control. If job_id is not specified, the current job is placed in the background.

stop stops the execution of a background job(s) by using its job_id, or of any process by using its pid. See ps(1).

jobs displays information about specified jobs that were started by the current shell environment on standard output. The information contains the job number enclosed in [ . . . ], the status, and the command line that started the job.

If job_id is omitted, jobs displays the status of all stopped jobs, background jobs, and all jobs whose status has changed since last reported by the shell.

When jobs reports the termination status of a job, the shell removes the job from the list of known jobs in the current shell environment.

The following options modify or enhance the output of jobs:

- l Displays process IDs after the job number in addition to the usual information.
- n Displays only the jobs whose status has changed since the last prompt was displayed.
- p Displays the process group leader IDs for the specified jobs.

job_id can be specified to jobs, fg, and bg as one of the following:

number The process id of job.
-number The process group id of job.
The job number.

The job whose name begins with string.

The job whose name contains string.

The current job.

The previous job.

fg places the specified jobs into the foreground in sequence and sends a CONT signal to start each running. If job_id is omitted, the most recently started or stopped background job is moved to the foreground.

bg places the specified jobs into the background and sends a CONT signal to start them running. If job_id is omitted, the most recently started or stopped background job is resumed or continued in the background.

Output

If the -p option is specified, the output consists of one line for each process ID:

"%d\n", "process ID"

Otherwise, if the -l option is not specified, the output is a series of lines of the following form:

"[%d] %c %s %s\n", job-number, current, state, command

where the fields are as follows:

current The character + identifies the job that would be used as the default for the fg or bg commands. This job can also be specified using the job_id +% or %++. The character - identifies the job that would become the default if the current default job were to exit; this job can also be specified using the job_id %-. For other jobs, this field is a space character. At most, one job can be identified with + and at most one job can be identified with -. If there is any suspended job, then the current job is a suspended job. If there are at least two suspended jobs, then the previous job is also a suspended job.

job-number A number that can be used to identify the process group to the wait, fg, bg, and kill utilities. Using these utilities, the job can be identified by prefixing the job number with %.

state One of the following strings in the POSIX Locale:

Running Indicates that the job has not been suspended by a signal and has not exited.

Done Indicates that the job completed and returned exit status zero.
Done\((code)\) Indicates that the job completed normally and that it exited with the specified non-zero exit status, \textit{code}, expressed as a decimal number.

Stopped Indicates that the job was stopped.

Stopped (SIGTSTP) Indicates that the job was suspended by the SIGTSTP signal.

Stopped (SIGSTOP) Indicates that the job was suspended by the SIGSTOP signal.

Stopped (SIGTTIN) Indicates that the job was suspended by the SIGTTIN signal.

Stopped (SIGTTOU) Indicates that the job was suspended by the SIGTTOU signal.

The implementation can substitute the string Suspended in place of Stopped. If the job was terminated by a signal, the format of state is unspecified, but it is visibly distinct from all of the other state formats shown here and indicates the name or description of the signal causing the termination.

\textit{command} The associated command that was specified to the shell.

If the -l option is specified, a field containing the process group ID is inserted before the state field. Also, more processes in a process group can be output on separate lines, using only the process ID and command fields.

\textbf{Environment Variables} See \texttt{environ(5)} for descriptions of the following environment variables that affect the execution of jobs, \texttt{fg}, and \texttt{bg}: \texttt{LANG}, \texttt{LC\_ALL}, \texttt{LC\_CTYPE}, \texttt{LC\_MESSAGES}, and \texttt{NLSPATH}.

\textbf{Exit Status}

\texttt{sh}, \texttt{csh}, \texttt{ksh88} The following exit values are returned for jobs, \texttt{fg}, and \texttt{bg}:

\begin{itemize}
  \item \texttt{0} Successful completion.
  \item \texttt{>0} An error occurred.
\end{itemize}

\texttt{ksh} The following exit values are returned for jobs:

\begin{itemize}
  \item \texttt{0} The information for each job is written to standard output.
  \item \texttt{>0} One or more jobs does not exist.
\end{itemize}

The following exit values are returned for \texttt{fg}:

\begin{itemize}
  \item \texttt{exit status of last job} One or more jobs has been brought into the foreground.
  \item \texttt{non-zero} One or more jobs does not exist or has completed.
\end{itemize}
The following exit values are returned for bg:

0    All background jobs are started.

>0    One more jobs does not exist or there are no background jobs.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>Attributes</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>csh, sh, ksh88</td>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td></td>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td></td>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ksh</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td></td>
<td>Interface Stability</td>
<td>Uncommitted</td>
</tr>
</tbody>
</table>

See Also  csh(1), kill(1), ksh(1), ksh88(1), ps(1), sh(1), stop(1), shell_builtins(1), stty(1), wait(1), signal.h(3HEAD), attributes(5), environ(5), standards(5)
Name  
join – relational database operator

Synopsis
/usr/bin/join [-a filenumber] [-v filenumber] [-1 fieldnumber]
   [-2 fieldnumber] [-o list] [-e string][-t char] file1 file2

/usr/bin/join [-a filenumber] [-j fieldnumber] [-j1 fieldnumber]
   [-j2 fieldnumber] [-o list] [-e string][-t char] file1 file2

Description
join performs an equality join on the files file1 and file2 and writes the resulting joined files to
standard output. By default, a field is delimited by one or more spaces and tabs with leading
spaces and/or tabs ignored. The -t option can be used to change the field delimiter.

The join field is a field in each file on which files are compared. By default join writes one line
in the output for each pair of lines in files1 and files2 that have identical join fields. The default
output line consists of the join field, then the remaining fields from file1, then the remaining
fields from file2, but this can be changed with the -o option. The -a option can be used to add
unmatched lines to the output. The -v option can be used to output only unmatched lines.

The files file1 and file2 must be ordered in the collating sequence of sort -b on the fields on
which they are to be joined otherwise the results are unspecified.

If either file1 or file2 is -, join uses standard input starting at the current location.

Options
Some of the options below use the argument filenumber. This argument should be a 1 or a 2
referring to either file1 or file2, respectively.

-a filenumber
In addition to the normal output, produce a line for each unpairable line
in file filenumber, where filenumber is 1 or 2. If both -a 1 and -a 2 are
specified, all unpairable lines are output.

-e string
Replace empty output fields in the list selected by option -o with the
string string.

-j fieldnumber
Equivalent to -1 fieldnumber -2 fieldnumber. Fields are numbered
starting with 1.

-j1 fieldnumber
Equivalent to -1 fieldnumber. Fields are numbered starting with 1.

-j2 fieldnumber
Equivalent to -2 fieldnumber. Fields are numbered starting with 1.

-o list
Each output line includes the fields specified in list. Fields selected by list
that do not appear in the input are treated as empty output fields. (See the
-e option.) Each element of which has the either the form
filenumber.fieldnumber, or 0, which represents the join field. The
common field is not printed unless specifically requested.

-t char
Use character char as a separator. Every appearance of char in a line is
significant. The character char is used as the field separator for both input
and output. With this option specified, the collating term should be the
same as sort without the -b option.
Instead of the default output, produce a line only for each unpairable line in file1, where file1 is 1 or 2. If both -v 1 and -v 2 are specified, all unpairable lines are output.

-1 fieldnumber
-2 fieldnumber

Join on the fieldnumber-th field of file 1. Fields are decimal integers starting with 1.

The following operands are supported:

file1 A path name of a file to be joined. If either of the file1 or file2 operands is -, the standard input is used in its place.

file2 A path name of a file to be joined. If either of the file1 or file2 operands is -, the standard input is used in its place.

file1 and file2 must be sorted in increasing collating sequence as determined by LC_COLLATE on the fields on which they are to be joined, normally the first in each line (see sort(1)).

Usage

See largefile(5) for the description of the behavior of join when encountering files greater than or equal to 2 Gbyte (2^{31} bytes).

Examples

EXAMPLE 1 Joining the password File and Group File

The following command line joins the password file and the group file, matching on the numeric group ID, and outputting the login name, the group name and the login directory. It is assumed that the files have been sorted in ASCII collating sequence on the group ID fields.

example% join -j1 4-j2 3 -o 1.1 2.1 1.6 -t:/etc/passwd /etc/group

EXAMPLE 2 Using the -o Option

The -o 0 field essentially selects the union of the join fields. For example, given file phone:

<table>
<thead>
<tr>
<th>!Name</th>
<th>Phone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Don</td>
<td>+1 123-456-7890</td>
</tr>
<tr>
<td>Hal</td>
<td>+1 234-567-8901</td>
</tr>
<tr>
<td>Yasushi</td>
<td>+2 345-678-9012</td>
</tr>
</tbody>
</table>

and file fax:

<table>
<thead>
<tr>
<th>!Name</th>
<th>Fax Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Don</td>
<td>+1 123-456-7899</td>
</tr>
<tr>
<td>Keith</td>
<td>+1 456-789-0122</td>
</tr>
<tr>
<td>Yasushi</td>
<td>+2 345-678-9011</td>
</tr>
</tbody>
</table>
EXAMPLE 2  Using the -o Option  (Continued)

where the large expanses of white space are meant to each represent a single tab character), the
command:

    example% join -t"tab" -a 1 -a 2 -e '(unknown)' -o 0,1.2,2.2 phone fax

would produce

<table>
<thead>
<tr>
<th>Name</th>
<th>Phone Number</th>
<th>Fax Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Don</td>
<td>+1 123-456-7890</td>
<td>+1 123-456-7899</td>
</tr>
<tr>
<td>Hal</td>
<td>+1 234-567-0981</td>
<td>(unknown)</td>
</tr>
<tr>
<td>Keith</td>
<td>(unknown)</td>
<td>+1 456-789-012</td>
</tr>
<tr>
<td>Yasushi</td>
<td>+2 345-678-9012</td>
<td>+2 345-678-9011</td>
</tr>
</tbody>
</table>

**Environment Variables**

See `environ(5)` for descriptions of the following environment variables that affect the
execution of `join`: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, LC_COLLATE, and NLSPATH.

**Exit Status**

The following exit values are returned:

- **0**  All input files were output successfully.
- **>0**  An error occurred.

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See <code>standards(5)</code></td>
</tr>
</tbody>
</table>

**See Also**

`awk(1), comm(1), sort(1), uniq(1), attributes(5), environ(5), largefile(5), standards(5)`

**Notes**

With default field separation, the collating sequence is that of `sort -b`; with `-t`, the sequence is
that of a plain sort.

The conventions of the `join`, `sort`, `comm`, `uniq`, and `awk` commands are wildly incongruous.
**kbd(1)**

**Name**  
kbd – manipulate the state of the keyboard, or display the type of the keyboard, or change the default keyboard abort sequence effect

**Synopsis**  
kbd [-r] [-t] [-l] [-a enable | disable | alternate]  
[-c on | off] [-d keyboard device]  
[-D autorepeat delay] [-R autorepeat rate]

kbd [-i] [-d keyboard device]

kbd -s [language]

kbd -b [keyboard | console] frequency

The **kbd** utility manipulates the state of the keyboard, or displays the keyboard type, or allows the default keyboard abort sequence effect to be changed. The abort sequence also applies to serial console devices. The **kbd** utility sets the /dev/kbd default keyboard device.

The `-i` option reads and processes default values for the keyclick and keyboard abort settings from the keyboard configuration service, svc:/system/keymap:default. Only keyboards that support a clicker respond to the `-c` option. To turn clicking on by default, add or change the value of the keymap/keyclick property in the keymap service to:

```
$ svccfg -s keymap:default setprop keymap/keyclick=true
$ svcadm refresh keymap
```

Next, run the command **kbd -i** to change the setting. Valid settings for the keymap/keyclick property are true or false. All other values are ignored. If the keymap/keyclick property is not specified in the keymap service, the setting is unchanged.

The keyboard abort sequence effect can only be changed by a super user using the `-a` option. This sequence is typically Stop-A or L1-A and Shift-Pause on the keyboard on SPARC systems, F1-A and Shift-Pause on x86 systems, and BREAK on the serial console input device on most systems.

A **BREAK** condition that originates from an erroneous electrical signal cannot be distinguished from one deliberately sent by remote DCE. As a remedy, use the `-a` option with Alternate Break to switch break interpretation. Due to the risk of incorrect sequence interpretation, binary protocols such as SLIP and others should not be run over the serial console port when Alternate Break sequence is in effect.

Although PPP is a binary protocol, it has the ability to avoid using characters that interfere with serial operation. The default alternate break sequence is CTRL-m ~ CTRL-b, or 00 7E 02 in hexadecimal. In PPP, this can be avoided by setting either 0x00000004 or 0x00002000 in the ACCM. This forces an escape for the CTRL-b or CTRL-m characters, respectively.

To do this in Solaris PPP 4.0, add:

```
asyncmap 0x00002000
```

to the /etc/ppp/options file or any of the other configuration files used for the connection. See **pppd(1M)**.
SLIP has no comparable capability, and must not be used if the Alternate Break sequence is in use.

The Alternate Break sequence has no effect on the keyboard abort. For more information on the Alternate Break sequence, see zs(7D), se(7D), and asy(7D).

On many systems, the default effect of the keyboard abort sequence is to suspend the operating system and enter the debugger or the monitor. Some systems feature key switches with a secure position. On these systems, setting the key switch to the secure position overrides any software default set with this command.

To permanently change the software default effect of the keyboard abort sequence, first add or change the value of the keymap/keyboard_abort property in the keymap service to:

```
$ svccfg -s keymap:default setprop keymap/keyboard_abort=disable
$ svcadm refresh keymap
```

Next, run the command kbd -i to change the setting. Valid settings are enable, disable, and alternate; all other values are ignored. If the variable is not specified in the keymap service, the setting is unchanged.

To set the abort sequence to the hardware BREAK, set the value of keymap/keyboard_abort in the keymap service to:

```
$ svccfg -s keymap:default setprop keymap/keyboard_abort=enable
$ svcadm refresh keymap
```

To change the current setting, run the command kbd -i. To set the abort sequence to the Alternate Break character sequence, first set the current value of the keyboard_abort property in the keymap service to:

```
$ svccfg -s keymap:default setprop keymap/keyboard_abort=alternate
$ svcadm refresh keymap
```

Next, run the command kbd -i to change the setting. When the Alternate Break sequence is in effect, only serial console devices are affected.

To set the autorepeat delay by default, set the repeat_delay property in the keymap service to the expected value with units in milliseconds (ms). To avoid making the keyboard unusable due to a typographical error, delay values below KIOCRPTDELAY_MIN (defined in /usr/include/sys/kbio.h) are rejected with EINVAL:

```
$ svccfg -s keymap:default setprop keymap/repeate_delay=500
$ svcadm refresh keymap
```

To set the autorepeat rate by default, set the repeat_rate property in the keymap service to the expected value with units in milliseconds. Negative and zero repeat rates are ejected with EINVAL:

```
$ svccfg -s keymap:default setprop keymap/repeate_rate=500
$ svcadm refresh keymap
```
$ svccfg -s keymap:default setprop keymap/repeate_rate=40
$ svcadm refresh keymap

To change the current settings of delay and rate, run the command, kbd -i. When the Auto Repeat Delay and/or Auto Repeat Rate are in effect, only command line mode is affected.

To set the language by default, set the keymap/layout property in the keymap service to the expected language. These languages supported in kernel can be found by running kbd -s. Other values are ignored. For example, the following sets Spanish layout to the keyboard:

$ svccfg -s keymap:default setprop keymap/layout=Spanish
$ svcadm refresh keymap

Next, run the kbd -i to change the setting. When Solaris reboots, the Spanish key table is loaded into kernel. These layouts are valid for usb and ps/2 keyboards.

To set the keyboard beeper frequency by default, set the keymap/kbd_beeper_freq property in the keymap service to the expected value with units in HZ. This value should be between 0 and 32767, inclusive. Otherwise it is rejected with EINVAL:

$ svccfg -s keymap:default setprop keymap/kbd_beeper_freq=2000
$ svcadm refresh keymap

To set the console beeper frequency by default, set the keymap/console_beeper_freq property in the keymap service to the expected value with units in HZ. This value should be between 0 and 32767, inclusive. Otherwise it is rejected with EINVAL:

$ svccfg -s keymap:default setprop keymap/console_beeper_freq=900
$ svcadm refresh keymap

To change the current settings of the keyboard beeper frequency and console beeper frequency, run kbd -i.

**Options**

The following options are supported:

- `-a enable|disable|alternate`

  Enables, disables, or alternates the keyboard abort sequence effect. By default, a keyboard abort sequence suspends the operating system on most systems. This sequence is typically Stop-A or L1-A and Shift-Pause on the keyboard on SPARC systems, F1-A and Shift-Pause on x86 systems, and BREAK on the serial console device.

  The default keyboard behavior can be changed using this option. The -a option can only be used by a super user.
enable Enables the default effect of the keyboard abort sequence (suspend the operating system and enter the debugger or the monitor).

disable Disables the default/alternate effect and ignores keyboard abort sequences.

alternate Enables the alternate effect of the keyboard abort sequences (suspend the operating system and enter the debugger or the monitor) upon receiving the Alternate Break character sequence on the console. The Alternate Break sequence is defined by the drivers \texttt{zs(7D), se(7D), asy(7D)}. Due to a risk of incorrect sequence interpretation, binary protocols cannot be run over the serial console port when this value is used.

-\textbf{b} \texttt{keyboard|console} Sets the beeper frequency for keyboard or console.

\textbf{keyboard} Set the keyboard beeper frequency to the operand in HZ. See \texttt{OPERANDS}.

\textbf{console} Sets the console beeper frequency to the operand in HZ. See \texttt{OPERANDS}.

-\textbf{c} \texttt{on|off} Turns the clicking of the keyboard on or off.

\textbf{on} Enables clicking

\textbf{off} Disables clicking

-\textbf{d} \texttt{keyboard device} Specifies the keyboard device being set. The default setting is \texttt{/dev/kbd}.

-\textbf{D} \texttt{autorepeat delay} Sets the autorepeat delay in milliseconds.

-\textbf{i} Sets keyboard properties from the keymap service. With the exception of -d keyboard device, this option cannot be used with any other option. The -i option instructs the keyboard command to read and process keyclick and keyboard abort default values from the keyboard properties in the keymap service. The -i option can only be used by a user or role with the Device Security Rights Profile.
Returnsthelayoutcodeofthekeyboardbeingused,and
theautorepeatdelayandautorepeatratebeingused.

If used with -R or -D option, this option returns the value
before the changes.

Sets the autorepeat rate in milliseconds.

Sets the keyboard layout into kernel.

If language is specified, the layout is set to language. If
language is not specified, a list of available layouts are
presented, prompting for the user to specify the
language. See OPERANDS.

Returns the type of the keyboard being used.

The following operands are supported:

frequency The frequency value specified to be set in kernel. The receiver of this value is
specified by the -b option. This value should be between 0 and 32767 otherwise
it is ejected with EINVAL.

language The language specified to be set in kernel. If the language is not found, the
languages supported are listed for selection. It only applies to -s option.

The following example displays the keyboard type:

```
example% kbd -t
Type 4 Sun keyboard
example%
```

The following example sets the keyboard defaults as specified in the keymap service:

```
example# kbd -i
example#
```

The following example displays keyboard type and layout code. It also displays auto repeat
delay and rate settings.

```
example% kbd -l
type=4
layout=43 (0x2b)
```
EXAMPLE 3  Displaying Information  (Continued)

delay(ms)=500
rate(ms)=33
example%

EXAMPLE 4  Setting Keyboard Autorepeat Delay
The following example sets the keyboard autorepeat delay:

example% kbd -D 300
example%

EXAMPLE 5  Setting Keyboard Autorepeat Rate
The following example sets the keyboard autorepeat rate:

example% kbd -R 50
example%

EXAMPLE 6  Selecting and Setting the Keyboard Language
The following example selects and sets the keyboard language from a list of languages specified:

example% kbd -s
1. Albanian 16. Malta_UK
2. Belarusian 17. Malta_US
4. Bulgarian 19. Portuguese
5. Croatian 20. Russian
7. Dutch 22. Slove
......

To select the keyboard layout, enter a number [default n]:

example%

The following example sets the keyboard language specified:

example% kbd -s Dutch
example%

EXAMPLE 7  Setting the Keyboard Beeper Frequency
The following example sets the keyboard beeper frequency:

example% kbd -b keyboard 1000
example%
Files
/dev/kbd    Keyboard device file

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also
kdb(1), loadkeys(1), svcs(1), inetd(1M), inetadm(1M), svcadm(1M), pppd(1M), keytables(4), attributes(5), smf(5), kb(7M), zs(7D), se(7D), asy(7D), virtuallkm(7D)

Notes
Some server systems have key switches with a secure key position that can be read by system software. This key position overrides the normal default of the keyboard abort sequence effect and changes the default so the effect is disabled. When the key switch is in the secure position on these systems, the keyboard abort sequence effect cannot be overridden by the software default, which is settable with the kbd utility.

Currently, there is no way to determine the state of the keyboard click setting.

The kdb service is managed by the service management facility, smf(5), under the service identifier:
	svc:/system/keymap:default

Administrative actions on this service, such as enabling, disabling, or requesting restart, can be performed using svcadm(1M). Responsibility for initiating and restarting this service is delegated to inetd(1M). Use inetadm(1M) to make configuration changes and to view configuration information for this service. The service's status can be queried using the svcs(1) command.
**Name**

kdestroy – destroy Kerberos tickets

**Synopsis**

```
/usr/bin/kdestroy [-q] [-c cache_name]
```

**Description**

The `kdestroy` utility destroys the user's active Kerberos authorization tickets by writing zeros to the specified credentials cache that contains them. If the credentials cache is not specified, the default credentials cache is destroyed. If the credentials cache does not exist, `kdestroy` displays a message to that effect.

After overwriting the cache, `kdestroy` removes the cache from the system. The utility displays a message indicating the success or failure of the operation. If `kdestroy` is unable to destroy the cache, it will warn you by making your terminal beep.

If desired, you can place the `kdestroy` command in your `.logout` file so that your tickets are destroyed automatically when you logout.

**Options**

The following options are supported:

- `-c cache_name`
  
  Uses `cache_name` as the credentials (ticket) cache name and location. If this option is not used, the default cache name and location are used.

- `-q`
  
  Runs quietly. Your terminal will not beep when `kdestroy` fails to destroy the tickets.

**Environment Variables**

`kdestroy` uses the following environment variable:

- `KRB5CCNAME`
  
  Location of the credentials (ticket) cache. See `krb5envvar(5)` for syntax and details.

**Files**

```
/tmp/krb5cc_uid
```

Default credentials cache (`uid` is the decimal UID of the user).

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/security/kerberos-5</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Command arguments</td>
<td>Committed</td>
</tr>
<tr>
<td>Command output</td>
<td>Uncommitted</td>
</tr>
</tbody>
</table>

**See Also**

`kinit(1), klist(1), attributes(5), kerberos(5), krb5envvar(5)`

**Bugs**

Only the tickets in the specified credentials cache are destroyed. Separate ticket caches are used to hold root instance and password changing tickets. These files should probably be destroyed too, or all of a user's tickets should be kept in a single credential cache.
The keylogin command prompts for a password, and uses it to decrypt the user's secret key. The key can be found in the /etc/publickey file (see publickey(4)) or the NIS map "publickeybyname" in the user's home domain. The sources and their lookup order are specified in the /etc/nsswitch.conf file. See nsswitch.conf(4). Once decrypted, the user's secret key is stored by the local key server process, keyserv(1M). This stored key is used when issuing requests to any secure RPC services, such as NFS. The program keylogout(1) can be used to delete the key stored by keyserv.

keylogin fails if it cannot get the caller's key, or the password given is incorrect. For a new user or host, a new key can be added using newkey(1M).

If multiple authentication mechanisms are configured for the system, each of the configured mechanism's secret key is decrypted and stored by keyserv(1M).

The following options are supported:

- r Update the /etc/.rootkey file. This file holds the unencrypted secret key of the superuser. Only the superuser can use this option. It is used so that processes running as superuser can issue authenticated requests without requiring that the administrator explicitly run keylogin as superuser at system startup time. See keyserv(1M). The -r option should be used by the administrator when the host's entry in the publickey database has changed, and the /etc/.rootkey file has become out-of-date with respect to the actual key pair stored in the publickey database. The permissions on the /etc/.rootkey file are such that it can be read and written by the superuser but by no other user on the system.

If multiple authentication mechanisms are configured for the system, each of the configured mechanism's secret keys is stored in the /etc/.rootkey file.

Files /etc/.rootkey superuser's secret key

Attributes See attributes(5) for descriptions of the following attributes:

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<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also chkey(1), keylogout(1), login(1), keyserv(1M), newkey(1M), nsswitch.conf(4), publickey(4), attributes(5)
**Name**  
keylogout – delete stored secret key with keyserv

**Synopsis**  
/usr/bin/keylogout [-f]

**Description**  
keylogout deletes the key stored by the key server process `keyserv(1M)`. Further access to the key is revoked; however, current session keys might remain valid until they expire or are refreshed.

Deleting the keys stored by `keyserv` causes any background jobs or scheduled `at(1)` jobs that need secure RPC services to fail. Since only one copy of the key is kept on a machine, it is a bad idea to place a call to this command in your `.logout` file since it affects other sessions on the same machine.

**Options**  
The following options are supported:

- `-f` Force keylogout to delete the secret key for the superuser. By default, keylogout by the superuser is disallowed because it would break all RPC services, such as NFS, that are started by the superuser.

**Attributes**  
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

**See Also**  
`at(1), chkey(1), login(1), keylogin(1), keyserv(1M), newkey(1M), pubkey(4), attributes(5)`
## kill(1)

### Name
kill – terminate or signal processes

### Synopsis

```
/usr/bin/kill -s signal_name pid...
/usr/bin/kill -l [exit_status]
/usr/bin/kill [-signal_name] pid...
/usr/bin/kill [-signal_number] pid...
```

### Description

The `kill` utility sends a signal to the process or processes specified by each `pid` operand.

For each `pid` operand, the `kill` utility performs actions equivalent to the `kill(2)` function called with the following arguments:

1. The value of the `pid` operand is used as the `pid` argument.
2. The `sig` argument is the value specified by the `-s` option, the `-signal_name` option, or the `-signal_number` option, or, if none of these options is specified, by `SIGTERM`.

The signaled process must belong to the current user unless the user is the super-user.

See NOTES for descriptions of the shell built-in versions of `kill`.

### Options

The following options are supported:

- `-l` (The letter ell.) Writes all values of `signal_name` supported by the implementation, if no operand is specified. If an `exit_status` operand is specified and it is a value of the `?` shell special parameter and `wait` corresponding to a process that was terminated by a signal, the `signal_name` corresponding to the signal that terminated the process is written. If an `exit_status` operand is specified and it is the unsigned decimal integer value of a signal number, the `signal_name` corresponding to that signal is written. Otherwise, the results are unspecified.

- `-s signal_name` Specifies the signal to send, using one of the symbolic names defined in the `<signal.h>` description. Values of `signal_name` is recognized in a case-independent fashion, without the `SIG` prefix. In addition, the symbolic name `0` is recognized, representing the signal value zero. The corresponding signal is sent instead of `SIGTERM`.

- `-signal_name` Equivalent to `-s signal_name`.

- `-signal_number` Specifies a non-negative decimal integer, `signal_number`, representing the signal to be used instead of `SIGTERM`, as the `sig` argument in the effective call to `kill(2)`.

### Operands
The following operands are supported:

- `pid` One of the following:
1. A decimal integer specifying a process or process group to be signaled. The process or processes selected by positive, negative and zero values of the \textit{pid} operand is as described for the \textit{kill} function. If process number 0 is specified, all processes in the process group are signaled. If the first \textit{pid} operand is negative, it should be preceded by \texttt{--} to keep it from being interpreted as an option.

2. A job control job ID that identifies a background process group to be signaled. The job control job ID notation is applicable only for invocations of \textit{kill} in the current shell execution environment.

   The job control job ID type of \textit{pid} is available only on systems supporting the job control option.

\textbf{exit\_status} A decimal integer specifying a signal number or the exit status of a process terminated by a signal.

\textbf{Usage} Process numbers can be found by using \texttt{ps(1)}.

The job control job ID notation is not required to work as expected when \textit{kill} is operating in its own utility execution environment. In either of the following examples:

\begin{verbatim}
example% nohup kill %1 &
example% system( "kill %1");
\end{verbatim}

\texttt{kill} operates in a different environment and does not share the shell's understanding of job numbers.

\textbf{Output} When the \texttt{-l} option is not specified, the standard output is not be used.

When the \texttt{-l} option is specified, the symbolic name of each signal is written in the following format:

"\%s\%c", <signal\_name>, <separator>

where the \texttt{<signal\_name>} is in upper-case, without the SIG prefix, and the \texttt{<separator>} is either a newline character or a space character. For the last signal written, \texttt{<separator>} is a newline character.

When both the \texttt{-l} option and \textit{exit\_status} operand are specified, the symbolic name of the corresponding signal is written in the following format:

"\%s\\n", <signal\_name>

\textbf{Examples} \textbf{EXAMPLE 1} Sending the kill signal

Any of the commands:
EXAMPLE 1  Sending the kill signal  (Continued)

    example% kill -9 100 -165
    example% kill -s kill 100 -165
    example% kill -s KILL 100 -165

sends the SIGKILL signal to the process whose process ID is 100 and to all processes whose
process group ID is 165, assuming the sending process has permission to send that signal to
the specified processes, and that they exist.

EXAMPLE 2  Avoiding ambiguity with an initial negative number

To avoid an ambiguity of an initial negative number argument specifying either a signal
number or a process group, the former is always the case. Therefore, to send the default
signal to a process group (for example, 123), an application should use a command similar to
two of the following:

    example% kill -TERM -123
    example% kill -- -123

Environment Variables  See environ(5) for descriptions of the following environment variables that affect the
execution of kill: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status  The following exit values are returned:

0       At least one matching process was found for each pid operand, and the specified signal
        was successfully processed for at least one matching process.

>0      An error occurred.

Attributes  See attributes(5) for descriptions of the following attributes:

```
ATTRIBUTETYPE       ATTRIBUTEVALUE
Availability          system/core-os
CSI                   Enabled
Interface Stability   Committed
Standard              See standards(5).
```

```
ATTRIBUTETYPE       ATTRIBUTEVALUE
Availability        system/core-os
CSI                  Enabled
Interface Stability  Uncommitted
```
The number of real-time signals supported is defined by the `getconf(1)` value `_POSIX_RTSIG_MAX`.

The Bourne shell, `sh`, has a built-in version of `kill` to provide the functionality of the `kill` command for processes identified with a `jobid`. The `sh` syntax is:

```bash
kill [ -sig ] [ pid ] [ %job ]...
kill -l
```

The C-shell, `csh`, also has a built-in `kill` command, whose syntax is:

```bash
kill [-sig][pid][%job]...
kill -l
```

The `csh kill` built-in sends the TERM (terminate) signal, by default, or the signal specified, to the specified process ID, the job indicated, or the current job. Signals are either specified by number or by name. There is no default. Typing `kill` does not send a signal to the current job. If the signal being sent is TERM (terminate) or HUP (hangup), then the job or process is sent a CONT (continue) signal as well.

```bash
- l
```

Lists the signal names that can be sent.

The syntax of the `ksh88 kill` is:

```bash
kill [-sig][pid][%job]...
kill -l
```

The `ksh88 kill` sends either the TERM (terminate) signal or the specified signal to the specified jobs or processes. Signals are either specified by number or by names (as specified in `signal.h(3HEAD)` stripped of the SIG prefix). If the signal being sent is TERM (terminate) or HUP (hangup), then the job or process is sent a CONT (continue) signal if it is stopped. The argument `job` can be the process id of a process that is not a member of one of the active jobs. In the second form, `kill -l`, the signal numbers and names are listed.

The syntax of the `ksh kill` is:

```bash
kill [-n signum] [-s signame] job ...
kill [-n signum] [-s signame] -l [arg ...]
```

With the first form in which `-l` is not specified, `kill` sends a signal to one or more processes specified by `job`. This normally terminates the processes unless the signal is being caught or ignored.

Specify `job` as one of the following:

```bash
number    The process id of job.
```
-number The process group id of job.
%number The job number.
%string The job whose name begins with string.
%?string The job whose name contains string.
%+ The current job.
%- The previous job.

If the signal is not specified with either the -n or the -s option, the SIGTERM signal is used.

If -l is specified, and no arg is specified, then kill writes the list of signals to standard output. Otherwise, arg can be either a signal name, or a number representing either a signal number or exit status for a process that was terminated due to a signal. If a name is specified the corresponding signal number is written to standard output. If a number is specified the corresponding signal name is written to standard output.

- l List signal names or signal numbers rather than sending signals as described above. The -n and -s options cannot be specified.

- n signum Specify a signal number to send. Signal numbers are not portable across platforms, except for the following:

<table>
<thead>
<tr>
<th>Signal Number</th>
<th>Signal Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No signal.</td>
</tr>
<tr>
<td>1</td>
<td>HUP</td>
</tr>
<tr>
<td>2</td>
<td>INT</td>
</tr>
<tr>
<td>3</td>
<td>QUIT</td>
</tr>
<tr>
<td>6</td>
<td>ABRT</td>
</tr>
<tr>
<td>9</td>
<td>KILL</td>
</tr>
<tr>
<td>14</td>
<td>ALRM</td>
</tr>
<tr>
<td>15</td>
<td>TERM</td>
</tr>
</tbody>
</table>

- s signame Specify a signal name to send. The signal names are derived from their names in <signal.h> without the SIG prefix and are case insensitive. kill -l generates the list of signals on the current platform.

kill in ksh exits with one of the following values:

0 At least one matching process was found for each job operand, and the specified signal was successfully sent to at least one matching process.

>0 An error occurred.
**kinit**–obtain and cache Kerberos ticket-granting ticket

**Synopsis**

```
/usr/bin/kinit [-ARvV] [-p | -P] [-f | -F] [-a] [-c cache_name]
[-C] [-E] [-k [-t keytab_file]] [-l lifetime]
[-r renewable_life] [-s start_time] [-n] [-S service_name]
[-X attribute=value] [-T armor_ccache] [principal]
```

**Description**

The `kinit` command is used to obtain and cache an initial ticket-granting ticket (credential) for `principal`. This ticket is used for authentication by the Kerberos system. Only users with Kerberos principals can use the Kerberos system. For information about Kerberos principals, see `kerberos(5)`.

When you use `kinit` without options, the utility prompts for your `principal` and Kerberos password, and tries to authenticate your login with the local Kerberos server. The `principal` can be specified on the command line if desired.

If Kerberos authenticates the login attempt, `kinit` retrieves your initial ticket-granting ticket and puts it in the ticket cache. By default your ticket is stored in the file `/tmp/krb5cc_uid`, where `uid` specifies your user identification number. Tickets expire after a specified lifetime, after which `kinit` must be run again. Any existing contents of the cache are destroyed by `kinit`.

Values specified in the command line override the values specified in the Kerberos configuration file for `lifetime` and `renewable_life`.

The `kdestroy(1)` command can be used to destroy any active tickets before you end your login session.

**Options**

The following options are supported:

- `-a`
  Requests tickets with the local addresses.
- `-A`
  Requests address-less tickets.
- `-c cache_name`
  Uses `cache_name` as the credentials (ticket) cache name and location. If this option is not used, the default cache name and location are used.
- `-C`
  Requests canonicalization of the principal name.
- `-E`
  Treats the principal name as an enterprise name.
- `-f`
  Requests forwardable tickets.
- `-F`
  Not forwardable. Does not request forwardable tickets.

Tickets that have been acquired on one host cannot normally be used on another host. A client can request that the ticket be marked forwardable. Once the TKT_FLG_FORWARDABLE flag is set on a ticket, the user can use this ticket to request a new ticket, but with a different
IP address. Thus, users can use their current credentials to get credentials valid on another machine. This option allows a user to explicitly obtain a non-forwardable ticket.

- k [ - t keytab_file]

Requests a host ticket, obtained from a key in the local host’s keytab file. The name and location of the keytab file can be specified with the - t keytab_file option. Otherwise, the default name and location is used.

- \ lifetime

Requests a ticket with the lifetime lifetime. If the - l option is not specified, the default ticket lifetime (configured by each site) is used. Specifying a ticket lifetime longer than the maximum ticket lifetime (configured by each site) results in a ticket with the maximum lifetime. See the Time Formats section for the valid time duration formats that you can specify for lifetime. See kdc.conf(4) and kadmin(1M) (for getprinc command to verify the lifetime values for the server principal).

The lifetime of the tickets returned is the minimum of the following:

- Value specified in the command line.
- Value specified in the KDC configuration file.
- Value specified in the Kerberos data base for the server principal.
  In the case of kinit, it is krbtgt/realm name.
- Value specified in the Kerberos database for the user principal.

- n

Requests anonymous processing.

Two types of anonymous principals are supported. For fully anonymous Kerberos, configure pkinit on the KDC and configure pkinit_anchors in the client’s krb5.conf. Then use the - n option with a principal of the form @REALM (an empty principal name followed by the at-sign and a realm name). If permitted by the KDC, an anonymous ticket is returned.

A second form of anonymous tickets is also supported. These realm-exposed tickets hide the identity of the client but not the client’s realm. For this mode, use kinit - n with a normal principal name. If supported by the KDC, the principal (but not realm) is replaced by the anonymous principal. As of release 1.8, MIT Kerberos KDC only supports fully anonymous operation.

- p

Requests proxiable tickets.

- P

Not proxiable. Does not request proxiable tickets.
A proxiable ticket is a ticket that allows you to get a ticket for a service with IP addresses other than the ones in the Ticket Granting Ticket. This option allows a user to explicitly obtain a non-proxiable ticket.

- **-r** renewable_life

Requests renewable tickets, with a total lifetime of `renewable_life`. See the `Time Formats` section for the valid time duration formats that you can specify for `renewable_life`. See `kdc.conf(4)` and `kadmin(1M)` (for `getprinc` command to verify the lifetime values for the server principal).

The renewable lifetime of the tickets returned is the minimum of the following:

- Value specified in the command line.
- Value specified in the KDC configuration file.
- Value specified in the Kerberos database for the server principal. 
  In the case of `kinit`, it is `krbtgt/realm name`.
- Value specified in the Kerberos database for the user principal.

- **-R**

Requests renewal of the ticket-granting ticket. Notice that an expired ticket cannot be renewed, even if the ticket is still within its renewable life.

- **-s** start_time

Requests a postdated ticket, valid starting at `start_time`. Postdated tickets are issued with the `invalid` flag set, and need to be fed back to the KDC before use. See the `Time Formats` section for either the valid absolute time or time duration formats that you can specify for `start_time`. `kinit` attempts to match an absolute time first before trying to match a time duration.

- **-S** service_name

Specifies an alternate service name to use when getting initial tickets.

- **-T** armor_ccache

If supported by the KDC, specifies the name of a credential cache (ccache) that already contains a ticket. This ccache is used to armor the request so that an attacker would have to know both the key of the armor ticket and the key of the principal used for authentication in order to attack the request.

Armoring also makes sure that the response from the KDC is not modified in transit.

- **-v**

Requests that the ticket granting ticket in the cache (with the `invalid` flag set) be passed to the KDC for validation. If the ticket is within its requested time range, the cache is replaced with the validated ticket.
-V Verbose output. Displays further information to the user, such as confirmation of authentication and version.

-X attribute[=value] Specifies a pre-authentication attribute and value to be passed to pre-authentication plugins. The acceptable attribute and value values vary from pre-authentication plugin to plugin. This option can be specified multiple times to specify multiple attributes. If no value is specified, it is assumed to be yes.

The following attributes are recognized by the OpenSSL pkinit pre-authentication mechanism:

X509_user_identity=URI Specifies where to find user's X509 identity information.

Valid URI types are FILE, DIR, PKCS11, PKCS12, and ENV. See the PKINIT URI Types section for details.

X509_anchors=URI Specifies where to find trusted X509 anchor information.

Valid URI types are FILE and DIR. See the PKINIT URI Types section for details.

flag_RSA_PROTOCOL[=yes] Specifies the use of RSA, rather than the default Diffie-Hellman protocol.

PKINIT URI Types

FILE:file-name[,key-file-name]
This option has context-specific behavior.

X509_user_identity file-name specifies the name of a PEM-format file containing the user's certificate. If key-file-name is not specified, the user's private key is expected to be in file-name as well. Otherwise, key-file-name is the name of the file containing the private key.

X509_anchors file-name is assumed to be the name of an OpenSSL-style ca-bundle file. The ca-bundle file should be base-64 encoded.

DIR:directory-name
This option has context-specific behavior.

X509_user_identity directory-name specifies a directory with files named *.crt and *.key, where the first part of the file name is the same for matching pairs of certificate and private key files. When a file with a name ending with .crt is found, a matching file ending with .key is assumed to contain the private key. If no such file is found, then the certificate in the .crt is not used.
X509_anchors directory-name is assumed to be an OpenSSL-style hashed CA directory where each CA cert is stored in a file named hash-of-ca-cert. This infrastructure is encouraged, but all files in the directory are examined and if they contain certificates (in PEM format), and are used.

PKCS12: pkcs12-file-name
pkcs12-file-name is the name of a PKCS #12 format file, containing the user’s certificate and private key.

PKCS11: [slotid=slot-id][:token=token-label][:certid=cert-id][:certlabel=cert-label]
All keyword and values are optional. PKCS11 modules (for example, opensc-pkcs11.so) must be installed as a crypto provider under /libpkcs11.soLIB). slotid= and/or token= can be specified to force the use of a particular smart card reader or token if there is more than one available. certid= and/or certlabel= can be specified to force the selection of a particular certificate on the device. See the pkinit_cert_match configuration option for more ways to select a particular certificate to use for pkinit.

ENV: environment-variable-name
environment-variable-name specifies the name of an environment variable which has been set to a value conforming to one of the previous values. For example, ENV: X509_PROXY, where environment variable X509_PROXY has been set to FILE: /tmp/my_proxy.pem.

Time Formats
The following absolute time formats can be used for the -s start_time option. The examples are based on the date and time of July 2, 1999, 1:35:30 p.m.

<table>
<thead>
<tr>
<th>Absolute Time Format</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>yymmddhhmm[ss]</td>
<td>990702133530</td>
</tr>
<tr>
<td>hhmm[ss]</td>
<td>133530</td>
</tr>
<tr>
<td>yy.mm.dd.hh:mm.ss</td>
<td>99:07:02:13:35:30</td>
</tr>
<tr>
<td>hh:mm:ss</td>
<td>13:35:30</td>
</tr>
<tr>
<td>ldatetime</td>
<td>07-07-99:13:35:30</td>
</tr>
<tr>
<td>dd-month-yyyyhh:mm[ss]</td>
<td>02-july-1999:13:35:30</td>
</tr>
</tbody>
</table>

Variable

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dd</td>
<td>day</td>
</tr>
<tr>
<td>hh</td>
<td>hour (24-hour clock)</td>
</tr>
<tr>
<td>mm</td>
<td>minutes</td>
</tr>
</tbody>
</table>
Variable Description

ss seconds

yy year within century (0-68 is 2000 to 2068; 69-99 is 1969 to 1999)

yyyy year including century

month locale's full or abbreviated month name

ldate locale's appropriate date representation

ltime locale's appropriate time representation

The following time duration formats can be used for the `-l lifetime`, `-r renewable_life`, and `-s start_time` options. The examples are based on the time duration of 14 days, 7 hours, 5 minutes, and 30 seconds.

<table>
<thead>
<tr>
<th>Time Duration Format</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>#d</td>
<td>14d</td>
</tr>
<tr>
<td>#h</td>
<td>7h</td>
</tr>
<tr>
<td>#m</td>
<td>5m</td>
</tr>
<tr>
<td>#s</td>
<td>30s</td>
</tr>
<tr>
<td>#d#h#m#s</td>
<td>14d7h5m30s</td>
</tr>
<tr>
<td>#h#m[s]</td>
<td>7h5m30s</td>
</tr>
<tr>
<td>days-hh:mm:ss</td>
<td>14-07:05:30</td>
</tr>
<tr>
<td>hours:mm[.ss]</td>
<td>7:05:30</td>
</tr>
</tbody>
</table>

Delimiter Description

d number of days

h number of hours

m number of minutes

s number of seconds

Variable Description

# number
Variable Description

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>days</td>
<td>number of days</td>
</tr>
<tr>
<td>hours</td>
<td>number of hours</td>
</tr>
<tr>
<td>hh</td>
<td>hour (24-hour clock)</td>
</tr>
<tr>
<td>mm</td>
<td>minutes</td>
</tr>
<tr>
<td>ss</td>
<td>seconds</td>
</tr>
</tbody>
</table>

Environment Variables

kinit uses the following environment variable:

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>KRB5CCNAME</td>
<td>Location of the credentials (ticket) cache. See krb5envvar(5) for syntax and details.</td>
</tr>
</tbody>
</table>

Files

<table>
<thead>
<tr>
<th>File</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>/tmp/krb5cc_uid</td>
<td>Default credentials cache (uid is the decimal UID of the user).</td>
</tr>
<tr>
<td>/etc/krb5/krb5.keytab</td>
<td>Default location for the local host's keytab file.</td>
</tr>
<tr>
<td>/etc/krb5/krb5.conf</td>
<td>Default location for the local host's configuration file. See krb5.conf(4).</td>
</tr>
</tbody>
</table>

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/security/kerberos-5</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>See below.</td>
</tr>
</tbody>
</table>

The command arguments are Committed. The command output is Uncommitted.

See Also

kdestroy(1), klist(1), kadmin(1M), kttk_warnd(1M), libpkcs11(3LIB), kdc.conf(4), krb5.conf(4), attributes(5), kerberos(5), krb5envvar(5), pam_krb5(5)

Notes

On success, kinit notifies kttk_warnd(1M) to alert the user when the initial credentials (ticket-granting ticket) are about to expire.
Name  
klist – list currently held Kerberos tickets

Synopsis  
/usr/bin/klist [-e]
   [ [-c] [-f] [-s] [-a [-n]]] [cache_name]
   [-k [-t] [-K] [keytab_file]]

Description  
The klist utility prints the name of the credentials cache, the identity of the principal that the
tickets are for (as listed in the ticket file), and the principal names of all Kerberos tickets
currently held by the user, along with the issue and expiration time for each authenticator.
Principal names are listed in the form name/instance@realm, with the '/' omitted if the
instance is not included, and the '@' omitted if the realm is not included.

If cache_file or keytab_name is not specified, klist displays the credentials in the default
credentials cache or keytab files as appropriate. By default, your ticket is stored in the file
/tmp/krb5cc_uid, where uid is the current user-ID of the user.

Options  
The following options are supported:

- a  Displays list of addresses in credentials. Uses the configured nameservice
to translate numeric network addresses to the associated hostname if possible.
- c [cache_name]  Lists tickets held in a credentials cache. This is the default if neither -c nor
- k is specified.
- e  Displays the encryption types of the session key and the ticket for each
credential in the credential cache, or each key in the keytab file.
- f  Shows the flags present in the credentials, using the following
abbreviations:
    a  Anonymous
    A  Pre-authenticated
    d  Post-dated
    D  Post-dateable
    f  Forwarded
    F  Forwardable
    H  Hardware authenticated
    i  Invalid
    I  Initial
    O  Okay as delegate
    p  Proxy
    P  Proxiable
R Renewable
T Transit policy checked
-k [keytab_file] List keys held in a keytab file.
-K Displays the value of the encryption key in each keytab entry in the keytab file.
-n Shows numeric IP addresses instead of reverse-resolving addresses. Only valid with -a option.
-s Causes klist to run silently (produce no output), but to still set the exit status according to whether it finds the credentials cache. The exit status is 0 if klist finds a credentials cache, and '1' if it does not, or if the local-realm TGT has expired.
-t Displays the time entry timestamps for each keytab entry in the keytab file.

Environment Variables
klist uses the following environment variable:

KRBCCCNAME Location of the credentials (ticket) cache. See krb5envvar(5) for syntax and details.

Files
/tmp/krb5cc_uid Default credentials cache (uid is the decimal UID of the user).
/etc/krb5/krb5.keytab Default location for the local host's keytab file.
/etc/krb5/krb5.conf Default location for the local host's configuration file. See krb5.conf(4).

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/security/kerberos-5</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>See below.</td>
</tr>
</tbody>
</table>

The command arguments are Committed. The command output is Uncommitted.

See Also
kdestroy(1), kinit(1), krb5.conf(4), attributes(5), krb5envvar(5), kerberos(5)

Bugs When reading a file as a service key file, very little error checking is performed.
Name  kmdb – in situ kernel debugger

Synopsis

Boot-time Loading  SPARC

ok boot [device-specifier] -k [-d] [boot-flags]
ok boot [device-specifier] kmdb [-d] [boot-flags]

x86

kernel$ /platform/i86pc/kernel/$ISADIR/unix -k [-d] [boot-flags]

Runtime Loading  mdb -K

Description  kmdb is an interactive kernel debugger which implements the user interface and functionality of mdb(1) in a live kernel context. kmdb provides features that allow for the control of kernel execution and for the inspection and modification of live kernel state. kmdb can be loaded at the beginning of a boot session or after the system is booted.

This man page describes the features and functionality that are unique to kmdb or different in kmdb as compared to mdb(1). For more information on mdb(1) or further details on the features and functionality implemented by kmdb, see the mdb(1) man page and the Oracle Solaris Modular Debugger Guide.

Loading and Unloading  Boot-time Loading

When requested, the kernel runtime linker (krtld) loads kmdb prior to the transfer of control to the kernel. If the -d flag is used, the debugger gains control of the system prior to the execution of the initial function in the unix object. If -d is not used, kmdb is loaded but does not gain control until such time as it is explicitly entered. See the Debugger Entry section below. For a list of the boot commands which cause kmdb to be loaded at boot, see the SYNOPSIS section above. See eeprom(1M) for an example of the use of that command on a SPARC machine to specify that kmdb is always loaded upon boot.

Boot-loaded kmdb can be unloaded only by means of a system reboot.

Some features of kmdb rely on the presence of kernel services and are not immediately available to boot-loaded kmdb. In particular, the loading and unloading of dmods is not available until the module subsystem is initialized. Requests are queued until they can be processed. Similarly, translation of virtual addresses to physical addresses is not be available until the VM system has been initialized. Attempted translations fail until translation facilities are available.

Run-time Loading  kmdb can also be loaded after the system has booted, using the -K flag to mdb(1). When loaded in this fashion, it will immediately gain control of the system. Run-time-loaded kmdb can be unloaded using the -U flag to mdb(1) or from within the debugger with the -u flag to the ::quit dcmd.
Terminal types
When loaded, kmdb attempts to determine the proper terminal type in use on the system console. If the system being debugged has an attached keyboard and local display that are both used for the system console, kmdb uses the terminal type appropriate for the machine: 'sun' for SPARC; 'sun-color' for x86. When a serial console is in use, boot-loaded kmdb defaults to a terminal type 'vt100'. Run-time-loaded kmdb defaults to the terminal type requested by mdb(1). mdb(1) requests the terminal type specified by the value of the TERM environment variable unless overridden by the -T flag. ::term can be used to view the current terminal type.

Debugger entry
Debugger entry can be requested explicitly or implicitly. Implicit entry, encountered when breakpoints or other execution control features are used, is discussed in the Execution Control section.

The primary means for explicit debugger entry is with the keyboard abort sequence for systems with local consoles and the BREAK character for those with serial consoles. The abort sequence is STOP-A or Shift-Pause for SPARC systems with local consoles, and F1–A or Shift-Pause for x86 systems with local consoles. See kbd(1) for a discussion of the abort sequence and for instructions on disabling it.

A second way to request entry into the debugger is with the mdb(1) command. Invocations of mdb(1) with the -K flag after the debugger is loaded trigger debugger entry.

If the kernel panics and kmdb is loaded, by default, the panic routine enters kmdb for live debugging. If a dump device is specified, and you enter ::cont, the debugger exits and a crash dump is performed. To prevent the kernel from entering kmdb when panicking, you can set the nopanicdebug variable to 1. Set the nopanicdebug variable to 1 using kmdb or including the following a line in /etc/system:

```
set nopanicdebug = 1
```

This can be useful if you want to keep kmdb loaded, but always want a panic to trigger a crash dump without entering the debugger.

Execution control
For the most part, the execution control facilities provided by kmdb for the kernel mirror those provided by the mdb(1) process target. Breakpoints (::bp), watchpoints (::wp), ::continue, and the various flavors of ::step can be used.

In contrast to the unlimited user process watchpoints supplied by the kernel, kmdb is restricted to a set of CPU watchpoints that limit the number, size, and type of watchpoints allowed. The ::wp command does not allow a watchpoint to be created if it is incompatible with the watchpoints supported by the hardware.

Debugger modules (dmods)
As with mdb(1), kmdb is installed with a number of subsystem-specific debugger modules, or dmods. The dmods are loaded and unloaded automatically with the loading and unloading of the subsystems that they support. The dmods can also be explicitly loaded and unloaded using ::load and ::unload.
**kmdb** uses kernel facilities to load and unload dmods and must resume system execution to perform each requested action. When a dmod load or unload is complete, the system is stopped and the debugger is automatically re-entered. For a dmod load, processing is completed when the load of a requested dmod succeeds or fails. Status messages are provided in either case.

**Processor-specific functionality**

Some functionality is specific to an individual processor type. An example of such functionality is the branch tracing provided by various x86 processors. Access to these processor-specific features is provided with processor-specific dcmds that are present only on systems that support them. The availability of processor-specific support is indicated in the output of the **::status** dcmd. The debugger relies on the kernel to determine the processor type. Even though the debugger might provide support for a given processor type, the support is not exposed until the kernel has progressed to the point at which processor identification has completed.

**Kernel Macros**

The debugger provides access to a set of macros that are precompiled into the debugger. Only the precompiled macros are available. Unlike with **mdb**(1), the $< dcmd may not be used to load macros from arbitrary locations. Use the $M command to list the available macros.

**Built-in dcmds**

This section lists dcmds that are unique to **kmdb** or those with behavior that differs in **kmdb** as compared to **mdb**(1).

```
[ address ]::bp [+/-dDestT] [-c cmd] [-n count] sym ...
address : b [ cmd . . . ]
```

Set a breakpoint at the specified locations. The **::bp** dcmd sets a breakpoint at each address or symbol specified, including an optional address specified by an explicit expression preceding the dcmd, and each string or immediate value following the dcmd. The arguments can be symbol names or immediate values denoting a particular virtual address of interest.

If a symbol name is specified, the name may refer to a symbol that cannot yet be evaluated. It might consist of an object name and function name in a load object that has not yet been opened. In such a case, the breakpoint is deferred and is not active in the target until an object matching the given name is loaded. The breakpoint is automatically enabled when the load object is opened.

The -d, -o, -e, -s, -t, -T, -c, and -n options have the same meaning as they do for the **::evset** dcmd. See **mdb**(1) for a description of **::evset**. If the :b form of the dcmd is used, a breakpoint is set only at the virtual address specified by the expression preceding the dcmd. The arguments following the :b dcmd are concatenated together to form the callback string. If this string contains meta-characters, it must be quoted.

```
::branches [-v]
```

(x86 only)

Display the last branches taken by the CPU. This dcmd is supported only on x86 systems, and is available only when processor-specific support is detected and enabled. The number
and type of branches displayed is dependent on the capabilities of the branch tracing facilities provided by the CPU. When the -v option is used, the instructions prior to a given branch are displayed.

[function] :: call [arg [arg ...]]
Call the specified function using the specified arguments. The called function must be listed as a function in the symbol table for a loaded module. String arguments are passed by reference. When the call completes, the return value of the function is displayed.

This dcmd must be used with extreme caution. The kernel will not be resumed when the call is made. The function being called may not make any assumptions regarding the availability of any kernel services, and must not perform operations or calls that may block. The user must also beware of any side-effects introduced by the called function, as kernel stability might be affected.

[addr] :: cpuregs [-c cpuid]
Display the current general purpose register set for the specified CPU, in the format used by : : regs.

[addr] :: cputrack [-c cpuid]
Print a C stack backtrace for the specified CPU. The backtrace displayed is for the point at which the specified CPU entered or was stopped by the debugger.

addr[len] :: in [-L len]
(x86 only)
Read len bytes from the I/O port specified by addr. The value of the -L option, if provided, takes precedence over the value of the repeat count. The read length must be 1, 2, or 4 bytes, and the port address must have the same alignment as the length.

addr[len] :: out [-L len] value
(x86 only)
Write value to the len-byte I/O port specified by addr. The value of the -L option, if provided, takes precedence over the value of the repeat count. The write length must be 1, 2, or 4 bytes and the port address must have the same alignment as the length.

:: quit [-u]
$q
Causes the debugger to exit. When the -u option is used, the system is resumed and the debugger is unloaded. The -u option may not be used if the debugger was loaded at boot. When the -u option is not used, SPARC systems will exit to the boot PROM ok prompt. The go command can be used to re-enter the debugger. On x86 systems, a prompt is displayed that requests permission to reboot the machine.

:: step [over|out|branch]
Step the target one instruction. The optional over argument is used to step over subroutine calls. When the optional out argument is specified, the target program continues until control returns from the current function.
The optional branch argument is available only on x86 systems when processor-specific support is detected and enabled. When ::step branch is specified, the target program continues until the next branching instruction is encountered.

On SPARC systems, the ::step dcmd may not be used to step 'ta' instructions. Similarly, it may not be used on x86 systems to step 'int' instructions. If the step results in a trap that cannot be resolved by the debugger, a message to that effect is printed and the step will fail.

```
cpuid::switch
cpuid:x
```

Use the specified CPU as the representative. Stack traces, general purpose register dumps, and similar functionality use the new representative CPU as the data source. Full execution control functionality is available on the new representative CPU.

```
::term
```

Display the current terminal type.

```
addr[,len]:wp [+/-dDestT] [-rwx] [-p1] [-n count] [-c cmd]
addr[,len]:a [cmd ...]
addr[,len]:p [cmd ...]
addr[,len]:w [cmd ...]
```

Set a watchpoint at the specified address, interpreted by default as a virtual address. If the -p option is used, the address is interpreted as a physical address. On x86 platforms, watchpoints can be set on I/O ports using the -i option. When the -i option is used, the address is interpreted as that of an I/O port.

The length in bytes of the watched region can be set by specifying an optional repeat count preceding the dcmd. If no length is explicitly set, the default is one byte. The :wp dcmd allows the watchpoint to be configured to trigger on any combination of read (-r option), write (-w option), or execute (-x option) access.

The -d, -D, -e, -s, -t, -T, -c, and -n options have the same meaning as they do for the ::evset dcmd. See mdb(1) for a description of ::evset. The :a dcmd sets a read access watchpoint at the specified address. The :p dcmd sets an execute access watchpoint at the specified address. The :w dcmd sets a write access watchpoint at the specified address. The arguments following the :a, :p, and :w dcmds are concatenated together to form the callback string. If the string contains meta-characters, it must be quoted.

**Attributes**

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/kernel (debugger)</td>
</tr>
<tr>
<td></td>
<td>developer/debug/mdb (dmods)</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>
The memory region available to the debugger is allocated when the debugger is loaded, and is fixed at that point. If dcmds attempt to allocate more memory than is available, they will, if possible, be terminated. The debugger will attempt to recover gracefully from an out-of-memory situation, but may be unable to, and may be forced to terminate the system. This constraint is especially acute on 32-bit x86 systems.

System performance will be negatively impacted by the loading of kmdb, as the debugger will consume kernel memory and other limited system resources.

To troubleshoot a panic() on a SPARC machine, it can be useful to use eeprom(1M) to specify that the system always load kmdb upon booting. Following a panic, the system starts to reboot, in so doing clearing the panic stack from the console. By booting into kmdb, one can capture and interpret the panic stack. See eeprom(1M) for an example of specifying that kmdb load upon boot.
kmfcfg — Key Management Policy and Plugin Configuration Utility

**Name**
kmfcfg — Key Management Policy and Plugin Configuration Utility

**Synopsis**

```
kmfcfg subcommand [option ...]
```

**Description**
The `kmfcfg` command allows users to configure Key Management Framework (KMF) policy databases. The KMF policy database (DB) restricts the use of keys and certificates that are managed through the KMF framework.

The `kmfcfg` command provides the ability to list, create, modify, delete, import and export policy definitions either in the system default database file `/etc/security/kmfpolicy.xml` or a user-defined database file.

For plugin configuration, `kmfcfg` allows users to display plugin information, install or uninstall a KMF plugin, and modify the plugin option.

**Subcommands**
The following subcommands are supported:

### create

Adds a new policy into the policy database file.

The format for the `create` subcommand is as follows:

```
create [dbfile=dbfile] policy=policyname
[ignore-date=true|false]
[ignore-unknown-eku=true|false]
[ignore-trust-anchor=true|false]
[validity-adjust-time=adjusttime]
[ta-name=trust anchor subject DN]
[ta-name=trust anchor subject DN | search]
[ta-serial=trust anchor serial number]
[ocsp-responder=URL]
[ocsp-proxy=URL]
[ocsp-use-cert-responder=true|false]
[ocsp-response-lifetime=timelimit]
[ocsp-ignore-response-sign=true|false]
[ocsp-responder-cert-name=Issuer DN]
[ocsp-responder-cert-serial=serial number]
[crl-base-filename=basefilename]
[crl-directory=directory]
[crl-get-crl-uri=true|false]
[crl-proxy=URL]
[crl-ignore-crl-sign=true|false]
[crl-ignore-crl-date=true|false]
[keyusage=digitalSignature|nonRepudiation
 | keyEncipherment | dataEncipherment |
 | keyAgreement | keyCertSign |
 | cRLSign | encipherOnly | decipherOnly], [...]
[ekunames=serverAuth | clientAuth |
 | codeSigning | emailProtection |
```
The create subcommand supports the following options:

crl-basefilename=filename

crl-directory=directory

These two attributes are used to specify the location for CRL files. The crl-basefilename attribute represents the base filename for a CRL file. The crl-directory attribute represents the directory for CRL files, which defaults to the current directory.

If the crl-get-crl-uri attribute is set to true and the crl-basefilename is not specified, the basefilename for the cached CRL file is the basename of the URI used to fetch the CRL file.

If the crl-get-crl-uri attribute is set to false the crl-basefilename needs to be specified to indicate an input CRL file. The setting for crl-get-crl-uri is false by default.

These two attributes only apply to the file-based CRL plugins. The current file-based CRL plugins are file and pkcs11 keystores. For the nss keystore, the CRL location is always the NSS internal database.

crl-get-crl-uri=true | false

Configure if a CRL file is fetched and cached dynamically as part of the certificate validation, using the URI information from the certificate's distribution points extension.

The default for this attribute is false.

crl-ignore-crl-date=true | false

If crl-ignore-crl-date is set to true, the validity time period of the CRL is not checked.

The default for this attribute is false.

crl-ignore-crl-sign=true | false

If crl-ignore-crl-sign is set to true, the signature of the CRL is not checked.

The default for this attribute is false.
crl-proxy = URL
Sets the proxy server name and port for dynamically retrieving a CRL file when
crl-get-crl-uri is set to true.

The port number is optional. If the port number is not specified, the default value is
8080. An example crl-proxy setting might be: crl-proxy=webcache.sfbay:8080.

dbfile = dbfile
The DB file to add the new policy. If not specified, the default is the system KMF policy
database file /etc/security/kmfpolicy.xml.

ekuoids = EKUOIDS
A comma separated list of Extended Key Usage OIDs that are required by the policy
being defined. The OIDs are expressed in dot notation, for example, 1.2.3.4. An
example ekuoids setting might be: ekuoids=1.2.3.4,9.8.7.6.5.

ekunames = EKUNAMES
A comma separated list of Extended Key Usage names that are required by the policy
being defined. The list of values allowed for EKUNAMES are: serverAuth, clientAuth,
codeSigning, emailProtection, ipsecEndSystem, ipsecTunnel, ipsecUser,
timeStamping, and OCSPSigning

The OCSP, CRL, key usage and extended key usage checkings are off by default. To turn
on any one of them, specify one or more attributes for the particular checking. For
example, if the ocsp-responder attribute is set, then the OCSP checking is turned on. If
the ekuname attribute or the ekuoids attribute is set, then the extended key usage
checking is turned on.

ignore-date = true | false
Set the Ignore Date option for this policy. By default this value is false. If true is
specified, the policy ignores the validity periods defined in the certificates when
evaluating their validity.

ignore-unknown-eku = true | false
Set the Ignore Unknown EKU option for this policy. By default this value is false. If
true, the policy ignores any unrecognized EKU values in the Extended Key Usage
extension.

ignore-trust-anchor = true | false
Set the Ignore Trust Anchor option for this policy. By default this value is false. If
ture is specified, the policy does not verify the signature of the subject certificate using
trust anchor certificate at validation.

keyusage = KUVALUES
A comma separated list of key usage values that are required by the policy being defined.
The list of values allowed are: digitalSignature, nonRepudiation, keyEncipherment,
dataEncipherment, keyAgreement, keyCertSign, cRLSign, encipherOnly, 
decipherOnly
ocsp-ignore-response-sign=true | false
    If this attribute is set to true, the signature of the OCSP response is not verified. This attribute value is default to false.

ocsp-proxy=URL
    Set the proxy server name and port for OCSP. The port number is optional. If the port number is not specified, the default value is 8080. An example ocsp-proxy setting might be: ocsp-proxy="webcache.sf.bay:8080"

ocsp-response-lifetime=timelimit
    Set the freshness period that a response must be. The timelimit can be specified by number-day, number-hour, number-minute, or number-second. An example ocsp-response-lifetime setting might be: ocsp-response-lifetime=6-hour.

ocsp-responder-cert-name=IssuerDN
ocsp-responder-cert-serial=serialNumber
    These two attributes represent the OCSP responde certificate. The ocsp-responder-cert-name is to specify the issuer name of the certificate. See the ta-name option for example. The ocsp-responder-cert-serial is for the serial number and must be specified as a hex value, for example, 0x0102030405060708090a0b0c0d0e0f. If an OCSP responde is different from the issuer of the certificate and if the OCSP response needs to be verified, an OCSP responde certificate information should be provided.

ocsp-responder=URL
    Set the OCSP responde URL for use with the OCSP validation method. For example, ocsp-responder=http://ocsp.verisign.com/ocsp/status

ocsp-use-cert-responder=true | false
    Configure this policy to always use the responder defined in the certificate itself if possible.

domain=policynamel
    The policy record to be created. policynamel is required.

ta-name=trust anchor subject DN | search
    ta-name identifies the trust anchor used to validate a certificate. The KMF policy engine does not do full PKIX path validation, but rather just treats the trust anchor as if it were the parent of the certificate to be validated.

    If an explicit Subject DN is specified, it must be combined with ta-serial value to uniquely identify the certificate to use. Also, the certificate identified must be available in the keystore that is selected.

    If the value search is used instead of an explicit subject and serial number, the KMF policy engine attempts to locate a certificate that matches the issuer name of the certificate to be validated and uses that for the validation.

    If search is used, the ta-serial value is ignored.
ta-serial=trust anchor serial number
If the ta-name is specified as an explicit subject name, the serial number of that certificate must be indicated by the ta-serial value. The serial number must be represented in hexadecimal format, for example, ta-serial=0x01020a0b.

validity-adjusttime=adjusttime
Set the adjust time for both ends of validity period for a certificate. The time can be specified by number-day, number-hour, number-minute, or number-second. An example validity-adjusttime setting might be: validity-adjusttime=6-hour.

The two attributes represent the trust anchor certificate and are used to find the trust anchor certificate in the keystore. The ta-name is to specify the distinguished name of the trust anchor certificate subject name. For example, ta-name="O=Sun Microsystems Inc.,
\OU=Solaris Security Technologies Group, \L=Ashburn, \ST=VA, \C=US,
\CN=John Smith" The serial number of the TA certificate. This, along with the Issuer DN, is used to find the TA certificate in the keystore. The serial number must be specified as a hex value, for example, 0x0102030405060708090a0b0c0d0e The trust anchor attributes need to be set, if the value of ignore-trust-anchor attribute is false.

mapper-name=name
mapper-dir=directory
mapper-path=path
mapper-options=options
These four options support the certificate to name mapping. mapper-name provides the name of the mapper. For example, the cn name represents the mapper object kmf.mapper.cn.so.1 mapper-dir overrides the default mapper directory /lib/crypto. mapper-path specifies the full path to the mapper object. mapper-options is an ASCII only string of maximum of 255 bytes long. Its format is mapper specific but mappers are expected to accept a comma separated list of options, for example casesensitive, ignoredomain. mapper-path and mapper-name are mutually exclusive. mapper-dir can be set only if mapper-name is set. mapper-options can be set only if mapper-name or mapper-path is set. Trying to use any of the above mentioned incorrect settings results in an error and the policy database is not modified.

delete
Deleted any policy matching the indicated policy name. The system default policy (default) cannot be deleted.

The format for the delete subcommand is as follows:

delete [dbfile=dbfile] policy=policyname

The delete subcommand supports the following options:

dbfile=dbfile Read policy definitions from the indicated file. If dbfile is not specified, the default is the system KMF policy database file: /etc/security/kmpolicy.xml.
policy=policyname  The name of the policy to delete. policyname is required, if using the system database.

export  Exports a policy from one policy database file to another policy database file.  
The format for the export subcommand is as follows:  
kmfcfg export policy=policyname outfile=newdbfile [dbfile=dbfile]

The export subcommand supports the following options:

dbfile=dbfile  The DB file where the exported policy is read. If dbfile is not specified, the default is the system KMF policy database file: /etc/security/kmpolicy.xml.

outfile=outputdbfile  The DB file where the exported policy is stored.

policy=policyname  The policy record to be exported.

help  Displays help for the kmfcfg command.  
The format for the help subcommand is as follows:  
help

import  Imports a policy from one policy database file to another policy database file.  
The format for the import subcommand is as follows:  
kmfcfg import policy=policyname infile=inputdbfile [dbfile=dbfile]

The import subcommand supports the following options:

policy=policyname  The policy record to be imported.

infile=inputdbfile  The DB file to read the policy from.

dbfile=oudtputdbfile  The DB file to add the new policy. If not specified, the default is the system KMF policy database file /etc/security/kmpolicy.xml.

list  Without arguments, lists all policy definitions from the default system database.  
The format for the list subcommand is as follows:  
list [dbfile=dbfile] [policy=policyname]

The list subcommand supports the following options:

dbfile=dbfile  Reads policy definitions from the indicated file. If not specified, the default is the system KMF policy database file /etc/security/kmpolicy.xml.
policy=policyname Only display policy definition for the named policy.

modify  
Modifies any policy matching the indicated name. The system default policy (default) cannot be modified.

The format for the modify subcommand is as follows:

modify [dbfile=dbfile] policy=policyname
   [ignore-date=true|false]
   [ignore-unknown-eku=true|false]
   [ignore-trust-anchor=true|false]
   [validity-adjusttime=adjusttime]
   [ta-name=trust anchor subject DN]
   [ta-serial=trust anchor serial number]
   [ocsp-responder=URL]
   [ocsp-proxy=URL]
   [ocsp-use-cert-responder=true|false]
   [ocsp-response-lifetime=timelimit]
   [ocsp-ignore-response-sign=true|false]
   [ocsp-responder-cert-name=Issuer DN]
   [ocsp-responder-cert-serial=serial number]
   [ocsp-none=true|false]
   [crl-basefilename=basefilename]
   [crl-directory=directory]
   [crl-get-crl-uri=true|false]
   [crl-proxy=URL]
   [crl-ignore-crl-sign=true|false]
   [crl-ignore-crl-date=true|false]
   [crl-none=true|false]
   [keyusage=digitalSignature| nonRepudiation
      | keyEncipherment | dataEncipherment |
      | keyAgreement | keyCertSign |
      | cRLSign | encipherOnly | decipherOnly],[...]
   [keyusage-none=true|false]
   [ekunames=serverAuth | clientAuth |
      codeSigning | emailProtection |
      ipsecEndSystem | ipsecTunnel |
      ipsecUser | timeStamping |
      OCSPSigning],[...]
   [ekuoids=OID,OID,OID]
   [eku-none=true|false]
   [mapper-name= name of the mapper]
   [mapper-dir=dir where mapper library resides]
   [mapper-path=full pathname of mapper library]
   [mapper-options=mapper options]

The modify subcommand supports many of the same options as the create subcommand. 
For descriptions of shared options, see the create subcommand.
The modify subcommand supports the following unique options:

- **crl-none** = true | false: If **crl-none** is set to true, CRL checking is turned off. If this attribute is set to true, other CRL attributes cannot be set.

- **dfile** = [dbfile]: The database file to modify a policy. If not specified, the default is the system KMF policy database file `/etc/security/kmfpolicy.xml`.

- **eku-none** = true | false: If **eku-none** is set to true, extended key usage checking is turned off. The extended key usage attributes, ekuname and ekuids cannot be set at the same time if **eku-none** is set to true.

- **keyusage-none** = true | false: If **keyusage-none** is set to true, key usage checking is turned off. The keyusage attribute cannot be set at the same time if this attribute is set to true.

- **ocsp-none** = true | false: If **ocsp-none** is set to true, OCSP checking is turned off. Any other OCSP attribute is not set at the same time if this attribute is set to true.

- **policy** = policyname: The name of the policy to modify. **policyname** is required. The default policy in the system KMF policy database cannot be modified.

- **mapper-name** = name
- **mapper-dir** = directory
- **mapper-path** = path
- **mapper-options** = options: See the create subcommand for more information.

### Plugin Subcommands

**install keystore=keystore_name modulepath=pathname\ [option=option_str]**

Install a plugin into the system. The **modulepath** field specifies the pathname to a KMF plugin shared library object. If **pathname** is not specified as an absolute pathname, shared library objects are assumed to be relative to `/lib/security/$ISA/`. The **ISA** token is replaced by an implementation defined directory name which defines the pathname relative to the calling program's instruction set architecture.

**list plugin**

Display KMF plugin information.

Without the **plugin** keyword, `kmfcfg list` shows the policy information as described in the **SUBCOMMANDS** section.
modify plugin keystore=keystore_name option=option_str
Modify the plugin option. The plugin option is defined by the plugin and is interpreted by the plugin specifically, therefore this command accepts any option string.

Without the plugin keyword, kmfcfg modify updates the policy configuration as described in the SUBCOMMANDS section.

uninstall keystore=keystore_name
Uninstall the plugin with the keystore_name.

Examples

EXAMPLE 1  Creating a New Policy
The following example creates a new policy called IPSEC in the system database:

```bash
$ kmfcfg create IPSEC \
  ignore-trust-anchor=true \
  ocsf-use-cert-responder=true \
  keyusage=keyAgreement,keyEncipherment,dataEncipherment \
  ekuname=ipsecTunnel,ipsecUser
```

Exit Status  The following exit values are returned:

0  Successful completion.

>0  An error occurred.

Files  /etc/security/kmpolicy.xml  Default system policy database

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Uncommitted</td>
</tr>
</tbody>
</table>

See Also  attributes(5)
**Name**  
kpasswd – change a user’s Kerberos password

**Synopsis**  
/usr/bin/kpasswd [principal]

**Description**  
The `kpasswd` command is used to change a Kerberos principal’s password. `kpasswd` prompts for the current Kerberos password, which is used to obtain a `changepw` ticket from the KDC for the user’s Kerberos realm. If `kpasswd` successfully obtains the `changepw` ticket, the user is prompted twice for the new password, and the password is changed.

If the principal is governed by a policy that specifies the length and/or number of character classes required in the new password, the new password must conform to the policy. (The five character classes are lower case, upper case, numbers, punctuation, and all other characters.)

**Operands**  
The following operand is supported:

- `principal` Change the password for the Kerberos principal `principal`. Otherwise, the principal is derived from the identity of the user invoking the `kpasswd` command.

**Files**  
`/tmp/ovsec_adm.xxxxxx` Temporary credentials cache for the lifetime of the password changing operation. (`xxxxxx` is a random string.)

**Attributes**  
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/security/kerberos-5</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

**See Also**  
kerberos(5)

**Bugs**  
If `kpasswd` is suspended, the `changepw` tickets may not be destroyed.
krb5-config(1)

Name  krb5-config – link against the installed Kerberos libraries

Synopsis  krb5-config
          [--all | --cflags | --exec-prefix | --help | --libs library |
           --prefix | --vendor | --version]

Description  krb5-config identifies and displays the special flags that are needed to compile and link programs against the installed Kerberos libraries.

Options  The following options are supported:

- --all          Displays the version, vendor, prefix and exec-prefix.
- --cflags       Displays the compiler flags with which Kerberos was built.
- --exec-prefix  Displays the exec-prefix with which Kerberos was built.
- --help         Displays the usage message.
                   This is the default.
- --libs library  Displays compiler options required to link with library.
                   The following library values are supported:
                   krb5        Kerberos 5 application
                   --prefix    Displays the prefix with which Kerberos was built.
                   --vendor    Displays the vendor of the installed Kerberos implementation.
                   --version   Displays the version of the installed Kerberos implementation.

Examples  EXAMPLE 1  Using the --cflags Option

The following example displays the C compiler flags needed to use libkrb5(3LIB):

% krb5-config --cflags
-I/usr/include/kerberosv5

EXAMPLE 2  Using the --libs Option

The following example shows the C compiler options needed to link against libkrb5(3LIB):

% krb5-config --libs
-L/usr/lib -R/usr/lib -lkrb5

Exit Status  The following exit values are returned:

0         Successful completion.
>0         An error occurred.
Attributes

See *attributes(5)* for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/security/kerberos-5</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Volatile</td>
</tr>
</tbody>
</table>

See Also  *libgss(3LIB), libkrb5(3LIB), attributes(5)*
ksh(1)

Name  ksh, ksh93, rksh – Korn Shell, a standard and restricted command and programming language

Synopsis  ksh [±abcefhikmnoprstuvxBCD] [-R file] [ ±o option] ...
          [-] [arg ...]

rksh [±abcefhikmnoprstuvxBCD] [-R file] [ ±o option] ...
[-] [arg ...]

Description  ksh is a command and programming language that executes commands read from a terminal or a file. rksh is a restricted version of the command interpreter ksh. rksh is used to set up login names and execution environments whose capabilities are more controlled than those of the standard shell.

See Invocation for the meaning of arguments to the shell.

Definitions  A *metacharacter* is defined as one of the following characters:

  ; & ( ) | < > NEWLINE SPACE TAB

A *blank* is a TAB or a SPACE.

An *identifier* is a sequence of letters, digits, or underscores starting with a letter or underscore. Identifiers are used as components of *variable names*.

A *vname* is a sequence of one or more identifiers separated by a period (.) and optionally preceded by a period (.). *vnames* are used as function and variable names.

A *word* is a sequence of *characters* from the character set defined by the current locale, excluding non-quoted *metacharacters*.

A *command* is a sequence of characters in the syntax of the shell language. The shell reads each command and carries out the desired action either directly or by invoking separate utilities. A built-in command is a command that is carried out by the shell itself without creating a separate process. Some commands are built-in purely for convenience and are not documented in this manual page. Built-ins that cause side effects in the shell environment and built-ins that are found before performing a path search (see Execution) are documented in this manual page. For historical reasons, some of these built-ins behave differently than other built-ins and are called special built-ins.

Commands  A *simple-command* is a list of variable assignments (see Variable Assignments) or a sequence of *blank*-separated words which can be preceded by a list of variable assignments. See the Environment section of this manual page.

The first word specifies the name of the command to be executed. Except as specified in this section, the remaining words are passed as arguments to the invoked command. The command name is passed as argument 0. See exec(2). The *value* of a simple-command is its exit status. If it terminates normally, its value is 0-255. If it terminates abnormally, its value is 256+*signum*. The name of the signal corresponding to the exit status can be obtained by way of the -l option of the kill built-in utility.
A pipeline is a sequence of one or more commands separated by |. The standard output of each command but the last is connected by a pipe to the standard input of the next command. Each command, except possibly the last, is run as a separate process. The shell waits for the last command to terminate. The exit status of a pipeline is the exit status of the last command unless the pipefail option is enabled. Each pipeline can be preceded by the reserved word !. This causes the exit status of the pipeline to become 0 if the exit status of the last command is non-zero, and 1 if the exit status of the last command is 0.

A list is a sequence of one or more pipelines separated by ;, &|, |&|, &&|, or ||. Of these five symbols, ;, &|, and |&| have equal precedence, which is lower than that of &&| and ||. The symbols &&| and || also have equal precedence.

A semicolon (;) causes sequential execution of the preceding pipeline. An ampersand (&) causes asynchronous execution of the preceding pipeline, that is, the shell does not wait for that pipeline to finish. The symbol |& causes asynchronous execution of the preceding pipeline with a two-way pipe established to the parent shell. The standard input and output of the spawned pipeline can be written to and read from by the parent shell by applying the redirection operators <& and >& with arg p to commands and by using -p option of the built-in commands read and print. The symbol &&| (||) causes the list following it to be executed only if the preceding pipeline returns a zero (non-zero) value. One or more NEWLINEs can appear in a list instead of a semicolon, to delimit a command. The first item of the first pipeline of a list that is a simple command not beginning with a redirection, and not occurring within a while, until, or if list, can be preceded by a semicolon. This semicolon is ignored unless the showme option is enabled as described with the set built-in.

A command is either a simple-command or one of commands in the following list. Unless otherwise stated, the value returned by a command is that of the last simple-command executed in the command.

for vname [ in word ... ] ; do list ; done

Each time a for command is executed, vname is set to the next word taken from the in word list. If in word... is omitted, the for command executes the do list once for each positional parameter that is set starting from 1. Execution ends when there are no more words in the list. See Parameter Expansion.

(( [expr1] ; [expr2] ; [expr3] )) ; do list ; done

The arithmetic expression expr1 is evaluated first. The arithmetic expression expr2 is repeatedly evaluated until it evaluates to zero and when non-zero, list is executed and the arithmetic expression expr3 evaluated. If any expression is omitted, then it behaves as if it evaluated to 1. See Arithmetic Evaluation.

select vname [ in word ... ] ; do list ; done

A select command prints on standard error (file descriptor 2) the set of words, each preceded by a number. If in word... is omitted, the positional parameters starting from 1 are used instead. See Parameter Expansion. The PS3 prompt is printed and a line is read from the standard input. If this line consists of the number of one of the listed words, then the value of the variable vname is set to the word corresponding to this number. If this line
is empty, the selection list is printed again. Otherwise the value of the variable \texttt{vname} is set to \texttt{null}. The contents of the line read from standard input is saved in the variable \texttt{REPLY}. The \texttt{list} is executed for each selection until a break or EOF is encountered. If the \texttt{REPLY} variable is set to \texttt{null} by the execution of \texttt{list}, the selection list is printed before displaying the PS3 prompt for the next selection.

\texttt{case word in [ [() pattern [ | pattern ] ... ] list ;] ... esac}

A case command executes the \texttt{list} associated with the first \texttt{pattern} that matches \texttt{word}. The form of the patterns is the same as that used for file name generation. See File Name Generation.

The \texttt{;;} operator causes execution of case to terminate. If \texttt{&} is used in place of \texttt{;} the next subsequent list, if any, is executed.

\texttt{if list ; then list [ ;elif list ; then list ] ... [ ;else list ] ; fi}

The \texttt{list} following \texttt{if} is executed and, if it returns a zero exit status, the \texttt{list} following the first \texttt{then} is executed. Otherwise, the \texttt{list} following \texttt{elif} is executed, and, if its value is zero, the \texttt{list} following the next \texttt{then} is executed. Failing each successive \texttt{elif} \texttt{list}, the \texttt{else list} is executed. If the \texttt{if list} has non-zero exit status and there is no \texttt{else list}, then the \texttt{if} command returns a zero exit status.

\texttt{while list ; do list ; done}

A while command repeatedly executes the while \texttt{list} and, if the exit status of the last command in the list is zero, executes the do \texttt{list}, otherwise the loop terminates. If no commands in the do \texttt{list} are executed, then the while command returns a zero exit status, until can be used in place of while to negate the loop termination test.

\texttt{((expression))}

The \texttt{expression} is evaluated using the rules for arithmetic evaluation described in this manual page. If the value of the arithmetic expression is non-zero, the exit status is 0. Otherwise the exit status is 1.

\texttt{(list;)}

Execute list in a separate environment. If two adjacent open parentheses are needed for nesting, a SPACE must be inserted to avoid evaluation as an arithmetic command as described in this section.

\texttt{list} is simply executed. Unlike the metacharacters, ( and ), { and } are reserved words and must occur at the beginning of a line or after a ; to be recognized.

\texttt{[[ expression ]]}

Evaluates \texttt{expression} and returns a zero exit status when \texttt{expression} is true. See Conditional Expressions for a description of \texttt{expression}.

\texttt{function varname \{ list \; \} \}

\texttt{varname () \{ list ;\}
Define a function which is referenced by `varname`. A function whose `varname` contains a .
is called a discipline function and the portion of the `varname` preceding the last . must refer
to an existing variable.

The body of the function is the list of commands between { and }. A function defined with
the function `varname` syntax can also be used as an argument to the . special built-in
command to get the equivalent behavior as if the `varname()` syntax were used to define it.
See Functions.

time [ pipeline ]
If `pipeline` is omitted, the user and system time for the current shell and completed child
processes is printed on standard error. Otherwise, `pipeline` is executed and the elapsed time
as well as the user and system time are printed on standard error. The `TIMEFORMAT` variable
can be set to a format string that specifies how the timing information should be displayed.
See Shell Variables for a description of the `TIMEFORMAT` variable.

The following reserved words are recognized as reserved only when they are the first word of a
command and are not quoted:

case
do
done
else
elif
esac
for
fi
function
if
select
then
time
until
while
{}
[[ ]]!

Variable Assignments One or more variable assignments can start a simple command or can be arguments to the
typeset, export, or readonly special built-in commands. The syntax for an assignment is of
the form:

`varname=word`
`varname[word]=word`

No space is permitted between `varname` and the = or between = and `word`. 
varname=(assignlist)

No space is permitted between varname and the =. An assignlist can be one of the following:

word ...

Indexed array assignment.

[word]=word ...

Associative array assignment. If prefixed by typeset -a, creates an indexed array instead.

assignment ...

Compound variable assignment. This creates a compound variable varname with sub-variables of the form varname.name, where name is the name portion of assignment. The value of varname contains all the assignment elements. Additional assignments made to sub-variables of varname are also displayed as part of the value of varname. If no assignments are specified, varname is a compound variable allowing subsequence child elements to be defined.

typeset [options] assignment . . .

Nested variable assignment. Multiple assignments can be specified by separating each of them with a ;. The previous value is unset before the assignment.

In addition, a += can be used in place of the = to signify adding to or appending to the previous value. When += is applied to an arithmetic type, word is evaluated as an arithmetic expression and added to the current value. When applied to a string variable, the value defined by word is appended to the value. For compound assignments, the previous value is not unset and the new values are appended to the current ones provided that the types are compatible.

Comments

A word beginning with # causes that word and all the following characters up to a NEWLINE to be commented, or ignored.

Aliasing

The first word of each command is replaced by the text of an alias if an alias for this word has been defined. An alias name consists of any number of characters excluding metacharacters, quoting characters, file expansion characters, parameter expansion characters, command substitution characters, and =. The replacement string can contain any valid shell script including the metacharacters listed in the Commands section. The first word of each command in the replaced text, other than any that are in the process of being replaced, are tested for aliases. If the last character of the alias value is a BLANK then the word following the alias is also checked for alias substitution.

Aliases can be used to redefine built-in commands but cannot be used to redefine the reserved words listed in the Commands section. Aliases can be created and listed with the alias command and can be removed with the unalias command.
Aliasing is performed when scripts are read, not while they are executed. For an alias to take effect, the alias definition command has to be executed before the command which references the alias is read. The following aliases are compiled into the shell but can be unset or redefined:

```
autoload='typeset -fu'
command='command '
fc=hist
float='typeset -lE'
functions='typeset -f'
hash='alias -t --'
history='hist -l'
integer='typeset -li'
nameref='typeset -n'
nohup='nohup '
r='hist -s'
redirect='command exec'
source='command .'
stop='kill -s STOP'
suspend='kill -s STOP $$'
times='( { time;} 2>&1;)' 
type='whence -v'
```

After alias substitution is performed, each word is checked to see if it begins with an unquoted tilde (~). For tilde substitution, word also refers to the word portion of parameter expansion. See Parameter Expansion.

If it does, the word up to a / is checked to see if it matches a user name in the password database. If a match is found, the - and the matched login name are replaced by the login directory of the matched user. If no match is found, the original text is left unchanged. A ~ by itself, or in front of a /, is replaced by $HOME. A ~ followed by a + or - is replaced by the value of $PWD and $OLDPWD respectively.

In addition, when expanding a variable assignment, tilde substitution is attempted when the value of the assignment begins with a ~, and when a ~ appears after a colon (:). The : also terminates a ~ login name.

The standard output from a command enclosed in parentheses preceded by a dollar sign ($) or a pair of grave accents (""") can be used as part or all of a word. Trailing NEWLINEs are removed. In the second (obsolete) form, the string between the quotes is processed for special quoting characters before the command is executed. See Quoting.

The command substitution $(cat file) can be replaced by the equivalent but faster $(<file). The command substitution $(n<#) expands to the current byte offset for file descriptor n.
## ksh(1)

<table>
<thead>
<tr>
<th><strong>Arithmetic Substitution</strong></th>
<th>An arithmetic expression enclosed in double parentheses preceded by a dollar sign ($((arithmetic_expression))) is replaced by the value of the arithmetic expression within the double parentheses.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Process Substitution</strong></td>
<td>Process substitution is only available on versions of the UNIX operating system that support the /dev/fd directory for naming open files. Each command argument of the form <code>&lt;(list) or &gt;(list)</code> runs process list asynchronously connected to some file in /dev/fd. The name of this file becomes the argument to the command. If the form with &gt; is selected then writing on this file provides input for list. If &lt; is used, then the file passed as an argument contains the output of the list process. For example,</td>
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<tr>
<td></td>
<td>`paste &lt;(cut -f1 file1) &lt;(cut -f3 file2)</td>
</tr>
<tr>
<td></td>
<td><code> &gt;(process1) &gt;(process2)</code></td>
</tr>
<tr>
<td></td>
<td>cuts fields 1 and 3 from the files file1 and file2 respectively, pastes the results together, and sends it to the processes process1 and process2. It also displays the results to the standard output. The file, which is passed as an argument to the command, is a UNIX pipe(2). Programs that expect to lseek(2) on the file do not work.</td>
</tr>
<tr>
<td><strong>Parameter Expansion</strong></td>
<td>A parameter is a variable, one or more digits, or any of the characters *, @, #, ?, -, $, and !. A variable is denoted by a vname. To create a variable whose vname contains a , a variable whose vname consists of everything before the last . must already exist. A variable has a value and zero or more attributes. Variables can be assigned values and attributes by using the typeset special built-in command. The attributes supported by the shell are described later with the typeset special built-in command. Exported variables pass values and attributes to the environment. The shell supports both indexed and associative arrays. An element of an array variable is referenced by a subscript. A subscript for an indexed array is denoted by an arithmetic expression, (see Arithmetic Evaluation), between a [ and a ]. Use set -A vname value ... to assign values to an indexed array. The value of all subscripts must be in the range of 0 through 1,048,575. Indexed arrays do not need to be declared. Any reference to a variable with a valid subscript is legal and an array is created if necessary. An associative array is created with the -A option to typeset. A subscript for an associative array is denoted by a string enclosed between [ and ]. Referencing any array without a subscript is equivalent to referencing the array with subscript 0. The value of a variable can be assigned by:</td>
</tr>
<tr>
<td></td>
<td>vname=value [vname=value] ...</td>
</tr>
<tr>
<td></td>
<td>or</td>
</tr>
</tbody>
</table>

No space is allowed before or after the `=`. A `nameref` is a variable that is a reference to another variable. A `nameref` is created with the `-n` attribute of `typeset`. The value of the variable at the time of the `typeset` command becomes the variable that is referenced whenever the `nameref` variable is used. The name of a `nameref` cannot contain a dot (`.`). When a variable or function name contains a `.` , and the portion of the name up to the first `.` matches the name of a `nameref`, the variable referred to is obtained by replacing the `nameref` portion with the name of the variable referenced by the `nameref`. If a `nameref` is used as the index of a `for` loop, a name reference is established for each item in the list. A `nameref` provides a convenient way to refer to the variable inside a function whose name is passed as an argument to a function. For example, if the name of a variable is passed as the first argument to a function, the command

```
typeset -n var=$1
```

inside the function causes references and assignments to `var` to be references and assignments to the variable whose name has been passed to the function. If either of the floating point attributes, `-E`, or `-F`, or the integer attribute, `-i`, is set for `vname`, then the `value` is subject to arithmetic evaluation as described in this manual page. Positional parameters, parameters denoted by a number, can be assigned values with the `set` special built-in command. Parameter `$0` is set from argument zero when the shell is invoked. The character `$` is used to introduce substitutable parameters.

`${parameter}`  
The shell reads all the characters from `${` to the matching `}` as part of the same word even if it contains braces or metacharacters. The value, if any, of the parameter is substituted. The braces are required when `parameter` is followed by a letter, digit, or underscore that is not to be interpreted as part of its name, when the variable name contains a `.` , or when a variable is subscripted. If `parameter` is one or more digits then it is a positional parameter. A positional parameter of more than one digit must be enclosed in braces. If `parameter` is `*` or `@`, then all the positional parameters, starting with `$1`, are substituted and separated by a field separator character. If an array `vname` with subscript `*` or `@` is used, then the value for each of the elements is substituted, separated by the first character of the value of `IFS`.

`${#parameter}`  
If `parameter` is `*` or `@`, the number of positional parameters is substituted. Otherwise, the length of the value of the `parameter` is substituted.

`${#vname[*]}`

The number of elements in the array `vname` is substituted.
\${vname}

Expands to the name of the variable referred to by \texttt{vname}. This is \texttt{vname} except when \texttt{vname} is a name reference.

\${vname[script]}

Expands to name of the subscript unless \texttt{script} is * or @. When \texttt{script} is *, the list of array subscripts for \texttt{vname} is generated. For a variable that is not an array, the value is \texttt{0} if the variable is set. Otherwise it is \texttt{null}. When \texttt{script} is @, it is the same as \texttt{\{vname[@]\}}, except that when used in double quotes, each array subscript yields a separate argument.

\${prefix*}

Expands to the names of the variables whose names begin with \texttt{prefix}.

\{parameter: -word\}

If \texttt{parameter} is set and is non-null then substitute its value. Otherwise substitute \texttt{word}.

\texttt{word} is not evaluated unless it is to be used as the substituted string.

In the following example, \texttt{pwd} is executed only if \texttt{d} is not set or is \texttt{NULL}:

\begin{verbatim}
print \{d:-$(pwd)\}
\end{verbatim}

If the colon (:) is omitted from the expression, the shell only checks whether \texttt{parameter} is set or not.

\{parameter:offset:length\}

Expands to the portion of the value of \texttt{parameter} starting at the character (counting from \texttt{0}) determined by expanding \texttt{offset} as an arithmetic expression and consisting of the number of characters determined by the arithmetic expression defined by \texttt{length}.

In the second form, the remainder of the value is used. A negative \texttt{offset} counts backwards from the end of \texttt{parameter}.

One or more BLANKs is required in front of a minus sign to prevent the shell from interpreting the operator as \texttt{-}. If parameter is * or @, or is an array name indexed by * or @, then \texttt{offset} and \texttt{length} refer to the array index and number of elements respectively. A negative \texttt{offset} is taken relative to one greater than the highest subscript for indexed arrays. The order for associative arrays is unspecified.
If the shell pattern matches the beginning of the value of parameter, then the value of this expansion is the value of the parameter with the matched portion deleted. Otherwise the value of this parameter is substituted. In the first form the smallest matching pattern is deleted and in the second form the largest matching pattern is deleted. When parameter is @, *, or an array variable with subscript @ or *, the substring operation is applied to each element in turn.

If the shell pattern matches the end of the value of parameter, then the value of this expansion is the value of the parameter with the matched part deleted. Otherwise substitute the value of parameter. In the first form the smallest matching pattern is deleted, and in the second form the largest matching pattern is deleted. When parameter is @, *, or an array variable with subscript @ or *, the substring operation is applied to each element in turn.

Expands parameter and replaces the longest match of pattern with the specified string. Each occurrence of \n in string is replaced by the portion of parameter that matches the n\textsuperscript{th} sub-pattern.

When string is null, the pattern is deleted and the / in front of string can be omitted. When parameter is @, *, or an array variable with subscript @ or *, the substitution operation is applied to each element in turn. In this case, the string portion of word is re-evaluated for each element.

In the first form, only the first occurrence of pattern is replaced.

In the second form, each match for pattern is replaced by the specified string.

The third form restricts the pattern match to the beginning of the string.

The fourth form restricts the pattern match to the end of the string.
The following parameters are automatically set by the shell:

#  The number of positional parameters in decimal.
-  Options supplied to the shell on invocation or by the set command.
?  The decimal value returned by the last executed command.
$  The process number of this shell.
  Initially, the value of _ is the absolute pathname of the shell or script being executed as passed in the environment. It is subsequently assigned the last argument of the previous command.

This parameter is not set for commands which are asynchronous. This parameter is also used to hold the name of the matching MAIL file when checking for mail.
!
  The process number of the last background command invoked or the most recent job put in the background with the bg built-in command.

.sh.command  When processing a DEBUG trap, this variable contains the current command line that is about to run.

.sh.edchar  This variable contains the value of the keyboard character (or sequence of characters if the first character is an ESC, ASCII 033) that has been entered when processing a KEYBD trap. If the value is changed as part of the trap action, then the new value replaces the key (or key sequence) that caused the trap. See the Key Bindings section of this manual page.

.sh.edcol  The character position of the cursor at the time of the most recent KEYBD trap.

.sh.edmode  The value is set to ESC when processing a KEYBD trap while in vi insert mode. Otherwise, .sh.edmode is null when processing a KEYBD trap. See the vi Editing Mode section of this manual page.

.sh.edtext  The characters in the input buffer at the time of the most recent KEYBD trap. The value is null when not processing a KEYBD trap.

.sh.file  The pathname of the file than contains the current command.

.sh.fun  The name of the current function that is being executed.

.sh.match  An indexed array which stores the most recent match and sub-pattern matches after conditional pattern matches that match and after variables expansions using the operators #, %, or /. The 0th element stores the complete match and the ith element stores the ith sub-match. The .sh.match variable is unset when the variable that has expanded is assigned a new value.
.sh.name Set to the name of the variable at the time that a discipline function is invoked.

.sh.subscript Set to the name subscript of the variable at the time that a discipline function is invoked.

.sh.subshell The current depth for sub-shells and command substitution.

.sh.value Set to the value of the variable at the time that the set or append discipline function is invoked.

.sh.version Set to a value that identifies the version of this shell.

LINENO The current line number within the script or function being executed.

OLDPWD The previous working directory set by the cd command.

OPTARG The value of the last option argument processed by the getopts built-in command.

OPTIND The index of the last option argument processed by the getopts built-in command.

PPID The process number of the parent of the shell.

PWD The present working directory set by the cd command.

RANDOM Each time this variable is referenced, a random integer, uniformly distributed between 0 and 32767, is generated. The sequence of random numbers can be initialized by assigning a numeric value to RANDOM.

REPLY This variable is set by the select statement and by the read built-in command when no arguments are supplied.

SECONDS Each time this variable is referenced, the number of seconds since shell invocation is returned. If this variable is assigned a value, then the value returned upon reference is the value that was assigned plus the number of seconds since the assignment.

The following variables are used by the shell:

CDPATH Defines the search path for the cd command.

COLUMNS Defines the width of the edit window for the shell edit modes and for printing select lists.

EDITOR If the VISUAL variable is not set, the value of this variable is checked for the patterns as described with VISUAL and the corresponding editing option is turned on.

See the set command in the Special Command section of this manual page.
ENV

Performs parameter expansion, command substitution, and arithmetic substitution on the value to generate the pathname of the script that is executed when the shell is invoked. This file is typically used for alias and function definitions. The default value is $HOME/.kshrc.

See the Invocation section of this manual page.

ENV is not set by the shell.

FCEDIT

Obsoletename for the default editor name for the hist command. FCEDIT is not used when HISTEDIT is set.

The shell specifies a default value to FCEDIT.

IGNORE

A pattern that defines the set of file names that is ignored when performing file name matching.

FPATH

The search path for function definitions. The directories in this path are searched for a file with the same name as the function or command when a function with the -u attribute is referenced and when a command is not found. If an executable file with the name of that command is found, then it is read and executed in the current environment. Unlike PATH, the current directory must be represented explicitly by dot (.) rather than by adjacent colon (:) characters or a beginning or ending colon (:).

HISTCMD

The number of the current command in the history file.

HISTEDIT

The name for the default editor name for the hist command.

HISTFILE

If this variable is set when the shell is invoked, the value is the pathname of the file that is used to store the command history. See the Command Re-entry section of this manual page.

HISTSIZE

If this variable is set when the shell is invoked, then the number of previously entered commands that are accessible by this shell is greater than or equal to this number. The default is 512.

HOME

The default argument (home directory) for the cd command.

HOME is not set by the shell. HOME is set by login(1).

IFS

Internal field separators, normally SPACE, TAB, and NEWLINE that are used to separate the results of command substitution or parameter expansion and to separate fields with the
built-in command read. The first character of the IFS variable is used to separate arguments for the "$*" substitution. See the Quoting section of this manual page.

Each single occurrence of an IFS character in the string to be split, that is not in the isspace character class, and any adjacent characters in IFS that are in the isspace character class, delimit a field. One or more characters in IFS that belong to the isspace character class, delimit a field. In addition, if the same isspace character appears consecutively inside IFS, this character is treated as if it were not in the isspace class, so that if IFS consists of two tab characters, then two adjacent tab characters delimit a null field.

The shell specifies a default value to IFS.

**LANG**
This variable determines the locale category for any category not specifically selected with a variable starting with LC_ or LANG.

**LC_ALL**
This variable overrides the value of the LANG variable and any other LC_ variable.

**LC_COLLATE**
This variable determines the locale category for character collation information.

**LC_CTYPE**
This variable determines the locale category for character handling functions. It determines the character classes for pattern matching. See the File Name Generation section of this manual page.

**LC_NUMERIC**
This variable determines the locale category for the decimal point character.

**LINES**
If this variable is set, the value is used to determine the column length for printing select lists. Select lists prints vertically until about two-thirds of LINES lines are filled.

**MAIL**
If this variable is set to the name of a mail file and the MAILPATH variable is not set, then the shell informs the user of arrival of mail in the specified file.

**MAIL** is not set by the shell. On some systems, MAIL is set by login(1).

**MAILCHECK**
Specifies how often in seconds the shell checks for changes in the modification time of any of the files specified by the MAILPATH or MAIL variables. The default value is 600 seconds. When the time has elapsed the shell checks before issuing the next prompt.

The shell specifies a default value to MAILCHECK.
MAILPATH
A colon (:) separated list of file names. If this variable is set, then the shell informs the user of any modifications to the specified files that have occurred within the last MAILCHECK seconds. Each file name can be followed by a ? and a message that is printed. The message undergoes parameter expansion, command substitution, and arithmetic substitution with the variable $_ defined as the name of the file that has changed. The default message is you have mail in $_.

PATH
The search path for commands. Except in .profile, users cannot change PATH if executing under rksh. See the Execution section of this manual page.

The shell specifies a default value to PATH.

PS1
The value of this variable is expanded for parameter expansion, command substitution, and arithmetic substitution to define the primary prompt string which by default is $. The character ! in the primary prompt string is replaced by the command number. Two successive occurrences of ! produces a single ! when the prompt string is printed. See the Command Re-entry section of this manual page.

The shell specifies a default value to PS1.

PS2
Secondary prompt string, by default, >.

The shell specifies a default value to PS2.

PS3
Selection prompt string used within a select loop, by default #?.

The shell specifies a default value to PS3.

PS4
The value of this variable is expanded for parameter evaluation, command substitution, and arithmetic substitution and precedes each line of an execution trace. By default, PS4 is +. When PS4 is unset, the execution trace prompt is also +.

The shell specifies a default value to PS4.

SHELL
The pathname of the shell is kept in the environment. At invocation, if the basename of this variable is rsh, rksh, rksh, or krsh, the shell becomes restricted.

SHELL is not set by the shell. On some systems, SHELL is set by login(1).
TIMEFORMAT
The value of this parameter is used as a format string specifying how the timing information for pipelines prefixed with the \texttt{time} reserved word should be displayed. The \% character introduces a format sequence that is expanded to a time value or other information.

The format sequences and their meanings are as follows.

\%
A literal \%.

\%[p][l]R
The elapsed time in seconds.

\%[p][l]U
The number of CPU seconds spent in user mode.

\%[p][l]S
The number of CPU seconds spent in system mode.

\%P
The CPU percentage, computed as \((U+S)/R\).

The braces denote optional portions. The optional \(p\) is a digit specifying the \textit{precision}, the number of fractional digits after a decimal point. A value of 0 causes no decimal point or fraction to be output. At most three places after the decimal point can be displayed. Values of \(p\) greater than 3 are treated as 3. If \(p\) is not specified, the value 3 is used.

The optional \(l\) specifies a longer format, including hours if greater than zero, minutes, and seconds of the form \texttt{HHhMMmSS.FFs}. The value of \(p\) determines whether or not the fraction is included.

All other characters are output without change and a trailing NEWLINE is added. If unset, the default value, \$'\texttt{\%real\ t\%2R\ t\%2U\ t\%2S}'\', is used. If the value is null, no timing information is displayed.

TMOUT
If set to a value greater than zero, \texttt{TMOUT} is the default time-out value for the \texttt{read} built-in command. The \texttt{select} compound command terminates after \texttt{TMOUT} seconds when input is from a terminal. Otherwise, the shell terminates if a line is not entered within the prescribed number of seconds while reading from a terminal. The shell can be compiled with a maximum bound for this value which cannot be exceeded.

The shell specifies a default value to \texttt{TMOUT}.

VISUAL
If the value of this variable matches the pattern \*\texttt{[Vv][Ii]}\*, then the \texttt{vi} option is turned on. See \textit{Special Commands}. If the value matches the pattern \*\texttt{gemacs}\*, the \texttt{gemacs} option is turned on. If the value matches the pattern \*\texttt{emacs}\*, then the \texttt{emacs} option is turned on. The
value of VISUAL overrides the value of EDITOR.

Field Splitting

After parameter expansion and command substitution, the results of substitutions are scanned for the field separator characters (those found in IFS) and split into distinct fields where such characters are found. Explicit null fields ("" or '') are retained. Implicit null fields, those resulting from parameters that have no values or command substitutions with no output, are removed.

If the braceexpand (-B) option is set, each of the fields resulting from IFS are checked to see if they contain one or more of the brace patterns. Valid brace patterns: {*,*}, {l1..l2}, {n1..n2}, {n1..n2%fmt} {n1..n2..n3}, or {n1..n2..n3%fmt} , where * represents any character, l1,l2 are letters and n1,n2,n3 are signed numbers and fmt is a format specified as used by printf. In each case, fields are created by prepending the characters before the { and appending the characters after the } to each of the strings generated by the characters between the { and }. The resulting fields are checked to see if they have any brace patterns.

In the first form, a field is created for each string between { and , between , and , and between , and }. The string represented by * can contain embedded matching { and } without quoting. Otherwise, each { and } with * must be quoted.

In the second form, l1 and l2 must both be either upper case or both be lower case characters in the C locale. In this case a field is created for each character from l1 through l2.

In the remaining forms, a field is created for each number starting at n1. This continues until it reaches n2 and increments n1 by n3. The cases where n3 is not specified behave as if n3 were 1 if n1<=n2, and -1 otherwise. In forms which specify %fmt, any format flags, widths and precisions can be specified and fmt can end in any of the specifies cdioxuxX. For example, {a,z} {1..5} {3%2d} {b..c} x expands to the 8 fields, a01bx, a01cx, a04bx, a04cx, z01bx, z01cx, z04bx, and z4cx.

File Name Generation

Following splitting, each field is scanned for the characters *, ?, (, and [, unless the -f option has been set. If one of these characters appears, then the word is regarded as a pattern.

Each file name component that contains any pattern character is replaced with a lexicographically sorted set of names that matches the pattern from that directory. If no file name is found that matches the pattern, then that component of the file name is left unchanged unless the pattern is prefixed with ~- (N) in which case it is removed. If FIGNORE is set, then each file name component that matches the pattern defined by the value of FIGNORE is ignored when generating the matching file names. The names . and .. are also ignored. If FIGNORE is not set, the character . at the start of each file name component is ignored unless the first character of the pattern corresponding to this component is the character . itself. For other uses of pattern matching the / and . are not specially treated.

* Match any string, including the null string. When used for file name expansion, if the globstar option is on, two adjacent *s by themselves match all files and zero or more directories and subdirectories. If the two adjacent *s are followed by a /, only directories and subdirectories match.
? Matches any single character.

[... ] Match any one of the enclosed characters. A pair of characters separated by - matches any character lexically between the pair, inclusive. If the first character following the opening [ is a !, any character not enclosed is matched. A - can be included in the character set by putting it as the first or last character. Within [ and ], character classes can be specified with the syntax [:class:] where class is one of the following classes defined in the ANSI-C standard:

alnum alpha blank ctrl digit graph
lower print punct space upper
word xdigit

word is equivalent to alnum plus the character _. Within [ and ], an equivalence class can be specified with the syntax [:=c:] which matches all characters with the same primary collation weight (as defined by the current locale) as the character c. Within [ and ], [:symbol:] matches the collating symbol symbol.

A pattern-list is a list of one or more patterns separated from each other with an & or |. An & signifies that all patterns must be matched whereas | requires that only one pattern be matched. Composite patterns can be formed with one or more of the following sub-patterns:

?(pattern-list) Optionally matches any one of the specified patterns.
*(pattern-list) Matches zero or more occurrences of the specified patterns.
+(pattern-list) Matches one or more occurrences of the specified patterns.
{n}(pattern-list) Matches n occurrences of the specified patterns.
{m,n}(pattern-list) Matches from m to n occurrences of the specified patterns. If m is omitted, 0 is used. If n is omitted at least m occurrences are matched.
@(pattern-list) Matches exactly one of the specified patterns.
!(pattern-list) Matches anything except one of the specified patterns.

By default, each pattern, or sub-pattern matches the longest string possible consistent with generating the longest overall match. If more than one match is possible, the one starting closest to the beginning of the string is chosen. However, for each of the compound patterns a - can be inserted in front of the ( to cause the shortest match to the specified pattern-list to be used.

When pattern-list is contained within parentheses, the backslash character \ is treated specially even when inside a character class. All ANSI-C character escapes are recognized and match the specified character. In addition the following escape sequences are recognized:

\d Matches any character in the digit class.
\D Matches any character not in the digit class.
\s Matches any character in the space class.
\S Matches any character not in the space class.
\w Matches any character in the word class.
\W Matches any character not in the word class.

A pattern of the form \%(pattern-pairs) is a sub-pattern that can be used to match nested character expressions. Each pattern-pair is a two character sequence which cannot contain & or \. The first pattern-pair specifies the starting and ending characters for the match. Each subsequent pattern-pair represents the beginning and ending characters of a nested group that is skipped over when counting starting and ending character matches. The behavior is unspecified when the first character of a pattern-pair is alphanumeric except for the following:

D Causes the ending character to terminate the search for this pattern without finding a match.
E Causes the ending character to be interpreted as an escape character.
L Causes the ending character to be interpreted as a quote character causing all characters to be ignored when looking for a match.
Q Causes the ending character to be interpreted as a quote character causing all characters other than any escape character to be ignored when looking for a match.

\%(\{E\}) matches characters starting at \{ until the matching } is found not counting any { or } that is inside a double quoted string or preceded by the escape character \. Without the \{ this pattern matches any C language string.

Each sub-pattern in a composite pattern is numbered, starting at 1, by the location of the \( within the pattern. The sequence \n, where \( is a single digit and \n comes after the \n th sub-pattern, matches the same string as the sub-pattern itself.

A pattern can contain sub-patterns of the form ~(options:pattern-list), where either options or :pattern-list can be omitted. Unlike the other compound patterns, these sub-patterns are not counted in the numbered sub-patterns. If options is present, it can consist of one or more of the following:

+ Enable the following options. This is the default.
- Disable the following options.
E The remainder of the pattern uses extended regular expression syntax like the egrep(1) command.
F The remainder of the pattern uses fgrep(1) expression syntax.
g File the longest match (greedy).

This is the default.
The remainder of the pattern uses basic regular expression syntax like the `grep(1)` command.

Treat the match as case insensitive.

The remainder of the pattern uses shell pattern syntax. This is the default.

Left anchor the pattern. This is the default for \texttt{K} style patterns.

This is ignored. However, when it is the first letter and is used with file name generation, and no matches occur, the file pattern expands to the empty string.

Right anchor the pattern. This is the default for \texttt{K} style patterns.

If both \texttt{options} and \texttt{:pattern-list} are specified, then the options apply only to \texttt{pattern-list}. Otherwise, these options remain in effect until they are disabled by a subsequent \texttt{~(...)} or at the end of the sub-pattern containing \texttt{~(...)}.

Each of the metacharacters listed in the \texttt{Definitions} has a special meaning to the shell.

File the longest match (greedy). This is the default.

Treat the match as case insensitive.

If both \texttt{options} and \texttt{:pattern-list} are specified, then the options apply only to \texttt{pattern-list}. Otherwise, the options remain in effect until they are disabled by a subsequent \texttt{~(...)} or at the end of the sub-pattern containing \texttt{~(...)}.

Each of the metacharacters listed in the \texttt{Definitions} section of this manual page has a special meaning to the shell and causes termination of a word unless quoted. A character can be quoted, that is, made to stand for itself, by preceding it with a backslash \texttt{\}. The pair \texttt{\NEWLINE} is removed. All characters enclosed between a pair of single quote marks (\texttt{''}) that is not preceded by a \texttt{$} are quoted. A single quote cannot appear within the single quotes. A single quoted string preceded by an unquoted \texttt{$} is processed as an \texttt{ANSI-C} string except for the following:

\texttt{\0} Causes the remainder of the string to be ignored.\n\texttt{\cx} Expands to the character CTRL-x.\n\texttt{\C [.name.]} Expands to the collating element \texttt{name}.\n\texttt{\e} Equivalent to the escape character (ASCII 033),\n\texttt{\E} Equivalent to the escape character (ASCII 033),
Inside double quote marks (""), parameter and command substitution occur and \ quotes the characters \, '*, and $. A $ in front of a double quoted string is ignored in the C or POSIX locale, and might cause the string to be replaced by a locale specific string otherwise. The meaning of $* and $@ is identical when not quoted or when used as a variable assignment value or as a file name. However, when used as a command argument, "$*" is equivalent to "$1\$2\ldots" where d is the first character of the IFS variable, whereas "$@" is equivalent to "$1\"$2\ldots". Inside grave quote marks (''), \ quotes the characters \, ' , and $. If the grave quotes occur within double quotes, then \ also quotes the character ".

The special meaning of reserved words or aliases can be removed by quoting any character of the reserved word. The recognition of function names or built-in command names cannot be altered by quoting them.

### Arithmetic Evaluation

The shell performs arithmetic evaluation for arithmetic substitution, to evaluate an arithmetic command, to evaluate an indexed array subscript, and to evaluate arguments to the built-in commands shift and let. Arithmetic evaluation is also performed on argument operands of the built-in command printf that correspond to numeric format specifiers in the format operand. See printf(1). Evaluations are performed using double precision floating point arithmetic or long double precision floating point for systems that provide this data type. Floating point constants follow the ANSI-C programming language floating point conventions. Integer constants follow the ANSI-C programming language integer constant conventions although only single byte character constants are recognized and character casts are not recognized. Constants can be of the form [base#]n where base is a decimal number between two and sixty-four representing the arithmetic base and n is a number in that base. The digits greater than 9 are represented by the lower case letters, the upper case letters, @, and _ respectively. For bases less than or equal to 36, upper and lower case characters can be used interchangeably.

An arithmetic expression uses the same syntax, precedence, and associativity of expression as the C language. All the C language operators that apply to floating point quantities can be used. In addition, the operator ** can be used for exponentiation. It has higher precedence than multiplication and is left associative. When the value of an arithmetic variable or subexpression can be represented as a long integer, all C language integer arithmetic operations can be performed. Variables can be referenced by name within an arithmetic expression without using the parameter expansion syntax. When a variable is referenced, its value is evaluated as an arithmetic expression.

Any of the following math library functions that are in the C math library can be used within an arithmetic expression:

- abs acos acosh asin asinh atan atan2 atanh cbt
- copysign cos cosh erf erfc exp exp2 expm1 fabs
- fdim finite floor fma fmax fmod hypot ilogb
- int isinf isnan lgamma log log2 logb
- nearbyint nextafter nexttoward pow remainder

```
man pages section 1: User Commands • Last Revised 24 May 2012
```
An internal representation of a variable as a double precision floating point can be specified with the \(-E\ [n]\) or \(-F\ [n]\) option of the typeset special built-in command. The \(-E\) option causes the expansion of the value to be represented using scientific notation when it is expanded. The optional option argument \(n\) defines the number of significant figures. The \(-F\) option causes the expansion to be represented as a floating decimal number when it is expanded. The optional option argument \(n\) defines the number of places after the decimal point in this case.

An internal integer representation of a variable can be specified with the \(-i\ [n]\) option of the typeset special built-in command. The optional option argument \(n\) specifies an arithmetic base to be used when expanding the variable. If you do not specify an arithmetic base, base 10 is used.

Arithmetic evaluation is performed on the value of each assignment to a variable with the \(-E\), \(-F\), or \(-i\) option. Assigning a floating point number to a variable whose type is an integer causes the fractional part to be truncated.

When used interactively, the shell prompts with the value of \(PS1\) after expanding it for parameter expansion, command substitution, and arithmetic substitution, before reading a command. In addition, each single `!` in the prompt is replaced by the command number. A `!!` is required to place `!` in the prompt. If at any time a NEWLINE is typed and further input is needed to complete a command, then the secondary prompt, that is, the value of \(PS2\), is issued.

A conditional expression is used with the `[` compound command to test attributes of files and to compare strings. Field splitting and file name generation are not performed on the words between `[` and `]`.

Each expression can be constructed from one or more of the following unary or binary expressions:

\[-a\ file\] True, if \(file\) exists.

This option is the same as `-e`. This option is obsolete.

\[-b\ file\] True, if \(file\) exists and is a block special file.

\[-c\ file\] True, if \(file\) exists and is a character special file.

\[-d\ file\] True, if \(file\) exists and is a directory.

\[-e\ file\] True, if \(file\) exists.

\[-f\ file\] True, if \(file\) exists and is an ordinary file.

\[-g\ file\] True, if \(file\) exists and it has its setgid bit set.
<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-G file</td>
<td>True, if file exists and its group matches the effective group id of this process.</td>
</tr>
<tr>
<td>-h file</td>
<td>True, if file exists and is a symbolic link.</td>
</tr>
<tr>
<td>-k file</td>
<td>True, if file exists and it has its sticky bit set.</td>
</tr>
<tr>
<td>-L file</td>
<td>True, if file exists and is a symbolic link.</td>
</tr>
<tr>
<td>-n string</td>
<td>True, if length of string is non-zero.</td>
</tr>
<tr>
<td>-N file</td>
<td>True, if file exists and the modification time is greater than the last access time.</td>
</tr>
<tr>
<td>-o option</td>
<td>True, if option named option is on.</td>
</tr>
<tr>
<td>-o ?option</td>
<td>True, if option named option is a valid option name.</td>
</tr>
<tr>
<td>-O file</td>
<td>True, if file exists and is owned by the effective user id of this process.</td>
</tr>
<tr>
<td>-p file</td>
<td>True, if file exists and is a FIFO special file or a pipe.</td>
</tr>
<tr>
<td>-r file</td>
<td>True, if file exists and is readable by current process.</td>
</tr>
<tr>
<td>-s file</td>
<td>True, if file exists and has size greater than zero.</td>
</tr>
<tr>
<td>-S file</td>
<td>True, if file exists and is a socket.</td>
</tr>
<tr>
<td>-t fildes</td>
<td>True, if file descriptor number fildes is open and associated with a terminal device.</td>
</tr>
<tr>
<td>-u file</td>
<td>True, if file exists and it has its setuid bit set.</td>
</tr>
<tr>
<td>-w file</td>
<td>True, if file exists and is writable by current process.</td>
</tr>
<tr>
<td>-x file</td>
<td>True, if file exists and is executable by current process. If file exists and is a directory, then true if the current process has permission to search in the directory.</td>
</tr>
<tr>
<td>-z string</td>
<td>True, if length of string is zero.</td>
</tr>
</tbody>
</table>

file1 -ef file2 | True, if file1 and file2 exist and refer to the same file. |
file1 -nt file2 | True, if file1 exists and file2 does not, or file1 is newer than file2. |
file1 -ot file2 | True, if file2 exists and file1 does not, or file1 is older than file2. |
string | True, if string is not null. |
string == pattern | True, if string matches pattern. Any part of pattern can be quoted to cause it to be matched as a string. With a successful match to pattern, the .sh.match array variable contains the match and sub-pattern matches. |
string = pattern | Same as ==, but is obsolete. |
string $\neq$ pattern  True, if string does not match pattern. When the string matches the pattern the .sh.match array variable contains the match and sub-pattern matches.

string =~ ere  True if string matches the pattern ~(E) ere where ere is an extended regular expression.

string1 < string2  True, if string1 comes before string2 based on ASCII value of their characters.

string1 > string2  True, if string1 comes after string2 based on ASCII value of their characters.

In each of the following expressions, if file is of the form /dev/fd/n, where n is an integer, the test is applied to the open file whose descriptor number is n. The following obsolete arithmetic comparisons are supported:

exp1 -eq exp2  True, if exp1 is equal to exp2.

exp1 -ge exp2  True, if exp1 is greater than or equal to exp2.

exp1 -gt exp2  True, if exp1 is greater than exp2.

exp1 -le exp2  True, if exp1 is less than or equal to exp2.

exp1 -lt exp2  True, if exp1 is less than exp2.

exp1 -ne exp2  True, if exp1 is not equal to exp2.

A compound expression can be constructed from these primitives by using any of the following, listed in decreasing order of precedence:

(expression)  True, if expression is true. Used to group expressions.

! expression  True, if expression is false.

expression1 && expression2  True, if expression1 and expression2 are both true.

expression1 || expression2  True, if either expression1 or expression2 is true.

Input and Output

Before a command is executed, its input and output can be redirected using a special notation interpreted by the shell. The following can appear anywhere in a simple command or can precede or follow a command and are not passed on to the invoked command. Command substitution, parameter expansion, and arithmetic substitution occur before word or digit is used except as noted in this section. File name generation occurs only if the shell is interactive and the pattern matches a single file. Field splitting is not performed.

In each of the following redirections, if file is of the form /dev/scp/host/port, /dev/tcp/host/port, or /dev/udp/host/port, where host is a hostname or host address, and port is a service specified by name or an integer port number, then the redirection attempts to make a tcp, scp or udp connection to the corresponding socket.
No intervening space is allowed between the characters of redirection operators.

<word> Use file word as standard input (file descriptor 0).

>word Use file word as standard output (file descriptor 1). If the file does not exist then it is created. If the file exists, and the noclobber option is on, this causes an error. Otherwise, it is truncated to zero length.

>|word Same as >, except that it overrides the noclobber option.

>>word Use file word as standard output. If the file exists, then output is appended to it (by first seeking to the end-of-file). Otherwise, the file is created.

<word> Open file word for reading and writing as standard input.

<<[ - ]word The shell input is read up to a line that is the same as word after any quoting has been removed, or to an end-of-file. No parameter substitution, command substitution, arithmetic substitution or file name generation is performed on word. The resulting document, called a here-document, becomes the standard input. If any character of word is quoted, then no interpretation is placed upon the characters of the document. Otherwise, parameter expansion, command substitution, and arithmetic substitution occur, \NEWLINE is ignored, and \ must be used to quote the characters \, $, '. If - is appended to <<, then all leading tabs are stripped from word and from the document. If # is appended to <<, then leading SPACES and TABs are stripped off the first line of the document and up to an equivalent indentation is stripped from the remaining lines and from word. A tab stop is assumed to occur at every 8 columns for the purposes of determining the indentation.

<<<word A short form of here document in which word becomes the contents of the here-document after any parameter expansion, command substitution, and arithmetic substitution occur.

<&digit> The standard input is duplicated from file descriptor digit, and similarly for the standard output using >&digit. See dup(2).

<&digit- The file descriptor specified by digit is moved to standard input. Similarly for the standard output using >&digit-.

<& The standard input is closed. Similarly for the standard output using >&-.

<&p The input from the co-process is moved to standard input.

>&p The output to the co-process is moved to standard output.

<#( (expr) ) Evaluate arithmetic expression expr and position file descriptor 0 to the resulting value bytes from the start of the file. The variables CUR and EOF evaluate to the current offset and end-of-file offset respectively when evaluating expr.
The same as <# except applies to file descriptor 1.

\texttt{seekforward} \texttt{to the beginning of the next line containing pattern.}

The same as <#, except that the portion of the file that is skipped is copied to standard output.

If one of the redirection operators is preceded by a digit, with no intervening space, then the file descriptor number referred to is that specified by the digit (instead of the default 0 or 1). If one of the redirection operators other than \texttt{>&} and the \texttt{>\#} and \texttt{<\#} forms, is preceded by \texttt{\{varname\}} with no intervening space, then a file descriptor number > 10 is selected by the shell and stored in the variable \texttt{varname}. If \texttt{>&} or the any of the \texttt{>\#} and \texttt{<\#} forms is preceded by \texttt{\{varname\}} the value of \texttt{varname} defines the file descriptor to close or position. For example:

\texttt{... \textbackslash{} 2>&1}

means file descriptor 2 is to be opened for writing as a duplicate of file descriptor 1 and

\texttt{exec [n]<file}

means open \texttt{file} for reading and store the file descriptor number in variable \texttt{n}. The order in which redirections are specified is significant. The shell evaluates each redirection in terms of the \texttt{(file_descriptor, file)} association at the time of evaluation. For example:

\texttt{... \textbackslash{} 1>fname 2>&1}

first associates file descriptor 1 with file \texttt{fname}. It then associates file descriptor 2 with the file associated with file descriptor 1, that is, \texttt{fname}. If the order of redirections were reversed, file descriptor 2 would be associated with the terminal (assuming file descriptor 1 had been) and then file descriptor 1 would be associated with file \texttt{fname}. If a command is followed by \& and job control is not active, the default standard input for the command is the empty file \texttt{/dev/null}. Otherwise, the environment for the execution of a command contains the file descriptors of the invoking shell as modified by input and output specifications.

\textbf{Environment}

The \textit{environment} is a list of name-value pairs that is passed to an executed program in the same way as a normal argument list. See \texttt{environ(5)}.

The names must be \textit{identifiers} and the values are character strings. The shell interacts with the environment in several ways. On invocation, the shell scans the environment and creates a variable for each name found, giving it the corresponding value and attributes and marking it \texttt{export}. Executed commands inherit the environment. If the user modifies the values of these variables or creates new ones, using the \texttt{export} or \texttt{typeset -x} commands, they become part of the environment. The environment seen by any executed command is thus composed of any name-value pairs originally inherited by the shell, whose values can be modified by the current shell, plus any additions which must be noted in \texttt{export} or \texttt{typeset -x} commands. The
environment for any simple-command or function can be augmented by prefixing it with one or more variable assignments. A variable assignment argument is a word of the form `identifier=value`. Thus:

```
TERM=450 cmd args
```

and

```
(export TERM; TERM=450; cmd args)
```

are equivalent (as far as the execution of `cmd` is concerned except for special built-in commands listed in the `Built-Ins` section, those that are preceded with a dagger. If the obsolete `-k` option is set, all variable assignment arguments are placed in the environment, even if they occur after the command name.

The following example first prints `a=b c` and then `c`:

```
echo a=b c
set -k
echo a=b c
```

This feature is intended for use with scripts written for early versions of the shell and its use in new scripts is strongly discouraged.

Functions

For historical reasons, there are two ways to define functions, the `name()` syntax and the `function name` syntax. These are described in the `Commands` section of this manual page.

Shell functions are read in and stored internally. Alias names are resolved when the function is read. Functions are executed like commands with the arguments passed as positional parameters. See the `Execution` section of this manual page for details.

Functions defined by the `function name` syntax and called by name execute in the same process as the caller and share all files and present working directory with the caller. Traps caught by the caller are reset to their default action inside the function. A trap condition that is not caught or ignored by the function causes the function to terminate and the condition to be passed on to the caller. A trap on `EXIT` set inside a function is executed in the environment of the caller after the function completes. Ordinarily, variables is shared between the calling program and the function. However, the `typeset` special built-in command used within a function defines local variables whose scope includes the current function. They can be passed to functions that they call in the variable assignment list that precedes the call or as arguments passed as name references. Errors within functions return control to the caller.

Functions defined with the `name()` syntax and functions defined with the `function name` syntax that are invoked with the `. special built-in are executed in the caller's environment and share all variables and traps with the caller. Errors within these function executions cause the script that contains them to abort.

The special built-in command `return` is used to return from function calls.
Function names can be listed with the -f or +f option of the typeset special built-in command. The text of functions, when available, is also listed with -f. Functions can be undefined with the -f option of the unset special built-in command.

Ordinarily, functions are unset when the shell executes a shell script. Functions that need to be defined across separate invocations of the shell should be placed in a directory and the FPATH variable should contain the name of this directory. They can also be specified in the ENV file.

Each variable can have zero or more discipline functions associated with it. The shell initially understands the discipline names get, set, append, and unset but on most systems others can be added at run time via the C programming interface extension provided by the built-in utility. If the get discipline is defined for a variable, it is invoked whenever the specified variable is referenced. If the variable .sh.value is assigned a value inside the discipline function, the referenced variable is evaluated to this value instead. If the set discipline is defined for a variable, it is invoked whenever a value is appended to the specified variable. The variable .sh.value is specified the value of the variable before invoking the discipline, and the variable is assigned the value of .sh.value after the discipline completes. If .sh.value is unset inside the discipline, then that value is unchanged. If the unset discipline is defined for a variable, it is invoked whenever the specified variable is unset. The variable is not unset unless it is unset explicitly from within this discipline function.

The variable .sh.name contains the name of the variable for which the discipline function is called, .sh.subscript is the subscript of the variable, and .sh.value contains the value being assigned inside the set discipline function. For the set discipline, changing .sh.value changes the value that gets assigned.

If the monitor option of the set command is turned on, an interactive shell associates a job with each pipeline. It keeps a table of current jobs, printed by the jobs command, and assigns them small integer numbers. When a job is started asynchronously with &, the shell prints a line which looks like:

[1] 1234

indicating that the job which was started asynchronously was job number 1 and had one (top-level) process, whose process id was 1234.

If you are running a job and wish to stop it, CTRL-z sends a STOP signal to the current job. The shell normally displays a message that the job has been stopped, and displays another prompt. You can then manipulate the state of this job, putting it in the background with the bg command, or run some other commands and then eventually bring the job back into the foreground with the foreground command fg. A CTRL-z takes effect immediately and is like an interrupt in that pending output and unread input are discarded when it is typed.
A job being run in the background stops if it tries to read from the terminal. Background jobs are normally allowed to produce output, but this can be disabled by giving the command `stty to stop`. If you set this `tty` option, then background jobs stop when they try to produce output like they do when they try to read input.

There are several ways to refer to jobs in the shell. A job can be referred to by the process id of any process of the job or by one of the following:

- `%number` The job with the specified number.
- `%string` Any job whose command line begins with `string`.
- `?string` Any job whose command line contains `string`.
- `%` Current job.
- `%+` Equivalent to `%`.
- `%` Previous job.

The shell learns immediately whenever a process changes state. It normally informs you whenever a job becomes blocked so that no further progress is possible, but only just before it prints a prompt. This is done so that it does not otherwise disturb your work. The notify option of the `set` command causes the shell to print these job change messages as soon as they occur.

When the `monitor` option is on, each background job that completes triggers any trap set for `CHLD`.

When you try to leave the shell while jobs are running or stopped, you are warned that `You have stopped (running) jobs`. You can use the `jobs` command to see what they are. If you immediately try to exit again, the shell does not warn you a second time, and the stopped jobs are terminated. When a login shell receives a `HUP` signal, it sends a `HUP` signal to each job that has not been disown with the `disown` built-in command.

**Signals** The `INT` and `QUIT` signals for an invoked command are ignored if the command is followed by `&` and the `monitor` option is not active. Otherwise, signals have the values inherited by the shell from its parent. See the `trap` built-in command.

**Execution** Each time a command is read, the substitutions are carried out. If the command name matches one of the ones in the `Special Built-in Commands` section of this manual page, it is executed within the current shell process. Next, the command name is checked to see if it matches a user defined function. If it does, the positional parameters are saved and then reset to the arguments of the function call. A function is also executed in the current shell process. When the function completes or issues a return, the positional parameter list is restored. For functions defined with the `function name` syntax, any trap set on `EXIT` within the function is executed. The exit value of a function is the value of the last command executed. If a command
name is not a special built-in command or a user defined function, but it is one of the built-in commands, it is executed in the current shell process.

The shell variable **PATH** defines the search path for the directory containing the command. Alternative directory names are separated by a colon (:). The default path is `/bin:/usr/bin:`, specifying `/bin`, `/usr/bin`, and the current directory in that order. The current directory can be specified by two or more adjacent colons, or by a colon at the beginning or end of the path list. If the command name contains a slash (/), the search path is not used. Otherwise, each directory in the path is searched for an executable file of the specified name that is not a directory. If found, and if the shell determines that there is a built-in version of a command corresponding to a specified pathname, this built-in is invoked in the current process. If found, and this directory is also contained in the value of the **FPATH** variable, then this file is loaded into the current shell environment as if it were the argument to the .special built-in command and a function of the specified name is executed. Otherwise, if found, a process is created and an attempt is made to execute the command using exec(2).

When an executable is found, the directory where it is found in is searched for a file named .paths. If this file is found and it contains a line of the form BUILTIN_LIB=value, the library named by value is searched for as if it were an option argument to builtin -f, and if it contains a built-in of the specified name this is executed instead of a command by this name. Otherwise, if this file is found and it contains a line of the form name=value in the first or second line, then the environment variable name is modified by prepending the directory specified by value to the directory list. If value is not an absolute directory, then it specifies a directory relative to the directory that the executable was found. If the environment variable name does not already exist it is added to the environment list for the specified command.

If the file has execute permission but is not an a.out file, it is assumed to be a file containing shell commands. A separate shell is spawned to read it. All non-exported variables are removed in this case. If the shell command file doesn't have read permission, and/or if the setuid and setgid bits are set on the file, then the shell executes an agent whose job it is to set up the permissions and execute the shell with the shell command file passed down as an open file. A parenthesized command is executed in a sub-shell without removing non-exported variables.

**Command Re-entry**

The text of the last HISTSIZE (default 512) commands entered from a terminal device is saved in a history file. The file $HOME/.sh_history is used if the HISTFILE variable is not set or if the file it names is not writable. A shell can access the commands of all interactive shells which use the same named HISTFILE. The built-in command hist is used to list or edit a portion of this file. The portion of the file to be edited or listed can be selected by number or by giving the first
character or characters of the command. A single command or range of commands can be specified. If you do not specify an editor program as an argument to `hist` then the value of the variable `HISTEDIT` is used. If `HISTEDIT` is unset, the obsolete variable `FCEDIT` is used. If `FCEDIT` is not defined, then `/bin/ed` is used. The edited commands are printed and executed again upon leaving the editor unless you quit without writing. The `-s` option (and in obsolete versions, the editor name `-`) is used to skip the editing phase and to re-execute the command. In this case a substitution parameter of the form `old=new` can be used to modify the command before execution. For example, with the preset alias `r`, which is aliased to `hist -s`, typing `r bad=good c` re-executes the most recent command which starts with the letter `c`, replacing the first occurrence of the string `bad` with the string `good`.

Normally, each command line entered from a terminal device is simply typed followed by a `NEWLINE` (RETURN or LINE FEED). If either the `emacs`, `gmacs`, or `vi` option is active, the user can edit the command line. To be in either of these edit modes set the corresponding option. An editing option is automatically selected each time the `VISUAL` or `EDITOR` variable is assigned a value ending in either of these option names.

The editing features require that the user’s terminal accept RETURN as carriage return without line feed and that a SPACE must overwrite the current character on the screen.

Unless the `multiline` option is on, the editing modes implement a concept where the user is looking through a window at the current line. The window width is the value of `COLUMNS` if it is defined, otherwise 80. If the window width is too small to display the prompt and leave at least 8 columns to enter input, the prompt is truncated from the left. If the line is longer than the window width minus two, a mark is displayed at the end of the window to notify the user. As the cursor moves and reaches the window boundaries the window is centered about the cursor. The mark is a `>` ( `<`, `*`) if the line extends on the right, left, or both sides of the window.

The search commands in each edit mode provide access to the history file. Only strings are matched, not patterns, although a leading `^` in the string restricts the match to begin at the first character in the line.

Each of the edit modes has an operation to list the files or commands that match a partially entered word. When applied to the first word on the line, or the first word after a `;`, `,`, `&`, or `(`, and the word does not begin with `~` or contain a `/`, the list of aliases, functions, and executable commands defined by the `PATH` variable that could match the partial word is displayed. Otherwise, the list of files that match the specified word is displayed. If the partially entered word does not contain any file expansion characters, a `*` is appended before generating these lists. After displaying the generated list, the input line is redrawn. These operations are called command name listing and file name listing, respectively. There are additional operations, referred to as command name completion and file name completion, which compute the list of matching commands or files, but instead of printing the list, replace the current word with a complete or partial match. For file name completion, if the match is unique, a `/` is appended if the file is a directory and a space is appended if the file is not a directory. Otherwise, the longest common prefix for all the matching files replaces the word. For command name
completion, only the portion of the file names after the last / are used to find the longest command prefix. If only a single name matches this prefix, then the word is replaced with the command name followed by a space. When using a TAB for completion that does not yield a unique match, a subsequent TAB provides a numbered list of matching alternatives. A specific selection can be made by entering the selection number followed by a TAB.

Key Bindings

The KEYBD trap can be used to intercept keys as they are typed and change the characters that are actually seen by the shell. This trap is executed after each character (or sequence of characters when the first character is ESC) is entered while reading from a terminal.

The variable .sh.edchar contains the character or character sequence which generated the trap. Changing the value of .sh.edchar in the trap action causes the shell to behave as if the new value were entered from the keyboard rather than the original value. The variable .sh.edcol is set to the input column number of the cursor at the time of the input. The variable .sh.edmode is set to ESC when in vi insert mode and is null otherwise. By prepending ${.sh.edmode} to a value assigned to .sh.edchar it causes the shell to change to control mode if it is not already in this mode.

This trap is not invoked for characters entered as arguments to editing directives, or while reading input for a character search.

emacs Editing Mode

This mode is entered by enabling either the emacs or gmacs option. The only difference between these two modes is the way they handle ^T. To edit, the user moves the cursor to the point needing correction and then inserts or deletes characters or words as needed. All the editing commands are control characters or escape sequences. The notation for control characters is caret (^) followed by the character.

For example, ^F is the notation for CTRL/F. This is entered by depressing f while holding down the CTRL (control) key. The SHIFT key is not depressed. (The notation ^? indicates the DEL (delete) key.)

The notation for escape sequences is M- followed by a character. For example, M- f (pronounced Meta f) is entered by depressing ESC (ASCII 033) followed by f. M-F is the notation for ESC followed by F.

All edit commands operate from any place on the line, not just at the beginning. The RETURN or the LINE FEED key is not entered after edit commands except when noted.

^F Move the cursor forward (right) one character.
M- [C Move the cursor forward (right) one character.
M- f Move the cursor forward one word. The emacs editor’s idea of a word is a string of characters consisting of only letters, digits and underscores.
^B Move the cursor backward (left) one character.
M- [D Move the cursor backward (left) one character.
M-b  Move the cursor backward one word.
^A   Move the cursor to the beginning of the line.
M- [H Move the cursor to the beginning of the line.
^E   Move the cursor to the end of the line.
M- [Y Move the cursor to the end of line.
^} char Move the cursor forward to the character char on the current line.
M- ^} char Move the cursor backwards to the character char on the current line.
^X^X Interchange the cursor and the mark.
erase Delete the previous character. The user-defined erase character is defined by the
     stty(1) command, and is usually ^H or #.
lnext Removes the next character’s editing features. The user-defined literal next
     character is defined by the stty(1) command, or is ^V if not defined.
^D   Delete the current character.
M- d  Delete the current word.
M- ^H MetaBACKSPACE. Delete the previous word.
M- h  Delete the previous word.
M- ^? MetaDEL. Delete the previous word. If your interrupt character is ^? (DEL, the
     default), this command does not work.
^T   Transpose the current character with the previous character, and advance the
     cursor in emacs mode. Transpose two previous characters in gnuacs mode.
^C   Capitalize the current character.
M- c  Capitalize the current word.
M- l  Change the current word to lower case.
^K   Delete from the cursor to the end of the line. If preceded by a numerical
     parameter whose value is less than the current cursor position, delete from
     specified position up to the cursor. If preceded by a numerical parameter whose
     value is greater than the current cursor position, then delete from cursor up to
     specified cursor position.
^W   Kill from the cursor to the mark.
M- p  Push the region from the cursor to the mark on the stack.
**kill**  
Kill the entire current line. The user-defined kill character is defined by the `stty(1)` command, usually a ^G or @. If two kill characters are entered in succession, all kill characters from then on cause a line feed. This is useful when using paper terminals.

^Y  
Restore the last item removed from line. Yank the item back to the line.

^L  
Line feed and print the current line.

M-^L  
Clear the screen.

^@  
Null character. Set mark.

M-space  
MetaSPACE. Set the mark.

^J  
New line. Execute the current line.

^M  
Return. Execute the current line.

EOF  
End-of-file character, normally ^D, is processed as an end-of-file only if the current line is null.

^P  
Fetch the previous command. Each time ^P is entered the previous command back in time is accessed. Moves back one line when it is not on the first line of a multi-line command.

M-[A  
Equivalent to ^P.

M-<  
Fetch the least recent (oldest) history line.

M->  
Fetch the most recent (youngest) history line.

^N  
Fetch the next command line. Each time ^N is entered the next command line forward in time is accessed.

M-[B  
Equivalent to ^N.

^Rstring  
Reverse search history for a previous command line containing string. If a parameter of zero is specified, the search is forward. string is terminated by a RETURN or NEWLINE. If string is preceded by a ^, the matched line must begin with string. If string is omitted, then the next command line containing the most recent string is accessed. In this case a parameter of zero reverses the direction of the search.

^O  
Operate. Execute the current line and fetch the next line relative to current line from the history file.

M-digits  
Escape. Define numeric parameter. The digits are taken as a parameter to the next command. The commands that accept a parameter are: ^F, ^B, ERASE, ^C, ^D, ^K, ^R, ^P, ^N, ^ ], M- . , M-, M- ^ ], M- . , M- =, M- b, M- c, M- d, M- f, M- h, M- l, and M- ^H.
<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-letter</td>
<td>Soft-key. Search the alias list for an alias by the name <em>letter</em>. If an alias of <em>letter</em> is defined, insert its value on the input queue. <em>letter</em> must not be one of the metafunctions in this section.</td>
</tr>
<tr>
<td>M-[letter]</td>
<td>Soft key. Search the alias list for an alias by the name <em>letter</em>. If an alias of this name is defined, insert its value on the input queue. This can be used to program function keys on many terminals.</td>
</tr>
<tr>
<td>M- .</td>
<td>The last word of the previous command is inserted on the line. If preceded by a numeric parameter, the value of this parameter determines which word to insert rather than the last word.</td>
</tr>
<tr>
<td>M- _</td>
<td>Same as M-.</td>
</tr>
<tr>
<td>M- *</td>
<td>Attempt filename generation on the current word. An asterisk is appended if the word does not match any file or contain any special pattern characters.</td>
</tr>
<tr>
<td>M- ESC</td>
<td>Command or file name completion as described in this manual page.</td>
</tr>
<tr>
<td>^ITAB</td>
<td>Attempts command or file name completion as described in this manual page. If a partial completion occurs, repeating this behaves as if M-= were entered. If no match is found or entered after SPACE, a TAB is inserted.</td>
</tr>
<tr>
<td>M- =</td>
<td>If not preceded by a numeric parameter, generates the list of matching commands or file names as described in this manual page. Otherwise, the word under the cursor is replaced by the item corresponding to the value of the numeric parameter from the most recently generated command or file list. If the cursor is not on a word, the word is inserted instead.</td>
</tr>
<tr>
<td>^U</td>
<td>Multiply parameter of next command by 4.</td>
</tr>
<tr>
<td>\</td>
<td>Escape the next character. Editing characters, the user's <code>erase</code>, <code>kill</code> and <code>interrupt</code> (normally <code>^[?</code> ) characters can be entered in a command line or in a search string if preceded by a . The \ removes the next character's editing features, if any.</td>
</tr>
<tr>
<td>M- ^V</td>
<td>Display the version of the shell.</td>
</tr>
<tr>
<td>M- #</td>
<td>If the line does not begin with a #, a # is inserted at the beginning of the line and after each NEWLINE, and the line is entered. This causes a comment to be inserted in the history file. If the line begins with a #, the # is deleted and one # after each NEWLINE is also deleted.</td>
</tr>
</tbody>
</table>

**vi Editing Mode**

There are two typing modes. Initially, when you enter a command you are in the input mode. To edit, the user enters control mode by typing ESC (033) and moves the cursor to the point needing correction and then inserts or deletes characters or words as needed. Most control commands accept an optional repeat *count* prior to the command.

When in vi mode on most systems, canonical processing is initially enabled and the command is echoed again if the speed is 1200 baud or greater and it contains any control characters or
less than one second has elapsed since the prompt was printed. The ESC character terminates
canonical processing for the remainder of the command and the user can then modify the
command line. This scheme has the advantages of canonical processing with the type-ahead
echoing of raw mode.

If the option \texttt{viraw} is also set, the terminal is always have canonical processing disabled. This
mode is implicit for systems that do not support two alternate end of line delimiters, and
might be helpful for certain terminals.

\textbf{Input Edit Commands}

By default the editor is in input mode.

The following input edit commands are supported:

- \texttt{ERASE} User defined erase character as defined by the \texttt{stty} command, usually \texttt{^H} or \texttt{#}. Delete previous character.
- \texttt{^w} Delete the previous blank separated word. On some systems the \texttt{viraw} option might be required for this to work.
- \texttt{EOF} As the first character of the line causes the shell to terminate unless the \texttt{ignoreeof} option is set. Otherwise this character is ignored.
- \texttt{lnext} User defined literal next character as defined by the \texttt{stty(1)} or \texttt{^V} if not defined. Removes the next character’s editing features, if any. On some systems the \texttt{viraw} option might be required for this to work.
- \texttt{\} Escape the next ERASE or KILL character.
- \texttt{^I TAB} Attempts command or file name completion as described in this manual page and returns to input mode. If a partial completion occurs, repeating this behaves as if \texttt{=} were entered from control mode. If no match is found or entered after \texttt{SPACE}, a TAB is inserted.

\textbf{Motion Edit Commands}

The motion edit commands move the cursor.

The following motion edit commands are supported:

- \texttt{[count]\texttt{\}} Move the cursor forward (right) one character.
- \texttt{[count][C} Move the cursor forward (right) one character.
- \texttt{[count]w} Move the cursor forward one alphanumeric word.
- \texttt{[count]W} Move the cursor to the beginning of the next word that follows a blank.
- \texttt{[count]e} Move the cursor to the end of the word.
- \texttt{[count]E} Move the cursor to the end of the current blank delimited word.
[count]h  Move the cursor backward (left) one character.
[count]D  Move the cursor backward (left) one character.
[count]b  Move the cursor backward one word.
[count]B  Move the cursor to the preceding blank separated word.
[count]|  Move the cursor to column count.
[count]fc  Find the next character c in the current line.
[count]Fc  Find the previous character c in the current line.
[count]tC  Equivalent to f followed by h.
[count]tC  Equivalent to F followed by 1.
[count];  Repeat count times the last single character find command: f, F, t, or T.
[count],  Reverse the last single character find command count times.
0       Move the cursor to the start of line.
^       Move the cursor to start of line.
[H       Move the cursor to the first non-blank character in the line.
$       Move the cursor to the end of the line.
[Y       Move the cursor to the end of the line.
%       Moves to balancing (, ), {, }, [, or ]. If cursor is not on one of the characters described in this section, the remainder of the line is searched for the first occurrence of one of the characters first.

Search Edit Commands

The search edit commands access your command history.

The following search edit commands are supported:
[count]k  Fetch the previous command. Each time k is entered, the previous command back in time is accessed.
[count]-  Fetch the previous command. Each time k is entered, the previous command back in time is accessed.
               Equivalent to k.
[count][A  Fetch the previous command. Each time k is entered, the previous command back in time is accessed.
               Equivalent to k.
<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>[count]j</code></td>
<td>Fetch the next command. Each time <code>j</code> is entered, the next command forward in time is accessed.</td>
</tr>
<tr>
<td><code>[count]+</code></td>
<td>Fetch the next command. Each time <code>j</code> is entered, the next command forward in time is accessed. Equivalent to <code>j</code>.</td>
</tr>
<tr>
<td><code>[count][B</code></td>
<td>Fetch the next command. Each time <code>j</code> is entered, the next command forward in time is accessed. Equivalent to <code>j</code>.</td>
</tr>
<tr>
<td><code>[count]G</code></td>
<td>Fetch command number <code>count</code>. The default is the least recent history command.</td>
</tr>
<tr>
<td><code>/string</code></td>
<td>Search backward through history for a previous command containing <code>string</code>. <code>string</code> is terminated by a RETURN or NEWLINE. If <code>string</code> is preceded by a <code>^</code>, the matched line must begin with <code>string</code>. If <code>string</code> is null, the previous string is used.</td>
</tr>
<tr>
<td><code>?string</code></td>
<td>Search forward through history for a previous command containing <code>string</code>. <code>string</code> is terminated by a RETURN or NEWLINE. If <code>string</code> is preceded by a <code>^</code>, the matched line must begin with <code>string</code>. If <code>string</code> is null, the previous string is used. Same as <code>/</code> except that search is in the forward direction.</td>
</tr>
<tr>
<td><code>n</code></td>
<td>Search in the backwards direction for the next match of the last pattern to <code>/</code> or <code>?</code> commands.</td>
</tr>
<tr>
<td><code>N</code></td>
<td>Search in the forward direction for the next match of the last pattern to <code>/</code> or <code>?</code>.</td>
</tr>
</tbody>
</table>

**Text Modification Edit Commands**

The following commands modify the line:

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>a</code></td>
<td>Enter input mode and enter text after the current character.</td>
</tr>
<tr>
<td><code>A</code></td>
<td>Append text to the end of the line. Equivalent to <code>$a</code>.</td>
</tr>
<tr>
<td><code>[count]c motion</code></td>
<td>Delete current character through the character that <code>motion</code> would move the cursor to and enter input mode. If <code>motion</code> is <code>c</code>, the entire line is deleted and input mode entered.</td>
</tr>
<tr>
<td><code>C</code></td>
<td>Delete the current character through the end of line and enter input mode. Equivalent to <code>c$</code>.</td>
</tr>
<tr>
<td><code>S</code></td>
<td>Equivalent to <code>cc</code>.</td>
</tr>
</tbody>
</table>
[count]s  Replace characters under the cursor in input mode.
D[count]motion  Delete the current character through the end of line. Equivalent to d$.
d[count]motion  Delete current character through the character that motion would move to. If motion is d, the entire line is deleted.
i  Enter input mode and insert text before the current character.
I  Insert text before the beginning of the line. Equivalent to 0i.
[count]P  Place the previous text modification before the cursor.
[count]p  Place the previous text modification after the cursor.
R  Enter input mode and replace characters on the screen with characters you type overlay fashion.
[count]rc  Replace the count characters starting at the current cursor position with c, and advance the cursor.
[count]x  Delete current character.
[count]X  Delete preceding character.
[count]  Repeat the previous text modification command.
[count]~  Invert the case of the count characters starting at the current cursor position and advance the cursor.
[count]_  Causes the count word of the previous command to be appended and input mode entered. The last word is used if count is omitted.
*  Causes an * to be appended to the current word and file name generation attempted. If no match is found, it rings the bell. Otherwise, the word is replaced by the matching pattern and input mode is entered.
\  Command or file name completion as described in this manual page.

Other Edit Commands

The following miscellaneous edit commands are supported:

[count]ymotion  Yank the current character through the character to which motion would move the cursor. Put the yanked characters in the delete buffer. The text and cursor position are unchanged.

yy  Yank the current line.
Y  Yank the current line from the current cursor location to the end of the line. Equivalent to y$.
u  Undo the last text modifying command.
Undo all the text modifying commands performed on current line.

[count]V Return the command:

```
hist - e ${VISUAL::${EDITOR::vi}} count
```
in the input buffer. If count is omitted, the current line is used.

^L Line feed and print the current line. This command only works in control mode.

^J New line. Execute the current line, regardless of mode.

^M Return. Execute the current line, regardless of mode.

# If the first character of the command is a #, delete this # and each # that follows a NEWLINE.

Otherwise, send the line after inserting a # in front of each line in the command.

This is command is useful for causing the current line to be inserted in the history as a comment and un-commenting previously commented commands in the history file.

[count]= If count is not specified, generate the list of matching commands or file names as described in this manual page.

Otherwise, replace the word at the current cursor location with the count item from the most recently generated command or file list. If the cursor is not on a word, it is inserted after the current cursor location.

@letter Search your alias list for an alias by the name letter. If an alias of this name is defined, insert its value on the input queue for processing.

^V Display version of the shell.

---

**Built-in Commands**

The following simple-commands are executed in the shell process. Input and output redirection is permitted. Unless otherwise indicated, the output is written on file descriptor 1 and the exit status, when there is no syntax error, is 0. Except for ;, true, false, echo, newgrp, and login, all built-in commands accept - - to indicate the end of options. They also interpret the option - -man as a request to display the manual page onto standard error and - -? as a help request which prints a usage message on standard error.

Commands that are preceded by one or two ++ symbols are special built-in commands and are treated specially in the following ways:

1. Variable assignment lists preceding the command remain in effect when the command completes.

2. I/O redirections are processed after variable assignments.
3. Errors cause a script that contains them to abort.
4. They are not valid function names.
5. Words following a command preceded by ++ that are in the format of a variable assignment are expanded with the same rules as a variable assignment. This means that tilde substitution is performed after the = sign and field splitting and file name generation are not performed.

```
++ : [arg ...]
The command only expands parameters.
++ . name [arg ...]
If name is a function defined with the function name reserved word syntax, the function is executed in the current environment (as if it had been defined with the name() syntax.) Otherwise if name refers to a file, the file is read in its entirety and the commands are executed in the current shell environment. The search path specified by PATH is used to find the directory containing the file. If any arguments arg are specified, they become the positional parameters while processing the . command and the original positional parameters are restored upon completion. Otherwise the positional parameters are unchanged. The exit status is the exit status of the last command executed.
```

```
++ alias [-ptx] [name[ =value]] ...
alias with no arguments prints the list of aliases in the form name=value on standard output. The -p option causes the word alias to be inserted before each one. When one or more arguments are specified, an alias is defined for each name whose value is specified. A trailing space in value causes the next word to be checked for alias substitution. The obsolete -t option is used to set and list tracked aliases. The value of a tracked alias is the full pathname corresponding to the specified name. The value becomes undefined when the value of PATH is reset but the alias remains tracked. Without the -t option, for each name in the argument list for which no value is specified, the name and value of the alias is printed. The obsolete -x option has no effect. The exit status is non-zero if a name is specified, but no value, and no alias has been defined for the name.
```

```
bg [ job ...]
This command is only on systems that support job control. Puts each specified job into the background. The current job is put in the background if job is not specified. See the Jobs section of this manual page for a description of the format of job.
```

```
break [ n]
Exit from the enclosing for, while, until, or select loop, if any. If n is specified, then break n levels.
```

```
builtin [-ds] [-f file] [name ...]
If name is not specified, and no -f option is specified, the built-ins are printed on standard output. The -s option prints only the special built-ins. Otherwise, each name represents the pathname whose basename is the name of the built-in. The entry point function name is determined by prepending b to the built-in name. The ISO C/C++ prototype is bmycommand(int argc, char *argv[], void *context) for the built-in command mycommand
```
where `argv` is an array of `argc` elements and `context` is an optional pointer to a `Shell_t` structure as described in `<ast/shell.h>`. Special built-ins cannot be bound to a pathname or deleted. The `-d` option deletes each of the specified built-ins. On systems that support dynamic loading, the `-f` option names a shared library containing the code for built-ins. The shared library prefix and/or suffix, which depend on the system, can be omitted. Once a library is loaded, its symbols become available for subsequent invocations of `builtin`. Multiple libraries can be specified with separate invocations of the `builtin` command. Libraries are searched in the reverse order in which they are specified. When a library is loaded, it looks for a function in the library whose name is `lib_init()` and invokes this function with an argument of 0.

```bash
cd [-LP] [arg]
```

This command has two forms.

In the first form it changes the current directory to `arg`. If `arg` is a `-`, the directory is changed to the previous directory. The shell variable `HOME` is the default `arg`. The variable `PWD` is set to the current directory. The shell variable `CDPATH` defines the search path for the directory containing `arg`. Alternative directory names are separated by a colon (`:`). The default path is `NULL` (specifying the current directory). The current directory is specified by a null path name, which can appear immediately after the equal sign or between the colon delimiters anywhere else in the path list. If `arg` begins with a `/`, the search path is not used. Otherwise, each directory in the path is searched for `arg`.

The second form of `cd` substitutes the string `new` for the string `old` in the current directory name, `PWD`, and tries to change to this new directory. By default, symbolic link names are treated literally when finding the directory name. This is equivalent to the `-L` option. The `-P` option causes symbolic links to be resolved when determining the directory. The last instance of `-L` or `-P` on the command line determines which method is used. The `cd` command cannot be executed by `rksh`.

```bash
command [-pVx] name [arg ...]
```

Without the `-v` or `-V` options, executes `name` with the arguments specified by `arg`.

The `-p` option causes a default path to be searched rather than the one defined by the value of `PATH`. Functions are not searched when finding `name`. In addition, if `name` refers to a special built-in, none of the special properties associated with the leading daggers are honored. For example, the predefined alias `redirect='command exec'` prevents a script from terminating when an invalid redirection is specified.

With the `-x` option, if command execution would result in a failure because there are too many arguments, `errno E2BIG`, the shell invokes command `name` multiple times with a subset of the arguments on each invocation. Arguments that occur prior to the first word that expands to multiple arguments and after the last word that expands to multiple arguments are passed on each invocation. The exit status is the maximum invocation exit status.
With the -v option, command is equivalent to the built-in whence command described in this section. The -V option causes command to act like whence -v.

+continue [n]
   Resumes the next iteration of the enclosing for, while, until, or select loop. If n is specified, then resume at the nth enclosing loop.

disown [job...]
   Causes the shell not to send a HUP signal to each specified job, or all active jobs if job is omitted, when a login shell terminates.

echo [arg...]
   When the first arg does not begin with a -, and none of the arguments contain a backslash (\), prints each of its arguments separated by a SPACE and terminated by a NEWLINE. Otherwise, the behavior of echo is system dependent and printf described in this section should be used. See echo(1) for usage and description.

+eval [arg...]
   The arguments are read as input to the shell and the resulting commands are executed.

+exec [-c] [-a name ...] [arg...]
   If arg is specified, the command specified by the arguments is executed in place of this shell without creating a new process. The -c option causes the environment to be cleared before applying variable assignments associated with the exec invocation. The -a option causes name rather than the first arg, to become argv[0] for the new process. Input and output arguments can appear and affect the current process. If arg is not specified, the effect of this command is to modify file descriptors as prescribed by the input/output redirection list. In this case, any file descriptor numbers greater than 2 that are opened with this mechanism are closed when invoking another program.

+exit [n]
   Causes the shell to exit with the exit status specified by n. The value is the least significant 8 bits of the specified status. If n is omitted, then the exit status is that of the last command executed. An end-of-file also causes the shell to exit except for a shell which has the ignoreeof option turned on. See set.

++export [-p] [name[=value]] ...
   If name is not specified, the names and values of each variable with the export attribute are printed with the values quoted in a manner that allows them to be re-entered. The -p option causes the word export to be inserted before each one. Otherwise, the specified names are marked for automatic export to the environment of subsequently-executed commands.

false
   Does nothing, and exits 1. Used with until for infinite loops.
This command is only on systems that support job control. Each job specified is brought to
the foreground and waited for in the specified order. Otherwise, the current job is brought
into the foreground. See Jobs for a description of the format of job.

getconf [name [pathname]]
Prints the current value of the configuration parameter specified by name. The
configuration parameters are defined by the IEEE POSIX 1003.1 and IEEE POSIX 1003.2
standards. See pathconf(2) and sysconf(3C).

The pathname argument is required for parameters whose value depends on the location in
the file system. If no arguments are specified, getconf prints the names and values of the
current configuration parameters. The pathname / is used for each of the parameters that
requires pathname.

getopts [-a] optstring vname [arg ...]
Checks arg for legal options. If arg is omitted, the positional parameters are used. An
option argument begins with a + or a -. An option that does not begin with + or - or the
argument - - ends the options. Options beginning with + are only recognized when
optstring begins with a +. optstring contains the letters that getopts recognizes. If a letter is
followed by a :, that option is expected to have an argument. The options can be separated
from the argument by blanks. The option -?causes getopts to generate a usage message on
standard error. The -a option can be used to specify the name to use for the usage message,
which defaults to $0. getopts places the next option letter it finds inside variable vname
each time it is invoked. The option letter is prepended with a + when arg begins with a +.
The index of the next arg is stored in OPTIND. The option argument, if any, gets stored in
OPTARG. A leading : in optstring causes getopts to store the letter of an invalid option in
OPTARG, and to set vname to ? for an unknown option and to: when a required option
argument is missing. Otherwise, getopts prints an error message. The exit status is
non-zero when there are no more options. There is no way to specify any of the options ;,
+, -, ?, [], and . The option # can only be specified as the first option.

hist [ -e ename] [-nrl] [first[last]]
hist -s [old=new ] [ command]
In the first form, a range of commands from first to last is selected from the last HISTSIZE
commands that were typed at the terminal. The arguments first and last can be specified as
a number or as a string. A string is used to locate the most recent command starting with
the specified string. A negative number is used as an offset to the current command
number. If the -l option is selected, the commands are listed on standard output.
Otherwise, the editor program ename is invoked on a file containing these keyboard
commands. If ename is not supplied, then the value of the variable HISTEDIT is used. If
HISTEDIT is not set, then FEDIT (default /bin/ed) is used as the editor. When editing is
complete, the edited command(s) is executed if the changes have been saved. If last is not
specified, then it is set to first. If first is not specified, the default is the previous command
for editing and -16 for listing. The option -r reverses the order of the commands and the
option -n suppresses command numbers when listing. In the second form, command is
interpreted as first described in this section and defaults to the last command executed. The resulting command is executed after the optional substitution old=new is performed.

**jobs -lnp [job ...]**

Lists information about each specified job, or all active jobs if job is omitted. The -l option lists process ids in addition to the normal information. The -n option only displays jobs that have stopped or exited since last notified. The -p option causes only the process group to be listed. See Jobs for a description of the format of job.

**kill [-s signame] job ...**

**kill [-n signum] job ...**

**kill -l [sig...]**

Sends either the TERM (terminate) signal or the specified signal to the specified jobs or processes. Signals are either specified by number with the -n option or by name with the -s option (as specified in <signal.h>, stripped of the prefix 'SIG with the exception that SIGCLD is named CHLD). For backward compatibility, the n and s can be omitted and the number or name placed immediately after the -. If the signal being sent is TERM (terminate) or HUP (hang up), then the job or process is sent a CONT (continue) signal if it is stopped. The argument job can be the process id of a process that is not a member of one of the active jobs. See Jobs for a description of the format of job. In the third form, kill -l, if sig is not specified, the signal names are listed. Otherwise, for each sig that is a name, the corresponding signal number is listed. For each sig that is a number, the signal name corresponding to the least significant 8 bits of sig is listed.

**let [arg ...]**

Each arg is a separate arithmetic expression to be evaluated. See the Arithmetic Evaluation section of this manual page for a description of arithmetic expression evaluation. The exit status is 0 if the value of the last expression is non-zero, and 1 otherwise.

**+newgrp [arg ...]**

Equivalent to exec /bin/newgrp arg ...

**print [-Renprs] [-u unit] [-f format] [arg ...]**

With no options or with option - or --, each arg is printed on standard output. The -f option causes the arguments to be printed as described by printf. In this case, any e, n, r, or R options are ignored. Otherwise, unless the -R or -r, are specified, the following escape conventions are applied:

- \a Alert character (ASCII 07)
- \b Backspace character (ASCII 010)
- \c Causes print to end without processing more arguments and not adding a NEWLINE
- \f Form-feed character (ASCII 014)
- \n NEWLINE character (ASCII 012)
\r  RETURN character (ASCII 015)
\t  TAB character (ASCII 011)
\v  Vertical TAB character (ASCII 013)
\E  Escape character (ASCII 033)
\\ Backslash character \n\0x  Character defined by the 1, 2, or 3-digit octal string specified by x

The -R option prints all subsequent arguments and options other than -n. The -e causes the escape conventions to be applied. This is the default behavior. It reverses the effect of an earlier -r. The -p option causes the arguments to be written onto the pipe of the process spawned with | & instead of standard output. The -s option causes the arguments to be written onto the history file instead of standard output. The -u option can be used to specify a one digit file descriptor unit number unit on which the output is placed. The default is 1. If the option -n is used, no NEWLINE is added to the output.

printf format[arg ...]
The arguments arg are printed on standard output in accordance with the ANSI-C formatting rules associated with the format string format. If the number of arguments exceeds the number of format specifications, the format string is reused to format remaining arguments. The following extensions can also be used: A %b format can be used instead of %s to cause escape sequences in the corresponding arg to be expanded as described in printf. A %B option causes each of the arguments to be treated as variable names and the binary value of the variables is printed. This is most useful for variables with an attribute of b. A %h format can be used instead of %s to cause characters in arg that are special in HTML and XML to be output as their entity name. A %P format can be used instead of %s to cause arg to be interpreted as an extended regular expression and be printed as a shell pattern. A %R format can be used instead of %s to cause arg to be interpreted as a shell pattern and to be printed as an extended regular expression. A %q format can be used instead of %s to cause the resulting string to be quoted in a manner than can be input again to the shell. A %(%(date-format)T format can be use to treat an argument as a date/time string and to format the date/time according to the date-format as defined for the date(1) command. A %Z format outputs a byte whose value is 0. The precision field of the %d format can be followed by . and the output base. In this case, the # flag character causes base# to be prepended. The # flag when used with the d specifier without an output base, causes the output to be displayed in thousands units with one of the suffixes k M G T P E to indicate the unit. The # flag when used with the i specifier causes the output to be displayed in 1024 with one of the suffixes Ki Mi Gi Ti Pi Ei to indicate the unit. The = flag has been added to center the output within the specified field width.
**pwd [-LP]**

Outputs the value of the current working directory. The `-L` option is the default. It prints the logical name of the current directory. If the `-P` option is specified, all symbolic links are resolved from the name. The last instance of `-L` or `-P` on the command line determines which method is used.

**read [-Aprs] [-d delim] [-n n] [[ -N n] [[ -t timeout] [-u unit] [vname?prompt] [vname ...]]]

The shell input mechanism. One line is read and is broken up into fields using the characters in IFS as separators. The escape character, `\`, is used to remove any special meaning for the next character and for line continuation. The `-d` option causes the read to continue to the first character of `delim` rather than `NEWLINE`. The `-n` option causes at most `n` bytes to be read rather a full line but returns when reading from a slow device as soon as any characters have been read. The `-N` option causes exactly `n` to be read unless an end-of-file has been encountered or the read times out because of the `-t` option. In raw mode, `-r`, the `\` character is not treated specially. The first field is assigned to the first `vname`, the second field to the second `vname`, etc., with leftover fields assigned to the last `vname`. When `vname` has the binary attribute and `-n` or `-N` is specified, the bytes that are read are stored directly into the variable. If the `-v` is specified, then the value of the first `vname` is used as a default value when reading from a terminal device. The `-A` option causes the variable `vname` to be unset and each field that is read to be stored in successive elements of the indexed array `vname`. The `-p` option causes the input line to be taken from the input pipe of a process spawned by the shell using `|&`. If the `-s` option is present, the input is saved as a command in the history file. The option `-u` can be used to specify a one digit file descriptor unit `unit` to read from. The file descriptor can be opened with the `exec` special built-in command. The default value of `unit n` is `0`. The option `-t` is used to specify a time out in seconds when reading from a terminal or pipe. If `vname` is omitted, then `REPLY` is used as the default `vname`. An end-of-file with the `-p` option causes cleanup for this process so that another can be spawned. If the first argument contains a `?`, the remainder of this word is used as a prompt on standard error when the shell is interactive. The exit status is `0` unless an end-of-file is encountered or read has timed out.

```
++readonly [-p] [ vname[=value]] ... 
```

If `vname` is not specified, the names and values of each variable with the read-only attribute is printed with the values quoted in a manner that allows them to be input again. The `-p` option causes the word `readonly` to be inserted before each one. Otherwise, the specified `vnames` are marked `readonly` and these names cannot be changed by subsequent assignment.

```
+return [n]
```

Causes a shell function or script to return to the invoking script with the exit status specified by `n`. The value is the least significant 8 bits of the specified status. If `n` is omitted, then the return status is that of the last command executed. If `return` is invoked while not in a function or a script, then it behaves the same as `exit`.

```
+set [ ±BCGabcdefhknoprstuvx] [±o [ option ] ] ... [ ±A vname] [arg...]
```

The set command supports the following options:

```
man pages section 1: User Commands • Last Revised 24 May 2012
```
- a
  All subsequent variables that are defined are automatically exported.

- A
  Array assignment. Unset the variable vname and assign values sequentially from the arg list. If +A is used, the variable vname is not unset first.

- b
  Prints job completion messages as soon as a background job changes state rather than waiting for the next prompt.

- B
  Enable brace pattern field generation. This is the default behavior.

- C
  Prevents redirection (>) from truncating existing files. Files that are created are opened with the O_EXCL mode. Requires > | to truncate a file when turned on.

- e
  If a command has a non-zero exit status, execute the ERR trap, if set, and exit. This mode is disabled while reading profiles.

- f
  Disables file name generation.

- G
  Causes the pattern ** by itself to match files and zero or more directories and subdirectories when used for file name generation. If followed by a / only directories and subdirectories are matched.

- h
  Each command becomes a tracked alias when first encountered.

- k
  Obsolete. All variable assignment arguments are placed in the environment for a command, not just those that precede the command name.

- m
  Background jobs run in a separate process group and a line prints upon completion. The exit status of background jobs is reported in a completion message. On systems with job control, this option is turned on automatically for interactive shells.

- n
  Read commands and check them for syntax errors, but do not execute them. Ignored for interactive shells.

- o
  If no option name is supplied, the list of options and their current settings are written to standard output. When invoked with a +, the options are written in a format that can be input again to the shell to restore the settings. This option can be repeated to enable or disable multiple options.
The following argument can be one of the following option names:

- `allexport`
  - Same as `-a`.

- `bgnice`
  - All background jobs are run at a lower priority. This is the default mode.

- `braceexpand`
  - Same as `-B`.

- `emacs`
  - Puts you in an `emacs` style inline editor for command entry.

- `errexit`
  - Same as `-e`.

- `globstar`
  - Same as `-G`.

- `gmacs`
  - Puts you in a `gmacs` style inline editor for command entry.

- `ignoreeof`
  - The shell does not exit on end-of-file. The command `exit` must be used.

- `keyword`
  - Same as `-k`.

- `mindirs`
  - All directory names resulting from file name generation have a trailing `/` appended.

- `monitor`
  - Same as `-m`.

- `multiline`
  - The built-in editors use multiple lines on the screen for lines that are longer than the width of the screen. This might not work for all terminals.

- `noclobber`
  - Same as `-C`.

- `noexec`
  - Same as `-n`.

- `noglob`
  - Same as `-f`.

- `nolog`
  - Do not save function definitions in the history file.

- `notify`
  - Same as `-b`. 
nounset
  Same as -u.

pipefail
  A pipeline does not complete until all components of the pipeline have completed, and the return value is the value of the last non-zero command to fail or zero if no command has failed.

privileged
  Same as -p.

showme
  When enabled, simple commands or pipelines preceded by a a semicolon (;) is displayed as if the xtrace option were enabled but is not executed. Otherwise, the leading ; is ignored.

trackall
  Same as -h.

verbose
  Same as -v.

vi
  Puts you in insert mode of a vi style inline editor until you hit the escape character 033. This puts you in control mode. A return sends the line.

viraw
  Each character is processed as it is typed in vi mode.

xtrace
  Same as -x.

If no option name is supplied, the current options settings are printed.

-p
  Disables processing of the $HOME/.profile file and uses the file /etc/suid_profile instead of the ENV file. This mode is on whenever the effective uid (gid) is not equal to the real uid (gid). Turning this off causes the effective uid and gid to be set to the real uid and gid.

-r
  Enables the restricted shell. This option cannot be unset once set.

-s
  Sort the positional parameters lexicographically.

-t
  Obsolete. Exit after reading and executing one command.

-u
  Treat unset parameters as an error when substituting.
-v
  Print shell input lines as they are read.

-x
  Print commands and their arguments as they are executed.

--
  Do not change any of the options. This is useful in setting $1 to a value beginning with --.
  If no arguments follow this option then the positional parameters are unset.

As an obsolete feature, if the first arg is - then the -x and -v options are turned off and the next arg is treated as the first argument. Using + rather than - causes these options to be turned off. These options can also be used upon invocation of the shell. The current set of options can be found in $-. Unless -A is specified, the remaining arguments are positional parameters and are assigned, in order, to $1 $2 . . . . If no arguments are specified, then the names and values of all variables are printed on the standard output.

+shift [n]
  The positional parameters from $n+1 . . . are renamed $1 . . . , the default n is 1. The parameter n can be any arithmetic expression that evaluates to a non-negative number less than or equal to $#.

+trap -p [action] [sig] . . .
  The -p option causes the trap action associated with each trap as specified by the arguments to be printed with appropriate quoting. Otherwise, action is processed as if it were an argument to eval when the shell receives signal(s) sig. Each sig can be specified as a number or as the name of the signal. Trap commands are executed in order of signal number. Any attempt to set a trap on a signal that was ignored on entry to the current shell is ineffective. If action is omitted and the first sig is a number, or if action is -, then the trap(s) for each sig are reset to their original values. If action is the null string then this signal is ignored by the shell and by the commands it invokes. If sig is ERR then action is executed whenever a command has a non-zero exit status. If sig is DEBUG then action is executed before each command. The variable .sh.command contains the contents of the current command line when action is running. If sig is 0 or EXIT and the trap statement is executed inside the body of a function defined with the function name syntax, then the command action is executed after the function completes. If sig is 0 or EXIT for a trap set outside any function then the command action is executed on exit from the shell. If sig is KEYBD, then action is executed whenever a key is read while in emacs, gnacs, or vi mode. The trap command with no arguments prints a list of commands associated with each signal number.

true
  Does nothing, and exits 0. Used with while for infinite loops.

++typeset [±AHflabnprtux ] [ ±EFLRZi{[n]} ] [ vname[=value ] ]
  Sets attributes and values for shell variables and functions. When invoked inside a function defined with the function name syntax, a new instance of the variable vname is created, and the variable’s value and type are restored when the function completes.
Using + rather than - causes these options to be turned off. If no vname arguments are specified, a list of vnames (and optionally the values) of the variables is printed. Using + rather than - keeps the values from being printed.) The -p option causes typeset followed by the option letters to be printed before each name rather than the names of the options. If any option other than -p is specified, only those variables which have all of the specified options are printed. Otherwise, the vnames and attributes of all variables that have attributes are printed.

The following list of attributes can be specified:

- **a** Declares vname to be an indexed array. This is optional unless except for compound variable assignments.

- **A** Declares vname to be an associative array. Sub-scripts are strings rather than arithmetic expressions.

- **b** The variable can hold any number of bytes of data. The data can be text or binary. The value is represented by the base64 encoding of the data. If -Z is also specified, the size in bytes of the data in the buffer is determined by the size associated with the -Z. If the base64 string assigned results in more data, it is truncated. Otherwise, it is filled with bytes whose value is zero. The printf format %B can be used to output the actual data in this buffer instead of the base64 encoding of the data.

- **E** Declares vname to be a double precision floating point number. If n is non-zero, it defines the number of significant figures that are used when expanding vname. Otherwise, ten significant figures is used.

- **f** The names refer to function names rather than variable names. No assignments can be made and the only other valid options are -t, -u, and -x. The -t option turns on execution tracing for this function. The -u option causes this function to be marked undefined. The FPATH variable is searched to find the function definition when the function is referenced. If no options other than -f is specified, then the function definition is displayed on standard output. If +f is specified, then a line containing the function name followed by a shell comment containing the line number and path name of the file where this function was defined, if any, is displayed.

The -i attribute cannot be specified with -f.

- **F** Declares vname to be a double precision floating point number. If n is non-zero, it defines the number of places after the decimal point that are used when expanding vname. Otherwise ten places after the decimal point is used.

- **H** This option provides UNIX to hostname file mapping on non-UNIX machines.

- **i** Declares vname to be represented internally as integer. The right hand side of an assignment is evaluated as an arithmetic expression when assigning to an integer. If n is non-zero, it defines the output arithmetic base, otherwise the output base is ten.
The -i attribute cannot be specified along with -R, -L, -Z, or -f.

- l
  All uppercase characters are converted to lowercase. The uppercase option, -u, is turned off.

- L
  Left justify and remove leading blanks from value. If \( n \) is non-zero, it defines the width of the field, otherwise it is determined by the width of the value of first assignment. When the variable is assigned to, it is filled on the right with blanks or truncated, if necessary, to fit into the field. The -R option is turned off.

  The -i attribute cannot be specified with -L.

- n
  DECLARES \( vname \) to be a reference to the variable whose name is defined by the value of variable \( vname \). This is usually used to reference a variable inside a function whose name has been passed as an argument.

- R
  Right justify and fill with leading blanks. If \( n \) is non-zero, it defines the width of the field, otherwise it is determined by the width of the value of first assignment. The field is left filled with blanks or truncated from the end if the variable is reassigned.

  The -i attribute cannot be specified with -R.

- r
  The specified \( vnames \) are marked read-only and these names cannot be changed by subsequent assignment.

- t
  Tags the variables. Tags are user definable and have no special meaning to the shell.

- u
  All lowercase characters are converted to uppercase. The lowercase option, -l, is turned off.

- x
  The specified \( vnames \) are marked for automatic export to the environment of subsequently-executed commands. Variables whose names contain a . cannot be exported.

- Z
  Right justify and fill with leading zeros if the first non-blank character is a digit and the -L option has not been set. Remove leading zeros if the -L option is also set. If \( n \) is non-zero, it defines the width of the field, otherwise it is determined by the width of the value of first assignment.

  The -i attribute cannot be specified with -Z.

ulimit [-HSacdfmpstv] [ \( limit \)]
Set or display a resource limit. Many systems do not support one or more of these limits. The limit for a specified resource is set when \( limit \) is specified. The value of \( limit \) can be a number in the unit specified with each resource, or the value unlimited. When more than one resource is specified, then the limit name and unit is printed before the value.

If no option is specified, -f is assumed.
The following are the available resource limits:

- **-a** Lists all of the current resource limits.
- **-c** The number of 512-byte blocks on the size of core dumps.
- **-d** The number of Kbytes on the size of the data area.
- **-f** The number of 512-byte blocks on files that can be written by the current process or by child processes (files of any size can be read).
- **-H** Specifies a hard limit for the specified resource.

A hard limit cannot be increased once it is set.

If neither the `-H` nor `-S` option is specified, the limit applies to both. The current resource limit is printed when `limit` is omitted. In this case, the soft limit is printed unless `-H` is specified.

- **-m** The number of Kbytes on the size of physical memory.
- **-n** The number of file descriptors plus 1.
- **-p** The number of 512-byte blocks for pipe buffering.
- **-s** The number of Kbytes on the size of the stack area.
- **-S** Specifies a soft limit for the specified resource.

A soft limit can be increased up to the value of the hard limit.

If neither the `-H` nor `-S` option is specified, the limit applies to both. The current resource limit is printed when `limit` is omitted. In this case, the soft limit is printed unless `-H` is specified.

- **-t** The number of CPU seconds to be used by each process.
- **-v** The number of Kbytes for virtual memory.

**umask [-S] [mask]**

The user file-creation mask is set to `mask`. `mask` can either be an octal number or a symbolic value as described in `chmod(1)`.

If a symbolic value is specified, the new `umask` value is the complement of the result of applying `mask` to the complement of the previous `umask` value. If `mask` is omitted, the current value of the mask is printed. The `-S` option causes the mode to be printed as a symbolic value. Otherwise, the mask is printed in octal.

See `umask(2)`
+unalias [-a] name
   The aliases specified by the list of names are removed from the alias list. The -a option causes all the aliases to be unset.

+unset [-fnv] vname
   The variables specified by the list of vnames are unassigned, i.e., their values and attributes are erased. Read-only variables cannot be unset. If the -f option is set, then the names refer to function names. If the -v option is set, then the names refer to variable names. The -f option overrides -v. If -n is set and name is a name reference, then name is unset rather than the variable that it references. The default is equivalent to -v. Unsetting LINENO, MAILCHECK, OPTARG, OPTIND, RANDOM, SECONDS, TMOUT, and _ removes their special meaning even if they are subsequently assigned to.

wait [job]
   Wait for the specified job and report its termination status. If job is not specified, then all currently active child processes are waited for. The exit status from this command is that of the last process waited for if job is specified; otherwise it is zero. See Jobs for a description of the format of job.

whence [-afpv] name...
   For each name, indicate how it would be interpreted if used as a command name. The -v option produces a more verbose report. The -f option skips the search for functions. The -p option does a path search for name even if name is an alias, a function, or a reserved word. The -a option is similar to the -v option but causes all interpretations of the specified name to be reported.

Invocation
   If the shell is invoked by exec(2), and the first character of argument zero ($0) is -, then the shell is assumed to be a login shell and commands are read from /etc/profile and then from either .profile in the current directory or $HOME/.profile, if either file exists. Next, for interactive shells, commands are read first from /etc/ksh.kshrc, and then from the file named by performing parameter expansion, command substitution, and arithmetic substitution on the value of the environment variable ENV if the file exists. If the -s option is not present and arg and a file by the name of arg exists, then it reads and executes this script. Otherwise, if the first arg does not contain a /, a path search is performed on the first arg to determine the name of the script to execute. The script arg must have execute permission and any setuid and setgid settings are ignored. If the script is not found on the path, arg is processed as if it named a built-in command or function.

   Commands are then read as described, and the following options are interpreted by the shell when it is invoked:

   -c      If the -c option is present, then commands are read from the first arg. Any remaining arguments become positional parameters starting at 0.

   -D      A list of all double quoted strings that are preceded by a $ is printed on standard output and the shell exits. This set of strings is subject to language translation when the locale is not C or POSIX. No commands are executed.
If the -i option is present or if the shell input and output are attached to a
terminal (as told by tcgetattr(3C)), this shell is interactive. In this case TERM is
ignored (so that kill 0 does not kill an interactive shell) and INTR is caught
and ignored (so that wait is interruptible). In all cases, QUIT is ignored by the
shell.

-R filename
The -R filename option is used to generate a cross reference database that can
be used by a separate utility to find definitions and references for variables and
commands.

-r
If the -r option is present, the shell is a restricted shell.

-s
If the -s option is present or if no arguments remain, then commands are read
from the standard input. Shell output, except for the output of the Special
Commands listed, is written to file descriptor 2.

The remaining options and arguments are described under the set command. An optional -
as the first argument is ignored.

rksh Only
rksh is used to set up login names and execution environments whose capabilities are more
controlled than those of the standard shell.

The actions of rksh are identical to those of ksh, except that the following are disallowed:

- Unsetting the restricted option
- Changing directory. See cd(1).
- Setting or unsetting the value or attributes of SHELL, ENV, FPATH, or PATH
- Specifying path or command names containing /,
- Redirecting output (>, >|, <>, and >>).
- Adding or deleting built-in commands.
- Using command -p to invoke a command.

These restrictions are enforced after .profile and the ENV files are interpreted.

When a command to be executed is found to be a shell procedure, rksh invokes ksh to execute
it. Thus, it is possible to provide to the end-user shell procedures that have access to the full
power of the standard shell, while imposing a limited menu of commands. This scheme
assumes that the end-user does not have write and execute permissions in the same directory.
The net effect of these rules is that the writer of the .profile has complete control over user
actions, by performing guaranteed setup actions and leaving the user in an appropriate
directory (probably not the login directory). The system administrator often sets up a
directory of commands, for example, /usr/rbin, that can be safely invoked by rksh.

Usage
See largefile(5) for the description of the behavior of ksh and rksh when encountering files
greater than or equal to 2 Gbyte ($2^{31}$ bytes).
Exit Status  The following exit values are returned:

non-zero
Returns non-zero when errors, such as syntax errors, are detected by the shell.

If the shell is being used non-interactively, then execution of the shell file is abandoned
unless the error occurs inside a sub-shell in which case the sub-shell is abandoned.

exit status of last command executed
Returns the exit status of the last command executed.

Run time errors detected by the shell are reported by printing the command or function
name and the error condition. If the line number that the error occurred on is greater than
one, then the line number is also printed in square brackets ([ ]) after the command or
function name.

See the ksh exit command for additional details.

Files  /etc/profile
The system initialization file, executed for login shells.

/etc/ksh.kshrc
The system wide startup file, executed for interactive shells.

$HOME/.profile
The personal initialization file, executed for login shells after /etc/profile.

$HOME/.kshrc
Default personal initialization file, executed after /etc/ksh.kshrc, for interactive shells
when ENV is not set.

/etc/suid-profile
Alternative initialization file, executed instead of the personal initialization file when the
real and effective user or group id do not match.

/dev/null
NULL device.

Authors  David Korn, dgk@research.att.com

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>shell/ksh</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>See below.</td>
</tr>
</tbody>
</table>

The scripting interface is Uncommitted. The environment variables, .paths feature, and
editing modes are Volatile.
See Also  cat(1), cd(1), chmod(1), cut(1), date(1), egrep(1), echo(1), egrep(1), env(1), fgrep(1), grep(1), login(1), newgrp(1), paste(1), printf(1), shell builtins(1), stty(1), test(1), umask(1), vi(1), dup(2), exec(2), fork(2), ioctl(2), lseek(2), pathconf(2), pipe(2), sysconf(3C), ulimit(2), umask(2), rand(3C), tcgetattr(3C), wait(3C), a.out(4), profile(4), attributes(5), environ(5), largefile(5), standards(5)


Notes  ksh scripts should choose shell function names outside the namespace used by reserved keywords of the ISO C99, C++ and JAVA languages to avoid collisions with future enhancements to ksh.

If a command is executed, and then a command with the same name is installed in a directory in the search path before the directory where the original command was found, the shell continues to exec the original command. Use the -t option of the alias command to correct this situation.

Some very old shell scripts contain a caret (^) as a synonym for the pipe character (|).

Using the hist built-in command within a compound command causes the whole command to disappear from the history file.

The built-in command . file reads the whole file before any commands are executed. alias and unalias commands in the file do not apply to any commands defined in the file.

Traps are not processed while a job is waiting for a foreground process. Thus, a trap on CHLD is not executed until the foreground job terminates.

It is a good idea to leave a space after the comma operator in arithmetic expressions to prevent the comma from being interpreted as the decimal point character in certain locales.

There might be some restrictions on creating a .paths file which is portable across other operating systems.

If the system supports the 64-bit instruction set, /bin/ksh executes the 64-bit version of ksh.
**Name**  
ksh88, rksh88 – KornShell, a standard/restricted command and programming language

**Synopsis**  
/usr/sunos/bin/ksh [± abCefhikmnoprstuvx] [± o option]...
   [arg]...

/usr/sunos/bin/ksh -c [± abCefhikmnoprstuvx]
   [± o option]... command_string
   [command_name [arg...]]

/usr/xpg4/bin/sh [± abCefhikmnoprstuvx]
   [± o option]... [arg]...

/usr/xpg4/bin/sh -c [± abCefhikmnoprstuvx]
   [± o option]... command_string
   [command_name [arg...]]

/usr/sunos/bin/rksh [± abCefhikmnoprstuvx] [± o option]...
   [arg]...

/usr/sunos/bin/rksh -c [± abCefhikmnoprstuvx]
   [± o option]... command_string
   [command_name [arg...]]

**Description**  
The `/usr/xpg4/bin/sh` utility is a standards compliant shell. This utility provides all the functionality of `/usr/sunos/bin/ksh`, except in cases where differences in behavior exist. See Arithmetic Expansions section for details.

/usr/sunos/bin/ksh is a command and programming language that executes commands read from a terminal or a file. rksh is a restricted version of the command interpreter ksh; it is used to set up login names and execution environments whose capabilities are more controlled than those of the standard shell. See the Invocation section for the meaning of arguments to the shell.

**Definitions**  
A *metacharacter* is one of the following characters:

```
; & ( ) | < > NEWLINE SPACE TAB
```

A *blank* is a TAB or a SPACE. An *identifier* is a sequence of letters, digits, or underscores starting with a letter or underscore. Identifiers are used as names for functions and variables. A *word* is a sequence of characters separated by one or more non-quoted *metacharacters*.

A *command* is a sequence of characters in the syntax of the shell language. The shell reads each command and carries out the desired action either directly or by invoking separate utilities. A *special-command* is a command that is carried out by the shell without creating a separate process. Except for documented side effects, most special commands can be implemented as separate utilities.

**Commands**  
A *simple-command* is a sequence of blank-separated words which can be preceded by a variable assignment list. See Environment. The first word specifies the name of the command to be executed. Except as specified, the remaining words are passed as arguments to the
invoked command. The command name is passed as argument 0 (see exec(2)). The value of a simple-command is its exit status if it terminates normally. If it terminates abnormally due to receipt of a signal, the value is the signal number plus 128. See signal.h(3HEAD) for a list of signal values. Obviously, normal exit status values 129 to 255 cannot be distinguished from abnormal exit caused by receiving signal numbers 1 to 127.

A pipeline is a sequence of one or more commands separated by |. The standard output of each command but the last is connected by a pipe(2) to the standard input of the next command. Each command is run as a separate process; the shell waits for the last command to terminate. The exit status of a pipeline is the exit status of the last command.

A list is a sequence of one or more pipelines separated by ; & & or | |, and optionally terminated by ; & or | &. Of these five symbols, ; & and | | have equal precedence, which is lower than that of && and | |. The symbols && and | | also have equal precedence. A semicolon (;) causes sequential execution of the preceding pipeline; an ampersand (&) causes asynchronous execution of the preceding pipeline (that is, the shell does not wait for that pipeline to finish). The symbol | & causes asynchronous execution of the preceding command or pipeline with a two-way pipe established to the parent shell.

The standard input and output of the spawned command can be written to and read from by the parent shell using the -p option of the special commands read and print described in Special Commands. The symbol && ( || ) causes the list following it to be executed only if the preceding pipeline returns 0 (or a non-zero value). An arbitrary number of new-lines can appear in a list, instead of a semicolon, to delimit a command.

A command is either a simple-command or one of the following. Unless otherwise stated, the value returned by a command is that of the last simple-command executed in the command.

for identifier [ in word ... ] ; do list ; done

Each time a for command is executed, identifier is set to the next word taken from the in word list. If in word ... is omitted, then the for command executes the do list once for each positional parameter that is set. See Parameter Substitution. Execution ends when there are no more words in the list.

select identifier [ in word ... ] ; do list ; done

A select command prints to standard error (file descriptor 2), the set of words, each preceded by a number. If in word ... is omitted, then the positional parameters are used instead. See Parameter Substitution. The PS3 prompt is printed and a line is read from the standard input. If this line consists of the number of one of the listed words, then the value of the variable identifier is set to the word corresponding to this number. If this line is empty the selection list is printed again. Otherwise the value of the variable identifier is set to NULL. (See Blank Interpretation about NULL). The contents of the line read from standard input is saved in the shell variable REPLY. The list is executed for each selection until a break or EOF is encountered. If the REPLY variable is set to NULL by the execution of list, then the selection list is printed before displaying the PS3 prompt for the next selection.
case word in [ pattern [ | pattern ] ] list ; ] ... esac
A case command executes the list associated with the first pattern that matches word. The form of the patterns is the same as that used for file-name generation. See File Name Generation.

if list ; then list ; [ elif list ; then list ; ... ] [ else list ; ] fi
The list following if is executed and, if it returns an exit status of 0, the list following the first then is executed. Otherwise, the list following elif is executed and, if its value is 0, the list following the next then is executed. Failing that, the else list is executed. If no else list or then list is executed, then the if command returns 0 exit status.

while list ; do list ; done
until list ; do list ; done
A while command repeatedly executes the while list and, if the exit status of the last command in the list is 0, executes the do list; otherwise the loop terminates. If no commands in the do list are executed, then the while command returns 0 exit status. until can be used in place of while to negate the loop termination test.

(list)
Execute list in a separate environment. If two adjacent open parentheses are needed for nesting, a space must be inserted to avoid arithmetic evaluation.

{list}
list is simply executed. Unlike the metacharacters ( and ), { and } are reserved words and must occur at the beginning of a line or after a ; in order to be recognized.

[[expression]]
Evaluates expression and returns 0 exit status when expression is true. See Conditional Expressions for a description of expression.

function identifier { list ;}
identifier ( ) { list ;}
Define a function which is referenced by identifier. The body of the function is the list of commands between { and }. See Functions.

time pipeline
The pipeline is executed and the elapsed time as well as the user and system time are printed to standard error.

The following reserved words are only recognized as the first word of a command and when not quoted:
! if then else elif fi case esac for while until do done { }
function select time [ [ [ ] ] ]

Comments A word beginning with # causes that word and all the following characters up to a new-line to be ignored.
The first word of each command is replaced by the text of an alias if an alias for this word has been defined. An alias name consists of any number of characters excluding metacharacters, quoting characters, file expansion characters, parameter and command substitution characters, and `=`. The replacement string can contain any valid shell script including the metacharacters listed above. The first word of each command in the replaced text, other than any that are in the process of being replaced, is tested for aliases. If the last character of the alias value is a `blank` then the word following the alias is also be checked for alias substitution. Aliases can be used to redefine special built-in commands but cannot be used to redefine the reserved words listed above. Aliases can be created, listed, and exported with the `alias` command and can be removed with the `unalias` command. Exported aliases remain in effect for scripts invoked by name, but must be reinitialized for separate invocations of the shell. See Invocation. To prevent infinite loops in recursive aliasing, if the shell is not currently processing an alias of the same name, the word is replaced by the value of the alias; otherwise, it is not be replaced.

Aliasing is performed when scripts are read, not while they are executed. Therefore, for an alias to take effect, the `alias` definition command has to be executed before the command which references the alias is read.

Aliases are frequently used as a shorthand for full path names. An option to the aliasing facility allows the value of the alias to be automatically set to the full pathname of the corresponding command. These aliases are called tracked aliases. The value of a tracked alias is defined the first time the corresponding command is looked up and becomes undefined each time the `PATH` variable is reset. These aliases remain tracked so that the next subsequent reference redefines the value. Several tracked aliases are compiled into the shell. The `-h` option of the `set` command makes each referenced command name into a tracked alias.

The following exported aliases are compiled into (and built-in to) the shell but can be unset or redefined:

```
autoload='typeset -fu'
functions='typeset -f'
history='fc -l'
integer='typeset -i'
nohup='nohup '
r='fc -e -'
```

An example concerning trailing blank characters and reserved words follows. If the user types:

```
$ alias foo="/bin/ls "
$ alias while="/"
```

the effect of executing:

```
$ while true
> do
> echo "Hello, World"
> done
```
is a never-ending sequence of Hello, World strings to the screen. However, if the user types:

```bash
$ foo while
```

the result is an `ls` listing of `/`. Since the alias substitution for `foo` ends in a space character, the next word is checked for alias substitution. The next word, `while`, has also been aliased, so it is substituted as well. Since it is not in the proper position as a command word, it is not recognized as a reserved word.

If the user types:

```bash
$ foo; while
```

`while` retains its normal reserved-word properties.

**Tilde Substitution**

After alias substitution is performed, each word is checked to see if it begins with an unquoted `~`. If it does, then the word up to a `/` is checked to see if it matches a user name. If a match is found, the `~` and the matched login name are replaced by the login directory of the matched user. This is called a *tilde* substitution. If no match is found, the original text is left unchanged. A `~` by itself, or in front of a `/`, is replaced by `$HOME`. A `~` followed by a `+` or `−` is replaced by `$PWD` and `$OLDPWD`, respectively.

In addition, *tilde* substitution is attempted when the value of a *variable assignment* begins with a `~`.

**Tilde Expansion**

A *tilde-prefix* consists of an unquoted tilde character at the beginning of a word, followed by all of the characters preceding the first unquoted slash in the word, or all the characters in the word if there is no slash. In an assignment, multiple *tilde-prefixes* can be used: at the beginning of the word (that is, following the equal sign of the assignment), following any unquoted colon or both. A *tilde-prefix* in an assignment is terminated by the first unquoted colon or slash. If none of the characters in the *tilde-prefix* are quoted, the characters in the *tilde-prefix* following the tilde are treated as a possible login name from the user database.

A portable login name cannot contain characters outside the set given in the description of the `LOGNAME` environment variable. If the login name is null (that is, the *tilde-prefix* contains only the tilde), the *tilde-prefix* is replaced by the value of the variable `HOME`. If `HOME` is unset, the results are unspecified. Otherwise, the *tilde-prefix* is replaced by a pathname of the home directory associated with the login name obtained using the `getpwnam` function. If the system does not recognize the login name, the results are undefined.

Tilde expansion generally occurs only at the beginning of words, but an exception based on historical practice has been included:

`PATH=/posix/bin:~dgk/bin`

is eligible for tilde expansion because tilde follows a colon and none of the relevant characters is quoted. Consideration was given to prohibiting this behavior because any of the following are reasonable substitutes:
PATH=$(printf %s ~karels/bin : ~bostic/bin)
for Dir in ~maart/bin ~srb/bin .
do
  PATH=${PATH:+$PATH:}$Dir
done

With the first command, explicit colons are used for each directory. In all cases, the shell performs tilde expansion on each directory because all are separate words to the shell.

Expressions in operands such as:
make -k mumble LIBDIR=~chet/lib

do not qualify as shell variable assignments and tilde expansion is not performed (unless the command does so itself, which make does not).

The special sequence $~ has been designated for future implementations to evaluate as a means of forcing tilde expansion in any word.

Because of the requirement that the word not be quoted, the following are not equivalent; only the last causes tilde expansion:
\~hlj/ ~hlj/ ~"hlj"/ ~hlj/ ~hlj/

The results of giving tilde with an unknown login name are undefined because the KornShell ~+ and ~− constructs make use of this condition, but, in general it is an error to give an incorrect login name with tilde. The results of having HOME unset are unspecified because some historical shells treat this as an error.

Command Substitution

The standard output from a command enclosed in parenthesis preceded by a dollar sign (that is, $(command)) or a pair of grave accents (""") can be used as part or all of a word. Trailing new-lines are removed. In the second (archaic) form, the string between the quotes is processed for special quoting characters before the command is executed. See Quoting. The command substitution $(cat file) can be replaced by the equivalent but faster $(<file).

Command substitution of most special commands that do not perform input/output redirection are carried out without creating a separate process.

Command substitution allows the output of a command to be substituted in place of the command name itself. Command substitution occurs when the command is enclosed as follows:
$(command)

or (backquoted version):
'command'

The shell expands the command substitution by executing command in a subshell environment and replacing the command substitution (the text of command plus the enclosing $( or backquotes) with the standard output of the command, removing sequences
of one or more newline characters at the end of the substitution. Embedded newline characters before the end of the output is not be removed; however, they can be treated as field delimiters and eliminated during field splitting, depending on the value of IFS and quoting that is in effect.

Within the backquoted style of command substitution, backslash shall retain its literal meaning, except when followed by:

\$ ' " \ (
dollar-sign, backquote, backslash). The search for the matching backquote is satisfied by the first backquote found without a preceding backslash. During this search, if a non-escaped backquote is encountered within a shell comment, a here-document, an embedded command substitution of the $\text{(command)}$ form, or a quoted string, undefined results occur. A single- or double-quoted string that begins, but does not end, within the ‘ . . . ‘ sequence produces undefined results.

With the $\text{(command)}$ form, all characters following the open parenthesis to the matching closing parenthesis constitute the \textit{command}. Any valid shell script can be used for \textit{command}, except:

- A script consisting solely of redirections produces unspecified results.
- See the restriction on single subshells.

The results of command substitution are not field splitting and pathname expansion processed for further tilde expansion, parameter expansion, command substitution or arithmetic expansion. If a command substitution occurs inside double-quotes, it is not be performed on the results of the substitution.

Command substitution can be nested. To specify nesting within the backquoted version, the application must precede the inner backquotes with backslashes; for example:

\texttt{\textbackslash \textit{command}\textbackslash}

The $\text{(command)}$ form of command substitution solves a problem of inconsistent behavior when using backquotes. For example:

<table>
<thead>
<tr>
<th>Command</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>echo $x</td>
<td>$x</td>
</tr>
<tr>
<td>echo 'echo $x'</td>
<td>$x</td>
</tr>
<tr>
<td>echo $(echo $x)</td>
<td>$x</td>
</tr>
</tbody>
</table>

Additionally, the backquoted syntax has historical restrictions on the contents of the embedded command. While the new $\text{(command)}$ form can process any kind of valid embedded script,
the backquoted form cannot handle some valid scripts that include backquotes. For example, these otherwise valid embedded scripts do not work in the left column, but do work on the right:

```
| echo ' |
| cat <<eof |
| a here-doc with ' |
| eof |
| ' |
| echo ' |
| echo abc # a comment with ' |
| ' |
| echo ' |
| echo " |
```

Because of these inconsistent behaviors, the backquoted variety of command substitution is not recommended for new applications that nest command substitutions or attempt to embed complex scripts.

If the command substitution consists of a single subshell, such as:

```
$( (command ) )
```

a portable application must separate the $ ( and ( into two tokens (that is, separate them with white space). This is required to avoid any ambiguities with arithmetic expansion.

**Arithmetic Expansion**

An arithmetic expression enclosed in double parentheses preceded by a dollar sign ( $((arithmetic-expression)) ) is replaced by the value of the arithmetic expression within the double parenthesis. Arithmetic expansion provides a mechanism for evaluating an arithmetic expression and substituting its value. The format for arithmetic expansion is as follows:

```
$((expression))
```

The expression is treated as if it were in double-quotes, except that a double-quote inside the expression is not treated specially. The shell expands all tokens in the expression for parameter expansion, command substitution and quote removal.

Next, the shell treats this as an arithmetic expression and substitute the value of the expression. The arithmetic expression is processed according to the rules of the ISO C with the following exceptions:
- Only integer arithmetic is required.
- The `sizeof()` operator and the prefix and postfix `++` and `--` operators are not required.
- Selection, iteration, and jump statements are not supported.
- `/usr/sunos/bin/ksh` and `/usr/sunos/bin/rksh` treat prefix 0 through 9 as decimal constants. See the following examples:

<table>
<thead>
<tr>
<th>Command</th>
<th>Result in <code>/bin/ksh</code></th>
<th>Result in <code>/usr/xpg4/bin/sh</code></th>
</tr>
</thead>
<tbody>
<tr>
<td><code>echo $((010+10))</code></td>
<td>20</td>
<td>18</td>
</tr>
<tr>
<td><code>echo $((019+10))</code></td>
<td>29</td>
<td>error</td>
</tr>
<tr>
<td><code>[ 10 -le $((011)) ]</code></td>
<td>true</td>
<td>false</td>
</tr>
</tbody>
</table>

As an extension, the shell can recognize arithmetic expressions beyond those listed. If the expression is invalid, the expansion fails and the shell writes a message to standard error indicating the failure.

A simple example using arithmetic expansion:

```bash
# repeat a command 100 times
x=100
while [ $x -gt 0 ]
do
  command
  x=$((x-1))
done
```

**Process Substitution**

This feature is available in SunOS and only on versions of the UNIX operating system that support the `/dev/fd` directory for naming open files. Each command argument of the form `<(list) or >(list)` runs process `list` asynchronously connected to some file in `/dev/fd`. The name of this file becomes the argument to the command. If the form with `>` is selected, then writing on this file provides input for `list`. If `<` is used, then the file passed as an argument contains the output of the `list` process. For example:

```bash
paste <(cut -f1 file1) <(cut -f3 file2) | tee >(process1) >(process2)
```

cuts fields 1 and 3 from the files `file1` and `file2`, respectively, pastes the results together, and sends it to the processes `process1` and `process2`, as well as putting it onto the standard output. The file, which is passed as an argument to the command, is a UNIX `pipe(2)` so programs that expect `lseek(2)` on the file does not work.

**Parameter Substitution**

A `parameter` is an `identifier`, one or more digits, or any of the characters `*`,`@`, `#`, `?`, `~`, `$`, and `!`. A `variable` (a `parameter` denoted by an `identifier`) has a `value` and zero or more `attributes`. `variables` can be assigned `values` and `attributes` by using the `typeset` special command. The attributes supported by the shell are described later with the `typeset` special command. Exported variables pass values and attributes to the environment.
The shell supports a one-dimensional array facility. An element of an array variable is referenced by a subscript. A subscript is denoted by a [, followed by an arithmetic expression, followed by a ]. See Arithmetic Evaluation. To assign values to an array, use set -A name value ... The value of all subscripts must be in the range of 0 through 4095. Arrays need not be declared. Any reference to a variable with a valid subscript is legal and an array is created if necessary. Referencing an array without a subscript is equivalent to referencing the element 0. If an array identifier with subscript * or @ is used, then the value for each of the elements is substituted (separated by a field separator character).

The value of a variable can be assigned by writing:

```
name=value [ name=value ] ...
```

If the integer attribute, -i, is set for name, the value is subject to arithmetic evaluation.

Positional parameters, parameters denoted by a number, can be assigned values with the set special command. Parameter $0 is set from argument zero when the shell is invoked. If parameter is one or more digits then it is a positional parameter. A positional parameter of more than one digit must be enclosed in braces.

The format for parameter expansion is as follows:

```
${expression}
```

where expression consists of all characters until the matching }. Any } escaped by a backslash or within a quoted string, and characters in embedded arithmetic expansions, command substitutions and variable expansions, are not examined in determining the matching }.

The simplest form for parameter expansion is:

```
${parameter}
```

The value, if any, of parameter is substituted.

The parameter name or symbol can be enclosed in braces, which are optional except for positional parameters with more than one digit or when parameter is followed by a character that could be interpreted as part of the name. The matching closing brace are determined by counting brace levels, skipping over enclosed quoted strings and command substitutions.

If the parameter name or symbol is not enclosed in braces, the expansion uses the longest valid name whether or not the symbol represented by that name exists. When the shell is scanning its input to determine the boundaries of a name, it is not bound by its knowledge of what names are already defined. For example, if F is a defined shell variable, the command:

```
echo $Fred
```

does not echo the value of $F followed by red; it selects the longest possible valid name, Fred, which in this case might be unset.

If a parameter expansion occurs inside double-quotes:
Pathname expansion is not be performed on the results of the expansion.

Field splitting is not performed on the results of the expansion, with the exception of @.

In addition, a parameter expansion can be modified by using one of the following formats. In each case that a value of word is needed (based on the state of parameter), word is subjected to tilde expansion, parameter expansion, command substitution and arithmetic expansion. If word is not needed, it is not expanded. The } character that delimits the following parameter expansion modifications is determined as described previously in this section and in dquote. (For example, ${foo-bar}xyz} would result in the expansion of foo followed by the string xyz} if foo is set, else the string barxyz}).

${[parameter:word]} Use Default Values. If parameter is unset or null, the expansion of word is substituted. Otherwise, the value of parameter is substituted.

${[parameter=word]} Assign Default Values. If parameter is unset or null, the expansion of word is assigned to parameter. In all cases, the final value of parameter is substituted. Only variables, not positional parameters or special parameters, can be assigned in this way.

${[parameter?:word]} Indicate Error if Null or Unset. If parameter is unset or null, the expansion of word (or a message indicating it is unset if word is omitted) is written to standard error and the shell exits with a non-zero exit status. Otherwise, the value of parameter is substituted. An interactive shell need not exit.

${[parameter:+word]} Use Alternative Value. If parameter is unset or null, null is substituted. Otherwise, the expansion of word is substituted.

In the parameter expansions shown previously, use of the colon in the format results in a test for a parameter that is unset or null. Omission of the colon results in a test for a parameter that is only unset. The following two tables summarize the effect of the colon:

<table>
<thead>
<tr>
<th>Parameter Expansion</th>
<th>Parameter Set and Not Null</th>
<th>Parameter Set and Null</th>
</tr>
</thead>
<tbody>
<tr>
<td>${[parameter:word]}</td>
<td>substitute parameter</td>
<td>substitute word</td>
</tr>
<tr>
<td>${[parameter=word]}</td>
<td>substitute parameter</td>
<td>substitute null</td>
</tr>
<tr>
<td>${[parameter:=word]}</td>
<td>substitute parameter</td>
<td>assign word</td>
</tr>
<tr>
<td>${[parameter]+word}</td>
<td>substitute parameter</td>
<td>substitute parameter</td>
</tr>
<tr>
<td>${[parameter?:word]}</td>
<td>substitute parameter</td>
<td>error, exit</td>
</tr>
<tr>
<td>${[parameter?word]}</td>
<td>substitute parameter</td>
<td>substitute null</td>
</tr>
<tr>
<td>${[parameter:+word]}</td>
<td>substitute word</td>
<td>substitute null</td>
</tr>
</tbody>
</table>
In all cases shown with "substitute", the expression is replaced with the value shown. In all cases shown with "assign", parameter is assigned that value, which also replaces the expression.

<table>
<thead>
<tr>
<th></th>
<th>parameter set and not null</th>
<th>parameter set and null</th>
</tr>
</thead>
<tbody>
<tr>
<td>$(parameter+word</td>
<td>substitute word</td>
<td>substitute word</td>
</tr>
<tr>
<td>$(parameter:-word</td>
<td>substitute word</td>
<td></td>
</tr>
<tr>
<td>$(parameter-word</td>
<td>substitute word</td>
<td></td>
</tr>
<tr>
<td>$(parameter:=word</td>
<td>assign word</td>
<td></td>
</tr>
<tr>
<td>$(parameter=word</td>
<td>assign null</td>
<td></td>
</tr>
<tr>
<td>$(parameter:=?word</td>
<td>error, exit</td>
<td></td>
</tr>
<tr>
<td>$(parameter=?word</td>
<td>error, exit</td>
<td></td>
</tr>
<tr>
<td>$(parameter:+word</td>
<td>substitute null</td>
<td></td>
</tr>
<tr>
<td>$(parameter+word</td>
<td>substitute null</td>
<td></td>
</tr>
</tbody>
</table>

The following four varieties of parameter expansion provide for substring processing. In each case, pattern matching notation (see patmat), rather than regular expression notation, is used to evaluate the patterns. If parameter is * or @, then all the positional parameters, starting with $1, are substituted (separated by a field separator character). Enclosing the full parameter expansion string in double-quotes does not cause the following four varieties of pattern characters to be quoted, whereas quoting characters within the braces has this effect.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$(#parameter)</td>
<td>String Length. The length in characters of the value of parameter. If parameter is * or @, then all the positional parameters, starting with $1, are substituted (separated by a field separator character).</td>
</tr>
</tbody>
</table>

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$(parameter%word</td>
<td>Remove Smallest Suffix Pattern. The word is expanded to produce a pattern. The parameter expansion then results in parameter, with the smallest portion of the suffix matched by the pattern deleted.</td>
</tr>
</tbody>
</table>

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$(parameter%word</td>
<td>Remove Largest Suffix Pattern. The word is expanded to produce a pattern. The parameter expansion then results in parameter, with the largest portion of the suffix matched by the pattern deleted.</td>
</tr>
</tbody>
</table>
Remove Smallest Prefix Pattern. The word is expanded to produce a pattern. The parameter expansion then results in pattern, with the smallest portion of the prefix matched by the pattern deleted.

Remove Largest Prefix Pattern. The word is expanded to produce a pattern. The parameter expansion then results in pattern, with the largest portion of the prefix matched by the pattern deleted.

Examples:

$x:-$(ls)

In this example, ls is executed only if x is null or unset. (The $(ls) command substitution notation is explained in Command Substitution above.)

 unset X
 echo ${X:=abc}
 abc

 unset posix
 echo ${posix:?}
 sh: posix: parameter null or not set

 set a b c
 echo ${3:+posix}
 posix

 HOME=/usr/posix
 echo ${#HOME}
 10

 x=file.c
 echo ${x%.c}.o
 file.o

 $
x=posix/src/std
echo ${x%/*}
posix

${parameter#word}

x=HOME/src/cmd
echo ${x#$HOME}
/Home/src/cmd

${parameter##*/}

x=one/two/three
echo ${x##*/}
three

Parameters Set by Shell

The following parameters are automatically set by the shell:

# The number of positional parameters in decimal.
-
Flags supplied to the shell on invocation or by the set command.
?
The decimal value returned by the last executed command.
$
The process number of this shell.
-
Initially, the value of _ is an absolute pathname of the shell or script being executed as passed in the environment. Subsequently it is assigned the last argument of the previous command. This parameter is not set for commands which are asynchronous. This parameter is also used to hold the name of the matching MAIL file when checking for mail.
!
The process number of the last background command invoked.

ERRNO The value of errno as set by the most recently failed system call. This value is system dependent and is intended for debugging purposes.

LINENO The line number of the current line within the script or function being executed.

OLDPWD The previous working directory set by the cd command.

OPTARG The value of the last option argument processed by the getopts special command.

OPTIND The index of the last option argument processed by the getopts special command.

PPID The process number of the parent of the shell.

PWD The present working directory set by the cd command.
RANDOM Each time this variable is referenced, a random integer, uniformly distributed between 0 and 32767, is generated. The sequence of random numbers can be initialized by assigning a numeric value to RANDOM.

REPLY This variable is set by the select statement and by the read special command when no arguments are supplied.

SECONDS Each time this variable is referenced, the number of seconds since shell invocation is returned. If this variable is assigned a value, then the value returned upon reference is the value that was assigned plus the number of seconds since the assignment.

Variables Used by Shell

The following variables are used by the shell:

CDPATH The search path for the cd command.

COLUMNS If this variable is set, the value is used to define the width of the edit window for the shell edit modes and for printing select lists.

EDITOR If the value of this variable ends in emacs, gmacs, or vi and the VISUAL variable is not set, then the corresponding option is turned on. See the set special command.

ENV This variable, when and only when an interactive shell is invoked, is subjected to parameter expansion by the shell and the resulting value is used as a pathname of a file containing shell commands to execute in the current environment. The file need not be executable. If the expanded value of ENV is not an absolute pathname, the results are unspecified. ENV is ignored if the user’s real and effective user IDs or real and effective group IDs are different.

This variable can be used to set aliases and other items local to the invocation of a shell. The file referred to by ENV differs from $HOME/.profile in that .profile is typically executed at session startup, whereas the ENV file is executed at the beginning of each shell invocation. The ENV value is interpreted in a manner similar to a dot script, in that the commands are executed in the current environment and the file needs to be readable, but not executable. However, unlike dot scripts, no PATH searching is performed. This is used as a guard against Trojan Horse security breaches.

FCEDIT The default editor name for the fc command.

FPATH The search path for function definitions. By default, the FPATH directories are searched after the PATH variable. If an executable file is found, then it is read and executed in the current environment. FPATH is searched before PATH when a function with the -u attribute is referenced. The preset alias autoload causes a function with the -u attribute to be created.
HISTFILE If this variable is set when the shell is invoked, then the value is the
pathname of the file that is used to store the command history. See Command
re-entry.

HISTSIZE If this variable is set when the shell is invoked, then the number of
previously entered commands that are accessible by this shell is greater than
or equal to this number. The default is 128.

HOME The default argument (home directory) for the cd command.

IFS Internal field separators, normally space, tab, and new-line that are used to
separate command words which result from command or parameter
substitution and for separating words with the special command read. The
first character of the IFS variable is used to separate arguments for the $*
substitution. See Quoting.

LANG Provide a default value for the internationalization variables that are unset
or null. If any of the internationalization variables contains an invalid
setting, the utility behaves as if none of the variables had been defined.

LC_ALL This variable provides a default value for the LC_ * variables.

LC_COLLATE This variable determines the behavior of range expressions, equivalence
classes and multi-byte character collating elements within pattern
matching.

LC_CTYPE Determines how the shell handles characters. When LC_CTYPE is set to a
valid value, the shell can display and handle text and filenames containing
valid characters for that locale. If LC_CTYPE (see environ(5)) is not set in the
environment, the operational behavior of the shell is determined by the
value of the LANG environment variable. If LC_ALL is set, its contents are used
to override both the LANG and the other LC_ * variables.

LC_MESSAGES This variable determines the language in which messages should be written.

LINENO This variable is set by the shell to a decimal number representing the current
sequential line number (numbered starting with 1) within a script or
function before it executes each command. If the user unsets or resets
LINENO, the variable can lose its special meaning for the life of the shell. If the
shell is not currently executing a script or function, the value of LINENO is
unspecified.

LINES If this variable is set, the value is used to determine the column length for
printing select lists. Select lists print vertically until about two-thirds of
LINES lines are filled.

MAIL If this variable is set to the name of a mail file and the MAILPATH variable is
not set, then the shell informs the user of arrival of mail in the specified file.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAILCHECK</td>
<td>This variable specifies how often (in seconds) the shell checks for changes in the modification time of any of the files specified by the MAILPATH or MAIL variables. The default value is 600 seconds. When the time has elapsed the shell checks before issuing the next prompt.</td>
</tr>
<tr>
<td>MAILPATH</td>
<td>A colon (:) separated list of file names. If this variable is set, then the shell informs the user of any modifications to the specified files that have occurred within the last MAILCHECK seconds. Each file name can be followed by a ? and a message that is printed. The message undergoes parameter substitution with the variable $_ defined as the name of the file that has changed. The default message is you have mail in $_.</td>
</tr>
<tr>
<td>NLSPATH</td>
<td>Determine the location of message catalogues for the processing of LC_MESSAGES.</td>
</tr>
<tr>
<td>PATH</td>
<td>The search path for commands. See Execution. The user cannot change PATH if executing under rsh (except in .profile).</td>
</tr>
<tr>
<td>PPID</td>
<td>This variable is set by the shell to the decimal process ID of the process that invoked the shell. In a subshell, PPID is set to the same value as that of the parent of the current shell. For example, echo $PPID and (echo $PPID) would produce the same value.</td>
</tr>
<tr>
<td>PS1</td>
<td>The value of this variable is expanded for parameter substitution to define the primary prompt string which by default is &quot;$ &quot;. The character ! in the primary prompt string is replaced by the command number. See Command Re-entry. Two successive occurrences of ! produces a single ! when the prompt string is printed.</td>
</tr>
<tr>
<td>PS2</td>
<td>Secondary prompt string, by default ”&gt; &quot;.</td>
</tr>
<tr>
<td>PS3</td>
<td>Selection prompt string used within a select loop, by default &quot;#? &quot; .</td>
</tr>
<tr>
<td>PS4</td>
<td>The value of this variable is expanded for parameter substitution and precedes each line of an execution trace. If omitted, the execution trace prompt is “+ &quot;.</td>
</tr>
<tr>
<td>PWD</td>
<td>Set by the shell to be an absolute pathname of the current working directory, containing no components of type symbolic link, no components that are dot, and no components that are dot-dot when the shell is initialized. If an application sets or unsets the value of PWD, the behaviors of the cd and pwd utilities are unspecified</td>
</tr>
<tr>
<td>SHELL</td>
<td>The pathname of the shell is kept in the environment. At invocation, if the basename of this variable is rsh, rksh, or krsh, then the shell becomes restricted.</td>
</tr>
</tbody>
</table>
TMOUT  If set to a value greater than zero, the shell terminates if a command is not entered within the prescribed number of seconds after issuing the PS1 prompt. The shell can be compiled with a maximum bound for this value which cannot be exceeded.

VISUAL  If the value of this variable ends in emacs, gmacs, or vi, then the corresponding option is turned on. See Special Command set.

The shell gives default values to PATH, PS1, PS2, PS3, PS4, MAILCHECK, FCEDIT, TMOUT, and IFS, while HOME, SHELL, ENV, and MAIL are not set at all by the shell (although HOME is set by login(1)). On some systems MAIL and SHELL are also set by login.

Blank Interpretation  After parameter and command substitution, the results of substitutions are scanned for the field separator characters (those found in IFS) and split into distinct arguments where such characters are found. Explicit null arguments ("" or '') are retained. Implicit null arguments (those resulting from parameters that have no values) are removed.

File Name Generation  Following substitution, each command word is scanned for the characters *, ?, and [- unless the -f option has been set. If one of these characters appears, the word is regarded as a pattern. The word is replaced with lexicographically sorted file names that match the pattern. If no file name is found that matches the pattern, the word is left unchanged. When a pattern is used for file name generation, the character period (.) at the start of a file name or immediately following a /, as well as the character / itself, must be matched explicitly. A file name beginning with a period is not matched with a pattern with the period inside parentheses. That is, ls @(r*) would locate a file named .restore, but ls @(..r*) would not. In other instances of pattern matching, the / and . are not treated specially.

* matches any string, including the null string.

? matches any single character.

[...] matches any one of the enclosed characters. A pair of characters separated by – matches any character lexically between the pair, inclusive. If the first character following the opening "[" is a "!", then any character not enclosed is matched. A – can be included in the character set by putting it as the first or last character.

A pattern-list is a list of one or more patterns separated from each other with a |. Composite patterns can be formed with one or more of the following:

? (pattern-list) Optionally matches any one of the given patterns.

* (pattern-list) Matches zero or more occurrences of the given patterns.

+ (pattern-list) Matches one or more occurrences of the given patterns.

@ (pattern-list) Matches exactly one of the given patterns.

! (pattern-list) Matches anything, except one of the given patterns.
Quoting  Each of the metacharacters listed above (see Definitions) has a special meaning to the shell and causes termination of a word unless quoted. A character can be quoted (that is, made to stand for itself) by preceding it with a `\'. The pair `\ NEWLINE is removed. All characters enclosed between a pair of single quote marks (`'`) are quoted. A single quote cannot appear within single quotes. Inside double quote marks (`"`), parameter and command substitution occur and `\` quotes the characters ``, `'`, and `$`. The meaning of `$*` and `$@` is identical when not quoted or when used as a parameter assignment value or as a file name. However, when used as a command argument, `$*` is equivalent to `"$1 $2 ... "`, where `d` is the first character of the IFS variable, whereas `$@` is equivalent to `"$1 $2 ... `. Inside grave quote marks (`'`), `\` quotes the characters ``, `'`, and `$`. If the grave quotes occur within double quotes, then `\` also quotes the character `"`.

The special meaning of reserved words or aliases can be removed by quoting any character of the reserved word. The recognition of function names or special command names listed cannot be altered by quoting them.

Arithmetic Evaluation  An ability to perform integer arithmetic is provided with the special command `let`. Evaluations are performed using long arithmetic. Constants are of the form `[ base# ] n` where `base` is a decimal number between two and thirty-six representing the arithmetic base and `n` is a number in that base. If `base` is omitted then base 10 is used.

An arithmetic expression uses the same syntax, precedence, and associativity of expression as the C language. All the integral operators, other than `++`, `-;`, `?;`, and `,`, are supported. Variables can be referenced by name within an arithmetic expression without using the parameter substitution syntax. When a variable is referenced, its value is evaluated as an arithmetic expression.

An internal integer representation of a variable can be specified with the `-i` option of the `typeset` special command. Arithmetic evaluation is performed on the value of each assignment to a variable with the `-i` attribute. If you do not specify an arithmetic base, the first assignment to the variable determines the arithmetic base. This base is used when parameter substitution occurs.

Since many of the arithmetic operators require quoting, an alternative form of the `let` command is provided. For any command which begins with a `(`, all the characters until a matching `)` are treated as a quoted expression. More precisely, `((...))` is equivalent to `let "$..."`.

Prompting  When used interactively, the shell prompts with the parameter expanded value of `PS1` before reading a command. If at any time a new-line is typed and further input is needed to complete a command, then the secondary prompt (that is, the value of `PS2`) is issued.
A conditional expression is used with the `[[` compound command to test attributes of files and to compare strings. Word splitting and file name generation are not performed on the words between `[[` and `]]`. Each expression can be constructed from one or more of the following unary or binary expressions:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>-a file</code></td>
<td>True, if file exists.</td>
</tr>
<tr>
<td><code>-b file</code></td>
<td>True, if file exists and is a block special file.</td>
</tr>
<tr>
<td><code>-c file</code></td>
<td>True, if file exists and is a character special file.</td>
</tr>
<tr>
<td><code>-d file</code></td>
<td>True, if file exists and is a directory.</td>
</tr>
<tr>
<td><code>-e file</code></td>
<td>True, if file exists.</td>
</tr>
<tr>
<td><code>-f file</code></td>
<td>True, if file exists and is an ordinary file.</td>
</tr>
<tr>
<td><code>-g file</code></td>
<td>True, if file exists and has its setgid bit set.</td>
</tr>
<tr>
<td><code>-h file</code></td>
<td>True, if file exists and is a symbolic link.</td>
</tr>
<tr>
<td><code>-k file</code></td>
<td>True, if file exists and has its sticky bit set.</td>
</tr>
<tr>
<td><code>-n string</code></td>
<td>True, if length of string is non-zero.</td>
</tr>
<tr>
<td><code>-o option</code></td>
<td>True, if length of string is non-zero.</td>
</tr>
<tr>
<td><code>-p file</code></td>
<td>True, if file exists and is a fifo special file or a pipe.</td>
</tr>
<tr>
<td><code>-r file</code></td>
<td>True, if file exists and is readable by current process.</td>
</tr>
<tr>
<td><code>-s file</code></td>
<td>True, if file exists and has size greater than zero.</td>
</tr>
<tr>
<td><code>-t filedes</code></td>
<td>True, if file descriptor number filedes is open and associated with a terminal device.</td>
</tr>
<tr>
<td><code>-u file</code></td>
<td>True, if file exists and has its setuid bit set.</td>
</tr>
<tr>
<td><code>-w file</code></td>
<td>True, if file exists and is writable by current process.</td>
</tr>
<tr>
<td><code>-x file</code></td>
<td>True, if file exists and is executable by current process. If file exists and is a directory, then the current process has permission to search in the directory.</td>
</tr>
<tr>
<td><code>-Z string</code></td>
<td>True, if length of string is zero.</td>
</tr>
<tr>
<td><code>-L file</code></td>
<td>True, if file exists and is a symbolic link.</td>
</tr>
<tr>
<td><code>-O file</code></td>
<td>True, if file exists and is owned by the effective user id of this process.</td>
</tr>
<tr>
<td><code>-G file</code></td>
<td>True, if file exists and its group matches the effective group id of this process.</td>
</tr>
<tr>
<td><code>-S file</code></td>
<td>True, if file exists and is a socket.</td>
</tr>
</tbody>
</table>
file1 -nt file2  True, if file1 exists and is newer than file2.
file1 -ot file2  True, if file1 exists and is older than file2.
file1 -ef file2  True, if file1 and file2 exist and refer to the same file.
string == pattern True, if string matches pattern.
string = pattern Same as ==, but is obsolete.
string != pattern True, if string does not match pattern.
string1 < string2 True, if string1 comes before string2 based on strings interpreted as appropriate to the locale setting for category LC_COLLATE.
string1 > string2 True, if string1 comes after string2 based on strings interpreted as appropriate to the locale setting for category LC_COLLATE.
exp1 -eq exp2  True, if exp1 is equal to exp2.
exp1 -ne exp2  True, if exp1 is not equal to exp2.
exp1 -lt exp2  True, if exp1 is less than exp2.
exp1 -gt exp2  True, if exp1 is greater than exp2.
exp1 -le exp2  True, if exp1 is less than or equal to exp2.
exp1 -ge exp2  True, if exp1 is greater than or equal to exp2.

In each of the above expressions, if file is of the form /dev/fd/n, where n is an integer, then the test is applied to the open file whose descriptor number is n.

A compound expression can be constructed from these primitives by using any of the following, listed in decreasing order of precedence.

(expression) True, if expression is true. Used to group expressions.
! expression True if expression is false.
expression1 & expression2 True, if expression1 and expression2 are both true.
expression1 || expression2 True, if either expression1 or expression2 is true.

Before a command is executed, its input and output can be redirected using a special notation interpreted by the shell. The following can appear anywhere in a simple-command or can precede or follow a command and are not passed on to the invoked command. Command and parameter substitution occur before word or digit is used except as noted. File name generation occurs only if the pattern matches a single file, and blank interpretation is not performed.

<word Use file word as standard input (file descriptor 0).
Use file `word` as standard output (file descriptor 1). If the file does not exist then it is created. If the file exists, and the `-noclobber` option is on, this causes an error; otherwise, it is truncated to zero length.

Sames as >, except that it overrides the `-noclobber` option.

Use file `word` as standard output. If the file exists, output is appended to it (by first seeking to the EOF). Otherwise, the file is created.

Open file `word` for reading and writing as standard input.

The shell input is read up to a line that is the same as `word`, or to an EOF. No parameter substitution, command substitution, or file name generation is performed on `word`. The resulting document, called a here-document, becomes the standard input. If any character of `word` is quoted, no interpretation is placed upon the characters of the document. Otherwise, parameter and command substitution occur, \NEWLINE is ignored, and \ must be used to quote the characters \, $, ', and the first character of `word`. If – is appended to <<, then all leading tabs are stripped from `word` and from the document.

Similarly for the standard output using >&digit.

The standard input is closed. Similarly for the standard output using >&–.

The input from the co-process is moved to standard input.

The output to the co-process is moved to standard output.

If one of the above is preceded by a digit, then the file descriptor number referred to is that specified by the digit (instead of the default 0 or 1). For example:

```bash
... 2>&1
```

means file descriptor 2 is to be opened for writing as a duplicate of file descriptor 1.

The order in which redirections are specified is significant. The shell evaluates each redirection in terms of the (file descriptor, file) association at the time of evaluation. For example:

```bash
... 1>fname 2>&1
```

first associates file descriptor 1 with file `fname`. It then associates file descriptor 2 with the file associated with file descriptor 1 (that is, `fname`). If the order of redirections were reversed, file descriptor 2 would be associated with the terminal (assuming file descriptor 1 had been) and then file descriptor 1 would be associated with file `fname`. 
If a command is followed by & and job control is not active, then the default standard input for the command is the empty file /dev/null. Otherwise, the environment for the execution of a command contains the file descriptors of the invoking shell as modified by input/output specifications.

Environment
The environment (see environ(5)) is a list of name-value pairs that is passed to an executed program in the same way as a normal argument list. The names must be identifiers and the values are character strings. The shell interacts with the environment in several ways. On invocation, the shell scans the environment and creates a variable for each name found, giving it the corresponding value and marking it export. Executed commands inherit the environment. If the user modifies the values of these variables or creates new ones, using the export or typeset -x commands, they become part of the environment. The environment seen by any executed command is thus composed of any name-value pairs originally inherited by the shell, whose values can be modified by the current shell, plus any additions which must be noted in export or typeset -x commands.

The environment for any simple-command or function can be augmented by prefixing it with one or more variable assignments. A variable assignment argument is a word of the form identifier=value. Thus:

```bash
TERM=450 cmd args
```

and

```bash
(export TERM; TERM=450; cmd args)
```

are equivalent (as far as the above execution of cmd is concerned, except for special commands listed that are preceded with an asterisk).

If the -k flag is set, all variable assignment arguments are placed in the environment, even if they occur after the command name. The following first prints a=b c and then c:

```bash
echo a=b c
set -k echo
a=b c
```

This feature is intended for use with scripts written for early versions of the shell and its use in new scripts is strongly discouraged. It is likely to disappear someday.

Functions
The function reserved word, described in the Commands section above, is used to define shell functions. Shell functions are read in and stored internally. Alias names are resolved when the function is read. Functions are executed like commands with the arguments passed as positional parameters. See Execution.

Functions execute in the same process as the caller and share all files and present working directory with the caller. Traps caught by the caller are reset to their default action inside the
function. A trap condition that is not caught or ignored by the function causes the function to terminate and the condition to be passed on to the caller.

A trap on EXIT set inside a function is executed after the function completes in the environment of the caller. This is true only for non-POSIX-style functions, that is, functions declared as

```bash
function func
```

as opposed to POSIX-style functions, declared as

```bash
func()
```

Ordinarily, variables are shared between the calling program and the function. However, the `typeset` special command used within a function defines local variables whose scope includes the current function and all functions it calls.

The special command `return` is used to return from function calls. Errors within functions return control to the caller.

The names of all functions can be listed with `typeset -f`. `typeset -f` lists all function names as well as the text of all functions. `typeset -f function-names` lists the text of the named functions only. Functions can be undefined with the `-f` option of the `unset` special command.

Ordinarily, functions are unset when the shell executes a shell script. The `-xf` option of the `typeset` command allows a function to be exported to scripts that are executed without a separate invocation of the shell. Functions that need to be defined across separate invocations of the shell should be specified in the `ENV` file with the `-xf` option of `typeset`.

A function is a user-defined name that is used as a simple command to call a compound command with new positional parameters. A function is defined with a function definition command.

The format of a function definition command is as follows:

```bash
fname() compound-command[io-redirect ...]
```

The function is named `fname`; it must be a name. An implementation can allow other characters in a function name as an extension. The implementation maintains separate name spaces for functions and variables.

The `()` in the function definition command consists of two operators. Therefore, intermixing blank characters with the `fname`, `,`, and `)` is allowed, but unnecessary.

The argument `compound-command` represents a compound command.

When the function is declared, none of the expansions in `wordexp` is performed on the text in `compound-command` or `io-redirect`; all expansions is performed as normal each time the
function is called. Similarly, the optional \texttt{io-redirect} redirections and any variable assignments within \texttt{compound-command} is performed during the execution of the function itself, not the function definition.

When a function is executed, it has the syntax-error and variable-assignment properties described for the special built-in utilities.

The \texttt{compound-command} is executed whenever the function name is specified as the name of a simple command. The operands to the command temporarily becomes the positional parameters during the execution of the \texttt{compound-command}; the special parameter \texttt{#} is also changed to reflect the number of operands. The special parameter \texttt{0} is unchanged. When the function completes, the values of the positional parameters and the special parameter \texttt{#} is restored to the values they had before the function was executed. If the special built-in \texttt{return} is executed in the \texttt{compound-command}, the function completes and execution resumes with the next command after the function call.

An example of how a function definition can be used wherever a simple command is allowed:

\begin{verbatim}
# If variable \texttt{i} is equal to "yes",
# define function \texttt{foo} to be \texttt{ls -l}
#
# [ "$i" = yes ] && foo() {
    ls -l
}
\end{verbatim}

The exit status of a function definition is \texttt{0} if the function was declared successfully; otherwise, it is greater than zero. The exit status of a function invocation is the exit status of the last command executed by the function.

\section*{Jobs}

If the \texttt{monitor} option of the \texttt{set} command is turned on, an interactive shell associates a job with each pipeline. It keeps a table of current jobs, printed by the \texttt{jobs} command, and assigns them small integer numbers. When a job is started asynchronously with \&\&, the shell prints a line which looks like:

\begin{verbatim}
[1] 1234
\end{verbatim}

indicating that the job, which was started asynchronously, was job number 1 and had one (top-level) process, whose process id was 1234.

If you are running a job and wish to do something else you can press the key \texttt{^Z \textendash (Control-Z)} which sends a \texttt{STOP} signal to the current job. The shell normally indicates that the job has been 'Stopped ', and print another prompt. You can then manipulate the state of this job, putting it in the background with the \texttt{bg} command, or run some other commands and then eventually bring the job back into the foreground with the foreground command \texttt{fg}. A \texttt{^Z} takes effect immediately and is like an interrupt in that pending output and unread input are discarded when it is typed.
A job being run in the background stops if it tries to read from the terminal. Background jobs are normally allowed to produce output, but this can be disabled by giving the command “stty tostop”. If you set this tty option, then background jobs stop when they try to produce output as they do when they try to read input.

There are several ways to refer to jobs in the shell. A job can be referred to by the process id of any process of the job or by one of the following:

- %number: The job with the given number.
- %string: Any job whose command line begins with string.
- %?string: Any job whose command line contains string.
- %: Current job.
- %+: Equivalent to %.
- %−: Previous job.

The shell learns immediately whenever a process changes state. It normally informs you whenever a job becomes blocked so that no further progress is possible, but only just before it prints a prompt. This is done so that it does not otherwise disturb your work.

When the monitor mode is on, each background job that completes triggers any trap set for CHLD.

When you try to leave the shell while jobs are running or stopped, you are warned with the message, ‘You have stopped (running) jobs.’ You can use the jobs command to see what they are. If you do this or immediately try to exit again, the shell does not warn you a second time, and the stopped jobs is terminated. If you have jobs running for which the nohup command was invoked and attempt to logout, you are warned with the message:

You have jobs running.

You need to logout a second time to actually logout. However, your background jobs continue to run.

Signals: The INT and QUIT signals for an invoked command are ignored if the command is followed by & and the -monitor option is not active. Otherwise, signals have the values inherited by the shell from its parent. See the trap special command section.

Execution: Each time a command is executed, the above substitutions are carried out. If the command name matches one of the Special Commands listed, it is executed within the current shell process. Next, the command name is checked to see if it matches one of the user defined functions. If it does, the positional parameters are saved and then reset to the arguments of the function call. When the function completes or issues a return, the positional parameter list is restored and any trap set on EXIT within the function is executed. The value of a function is
the value of the last command executed. A function is also executed in the current shell process. If a command name is not a special command or a user defined function, a process is created and an attempt is made to execute the command using `exec(2)`.

The shell variable `PATH` defines the search path for the directory containing the command. Alternative directory names are separated by a colon (:``). The default path is `/usr/bin:` (specifying `/usr/bin` and the current directory in that order). The current directory can be specified by two or more adjacent colons, or by a colon at the beginning or end of the path list. If the command name contains a `/` then the search path is not used. Otherwise, each directory in the path is searched for an executable file. If the file has execute permission but is not a directory or an `.out` file, it is assumed to be a file containing shell commands. A sub-shell is spawned to read it. All non-exported aliases, functions, and variables are removed in this case. A parenthesized command is executed in a sub-shell without removing non-exported quantities.

Command Re-entry The text of the last `HISTSIZE` (default 128) commands entered from a terminal device is saved in a history file. The file `$HOME/.sh_history` is used if the `HISTFILE` variable is not set or if the file it names is not writable. A shell can access the commands of all `interactive` shells which use the same named `HISTFILE`. The special command `fc` is used to list or edit a portion of this file. The portion of the file to be edited or listed can be selected by number or by giving the first character or characters of the command. A single command or range of commands can be specified. If you do not specify an editor program as an argument to `fc` then the value of the variable `FCEDIT` is used. If `FCEDIT` is not defined, then `/bin/ed` is used. The edited command(s) is printed and re-executed upon leaving the editor. The editor name – is used to skip the editing phase and to re-execute the command. In this case a substitution parameter of the form `old=new` can be used to modify the command before execution. For example, if `r` is aliased to `’fc -e -’` then typing `’r bad=good c’` re-executes the most recent command which starts with the letter `c`, replacing the first occurrence of the string `bad` with the string `good`.

In-line Editing Option Normally, each command line entered from a terminal device is simply typed followed by a new-line (RETURN or LINEFEED). If either the `emacs`, `gmacs`, or `vi` option is active, the user can edit the command line. To be in either of these edit modes set the corresponding option. An editing option is automatically selected each time the `VISUAL` or `EDITOR` variable is assigned a value ending in either of these option names.

The editing features require that the user’s terminal accept RETURN as carriage return without line feed and that a space must overwrite the current character on the screen.

The editing modes implement a concept where the user is looking through a window at the current line. The window width is the value of `COLUMNS` if it is defined, otherwise 80. If the window width is too small to display the prompt and leave at least 8 columns to enter input, the prompt is truncated from the left. If the line is longer than the window width minus two, a mark is displayed at the end of the window to notify the user. As the cursor moves and reaches
the window boundaries the window are centered about the cursor. The mark is a > if the line extends on the right side of the window, < if the line extends on the left, and * if the line extends on both sides of the window.

The search commands in each edit mode provide access to the history file. Only strings are matched, not patterns, although a leading caret (^) in the string restricts the match to begin at the first character in the line.

This mode is entered by enabling either the emacs or gmacs option. The only difference between these two modes is the way they handle ^T. To edit, move the cursor to the point needing correction and then insert or delete characters or words as needed. All the editing commands are control characters or escape sequences. The notation for control characters is caret (^) followed by the character. For example, ^F is the notation for control F. This is entered by depressing 'F while holding down the CTRL (control) key. The SHIFT key is not depressed. (The notation ^? indicates the DEL (delete) key.)

The notation for escape sequences is M- followed by a character. For example, M- f (pronounced Meta f) is entered by depressing ESC (ascii 033) followed by 'f. (M- F would be the notation for ESC followed by SHIFT (capital) 'F.)

All edit commands operate from any place on the line (not just at the beginning). Neither the RETURN nor the LINEFEED key is entered after edit commands except when noted.

- ^F: Move cursor forward (right) one character.
- M- f: Move cursor forward one word. (The emacs editor's idea of a word is a string of characters consisting of only letters, digits and underscores.)
- ^B: Move cursor backward (left) one character.
- M- b: Move cursor backward one word.
- ^A: Move cursor to start of line.
- ^E: Move cursor to end of line.
- ^} char: Move cursor forward to character char on current line.
- M-. ^} char: Move cursor backward to character char on current line.
- ^X^X: Interchange the cursor and mark.
- erase: (User defined erase character as defined by the stty(1) command, usually ^H or #.) Delete previous character.
- ^D: Delete current character.
- M- d: Delete current word.
- M-. ^H: (Meta-backspace) Delete previous word.
M-h Delete previous word.
M-^? (Meta-DEL) Delete previous word (if your interrupt character is ^? (DEL, the default) then this command does not work).
^T Transpose current character with next character in emacs mode. Transpose two previous characters in gmacs mode.
^C Capitalize current character.
M-c Capitalize current word.
M-\ Change the current word to lower case.
^K Delete from the cursor to the end of the line. If preceded by a numerical parameter whose value is less than the current cursor position, then delete from given position up to the cursor. If preceded by a numerical parameter whose value is greater than the current cursor position, then delete from cursor up to given cursor position.
^W Kill from the cursor to the mark.
M-p Push the region from the cursor to the mark on the stack.
kill (User defined kill character as defined by the stty(1) command, usually ^G or @.) Kill the entire current line. If two kill characters are entered in succession, all kill characters from then on cause a line feed (useful when using paper terminals).
^Y Restore last item removed from line. (Yank item back to the line.)
^L Line feed and print current line.
^@ (null character) Set mark.
M-space (Meta space) Set mark.
J (New line) Execute the current line.
M (Return) Execute the current line.
eof End-of-file character, normally ^D, is processed as an End-of-file only if the current line is null.
^P Fetch previous command. Each time ^P is entered the previous command back in time is accessed. Moves back one line when not on the first line of a multi-line command.
M-< Fetch the least recent (oldest) history line.
M-> Fetch the most recent (youngest) history line.
^N Fetch next command line. Each time ^N is entered the next command line forward in time is accessed.
\^Rstring  Reverse search history for a previous command line containing string. If a
parameter of zero is given, the search is forward. string is terminated by a
RETURN or NEW LINE. If string is preceded by a ^, the matched line must
begin with string. If string is omitted, then the next command line containing the
most recent string is accessed. In this case a parameter of zero reverses the
direction of the search.

^O  Operate. Execute the current line and fetch the next line relative to current line
from the history file.

M-- digits  (Escape) Define numeric parameter, the digits are taken as a parameter to the
next command. The commands that accept a parameter are ^F, ^B, erase, ^C, ^D,
^K, ^R, ^P, ^N, ^], M-.., M-~, M-b, M-c, M-d, M-f, M-h, M-l and M-^H.

M-letter  Soft-key. Your alias list is searched for an alias by the name _letter and if an alias
of this name is defined, its value is inserted on the input queue. The letter must
not be one of the above meta-functions.

M-[letter  Soft-key. Your alias list is searched for an alias by the name _-letter and if an alias
of this name is defined, its value is inserted on the input queue. The can be used
to program functions keys on many terminals.

M--  The last word of the previous command is inserted on the line. If preceded by a
numeric parameter, the value of this parameter determines which word to insert
rather than the last word.

M--  Same as M--.

M--*  An asterisk is appended to the end of the word and a file name expansion is
attempted.

M-ESC  File name completion. Replaces the current word with the longest common
prefix of all filenames matching the current word with an asterisk appended. If
the match is unique, a / is appended if the file is a directory and a space is
 appended if the file is not a directory.

M-=  List files matching current word pattern if an asterisk were appended.

^U  Multiply parameter of next command by 4.

\  Escape next character. Editing characters, the user’s erase, kill and interrupt
(normally ^?) characters can be entered in a command line or in a search string if
preceded by a \ . The \ removes the next character’s editing features (if any).

^V  Display version of the shell.

M-#  Insert a # at the beginning of the line and execute it. This causes a comment to be
inserted in the history file.
There are two typing modes. Initially, when you enter a command you are in the input mode. To edit, enter control mode by typing ESC (033) and move the cursor to the point needing correction and then insert or delete characters or words as needed. Most control commands accept an optional repeat count prior to the command.

When in vi mode on most systems, canonical processing is initially enabled and the command is echoed again if the speed is 1200 baud or greater and it contains any control characters or less than one second has elapsed since the prompt was printed. The ESC character terminates canonical processing for the remainder of the command and the user can then modify the command line. This scheme has the advantages of canonical processing with the type-ahead echoing of raw mode.

If the option vi raw is also set, the terminal always have canonical processing disabled. This mode is implicit for systems that do not support two alternate end of line delimiters, and can be helpful for certain terminals.

By default the editor is in input mode.

```plaintext
erase  (User defined erase character as defined by the stty(1) command, usually ^H or #.)  
      Delete previous character.

^W    Delete the previous blank separated word.

^D    Terminate the shell.

^V    Escape next character. Editing characters and the user’s erase or kill characters can 
      be entered in a command line or in a search string if preceded by a ^V. The ^V 
      removes the next character’s editing features (if any).

\    Escape the next erase or kill character.
```

The following commands move the cursor:

```plaintext
[count]\l  Cursor forward (right) one character.
[count]\w  Cursor forward one alpha-numeric word.
[count]\W  Cursor to the beginning of the next word that follows a blank.
[count]\e  Cursor to end of word.
[count]E  Cursor to end of the current blank delimited word.
[count]\h  Cursor backward (left) one character.
[count]\b  Cursor backward one word.
[count]\B  Cursor to preceding blank separated word.
[count]\l  Cursor to column count.
[count]\c  Find the next character c in the current line.
```
[count]Fe  Find the previous character c in the current line.
[count]te  Equivalent to f followed by h.
[count]Te  Equivalent to F followed by t.
[count];  Repeats count times, the last single character find command, f, F, t, or T.
[count],  Reverses the last single character find command count times.
∅       Cursor to start of line.
^       Cursor to first non-blank character in line.
$       Cursor to end of line.
%       Moves to balancing (, ), {, }, [, or ]. If cursor is not on one of the above characters, the remainder of the line is searched for the first occurrence of one of the above characters first.

Search Edit Commands  These commands access your command history.
[count]k  Fetch previous command. Each time k is entered the previous command back in time is accessed.
[count]−  Equivalent to k.
[count]j  Fetch next command. Each time j is entered, the next command forward in time is accessed.
[count]+  Equivalent to j.
[count]G  The command number count is fetched. The default is the least recent history command.
/string  Search backward through history for a previous command containing string. string is terminated by a RETURN or NEWLINE. If string is preceded by a ^, the matched line must begin with string. If string is NULL, the previous string is used.
?string  Same as / except that search is in the forward direction.
n       Search for next match of the last pattern to / or ? commands.
N       Search for next match of the last pattern to / or ?, but in reverse direction. Search history for the string entered by the previous / command.

Text Modification Edit Commands  These commands modifies the line.
a       Enter input mode and enter text after the current character.
A       Append text to the end of the line. Equivalent to $a.
Delete current character through the character that `motion` would move the cursor to and enter input mode. If `motion` is `c`, the entire line is deleted and input mode entered.

Delete the current character through the end of line and enter input mode. Equivalent to `c$`.

Delete `count` characters and enter input mode.

Equivalent to `cc`.

Delete the current character through the end of line. Equivalent to `d$`.

Delete `count` character through the character that `motion` would move to. If `motion` is `d`, the entire line is deleted.

Insert input mode and insert text before the current character.

Insert text before the beginning of the line. Equivalent to `0i`.

Place the previous text modification before the cursor.

Place the previous text modification after the cursor.

Enter input mode and replace characters on the screen with characters you type overlay fashion.

Replace the `count` character(s) starting at the current cursor position with `c`, and advance the cursor.

Delete current character.

Delete preceding character.

Repeat the previous text modification command.

Invert the case of the `count` character(s) starting at the current cursor position and advance the cursor.

Causes the `count` word of the previous command to be appended and input mode entered. The last word is used if `count` is omitted.

Causes an * to be appended to the current word and file name generation attempted. If no match is found, it rings the bell. Otherwise, the word is replaced by the matching pattern and input mode is entered.

Filename completion. Replaces the current word with the longest common prefix of all filenames matching the current word with an asterisk appended. If the match is unique, a / is appended if the file is a directory and a space is appended if the file is not a directory.
**Other Edit Commands**

Miscellaneous commands.

- `y[count]motion` Yank current character through character that `motion` would move the cursor to and puts them into the delete buffer. The text and cursor are unchanged.
- `Y` Yanks from current position to end of line. Equivalent to `y$`.
- `u` Undo the last text modifying command.
- `U` Undo all the text modifying commands performed on the line.
- `[count]v` Returns the command `fc -e ${VISUAL:-${EDITOR:-vi}} count` in the input buffer. If `count` is omitted, then the current line is used.
- `^L` Line feed and print current line. Has effect only in control mode.
- `J` (New line) Execute the current line, regardless of mode.
- `M` (Return) Execute the current line, regardless of mode.
- `#` If the first character of the command is a `#`, then this command deletes this `#` and each `#` that follows a newline. Otherwise, sends the line after inserting a `#` in front of each line in the command. Useful for causing the current line to be inserted in the history as a comment and removing comments from previous comment commands in the history file.
- `=` List the file names that match the current word if an asterisk were appended it.
- `@letter` Your alias list is searched for an alias by the name `_letter` and if an alias of this name is defined, its value is inserted on the input queue for processing.

**Special Commands**

The following *simple-commands* are executed in the shell process. Input/Output redirection is permitted. Unless otherwise indicated, the output is written on file descriptor 1 and the exit status, when there is no syntax error, is 0. Commands that are preceded by one or two * (asterisks) are treated specially in the following ways:

1. Variable assignment lists preceding the command remain in effect when the command completes.
2. I/O redirections are processed after variable assignments.
3. Errors cause a script that contains them to abort.
4. Words, following a command preceded by ** that are in the format of a variable assignment, are expanded with the same rules as a variable assignment. This means that tilde substitution is performed after the `=` sign and word splitting and file name generation are not performed.
* : [arg ...]
The command only expands parameters.

* : file [arg ...]
Read the complete file then execute the commands. The commands are executed in the current shell environment. The search path specified by PATH is used to find the directory containing file. If any arguments arg are given, they become the positional parameters. Otherwise the positional parameters are unchanged. The exit status is the exit status of the last command executed.

** alias [-tx] [name=value] ... 
alias with no arguments prints the list of aliases in the form name=value on standard output. An alias is defined for each name whose value is given. A trailing space in value causes the next word to be checked for alias substitution. The -t flag is used to set and list tracked aliases. The value of a tracked alias is the full pathname corresponding to the given name. The value becomes undefined when the value of PATH is reset but the aliases remained tracked. Without the -t flag, for each name in the argument list for which no value is given, the name and value of the alias is printed. The -x flag is used to set or print exported aliases. An exported alias is defined for scripts invoked by name. The exit status is non-zero if a name is given, but no value, and no alias has been defined for the name.

bg [ %job... ]
This command is only on systems that support job control. Puts each specified job into the background. The current job is put in the background if job is not specified. See Jobs section above for a description of the format of job.

* break [n]
Exit from the enclosed for, while, until, or select loop, if any. If n is specified then break n levels. If n is greater than the number of enclosing loops, the outermost enclosing loop shall be exited.

* continue [n]
Resume the next iteration of the enclosed for, while, until, or select loop. If n is specified then resume at the n-th enclosed loop. If n is greater than the number of enclosing loops, the outermost enclosing loop shall be used.

cd [-L] [-P] [arg]
cd old new
This command can be in either of two forms. In the first form it changes the current directory to arg. If arg is – the directory is changed to the previous directory. The shell variable HOME is the default arg. The environment variablePWD is set to the current directory. If the PWD is changed, the OLDPWD environment variable shall also be changed to the value of the old working directory, that is, the current working directory immediately prior to the call to change directory (cd). The shell variableCDPATH defines the search path for the directory containing arg. Alternative directory names are separated by a colon (:). The default path is null (specifying the current directory). The current directory is specified by a null path name, which can appear immediately after the equal sign or between the
colon delimiters anywhere else in the path list. If `arg` begins with a `/` then the search path is not used. Otherwise, each directory in the path is searched for `arg`. If unsuccessful, `cd` attempts to change directories to the pathname formed by the concatenation of the value of `PWD`, a slash character, and `arg`.

- **-L** Handles the operation dot-dot (..) logically. Symbolic link components are *not* resolved before dot-dot components are processed.

- **-P** Handles the operand dot-dot physically. Symbolic link components are *resolved* before dot-dot components are processed.

If both `-L` and `-P` options are specified, the last option to be invoked is used and the other is ignored. If neither `-L` nor `-P` is specified, the operand is handled dot-dot logically.

The second form of `cd` substitutes the string `new` for the string `old` in the current directory name, `PWD`, and tries to change to this new directory. The `cd` command cannot be executed by `rksh`.

**command [ -p ] [command_name] [argument ...]**

**command [ -v | -V ] command_name**

The `command` utility causes the shell to treat the arguments as a simple command, suppressing the shell function lookup. The `-p` flag performs the command search using a default value for `PATH` that is guaranteed to find all of the standard utilities. The `-v` flag writes a string to standard output that indicates the pathname or command that is used by the shell, in the current shell execution environment, to invoke `command_name`. The `-V` flag writes a string to standard output that indicates how the name given in the `command_name` operand is interpreted by the shell, in the current shell execution environment.

**echo [ arg ... ]**

See `echo(1)` for usage and description.

* **eval [ arg ... ]**

  The arguments are read as input to the shell and the resulting command(s) executed.

* **exec [ arg ... ]**

  If `arg` is given, the command specified by the arguments is executed in place of this shell without creating a new process. Input/output arguments can appear and affect the current process. If no arguments are given the effect of this command is to modify file descriptors as prescribed by the input/output redirection list. In this case, any file descriptor numbers greater than 2 that are opened with this mechanism are closed when invoking another program.

* **exit [ n ]**

  Causes the calling shell or shell script to exit with the exit status specified by `n`. The value is the least significant 8 bits of the specified status. If `n` is omitted then the exit status is that of the last command executed. When `exit` occurs when executing a trap, the last command
refers to the command that executed before the trap was invoked. An EOF also causes the shell to exit except for a shell which has the `ignoreeof` option turned on. See `set`.

**export [ name[=value] ] ...
**export -p

The given names are marked for automatic export to the environment of subsequently-executed commands.

When `-p` is specified, `export` writes to the standard output the names and values of all exported variables in the following format:

"export %s=%s\n", name, value

if `name` is set, and:

"export %s\n", name

if `name` is unset.

The shell formats the output, including the proper use of quoting, so that it is suitable for reinput to the shell as commands that achieve the same exporting results, except for the following:

1. Read-only variables with values cannot be reset.
2. Variables that were unset at the time they were output are not reset to the unset state if a value is assigned to the variable between the time the state was saved and the time at which the saved output is reinput to the shell.

`fc` [-e `ename`] [-nlr] [ [ first [ last ] ]
`fc` -e [ old=new ] [ command ]
`fc` -s [ old=new ] [ command ]

In the first form, a range of commands from `first` to `last` is selected from the last HISTSIZE commands that were typed at the terminal. The arguments `first` and `last` can be specified as a number or as a string. A string is used to locate the most recent command starting with the given string. A negative number is used as an offset to the current command number. If the `-l` flag is selected, the commands are listed on standard output. Otherwise, the editor program `ename` is invoked on a file containing these keyboard commands. If `ename` is not supplied, then the value of the variable `FCEDIT` (default `/bin/ed`) is used as the editor. When editing is complete, the edited command(s) is executed. If `last` is not specified then it is set to `first`. If `first` is not specified the default is the previous command for editing and -16 for listing. The flag `-r` reverses the order of the commands and the flag `-n` suppresses command numbers when listing. In the second form the `command` is re-executed after the substitution `old=new` is performed. If there is not a `command` argument, the most recent command typed at this terminal is executed.

`fg` [ %job... ]

This command is only on systems that support job control. Each `job` specified is brought to the foreground. Otherwise, the current job is brought into the foreground. See "Jobs" section above for a description of the format of `job`.
getopts optstring name [ arg ... ]

Checks arg for legal options. If arg is omitted, the positional parameters are used. An option argument begins with a + or a −. An option not beginning with + or − or the argument – ends the options. optstring contains the letters that getopts recognizes. If a letter is followed by a :, that option is expected to have an argument. The options can be separated from the argument by blanks.

getopts places the next option letter it finds inside variable name each time it is invoked with a + prepended when arg begins with a +. The index of the next arg is stored in OPTIND. The option argument, if any, gets stored in OPTARG.

A leading : in optstring causes getopts to store the letter of an invalid option in OPTARG, and to set name to ? for an unknown option and to : when a required option is missing. Otherwise, getopts prints an error message. The exit status is non-zero when there are no more options. See getoptcv(1) for usage and description.

getopts supports both traditional single-character short options and long options defined by Sun’s Command Line Interface Paradigm (CLIP).

Each long option is an alias for a short option and is specified in parentheses following its equivalent short option. For example, you can specify the long option file as an alias for the short option f using the following script line:

getopts "f:(file)" opt

Precede long options on the command line with -- or ++. In the example above, --file on the command line would be the equivalent of -f, and ++file on the command line would be the equivalent of +f.

Each short option can have multiple long option equivalents, although this is in violation of the CLIP specification and should be used with caution. You must enclose each long option equivalent parentheses, as follows:

getopts "f:(file) (input-file) o: (output-file)"

In the above example, both --file and -input-file are the equivalent of -f, and --output-file is the equivalent of -o.

The variable name is always set to a short option. When a long option is specified on the command line, name is set to the short-option equivalent.

hash [ name ... ]

hash [-r ]

For each name, the location in the search path of the command specified by name is determined and remembered by the shell. The -r option causes the shell to forget all remembered locations. If no arguments are given, information about remembered commands is presented. Hits is the number of times a command has been invoked by the shell process. Cost is a measure of the work required to locate a command in the search path. If a command is found in a relative directory in the search path, after changing to that
directory, the stored location of that command is recalculated. Commands for which this is done are indicated by an asterisk (*) adjacent to the hits information. Cost is incremented when the recalculation is done.

```
jobs [ -l n p ] [ %job ... ]
```

Lists information about each given job; or all active jobs if job is omitted. The -l flag lists process ids in addition to the normal information. The -n flag displays only jobs that have stopped or exited since last notified. The -p flag causes only the process group to be listed. See "Jobs" section above and jobs(1) for a description of the format of job.

```
kill [ -s ig ] %job ...
kill [ -s ig ] pid ...
kill - l
```

Sends either the TERM (terminate) signal or the specified signal to the specified jobs or processes. Signals are either given by number or by names (as given in signal.h(3HEAD)) stripped of the prefix "SIG" with the exception that SIGCHD is named CHLD). If the signal being sent is TERM (terminate) or HUP (hangup), then the job or process is sent a CONT (continue) signal if it is stopped. The argument job can be the process id of a process that is not a member of one of the active jobs. See Jobs for a description of the format of job. In the second form, kill -l, the signal numbers and names are listed.

```
let arg...
```

Each arg is a separate arithmetic expression to be evaluated. See the Arithmetic Evaluation section above, for a description of arithmetic expression evaluation.

The exit status is 0 if the value of the last expression is non-zero, and 1 otherwise.

```
login argument...
```

Equivalent to 'exec login argument...'. See login(1) for usage and description.

```
* newgrp [ arg ... ]
```

Equivalent to exec /bin/newgrp arg ....

```
print [ -R n p r s u ] [ n ] [ arg ... ]
```

The shell output mechanism. With no flags or with flag - or --, the arguments are printed on standard output as described by echo(1). The exit status is 0, unless the output file is not open for writing.

```
- n          Suppresses NEWLINE from being added to the output.
- R | - r    Raw mode. Ignores the escape conventions of echo. The -R option prints all subsequent arguments and options other than -n.
- p          Writes the arguments to the pipe of the process spawned with |& instead of standard output.
- s          Writes the arguments to the history file instead of standard output.
- u [ n ]    Specifies a one digit file descriptor unit number n on which the output is placed. The default is 1.
pwd [-L | -P]

Writes to the standard output an absolute pathname of the current working directory, which does not contain the filenames dot (.) or dot-dot (..).

- L If the PWD environment variable contains an absolute pathname of the current directory that does not contain the filenames dot or dot-dot, pwd writes this pathname to standard output. Otherwise, the -L option behaves like the -P option.

- P The absolute pathname written shall not contain filenames that, in the context of the pathname, refer to files of type symbolic link.

If both -L and -P are specified, the last one applies. If neither -L nor -P is specified, pwd behaves as if -L had been specified.

read [ -prsун ] [ name?prompt ] [ name ... ]

The shell input mechanism. One line is read and is broken up into fields using the characters in IFS as separators. The escape character, (\), is used to remove any special meaning for the next character and for line continuation. In raw mode, -r, the \ character is not treated specially. The first field is assigned to the first name, the second field to the second name, etc., with leftover fields assigned to the last name. The -p option causes the input line to be taken from the input pipe of a process spawned by the shell using |&. If the -s flag is present, the input is saved as a command in the history file. The flag -u can be used to specify a one digit file descriptor unit n to read from. The file descriptor can be opened with the exec special command. The default value of n is 0. If name is omitted then REPLY is used as the default name. The exit status is 0 unless the input file is not open for reading or an EOF is encountered. An EOF with the -p option causes cleanup for this process so that another can be spawned. If the first argument contains a ?, the remainder of this word is used as a prompt on standard error when the shell is interactive. The exit status is 0 unless an EOF is encountered.

** readonly [ name[=value] ] ...
** readonly -p

The given names are marked readonly and these names cannot be changed by subsequent assignment.

When -p is specified, readonly writes to the standard output the names and values of all read-only variables, in the following format:

"readonly %s=%s\n", name, value

if name is set, and:

"readonly %s\n", name

if name is unset.

The shell formats the output, including the proper use of quoting, so that it is suitable for reinput to the shell as commands that achieve the same value and readonly attribute-setting results in a shell execution environment in which:
1. Variables with values set at the time they were output do not have the readonly attribute set.

2. Variables that were unset at the time they were output do not have a value at the time at which the saved output is reinput to the shell.

* **return [ n ]**

Causes a shell function or ' . ' script to return to the invoking script with the return status specified by n. The value is the least significant 8 bits of the specified status. If n is omitted then the return status is that of the last command executed. If return is invoked while not in a function or a ' . ' script, then it is the same as an `exit`.

**set [ ±abCefhkmnopstuvx ] [ ±o option ]...[ ±A name ] [ arg ... ]**

The flags for this command have meaning as follows:

- **-A** Array assignment. Unsets the variable name and assigns values sequentially from the list arg. If +A is used, the variable name is not unset first.
- **-a** All subsequent variables that are defined are automatically exported.
- **-b** Causes the shell to notify the user asynchronously of background job completions. The following message is written to standard error:

  "[%d]%c %s%s\n", <job-number>, <current>, <status>, \\
  where<job-name>

  where the fields are as follows:

  **<current>**

  The character + identifies the job that would be used as a default for the fg or bg utilities. This job can also be specified using the job id %+ or %. The character − identifies the job that would become the default if the current default job were to exit; this job can also be specified using the job id %−. For other jobs, this field is a space character. At most one job can be identified with + and at most one job can be identified with −. If there is any suspended job, then the current job is a suspended job. If there are at least two suspended jobs, then the previous job is also a suspended job.

  **<job-number>**

  A number that can be used to identify the process group to the wait, fg, bg, and kill utilities. Using these utilities, the job can be identified by prefixing the job number with %.

  **<status>**

  Unspecified.

  **<job-name>**

  Unspecified.

When the shell notifies the user a job has been completed, it can remove the job’s process ID from the list of those known in the current shell execution environment. Asynchronous notification is not enabled by default.
-C Prevents existing files from being overwritten by the shell’s > redirection operator. The >| redirection operator overrides this -noclobber option for an individual file.
-e If a command has a non-zero exit status, executes the ERR trap, if set, and exit. This mode is disabled while reading profiles.
-f Disables file name generation.
-h Each command becomes a tracked alias when first encountered.
-k All variable assignment arguments are placed in the environment for a command, not just those that precede the command name.
-m Background jobs runs in a separate process group and a line prints upon completion. The exit status of background jobs is reported in a completion message. On systems with job control, this flag is turned on automatically for interactive shells.
-n Reads commands and check them for syntax errors, but do not execute them. Ignored for interactive shells.
-o Writes the current option settings to standard output in a format that is suitable for reinput to the shell as commands that achieve the same option settings.
-o The following argument can be one of the following option names:

-alexport Same as -a.
-errexit Same as -e.
-bgnice All background jobs are run at a lower priority. This is the default mode.
-emacs Puts you in an emacs style in-line editor for command entry.
-gmacs Puts you in a gmacs style in-line editor for command entry.
-ignoreeof The shell does not exit on EOF. The command exit must be used.
-keyword Same as -k.
-markdirs All directory names resulting from file name generation have a trailing / appended.
-monitor Same as -m.
-noclobber Prevents redirection > from truncating existing files. Require >| to truncate a file when turned on. Equivalent to -C.
-noexec Same as -n.
-noglob Same as -f.
-nolog Do not save function definitions in history file.
notify Equivalent to -b.
nounset Same as -u.
privileged Same as -p.
verbose Same as -v.
trackall Same as -h.

vi Puts you in insert mode of a vi style in-line editor until you hit escape character Ø33. This puts you in control mode. A return sends the line.

viraw Each character is processed as it is typed in vi mode.
xtrace Same as -x.

If no option name is supplied, the current option settings are printed.

-p Disables processing of the $HOME/.profile file and uses the file /etc/suid_profile instead of the ENV file. This mode is on whenever the effective uid is not equal to the real uid, or when the effective gid is not equal to the real gid. Turning this off causes the effective uid and gid to be set to the real uid and gid.

-s Sorts the positional parameters lexicographically.

-t Exits after reading and executing one command.

-u Treats unset parameters as an error when substituting.

-v Prints shell input lines as they are read.

-x Prints commands and their arguments as they are executed.

- Turns off -x and -v flags and stops examining arguments for flags.

--- Does not change any of the flags. Useful in setting $1 to a value beginning with -. If no arguments follow this flag then the positional parameters are unset.

Using + rather than – causes these flags to be turned off. These flags can also be used upon invocation of the shell. The current set of flags can be found in $-. Unless -A is specified, the remaining arguments are positional parameters and are assigned, in order, to $1 $2 ... If no arguments are given, the names and values of all variables are printed on the standard output.

* shift [ n ]

The positional parameters from $n+1 $n+1 . . . are renamed $1 . . ., default n is 1.

The parameter n can be any arithmetic expression that evaluates to a non-negative number less than or equal to $#.

stop%jobid ...
stop pid ...
stop stops the execution of a background job(s) by using its jobid, or of any process by using its pid. See ps(1).

suspend
   Stops the execution of the current shell (but not if it is the login shell).

test expression
   Evaluates conditional expressions. See Conditional Expressions section above and test(1) for usage and description.

* times
   Prints the accumulated user and system times for the shell and for processes run from the shell.

* trap [ arg sig ... ]
   arg is a command to be read and executed when the shell receives signal(s) sig. arg is scanned once when the trap is set and once when the trap is taken. sig can be specified as a signal number or signal name. trap commands are executed in order of signal number. Any attempt to set a trap on a signal number that was ignored on entry to the current shell is ineffective.

If arg is --, the shell resets each sig to the default value. If arg is null (''), the shell ignores each specified sig if it arises. Otherwise, arg is read and executed by the shell when one of the corresponding sigs arises. The action of the trap overrides a previous action (either default action or one explicitly set). The value of $? after the trap action completes is the value it had before the trap was invoked.

sig can be EXIT, 0 (equivalent to EXIT) or a signal specified using a symbolic name, without the SIG prefix, for example, HUP, INT, QUIT, TERM. If sig is 0 or EXIT and the trap statement is executed inside the body of a function, then the command arg is executed after the function completes. If sig is 0 or EXIT for a trap set outside any function, the command arg is executed on exit from the shell. If sig is ERR, arg is executed whenever a command has a non-zero exit status. If sig is DEBUG, arg is executed after each command.

The environment in which the shell executes a trap on EXIT is identical to the environment immediately after the last command executed before the trap on EXIT was taken.

Each time the trap is invoked, arg is processed in a manner equivalent to eval "$arg".

Signals that were ignored on entry to a non-interactive shell cannot be trapped or reset, although no error need be reported when attempting to do so. An interactive shell can reset or catch signals ignored on entry. Traps remain in place for a given shell until explicitly changed with another trap command.

When a subshell is entered, traps are set to the default args. This does not imply that the trap command cannot be used within the subshell to set new traps.

The trap command with no arguments writes to standard output a list of commands associated with each sig. The format is:
The shell formats the output, including the proper use of quoting, so that it is suitable for 
reinput to the shell as commands that achieve the same trapping results. For example:

```
save_traps=$(trap)
... eval "$save_traps"
```

If the trap name or number is invalid, a non-zero exit status is returned. Otherwise, 0 is 
returned. For both interactive and non-interactive shells, invalid signal names or numbers 
are not considered a syntax error and do not cause the shell to abort.

Traps are not processed while a job is waiting for a foreground process. Thus, a trap on 
CHLD won't be executed until the foreground job terminates.

type name ...
For each name, indicates how it would be interpreted if used as a command name.

```
typeset [±HLRZfilrtux][name[=value]] ...
```
Sets attributes and values for shell variables and functions. When typeset is invoked inside 
a function, a new instance of the variables name is created. The variables value and type are 
restored when the function completes. The following list of attributes can be specified:

- **H**  This flag provides UNIX to host-name file mapping on non-UNIX machines.
- **L**  Left justifies and removes leading blanks from value. If n is non-zero it defines the 
  width of the field. Otherwise, it is determined by the width of the value of first 
  assignment. When the variable is assigned to, it is filled on the right with blanks or 
  truncated, if necessary, to fit into the field. Leading zeros are removed if the -Z flag is 
  also set. The -R flag is turned off.
- **R**  Right justifies and fills with leading blanks. If n is non-zero it defines the width of the 
  field, otherwise it is determined by the width of the value of first assignment. The 
  field is left filled with blanks or truncated from the end if the variable is reassigned. 
  The -L flag is turned off.
- **Z**  Right justifies and fills with leading zeros if the first non-blank character is a digit 
  and the -L flag has not been set. If n is non-zero it defines the width of the field. 
  Otherwise, it is determined by the width of the value of first assignment.
- **f**  The names refer to function names rather than variable names. No assignments can 
  be made and the only other valid flags are -t, -u, and -x. The flag -t turns on 
  execution tracing for this function. The flag -u causes this function to be marked 
  undefined. The FPATH variable is searched to find the function definition when the 
  function is referenced. The flag -x allows the function definition to remain in effect 
  across shell procedures invoked by name.
- **i**  Parameter is an integer. This makes arithmetic faster. If n is non-zero it defines the 
  output arithmetic base; otherwise, the first assignment determines the output base.
-l  All upper-case characters are converted to lower-case. The upper-case flag, -u is turned off.

-r  The given names are marked readonly and these names cannot be changed by subsequent assignment.

-t  Tags the variables. Tags are user definable and have no special meaning to the shell.

-u  All lower-case characters are converted to upper-case characters. The lower-case flag, -l is turned off.

-x  The given names are marked for automatic export to the environment of subsequently-executed commands.

The -i attribute cannot be specified along with -R, -L, -Z, or -f.

Using + rather than – causes these flags to be turned off. If no name arguments are given but flags are specified, a list of names (and optionally the values) of the variables which have these flags set is printed. (Using + rather than – keeps the values from being printed.) If no names and flags are given, the names and attributes of all variables are printed.

ulimit [-HSacdfnstv] [limit]
Sets or displays a resource limit. The available resources limits are listed in the following section. Many systems do not contain one or more of these limits. The limit for a specified resource is set when limit is specified. The value of limit can be a number in the unit specified with each resource, or the value unlimited. The string unlimited requests that the current limit, if any, be removed. The -H and -S flags specify whether the hard limit or the soft limit for the given resource is set. A hard limit cannot be increased once it is set. A soft limit can be increased up to the value of the hard limit. If neither the -H or -S options is specified, the limit applies to both. The current resource limit is printed when limit is omitted. In this case, the soft limit is printed unless -H is specified. When more than one resource is specified, the limit name and unit is printed before the value.

- a  Lists all of the current resource limits.
- c  The number of 512-byte blocks on the size of core dumps.
- d  The number of K-bytes on the size of the data area.
- f  The number of 512-byte blocks on files written by child processes (files of any size can be read).
- n  The number of file descriptors plus 1.
- s  The number of K-bytes on the size of the stack area.
- t  The number of seconds to be used by each process.
- v  The number of K-bytes for virtual memory.

If no option is given, -f is assumed.
umask [-S] [ mask ]
The user file-creation mask is set to mask (see umask(2)). mask can either be an octal number or a symbolic value as described in chmod(1). If a symbolic value is given, the new umask value is the complement of the result of applying mask to the complement of the previous umask value. If mask is omitted, the current value of the mask is printed. The -S flag produces symbolic output.

unalias name ...
unalias -a
The aliases given by the list of names are removed from the alias list. The -a option removes all alias definitions from the current execution environment.

unset [-f] name ...
The variables given by the list of names are unassigned, that is, their values and attributes are erased. readonly variables cannot be unset. If the -f, flag is set, then the names refer to function names. Unsetting ERRNO, LINENO, MAILCHECK, OPTARG, OPTIND, RANDOM, SECONDS, TMOUT, and _ removes their special meaning even if they are subsequently assigned to.

* wait [ job ]
Waits for the specified job and report its termination status. If job is not given then all currently active child processes are waited for. The exit status from this command is that of the process waited for. See Jobs for a description of the format of job.

whence [-pv] name ...
For each name, indicates how it would be interpreted if used as a command name.

The -v flag produces a more verbose report.

The -p flag does a path search for name even if name is an alias, a function, or a reserved word.

Invocation
If the shell is invoked by exec(2), and the first character of argument zero ($0) is −, then the shell is assumed to be a login shell and commands are read from /etc/profile and then from either .profile in the current directory or $HOME/.profile, if either file exists. Next, commands are read from the file named by performing parameter substitution on the value of the environment variable ENV if the file exists. If the -s flag is not present and arg is, then a path search is performed on the first arg to determine the name of the script to execute. The script arg must have read permission and any setuid and setgid settings are ignored. If the script is not found on the path, arg is processed as if it named a builtin command or function. Commands are then read as described as follows. The following flags are interpreted by the shell when it is invoked:

- c Reads commands from the command_string operand. Sets the value of special parameter 0 from the value of the command_name operand and the positional parameters ($1, $2, and so on) in sequence from the remaining arg operands. No commands are read from the standard input.
If the `-s` flag is present or if no arguments remain, commands are read from the standard input. Shell output, except for the output of the Special Commands listed above, is written to file descriptor 2.

If the `-i` flag is present or if the shell input and output are attached to a terminal (as told by `ioctl(2)`), then this shell is *interactive*. In this case, `TERM` is ignored (so that `kill 0` does not kill an interactive shell) and `INTR` is caught and ignored (so that `wait` is interruptible). In all cases, `QUIT` is ignored by the shell.

If the `-r` flag is present the shell is a restricted shell.

The remaining flags and arguments are described under the `set` command above.

**rksh Only**

`rksh` is used to set up login names and execution environments whose capabilities are more controlled than those of the standard shell. The actions of `rksh` are identical to those of `ksh`, except that the following are disallowed:

- changing directory (see `cd(1)`)
- setting the value of `SHELL`, `ENV`, or `PATH`
- specifying path or command names containing `/`
- redirecting output (`>`, `>`|, `<|`, and `>>`)
- changing group (see `newgrp(1)`).

The restrictions above are enforced after `.profile` and the `ENV` files are interpreted.

When a command to be executed is found to be a shell procedure, `rksh` invokes `ksh` to execute it. Thus, it is possible to provide to the end-user shell procedures that have access to the full power of the standard shell, while imposing a limited menu of commands; this scheme assumes that the end-user does not have write and execute permissions in the same directory.

The net effect of these rules is that the writer of the `.profile` has complete control over user actions, by performing guaranteed setup actions and leaving the user in an appropriate directory (probably *not* the login directory).

The system administrator often sets up a directory of commands (that is, `/usr/rbin`) that can be safely invoked by `rksh`.

**Errors**

Errors detected by the shell, such as syntax errors, cause the shell to return a non-zero exit status. Otherwise, the shell returns the exit status of the last command executed (see also the `exit` command above). If the shell is being used non-interactively then execution of the shell file is abandoned. Run time errors detected by the shell are reported by printing the command or function name and the error condition. If the line number that the error occurred on is greater than one, then the line number is also printed in square brackets ([]) after the command or function name.
For a non-interactive shell, an error condition encountered by a special built-in or other type of utility causes the shell to write a diagnostic message to standard error and exit as shown in the following table:

<table>
<thead>
<tr>
<th>Error</th>
<th>Special Built-in</th>
<th>Other Utilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shell language syntax error</td>
<td>exits</td>
<td>exits</td>
</tr>
<tr>
<td>Utility syntax error (option or operand error)</td>
<td>exits</td>
<td>does not exit</td>
</tr>
<tr>
<td>Redirection error</td>
<td>exits</td>
<td>does not exit</td>
</tr>
<tr>
<td>Variable assignment error</td>
<td>exits</td>
<td>does not exit</td>
</tr>
<tr>
<td>Expansion error</td>
<td>exits</td>
<td>exits</td>
</tr>
<tr>
<td>Command not found</td>
<td>n/a</td>
<td>might exit</td>
</tr>
<tr>
<td>Dot script not found</td>
<td>exits</td>
<td>n/a</td>
</tr>
</tbody>
</table>

An expansion error is one that occurs when the shell expansions are carried out (for example, `$\{x!y\}$, because `!` is not a valid operator). An implementation can treat these as syntax errors if it is able to detect them during tokenization, rather than during expansion.

If any of the errors shown as “might exit” or “exits” occur in a subshell, the subshell exits or might exit with a non-zero status, but the script containing the subshell does not exit because of the error.

In all of the cases shown in the table, an interactive shell writes a diagnostic message to standard error without exiting.

**Usage**  See `largefile(5)` for the description of the behavior of `ksh` and `rksh` when encountering files greater than or equal to 2 Gbyte ($2^{31}$ bytes).

**Exit Status**  Each command has an exit status that can influence the behavior of other shell commands. The exit status of commands that are not utilities is documented in this section. The exit status of the standard utilities is documented in their respective sections.

If a command is not found, the exit status is 127. If the command name is found, but it is not an executable utility, the exit status is 126. Applications that invoke utilities without using the shell should use these exit status values to report similar errors.

If a command fails during word expansion or redirection, its exit status is greater than zero.

When reporting the exit status with the special parameter `?`, the shell reports the full eight bits of exit status available. The exit status of a command that terminated because it received a signal reported as greater than 128.
Files
/etc/profile
/etc/suid_profile
$HOME/.profile
/tmp/sh*
/dev/null

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTETYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>shell/ksh88</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ATTRIBUTETYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5)</td>
</tr>
</tbody>
</table>

See Also
cat(1), cd(1), chmod(1), cut(1), echo(1), env(1), getoptcv(1), jobs(1), login(1), newgrp(1),
paste(1), pfksh(1), pexec(1), ps(1), shell builtins(1), stty(1), test(1), vi(1), dup(2),
exec(2), fork(2), ioctl(2), lseek(2), pipe(2), ulimit(2), umask(2), rand(3C), signal(3C),
signal.h(3HEAD), wait(3C), a.out(4), profile(4), attributes(5), environ(5),
largefile(5), standards(5)

Morris I. Bolsky and David G. Korn, The KornShell Command and Programming Language,

Warnings
The use of setuid shell scripts is strongly discouraged.

Notes
If a command which is a tracked alias is executed, and then a command with the same name is
installed in a directory in the search path before the directory where the original command
was found, the shell continues to exec the original command. Use the -t option of the alias
command to correct this situation.

Some very old shell scripts contain a ^ as a synonym for the pipe character |.

Using the fc built-in command within a compound command causes the whole command to
disappear from the history file.
The built-in command `.file` reads the whole file before any commands are executed. Therefore, `alias` and `unalias` commands in the file does not apply to any functions defined in the file.

When the shell executes a shell script that attempts to execute a non-existent command interpreter, the shell returns an erroneous diagnostic message that the shell script file does not exist.
ktutil – Kerberos keytab maintenance utility

Name

ktutil – Kerberos keytab maintenance utility

Synopsis

/usr/bin/ktutil

description

The ktutil command is an interactive command-line interface utility for managing the keylist in keytab files. You must read in a keytab's keylist before you can manage it. Also, the user running the ktutil command must have read/write permissions on the keytab. For example, if a keytab is owned by root, which it typically is, ktutil must be run as root to have the appropriate permissions.

Commands

clear_list

clear

Clears the current keylist.

read_kt file

rkt file

Reads a keytab into the current keylist. You must specify a keytab file to read.

write_kt file

wkt file

Writes the current keylist to a keytab file. You must specify a keytab file to write. If the keytab file already exists, the current keylist is appended to the existing keytab file.

add_entry number

addent number

Adds an entry to the current keylist. Specify the entry by the keylist slot number.

delete_entry number

delent number

Deletes an entry from the current keylist. Specify the entry by the keylist slot number.

list

l

Lists the current keylist.

list_request

lr

Lists available requests (commands).

quit

exit

q

Exits utility.

Examples

Example 1 Deleting a principal from a file

The following example deletes the host/denver@ACME.com principal from the /etc/krb5/krb5.keytab file. Notice that if you want to delete an entry from an existing keytab, you must first write the keylist to a temporary keytab and then overwrite the existing keytab with the temporary keytab. This is because the wkt command actually appends the current keylist to an existing keytab, so you can't use it to overwrite a keytab.

Example # /usr/krb5/bin/ktutil

ktutil: rkt /etc/krb5/krb5.keytab
EXAMPLE 1  Deleting a principal from a file  (Continued)

ktutil: list
slot KVNO Principal
--- ---- ---------------------------------------
 1  8 host/vail@ACME.COM
 2  5 host/denver@ACME.COM
ktutil: delent 2
ktutil: l
slot KVNO Principal
--- ---- --------------------------------------
 1  8 host/vail@ACME.COM
ktutil: wkt /tmp/krb5.keytab
ktutil: q

example# mv /tmp/krb5.keytab /etc/krb5/krb5.keytab

Files  /etc/krb5/krb5.keytab  keytab file for Kerberos clients

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/security/kerberos-5</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>See below.</td>
</tr>
</tbody>
</table>

The command arguments are Committed. The command output is Uncommitted.

See Also  kadmin(1M), k5srvutil(1M), attributes(5), kerberos(5)
Name  kvno – print key version numbers of Kerberos principals

          [-U for_user] princ_host [princ_host ...]

Description  kvno acquires a service ticket for the specified Kerberos principals and prints out the key
version numbers of each.

Options  The following options are supported:

-c ccache  Specify the name of a credentials cache to use, if not the default.

-e etype  Specify the enctype to be requested for the session key of all the services named
          on the command line.

          This is useful in certain backward compatibility situations.

-h  Print a usage statement and exit.

-P  Specify that the princ_host arguments are to be treated as services for which
    credentials should be acquired using constrained delegation.

          This option is only valid when used in conjunction with protocol transition.

-q  Suppress printing.

-S sname  Specify that krb5_sname_to_principal() is used to build principal names. If
          this flag is specified, the princ_host arguments are interpreted as host names
          (rather than principal names), and sname is interpreted as the service name.

-U for_user  Specify that protocol transition (S4U2Self) is to be used to acquire a ticket on
              behalf of for_user.

          If constrained delegation is not requested, the service name must match the
          credentials cache client principal.

Operands  The following operand is supported:

princ_host  If the -S option is specified, specifies either the principal name or host name, of
            the target principal for which to obtain the key version number.

Environment
Variables  See environ(5) for descriptions of the following environment variables that affect the
           execution of kvno: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

KRBS5CCNAME  Location of the credentials (ticket) cache.

Files  /tmp/krb5cc_ [uid]  Default location of the credentials cache. uid is the decimal UID of
       the user.
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTETYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/security/kerberos-5</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  kdestroy(1), kinit(1), attributes(5), krb5envvar(5)
lari – link analysis of runtime interfaces

Synopsis

```
lari [-bCDsv] [-a | -i | -o] file | directory ...
```

```
lari [-CDosv] [-m [-d mapdir]] file
```

Description

The `lari` utility analyzes the interface requirements of dynamic ELF objects. Two basic modes of operation are available. The first mode displays runtime interface information. The second mode generates interface definitions.

Dynamic objects offer symbolic definitions that represent the interface that the object provides for external consumers. At runtime, bindings are established from the symbolic references of one object to the symbolic definitions of another object. `lari` analyzes both the interface definitions and runtime bindings of the specified objects.

When displaying runtime interface information, `lari` can analyze a number of files and/or directories. `lari` analyzes each file that is specified on the command line. `lari` recursively descends into each directory that is specified on the command line, processing each file that is found.

When generating interface definitions, `lari` can only process a single file specified on the command line.

Without the `-D` option, `lari` processes files as dynamic ELF objects by using `ldd(1)`. This processing uses the following options:

```
-r and -e LD_DEBUG=files,bindings,detail
```

These options provide information on all bindings that are established as part of loading the object. Notice that by using `ldd`, the specified object is not executed, and hence no user controlled loading of objects, by `dlopen(3C)` for example, occurs. To capture all binding information from an executing process, the following environment variables can be passed directly to the runtime linker, `ld.so.1(1):

```
LD_DEBUG=files,bindings,detail LD_DEBUG_OUTPUT=lari.dbg
LD_BIND_NOW=yes
```

The resulting debug output, `lari.dbg.pid`, can be processed by `lari` using the `-D` option. Note: `lari` attempts to analyze each object that has been processed using the path name defined in the debug output. Each object must therefore be accessible to `lari` for a complete, accurate analysis to be provided. The debug output file must be generated in the C locale.

When displaying interface information, `lari` analyzes the interfaces of the processed dynamic objects and, by default, displays any interesting information. See Interesting Information under EXTENDED DESCRIPTION. The information that is displayed is also suitable for piping to other tools. This capability can aid developers in analyzing process bindings or debugging complex binding scenarios.

User Commands
The generation of interface definitions by lari can be used to refine the interface requirements of the dynamic objects that are processed. When creating a dynamic object, you should define an explicit, versioned interface. This definition controls the symbol definitions that are available to external users. In addition, this definition frequently reduces the overall runtime execution cost of the object. Interface definitions can be assigned to an object during its creation by the link-editor using the -M option and the associated mapfile directives. See the Linker and Libraries Guide for more details on using mapfiles to version objects. An initial version of these mapfiles can be created by lari.

Options The following options are supported.

- **a** Displays all interface information for the objects analyzed. *Note:* The output from this option can be substantial, but is often useful for piping to other analysis tools.

- **b** Limits the interface information to those symbols that have been explicitly bound to. *Note:* Symbols defined as protected might have been bound to from within the defining object. This binding is satisfied at link-edit time and is therefore not visible to the runtime environment. Protected symbols are displayed with this option.

- **C** Demangles C++ symbol names. This option is useful for augmenting runtime interface information. When generating interface definitions, demangled names are added to the mapfiles as comments.

- **d mapdir** Defines the directory, mapdir, in which mapfiles are created. By default, the current working directory is used.

- **D** Interprets any input files as debugging information rather than as dynamic objects.

- **i** Displays interesting interface binding information. This mode is the default if no other output controlling option is supplied. See Interesting Information under EXTENDED DESCRIPTION.

- **m** Creates mapfiles for each dynamic object that is processed. These mapfiles reflect the interface requirements of each object as required by the input file being processed.

- **o** Limits the interface information to those symbols that are deemed an overhead. When creating mapfiles, any overhead symbols are itemized as local symbols. See Overhead Information under EXTENDED DESCRIPTION.

- **s** Saves the bindings information produced from ldd(1) for further analysis. See FILES.

- **V** Appends interesting symbol visibilities. Symbols that are defined as singleton or are defined protected are identified with this option.
Ignores any objects that are already versioned. Versioned objects have had their interfaces defined, but can contribute to the interface information displayed. For example, a versioned shared object might reveal overhead symbols for a particular process. Shared objects are frequently designed for use by multiple processes, and thus the interfaces these objects provide can extend beyond the requirements of any one process. The `-v` option therefore, can reduce noise when displaying interface information.

The runtime interface information produced from `lari` has the following format:

```
[information]: symbol-name [demangled-name]: object-name
```

Each line describes the interface symbol, `symbol-name`, together with the object, `object-name`, in which the symbol is defined. If the symbol represents a function, the symbol name is followed by `()`. If the symbol represents a data object, the symbol name is followed by the symbols size, enclosed within `[ ]`. If the `-C` option is used, the symbol name is accompanied by the symbols demangled name, `demangled-name`. The information field provides one or more of the following tokens that describe the symbol's use:

```
cnt:bnd  Two decimal values indicate the symbol count, `cnt`, and the number of bindings to this object, `bnd`. The symbol count is the number of occurrences of this symbol definition that have been found in the objects that are analyzed. A count that is greater than 1 indicates multiple instances of a symbol definition. The number of bindings indicate the number of objects that have been bound to this symbol definition by the runtime linker.

E  This symbol definition has been bound to from an external object.

S  This symbol definition has been bound to from the same object.

D  This symbol definition has been directly bound to.

I  This symbol definition provides for an interposer. An object that explicitly identifies itself as an interposer defines all global symbols as interposers. See the `-z interposer` option of `ld(1)`, and the `LD_PRELOAD` variable of `ld.so.1(1)`. Individual symbols within a dynamic executable can be defined as interposers by using the `INTERPOSE mapfile` directive.

C  This symbol definition is the reference data of a copy-relocation.

F  This symbol definition resides in a filtee.

P  This symbol is defined as protected. This symbol might have an internal binding from the object in which the symbol is declared. Any internal bindings with this attribute can not be interposed upon by another symbol definition.

A  This symbol definition is the address of a procedure linkage table entry within a dynamic executable.

U  This symbol lookup originated from a user request, for example, `dlsym(3C)`.  

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>This symbol definition has been bound to from an external object.</td>
</tr>
<tr>
<td>S</td>
<td>This symbol definition has been bound to from the same object.</td>
</tr>
<tr>
<td>D</td>
<td>This symbol definition has been directly bound to.</td>
</tr>
<tr>
<td>I</td>
<td>This symbol definition provides for an interposer. An object that explicitly identifies itself as an interposer defines all global symbols as interposers. See the <code>-z interposer</code> option of <code>ld(1)</code>, and the <code>LD_PRELOAD</code> variable of <code>ld.so.1(1)</code>. Individual symbols within a dynamic executable can be defined as interposers by using the <code>INTERPOSE mapfile</code> directive.</td>
</tr>
<tr>
<td>C</td>
<td>This symbol definition is the reference data of a copy-relocation.</td>
</tr>
<tr>
<td>F</td>
<td>This symbol definition resides in a filtee.</td>
</tr>
<tr>
<td>P</td>
<td>This symbol is defined as protected. This symbol might have an internal binding from the object in which the symbol is declared. Any internal bindings with this attribute can not be interposed upon by another symbol definition.</td>
</tr>
<tr>
<td>A</td>
<td>This symbol definition is the address of a procedure linkage table entry within a dynamic executable.</td>
</tr>
<tr>
<td>U</td>
<td>This symbol lookup originated from a user request, for example, <code>dlsym(3C)</code>.</td>
</tr>
</tbody>
</table>
This symbol definition is acting as a filter, and provides for redirection to a filtee.

A binding to this symbol was rejected at some point during a symbol search. A rejection can occur when a direct binding request finds a symbol that has been tagged to prevent direct binding. In this scenario, the symbol search is repeated using a default search model. The binding can still resolve to the original, rejected symbol. A rejection can also occur when a non-default symbol search finds a symbol identified as a singleton. Again, the symbol search is repeated using a default search model.

This symbol definition explicitly prohibits directly binding to the definition.

See the *Linker and Libraries Guide* for more details of these symbol classifications.

By default, or specifically using the -i option, *lari* filters any runtime interface information to present interesting events. This filtering is carried out mainly to reduce the amount of information that can be generated from large applications. In addition, this information is intended to be the focus in debugging complex binding scenarios, and often highlights problem areas. However, classifying what information is interesting for any particular application is an inexact science. You are still free to use the -a option and to search the binding information for events that are unique to the application being investigated.

When an interesting symbol definition is discovered, all other definitions of the same symbol are output.

The focus of interesting interface information is the existence of multiple definitions of a symbol. In this case, one symbol typically interposes on one or more other symbol definitions. This interposition is seen when the binding count, *bnd*, of one definition is non-zero, while the binding count of all other definitions is zero. Interposition that results from the compilation environment, or the linking environment, is not characterized as interesting. Examples of these interposition occurrences include copy relocations ([C]) and the binding to procedure linkage addresses ([A]).

Interposition is often desirable. The intent is to overload, or replace, the symbolic definition from a shared object. Interpositioning objects can be explicitly tagged ([I]), using the -z interpose option of *ld*[1]. These objects can safely interpose on symbols, no matter what order the objects are loaded in a process. However, be cautious when non-explicit interposition is employed, as this interposition is a consequence of the load-order of the objects that make up the process.

User-created, multiply-defined symbols are output from *lari* as interesting. In this example, two definitions of *interpose1()* exist, but only the definition in *main* is referenced:

```
[2:1E]: interpose1(): ./main
[2:0]: interpose1(): ./libA.so
```
Interposition can also be an undesirable and surprising event, caused by an unexpected symbol name clash. A symptom of this interposition might be that a function is never called although you know a reference to the function exists. This scenario can be identified as a multiply defined symbol, as covered in the previous example. However, a more surprising scenario is often encountered when an object both defines and references a specific symbol.

An example of this scenario is if two dynamic objects define and reference the same function, `interpose2()`. Any reference to this symbol binds to the first dynamic object loaded with the process. In this case, the definition of `interpose2()` in object `libA.so` interposes on, and hides, the definition of `interpose2()` in object `libB.so`. The output from `lari` might be:

```
[2:2ES]: interpose2(): ./libA.so
[2:0]: interpose2(): ./libB.so
```

Multiply defined symbols can also be bound to separately. Separate bindings can be the case when direct bindings are in effect ([D]), or because a symbol has protected visibility ([P]). Although separate bindings can be explicitly established, instances can exist that are unexpected and surprising. Directly bound symbols, and symbols with protected visibility, are output as interesting information.

### Overhead Information

When using the `-o` option, `lari` displays symbol definitions that might be considered overhead.

Global symbols that are not referenced are considered an overhead. The symbol information that is provided within the object unnecessarily adds to the size of the object's text segment. In addition, the symbol information can increase the processing required to search for other symbolic references within the object at runtime.

Global symbols that are only referenced from the same object have the same characteristics. The runtime search for a symbolic reference, that results in binding to the same object that made the reference, is an additional overhead.

Both of these symbol definitions are candidates for reduction to local scope by defining the object's interface. Interface definitions can be assigned to a file during its creation by the link-editor using the `-M` option and the associated `mapfile` directives. See the Linker and Libraries Guide for more details on `mapfiles`. Use `lari` with the `-m` option to create initial versions of these `mapfiles`.

If `lari` is used to generate `mapfiles`, versioned shared objects will have `mapfiles` created indicating that their overhead symbols should be reduced to locals. This model allows `lari` to generate `mapfiles` for comparison with existing interface definitions. Use the `-v` option to ignore versioned shared objects when creating `mapfiles`.

Copy-relocations are also viewed as an overhead and generally should be avoided. The size of the copied data is a definition of its interface. This definition restricts the ability to change the data size in newer versions of the shared object in which the data is defined. This restriction,
plus the cost of processing a copy relocation, can be avoided by referencing data using a functional interface. The output from lari for a copy relocation might be:

```
[2:1EC]: __iob[0x140]: ./main
[2:0]: __iob[0x140]: ./libA.so.1
```

Notice that a number of small copy relocations, such as __iob used in the previous example, exist because of historic programming interactions with system libraries.

Another example of overhead information is the binding of a dynamic object to the procedure linkage table entry of a dynamic executable. If a dynamic executable references an external function, a procedure linkage table entry is created. This structure allows the reference binding to be deferred until the function call is actually made. If a dynamic object takes the address of the same referenced function, the dynamic object binds to the dynamic executables procedure linkage table entry. An example of this type of event reveals the following:

```
[2:1EA]: foo(): ./main
[2:1E]: foo(): ./libA.so
```

A small number of bindings of this type are typically not cause for concern. However, a large number of these bindings, perhaps from a jump-table programming technique, can contribute to start up overhead. Address relocation bindings of this type require relocation processing at application start up, rather than the deferred relocation processing used when calling functions directly. Use of this address also requires an indirection at runtime.

**Examples**

**EXAMPLE 1** Analyzing a case of multiple bindings

The following example shows the analysis of a process in which multiple symbol definitions exist. The shared objects libX.so and libY.so both call the function interpose(). This function exists in both the application main, and the shared object libA.so. Because of interposition, both references bind to the definition of interpose() in main.

The shared objects libX.so and libY.so also both call the function foo(). This function exists in the application main, and the shared objects libA.so, libX.so, and libY.so. Because both libX.so and libY.so were built with direct bindings enabled, each object binds to its own definition.

```
exmaple% lari ./main
[3:0]: foo(): ./libA.so
[3:1SD]: foo(): ./libX.so
[3:1SD]: foo(): ./libY.so
[2:0]: interpose(): ./libA.so
[2:2EP]: interpose(): ./main
```

To analyze binding information more thoroughly, the bindings data can be saved for further inspection. For example, the previous output indicates that the function interpose() was called from two objects external to main. Inspection of the binding output reveals where the references to this function originated.
EXAMPLE 1  Analyzing a case of multiple bindings

(example% lari -s ./main
lari: ./main: bindings information saved as: /usr/tmp/lari.dbg.main
....
(example% fgrep foo /usr/tmp/lari.dbg.main
binding file=./libX.so to file=./main: symbol 'interpose'
binding file=./libY.so to file=./main: symbol 'interpose'

Note: The bindings output is typically more extensive than shown here, as the output is accompanied with process identifier, address and other bindings information.

EXAMPLE 2  Generating an interface definition

The following example creates interface definitions for an application and its dependency, while ignoring any versioned system libraries. The application main makes reference to the interfaces one(), two(), and three() in foo.so:

(example% lari -omv ./main
example% cat mapfile-foo.so
#
# Interface Definition mapfile for:
# Dynamic Object: ./foo.so
# Process: ./main
#

foo.so {
    global:
        one;
        three;
        two;
    local:
        _one;
        _three;
        _two;
        *
};

Files  $TMPDIR/lari.dbg.file   Binding output produced by ldd(1).

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/base-developer-utilities</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>See below.</td>
</tr>
</tbody>
</table>
The human readable output is Uncommitted. The options are Committed.

See Also  ld(1), ldd(1), ld.so.1(1), dlopen(3C), dlsoy(3C), attributes(5)

Linker and Libraries Guide
last(1)

Name  last – display login and logout information about users and terminals

Synopsis  
\[ \text{last [-a] [-n number | -number] [-f filename] [name | tty]...} \]

Description  The last command looks in the /var/adm/wtmpx file, which records all logins and logouts, for information about a user, a terminal, or any group of users and terminals. Arguments specify names of users or terminals of interest. If multiple arguments are given, the information applicable to any of the arguments is printed. For example, last root console lists all of root’s sessions, as well as all sessions on the console terminal. last displays the sessions of the specified users and terminals, most recent first, indicating the times at which the session began, the duration of the session, and the terminal on which the session took place. last also indicates whether the session is continuing or was cut short by a reboot.

The pseudo-user reboot logs in when the system is shutdown and when it reboots. Thus, last reboot

gives an approximate record of when the operating system instance was shutdown and when it rebooted. This can be used to calculate the availability of the operating system over time.

last with no arguments displays a record of all logins and logouts, in reverse order.

If last is interrupted, it indicates how far the search has progressed in /var/adm/wtmpx. If interrupted with a quit signal (generated by a CTRL−q), last indicates how far the search has progressed, and then continues the search.

Options  The following options are supported:

- -a  Displays the hostname in the last column.

- -f filename  Uses filename as the name of the accounting file instead of /var/adm/wtmpx.

- -n number | -number  Limits the number of entries displayed to that specified by number. These options are identical; the -number option is provided as a transition tool only and is removed in future releases.

Environment Variables  Date and time format is based on locale specified by the LC_ALL, LC_TIME, or LANG environments, in that order of priority.

Files  /var/adm/wtmpx accounting file

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>
See Also  utmpx(4), attributes(5)
**lastcomm(1)**

<table>
<thead>
<tr>
<th>Name</th>
<th>lastcomm – display the last commands executed, in reverse order</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synopsis</td>
<td><code>lastcomm [-f file] [-x] [command-name] ... [user-name] ...</code></td>
</tr>
<tr>
<td></td>
<td><code>[terminal-name] ...</code></td>
</tr>
</tbody>
</table>
| Description | The `lastcomm` command gives information on previously executed commands. `lastcomm` with no arguments displays information about all the commands recorded during the current accounting file's lifetime. If called with arguments, `lastcomm` only displays accounting entries with a matching `command-name`, `user-name`, or `terminal-name`. If extended process accounting is active (see `acctadm(1M)` and is recording the appropriate data items, `lastcomm` attempts to take data from the current extended process accounting file. If standard process accounting is active, `lastcomm` takes data from the current standard accounting file (see `acct(2)`).
|         | If `terminal-name` is ' - - ', there was no controlling TTY for the process. The process was probably executed during boot time. If `terminal-name` is '?' , the controlling TTY could not be decoded into a printable name. For each process entry, `lastcomm` displays the following items of information: |
|         | - The command name under which the process was called. |
|         | - One or more flags indicating special information about the process. The flags have the following meanings: |
|         |   - `F` The process performed a `fork` but not an `exec`. |
|         |   - `S` The process ran as a set-user-id program. |
|         | - The name of the user who ran the process. |
|         | - The terminal which the user was logged in on at the time (if applicable). |
|         | - The amount of CPU time used by the process (in seconds). |
|         | - The date and time the process exited. |
| Options | The following options are supported: |
|         | - `-f file` Uses `file` as the source of accounting data. `file` may be either an extended process accounting file or a standard process accounting file. |
|         | - `-x` Uses the currently active extended process accounting file. If extended processing accounting is inactive, no output will be produced. |
| Examples | EXAMPLE 1 Listing executions of named commands |
|         | The command |
|         | `example% lastcomm a.out root term/01` |
|         | produces a listing of all the executions of commands named `a.out` by user `root` while using the terminal `term/01`. |
EXAMPLE 2  Listing all user commands

The command

```
example% lastcomm root
```

produces a listing of all the commands executed by user root.

Files  
/var/adm/pacct        standard accounting file
/var/adm/exacct/proc  extended accounting file

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  last(1), acctadm(1M), acct(2), acct.h(3HEAD), core(4), attributes(5)
**ld** - link-editor for object files

**Synopsis**


**Description**

The link-editor, \texttt{ld}, combines relocatable object files by resolving symbol references to symbol definitions, together with performing relocations. In all cases, the default output of \texttt{ld} is left in the file \texttt{a.out}. See NOTES.

\texttt{ld} has a large number of options. Those options that are relevant to modern programming practices are defined in the SYNOPSIS, and described in the sections that follow. Other options are less commonly used, and are described under the SECONDARY OPTIONS section.

\texttt{ld} operates in one of two modes, dynamic or static. Dynamic mode is the default, however this mode can be governed by the \texttt{-r} or \texttt{-d} options. In dynamic mode, relocatable object files that are provided as arguments, are combined to produce a dynamic executable file. This file is combined at runtime with any shared object files that are provided as arguments. If the \texttt{-G} option is specified, relocatable object files are combined to produce a shared object file. This dynamic linking environment tightly couples the work of the link-editor and the runtime linker, \texttt{ld.so.1(1)}. Both of these utilities, together with their related technologies and utilities, are extensively documented in the \textit{Linker and Libraries Guide}. 

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User Commands 775
In static mode, with the -r option, relocatable object files that are provided as arguments are combined to produce one relocatable object file. Modern versions of the Oracle Solaris operating system do not support the creation of static executables. See Static Executables. All discussion in this section assumes dynamic linking, or static linking with the -r option.

If any argument is a library, `ld` by default searches the library exactly once at the point the library is encountered on the command line. The library can be either a shared object or relocatable archive. See `ar.h(3HEAD)`.

A shared object consists of an indivisible, whole unit that has been generated by a previous link-edit of one or more input files. When the link-editor processes a shared object, the entire contents of the shared object become a logical part of the resulting output file image. The shared object is not physically copied during the link-edit as its actual inclusion is deferred until process execution. This logical inclusion means that all symbol entries defined in the shared object are made available to the link-editing process. See Chapter 4, “Shared Objects,” in Linker and Libraries Guide.

For an archive library, `ld` loads only those archive members that define an unresolved external reference. `ld` searches the symbol table of the archive library sequentially to resolve external references that can be satisfied by archive members. This search is repeated until no external references can be resolved by the archive. Thus, the order of members in the library is functionally unimportant, unless multiple archive members exist that define the same external symbol. Archive libraries that have interdependencies can require multiple command line definitions, or the use of one of the -z rescan options. See “Archive Processing” in Linker and Libraries Guide.

`ld` is a cross link-editor, able to link 32–bit objects or 64–bit objects, for SPARC or x86 targets. `ld` uses the ELF class and machine type of the first relocatable object on the command line to govern the mode in which to operate. The mixing of 32–bit objects and 64–bit objects is not permitted. Similarly, only objects of a single machine type are allowed. See the -32, -64 and -z target options, and the `LD_NOEXEC_64` environment variable.

### Static Executables

The creation of static executables has been discouraged for many releases. In fact, 64–bit system archive libraries have never been provided with Solaris. Because a static executable is built against system archive libraries, the executable contains system implementation details. This self-containment has a number of drawbacks:

- The executable is immune to the benefits of system patches delivered as shared objects. The executable therefore, must be rebuilt to take advantage of many system improvements.
- The ability of the executable to run on future releases can be compromised.
- The duplication of system implementation details negatively affects system performance.

Starting with Oracle Solaris 10, 32–bit system archive libraries are no longer provided. Without these libraries, specifically `libc.a`, the creation of static executables is no longer
achievable without specialized system knowledge. However, the capability of ld to process static linking options, and the processing of archive libraries, remains unchanged.

**Options**

The following options are supported.

- **-32** | **-64**
  - Create a 32–bit, or 64–bit object.

  By default, the class of the object being generated is determined from the first ELF object processed from the command line. If no objects are specified, the class is determined by the first object encountered within the first archive processed from the command line. If there are no objects or archives, the link-editor creates a 32–bit object.

  The `-64` option is required to create a 64–bit object solely from a map file.

  The `-32` or `-64` options can also be used in the rare case of linking entirely from an archive that contains a mixture of 32 and 64–bit objects. If the first object in the archive is not the class of the object that is required to be created, then the `-32` or `-64` option can be used to direct the link-editor.

- **-B direct** | **-B nodirect**
  - These options govern direct binding. `-B direct` establishes direct binding information by recording the relationship between a symbol reference and the dependency that provides the symbol definition. In addition, direct binding information can be established between a symbol reference and an associated definition within the object being created. The runtime linker uses this information to search directly for a symbol in the associated object rather than to carry out a default symbol search.

  Direct binding information can only be established to dependencies specified with the link-edit. Thus, you should also add the `-z defs` option. Objects that wish to interpose on symbols in a direct binding environment should identify themselves as interposers with the `-z interpose` option. The use of `-B direct` also enables `-z lazyload` for all dependencies.

  The `-B nodirect` option prevents any direct binding to the interfaces offered by the object being created. The object being created can continue to directly bind to external interfaces by specifying the `-z direct` option. See Chapter 9, "Direct Bindings," in Linker and Libraries Guide.

- **-B dynamic** | **-B static**
  - These options govern library inclusion. `-B dynamic` allows a `-l` option library search to expand to a shared object and an archive library name. This option is valid, and the default, in dynamic mode only. `-B static` restricts a `-l` option library search to expand to archive library names only. These options can be specified any number of times on the command line as toggles. If the `-B static` option is given, no shared objects are accepted until `-B dynamic` is seen. See the `-l` option.
Causes any symbols that default to global binding, to be eliminated from the symbol table, or reduced to local visibility. A global symbol that has a STV_DEFAULT visibility, can be reduced to a more restrictive visibility by the link-editor. A global symbol that has any other STV_visibility is considered to have an explicit visibility. An explicit visibility is honored by the link-editor, and can not be modified. See “SYMBOL_SCOPE / SYMBOL_VERSION Directives” in Linker and Libraries Guide. A symbols visibility can be explicitly defined through compiler directives, or through mapfiles that define version or interface definitions.

Mapfile version and interface definitions can contain auto-elimination or auto-reduction directives. See “SYMBOL_SCOPE / SYMBOL_VERSION Directives” in Linker and Libraries Guide. These directives result in symbols that are not explicitly defined in a mapfile, or do not define an explicit visibility, to be eliminated or reduced to local, respectively. Besides any explicit symbol definitions, symbol elimination or reduction can also be affected by the type of object being produced, as described in the paragraphs that follow. The -B eliminate option requests the same symbol elimination as the mapfile auto-elimination directive. The -B local option requests the same symbol reduction as the mapfile auto-reduction directive.

Either option can be qualified with a mode, external, or noexternal, to control the selection of eliminated or reduced global symbols. This fine-tuning is usually unnecessary, as the link-editor defaults to the appropriate mode for the type of object being produced, external for executables, and noexternal for shared objects.

When building a dynamic object, it can be necessary to ensure that some symbols remain global so that they can be referenced from external dependencies. This is particularly true for dynamic executables. When building an executable, relocatable objects are contributed by the compilation environment that provide for runtime process initialization. These relocatable objects can contain global symbols that are referenced from system dependencies. These symbols should remain global regardless of any auto-elimination or auto-reduction symbol techniques, so as not to compromise runtime execution.

Defining the mode as external results in the analysis of any external dependencies to determine if any symbol reference from the dependency might bind to a symbol definition within the object being built. Any global symbol that satisfies such a binding is not eliminated or reduced to local. This mode is the default when producing a dynamic executable.

Defining the mode as noexternal circumvents the analysis of any external dependencies, and results in the reduction of all symbols that are not explicitly defined in a mapfile, or do not define an explicit visibility. This mode is the default when producing a shared object.

See also the -B reduce option.
-B reduce
When generating a relocatable object, causes the reduction of symbolic information
defined by any symbol visibility attribute, or through map files that define version or
interface definitions. By default, when a relocatable object is generated, visibility attributes,
version definitions, or interface definitions are only recorded in the output image.
Visibility attributes, or map file version or interface definitions, are always applied to any
symbolic information when creating a dynamic executable or shared object.

-c name
Records the configuration file name for use at runtime. Configuration files can be
employed to alter default search paths, provide a directory cache, together with providing
alternative object dependencies. See crle(1).

-C
Demangles C++ symbol names displayed in diagnostic messages.

-D [!]token1,[!]token2,...
Prints debugging information as specified by each token, to the standard error. The special
token help indicates the full list of tokens available. See “Debugging Aids” in Linker and
Libraries Guide.

-e epsym
--entry epsym
Sets the entry point address for the output file to be the symbol epsym.

-f name
--auxiliary name
Used only when building a shared object. Specifies that the symbol table of the shared
object is used as an auxiliary filter on the symbol table of the shared object specified by
name. Multiple instances of this option are allowed. This option can not be combined with
the -F option. See “Generating Auxiliary Filters” in Linker and Libraries Guide.

-F name
--filter name
Used only when building a shared object. Specifies that the symbol table of the shared
object is used as a filter on the symbol table of the shared object specified by name. Multiple
instances of this option are allowed. This option can not be combined with the -f option.
See “Generating Standard Filters” in Linker and Libraries Guide.

-G
-shared
In dynamic mode only, produces a shared object. Undefined symbols are allowed. See

-h name
--soname name
In dynamic mode only, when building a shared object, records name in the object's
dynamic section. name is recorded in any dynamic objects that are linked with this object.
rather than the object’s file system name. Accordingly, name is used by the runtime linker as the name of the shared object to search for at runtime. See “Recording a Shared Object Name” in Linker and Libraries Guide.

-1
   Ignores LD_LIBRARY_PATH. This option is useful when an LD_LIBRARY_PATH setting is in effect to influence the runtime library search, which would interfere with the link-editing being performed.

-1x
   -l library
   Searches a library libx.so or libx.a, the conventional names for shared object and archive libraries, respectively. In dynamic mode, unless the -B static option is in effect, ld searches each directory specified in the library search path for a libx.so or libx.a file. The directory search stops at the first directory containing either. ld chooses the file ending in .so if -lx expands to two files with names of the form libx.so and libx.a. If no libx.so is found, then ld accepts libx.a. In static mode, or when the -B static option is in effect, ld selects only the file ending in .a. ld searches a library when the library is encountered, so the placement of -l is significant. See “Linking With Additional Libraries” in Linker and Libraries Guide.

-L path
   -l library-path path
   Adds path to the library search directories. ld searches for libraries first in any directories specified by the -L options and then in the standard directories. This option is useful only if the option precedes the -l options to which the -L option applies. See “Directories Searched by the Link-Editor” in Linker and Libraries Guide.

The environment variable LD_LIBRARY_PATH can be used to supplement the library search path, however the -L option is recommended, as the environment variable is also interpreted by the runtime environment. See LD_LIBRARY_PATH under ENVIRONMENT VARIABLES.

-m
   Produces a memory map or listing of the input/output sections, together with any non-fatal multiply-defined symbols, on the standard output.

-M mapfile
   Reads mapfile as a text file of directives to ld. This option can be specified multiple times. If mapfile is a directory, then all regular files, as defined by stat(2), within the directory are processed. See Appendix B, “System V Release 4 (Version 1) Mapfiles,” in Linker and Libraries Guide. Example mapfiles are provided in /usr/lib/ld. See FILES.

-N string
   This option causes a DT_NEEDED entry to be added to the .dynamic section of the object being built. The value of the DT_NEEDED string is the string that is specified on the command line. This option is position dependent, and the DT_NEEDED .dynamic entry is relative to the
other dynamic dependencies discovered on the link-edit line. This option is useful for specifying dependencies within device driver relocatable objects when combined with the "-dy and "-r options.

-o outfile
--output outfile

Produces an output object file that is named outfile. The name of the default object file is a.out.

-p auditlib
Identifies an audit library, auditlib. This audit library is used to audit the object being created at runtime. A shared object identified as requiring auditing with the "-p option, has this requirement inherited by any object that specifies the shared object as a dependency. See the "-p option. See “Runtime Linker Auditing Interface” in Linker and Libraries Guide.

-P auditlib
Identifies an audit library, auditlib. This audit library is used to audit the dependencies of the object being created at runtime. Dependency auditing can also be inherited from dependencies that are identified as requiring auditing. See the "-p option, and the "-z globalaudit option. See “Runtime Linker Auditing Interface” in Linker and Libraries Guide.

-Q y | n
Under "-Q y, an ident string is added to the .comment section of the output file. This string identifies the version of the ld used to create the file. This results in multiple ld idents when there have been multiple linking steps, such as when using ld "-r. This identification is identical with the default action of the cc command. -Q n suppresses version identification. .comment sections can be manipulated by the mcs(1) utility.

-r
--relocatable
Combines relocatable objects to produce one relocatable object file. ld does not complain about unresolved references. This option cannot be used with the "-a option.

-R path
- rpath path

A colon-separated list of directories used to specify library search directories to the runtime linker. If present and not NULL, the path is recorded in the output object file and passed to the runtime linker. Multiple instances of this option are concatenated together with each path separated by a colon. See “Directories Searched by the Runtime Linker” in Linker and Libraries Guide.

The use of a runpath within an associated object is preferable to setting global search paths such as through the LD_LIBRARY_PATH environment variable. Only the runpaths that are necessary to find the objects dependencies should be recorded. ldd(1) can also be used to discover unused runpaths in dynamic objects, when used with the -U option.
Various tokens can also be supplied with a runpath that provide a flexible means of identifying system capabilities or an objects location. See Chapter 6, “Establishing Dependencies with Dynamic String Tokens,” in Linker and Libraries Guide. The $ORIGIN token is especially useful in allowing dynamic objects to be relocated to different locations in the file system.

- strip-all
  Strip any symbolic information from the output file. These options are equivalent to using the -z strip-class option with the debug and symbol class identifiers. See also the -z redlocsym and -z noldynsym options.

- S supportlib
  The shared object supportlib is loaded with ld and given information regarding the linking process. Shared objects that are defined by using the -S option can also be supplied using the SGS_SUPPORT environment variable. See “Link-Editor Support Interface” in Linker and Libraries Guide.

- t
  Turns off the warning for multiply-defined symbols that have different sizes or different alignments.

- u symname
  --undefined symname
  Enters symname as an undefined symbol in the symbol table. This option is useful for loading entirely from an archive library. In this instance, an unresolved reference is needed to force the loading of the first routine. The placement of this option on the command line is significant. This option must be placed before the library that defines the symbol. See “Defining Additional Symbols with the -u option” in Linker and Libraries Guide.

- V
  --version
  Outputs a message giving information about the version of ld being used.

- Y P, dirlst
  Changes the default directories used for finding libraries. dirlst is a colon-separated path list.

- z allextract | defaultextract | weakextract
  --whole-archive | --no-whole-archive
  Alters the extraction criteria of objects from any archives that follow. By default, archive members are extracted to satisfy undefined references and to promote tentative definitions with data definitions. Weak symbol references do not trigger extraction. Under the -z allextract or --whole-archive options, all archive members are extracted from the archive. Under -z weakextract, weak references trigger archive extraction. The -z defaultextract or --no-whole-archive options provide a means of returning to the default following use of the former extract options. See “Archive Processing” in Linker and Libraries Guide.
-z altem64
Execute the 64-bit ld. Historically, the class of link-editor that was executed was
determined by the class of ELF object being created. Now, the class of the link-editor that is
executed is determined by the class of the underlying system. Typically this is 64-bit. This
option is maintained for backward compatibility.

-z ancillary[=outfile]
Specifies an ancillary output file, which will receive any non-allocable sections that would
normally be added to the output object. Non-allocable sections are not required at runtime,
and are primarily for use by debuggers and other observability tools. If outfile is present, the
ancillary file is created with the given name. If outfile is not present, the ancillary file is
given the same name as the primary output file with the addition of a .anc suffix. See

Ancillary objects are supported for executable and shared objects only. The -z ancillary
option cannot be used when the -r option is specified to build a relocatable object. The -z
ancillary option is quietly ignored if used in conjunction with the -z stub option. The -z
ancillary option is also ignored if specified without outfile, and the output file specified
via the -o option is a device special file such as /dev/null.

-z aslr[=mode]
Specifies the Address Space Layout Randomization (ASLR) behavior for an executable. The
mode value can be set to enabled or disabled. If mode is omitted, ASLR is enabled.

-z assert-deflib[=libname]
Enables warning messages for libraries specified with the -l command line option that are
found by examining the default search paths provided by the link-editor. If a libname value
is provided, the default library warning feature is enabled, and the specified library is added
to a list of libraries for which no warnings will be issued. Multiple -z assert-deflib
options can be specified in order to specify multiple libraries for which warnings should
not be issued.

The libname value should be the name of the library file, as found by the link-editor,
without any path components. For example, the following enables default library warnings,
and excludes the standard C library.

ld ... -z assert-deflib=libc.so ...

-z assert-deflib is a specialized option, primarily of interest in build environments
where multiple objects with the same name exist and tight control over the library used is
required. This option is not intended for general use.

-z deferred | nodeferred
Enables or disables the marking of dynamic dependencies as deferred. Dynamic
dependencies which are marked deferred, are also marked as lazy loadable, and are not
loaded at initial process start-up. The loading of deferred dependencies is delayed until
process execution, when the first binding to a deferred reference is made. Unlike basic lazy
loadable dependencies, deferred dependencies are not processed as part of LD_BIND_NOW processing, or through dlopen(3C) with the RTLD_NOW flag. See “Lazy Loading of Dynamic Dependencies” in Linker and Libraries Guide.

The use of deferred dependencies, together with dlsym(3C) and the RTLD_PROBE handle, provides a flexible mechanism, and natural coding style, for testing for functionality.

-z defs | nodefs
--no-undefined

The -z defs option and the --no-undefined option force a fatal error if any undefined symbols remain at the end of the link. This mode is the default when an executable is built. For historic reasons, this mode is not the default when building a shared object. Use of the -z defs option is recommended, as this mode assures the object being built is self-contained. A self-contained object has all symbolic references resolved internally, or to the object’s immediate dependencies.

The -z nodefs option allows undefined symbols. For historic reasons, this mode is the default when a shared object is built. When used with executables, the behavior of references to such undefined symbols is unspecified. Use of the -z nodefs option is not recommended.

-z direct | nodirect

Enables or disables direct binding to any dependencies that follow on the command line. These options allow finer control over direct binding than the global counterpart -B direct. The -z direct option also differs from the -B direct option in the following areas.

Direct binding information is not established between a symbol reference and an associated definition within the object being created. Lazy loading is not enabled.

-z discard-unused= item1, item2, ...

By default, the link-editor discards unused, empty sections. Other categories of input material can be determined to be unused during the link-edit. The -z discard-unused option enables the automatic removal of such items. The following item tokens are recognized.

sections
Unused sections are discarded from the output file created from the link-edit.

files
Unused relocatable object files are discarded from the output file created from the link-edit.

An input relocatable object file is determined to be unused if all allocatable sections provided by the relocatable object are unused. See also the “Non-Required Relocatable Object Files” discussion of the -z guidance option.

dependencies
Unused, explicit, shared object dependencies are not recorded in the output file created from the link-edit.
An explicit dependency is one that is defined on the command-line, either using the path name, or more commonly by using the `-l` option. Explicit dependencies can depend on other objects, which are referred to as implicit dependencies. An explicit dependency is determined to be unused if two conditions are true.

- No global symbols that are provided by the dependency are referenced from the object being built.
- The dependency does not compensate for the requirements of any implicit dependencies.

See also the “Non-Required or Compensating Dependencies” discussion of the `-z` guidance option.

none

Disables all unused processing, including the default action of removing unused, empty sections.

See also “Remove Unused Material” in Linker and Libraries Guide.

-z endfiltee

Marks a filtee so that when processed by a filter, the filtee terminates any further filtee searches by the filter. See “Reducing Filtee Searches” in Linker and Libraries Guide.

-z fatal-warnings | nofatal-warnings

--fatal-warnings | --no-fatal-warnings

The `-z fatal-warnings` and the `--fatal-warnings` option cause the link-editor to treat warnings as fatal errors.

The `-z nofatal-warnings` and the `--no-fatal-warnings` option cause the link-editor to treat warnings as non-fatal. This is the default behavior.

-z finiarray=function

Appends an entry to the `.fini_array` section of the object being built. If no `.fini_array` section is present, a section is created. The new entry is initialized to point to `function`. See “Initialization and Termination Sections” in Linker and Libraries Guide.

-z globalaudit

This option supplements an audit library definition that has been recorded with the `-P` option. This option is only meaningful when building a dynamic executable. Audit libraries that are defined within an object with the `-P` option typically allow for the auditing of the immediate dependencies of the object. The `-z globalaudit` promotes the auditor to a global auditor, thus allowing the auditing of all dependencies. See “Invoking the Auditing Interface” in Linker and Libraries Guide.

An auditor established with the `-P` option and the `-z globalaudit` option, is equivalent to the auditor being established with the `LD_AUDIT` environment variable. See `ld.so.1(1)`.
-z guidance[=item1,item2,...]

Provide guidance messages to suggest ld options that can improve the quality of the resulting object, or which are otherwise considered to be beneficial. The specific guidance offered is subject to change over time as the system evolves. Obsolete guidance offered by older versions of ld may be dropped in new versions. Similarly, new guidance may be added to new versions of ld. Guidance therefore always represents current best practices.

It is possible to enable guidance, while preventing specific guidance messages, by providing a list of item tokens, representing the class of guidance to be suppressed. In this way, unwanted advice can be suppressed without losing the benefit of other guidance. Unrecognized item tokens are quietly ignored by ld, allowing a given ld command line to be executed on a variety of older or newer versions of Solaris.

The guidance offered by the current version of ld, and the item tokens used to disable these messages, are as follows.

Specify Required Dependencies

Dynamic executables and shared objects should explicitly define all of the dependencies they require. Guidance recommends the use of the -z defs option, should any symbol references remain unsatisfied when building dynamic objects. This guidance can be disabled with -z guidance=nodefs.

Do Not Specify Non-Required or Compensating Dependencies

Dynamic executables and shared objects should not define any explicit dependencies that do not satisfy the symbol references made by the dynamic object. Guidance recommends that non-required, or unused dependencies, be removed. Unused dependencies, can fall into one of two categories.

- Explicit dependencies that satisfy no symbol references.
- Explicit dependencies that satisfy no symbol references from the dynamic object being built, but that compensate for implicit dependencies. See the "dependencies" discussion of the -z discard-unused option.

Guidance for both of these categories can be disabled with

- z guidance=nounused-dependencies, or the synonym - z guidance=nounused.

Guidance for compensating dependencies can be disabled with

- z guidance=nounused-compensators.

See also “Remove Unused Material” in Linker and Libraries Guide.

Do Not Specify Non-Required Relocatable Object Files

The output file being created should not contain any information from a relocatable object whose allocatable sections are not referenced by any other objects involved with the link-edit. Guidance recommends that unused relocatable objects be removed. This guidance can be disabled with -z guidance=nounused-files.

See also “Remove Unused Material” in Linker and Libraries Guide.
Lazy Loading
Dependencies should be identified for lazy loading. Guidance recommends the use of the -z lazyload option should any dependency be processed before either a -z lazyload or -z nolazyload option is encountered. This guidance can be disabled with -z guidance=nolazyload.

Direct Bindings
Dependencies should be referenced with direct bindings. Guidance recommends the use of the -B direct, or -z direct options should any dependency be processed before either of these options, or the -z nodirect option is encountered. This guidance can be disabled with -z guidance=nodirect.

Pure Text Segment
Dynamic objects should not contain relocations to non-writable, allocable sections. Guidance recommends compiling objects with Position Independent Code (PIC) should any relocations against the text segment remain, and neither the -z textwarn or -z textoff options are encountered. This guidance can be disabled with -z guidance=notext.

Mapfile Syntax
All mapfiles should use the version 2 mapfile syntax. Guidance recommends the use of the version 2 syntax should any mapfiles be encountered that use the version 1 syntax. This guidance can be disabled with -z guidance=nomapfile.

Library Search Path
Inappropriate dependencies that are encountered by ld are quietly ignored. For example, a 32-bit dependency that is encountered when generating a 64-bit object is ignored. These dependencies can result from incorrect search path settings, such as supplying an incorrect -L option. Although benign, this dependency processing is wasteful, and might hide a build problem that should be solved. Guidance recommends the removal of any inappropriate dependencies. This guidance can be disabled with -z guidance=nolibpath.

In addition, -z guidance=noall can be used to entirely disable the guidance feature. Chapter 7, “Link-Editor Quick Reference,” in Linker and Libraries Guide for more information on guidance and advice for building better objects.

-z help
--help
Print a summary of the command line options on the standard output and exit.

-z ignore | record
Ignores, or records, shared object dependencies that are not referenced as part of the link-edit.

-z ignore and -z record are positional options, used to toggle how ld handles unreferenced dependencies encountered on the command line. When -z ignore is
encountered, any subsequent unreferenced dependencies are quietly ignored. When \texttt{-z record} is encountered, all dependencies are recorded without regard to whether the dependency is referenced or not.

By default, \texttt{ld} records all dependencies whether or not the dependency is referenced. The non-positional \texttt{-z discard-unused=dependencies} option can be used to alter this initial default. Once the initial setting is established, \texttt{-z ignore} and \texttt{-z record} can be used to alter the default behavior.

\texttt{-z initarray=function}

Appends an entry to the \texttt{.init_array} section of the object being built. If no \texttt{.init_array} section is present, a section is created. The new entry is initialized to point to \texttt{function}. See “Initialization and Termination Sections” in Linker and Libraries Guide.

\texttt{-z initfirst}

Marks the object so that its runtime initialization occurs before the runtime initialization of any other objects brought into the process at the same time. In addition, the object runtime finalization occurs after the runtime finalization of any other objects removed from the process at the same time. This option is only meaningful when building a shared object.

\texttt{-z interpose}

Marks the object as an interposer. At runtime, an object is identified as an explicit interposer if the object has been tagged using the \texttt{-z interpose} option. An explicit interposer is also established when an object is loaded using the \texttt{LD_PRELOAD} environment variable. Implicit interposition can occur because of the load order of objects, however, this implicit interposition is unknown to the runtime linker. Explicit interposition can ensure that interposition takes place regardless of the order in which objects are loaded. Explicit interposition also ensures that the runtime linker searches for symbols in any explicit interposers when direct bindings are in effect.

\texttt{-z lazyload|nolazyload}

Enables or disables the marking of dynamic dependencies to be lazily loaded. Dynamic dependencies which are marked \texttt{lazyload} are not loaded at initial process start-up. These dependencies are delayed until the first binding to the object is made. \textit{Note}: Lazy loading requires the correct declaration of dependencies, together with associated runpaths for each dynamic object used within a process. See “Lazy Loading of Dynamic Dependencies” in Linker and Libraries Guide.

\texttt{-z ld32=arg1,arg2,....}
\texttt{-z ld64=arg1,arg2,....}

The class of the link-editor is affected by the class of the output file being created and by the capabilities of the underlying operating system. The \texttt{-z ld[32|64]} options provide a means of defining any link-editor argument. The defined argument is only interpreted, respectively, by the 32–bit class or 64–bit class of the link-editor.

For example, support libraries are class specific, so the correct class of support library can be ensured using:
ld ... -z ld32=-Saudit32.so.1 -z ld64=-Saudit64.so.1 ...

-z loadfltr
Marks a filter to indicate that filteres must be processed immediately at runtime. Normally, filter processing is delayed until a symbol reference is bound to the filter. The runtime processing of an object that contains this flag mimics that which occurs if the LD_LOADFLTR environment variable is in effect. See the ld.so.1(1).

-z mapfile-add=name
Adds name to the list of known mapfile conditional input expression predicates. This option is equivalent to placing the following lines at the top of the first mapfile read by the link-editor.

```
$mapfile_version 2
$add name
```

Names entered via -z mapfile-add can be used with mapfile $if and $elif directives to conditionally process mapfile input. See Chapter 10, "Mapfiles," in Linker and Libraries Guide.

-z muldefs
--allow-multiple-definition
Allows multiple symbol definitions. By default, multiple symbol definitions that occur between relocatable objects result in a fatal error condition. This option, suppresses the error condition, allowing the first symbol definition to be taken.

-z nodelete
Marks the object as non-deletable at runtime. This mode is similar to adding the object to the process by using dlopen(3C) with the RTLD_NODELETE mode.

-z nodlopen
Marks the object as not available to dlopen(3C), either as the object specified by the dlopen, or as any form of dependency required by the object specified by the dlopen. This option is only meaningful when building a shared object.

-z nodump
Marks the object as not available to dldump(3C).

-z parent=object
Specifies a parent object, which can be an executable or shared object, against which to link the output object. This option is typically used when creating plugin shared objects intended to be loaded by an executable at runtime via the dlopen() function. The symbol table from the parent object is used to satisfy references from the plugin object. See Chapter 2, "Link-Editor," in Linker and Libraries Guide.

-z preinitarray=function
Appends an entry to the .preinit_array section of the object being built. If no .preinit_array section is present, a section is created. The new entry is initialized to point to function. See "Initialization and Termination Sections" in Linker and Libraries Guide.
-z relaxreloc
   ld normally issues a fatal error upon encountering a relocation using a symbol that references an eliminated COMDAT section. If -z relaxreloc is enabled, ld instead redirects such relocations to the equivalent symbol in the COMDAT section that was kept. -z relaxreloc is a specialized option, mainly of interest to compiler authors, and is not intended for general use.

- z rescan - now
   These options rescan the archive files that are provided to the link-edit. By default, archives are processed once as the archives appear on the command line. Archives are traditionally specified at the end of the command line so that their symbol definitions resolve any preceding references. However, specifying archives multiple times to satisfy their own interdependencies can be necessary.

   -z rescan - now is a positional option, and is processed by the link-editor immediately when encountered on the command line. All archives seen on the command line up to that point are immediately reprocessed in an attempt to locate additional archive members that resolve symbol references. This archive rescanning is repeated until a pass over the archives occurs in which no new members are extracted.

   -z rescan is a position independent option. The link-editor defers the rescan operation until after it has processed the entire command line, and then initiates a final rescan operation over all archives seen on the command line. The -z rescan operation can interact incorrectly with objects that contain initialization (.init) or finalization (.fini) sections, preventing the code in those sections from running. For this reason, -z rescan is deprecated, and use of -z rescan - now is advised.

- z rescan - start ... - z rescan - end
   --start-group ... --end-group
   - ( ... - )
   Defines an archive rescan group. This is a positional construct, and is processed by the link-editor immediately upon encountering the closing delimiter option. Archives found within the group delimiter options are reprocessed as a group in an attempt to locate additional archive members that resolve symbol references. This archive rescanning is repeated until a pass over the archives occurs in which no new members are extracted. Archive rescan groups cannot be nested.

- z strip - class=[!]class1,[!]class2,...
   Strip a specific class of section from any input objects, preventing these sections from being added to the output file. This option provides fine grained control over the sections that can be omitted from the output file.

   The strip class descriptions that follow only apply to non-allocatable sections.
Each class token can be prepended with a '!' to indicate that the class should not be removed. This definition can be useful when combined with the nonalloc class. For example, using `-z strip-class=nonalloc,!note' removes all non-allocatable sections except for the note section.

Stripped sections are completely removed from the output object. The use of the -z ancillary option alters this behavior with regard to the non-dynamic symbol table .symtab, and the sections related to it. By default, the symbol table is written to both the primary and ancillary objects. If stripped, the symbol table is written to the ancillary object only, and is marked as absent in the primary object. If .symtab is stripped from an object without the use of -z ancillary, the section is completely removed in the usual manner.

The following classes of section can be defined.

nonalloc

Strip any non-allocatable section. These sections are identified as not including the SHF_ALLOC section flag. This class encapsulates all of the other classes, except for the symbol class. The nonalloc class is often sufficient by itself to remove any unwanted sections.

annotate

Strip any annotation section. These sections provide information that is used by memory access tools, and coverage related tools. These sections are identified by having a SHT_SUNW_ANNOTATE section type.

comment

Strip any comment section. These sections are identified by having a .comment section name. Alternatively, the mcs(1) utility is commonly used to manipulate comment sections.

debug

Strip sections commonly used to contain debugging data. These sections are identified by having a .compcom,.line,.stab*, or .debug* section name. These sections are also identified by having a SHT_SUNW_DEBUG* section type.

exclude

Strip any excludable section. These sections are identified by having a SHF_EXCLUDE section flag. This class can be useful when creating a relocatable object. By default, such sections are automatically excluded when a dynamic executable or shared object is created, and are retained when creating a relocatable object.

note

Strip any note section. These sections are identified by having a SHT_NOTE section type.

symbol

Strip any non-allocatable symbol table and string table sections, providing the output file is not a relocatable object. These sections are identified by having a SHT_SYMTAB section type. Any associated string table is also removed.
-z stub

Produces a stub shared object. A stub object is a shared object, built entirely from map files, that supplies the same linking interface as the real object, while containing no code or data. Stub objects cannot be used at runtime. However, an application can be built against a stub object, where the stub object provides the real object name to be used at runtime, and then use the real object at runtime.

Stub objects can only be produced for shared objects, and a map file defining the global symbols to be exported must be supplied. The -G and -M options are therefore required when -z stub is used. When building a stub object, the link-editor ignores any object or library files specified on the command line, and these files need not exist in order to build a stub. Since the compilation step can be omitted, and because the link-editor has relatively little work to do, stub objects can be built very quickly.

See “Stub Objects” in Linker and Libraries Guide.

-z symbolcap

Convert a relocatable object that defines object capabilities into a relocatable object that defines symbol capabilities. See “Converting Object Capabilities to Symbol Capabilities” in Linker and Libraries Guide.

-z target=sparc|x86

Specifies the machine type for the output object. Supported targets are SPARC and x86. The 32-bit machine type for the specified target is used unless the -64 option is also present, in which case the corresponding 64-bit machine type is used. By default, the machine type of the object being generated is determined from the first ELF object processed from the command line. If no objects are specified, the machine type is determined by the first object encountered within the first archive processed from the command line. If there are no objects or archives, the link-editor assumes the native machine. This option is useful when creating an object directly with ld whose input is solely from a map file. See the -M option. It can also be useful in the rare case of linking entirely from an archive that contains objects of different machine types for which the first object is not of the desired machine type.

-z text | textoff | textwarn

These options can be used in dynamic mode only. The -z text option forces a fatal error if any relocations against non-writable, allocatable sections remain. For historic reasons, this mode is not the default when building an executable or shared object. However, its use is recommended to ensure that the text segment of the dynamic object being built is shareable between multiple running processes. A shared text segment incurs the least relocation overhead when loaded into memory. See “Position-Independent Code” in Linker and Libraries Guide.

The -z textoff option allows relocations against all allocatable sections, including non-writable ones. This mode is the default when building a shared object.

The -z textwarn option lists a warning if any relocations against non-writable, allocatable sections remain. This mode is the default when building an executable.
This option provides additional warning diagnostics during a link-edit. Presently, this option enables the following warnings.

- Suspicious use of displacement relocations.
- Restricted use of static TLS relocations when building shared objects.
- Symbol visibility inconsistencies.

In the future, this option might be enhanced to provide additional diagnostics that are deemed too noisy to be generated by default.

-z verbose
-
-zwrap=symbol
-wrapsymbol
--wrapsymbol

Rename undefined references to symbol in order to allow wrapper code to be linked into the output object without having to modify source code. When -z wrap is specified, all undefined references to symbol are modified to reference __wrap_symbol, and all references to __real_symbol are modified to reference symbol. You are expected to provide an object containing the __wrap_symbol function. This wrapper function can call __real_symbol in order to reference the actual function being wrapped.

The following is an example of a wrapper for the malloc(3C) function.

```c
void *
__wrap_malloc(size_t c)
{
    (void) printf("malloc called with %zu\n", c);
    return (__real_malloc(c));
}
```

If you link other code with this file using -z wrap=malloc to compile all the objects, then all calls to malloc call the function __wrap_malloc instead. The call to __real_malloc calls the real malloc function.

The real and wrapped functions should be maintained in separate source files. Otherwise, the compiler or assembler may resolve the call instead of leaving that operation for the link-editor to carry out, and prevent the wrap from occurring.

Secondary Options

The following options are less commonly used. These options provide for backward compatibility, very specialized features, or options that have been superseded with improved variants.

-a

In static mode only, produces a static executable file. Undefined references are not permitted. This option is the default behavior for static mode. The -a option can not be used with the -r option. See Static Executables under DESCRIPTION.
-b
In dynamic mode only, provides no special processing for dynamic executable relocations that reference symbols in shared objects. Without the -b option, the link-editor applies techniques within a dynamic executable so that the text segment can remain read-only. One technique is the creation of special position-independent relocations for references to functions that are defined in shared objects. Another technique arranges for data objects that are defined in shared objects to be copied into the memory image of an executable at runtime.

The -b option is intended for specialized dynamic objects and is not recommended for general use. Its use suppresses all specialized processing required to ensure an object's shareability, and can even prevent the relocation of 64-bit executables.

-B group
Establishes a shared object and its dependencies as a group. Objects within the group are bound to other members of the group at runtime. This mode is similar to adding the object to the process by using `dlopen(3C)` with the RTLD_GROUP mode. An object that has an explicit dependency on a object identified as a group, becomes a member of the group.

As the group must be self contained, use of the -B group option also asserts the -zdefs option.

Establishing a group provides a primitive means of controlling the binding of a group of objects. However, better control can be accomplished with direct bindings. See the -B direct option.

-B symbolic
In dynamic mode only. When building a shared object, binds references to global symbols to their definitions, if available, within the object. Normally, references to global symbols within shared objects are not bound until runtime, even if definitions are available. This model allows definitions of the same symbol in an executable or other shared object to override the object's own definition. ld issues warnings for undefined symbols unless -zdefs overrides.

The -B symbolic option is intended for specialized dynamic objects and is not recommended for general use. To reduce the runtime relocation processing that is required an object, the creation of a version definition is recommended, together with the use of direct bindings. See the -B direct option.

-d y|n
When -d y, the default, is specified, ld uses dynamic linking. When -d n is specified, ld uses static linking. See Static Executables under DESCRIPTION, and -B dynamic|static.

-I name
--dynamic-linker name
When building an executable, uses name as the path name of the interpreter to be written into the program header. The default in static mode is no interpreter. In dynamic mode,
the default is the name of the runtime linker, \texttt{ld.so.1}. Either case can be overridden by
\texttt{-I name.\ exec(2)} loads this interpreter when the \texttt{a.out} is loaded, and passes control to the
interpreter rather than to the \texttt{a.out} directly.

\texttt{-z absexec}
Used only when building a dynamic executable. Specifies that references to external
absolute symbols should be resolved immediately instead of being left for resolution at
runtime. In very specialized circumstances, this option removes text relocations that can
result in excessive swap space demands by an executable.

\texttt{-z combreloc | noembreloc}
By default, \texttt{ld} combines multiple relocation sections when building executables or shared
objects. This section combination differs from relocatable objects, in which relocation
sections are maintained in a one-to-one relationship with the sections to which the
relocations must be applied. The \texttt{-z noembreloc} option disables this merging of
relocation sections, and preserves the one-to-one relationship found in the original
relocatable objects.

\texttt{ld} sorts the entries of data relocation sections by their symbol reference. This sorting
reduces runtime symbol lookup. When multiple relocation sections are combined, this
sorting produces the least possible relocation overhead when objects are loaded into
memory, and speeds the runtime loading of dynamic objects.

Historically, the individual relocation sections were carried over to any executable or
shared object, and the \texttt{-z combreloc} option was required to enable the relocation section
merging previously described. Relocation section merging is now the default. The \texttt{-z}
\texttt{combreloc} option is still accepted for the benefit of old build environments, but the option
is unnecessary, and has no effect.

\texttt{-z groupperm | nogroupperm}
Assigns, or deassigns each dependency that follows to a unique group. The assignment of a
dependency to a group has the same effect as if the dependency had been built using the \texttt{-B}
group option.

\texttt{-z nocompsrtab}
Disables the compression of ELF string tables, and comment sections. By default, string
compression is applied to \texttt{SHT STRTAB} sections, to \texttt{SHT PROGBITS} sections that have their
\texttt{SHF MERGE} and \texttt{SHF STRINGS} section flags set, and to comment sections.

The \texttt{mcs(1)} utility, together with the \texttt{-c} option, can be used to compress comment sections
after an object has been built.

\texttt{-z nodefaultlib}
Marks the object so that the runtime default library search path, used after any
\texttt{LD_LIBRARY_PATH} or runpaths, is ignored. This option implies that all dependencies of the
object can be satisfied from its runpath.
-z noldynsym
Prevents the inclusion of a .SUNW_ldynsym section in a dynamic executable or shared object. The .SUNW_ldynsym section augments the .dynsym section by providing symbols for local functions. Local function symbols allow debuggers to display local function names in stack traces from stripped programs. Similarly, dladdr(3C) is able to supply more accurate results.

The -z noldynsym option also prevents the inclusion of the two symbol sort sections that are related to the .SUNW_ldynsym section. The .SUNW_dynsymsort section provides sorted access to regular function and variable symbols. The .SUNW_dyltssort section provides sorted access to thread local storage (TLS) variable symbols.

The .SUNW_ldynsym, .SUNW_dynsymsort, and .SUNW_dyltssort sections, which becomes part of the allocable text segment of the resulting file, cannot be removed by strip(1).
Therefore, the -z noldynsym option is the only way to prevent their inclusion.

-z nopartial
Partially initialized symbols, that are defined within relocatable objects, are expanded in the output file being generated.

-z now
Marks the object as requiring non-lazy runtime binding. This mode is similar to adding the object to the process by using dlopen(3C) with the RTLD_NOW mode. This mode is also similar to having the LD_BIND_NOW environment variable in effect. See ld.so.1.

-z origin
Marks the object as requiring immediate $ORIGIN processing at runtime. This option is only maintained for historic compatibility, as the runtime analysis of objects to provide for $ORIGIN processing is now default.

-z redlocsym
Eliminates all local symbols except for the SECT symbols from the symbol table SHT_SYMTAB. All relocations that refer to local symbols are updated to refer to the corresponding SECT symbol. This option allows specialized objects to greatly reduce their symbol table sizes. See also the -z strip-class and -z noldynsym options.

Although useful for special objects such as those used within the operating system kernel, the -z redlocsym option is not recommended for general use. The size of the symbol table SHT_SYMTAB does not effect runtime behavior, and the elimination of local symbols can negatively effect process observability. Eliminated local symbols can reduce the debugging information that is generated using the compiler drivers -g option. Eliminated local symbols will also remove the information normally written to the .SUNW_ldynsym section, reducing the effectiveness of debuggers and tools such as pstack(1) and truss(1).

-z rescan
A position independent option that causes a rescan of the archive files that are provided to the link-edit. The link-editor defers the rescan operation until after it has processed the entire command line, and then initiates a final rescan operation over all archives seen on
the command line. The -z rescan operation can interact incorrectly with objects that contain initialization (.init) or finalization (.fini) sections, preventing the code in those sections from running. For this reason, -z rescan is deprecated, and use of -z rescan-now is advised.

### Environment Variables

**LD_ALTEXEC**

An alternative link-editor path name. ld executes, and passes control to this alternative link-editor. This environment variable provides a generic means of overriding the default link-editor that is called from the various compiler drivers. See the -z a1texec64 option.

**LD_LIBRARY_PATH**

A list of directories in which to search for the libraries specified using the -l option. Multiple directories are separated by a colon. In the most general case, this environment variable contains two directory lists separated by a semicolon.

```
dirlist1;dirlist2
```

If ld is called with any number of occurrences of -L, as in:

```
ld ... -L path1 ... -L pathn ...
```

then the search path ordering is:

```
dirlist1 path1 ... pathn dirlist2 LIBPATH
```

When the list of directories does not contain a semicolon, the list is interpreted as `dirlist2`.

The LD_LIBRARY_PATH environment variable also affects the runtime linkers search for dynamic dependencies.

This environment variable can be specified with a _32 or _64 suffix. This makes the environment variable specific, respectively, to 32–bit or 64–bit processes and overrides any non-suffixed version of the environment variable that is in effect.

**LD_NOEXEC_64**

Suppresses the automatic execution of the 64–bit link-editor. By default, the link-editor executes the 64–bit version when the ELF class of the first relocatable object identifies a 64–bit object. The 64–bit image that a 32–bit link-editor can create, has some limitations. However, some link-edits might find the use of the 32–bit link-editor faster.

**LD_OPTIONS**

A default set of options to ld. LD_OPTIONS is interpreted by ld just as though its value had been placed on the command line, immediately following the name used to invoke ld, as in:

```
ld $LD_OPTIONS ... other-arguments ...
```

**LD_RUN_PATH**

An alternative mechanism for specifying a runpath to the link-editor. See the -R option. If both LD_RUN_PATH and the -R option are specified, -R supersedes.
SGS_SUPPORT

Provides a colon-separated list of shared objects that are loaded with the link-editor and given information regarding the linking process. This environment variable can be specified with a _32 or _64 suffix. This makes the environment variable specific, respectively, to the 32-bit or 64-bit class of ld and overrides any non-suffixed version of the environment variable that is in effect. See the -S option.

Notice that environment variable names that begin with the characters 'LD_' are reserved for possible future enhancements to ld and ld.so.1(1).

Files

<table>
<thead>
<tr>
<th>File</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>libx.so</td>
<td>shared object libraries.</td>
</tr>
<tr>
<td>libx.a</td>
<td>archive libraries.</td>
</tr>
<tr>
<td>a.out</td>
<td>default output file.</td>
</tr>
</tbody>
</table>

LIBPATH

For 32-bit libraries, the default search path is /lib, followed by /usr/lib.
For 64-bit libraries, the default search path is /lib/64, followed by /usr/lib/64.

/usr/lib/ld

A directory containing several map files that can be used during link-editing. These map files provide various capabilities, such as defining memory layouts, aligning bss, and defining non-executable stacks.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/linker</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also

as(1), crle(1), gprof(1), ld.so.1(1), ldd(1), mcs(1), pvs(1), strip(1), exec(2), stat(2), dlopen(3C), dldump(3C), elf(3ELF), ar.h(3HEAD), a.out(4), attributes(5)

Linker and Libraries Guide

Default options applied by ld are maintained for historic reasons. In today's programming environment, where dynamic objects dominate, alternative defaults would often make more sense. However, historic defaults must be maintained to ensure compatibility with existing program development environments. Historic defaults are called out wherever possible in this manual. For a description of the current recommended options, see Chapter 7, "Link-Editor Quick Reference," in Linker and Libraries Guide.

If the file being created by ld already exists, the file is unlinked after all input files have been processed. A new file with the specified name is then created. This allows ld to create a new version of the file, while simultaneously allowing existing processes that are accessing the old file contents to continue running. If the old file has no other links, the disk space of the removed file is freed when the last process referencing the file terminates.
The behavior of \texttt{ld} when the file being created already exists was changed with Oracle Solaris 11. In older versions, the existing file was rewritten in place, an approach with the potential to corrupt any running processes that is using the file. This change has an implication for output files that have multiple hard links in the file system. Previously, all links would remain intact, with all links accessing the new file contents. The new \texttt{ld} behavior \textit{breaks} such links, with the result that only the specified output file name references the new file. All the other links continue to reference the old file. To ensure consistent behavior, applications that rely on multiple hard links to linker output files should explicitly remove and relink the other file names.
ldapdelete(1)

Name  ldapdelete – ldap delete entry tool

          [-O bindDN] [-w passwd] [-j file] [-J [:criticality]]
          [-?] [-H] [-h ldaphost] [-V version] [-I locale]
          [-k path] [-P path] [-N certificate] [-y proxyid]
          [-p ldapport] [-O hoplimit] [-o attributename=value]
          [-W password] [dn] ...

Description  The \`ldapdelete\' utility opens a connection to an LDAP server, then binds and deletes one or more entries. If one or more \dn\ arguments are provided, entries with those distinguished names are deleted. If no \dn\ arguments are provided, a list of DNs is read from \file, if the \-f\ option is specified, or from standard input.

Options  The following options are supported:

- **-a**  Bypass confirmation question when deleting a branch.

- **-c**  Continuous operation mode. Errors are reported, but \ldapdelete\ will continue with deletions. The default is to exit after reporting an error.

- **-d debuglevel**  Sets the LDAP debugging level. Useful levels of debugging for \ldapdelete\ are:
  
  - **1**  Trace
  - **2**  Packets
  - **4**  Arguments
  - **32**  Filters
  - **128**  Access control

  To request more than one category of debugging information, add the masks. For example, to request trace and filter information, specify a \debuglevel\ of \33\.

- **-O bindDN**  Uses the distinguished name \bindDN\ to bind to the directory.

- **-E**  Ask server to expose (report) bind identity by means of authentication response control.
-f file

Reads the entry deletion information from file instead of from standard input.

-?

Display the usage help text that briefly describes all options.

-H

Display the usage help text that briefly describes all options.

-h ldaphost

Specifies an alternate host on which the LDAP server is running.

-i locale

Specify the character set to use for command-line input. The default is the character set specified in the LANG environment variable. You might want to use this option to perform the conversion from the specified character set to UTF8, thus overriding the LANG setting.

Using this argument, you can input the bind DN and the target DNs in the specified character set. The ldapdelete tool converts the input from these arguments before it processes the search request. For example, -i no indicates that the bind DN and target DNs are provided in Norwegian.

This option affects only the command-line input. That is, if you specify a file containing DNs (with the -f option), ldapdelete will not convert the data in the file.

-j filename

Specify a file containing the password for the bind DN or the password for the SSL client’s key database. To protect the password, use this option in scripts and place the password in a secure file. This option is mutually exclusive of the -w
and -W options. The -j option is the more secure alternative between -j and -w/-W.

- J [ :criticality[:value][:b64value|b64value|fileurl]] Criticality is a boolean value (default is false).

- k path Specify the path to a directory containing conversion routines. These routines are used if you want to specify a locale that is not supported by default by your directory server. This is for NLS support.

- M Manage smart referrals. When they are the target of the operation, delete the actual entry containing the referral instead of the entry obtained by following the referral.

- n Shows what would be done, but does not actually delete entries. Useful in conjunction with options -v and -d for debugging.

- N certificate Specify the certificate name to use for certificate-based client authentication. For example: -N "directory-Cert".

- o attributename=value For SASL mechanisms and other options such as security properties, mode of operation, authorization ID, and so forth.

The different attribute names and their values are as follows:

- secProp="number" For defining SASL security properties.
- realm="value" Specifies SASL realm (default is realm=none).
- authzid="value" Specify the authorization
**authid=“value”** Specify the authentication ID for SASL bind.

**mech=“value”** Specifies the various SASL mechanisms.

- **-O hopLimit** Specify the maximum number of referral hops to follow while finding an entry to delete. By default, there is no limit.

- **-p ldapport** Specifies an alternate TCP port where the LDAP server is listening.

- **-P path** Specify the path and filename of the client's certificate database. For example:

  ```
  -P /home/uid/.netscape/cert7.db
  ```

  When using the command on the same host as the directory server, you can use the server's own certificate database. For example:

  ```
  -P installDir/ldapd-serverID/alias/cert7.db
  ```

- **-P installDir/ldapd-serverID/alias/cert7.db** Use the `-P` option alone to specify server authentication only.

- **-v** Uses verbose mode, with diagnostics written to standard output.

- **-V version** Specify the LDAP protocol version number to be used for the delete operation, either 2 or 3. LDAP v3 is the default. Specify LDAP v2 when connecting to servers that do not support v3.

- **-W password** Specify the password for the client's key database given in the `-P` option. This option is required for certificate-based client authentication. Specifying
password on the command line has security issues because the password can be seen by others on the system by means of the ps command. Use the -j instead to specify the password from the file. This option is mutually exclusive of -j.

-w passwd
Use passwd as the password for authentication to the directory. When you use -w passwd to specify the password to be used for authentication, the password is visible to other users of the system by means of the ps command, in script files or in shell history. If you use the ldapdelete command without this option, the command will prompt for the password and read it from standard in. When used without the -w option, the password will not be visible to other users.

-Y proxyid
Specify the proxy DN (proxied authorization id) to use for the delete operation, usually in double quotes (""") for the shell.

-Z
Specify that SSL be used to provide certificate-based client authentication. This option requires the -N and SSL password and any other of the SSL options needed to identify the certificate and the key database.

Operands
The following operand is supported:

  dn  Specifies one or several distinguished names of entries to delete.

Examples
EXAMPLE 1  Deleting an Entry
To delete the entry named with commonName Delete Me directly below the XYZ Corporation organizational entry, use the following command:

  example% ldapdelete -D "cn=Administrator, o=XYZ, c=US" \\  "cn=Delete Me, o=XYZ, c=US"
EXAMPLE 2  Deleting an Entry Using SASL Authentication

To delete the entry named with commonName "Delete Me" directly below the XYZ Corporation organizational entry, use the following command:

```bash
example% ldapdelete -o mech=DIGEST-MD5 -o secProp=noanonymous -o realm=none -o authid="dn:uid=foo,o=XYZ, c=US" "cn=Delete Me, o=XYZ, c=US"
```

Attributes  See attributes(5) for a description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

Exit Status  The following exit values are returned:

- 0  Successful completion.
- Non-zero  An error occurred. A diagnostic message is written to standard error.

See Also  ldapadd(1), ldapmodify(1), ldapmodrdn(1), ldapsearch(1), ldap_get_option(3LDAP), ldap_set_option(3LDAP), attributes(5)

Notes  The -M authentication option is obsolete.
**Name**
ldaplist – search and list naming information from an LDAP directory using the configured profile

**Synopsis**
```
/usr/bin/ldaplist [-dlv] [-h LDAP_server[:serverPort] [-M domainName]
    [-N profileName] [-a authenticationMethod] [-P certifPath]
    [-D bindDN] [-w bindPassword] [-j passwdFile]]
    [database [key]...]
```
```
/usr/bin/ldaplist -g

/usr/bin/ldaplist -h
```

**Description**
If the `-h LDAP_server[:serverPort]` option is specified, `ldaplist` establishes a connection to the server pointed to by the option to obtain a `DUAProfile` specified by the `-N` option. Then `ldaplist` lists the information from the directory described by the configuration obtained.

By default (if the `-h LDAP_server[:serverPort]` option is not specified), the utility searches for and lists the naming information from the LDAP directory service defined in the LDAP configuration files generated by `ldapclient(1M)` during the client initialization phase. To use the utility in the default mode, the Oracle Solaris LDAP client must be set up in advance.

The database is either a container name or a database name as defined in `nsswitch.conf(4)`. A container is a non-leaf entry in the Directory Information Tree (DIT) that contains naming service information. The container name is the LDAP Relative Distinguished Name (RDN) of the container relative to the `defaultSearchBase` as defined in the configuration files. For example, for a container named `ou=people`, the database name is the database specified in `nsswitch.conf`. This database is mapped to a container, for example, `passwd` maps to `ou=people`. If an invalid database is specified, it is mapped to a generic container, for example, `nisMapName=name`.

The key is the attribute value to be searched in the database. You can specify more than one key to be searched in the same database. The key can be specified in either of two forms: `attribute=value` or `value`. In the first case, `ldaplist` passes the search key to the server. In the latter case, an attribute is assigned depending on how the database is specified. If the database is a container name, then the “cn” attribute type is used. If the database is a valid database name as defined in the `nsswitch.conf`, then a predefined attribute type is used (see table below). If the database is an invalid database name, then `cn` is used as the attribute type.

The `ldaplist` utility relies on the Schema defined in the `RFC 2307bis`, currently an IETF draft. The data stored on the LDAP server must be stored based on this Schema, unless the profile contains schema mapping definitions. For more information on schema mapping see `ldapclient(1M)`. The following table lists the default mapping from the database names to the container, the LDAP object class, and the attribute type used if not defined in the key.

<table>
<thead>
<tr>
<th>Database</th>
<th>Object Class</th>
<th>Attribute Type</th>
<th>Container</th>
</tr>
</thead>
<tbody>
<tr>
<td>aliases</td>
<td>mailGroup</td>
<td>cn</td>
<td>ou=Aliases</td>
</tr>
<tr>
<td>automount</td>
<td>nisObject</td>
<td>cn</td>
<td>automountMapName=auto_*</td>
</tr>
</tbody>
</table>
The following databases are available only if the system is configured with Trusted Extensions:

```
tnrhttp  ipTnetTemplate  ipTnetTemplateName  ou=ipTnet
tnrhdb  ipTnetHost  ipTnetNumber  ou=ipTnet
```

- For the automount database, `auto_*`, in the container column, represents `auto_home`, `auto_direct`, ...
- For the publickey database, if the key starts with a digit, it is interpreted as an uid number. If the key starts with a non-digit, it is interpreted as a host name.

The `ldaplist` utility supports substring search by using the wildcard "*" in the key. For example, "my*" matches any strings that starts with "my". In some shell environments, keys containing the wildcard might need to be quoted.

If the key is not specified, all the containers in the current search baseDN is listed.

### Options

The following options are supported:

- `-a authenticationMethod`  
  Specifies the authentication method. The default value is what has been configured in the profile. The supported authentication methods are:

  ```
  simple
  sasl/CRAM-MD5
  sasl/DIGEST-MD5
  tls:simple
  ```
tls:sasl/CRAM-MD5
tls:sasl/DIGEST-MD5

Selecting simple causes passwords to be sent over the network in clear text. Its use is strongly discouraged.

Additionally, if the client is configured with a profile which uses no authentication, that is, either the credentialLevel attribute is set to anonymous or authenticationMethod is set to none, the user must use this option to provide an authentication method.

- d
  Lists the attributes for the specified database, rather than the entries. By default, the entries are listed.

- b bindDN
  Specifies an entry which has read permission to the requested database.

- g
  Lists the database mapping.

- h
  Lists the database mapping.

  This option has been deprecated.

- h LDAP_server:serverPort
  Specifies an address (or a name) and a port of the LDAP server from which the entries are read. The current naming service specified in the nsswitch.conf file is used. The default value for the port is 389, unless when TLS is specified in the authentication method. In this case, the default LDAP server port number is 636.

  The format to specify the address and port number for an IPv6 address is:

  [ipv6_addr]:port

  To specify the address and port number for an IPv4 address, use the following format:

  ipv4_addr:port

  If the host name is specified, use the format:

  host_name:port

- j passwdFile
  Specifies a file containing the password for the bind DN or the password for the SSL client’s key database. To protect the password, use this option in scripts and place the password in a secure file.

  This option is mutually exclusive of the -w option.
-l
Lists all the attributes for each entry matching the search criteria. By default, ldaplist lists only the Distinguished Name of the entries found.

-M domainName
Specifies the name of a domain served by the specified server. If this option is not specified, the default domain name is used.

-N profileName
Specifies a DUAProfile name. A profile with such a name is supposed to exist on the server specified by -H option. The default value is default.

-p certifPath
Specifies the certificate path to the location of the certificate database. The value is the path where security database files reside. This is used for TLS support, which is specified in the authenticationMethod and serviceAuthenticationMethod attributes. The default is /var/ldap.

-w bindPassword
Password to be used for authenticating the bindDN. If this parameter is missing, the command prompts for a password. NULL passwords are not supported in LDAP.

When you use -w bind_password to specify the password to be used for authentication, the password is visible to other users of the system by means of the ps command, in script files or in shell history.

If the value of - is supplied as a password, the command prompts for a password.

-v
Sets verbose mode. The ldaplist utility also prints the filter used to search for the entry. The filter is prefixed with "+++".

**Examples**

**EXAMPLE 1** Listing All Entries in the Hosts Database
The following example lists all entries in the hosts database:
example% ldaplist hosts

**EXAMPLE 2** Listing All Entries in a Non-Standard Database ou=new
The following example lists all entries in a non-standard database:
example% ldaplist ou=new

**EXAMPLE 3** Finding user1 in the passwd Database
The following example finds user1 in the passwd database:
example% ldaplist passwd user1
EXAMPLE 4  Finding the Entry With Service Port of 4045 in the services Database
The following example finds the entry with the service port of 4045 in the services database:

```bash
example% ldaplist services ipServicePort=4045
```

EXAMPLE 5  Finding All Users With Username Starting with new in the passwd Database
The following example finds all users with the username starting with new in the passwd database:

```bash
example% ldaplist passwd 'new*' 
```

EXAMPLE 6  Listing the Attributes for the hosts Database
The following example lists the attributes for the hosts database:

```bash
example% ldaplist -d hosts 
```

EXAMPLE 7  Finding user1 in the passwd Database
The following example finds user1 in the passwd database. An LDAP server is specified explicitly.

```bash
example% ldaplist -H 10.10.10.10:3890 \ 
   -M another.domain.name -N special_duaprofile \ 
   -D "cn=directory manager" -w secret \ 
   user1
```

**Exit Status**
The following exit values are returned:

0  Successfully matched some entries.
1  Successfully searched the table and no matches were found.
2  An error occurred. An error message is output.

**Files**
/var/ldap/ldap_client_file
/var/ldap/ldap_client_cred  Files that contain the LDAP configuration of the client. Do not manually modify these files. Their content is not guaranteed to be human readable. To update these files, use ldapclient(1M)

**Attributes**
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/network/nis</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>
See Also  ldapadd(1), ldapdelete(1), ldapmodify(1), ldapmodrdn(1), ldapsearch(1), idsconfig(1M), ldap_cachemgr(1M), ldapaddent(1M), ldapclient(1M), resolv.conf(4), attributes(5), ldap(5)

Notes  RFC 2307bis is an IETF informational document in draft stage that defines an approach for using LDAP as a naming service.

Currently StartTLS is not supported by libldap.so.5, therefore the port number provided refers to the port used during a TLS open, versus the port used as part of a StartTLS sequence. For example, -h foo:1000 -a tls:simple, refers to a raw TLS open on host foo, port 1000, not a open, StartTLS sequence on an unsecured port 1000. If port 1000 is unsecured the connection is not made.
ldapmodify, ldapadd – ldap entry addition and modification tools

Name
ldapmodify, ldapadd – ldap entry addition and modification tools

Synopsis
[-O bindDN] [-j filename] [-J [-:criticality]]
[-i locale] [-k path] [-e errorFile] [-P path]
[-N certificate] [-w passwd] [-o attributename=value]
[-h ldaphost] [-W password] [-p ldapport] [-f file]
[-l nb-ldap-connections]
ldapadd [-c] [-n] [-v] [-F]
[-Y proxyDN] [-O hopLimit] [-i locale] [-k path]
[-e errorFile] [-P path] [-N certificate] [-w passwd]
[-o attributename=value] [-h ldaphost] [-W password]
[-p ldapport] [-f file] [-l nb-ldap-connections]

Description
The ldapmodify utility opens a connection to an LDAP server, binds and modifies or adds entries. The entry information is read from standard input or from file, specified using the -f option. The ldapadd utility is implemented as a hard link to the ldapmodify tool. When invoked as ldapadd, the -a (add new entry) option is turned on automatically.

Both ldapadd and ldapmodify reject duplicate attribute-name/value pairs for the same entry.

Options
The following options are supported:

-a
Add new entries. The default for ldapmodify is to modify existing entries. If invoked as ldapadd, this option is always set.

-A
Non-ASCII mode: display non-ASCII values, in conjunction with the -v option.

-b
Handle binary files. The ldapmodify tool will scan every attribute value in the input to determine whether it is a valid file reference. If the reference is valid, it will use the contents of the file as the attribute's value. This option is used to input binary data, such as a JPEG image, for an attribute. For example, the corresponding LDIF input would be: jpegPhoto: /tmp/photo.jpg. The ldapmodify tool
also supports the LDIF :< URL notation for directly including file contents.

- **B baseDN** Specify the base DN when performing additions, usually in double quotes (""") for the shell. All entries will be placed under this suffix, thus providing bulk import functionality.

- **c** Specifies continuous operation mode. Errors are reported, but `ldapmodify` and `ldapadd` continue with modifications. The default is to exit after reporting an error.

- **D bindDN** Uses the distinguished name `bindDN` to bind to the directory.

- **d debuglevel** Sets the LDAP debugging level. Useful levels of debugging for `ldapmodify` and `ldapadd` are:

  1  Trace
  2  Packets
  4  Arguments
  32 Filters
  128 Access control

  To request more than one category of debugging information, add the masks. For example, to request trace and filter information, specify a `debuglevel` of 33.

- **e errorFile** Invalid update statements in the input will be copied to the `errorFile` for debugging. Use with the `-c` option to correct errors when processing large LDIF input.

- **E** Ask server to expose (report) bind identity by means of authentication response control.

- **F** Forces application of all changes regardless of the content of input lines.
that begin with `replica:`. By default, `replica: lines` are compared against the LDAP server host and port in use to decide whether a repl log record should be applied.

- `-f file` Reads the entry modification information from `file` instead of from standard input.

- `-?` Display the usage help text that briefly describes all options.

- `-H` Display the usage help text that briefly describes all options.

- `-h ldaphost` Specifies an alternate host on which the LDAP server is running.

- `-l locale` Specify the character set to use for the `-f LDIFfile` or standard input. The default is the character set specified in the `LANG` environment variable. You might choose to use this option to perform the conversion from the specified character set to UTF8, thus overriding the `LANG` setting.

- `-j filename` Specify a file containing the password for the bind DN or the password for the SSL client's key database. To protect the password, use this option in scripts and place the password in a secure file. This option is mutually exclusive of the `-w` and `-W` options.

- `-J [::criticality::value::b64value|b64value|fileurl]]` Criticality is a boolean value (default is `false`).

- `-K path` Specify the path to a directory containing conversion routines. These routines are used if you want to specify a locale that is not supported by default by your directory server. This is for NLS support.

- `-N nb-ldap-connections` Specifies the number of LDAP connections that `ldapadd` or
ldapmodify will open to process the modifications in the directory. The default is one connection.

-M
Manage smart referrals. When they are the target of the operation, modify the entry containing the referral instead of the entry obtained by following the referral.

-n
Previews modifications, but makes no changes to entries. Useful in conjunction with -v and -d for debugging.

-N certificate
Specify the certificate name to use for certificate-based client authentication. For example: -N "Directory-Cert".

-o attributename=value
For SASL mechanisms and other options such as security properties, mode of operation, authorization ID, authentication ID, and so forth.

The different attribute names and their values are as follows:

secProp=number
For defining SASL security properties.

realm=value
Specifies SASL realm (default is realm=none).

authzid=value
Specify the authorization ID name for SASL bind.

authid=value
Specify the authentication ID for SASL bind.

mech=value
Specifies the various SASL
-O hopLimit

Specify the maximum number of referral hops to follow while finding an entry to modify. By default, there is no limit.

-p ldapport

Specifies an alternate TCP port where the secure LDAP server is listening.

-P path

Specify the path and filename of the client’s certificate database. For example:

-P /home/uid/.netscape/cert7.db

When using the command on the same host as the directory server, you can use the server’s own certificate database. For example:

-P installDir/ldapd-serverID/alias/cert7.db

Use the -P option alone to specify server authentication only.

-r

Replaces existing value with the specified value. This is the default for ldapmodify. When ldapadd is called, or if the -a option is specified, the -r option is ignored.

-v

Uses verbose mode, with diagnostics written to standard output.

-V version

Specify the LDAP protocol version number to be used for the delete operation, either 2 or 3. LDAP v3 is the default. Specify LDAP v2 when connecting to servers that do not support v3.

-W password

Specify the password for the client’s key database given in the -P option. This option is required for certificate-based client authentication. Specifying password on the command line has security issues because the password can be seen by others on the system by
means of the ps command. Use the -j instead to specify the password from the file. This option is mutually exclusive of -j.

-\textbf{w passwd} \hspace{1cm} \textbf{Use passwd as the password for authentication to the directory. When you use -w passwd to specify the password to be used for authentication, the password is visible to other users of the system by means of the ps command, in script files or in shell history. If you use either the \texttt{\textbackslash{ldapmodi\textbackslash{fy}} command or the \texttt{\textbackslash{ldapadd}} command without this option, the command will prompt for the password and read it from standard in. When used without the -w option, the password will not be visible to other users.}

-\textbf{Y proxyid} \hspace{1cm} \textbf{Specify the proxy DN (proxied authorization id) to use for the modify operation, usually in double quotes ("") for the shell.}

-\textbf{Z} \hspace{1cm} \textbf{Specify that SSL be used to provide certificate-based client authentication. This option requires the -N and SSL password and any other of the SSL options needed to identify the certificate and the key database.}

\textbf{Exit Status} \hspace{1cm} The following exit values are returned:

0 \hspace{1cm} \textbf{Successful completion.}

Non-zero \hspace{1cm} \textbf{An error occurred. A diagnostic message is written to standard error.}

\textbf{Examples} \hspace{1cm} The format of the content of file (or standard input if no -f option is specified) is illustrated in the following examples.

\textbf{EXAMPLE 1} \hspace{1cm} Modifying an Entry

The file /tmp/entrymods contains the following modification instructions:

\begin{verbatim}
  dn: cn=Modify Me, o=XYZ, c=US
  changetype: modify
\end{verbatim}
EXAMPLE 1  Modifying an Entry  

(Continued)

replace: mail
mail: modme@atlanta.xyz.com
-
add: title
title: System Manager
-
add: jpegPhoto
jpegPhoto:< file:///tmp/modme.jpeg
-
delete: description
-

The command:
example% ldapmodify -r -f /tmp/entrymods

modifies the Modify Me entry as follows:
1. The current value of the mail attribute is replaced with the value,
   modme@atlanta.xyz.com.
2. A title attribute with the value, System Manager, is added.
3. A jpegPhoto attribute is added, using the contents of the file,
   /tmp/modme.jpeg, as the attribute value.
4. The description attribute is removed.

EXAMPLE 2  Creating a New Entry

The file, /tmp/newentry, contains the following information for creating a new entry:

dn: cn=Ann Jones, o=XYZ, c=US
objectClass: person
cn: Ann Jones
cn: Annie Jones
sn: Jones
title: Director of Research and Development
mail: ajones@londonrd.xyz.us.com
uid: ajones

The command
example% ldapadd -f /tmp/newentry

adds a new entry for Ann Jones, using the information in the file.
EXAMPLE 3  Creating a New Entry on an IPv6 Server

The file, /tmp/newentry, contains the following information for creating a new entry: on an IPv6 server.

\[\begin{array}{l}
dn: \text{cn=Ann Jones, o=XYZ, c=US} \\
oobjectClass: \text{person} \\
cn: \text{Ann Jones} \\
cn: \text{Annie Jones} \\
sn: \text{Jones} \\
title: \text{Director of Research and Development} \\
mail: \text{ajones@londonrd.xyz.us.com} \\
uid: \text{ajones}
\end{array}\]

The command

```bash
example% ldapadd -c -v -h '[:fec0::111:a00:20ff:feaa:a364']':389 \\
-D cn=Directory Manager -w secret \\
-f /tmp/entry
```

adds a new entry for Directory Manager, using the information in the file.

EXAMPLE 4  Deleting an Entry

The file, /tmp/badentry, contains the following information about an entry to be deleted:

\[\begin{array}{l}
dn: \text{cn=Ann Jones, o=XYZ, c=US} \\
changetype: \text{delete}
\end{array}\]

The command:

```bash
example% ldapmodify -f /tmp/badentry
```

removes Ann Jones’ entry.

Attributes  See attributes(5) for a description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  ldapdelete(1), ldaplist(1), ldapmodrdn(1), ldapsearch(1), ldapaddent(1M), ldap_cachemgr(1M), ldap_get_option(3LDAP), ldap_set_option(3LDAP), attributes(5), ldap(5)
ldapmodrdn - ldap modify entry RDN tool

Synopsis

[-w passwd] [-h ldaphost] [-i locale] [-j filename]
[-J [:criticality]] [-k path] [-N certificate]
[-o attributename=value] [-f file] [-Y proxyDN]
[dn rdn]

Description

ldapmodrdn opens a connection to an LDAP server, binds, and modifies the RDN of entries. The entry information is read from standard input, from file through the use of the -f option, or from the command-line pair dn and rdn.

Options

-c Continuous operation mode. Errors are reported, but ldapmodify continues with modifications. The default is to exit after reporting an error.

- b bindDN Use the distinguished name binddn to bind to the directory.

- o debuglevel Set the LDAP debugging level. Useful values of debuglevel for ldapmodrdn are:

1 Trace
2 Packets
4 Arguments
32 Filters
128 Access control

To request more than one category of debugging information, add the masks. For example, to request trace and filter information, specify a debuglevel of 33.

-E Ask server to expose (report) bind identity by means of authentication response control.

-f file Read the entry modification information from file instead of from standard input or the command-line.

-? Display the usage help text that briefly describes all options.
-H  Display the usage help text that briefly describes all options.

-h ldaphost  Specify an alternate host on which the LDAP server is running.

-i locale  Specify the character set to use for the -f LDIFfile or standard input. The default is the character set specified in the LANG environment variable. You might choose to use this option to perform the conversion from the specified character set to UTF8, thus overriding the LANG setting.

-J [:criticality::value::b64value|b64value|fileurl]]  Criticality is a boolean value (default is false).

-j filename  Specify a file containing the password for the bind DN or the password for the SSL client's key database. To protect the password, use this option in scripts and place the password in a secure file. This option is mutually exclusive of the -w and -W options.

-k path  Specify the path to a directory containing conversion routines. These routines are used if you want to specify a locale that is not supported by default by your directory server. This is for NLS support.

-M  Manage smart referrals. When they are the target of the operation, modify the entry containing the referral instead of the entry obtained by following the referral.

-n  Previews modifications, but makes no changes to entries. Useful in conjunction with -v and -d for debugging.

-N certificate  Specify the certificate name to use for certificate-based client authentication. For example: -N "Directory-Cert".
-n
Show what would be done, but do not actually change entries. Useful in conjunction with -v for debugging.

-o attribute=value
For SASL mechanisms and other options such as security properties, mode of operation, authorization ID, authentication ID, and so forth.

The different attribute names and their values are as follows:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>secProp=&quot;number&quot;</td>
<td>For defining SASL security properties.</td>
</tr>
<tr>
<td>realm=&quot;value&quot;</td>
<td>Specifies SASL realm (default is realm=none).</td>
</tr>
<tr>
<td>authzid=&quot;value&quot;</td>
<td>Specify the authorization ID name for SASL bind.</td>
</tr>
<tr>
<td>authid=&quot;value&quot;</td>
<td>Specify the authentication ID for SASL bind.</td>
</tr>
<tr>
<td>mech=&quot;value&quot;</td>
<td>Specifies the various SASL mechanisms.</td>
</tr>
</tbody>
</table>

-O hopLimit
Specify the maximum number of referral hops to follow while finding an entry to modify. By default, there is no limit.

-P path
Specify the path and filename of the client’s certificate database. For example:

-P /home/uid/.netscape/cert7.db
When using the command on the same host as the directory server, you can use the server's own certificate database. For example:

```
-P installDir/lapd-serverID/alias/cert7.db
```

Use the -P option alone to specify server authentication only.

```
-p ldapport
```

Specify an alternate TCP port where the secure LAPD server is listening.

```
-R
```

Do not automatically follow referrals returned while searching.

```
-r
```

Remove old RDN values from the entry. By default, old values are kept.

```
-v version
```

Specify the LDAP protocol version number to be used for the delete operation, either 2 or 3. LDAP v3 is the default. Specify LDAP v2 when connecting to servers that do not support v3.

```
-v
```

Use verbose mode, with diagnostics written to standard output.

```
-W password
```

Specify the password for the client's key database given in the -P option. This option is required for certificate-based client authentication. Specifying `password` on the command line has security issues because the password can be seen by others on the system by means of the `ps` command. Use the -j instead to specify the password from the file. This option is mutually exclusive of -j.

```
-w passwd
```

Use `passwd` as the password for authentication to the directory. When you use `-w passwd` to specify the password to be used for authentication, the password is visible to other users of the system by means of the `ps` command, in script files or in shell.
If you use the `ldapmodrdn` command without this option, the command will prompt for the password and read it from standard in. When used without the `-w` option, the password will not be visible to other users.

- `proxyid` Specify the proxy DN (proxied authorization id) to use for the modify operation, usually in double quotes (""") for the shell.

- `Z` Specify that SSL be used to provide certificate-based client authentication. This option requires the -N and SSL password and any other of the SSL options needed to identify the certificate and the key database.

If the command-line arguments `dn` and `rdn` are given, `rdn` replaces the RDN of the entry specified by the DN, `dn`.

Otherwise, the contents of file (or standard input if the – f option is not specified) must consist of one or more pair of lines:

```
Distinguished Name (DN)
Relative Distinguished Name (RDN)
```

Use one or more blank lines to separate each DN/RDN pair.

**Examples** The file `/tmp/entrymods` contains:

```
cn=Modify Me, o=XYZ, c=US
cn=The New Me
```

The command:

```
example% ldapmodify -r -f /tmp/entrymods
```

changes the RDN of the "Modify Me" entry from "Modify Me" to "The New Me" and the old cn, "Modify Me" is removed.

**Attributes** See attributes(5) for a description of the following attributes:
<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

**See Also**  
ldapadd(1), ldapdelete(1), ldapmodify(1), ldapsearch(1), attributes(5)

**Diagnostics**  
Exit status is 0 if no errors occur. Errors result in a non-zero exit status and a diagnostic message being written to standard error.
ldapsearch – ldap search tool

Synopsis

[-i locale] [-k path] [-S [-] attribute] [-C pattern]
[-c authzid] [-P path] [-N certificate] [-w passwd]
[-h ldaphost] [-p ldapport] [-o attributename=value]
[-b searchbase] [-s scope] [-a deref] [-l timelimit]
[-z sizelimit] filter [attrs]...

Description

The ldapsearch utility opens a connection to an LDAP server, binds, and performs a search using the filter filter.

If ldapsearch finds one or more entries, the attributes specified by attrs are retrieved and the entries and values are printed to standard output. If no attrs are listed, all attributes are returned.

Output Format

If one or more entries are found, each entry is written to standard output in the form:

dn: Distinguished Name (DN)
  attributename: value
  attributename: value
  attributename: value
...

Multiple entries are separated with a single blank line. If the -F option is used to specify a different separator character, this character is used instead of the : character. If the -t option is used, the name of a temporary file is returned in place of the actual value. If the -A option is given, only the “attributename” is returned and not the attribute value.

Options

The following options are supported:

- A
  
  Retrieve attributes only (no values). This is useful when you just want to see whether an attribute is present in an entry and are not interested in the specific value.

- a deref
  
  Specify how aliases dereferencing is done. The possible values for deref are never, always, search, or find to specify respectively that aliases are never dereferenced, always dereferenced, dereferenced when searching, or dereferenced only when
finding the base object for the search. The default is to never dereference aliases.

- B
Display non-ASCII values and use the old non-LDIF format. This option disables the default -L option.

- b searchbase
Use searchbase as the starting point for the search instead of the default.

- C pattern
Persistent search. Perform a search that keeps the connection open and displays results whenever entries matching the scope and filter of the search are added, modified, or removed. With this option, the ldapsearch tool runs indefinitely; you must type Control-c to stop it. The pattern has the following format:

```
ps:changeType[:changesOnly[:entryChangeControls]]
```

- c authzid
Specifies the getEffectiveRights control authzid. For example:

dn: uid=bjensen, dc=example, dc=com

- D bindDN
Use the distinguished name bindDN to bind to the directory.

- d debuglevel
Set the LDAP debugging level. Useful levels of debugging for ldapsearch are:

```
1   Trace
2   Packets
4   Arguments
32  Filters
128  Access control
```

To request more than one category of debugging information, add the masks. For example, to request trace and filter information, specify a debuglevel of 33.
- E
  Ask server to expose (report) bind identity by means of authentication response control.

- e
  Minimize base-64 encoding of values.

- F sep
  Use sep as the field separator between attribute names and values. If this option has been specified, the -L option is ignored.

- F file
  Read a series of lines from file, performing one LDAP search for each line. In this case, the filter given on the command line is treated as a pattern where the first occurrence of %s is replaced with a line from file. If file is a single - character, then the lines are read from standard input.

- G pattern
  Virtual list view. Retrieve only a portion of all results, as determined by the index or value of the search target and the number of entries to be returned before and after the target.
  This option always requires the -S and -x options to specify the sorting order on the server.

- ?
  Display the usage help text that briefly describes all options.

-H
  Display the usage help text that briefly describes all options.

-h ldaphost
  Specify an alternate host on which the secure LDAP server is running.

-1 locale
  Specify the character set to use for command-line input. The default is the character set specified in the LANG environment variable. You might want to use this option to perform the conversion from the specified character set to UTF8, thus overriding the LANG setting. Using this argument, you can input the bind DN, base DN, and the
search filter pattern in the specified character set. The `ldapsearch` tool converts the input from these arguments before it processes the search request. For example, `-i no` indicates that the bind DN, base DN, and search filter are provided in Norwegian. This argument only affects the command-line input. If you specify a file containing a search filter (with the `-f` option), `ldapsearch` does not convert the data in the file.

- `-j filename` Specify a file containing the password for the bind DN or the password for the SSL client's key database. To protect the password, use this option in scripts and place the password in a secure file. This option is mutually exclusive of the `-w` and `-W` options.

- `-J [:criticality[:value][:b64value]:b64value]:fileurl` Criticality is a boolean value (default is `false`).

- `-k path` Specify the path to a directory containing conversion routines. These routines are used if you want to specify a locale that is not supported by default by your directory server. This is for NLS support.

- `-L` Display search results in LDIF format. This option also turns on the `-B` option. This behavior is the default.

- `-l timelimit` Wait at most `timelimit` seconds for a search to complete.

- `-M` Manage smart referrals. When they are the target of the operation, search the entry containing the referral instead of the entry obtained by following the referral.

- `-N certificate` Specify the certificate name to use for certificate-based client authentication. For example: `-N "Directory-Cert"`. 

User Commands 829
Show what would be done, but do not actually perform the search. Useful in conjunction with -v and -d for debugging.

Specify the maximum number of referral hops to follow while finding an entry to modify. By default, there is no limit.

For SASL mechanisms and other options such as security properties, mode of operation, authorization ID, authentication ID, and so forth.

The different attribute names and their values are as follows:

- `secProp=number` For defining SASL security properties.
- `realm=value` Specifies SASL realm (default is `realm=none`).
- `authzid=value` Specify the authorization ID name for SASL bind.
- `authid=value` Specify the authentication ID for SASL bind.
- `mech=value` Specifies the various SASL mechanisms.

Specify the path and filename of the client's certificate database. For example:

```bash
-P /home/uid/.netscape/cert7.db
```
When using the command on the same host as the directory server, you can use the server's own certificate database. For example:

-P installDir/lapd-serverID/alias/cert7.db

Use the -P option alone to specify server authentication only.

-p ldapport

Specify an alternate TCP port where the secure LAPD server is listening.

-R

Do not automatically follow referrals returned while searching.

-r

Display the output of the ldapsearch command in the old format.

-S [-]attribute

Specify an attribute for sorting the entries returned by the search. The sort criteria is alphabetical on the attribute's value or reverse alphabetical with the form -attribute. You can give multiple -S options to refine the sorting. For example:

-S sn -S givenname

By default, the entries are not sorted. Use the -x option to perform server-side sorting.

-s scope

Specify the scope of the search. The possible values of scope are base, one, or sub to specify respectively a base object, one-level, or subtree search. The default is sub.

-T

Format the output of search results so that no line breaks are used within individual attribute values.

-t

Write retrieved values to a set of temporary files. This is useful for dealing with non-ASCII values such as jpegPhoto or audio.

-U

URL format (valid only with the -t option). When using temporary file
output, the standard output of the tool includes the URL of the file instead of the attributes value. For example:

```
jpegPhoto:< file:/tmp/ldapsearch-jpegPhoto-YzaOMh
```

- `u` Include the user-friendly form of the Distinguished Name (DN) in the output.

- `-V version` Specify the LDAP protocol version number to be used for the delete operation, either 2 or 3. LDAP v3 is the default. Specify LDAP v2 when connecting to servers that do not support v3.

- `-v` Run in verbose mode, with diagnostics written to standard output.

- `-w password` Specify the password for the client’s key database given in the `-P` option. This option is required for certificate-based client authentication. Specifying `password` on the command line has security issues because the password can be seen by others on the system by means of the `ps` command. Use the `-j` instead to specify the password from the file. This option is mutually exclusive of `-j`.

- `-w passwd` Use `passwd` as the password for authentication to the directory. When you use `-w passwd` to specify the password to be used for authentication, the password is visible to other users of the system by means of the `ps` command, in script files or in shell history. If you use the `ldapsearch` command without this option, the command prompts for the password and read it from standard in. When used without the `-w` option, the password is not visible to other users.
Use the -s option to specify that search results be sorted on the server rather than by the ldapsearch command running on the client. This is useful if you want to sort according to a matching rule, as with an international search. It is usually faster to sort on the server, if that is supported, rather than on the client.

-Y proxyDN
Specify the proxy DN (proxied authorization id) to use for the modify operation, usually in double quotes (" ") for the shell.

-Z
Specify that SSL be used to provide certificate-based client authentication. This option requires the -N and SSL password and any other of the SSL options needed to identify the certificate and the key database.

-z sizelimit
Retrieve at most `sizelimit` entries for a search to complete.

Examples

**EXAMPLE 1  Performing a Subtree Search**

The following command performs a subtree search (using the default search base) for entries with a commonName of “mark smith”. The commonName and telephoneNumber values is retrieved and printed to standard output. Use the -r option to display this output in the old format.

type example

type example% ldapsearch "cn=mark smith" cn telephoneNumber

The output looks something like this:

dn: Mark D Smith, ou=Sales, ou=Atlanta, ou=People, o=XYZ, c=US
cn: Mark Smith
cn: Mark David Smith
cn: Mark D Smith 1
cn: Mark D Smith
telephoneNumber: +1 123 456-7890

dn: Mark C Smith, ou=Distribution, ou=Atlanta, ou=People, o=XYZ, c=US
cn: Mark Smith
cn: Mark C Smith 1
cn: Mark C Smith
telephoneNumber: +1 123 456-9999
EXAMPLE 2    Performing a Subtree Search Using the Default Search Base

The following command performs a subtree search using the -r option to display in old style
format with a default search base for entries with user id of mcs. The user-friendly form of the
entry's DN is output after the line that contains the DN itself, and the jpegPhoto and audio
values are retrieved and written to temporary files.

\texttt{ldapsearch -r -u -t "uid=mcs" -r jpegPhoto audio}

The output might look like this if one entry with one value for each of the requested attributes
is found:

\begin{verbatim}
Mark C Smith, Distribution, Atlanta, People, XYZ, US
audio=/tmp/ldapsearch-audio-a19924
jpegPhoto=/tmp/ldapsearch-jpegPhoto-a19924
\end{verbatim}

EXAMPLE 3    Performing a One-Level Search

The following command performs a one-level search at the c=US level for all organizations
whose organizationName begins with XY.

\texttt{example\% ldapsearch -s one -b "c=US" "o=XY*" o description}

The organizationName and description attribute values are retrieved and printed to
standard output, resulting in output similar to this:

\begin{verbatim}
dn: o=XYZ c=US
  o: XYZ
description: XYZ Corporation

dn: o="XY Trading Company", c=US
  o: XY Trading Company
description: Import and export specialists

dn: o=XYInternational, c=US
  o: XYInternational
  o: XYI
  o: XY International
\end{verbatim}

EXAMPLE 4    Performing a Subtree Search on an IPv6 Server

The following command performs a subtree search using the default search base for entries
with a user id of mcs on an IPv6 (that is, -h) server:

\texttt{example\% ldapsearch -u -h \\
  '\{fec0::111:a00:20ff:fe3:edcf\}' \\
  -t "uid=mcs" jpegPhoto audio}

Exit Status    The following exit values are returned:

0      Successful completion.
>0  An error occurred. A diagnostic message is written to standard error.

Attributes  See attributes(5) for a description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  ldapadd(1), ldapdelete(1), ldapmodify(1), ldapmodrdn(1), attributes(5)
ldd – list dynamic dependencies of executable files or shared objects

Synopsis

```
     [-s] [-U | -u] [-v] [-w] filename...
```

Description

The `ldd` utility lists the dynamic dependencies of executable files or shared objects. `ldd` uses the runtime linker, `ld.so.1`, to generate the diagnostics. The runtime linker takes the object being inspected and prepares the object as would occur in a running process. By default, `ldd` triggers the loading of any lazy dependencies, and deferred dependencies.

`ldd` lists the path names of all shared objects that would be loaded when `filename` is loaded. `ldd` expects the shared objects that are being inspected to have execute permission. If a shared object does not have execute permission, `ldd` issues a warning before attempting to process the file.

`ldd` processes its input one file at a time. For each file, `ldd` performs one of the following:

- Lists the object dependencies if the dependencies exist.
- Succeeds quietly if dependencies do not exist.
- Prints an error message if processing fails.

The dynamic objects that are inspected by `ldd` are not executed. Therefore, `ldd` does not list any shared objects explicitly attached using `dlopen(3C)`. To display all the objects in use by a process, or a core file, use `pldd(1)`.

Options

`ldd` can also check the compatibility of `filename` with the shared objects `filename` uses. With the following options, `ldd` prints warnings for any unresolved symbol references that would occur when `filename` is loaded.

- `-d` Check immediate references.
- `-r` Check both immediate references and lazy references.

Only one of the options `-d` or `-r` can be specified during any single invocation of `ldd`.

Immediate references are typically to data items used by the executable or shared object code. Immediate references are also pointers to functions, and even calls to functions made from a position dependent shared object. Lazy references are typically calls to global functions made from a position independent shared object, or calls to external functions made from an executable. For more information on these types of reference, see When Relocations Are Performed in the `Linker and Libraries Guide`. Object loading can also be affected by relocation processing. See Lazy Loading under USAGE for more details.

Some unresolved symbol references are not reported by default. These unresolved references can be reported with the following options. These options are only useful when combined with either the `-d` or the `-r` options.

- `-p` Expose any unresolved symbol errors to explicit parent and external references.
- `-w` Expose any unresolved weak symbol references.
A shared object can make reference to symbols that should be supplied by the caller of the shared object. These references can be explicitly classified when the shared object is created, as being available from a parent, or simply as being external. See the `-M map file` option of `ld(1)`, and the `PARENT` and `EXTERN` symbol definition keywords. When examining a dynamic executable, a parent or external reference that can not be resolved is flagged as an error. However by default, when examining a shared object, a parent or external reference that can not be resolved is not flagged as an error. The `-p` option, when used with either the `-d` or `-r` options, causes any unresolved parent or external reference to be flagged as a relocation error.

Symbols that are used by relocations may be defined as weak references. By default, if a weak symbol reference cannot be resolved, the relocation is ignored and a zero written to the relocation offset. The `-w` option, when used with either the `-d` or the `-r` options, causes any unresolved relocation against a weak symbol reference to be flagged as a relocation error.

`ldd` can also check dependency use. With each of the following options, `ldd` prints warnings for any unreferenced, or unused dependencies that are loaded when `filename` is loaded. Only when a symbol reference is bound to a dependency, is that dependency deemed used. These options are therefore only useful when symbol references are being checked. If the `-r` option is not in effect, the `-d` option is enabled.

A dependency that is defined by an object but is not bound to from that object is an unreferenced dependency. A dependency that is not bound to by any other object when `filename` is loaded is an unused object.

Dependencies can be located in default system locations, or in locations that must be specified by search paths. Search paths may be specified globally, such as the environment variable `LD_LIBRARY_PATH`. Search paths can also be defined in dynamic objects as runpaths. See the `-R` option to `ld(1)`. Search paths that are not used to satisfy any dependencies cause unnecessary file system processing.

- `U`  Displays any unreferenced, or unused dependencies. If an unreferenced dependency is not bound to by other objects loaded with `filename`, the dependency is also flagged as unused. Cyclic dependencies that are not bound to from objects outside of the cycle are also deemed unreferenced.

  This option also displays any unused search paths.

- `u`  Displays any unused objects.

Only one of the options `-U` or `-u` can be specified during any single invocation of `ldd`, although `-U` is a superset of `-u`. Objects that are found to be unreferenced, or unused when using the `-r` option, should be removed as dependencies. These objects provide no references, but result in unnecessary overhead when `filename` is loaded. When using the `-d` option, any objects that are found to be unreferenced, or unused are not immediately required when `filename` is loaded. These objects are candidates for lazy loading. See Lazy Loading under USAGE for more details.
The removal of unused dependencies reduces runtime-linking overhead. The removal of unreferenced dependencies reduces runtime-linking overhead to a lesser degree. However, the removal of unreferenced dependencies guards against a dependency being unused when combined with different objects, or as the other object dependencies evolve.

The removal of unused search paths can reduce the work required to locate dependencies. This can be significant when accessing files from a file server over a network. Note, a search path can be encoded within an object to satisfy the requirements of \texttt{dlopen(3C)}. This search path might not be required to obtain the dependencies of this object, and hence will look unused to \texttt{ldd}.

The following additional options are supported:

- **-c**
  Disables any configuration file use. Configuration files can be employed to alter default search paths, and provide alternative object dependencies. See \texttt{crl\texttt{e(1)}}.

- **-D**
  Skip deferred dependency loading. By default, \texttt{ldd} forces the processing of both lazy dependencies and deferred dependencies. See also the -L option. During normal process execution, deferred dependencies are only loaded when the first runtime binding to a deferred reference is made. When using the -D option, the use of the -d or -r options do not trigger the loading of any deferred dependencies. See the -z deferred option of \texttt{ld(1)}.

- **-e envvar**
  Sets the environment variable \texttt{envvar}.

  This option is useful for experimenting with environment variables that are recognized by the runtime linker that can adversely affect \texttt{ldd}, for example, \texttt{LD\_PRELOAD}.

  This option is also useful for extracting additional information solely from the object under inspection, for example, \texttt{LD\_DEBUG}. See \texttt{ld\_so\_1(1)} and \texttt{lari\texttt{1(1)}}.

- **-f**
  Forces \texttt{ldd} to check for an executable file that is not secure. When \texttt{ldd} is invoked by a superuser, by default \texttt{ldd} does not process any executable that is not secure. An executable is not considered secure if the interpreter that the executable specifies does not reside under \texttt{/lib} or \texttt{/usr/lib}. An executable is also not considered secure if the interpreter cannot be determined. See Security under USAGE.

- **-i**
  Displays the order of execution of initialization sections. The order that is discovered can be affected by use of the -d or -r options. See Initialization Order under USAGE.

- **-L**
  Enables lazy loading. By default, \texttt{ldd} forces the processing of both lazy dependencies and deferred dependencies. See also the -D option. During normal process execution, lazy loading is the default mode of operation. In this case, any lazy dependencies, or filters, are only loaded into the process when reference is
made to a symbol that is defined within the lazy object. The -d or -r options, together with the -L option, can be used to inspect the dependencies, and their order of loading as would occur in a running process. See the -z lazyload option of ld(1).

-\l Forces the immediate processing of any filters so that all filtees, and their dependencies, are listed. The immediate processing of filters is now the default mode of operation for ldd. However, under this default any auxiliary filtees that cannot be found are silently ignored. Under the -l option, missing auxiliary filtees generate an error message.

-s Displays the search path used to locate shared object dependencies.

-v Displays all dependency relationships incurred when processing filename. This option also displays any dependency version requirements. See pvs(1).

Usage

Security A superuser should use the -f option only if the executable to be examined is known to be trustworthy. The use of -f on an untrustworthy executable while superuser can compromise system security. If an executables trustworthiness is unknown, a superuser should temporarily become a regular user. Then invoke ldd as this regular user.

Untrustworthy objects can be safely examined with dump(1), elfdump(1), elfedit(1), and with mdb(1), as long as the :r subcommand is not used. In addition, a non-supuser can use either the :r subcommand of mdb, or truss(1) to examine an untrustworthy executable without too much risk of compromise. To minimize risk when using ldd, mdb :r, or truss on an untrustworthy executable, use the UID "nobody".

Lazy Loading Lazy loading can be applied directly by specified lazy dependencies. See the -z lazyload option of ld(1). Lazy loading can also be applied indirectly through filters. See the -f option and -F option of ld(1). Objects that employ lazy loading techniques can experience variations in ldd output due to the options used. If an object expresses all its dependencies as lazy, the default operation of ldd lists all dependencies in the order in which the dependencies are recorded in that object:

```
example% ldd main
libelf.so.1 => /lib/libelf.so.1
libnsl.so.1 => /lib/libnsl.so.1
libc.so.1 => /lib/libc.so.1
```

The lazy loading behavior that occurs when this object is used at runtime can be enabled using the -L option. In this mode, lazy dependencies are loaded when reference is made to a symbol that is defined within the lazy object. Therefore, combining the -L option with use of the -d and -r options reveals the dependencies that are needed to satisfy the immediate, and lazy references respectively:
Notice that in this example, the order of the dependencies that are listed is not the same as displayed from ldd with no options. Even with the -r option, the lazy reference to dependencies might not occur in the same order as would occur in a running program.

Observing lazy loading can also reveal objects that are not required to satisfy any references. These objects, in this example, /libnsl.so.1, are candidates for removal from the link-line used to build the object being inspected.

Objectsthat do not explicitly define their required dependencies might observe variations in the initialization section order displayed by ldd due to the options used. For example, a simple application might reveal:

```
example% ldd -i main
libA.so.1 => ./libA.so.1
libc.so.1 => /lib/libc.so.1
libB.so.1 => ./libB.so.1
init object=./libB.so.1
init object=./libA.so.1
init object=/lib/libc.so.1
```

whereas, when relocations are applied, the initialization section order is:

```
example% ldd -ir main

init object=/libA.so.1
init object=./libA.so.1
init object=./libB.so.1
init object=/lib/libc.so.1
```

In this case, /libB.so.1 makes reference to a function in /usr/lib/libc.so.1. However, /libB.so.1 has no explicit dependency on this library. Only after a relocation is discovered is a dependency then established. This implicit dependency affects the initialization section order.

Typically, the initialization section order established when an application is executed, is equivalent to ldd with the -d option. The optimum order can be obtained if all objects fully define their dependencies. Use of the ldd(1) options -z defs and -z ignore when building dynamic objects is recommended.
Cyclic dependencies can result when one or more dynamic objects reference each other. Cyclic dependencies should be avoided, as a unique initialization sort order for these dependencies can not be established.

Users that prefer a more static analysis of object files can inspect dependencies using tools such as `dump(1)` and `elfdump(1)`.

**Files**

- `/usr/lib/lddstub` Fake 32-bit executable loaded to check the dependencies of shared objects.
- `/usr/lib/64/lddstub` Fake 64-bit executable loaded to check the dependencies of shared objects.

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/linker</td>
</tr>
</tbody>
</table>

**See Also**

`crle(1), dump(1), elfdump(1), elfedit(1), lari(1), ld(1), ld.so.1(1), mdb(1), pldd(1), pvs(1), truss(1), dlopen(3C), attributes(5)`

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The `ldd(1)` command prints the record of shared object path names to stdout. The optional list of symbol resolution problems is printed to stderr. If `filename` is not an executable file or a shared object, or if `filename` cannot be opened for reading, a non-zero exit status is returned.

**Notes**

Use of the `-d` or `-r` option with shared objects can give misleading results. `ldd` does a worst case analysis of the shared objects. However, in practice, the symbols reported as unresolved might be resolved by the executable file referencing the shared object. The runtime linkers preloading mechanism can be employed to add dependencies to the object being inspected. See `LD_PRELOAD`.

`ldd` uses the same algorithm as the runtime linker to locate shared objects.
Dynamic applications consist of one or more dynamic objects. A dynamic application is typically a dynamic executable and one or more shared object dependencies. As part of the initialization and execution of a dynamic application, an interpreter is called. This interpreter completes the binding of the application to its shared object dependencies. In Solaris, this interpreter is referred to as the runtime linker.

During the link-editing of a dynamic executable, a special .interp section, together with an associated program header, is created. This section contains a path name specifying the program's interpreter. An interpreter path name can be specified when the executable is constructed using the -I option to ld(1), the link-editor. The default name supplied by the link-editor is the name of the runtime linker, ld.so.1.

During the process of executing a dynamic executable, the kernel maps the file, and locates the required interpreter. See exec(2) and mmapobj(2). The kernel maps in, and transfers control to, this interpreter. Sufficient information is passed to the interpreter to allow the interpreter to continue to bind, and then execute the application.

In addition to initializing an application, the runtime linker provides services that allow the application to extend its address space. Additional shared objects can be mapped, and symbols within the shared objects can be bound to.

The runtime linker performs the following functions:

- A configuration file, if in existence, is processed. Configuration files can be employed to alter default search paths, provide a directory cache, and provide alternative object dependencies. See crle(1). By default, for 32-bit objects, the configuration file /var/ld/ld.config is used. For 64-bit objects, the default configuration file /var/ld/64/ld.config is used. Alternative configuration files can be specified with the LD_CONFIG environment variable. Alternative configuration files can also be encoded within a dynamic executable by using the -c option of ld(1).

- The runtime linker analyzes the application's dynamic information section, .dynamic, to determine which shared object dependencies are required.

- The runtime linker then locates and maps in these dependencies. The dynamic information section of each dependency is then analyzed to determine if any additional dependencies are required.

- Once all the shared object dependencies are loaded, the runtime linker performs any necessary relocations. These relocations bind the shared objects in preparation for process execution.
- Any initialization functions provided by the shared object dependencies and, possibly, by the dynamic executable are called. The functions are called in the reverse order of the topologically sorted dependencies. If cyclic dependencies exist, the initialization functions are called using the sorted order with the cycle removed. `ldd(1)` can be used to display the initialization order of shared object dependencies.

- Control is passed to the application.

- During the application’s execution, the runtime linker can be called upon to perform any delayed function binding.

- If any shared objects are deleted from the process, finalization functions are called. By default, these functions are called in the order of the topologically sorted dependencies.

- The application can also call upon the services of the runtime linker to acquire additional shared objects by using `dlopen(3C)`. Symbols provided by these objects, can be bound to using `dlsym(3C)`.

Further details on each of the previous topics can be found in the *Linker and Libraries Guide.*

The runtime linker uses a prescribed search path for locating the dynamic dependencies of an object. The default search paths are the runpath recorded in the object, followed by a series of defaults. For 32-bit objects, the defaults are `/lib` followed by `/usr/lib`. For 64-bit objects, the defaults are `/lib/64` followed by `/usr/lib/64`. These defaults component can be modified using a configuration file that is created with `crle(1)`. The runpath is specified when the dynamic object is constructed using the `-R` option to `ld(1)`. The environment variable `LD_LIBRARY_PATH` can be used to indicate directories to be searched before the default directories.

**Command Line Usage**

Typically, the runtime linker is invoked indirectly through executing a dynamic executable that declares the runtime linker as its interpreter. The runtime linker can also be executed directly from the command line. This mechanism is most often employed to experiment with new implementations of the runtime linker. Arguments that are supplied on the command line consist of options that are applicable to the runtime linker. Following these options is the name of the dynamic object to be executed, and any options required by this object. Effectively, the runtime linker replaces any interpreter specified by the dynamic object.

The following option is supported:

- `-e envvar` Specify a runtime linker specific environment variable. See `ENVIRONMENT VARIABLES`. Variables set using this option take precedence over any environment variables, or configuration file variables of the same name. The variable `LD_NOENVIRON` can be specified to indicate that no environment variables should be processed following `-e` option processing.

**Environment Variables**

Each environment variable can be specified with a `_32` or `_64` suffix. This makes the environment variable specific, respectively, to 32-bit or 64-bit processes. This environment variable overrides any non-suffixed version of the environment variable that might be in
effect. Environment variables specified without a value, that have a _32 or _64 suffix, effectively cancel any associated generic environment variable setting.

**LD_AUDIT, LD_AUDIT_32, and LD_AUDIT_64**
A colon-separated list of objects that are loaded by the runtime linker. As each object is loaded, the object is examined for Link-Auditing interface routines. The routines that are present are called as specified in the Link-Auditing interface described in the *Linker and Libraries Guide*. Also, see the -p and -P options of `ld(1)`.

**LD_BIND_LAZY, LD_BIND_LAZY_32, and LD_BIND_LAZY_64**
The runtime linker's default mode of performing lazy binding can be enforced by setting the environment variable LD_BIND_LAZY to any non-null value. This setting causes the runtime linker to perform only lazy reference relocations for all objects that are loaded into the process. Individual objects can request that lazy reference relocations are performed when the object is loaded. See the -z now option of `ld(1)`, and `dlopen(3C)` with the mode RTLD_NOW. Such requests to perform lazy reference relocations are suppressed when LD_BIND_LAZY is in effect.

If both LD_BIND_LAZY and LD_BIND_NOW are specified, then LD_BIND_NOW takes precedence.

**LD_BIND_NOW, LD_BIND_NOW_32, and LD_BIND_NOW_64**
The runtime linker's default mode of performing lazy binding can be overridden by setting the environment variable LD_BIND_NOW to any non-null value. This setting causes the runtime linker to perform both immediate reference and lazy reference relocations for all non-deferred objects that are loaded into the process. Individual objects can request that non-deferred, lazy reference relocations are performed when the object is loaded. See the -z now option of `ld(1)`, and `dlopen(3C)` with the mode RTLD_NOW. Deferred dependencies are not affected by LD_BIND_NOW or RTLD_NOW. See the -z deferred option of `ld(1)`.

If both LD_BIND_NOW and LD_BIND_LAZY are specified, then LD_BIND_NOW takes precedence.

**LD_CAP_FILES, LD_CAP_FILES_32, and LD_CAP_FILES_64**
Identifies a comma separated list of files that should be validated against any alternative capabilities. See LD_PLATCAP, LD_MACHCAP, LD_HWCAP, and LD_SFCAP.

**LD_CONFIG, LD_CONFIG_32, and LD_CONFIG_64**
Provides an alternative configuration file. Configuration files can be employed to alter default search paths, provide a directory cache, and provide alternate object dependencies. See `crle(1)`.

**LD_DEBUG, LD_DEBUG_32, and LD_DEBUG_64**
Provides a comma, or colon-separated list of tokens to cause the runtime linker to print debugging information to standard error. The special token `help` indicates the full list of tokens available. The environment variable LD_DEBUG_OUTPUT can also be supplied to specify a file to which the debugging information is sent. The filename is suffixed with the process ID of the application generating the debugging information. See `lari(1)`.
LD_DEMANGLE, LD_DEMANGLE_32, and LD_DEMANGLE_64
Any symbol name used as part of a diagnostic message is shown as defined within an ELF file. When LD_DEMANGLE is set to any non-null value, the runtime linker attempts to decode (demangle) any C++ symbol name.

LD_FLAGS, LD_FLAGS_32, and LD_FLAGS_64
Provides an alternative means of supplying environment variable information. Any of the LD_XXX environment variables can be specified as a xxx token. Multiple tokens can be supplied separated by commas. See EXAMPLES.

LD_HWCAP, LD_HWCAP_32, and LD_HWCAP_64
Identifies an alternative hardware capabilities value.

LD_HWCAP=[+-]{token | number}, . . .
A "+" prefix results in the capabilities that follow being added to the alternative capabilities.
A "-" prefix results in the capabilities that follow being removed from the alternative capabilities. The lack of "+-" result in the capabilities that follow replacing the alternative capabilities.

LD_LIBRARY_PATH, LD_LIBRARY_PATH_32, and LD_LIBRARY_PATH_64
The LD_LIBRARY_PATH environment variable, if set, is used to enhance the search path that the runtime linker uses to find dynamic dependencies. LD_LIBRARY_PATH specifies a colon-separated list of directories that are searched before the default directories. Also notice that LD_LIBRARY_PATH adds additional semantics to ld(1).

LD_LOADFLTR, LD_LOADFLTR_32, and LD_LOADFLTR_64
Filters are a form of shared object. Filters allow an alternative shared object to be selected at runtime that provide the implementation for any symbols that are defined within the filter. See the -f and -F options of ld(1). By default, the alternative shared object processing is deferred until symbol resolution occurs against the filter. When LD_LOADFLTR is set to any non-null value, any filters are processed immediately when the filter is loaded. Also, see the -z loadfltr option of ld(1).

LD_MACHCAP, LD_MACHCAP_32, and LD_MACHCAP_64
Identifies an alternative machine hardware name.

LD_NOAUDIT, LD_NOAUDIT_32, and LD_NOAUDIT_64
Local auditing libraries can be defined within applications and shared objects. See the -p and -P options of ld(1). When LD_NOAUDIT is set to any non-null value, the runtime linker ignores any local auditing libraries.

LD_NOAUXFLTR, LD_NOAUXFLTR_32, and LD_NOAUXFLTR_64
Auxiliary filters are a form of shared object. Auxiliary filters allow an alternative shared object to be selected at runtime which provides the implementation for any symbols that are defined within the filter. See the -f option of ld(1). When LD_NOAUXFLTR is set to any non-null value, the runtime linker disables this alternative shared object lookup.
LD_NOCONFIG, LD_NOCONFIG_32, and LD_NOCONFIG_64
By default the runtime linker attempts to open and process a configuration file. When
LD_NOCONFIG is set to any non-null value, the runtime linker disables this configuration file
processing.

LD_NODIRCONFIG, LD_NODIRCONFIG_32, and LD_NODIRCONFIG_64
Provides a subset of LD_NOCONFIG in that any directory cache information provided in a
configuration file is ignored.

LD_NODIRECT, LD_NODIRECT_32, and LD_NODIRECT_64
Direct binding information instructs the runtime linker to search directly for a symbol in
an associated object. See the -B direct option of ld(1). Without direct binding, the symbol
search performed by the runtime linker follows the default model. When LD_NODIRECT is
set to any non-null value, the runtime linker ignores any direct binding information.

LD_NOENVCONFIG, LD_NOENVCONFIG_32, and LD_NOENVCONFIG_64
Provides a subset of LD_NOCONFIG in that any environment variables provided in a
configuration file are ignored.

LD_NOLAZYLOAD, LD_NOLAZYLOAD_32, and LD_NOLAZYLOAD_64
Dependencies that are labeled for lazy loading are not loaded into memory until explicit
reference to the dependency has been made. See the -z lazyload option of ld(1). When
LD_NOLAZYLOAD is set to any non-null value, the runtime linker ignores a dependencies lazy
loading label and loads the dependency immediately.

LD_NOOBJALTER, LD_NOOBJALTER_32, and LD_NOOBJALTER_64
Provides a subset of LD_NOCONFIG in that any alternative object dependencies provided in a
configuration file are ignored.

LD_NOVERSION, LD_NOVERSION_32, and LD_NOVERSION_64
By default, the runtime linker verifies version dependencies for the primary executable and
all of its dependencies. When LD_NOVERSION is set to any non-null value, the runtime linker
disables this version checking.

LD_ORIGIN, LD_ORIGIN_32, and LD_ORIGIN_64
The immediate processing of $ORIGIN can be triggered by setting the environment variable
LD_ORIGIN to any non-null value. Before Solaris 9, this option was useful for applications
that invoked chdir(2) prior to locating dependencies that employed the $ORIGIN string
token. The establishment of the current working directory by the runtime linker is now
default thus making this option redundant.

LD_PLATCAP, LD_PLATCAP_32, and LD_PLATCAP_64
Identifies an alternative platform name.

LD_PRELOAD, LD_PRELOAD_32, and LD_PRELOAD_64
Provides a list of shared objects, separated by spaces. These objects are loaded after the
program being executed but before any other shared objects that the program references.
Symbol definitions provided by the preloaded objects interpose on references made by the
shared objects that the program references. Symbol definitions provided by the preloaded objects do not interpose on the symbol definitions provided by the program.

**LD_PROFILE, LD_PROFILE_32, and LD_PROFILE_64**
Defines a shared object to be profiled by the runtime linker. When profiling is enabled, a profiling buffer file is created and mapped. The name of the buffer file is the name of the shared object being profiled with a .profile extension. By default, this buffer is placed under /var/tmp. The environment variable LD_PROFILE_OUTPUT can also be supplied to indicate an alternative directory in which to place the profiling buffer.

The profiling buffer contains profi1(2) and call count information. This information is similar to the gmon.out information generated by programs that have been linked with the -xpg option of cc. Any applications that use the named shared object and run while this environment variable is set, accumulate data in the profile buffer. See also NOTES. The profile buffer information can be examined using gprof(1).

The LD_PROFILE profiling technique is an alternative to other techniques that might be provided by the compilation system. The shared object being profiled does not have to be instrumented in any way, and LD_PROFILE should not be combined with a profile-instrumented application. See the Linker and Libraries Guide for more information on profiling shared objects.

**LD_SFCAP, LD_SFCAP_32, and LD_SFCAP_64**
Identifies an alternative software capabilities value.

LD_SFCAP=+[+-]{token | number},...

A “+” prefix results in the capabilities that follow being added to the alternative capabilities. A “-” prefix results in the capabilities that follow being removed from the alternative capabilities. The lack of “+-” result in the capabilities that follow replacing the alternative capabilities.

**LD_SIGNAL, LD_SIGNAL_32, and LD_SIGNAL_64**
Provides a numeric signal number that the runtime linker uses to kill the process in the event of a fatal runtime error. See thr_kill(3C). By default, SIGKILL is used. For example, providing the alternative signal number 6 (SIGABRT), can provide for the creation of a core file to aid debugging. See also the RTLD_DI_SETSIGNAL request to dlinfo(3C).

Notice that environment variable names beginning with the characters ‘LD ’ are reserved for possible future enhancements to ld(1) and ld.so.1.

**Security**
Secure processes have some restrictions applied to the evaluation of their dependencies and runpaths to prevent malicious dependency substitution or symbol interposition.

The runtime linker categorizes a process as secure if the issetugid(2) system call returns true for the process.

For 32-bit objects, the default trusted directories that are known to the runtime linker are /lib/secure and /usr/lib/secure. For 64-bit objects, the default trusted directories are
The utility `crle(1)` can be used to specify additional trusted directories that are applicable for secure applications. Administrators who use this technique should ensure that the target directories are suitably protected from malicious intrusion.

If an `LD_LIBRARY_PATH` family environment variable is in effect for a secure process, only the trusted directories specified by this variable are used to augment the runtime linker's search rules.

In a secure process, runpath components that are provided by the application or any of its dependencies are used, provided the component is a full path name, that is, the path name starts with a`'/`.

In a secure process, the expansion of the `$ORIGIN` string is allowed only if the string expands to a trusted directory. However, should a `$ORIGIN` expansion match a directory that has already provided dependencies, then the directory is implicitly secure. This directory can be used to provide additional dependencies.

In a secure process, `LD_CONFIG` is ignored. However, a configuration file that is recorded in a secure application is used. See the `-c` option of `ld(1)`. A recorded configuration file must be a full path name, that is, the path name starts with a`'/`.

In a secure process, `LD_CONFIG` is ignored. However, a configuration file that is recorded in a secure application is used. See the `-c` option of `ld(1)`. A recorded configuration file must be a full path name, that is, the path name starts with a`'/`. A recorded configuration file that employs the `$ORIGIN` string is restricted to known trusted directories. Developers who record a configuration file within a secure application should ensure that the configuration file directory is suitably protected from malicious intrusion. In the absence of a recorded configuration file, a secure process uses the default configuration file, if a configuration file exists. See `crle(1)`.

In a secure process, `LD_SIGNAL` is ignored.

Additional objects can be loaded with a secure process using the `LD_PRELOAD`, or `LD_AUDIT` environment variables. These objects must be specified as full path names or simple file names. Full path names are restricted to known trusted directories. Simple file names, in which no`'/` appears in the name, are located subject to the search path restrictions previously described. Simple file names resolve only to known trusted directories.

In a secure process, any dependencies that consist of simple filenames are processed using the path name restrictions previously described. Dependencies expressed as full path names or relative path names are used as is. Therefore, the developer of a secure process should ensure that the target directory referenced as a full path name or relative path name dependency is suitably protected from malicious intrusion.

When creating a secure process, relative path names should **not** be used to express dependencies, or to construct `dlopen(3C)` path names. This restriction should be applied to the application and to *all* dependencies.
Examples

The following use of `LD_FLAGS` is equivalent to setting the individual environment variables `LD_BIND_NOW` and `LD_LIBRARY_PATH` for 32-bit applications:

```bash
example% LD_FLAGS_32=bind_now,library_path=/lib/one:/lib/two
```

The following use of `LD_FLAGS` is equivalent to setting the individual environment variables `LD_LIBRARY_PATH` and `LD_PRELOAD` for 64-bit applications:

```bash
example% LD_FLAGS_64=library_path=/lib/one/64,preload=foo.so
```

Files

- `/lib/ld.so.1` Default runtime linker.
- `/lib/libc.so.1` Alternate interpreter for SVID ABI compatibility.
- `/usr/lib/@0.so.1` A compatibility library to support null character pointers. See NOTES.
- `/lib/secure` and `/usr/lib/secure` LD_PRELOAD location for secure applications.
- `/lib/secure/64` and `/usr/lib/secure/64` LD_PRELOAD location for secure 64-bit applications.
- `/lib/64/ld.so.1` Default runtime linker for 64-bit applications.
- `/usr/lib/64/@0.so.1` A 64-bit compatibility library to support null character pointers. See NOTES.
- `/var/ld/ld.config` Default configuration file for 32-bit applications.
- `/var/ld/64/ld.config` Default configuration file for 64-bit applications.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/linker</td>
</tr>
</tbody>
</table>

See Also
crle(1), gprof(1), lari(1), ld(1), ldd(1), exec(2), issetugid(2), mmapobj(2), profil(2), dladdr(3C), dlclose(3C), dlerror(3C), dlinfo(3C), dlopen(3C), dlsym(3C), thr_kill(3C), proc(4), attributes(5)

Linker and Libraries Guide
Notes  Care should be exercised when using LD_PROFILE in combination with other process monitoring techniques, such as users of proc(4). Multiple process monitoring techniques can result in deadlock conditions that leave the profile buffer locked. A locked buffer blocks any processes that try to record profiling information. To reduce this likelihood, the runtime linker’s profile implementation determines if the process is being monitored at startup. If so, profiling of the process is silently disabled. However, this mechanism cannot catch monitoring processes that attach to the process during its execution.

The user compatibility library /usr/lib/0@0.so.1 provides a mechanism that establishes a value of 0 at location 0. Some applications exist that erroneously assume a null character pointer should be treated the same as a pointer to a null string. A segmentation violation occurs in these applications when a null character pointer is accessed. If this library is added to such an application at runtime using LD_PRELOAD, the library provides an environment that is sympathetic to this errant behavior. However, the user compatibility library is intended neither to enable the generation of such applications, nor to endorse this particular programming practice.

In many cases, the presence of /usr/lib/0@0.so.1 is benign, and it can be preloaded into programs that do not require it. However, there are exceptions. Some applications, such as the JVM (Java Virtual Machine), require that a segmentation violation be generated from a null pointer access. Applications such as the JVM should not preload /usr/lib/0@0.so.
let (1)

Name
let – shell built-in function to evaluate one or more arithmetic expressions

Synopsis
ksh88 let arg...
ksh let [expr...]

Description
ksh88 Each arg is a separate arithmetic expression to be evaluated.
ksh let evaluates each expr in the current shell environment as an arithmetic expression using ANSI C syntax. Variables names are shell variables and they are recursively evaluated as arithmetic expressions to get numerical values. let has been made obsolete by the ((...)) syntax of ksh(1) which does not require quoting of the operators to pass them as command arguments.

Exit Status
ksh88 ksh88 returns the following exit values:
0 The value of the last expression is non-zero.
1 The value of the last expression is zero.
ksh ksh returns the following exit values:
0 The last expr evaluates to a non-zero value.
>0 The last expr evaluates to 0 or an error occurred.

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also ksh(1), ksh88(1), set(1), typeset(1), attributes(5)
The `lex` utility generates C programs to be used in lexical processing of character input, and that can be used as an interface to `yacc`. The C programs are generated from `lex` source code and conform to the ISO C standard. Usually, the `lex` utility writes the program it generates to the file `lex.yy.c`. The state of this file is unspecified if `lex` exits with a non-zero exit status. See EXTENDED DESCRIPTION for a complete description of the `lex` input language.

The following options are supported:

- **-c**
  Indicates C-language action (default option).

- **-e**
  Generates a program that can handle EUC characters (cannot be used with the `-w` option). `yytext[ ]` is of type `unsigned char[ ]`.

- **-n**
  Suppresses the summary of statistics usually written with the `-v` option. If no table sizes are specified in the `lex` source code and the `-v` option is not specified, then `-n` is implied.

- **-t**
  Writes the resulting program to standard output instead of `lex.yy.c`.

- **-v**
  Writes a summary of `lex` statistics to the standard error. (See the discussion of `lex` table sizes under the heading Definitions in `lex`.) If table sizes are specified in the `lex` source code, and if the `-n` option is not specified, the `-v` option can be enabled.

- **-w**
  Generates a program that can handle EUC characters (cannot be used with the `-e` option). Unlike the `-e` option, `yytext[ ]` is of type `wchar_t[ ]`.

- **-V**
  Prints out version information on standard error.

- **-Q[y|n]**
  Prints out version information to output file `lex.yy.c` by using `-Qy`. The `-Qn` option does not print out version information and is the default.

The following operand is supported:

- **file**
  A pathname of an input file. If more than one such file is specified, all files is concatenated to produce a single `lex` program. If no file operands are specified, or if a `file` operand is `−`, the standard input is used.

The `lex` output files are described below.

**Stdout**
If the `-t` option is specified, the text file of C source code output of `lex` is written to standard output.

**Stderr**
If the `-t` option is specified informational, error and warning messages concerning the contents of `lex` source code input is written to the standard error.

If the `-t` option is not specified:
1. Informational error and warning messages concerning the contents of lex source code input is written to either the standard output or standard error.

2. If the -v option is specified and the -n option is not specified, lex statistics is also written to standard error. These statistics can also be generated if table sizes are specified with a % operator in the Definitions in lex section (see EXTENDED DESCRIPTION), as long as the -n option is not specified.

### Output Files
A text file containing C source code is written to lex.yy.c, or to the standard output if the -t option is present.

### Extended Description
Each input file contains lex source code, which is a table of regular expressions with corresponding actions in the form of C program fragments.

When lex.yy.c is compiled and linked with the lex library (using the -l l operand with c89 or cc), the resulting program reads character input from the standard input and partitions it into strings that match the given expressions.

When an expression is matched, these actions occur:

- The input string that was matched is left in yytext as a null-terminated string; yytext is either an external character array or a pointer to a character string. As explained in Definitions in lex, the type can be explicitly selected using the %array or %pointer declarations, but the default is %array.
- The external int yylen is set to the length of the matching string.
- The expression’s corresponding program fragment, or action, is executed.

During pattern matching, lex searches the set of patterns for the single longest possible match. Among rules that match the same number of characters, the rule given first is chosen.

The general format of lex source is:

```
Definitions
%
Rules
%
User Subroutines
```

The first % is required to mark the beginning of the rules (regular expressions and actions); the second % is required only if user subroutines follow.

Any line in the Definitions in lex section beginning with a blank character is assumed to be a C program fragment and is copied to the external definition area of the lex.yy.c file. Similarly, anything in the Definitions in lex section included between delimiter lines containing only %{ and %} is also copied unchanged to the external definition area of the lex.yy.c file.
Any such input (beginning with a blank character or within %{ and } delimiter lines) appearing at the beginning of the Rules section before any rules are specified is written to lex.yy.c after the declarations of variables for the yylex function and before the first line of code in yylex. Thus, user variables local to yylex can be declared here, as well as application code to execute upon entry to yylex.

The action taken by lex when encountering any input beginning with a blank character or within %{ and } delimiter lines appearing in the Rules section but coming after one or more rules is undefined. The presence of such input can result in an erroneous definition of the yylex function.

Definitions in lex appear before the first %% delimiter. Any line in this section not contained between %{ and } lines and not beginning with a blank character is assumed to define a lex substitution string. The format of these lines is:

name substitute

If a name does not meet the requirements for identifiers in the ISO C standard, the result is undefined. The string substitute replaces the string {name} when it is used in a rule. The name string is recognized in this context only when the braces are provided and when it does not appear within a bracket expression or within double-quotes.

In the Definitions in lex section, any line beginning with a % (percent sign) character and followed by an alphanumeric word beginning with either s or S defines a set of start conditions. Any line beginning with a % followed by a word beginning with either x or X defines a set of exclusive start conditions. When the generated scanner is in a % state, patterns with no state specified are active; in a %x state, such patterns are not active. The rest of the line, after the first word, is considered to be one or more blank-character-separated names of start conditions. Start condition names are constructed in the same way as definition names. Start conditions can be used to restrict the matching of regular expressions to one or more states as described in Regular expressions in lex.

Implementations accept either of the following two mutually exclusive declarations in the Definitions in lex section:

%array Declare the type of yytext to be a null-terminated character array.
%pointer Declare the type of yytext to be a pointer to a null-terminated character string.

When using the %pointer option, you cannot also use the yyless function to alter yytext.

%array is the default. If %array is specified (or neither %array nor %pointer is specified), then the correct way to make an external reference to yytext is with a declaration of the form:

extern char yytext[ ]

If %pointer is specified, then the correct external reference is of the form:
extern char *yytext;

lex accepts declarations in the Definitions in lex section for setting certain internal table sizes. The declarations are shown in the following table.

Table Size Declaration in lex

<table>
<thead>
<tr>
<th>Declaration</th>
<th>Description</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>%p</td>
<td>Number of positions</td>
<td>2500</td>
</tr>
<tr>
<td>%n</td>
<td>Number of states</td>
<td>500</td>
</tr>
<tr>
<td>%a</td>
<td>Number of transitions</td>
<td>2000</td>
</tr>
<tr>
<td>%o</td>
<td>Number of parse tree nodes</td>
<td>1000</td>
</tr>
<tr>
<td>%e</td>
<td>Number of packed character classes</td>
<td>10000</td>
</tr>
<tr>
<td>%o</td>
<td>Size of the output array</td>
<td>3000</td>
</tr>
</tbody>
</table>

Programs generated by lex need either the -e or -w option to handle input that contains EUC characters from supplementary code sets. If neither of these options is specified, yytext is of the type `char[]`, and the generated program can handle only ASCII characters.

When the -e option is used, yytext is of the type `unsigned char[]` and yyleng gives the total number of bytes in the matched string. With this option, the macros `input()`, `unput(c)`, and `output(c)` should do a byte-based I/O in the same way as with the regular ASCII lex. Two more variables are available with the -e option, `yywtext` and `yywleng`, which behave the same as `yytext` and `yyleng` would under the -w option.

When the -w option is used, yytext is of the type `wchar_t[]` and yyleng gives the total number of characters in the matched string. If you supply your own `input()`, `unput(c)`, or `output(c)` macros with this option, they must return or accept EUC characters in the form of wide character (`wchar_t`). This allows a different interface between your program and the lex internals, to expedite some programs.

Rules in lex

The Rules in lex source files are a table in which the left column contains regular expressions and the right column contains actions (C program fragments) to be executed when the expressions are recognized.

ERE action
ERE action
...
The entire expression appears within double-quotes.
The blank characters appear within double-quotes or square brackets.
Each blank character is preceded by a backslash character.

Anything in the user subroutines section is copied to `lex.y.c` following `yy`.

The `lex` utility supports the set of Extended Regular Expressions (EREs) described on `regex` with the following additions and exceptions to the syntax:

Any string enclosed in double-quotes represents the characters within the double-quotes as themselves, except that backslash escapes (which appear in the following table) are recognized. Any backslash-escape sequence is terminated by the closing quote. For example, " \011"1"" represents a single string: the octal value 1 followed by the character 1.

\begin{itemize}
  \item \texttt{<state>r} \quad The regular expression \texttt{r} is matched only when the program is in one of the start conditions indicated by \texttt{state}, \texttt{state1}, and so forth. For more information, see \texttt{Actions in lex}. As an exception to the typographical conventions of the rest of this document, in this case \texttt{<state>} does not represent a metavariable, but the literal angle-bracket characters surrounding a symbol. The start condition is recognized as such only at the beginning of a regular expression.
  \item \texttt{r/x} \quad The regular expression \texttt{r} is matched only if it is followed by an occurrence of regular expression \texttt{x}. The token returned in \texttt{yytext} is only matched \texttt{r}. If the trailing portion of \texttt{r} matches the beginning of \texttt{x}, the result is unspecified. The \texttt{r} expression cannot include further trailing context or the $ (match-end-of-line) operator; \texttt{x} cannot include the ^ (match-beginning-of-line) operator, nor trailing context, nor the $ operator. That is, only one occurrence of trailing context is allowed in a `lex` regular expression, and the ^ operator only can be used at the beginning of such an expression. A further restriction is that the trailing-context operator / (slash) cannot be grouped within parentheses.
  \item \texttt{\{name\}} \quad When \texttt{name} is one of the substitution symbols from the \texttt{Definitions} section, the string, including the enclosing braces, is replaced by the \texttt{substitute} value. The \texttt{substitute} value is treated in the extended regular expression as if it were enclosed in parentheses. No substitution occurs if \texttt{\{name\}} occurs within a bracket expression or within double-quotes.
\end{itemize}

Within an ERE, a backslash character ( \ or \a, \b, \f, \n, \r, \t, \v) is considered to begin an escape sequence. In addition, the escape sequences in the following table is recognized.
A literal newline character cannot occur within an ERE; the escape sequence `\n` can be used to represent a newline character. A newline character cannot be matched by a period operator.

### Escape Sequences in lex

<table>
<thead>
<tr>
<th>Escape Sequence</th>
<th>Description</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>\digits</code></td>
<td>A backslash character followed by the longest sequence of one, two or three octal-digit characters (01234567). If all of the digits are 0, (that is, representation of the NUL character), the behavior is undefined.</td>
<td>The character whose encoding is represented by the one-, two- or three-digit octal integer. Multi-byte characters require multiple, concatenated escape sequences of this type, including the leading <code>\</code> for each byte.</td>
</tr>
<tr>
<td><code>\xdigits</code></td>
<td>A backslash character followed by the longest sequence of hexadecimal-digit characters (01234567abcdefABCDEF). If all of the digits are 0, (that is, representation of the NUL character), the behavior is undefined.</td>
<td>The character whose encoding is represented by the hexadecimal integer.</td>
</tr>
<tr>
<td><code>\c</code></td>
<td>A backslash character followed by any character not described in this table. (<code>\</code>, <code>\a</code>, <code>\b</code>, <code>\f</code>, <code>\n</code>, <code>\r</code>, <code>\t</code>, <code>\v</code>).</td>
<td>The character c, unchanged.</td>
</tr>
</tbody>
</table>

The order of precedence given to extended regular expressions for `lex` is as shown in the following table, from high to low.

The escaped characters entry is not meant to imply that these are operators, but they are included in the table to show their relationships to the true operators. The start condition, trailing context and anchoring notations have been omitted from the table because of the placement restrictions described in this section; they can only appear at the beginning or ending of an ERE.

### ERE Precedence in lex

<table>
<thead>
<tr>
<th>collation-related bracket symbols</th>
<th>[ = ] [ : ] [ . ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>escaped characters</td>
<td>&lt;special character&gt;</td>
</tr>
<tr>
<td>bracket expression</td>
<td>[ ]</td>
</tr>
<tr>
<td>quoting</td>
<td>* . . *</td>
</tr>
<tr>
<td>grouping</td>
<td>()</td>
</tr>
</tbody>
</table>
ERE Precedence in lex

<table>
<thead>
<tr>
<th>Definition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>single-character RE duplication</td>
<td>* + ?</td>
</tr>
<tr>
<td>concatenation</td>
<td>m, n</td>
</tr>
<tr>
<td>interval expression</td>
<td></td>
</tr>
<tr>
<td>alternation</td>
<td></td>
</tr>
</tbody>
</table>

The ERE anchoring operators ( `^` and `$` ) do not appear in the table. With `lex` regular expressions, these operators are restricted in their use: the `^` operator can only be used at the beginning of an entire regular expression, and the `$` operator only at the end. The operators apply to the entire regular expression. Thus, for example, the pattern `(^abc) | (def$)` is undefined; it can instead be written as two separate rules, one with the regular expression `^abc` and one with `def$`, which share a common action via the special `|` action (see below). If the pattern were written `^abc | def $`, it would match either of `abc` or `def` on a line by itself.

Unlike the general ERE rules, embedded anchoring is not allowed by most historical `lex` implementations. An example of embedded anchoring would be for patterns such as `(^)foo($)` to match `foo` when it exists as a complete word. This functionality can be obtained using existing `lex` features:

`^foo/[ \ n\ ]`  
` ^ foo  / [ \ n\ ]  /* found foo as a separate word */`

Notice also that `$` is a form of trailing context (it is equivalent to `\n` and as such cannot be used with regular expressions containing another instance of the operator (see the preceding discussion of trailing context).

The additional regular expressions trailing-context operator `/` (slash) can be used as an ordinary character if presented within double-quotes, " / "; preceded by a backslash, \ /; or within a bracket expression, [ / ] . The start-condition < and > operators are special only in a start condition at the beginning of a regular expression; elsewhere in the regular expression they are treated as ordinary characters.

The following examples clarify the differences between `lex` regular expressions and regular expressions appearing elsewhere in this document. For regular expressions of the form `r/x`, the string matching `r` is always returned; confusion can arise when the beginning of `x` matches the trailing portion of `r`. For example, given the regular expression `a*b/cc` and the input `aaabcc`, `yytext` would contain the string `aaab` on this match. But given the regular expression `x*/xy` and the input `xxxxy`, the token `xxx`, not `xx`, is returned by some implementations because `xxx` matches `x*`. 
In the rule ab*/bc, the b* at the end of r extends r’s match into the beginning of the trailing context, so the result is unspecified. If this rule were ab/bc, however, the rule matches the text ab when it is followed by the text bc. In this latter case, the matching of r cannot extend into the beginning of x, so the result is specified.

The action to be taken when an ERE is matched can be a C program fragment or the special actions described below; the program fragment can contain one or more C statements, and can also include special actions. The empty C statement ; is a valid action; any string in the lexF . yy . c input that matches the pattern portion of such a rule is effectively ignored or skipped. However, the absence of an action is not valid, and the action lex takes in such a condition is undefined.

The specification for an action, including C statements and special actions, can extend across several lines if enclosed in braces:

ERE <one or more blanks> { program statement
       program statement } 

The default action when a string in the input to a lexF . yy . c program is not matched by any expression is to copy the string to the output. Because the default behavior of a program generated by lex is to read the input and copy it to the output, a minimal lex source program that has just %% generates a C program that simply copies the input to the output unchanged.

Four special actions are available:

| ECHO;  REJECT;  BEGIN
| The action | means that the action for the next rule is the action for this rule. 
| Unlike the other three actions, | cannot be enclosed in braces or be semicolon-terminated. It must be specified alone, with no other actions.

ECHO;  Writes the contents of the string yytext on the output.

REJECT; Usually only a single expression is matched by a given string in the input. REJECT means continue to the next expression that matches the current input, and causes whatever rule was the second choice after the current rule to be executed for the same input. Thus, multiple rules can be matched and executed for one input string or overlapping input strings. For example, given the regular expressions xyz and xy and the input xyz, usually only the regular expression xyz would match. The next attempted match would start after z. If the last action in the xyz rule is REJECT, both this rule and the xy rule would be executed. The REJECT action can be implemented in such a fashion that flow of control does not continue after it, as if it were equivalent to a goto to another part of yyLex. The use of REJECT can result in somewhat larger and slower scanners.

BEGIN  The action:

BEGIN newstate ;
switches the state (start condition) to newstate. If the string newstate has not been declared previously as a start condition in the Definitions in lex section, the results are unspecified. The initial state is indicated by the digit 0 or the token INITIAL.

The functions or macros described below are accessible to user code included in the lex input. It is unspecified whether they appear in the C code output of lex, or are accessible only through the -ll operand to c89 or cc (the lex library).

int yylex(void) Performs lexical analysis on the input; this is the primary function generated by the lex utility. The function returns zero when the end of input is reached; otherwise it returns non-zero values (tokens) determined by the actions that are selected.

int yymore(void) When called, indicates that when the next input string is recognized, it is to be appended to the current value of yytext rather than replacing it; the value in yyleng is adjusted accordingly.

int yyless(int n) Retains n initial characters in yytext, NUL-terminated, and treats the remaining characters as if they had not been read; the value in yyleng is adjusted accordingly.

int input(void) Returns the next character from the input, or zero on end-of-file. It obtains input from the stream pointer yyin, although possibly via an intermediate buffer. Thus, once scanning has begun, the effect of altering the value of yyin is undefined. The character read is removed from the input stream of the scanner without any processing by the scanner.

int unput(int c) Returns the character c to the input; yytext and yyleng are undefined until the next expression is matched. The result of using unput for more characters than have been input is unspecified.

The following functions appear only in the lex library accessible through the -ll operand; they can therefore be redefined by a portable application:

int yywrap(void) Called by yylex at end-of-file; the default yywrap always returns 1. If the application requires yylex to continue processing with another source of input, then the application can include a function yywrap, which associates another file with the external variable FILE *yyin and returns a value of zero.

int main(int argc, char *argv[ ]) Calls yylex to perform lexical analysis, then exits. The user code can contain main to perform application-specific operations, calling yylex as applicable.
The reason for breaking these functions into two lists is that only those functions in \texttt{libl.a} can be reliably redefined by a portable application.

Except for \texttt{input}, \texttt{unput} and \texttt{main}, all external and static names generated by \texttt{lex} begin with the prefix \texttt{yy} or \texttt{YY}.

**Usage**

Portable applications are warned that in the \texttt{Rules} in \texttt{lex} section, an ERE without an action is not acceptable, but need not be detected as erroneous by \texttt{lex}. This can result in compilation or run-time errors.

The purpose of \texttt{input} is to take characters off the input stream and discard them as far as the lexical analysis is concerned. A common use is to discard the body of a comment once the beginning of a comment is recognized.

The \texttt{lex} utility is not fully internationalized in its treatment of regular expressions in the \texttt{lex} source code or generated lexical analyzer. It would seem desirable to have the lexical analyzer interpret the regular expressions given in the \texttt{lex} source according to the environment specified when the lexical analyzer is executed, but this is not possible with the current \texttt{lex} technology. Furthermore, the very nature of the lexical analyzers produced by \texttt{lex} must be closely tied to the lexical requirements of the input language being described, which is frequently locale-specific anyway. (For example, writing an analyzer that is used for French text is not automatically be useful for processing other languages.)

**Examples**

**Example 1** Using \texttt{lex}

The following is an example of a \texttt{lex} program that implements a rudimentary scanner for a Pascal-like syntax:

```
{%
/* need this for the call to atof() below */
#include <math.h>
/* need this for printf(), fopen() and stdin below */
#include <stdio.h>
%

DIGIT    [0-9]
ID       [a-z][a-z0-9]*
%

(DIGIT)+  {
    printf("An integer: %s (%d)\n", yytext, atoi(yytext));
}

(DIGIT)*."(DIGIT)*  {
    printf("A float: %s (%g)\n", yytext, atof(yytext));
}

Usage Examples
```

User Commands 861
EXAMPLE 1 Using lex  (Continued)

}  

if|then|begin|end|procedure|function { 
    printf("A keyword: %s\n", yytext);
}

{ID}  printf("An identifier: %s\n", yytext);

"*"|"-"|"*"|"/"  printf("An operator: %s\n", yytext);

"[^\{\}\{\}]*" /* eat up one-line comments */

\[ \t\n\]+ /* eat up white space */
.

printf("Unrecognized character: %s\n", yytext);

%

int main(int argc, char *argv[]) 
{
    ++argv, --argc; /* skip over program name */
    if (argc > 0)
        yyin = fopen(argv[0], "r");
    else
        yyin = stdin;

    yylex();
}

Environment Variables  See environ(5) for descriptions of the following environment variables that affect the execution of lex: LANG, LC_ALL, LC_COLLATE, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status  The following exit values are returned:

0  Successful completion.

>0  An error occurred.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/base-developer-utilities</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>ATTRIBUTE TYPE</td>
<td>ATTRIBUTE VALUE</td>
</tr>
<tr>
<td>----------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Standard</td>
<td>See <code>standards(5)</code></td>
</tr>
</tbody>
</table>

See Also  `yacc(1), attributes(5), environ(5), regex(5), standards(5)`

Notes  If routines such as `yyback()`, `yywrap()`, and `yylock()` in `.l` (ell) files are to be external C functions, the command line to compile a C++ program must define the `__EXTERN_C__` macro. For example:

```bash
example% CC -D__EXTERN_C__ ... file
```
lgrpinfo – display information about locality groups

Synopsis

lgrpinfo [-aceGlLmrt] [-u unit] [-C | -P] lgrp ...

lgrpinfo -h

lgrpinfo -I [-c] [-G] [-C | -P] lgrp ...

lgrpinfo [-T] [-aceGlLmrt] [-u unit]

lgrpinfo -d device_path

Description

lgrpinfo prints information about the locality group (lgroup) hierarchy and its contents.

An lgroup represents the set of CPU and memory-like hardware devices that are at most some distance (latency) apart from each other. All lgroups in the system are identified by a unique integer called an lgroup ID.

lgroups are organized into a hierarchy to facilitate finding the nearest resources. Leaf lgroups each contain a set of resources that are closest (local) to each other. Each parent lgroup in the hierarchy contains the resources of its child lgroups plus their next nearest resources. Finally, the root lgroup contains all the resources in the domain within the largest latency.

A Uniform Memory Access (UMA) machine is simply represented by the root lgroup. A Non Uniform Memory Access (NUMA) machine is represented by a hierarchy of lgroups to show the corresponding levels of locality. For example, a NUMA machine with two latencies (local and remote) has an lgroup hierarchy consisting of two levels with its leaves and the root.

Every application thread is assigned a home lgroup. When the system needs to allocate a CPU or memory resource for a thread, it searches lgroup hierarchy from the thread’s home lgroup for the closest available resources to the thread’s home. See plgrp(1) for details.

Without arguments, lgrpinfo prints general information about all lgroups in the system. If any lgroup IDs are specified on the command line, the command only prints information about the specified lgroups. Various options control which lgroups are displayed and the exact information that is printed for each lgroup.

lgroups can be specified on the command line as lgroup IDs or by using specific keywords. See OPERANDS.

Options

You can combine options together and the order in which options are specified is not important. Lowercase options select what information should be printed about lgroups.

Invoking lgrpinfo without arguments is equivalent to:

lgrpinfo -c -e -l -m -r -t all

The following options are supported:

-a

Print topology, CPU, memory, load and latency information.

This option is a shorthand for
lgrpinfo -t -c -e -m -r -l -L

unless -T is specified as well. When -T is specified, the -t option is not included.

-c

Print CPU information.
This is the default.

-C

Replace each lgroup in the list with its children.
This option cannot be used with the -P or the -T option. When no arguments are specified, this option is applied to the lgroups displayed by default.

-d device_path

Print IDs of lgroups closest to the specified I/O device. device_path is a string representing the device path.

-e

Print lgroup load average. The lgroup load averages are only displayed for leaf lgroups.
This is the default.

-G

Print OS view of lgroup hierarchy.
By default, the caller's view of the lgroup hierarchy is displayed which only includes what the caller can use, for example, only the CPUs in the caller's processor set is displayed. See lgrp_init(3LGRP) on the operating system and the caller's view.

-h

Print short help message and exit.

-I

Print matching IDs only.
This option is intended for scripts and can be used with -c, -G, and -C or -P. If -c is specified, print list of CPUs contained in all matching lgroups. Otherwise, the IDs for the matching lgroups is displayed. See EXAMPLES.
When no arguments are specified, this option is applied to the lgroups displayed, which, by default is all lgroups.

-l

Print information about lgroup latencies.
The latency value specified for each lgroup is defined by the operating system and is platform-specific. It can only be used for relative comparison of lgroups on the running system. It does not necessarily represent the actual latency between hardware devices and might not be applicable across platforms.
-L Print the lgroup latency table. The lgroup latency table displays the relative latency from each lgroup to each of the other lgroups including itself.

-m Print memory information.

Memory sizes are scaled to the unit of measure that yields an integer from 0 to 1023 unless the -u option is specified as well. The fractional part of the number is only displayed for values less than 10. This behavior is similar to using the -h option of ls(1) or df(1M) to display a human readable format.

This is the default.

-P Replace each lgroup in the list with its parents.

This option cannot be used with the -c or -T option. When no arguments are specified, this option is applied to the lgroups displayed, which, by default is all lgroups.

-r Print information about lgroup resources.

The resources are represented by a set of lgroups in which each member lgroup directly contains CPU and memory resources. If -T is specified as well, only information about resources of the intermediate lgroups is displayed.

-t Print information about lgroup topology.

This is the default.

-T Print the lgroup topology of a system graphically as a tree. This option can only be used with the -a, -c, -e, -g, -l, -L, -m, -r, and -u options. It only prints lgroup resources for intermediate lgroups when used with the -r. The -t option is omitted when -T is used with -a. No information is printed for the root lgroup unless it is the only lgroup.

-u units Specify memory units. Units should be b, k, m, g, t, p, or e for bytes, kilobytes, megabytes, gigabytes, terabytes, petabytes, or exabytes respectively. The fractional part of the number is only displayed for values less than 10. This behavior is similar to using the -h option of ls(1) or df(1M) to display a human readable format.

Operands The following operands are supported:

lgrp lgroups can be specified on the command line as lgroup ID, by using one of the following keywords:

    all All lgroups.
This is the default.

**intermediate** All intermediate lgroups. An intermediate lgroup is an lgroup that has a parent and children.

**leaves** All leaf lgroups. A leaf lgroup is an lgroup that has no children in the lgroup hierarchy.

**root** Root lgroup. Root lgroup contains all the resources in the domain within the largest latency and has no parent lgroup.

If an invalid lgroup is specified, the lgrpinfo command prints a message on standard error showing the invalid ID and continues processing other lgroups specified on the command line. When none of the specified lgroups are valid, lgrpinfo exits with an exit status of 2.

### Examples

#### EXAMPLE 1  Printing Information about lgroups

The following example prints general information about lgroups in the system.

In this example, the system is a 2 CPU AMD Opteron machine with two nodes, each having one CPU and 2 gigabytes of memory. Each of these nodes is represented by a leaf lgroup. The root lgroup contains all the resources in the machine:

```bash
$ lgrpinfo
lgroup 0 (root):
  Children: 1 2
  CPUs:   0 1
  Memory: installed 4.0G, allocated 2.2G, free 1.8G
  Lgroup resources: 1 2 (CPU); 1 2 (memory)
  Latency: 83
lgroup 1 (leaf):
  Children: none, Parent: 0
  CPU: 0
  Memory: installed 2.0G, allocated 1.2G, free 788M
  Lgroup resources: 1 (CPU); 1 (memory)
  Load: 0.793
  Latency: 56
lgroup 2 (leaf):
  Children: none, Parent: 0
  CPU: 1
  Memory: installed 2.0G, allocated 1017M, free 1.0G
  Lgroup resources: 2 (CPU); 2 (memory)
  Load: 0.817
  Latency: 56
```

#### EXAMPLE 2  Printing lgroup Topology

The following example prints the lgroup topology tree on a 4 CPU AMD Opteron machine:
EXAMPLE 2  Printing lgroup Topology  (Continued)

$ lgrpinfo -T
  0
    |-- 5
    |    |-- 1
    |    |-- 6
    |    |-- 2
    |    |-- 7
    |    |-- 3
    |    '-- 8
    |        '-- 4

EXAMPLE 3  Printing lgroup Topology

The following example prints the lgroup topology tree, resources, memory and CPU information on a 2 CPU AMD Opteron machine:

$ lgrpinfo -Ta
  0
    |-- 1
        CPU: 0
        Memory: installed 2.0G, allocated 1.2G, free 790M
        Load: 0.274
        Latency: 56
    '-- 2
        CPU: 1
        Memory: installed 2.0G, allocated 1019M, free 1.0G
        Load: 0.937
        Latency: 56

lgroup latencies:

          0 1 2
          --------------
0 | 83 83 83
1 | 83 56 83
2 | 83 83 56

EXAMPLE 4  Printing lgroup IDs

The following example prints lgroup IDs for children of the root lgroup:

$ lgrpinfo -I -C root
  1 2
EXAMPLE 5  Printing CPU IDs
The following example prints CPU IDs for all CPUs in lgroup 1:

$ lgrpinfo -c -I 1  
0

EXAMPLE 6  Printing Information about lgroup Latencies
The following example prints information about lgroup latencies:

$ lgrpinfo -l  
  lgroup 0 (root):  
    Latency: 83  
  lgroup 1 (leaf):  
    Latency: 56  
  lgroup 2 (leaf):  
    Latency: 5

EXAMPLE 7  Printing IDs of lgroups Closest to a Given Device
The following example demonstrates that lgroups 2 and 6 are closest to the given device:

$ lgrpinfo -d /dev/dsk/c9t0d0s0  
  lgroup IDs: 2 6

Exit Status  The following exit values are returned:
0  Successful completion.
1  Unable to get lgroup information from the system.
2  All lgroups or the device_path specified are invalid.
3  Invalid syntax.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>See below.</td>
</tr>
</tbody>
</table>

The human readable output is Uncommitted.

See Also  ls(1), plgrp(1), pmap(1), proc(1), ps(1), df(1M), prstat(1M), lgrp_init(3LGRP),
liblgrp(3LIB), lgrp_cpus(3LGRP), lgrp_resources(3LGRP), proc(4), attributes(5)
The `ulimit` utility sets or reports the file-size writing limit imposed on files written by the shell and its child processes (files of any size can be read). Only a process with appropriate privileges can increase the limit.

The Bourne shell built-in function, `ulimit`, prints or sets hard or soft resource limits. These limits are described in `getrlimit(2)`.

If `limit` is not present, `ulimit` prints the specified limits. Any number of limits can be printed at one time. The `-a` option prints all limits.

If `limit` is present, `ulimit` sets the specified limit to `limit`. The string `unlimited` requests that the current limit, if any, be removed. Any user can set a soft limit to any value less than or equal to the hard limit. Any user can lower a hard limit. Only a user with appropriate privileges can raise or remove a hard limit. See `getrlimit(2)`.

The `-H` option specifies a hard limit. The `-S` option specifies a soft limit. If neither option is specified, `ulimit` sets both limits and prints the soft limit.

The following options specify the resource whose limits are to be printed or set. If no option is specified, the file size limit is printed or set.

- `-c` Maximum core file size (in 512-byte blocks)
- `-d` Maximum size of data segment or heap (in Kbytes)
- `-f` Maximum file size (in 512-byte blocks)
- `-n` Maximum file descriptor plus 1
- `-s` Maximum size of stack segment (in Kbytes)
- `-t` Maximum CPU time (in seconds)
- `-v` Maximum size of virtual memory (in Kbytes)
The C-shell built-in function, `limit`, limits the consumption by the current process or any process it spawns, each not to exceed `limit` on the specified `resource`. The string `unlimited` requests that the current limit, if any, be removed. If `limit` is omitted, prints the current limit. If `resource` is omitted, displays all limits.

- `h` Use hard limits instead of the current limits. Hard limits impose a ceiling on the values of the current limits. Only the privileged user can raise the hard limits.

`resource` is one of:

- `cputime` Maximum CPU seconds per process.
- `filesize` Largest single file allowed. Limited to the size of the filesystem and capabilities of the filesystem. See `df(1M)`.
- `datasize` The maximum size of a process's heap in kilobytes.
- `stacksize` Maximum stack size for the process. The default stack size is $2^{13}$.
- `coredumpsize` Maximum size of a core dump (file). This is limited to the size of the filesystem.
- `descriptors` Maximum number of file descriptors. Run the `sysdef(1M)` command to obtain the maximum possible limits for your system. The values reported by `sysdef` are in hexadecimal, but can be translated into decimal numbers using the `bc(1)` command.
- `memorysize` Maximum size of virtual memory.

`limit` is a number, with an optional scaling factor, as follows:

- `nh` Hours (for `cputime`).
- `nk` $n$ kilobytes. This is the default for all but `cputime`.
- `nm` $n$ megabytes or minutes (for `cputime`).
- `mm:ss` Minutes and seconds (for `cputime`).

`unlimit` removes a limitation on `resource`. If no `resource` is specified, then all resource limitations are removed. See the description of the `limit` command for the list of resource names.

- `h` Remove corresponding hard limits. Only the privileged user can do this.

The Korn shell built-in function, `ulimit`, sets or displays a resource limit. The available resources limits are listed below. Many systems do not contain one or more of these limits. The limit for a specified resource is set when `limit` is specified. The value of `limit` can be a number in the unit specified below with each resource, or the value `unlimited`. The string `unlimited` requests that the current limit, if any, be removed. The `-H` and `-S` flags specify whether the hard limit or the soft limit for the specified resource is set. A hard limit cannot be
increased once it is set. A soft limit can be increased up to the value of the hard limit. If neither the -H or -S options is specified, the limit applies to both. The current resource limit is printed when limit is omitted. In this case, the soft limit is printed unless -H is specified. When more than one resource is specified, then the limit name and unit is printed before the value.

- a Lists all of the current resource limits.
- c The number of 512-byte blocks on the size of core dumps.
- d The number of K-bytes on the size of the data area.
- f The number of 512-byte blocks on files written by child processes (files of any size can be read).
- n The number of file descriptors plus 1.
- s The number of K-bytes on the size of the stack area.
- t The number of seconds (CPU time) to be used by each process.
- v The number of K-bytes for virtual memory.

If no option is specified, -f is assumed.

The heapsize, datasize, and stacksize parameters are not system tunables. The only controls for these are hard limits, set in a shell startup file, or system-wide soft limits, which, for the current version of the Solaris OS, is $2^{15}$ byes.

Per-Shell Memory Parameters

The heapsize, datasize, and stacksize parameters are not system tunables. The only controls for these are hard limits, set in a shell startup file, or system-wide soft limits, which, for the current version of the Solaris OS, is $2^{15}$ byes.

ksh ulimit sets or displays resource limits. These limits apply to the current process and to each child process created after the resource limit has been set. If limit is specified, the resource limit is set, otherwise, its current value is displayed on standard output.

Increasing the limit for a resource usually requires special privileges. Some systems allow you to lower resource limits and later increase them. These are called soft limits. Once a hard limit is set the resource cannot be increased.

Different systems allow you to specify different resources and some restrict how much you can raise the limit of the resource.

The value of limit depends on the unit of the resource listed for each resource. In addition, limit can be “unlimited” to indicate no limit for that resource.

If you do not specify -H or -S, -S is used for listing and both -S and -H are used for setting resources.

If you do not specify any resource, the default is -f.

The following options are available for ulimit in ksh:

- a Displays all current resource limits.
-b
--sbsize    Specifies the socket buffer size in bytes.
-c
--core      Specifies the core file size in blocks.
-d
--data      Specifies the data size in kbytes.
-f
--fsize     Specifies the file size in blocks.
-H
Displays or sets a hard limit.
-L
--locks     Specifies the number of file locks.
-l
--memlock   Specifies the locked address space in Kbytes.
-M
--as        Specifies the address space limit in Kbytes.
-n
--nofile    Specifies the number of open files.
-p
--pipe      Specifies the pipe buffer size in bytes.
-m
--rss       Specifies the resident set size in Kbytes
-S
Displays or sets a soft limit.
-s
--stack     Specifies the stack size in Kbytes.
-T
--threads   Specifies the number of threads.
-t
--cpu       Specifies the CPU time in seconds.
-u
--nproc     Specifies the number of processes.
-v
--vmem      Specifies the process size in Kbytes.

Options  The following option is supported by /usr/bin/ulimit:

User Commands
-f  Sets (or reports, if no blocks operand is present), the file size limit in blocks. The -f option is also the default case.

Operands  The following operand is supported by /usr/bin/ulimit:

blocks   The number of 512-byte blocks to use as the new file size limit.

Examples

/usr/bin/ulimit  EXAMPLE 1  Limiting the Stack Size
The following example limits the stack size to 512 kilobytes:

example% ulimit -s 512
example% ulimit -a

EXAMPLE 2  Limiting the Number of File Descriptors
The following command limits the number of file descriptors to 12:

example$ ulimit -n 12
example$ ulimit -a

EXAMPLE 3  Limiting the Core Dump File Size
The following command limits the size of a core dump file size to 0 kilobytes:

example% limit coredumpsize 0
example% limit

EXAMPLE 4  Removing the limitation for core file size

The following command removes the above limitation for the core file size:

```
example% unlimit coredumpsize
example% limit
cputime unlimited
filesize unlimited
data size 523256 kbytes
stacksize 8192 kbytes
coredumpsize unlimited
descriptors 64
memorysize unlimited
```

See `environ(5)` for descriptions of the following environment variables that affect the execution of `ulimit`: `LANG`, `LC_ALL`, `LC_CTYPE`, `LC_MESSAGES`, and `NLSPATH`.

**Exit Status**  The following exit values are returned by `ulimit`:

- `0`  Successful completion.
- `>0`  A request for a higher limit was rejected or an error occurred.

**Attributes**  See `attributes(5)` for descriptions of the following attributes:

```
ATTRIBUTE TYPE     ATTRIBUTE VALUE
Availability        system/core-os
Interface Stability Committed
Standard            See `standards(5)`.  
```

**See Also**  `bc(1), csh(1), ksh(1), ksh88(1), sh(1), df(1M), su(1M), swap(1M), sysdef(1M),
getrlimit(2), attributes(5), environ(5), standards(5)`

**Notes**  Be aware of possible unexpected consequences when using `ulimit` in conjunction with other Solaris resource-limiting features, such as `prctl(1)`. See `resource_controls(5)`.

With the use of the project resource controls described in `resource_controls(5)`, you should use `prctl(1)` to get an accurate observation of the limits in effect at any given time.
Name  line – read one line

Synopsis  line

Description  The line utility copies one line (up to and including a new-line) from the standard input and writes it on the standard output. It returns an exit status of 1 on EOF and always prints at least a new-line. It is often used within shell files to read from the user’s terminal.

Exit Status  Exit status is:

    0  Successful completion
    >0  End-of-file on input.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  sh(1), read(2), attributes(5)
Name  list_devices – list allocatable devices

Synopsis

\texttt{\textasciitilde} list\_devices \{-s\} \{-U \textit{uid}\} \{-z \textit{zonename}\} \{-a \{-w\}\}
\{-l\} \{-n\} \{-u \textit{device}\} \{-c \textit{dev-class}\}

\texttt{\textasciitilde} list\_devices \{-s\} \{-d \textit{dev-type}\}

Description

The \texttt{list\_devices} utility lists the allocatable devices in the system according to specified qualifications.

The \textit{device} and all device special files associated with the device are listed. The device argument is optional and, if it is not present, all relevant devices are listed. If \textit{dev-class} is present, devices belonging to the specified \textit{dev-class} are listed. There is no default \textit{dev-class}.

Options

The following options are supported:

\texttt{-l} \{-c \textit{dev-class} \} \{-device\}

Lists the pathnames of the device special files associated with the \textit{device} that are allocatable to the current process.

If \textit{dev-class} is specified, lists only the files associated with all devices of the specified device class.

If \textit{device} is specified, lists only the files associated with the specified device.

\texttt{-n} \{-c \textit{dev-class} \} \{-device\}

Lists the pathnames of the device special files associated with the \textit{device} that are allocatable to the current process but are not currently allocated.

If \textit{dev-class} is specified, lists only the files associated with all devices of the specified device class.

If \textit{device} is specified, lists only the files associated with the specified device.

\texttt{-s}

Silent. Suppresses any diagnostic output.

\texttt{-u} \{-c \textit{dev-class} \} \{-device\}

Lists the pathnames of device special files associated with the \textit{device} that are allocated to the owner of the current process.

If \textit{dev-class} is specified, lists only the files associated with all devices of the specified device class.

If \textit{device} is specified, lists only the files associated with the specified device.

\texttt{-U \textit{uid}}

Uses the user ID \textit{uid} instead of the real user ID of the current process when performing the \texttt{list\_devices} operation. Only a user with the \texttt{solaris\_device\_revoke} authorization can use this option.
The following options are supported when the system is configured with Trusted Extensions:

- **-a**
  Lists attributes like authorizations, cleaning programs and labels associated with a device.

  The list is a single line of semicolon (;) separated key=value pairs for each device in the format:

  ```
  device=device-name;type=device-type;\n  auths=auths;clean=device-exec;\n  device-attributes;\n  files=device-list
  ```

  where `device-attributes` is the contents of the `reserved1` field of `device_allocate(4)`. The field is colon (:) separated.

  See `device_allocate(4)` for a description of these attributes and their format.

  The -a output has the following keys:

  - **auths**
    Specifies the list of authorizations. The value is `auths` as described in `device_allocate(4)`.
  - **clean**
    Specifies the device cleaning script. The value is `device-exec` as described in `device_allocate(4)`.
  - **device**
    Specifies the device name. The value is `device-name` as described in `device_allocate(4)`.
  - **files**
    Specifies the device file paths. The value is `device-list` as described in `device_maps(4)`.
  - **type**
    Specifies the device type. The value is `device-type` as described in `device_allocate(4)`.

- **-d**
  Displays the system-supplied default attributes for the device types managed by device allocation. If `dev-type` is specified, it lists the default attributes for only that device type.

- **-w**
  This option can be used with -a to list the current owner of the device as the key value pair `owner=value`. `value` is the uid of the current owner of the device. If the device is unallocated, value is `/FREE`. If the device is in error state, value is `/ERROR`. This option also suppresses any diagnostic output.

- **-z zonename**
  When specified with the -l option, lists only those non-allocated devices whose label range includes the label of the zonename, and of the allocated devices, only those that are allocated at the same label as that of zonename.
When specified with the `-n` option, lists only those non-allocated devices whose label range includes the label of the `zonename`.

When specified with the `-u` option, lists only those devices that are allocated at the same label as that of `zonename`.

**Examples**

**EXAMPLE 1  Listing All Devices**

The following example lists all devices available to the caller for allocation:

```bash
% list_devices -l
device: audio type: audio \
files: /dev/audio /dev/audioctl /dev/sound/0 /dev/sound/0ctl
```

**EXAMPLE 2  Listing Attributes of All Devices**

On a system configured with Trusted Extensions, the following example lists attributes of all devices available to the caller for allocation:

```bash
% list_devices -al
device=audio1;type=audio;
auths=solaris.device.allocate;\
clean=/etc/security/lib/audio_clean;\
minlabel=admin_low:maxlabel=admin_high;\
files=/dev/audio1 /dev/audio1ctl /dev/sound/1 /dev/sound/1ctl
```

**EXAMPLE 3  Listing Attributes Including the Device Owner**

On a system configured with Trusted Extensions, the following example lists attributes including the device owner of all devices allocated to the user:

```bash
% list_devices -auw
device=audio2;type=audio;auths=solaris.device.allocate;\
clean=/etc/security/lib/audio_clean;\
minlabel=admin_low:maxlabel=admin_high:zone=public;\
owner=1234;\
files=/dev/audio2 /dev/audio2ctl /dev/sound/2 /dev/sound/2ctl
```

**Exit Status**

The following exit values are returned:

- `0`  Successful completion.
- `20`  No entry for the specified device.
- `other value`  An error occurred.

**Files**

- `/etc/security/device_allocate`
- `/etc/security/device_maps`
- `/etc/security/dev/*`
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>See below.</td>
</tr>
</tbody>
</table>

The invocation is Uncommitted. The options are Uncommitted. The output from the -a and -w options is Uncommitted. All other output is Not-an-Interface.

See Also allocate(1), deallocate(1), device_allocate(1M), dinfo(1M), mkdevalloc(1M), mkdevmaps(1M), device_allocate(4), device_maps(4), attributes(5)

Controlling Access to Devices

Notes The functionality described in this man page is available only if Solaris Auditing has been enabled.

The functionality described in this man page is available only if the device_allocate(1M) service is enabled.

On systems configured with Trusted Extensions, the functionality is enabled by default.

/etc/security/dev, mkdevalloc(1M), and mkdevmaps(1M) might not be supported in a future release of the Solaris Operating Environment.
Name  listusers – list user login information

Synopsis  listusers [-g groups] [-l logins]

Description  Executed without any options, this command lists all user logins sorted by login. The output shows the login ID and the account field value from the system’s password database as specified by /etc/nsswitch.conf.

Options  The following options are supported:

- `-g groups`  Lists all user logins belonging to group, sorted by login. Multiple groups can be specified as a comma-separated list.

- `-l logins`  Lists the user login or logins specified by logins, sorted by login. Multiple logins can be specified as a comma-separated list.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  nsswitch.conf(4), attributes(5)

Notes  A user login is one that has a UID of 100 or greater.

The `-l` and `-g` options can be combined. User logins will only be listed once, even if they belong to more than one of the selected groups.
llc2_autoconfig(1)

Name    llc2_autoconfig – generate LLC2 configuration files

Synopsis  /usr/lib/llc2/llc2_autoconfig [-f]

Description  The llc2_autoconfig utility is used to generate LLC2 configuration files
              (/etc/llc2/default/llc2.*). If there is no configuration file in /etc/llc2_default/, it
detects all the available interfaces in the system and generates corresponding default
configuration files.

              If there are existing configuration files in /etc/llc2_default/, it will check if those interfaces
defined in the files still exist. If they do not exist in the system, it will set llc2_on in those files
to 0. After this, it will detect if there are new interfaces in the system. If there are, it will
generate configuration files for them.

Options    The following option is supported:

              -f    Erases all configuration files in /etc/llc2/default/. Then detects all the available
              interfaces in the system and generates corresponding default configuration files. Use
              this option with caution.

Files      /etc/llc2/default/llc2.*    LLC2 configuration files

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/network/llc2</td>
</tr>
</tbody>
</table>

See Also    llc2_config(1), llc2(4), attributes(5), llc2(7D)
The `llc2_config` utility is used to start/stop the LLC2 subsystem and to configure LLC2 interface parameters.

**Options**

The following options are supported:

- `-d`  
  Turns on debug mode. Extra debugging information will be printed out.

- `-i ppa`  
  Initializes the corresponding interface using the file `/etc/llc2/default/llc2.ppa`.

- `-P`  
  Reads in all `/etc/llc2/default/llc2.*` configuration files, opens those devices defined in the files, and sets up the streams needed for LLC2 to use those devices. Before doing this, `llc2_config -q` will not show anything.

- `-q`  
  Queries the LLC2 subsystem. Information similar to the following example will be printed out for all PPAs (Physical Point of Attachment) available under the LLC2 module:

```plaintext
PPA State ID MACAddr Type MaxSDU MinSDU Mode  
0 up 0000 0800208a217e ethernet 1500 0 3
```

The fields displayed are described below:

- **PPA**  
  The relative logical position of the interface.

- **State**  
  The state of the interface:

  - `up`  
    The interface is initialized and operational.

  - `down`  
    The interface was "discovered" by the LLC2 driver, has passed its bootup diagnostics, and is awaiting initialization.

  - `bad`  
    The interface is known to the LLC2 driver, but failed one or more of the integrity checks performed at boot time. This might include detecting Interrupt Request and shared memory conflicts or failures detected during the execution of the level 0 diagnostics.

- **ID**  
  The interface ID.

- **MACAddr**  
  The MAC address currently in effect for the interface.

- **Type**  
  The MAC type. Current types supported include:

  - `csma/cd`  
    10 Megabit Ethernet

  - `ethernet`  
    Ethernet type device

  - `tkn-ring`  
    4/16 Megabit Token Ring
fddi 100 Megabit Fiber Distributed Data Interface

MaxSDU  The Maximum Service Data Unit size transmitted on this interface.

Mode  The Service Modes supported by this interface. This field consists of
       the bitwise logical-ORing of the supported modes, also defined in
       /usr/include/sys/dlpi.h.

- r ppa  Uninitializes the corresponding interface. By using this option, and then using the
       -i option, the parameters associated with an interface can be changed.

-U  Destroys all streams used by the LLC2 subsystem. This is the reverse of the -P
       option. After this is executed, llc2_config -q will not show anything.

Files  /etc/llc2/default/llc2.*  LLC2 configuration files

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/network/llc2</td>
</tr>
</tbody>
</table>

See Also  llc2_autoconfig(1), llc2(4), attributes(5), llc2(7D)
The `llc2_stats` command is used to retrieve statistical information from the Host-based Logical Link Control Class 2 component of the LLC2 Driver. Statistics are kept for the station, SAP (Service Access Point), and connection components.

### Options

The following options are supported:

- `-c connection` Specifies the connection of interest. Its value is entered in hexadecimal notation with no leading `0x`.

- `-r` Resets the specified counters to zero after reading them. This option is only valid if the root user is executing the command.

- `-s sap` Specifies the SAP for this request. It is a single-byte value, expressed in hexadecimal notation with no leading `0x`. For example, the NetBIOS sap, 240 (0xf0) would be entered as: `-s f0`.

### Operands

The following operand is supported:

- `ppa` The logical number used to address the adapter. The PPA (Physical Point of Attachment) must be the first argument.

### Examples

**Example 1** Station Statistics

The following command will display the station statistics for PPA 4. After the example, a brief description of each field is presented.

```
example% /usr/lib/llc2/llc2_stats 4
```

Station values received:

- `ppa` = 0x00000004
- `clearFlag` = 0x00
- `# of saps (hex)` = 0x0002
- `saps (hex)` = 02 aa
- `state` = 0x01
- `nullSapXidCmdRcvd` = 0x00000000
- `nullSapXidRspSent` = 0x00000000
- `nullSapTestCmdRcvd` = 0x00000000
- `nullSapTestRspSent` = 0x00000000
- `outOfState` = 0x00000000
- `allocFail` = 0x00000000
- `protocolError` = 0x00000000

The fields are described as follows:

- `ppa` The logical number used to address the adapter.
- `clearFlag` This flag indicates if the statistics will be reset to zero after reading (set to a 1) or if the statistics are read only (set to 0).
EXAMPLE 1  Station Statistics  (Continued)

# of saps  The number of SAPs currently bound on this station.
saps   The array of the station's Service Access Point (SAP) logical
      interface values between the LLC and its adjacent layers.
state  A number indicating the current state of the station component (0
      = down, 1 = up).
nullSapXidCmdRcvd  The number of XID command Protocol Data Units (PDUs)
      received for the NULL SAP address (sap = 0x00).
nullSapXidRspSent  The number of XID response PDUs sent in response to XID
      command PDUs received for the NULL SAP address.
nullSapTestCmdRcvd  The number of TEST command PDUs received for the NULL SAP
      address.
nullSapTestRspSent  The number of TEST response PDUs sent in response to TEST
      command PDUs received for the NULL SAP address.
outOfState  The number of events received in an invalid state.
allocFail  The number of buffer allocation failures.
protocolError  The number of LLC protocol errors, that is, the receipt of
      malformed PDUs or the receipt of frame X when frame Y was
      expected.

EXAMPLE 2  SAP Statistics

In the above display, there are two active SAPs, 0x02 and 0xaa. The following is an example of
a command for retrieving the statistics for SAP 02 and a brief explanation of each field
presented.

eexample% /usr/lib/llc2/llc2_stats 4 -s 02

Sap values received:
ppa       = 0x00000004  clearFlag = 0x00
sap       = 0x02
state     = 0x01
# of cons (hex) = 0x0000000a
connections (hex) = 0000 0001 0002 0003 0004 0005 0006 0007 0008 0009
xicCmdSent = 0x00000000
xicCmdRcvd = 0x00000000
xicRspSent = 0x00000000
xicRspRcvd = 0x00000000
testCmdSent = 0x00000000
testCmdRcvd = 0x00000000
EXAMPLE 2  SAP Statistics  (Continued)

testRspSent = 0x00000000
testRspRcvd = 0x00000000
uiSent = 0x00000000
uiRcvd = 0x00000000
outOfState = 0x00000000
allocFail = 0x00000000
protocolError = 0x00000000

The fields are described as follows:

ppa  The logical number used to address the adapter.
clearFlag  This flag indicates if the statistics will be reset to zero after reading (set to a 1) or if the statistics are read only (set to 0).
sap  The specified Service Access Point (SAP) logical interface value for the station.
state  A number indicating the current state of the SAP component (0 = inactive, 1 = active).
# of cons  The number of active connections on this SAP.
connections  The array of active connection indexes.
xidCmdSent  The number of XID command PDUs sent (Source SAP = this sap).
xidCmdRcvd  The number of XID command PDUs received (Destination SAP = this sap).
xidRspSent  The number of XID response PDUs sent (Source SAP = this sap).
xidRspRcvd  The number of XID response PDUs received (Source SAP = this sap).
testCmdSent  The number of TEST command PDUs sent (Source SAP = this sap).
testCmdRcvd  The number of TEST command PDUs received (Destination SAP = this sap).
testRspSent  The number of TEST response PDUs sent (Source SAP = this sap).
testRspRcvd  The number of TEST response PDUs received (Source SAP = this sap).
uiSent  The number of Unnumbered Information Frames sent.
uiRcvd  The number of Unnumbered Information Frames received.
outOfState  The number of events received in an invalid state.
allocFail  The number of buffer allocation failures.
EXAMPLE 2  SAP Statistics  (Continued)

protocolError  The number of LLC protocol errors, that is, the receipt of malformed PDUds or the receipt of frame X when frame Y was expected.

EXAMPLE 3  Connection Statistics

Ten established connections are associated with this SAP. To retrieve the statistics for connection 1, enter the following command:

```
example% /usr/lib/llc2/llc2_stats 4 -s 2 -c 1
```

Connection values received:

```
ppa = 0x0004  clearFlag = 0x00
sap = 0x02  con = 0x0001  sid = 0x0201
stateOldest = 0x00  stateOlder = 0x00  stateOld = 0x01
state = 0x08
dl_nodeaddr = 0x0080d84008c2  dl_sap = 0x04
flag = 0x50  dataFlag = 0x00  timerOn = 0x18
vs = 0x29  vr = 0x1e  nrRcvd = 0x29  k = 0x14
retryCount = 0x0000  numToBeAced = 0x0000  numToResend = 0x0000
macOutSave = 0x0000  macOutDump = 0x0000
iSent = 0x0ba9  iRcvd = 0x001e
frmrSent = 0x0000  frmrRcvd = 0x0000
rrSent = 0x0016a  rrRcvd = 0x00c1
rnrSent = 0x0000  rnrRcvd = 0x06fb
rejSent = 0x0000  rejRcvd = 0x0000
sabmeSent = 0x0000  sabmeRcvd = 0x0001
uaSent = 0x0001  uaRcvd = 0x0000  discSent = 0x0000
outOfState = 0x0000  allocFail = 0x0000  protocolError = 0x0000
localBusy = 0x0000  remoteBusy = 0x0085  maxRetryFail = 0x0000
ackTimerExp = 0x0000  pollTimerExp = 0x0000  rejTimerExp = 0x0000
remBusyTimerExp = 0x0000
inactTimerExp = 0x0000
sendAckTimerExp = 0x0000
```

ppa  The logical number used to address the adapter.

clearFlag  This flag indicates if the statistics will be reset to zero after reading (set to 1) or if the statistics are read only (set to 0).

sap  The specified Service Access Point (SAP) logical interface value for the station.

con  The specified connection index value for the SAP.

stateOldest  A number representing the state of the connection component prior to stateOlder.

stateOlder  A number representing the state of the connection component prior to stateOld.
EXAMPLE 3  Connection Statistics  (Continued)

\textbf{stateOld}  A number representing the state of the connection component prior to state.

\textbf{state}  A number representing the most current state of the connection component. See Table 1.

\textbf{sid}  The Station Identifier composed of the SAP (upper byte) and connection index (lower byte).

\textbf{dl_nodeaddr}  The Data Link Node Address. This is the destination node's MAC address.

\textbf{dl_sap}  The destination node's SAP.

\textbf{flag}  The connection component processing flag. See Table 3.

\textbf{dataFlag}  A number representing the status of the data units from received I-frame PDUs (0 = not discarded, 1 = discarded, 2 = busy state entered with REJ PDU outstanding).

\textbf{timerOn}  A number representing the timer activity flag, with each bit representing an active timer for this connection. See Table 2 for timer definitions.

\textbf{vs}  The sequence number of the next I-frame PDU to send.

\textbf{vr}  The expected sequence number of the next I-frame PDU to be received.

\textbf{nrRcvd}  The sequence number plus 1 of the last sent I-frame PDU acknowledged by the remote node.

\textbf{k}  The transmit window size.

\textbf{retryCount}  The \texttt{retryCount} is incremented whenever a timer expiration occurs. These timers protect outbound frames.

\textbf{numToBeAcked}  The number of outbound I-frames awaiting acknowledgement.

\textbf{numToResend}  The number of outbound I-frames to be retransmitted.

\textbf{macOutSave}  No longer used.

\textbf{macOutDump}  No longer used.

\textbf{iSent}  The number of I-frames sent.

\textbf{iRcvd}  The number of I-frames received.

\textbf{frmrSent}  The number of Frame Reject PDUs (FRMR) sent.
### EXAMPLE 3  Connection Statistics  (Continued)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>frmrRcvd</td>
<td>The number of Frame Reject PDUs (FRMR) received.</td>
</tr>
<tr>
<td>rrSent</td>
<td>The number of Receiver Ready PDUs (RR) sent.</td>
</tr>
<tr>
<td>rrRcvd</td>
<td>The number of Receiver Ready PDUs (RR) received.</td>
</tr>
<tr>
<td>rnrSent</td>
<td>The number of Receiver Not Ready PDUs (RNR) sent.</td>
</tr>
<tr>
<td>rnrRcvd</td>
<td>The number of Receiver Not Ready PDUs (RNR) received.</td>
</tr>
<tr>
<td>rejSent</td>
<td>The number of Reject PDUs (REJ) sent.</td>
</tr>
<tr>
<td>rejRcvd</td>
<td>The number of Reject PDUs (REJ) received.</td>
</tr>
<tr>
<td>sabmeSent</td>
<td>The number of Set Asynchronous Balanced Mode Extended PDUs (SABME) sent.</td>
</tr>
<tr>
<td>sabmeRcvd</td>
<td>The number of Set Asynchronous Balanced Mode Extended PDUs (SABME) received.</td>
</tr>
<tr>
<td>uaSent</td>
<td>The number of Unnumbered Acknowledgment PDUs (UA) sent.</td>
</tr>
<tr>
<td>uaRcvd</td>
<td>The number of Unnumbered Acknowledgment PDUs (UA) received.</td>
</tr>
<tr>
<td>discSent</td>
<td>The number of Disconnect PDUs (DISC) sent.</td>
</tr>
<tr>
<td>outOfState</td>
<td>The number of events received in an invalid state.</td>
</tr>
<tr>
<td>allocFail</td>
<td>The number of buffer allocation failures.</td>
</tr>
<tr>
<td>protocolError</td>
<td>The number of LLC protocol errors, that is, the receipt of malformed PDUs or the receipt of frame X when frame Y was expected.</td>
</tr>
<tr>
<td>localBusy</td>
<td>The number of times this component was in local busy state and could not accept I-frames.</td>
</tr>
<tr>
<td>remoteBusy</td>
<td>The number of times the remote connection component was busy and could not accept I-frames.</td>
</tr>
<tr>
<td>maxRetryFail</td>
<td>The number of failures that occurred because maxRetry was reached.</td>
</tr>
<tr>
<td>ackTimerExp</td>
<td>The number of expirations of the Acknowledgement timer.</td>
</tr>
<tr>
<td>pollTimerExp</td>
<td>The number of expirations of the Poll timer.</td>
</tr>
<tr>
<td>rejTimerExp</td>
<td>The number of expirations of the Reject timer.</td>
</tr>
<tr>
<td>remBusyTimerExp</td>
<td>The number of expirations of the Remote Busy timer.</td>
</tr>
<tr>
<td>inactTimerExp</td>
<td>The number of expirations of the Inactivity timer.</td>
</tr>
<tr>
<td>sendAckTimerExp</td>
<td>The number of expirations of the Send Acknowledgement timer.</td>
</tr>
</tbody>
</table>
### Table 1: LLC2 States

<table>
<thead>
<tr>
<th>State</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATION DOWN</td>
<td>0x00</td>
</tr>
<tr>
<td>STATION UP</td>
<td>0x01</td>
</tr>
<tr>
<td>SAP INACTIVE</td>
<td>0x00</td>
</tr>
<tr>
<td>SAP ACTIVE</td>
<td>0x01</td>
</tr>
<tr>
<td>CONNECTION ADM</td>
<td>0x00</td>
</tr>
<tr>
<td>CONNECTION CONN</td>
<td>0x01</td>
</tr>
<tr>
<td>CONNECTION RESET_WAIT</td>
<td>0x02</td>
</tr>
<tr>
<td>CONNECTION RESET_CHECK</td>
<td>0x03</td>
</tr>
<tr>
<td>CONNECTION SETUP</td>
<td>0x04</td>
</tr>
<tr>
<td>CONNECTION RESET</td>
<td>0x05</td>
</tr>
<tr>
<td>CONNECTION D_CONN</td>
<td>0x06</td>
</tr>
<tr>
<td>CONNECTION ERROR</td>
<td>0x07</td>
</tr>
<tr>
<td>CONNECTION NORMAL</td>
<td>0x08</td>
</tr>
<tr>
<td>CONNECTION BUSY</td>
<td>0x09</td>
</tr>
<tr>
<td>CONNECTION REJECT</td>
<td>0x0a</td>
</tr>
<tr>
<td>CONNECTION AWAIT</td>
<td>0x0b</td>
</tr>
<tr>
<td>CONNECTION AWAIT_BUSY</td>
<td>0x0c</td>
</tr>
<tr>
<td>CONNECTION AWAIT_REJECT</td>
<td>0x0d</td>
</tr>
</tbody>
</table>

### Table 2: timersOn

<table>
<thead>
<tr>
<th>Timer</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acknowledgement</td>
<td>0x80</td>
</tr>
<tr>
<td>Poll</td>
<td>0x40</td>
</tr>
<tr>
<td>Reject</td>
<td>0x20</td>
</tr>
<tr>
<td>Remove Busy</td>
<td>0x10</td>
</tr>
</tbody>
</table>
Table 2: timersOn

<table>
<thead>
<tr>
<th>Inactivity</th>
<th>0x08</th>
</tr>
</thead>
<tbody>
<tr>
<td>Send Acknowledgement</td>
<td>0x04</td>
</tr>
</tbody>
</table>

Table 3: LLC2 Flags

<table>
<thead>
<tr>
<th>Flag</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>P_FLAG</td>
<td>0x80</td>
</tr>
<tr>
<td>F_FLAG</td>
<td>0x40</td>
</tr>
<tr>
<td>S_FLAG</td>
<td>0x20</td>
</tr>
<tr>
<td>REMOTE_BUSY</td>
<td>0x10</td>
</tr>
<tr>
<td>RESEND_PENDING</td>
<td>0x08</td>
</tr>
</tbody>
</table>

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/network/llc2</td>
</tr>
</tbody>
</table>

Files

/dev/llc2  clone device

See Also

attributes(5)

Notes

For further information on the LLC2 components, states and flags, see the International Standards Organization document, ISO 8802-2: 1994, Section 7.
ln(1)

Name
ln – make hard or symbolic links to files

Synopsis
/usr/bin/ln [-fns] source_file [target]
/usr/bin/ln [-fns] source_file... target
/usr/xpg4/bin/ln [-fs] source_file [target]
/usr/xpg4/bin/ln [-fs] source_file... target

Description
In the first synopsis form, the ln utility creates a new directory entry (link) for the file specified by source_file, at the destination path specified by target. If target is not specified, the link is made in the current directory. This first synopsis form is assumed when the final operand does not name an existing directory; if more than two operands are specified and the final is not an existing directory, an error will result.

In the second synopsis form, the ln utility creates a new directory entry for each file specified by a source_file operand, at a destination path in the existing directory named by target.

The ln utility may be used to create both hard links and symbolic links. A hard link is a pointer to a file and is indistinguishable from the original directory entry. Any changes to a file are effective independent of the name used to reference the file. Hard links may not span file systems and may not refer to directories.

ln by default creates hard links. source_file is linked to target. If target is a directory, another file named source_file is created in target and linked to the original source_file.

If target is an existing file and the -f option is not specified, ln will write a diagnostic message to standard error, do nothing more with the current source_file, and go on to any remaining source_files.

A symbolic link is an indirect pointer to a file; its directory entry contains the name of the file to which it is linked. Symbolic links may span file systems and may refer to directories.

File permissions for target may be different from those displayed with an -l listing of the ls(1) command. To display the permissions of target, use ls -lL. See stat(2) for more information.

Options
The following options are supported for both /usr/bin/ln and /usr/xpg4/bin/ln:

- f Links files without questioning the user, even if the mode of target forbids writing. This is the default if the standard input is not a terminal.
- `s` Creates a symbolic link.

If the `-s` option is used with two arguments, `target` may be an existing directory or a non-existent file. If `target` already exists and is not a directory, an error is returned. `source_file` may be any path name and need not exist. If it exists, it may be a file or directory and may reside on a different file system from `target`. If `target` is an existing directory, a file is created in directory `target` whose name is `source_file` or the last component of `source_file`. This file is a symbolic link that references `source_file`. If `target` does not exist, a file with name `target` is created and it is a symbolic link that references `source_file`.

If the `-s` option is used with more than two arguments, `target` must be an existing directory or an error will be returned. For each `source_file`, a link is created in `target` whose name is the last component of `source_file`. Each new `source_file` is a symbolic link to the original `source_file`. The files and `target` may reside on different file systems.

```
/usr/bin/ln
```

The following option is supported for `/usr/bin/ln` only:

- `n` If `target` is an existing file, writes a diagnostic message to stderr and goes on to any remaining `source_file`. The `-f` option overrides this option. This is the default behavior for `/usr/bin/ln` and `/usr/xpg4/bin/ln`, and is silently ignored.

**Operands**
The following operands are supported:

- `source_file` A path name of a file to be linked. This can be either a regular or special file. If the `-s` option is specified, `source_file` can also be a directory.
- `target` The path name of the new directory entry to be created, or of an existing directory in which the new directory entries are to be created.

**Usage**
See `largefile(5)` for the description of the behavior of `ln` when encountering files greater than or equal to 2 Gbyte ($2^{31}$ bytes).

**Environment Variables**
See `environ(5)` for descriptions of the following environment variables that affect the execution of `ln`: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

**Exit Status**
The following exit values are returned:

- `0` All the specified files were linked successfully
- `>0` An error occurred.

**Attributes**
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>/usr/bin/ln</th>
<th>ATTRIBUTETYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
<td></td>
</tr>
</tbody>
</table>
As a symbolic link to a directory behaves differently than you might expect in certain cases. While an `ls(1)` command on such a link displays the files in the pointed-to directory, entering `ls -l` displays information about the link itself:

```
example% ln -s dir link
example% ls link
file1 file2 file3 file4
example% ls -l link
lrwxrwxrwx 1 user 7 Jan 11 23:27 link -> dir
```

When you change to a directory (see `cd(1)`) through a symbolic link, using `/usr/bin/sh` or `/usr/bin/csh`, you wind up in the pointed-to location within the file system. This means that the parent of the new working directory is not the parent of the symbolic link, but rather, the parent of the pointed-to directory. This will also happen when using `cd` with the `-P` option from `/usr/bin/ksh` or `/usr/xpg4/bin/sh`. For instance, in the following case, the final working directory is `/usr` and not `/home/user/linktest`.

```
example% pwd
/home/user/linktest
example% ln -s /usr/tmp symlink
example% cd symlink
example% cd ..
example% pwd
/usr
```

C shell users can avoid any resulting navigation problems by using the `pushd` and `popd` built-in commands instead of `cd`.

### See Also

`chmod(1), ls(1), stat(2), attributes(5), environ(5), largefile(5), standards(5)`
ln – make hard or symbolic links to files

/sdr/ucb/ln [-fs] filename [linkname]

/sdr/ucb/ln [-fs] pathname... directory

Description

The /usr/ucb/ln utility creates an additional directory entry, called a link, to a file or directory. Any number of links can be assigned to a file. The number of links does not affect other file attributes such as size, protections, data, etc.

filename is the name of the original file or directory. linkname is the new name to associate with the file or filename. If linkname is omitted, the last component of filename is used as the name of the link.

If the last argument is the name of a directory, symbolic links are made in that directory for each pathname argument; /usr/ucb/ln uses the last component of each pathname as the name of each link in the named directory.

A hard link (the default) is a standard directory entry just like the one made when the file was created. Hard links can only be made to existing files. Hard links cannot be made across file systems (disk partitions, mounted file systems). To remove a file, all hard links to it must be removed, including the name by which it was first created; removing the last hard link releases the inode associated with the file.

A symbolic link, made with the -s option, is a special directory entry that points to another named file. Symbolic links can span file systems and point to directories. In fact, you can create a symbolic link that points to a file that is currently absent from the file system; removing the file that it points to does not affect or alter the symbolic link itself.

A symbolic link to a directory behaves differently than you might expect in certain cases. While an ls(1) on such a link displays the files in the pointed-to directory, an `ls -l` displays information about the link itself:

```
example% /usr/ucb/ln -s dir link
example% ls link
file1 file2 file3 file4
example% ls -l link
rwxrwxrwx 1 user 7 Jan 11 23:27 link → dir
```

When you use cd(1) to change to a directory through a symbolic link, you wind up in the pointed-to location within the file system. This means that the parent of the new working directory is not the parent of the symbolic link, but rather, the parent of the pointed-to directory. For instance, in the following case the final working directory is /usr and not /home/user/linktest.

```
example% pwd
/home/user/linktest
example% /usr/ucb/ln -s /var/tmp symlink
example% cd symlink
```
example% cd ..
ex ample% pwd
/usr

C shell user's can avoid any resulting navigation problems by using the pushd and popd built-in commands instead of cd.

**Options**
- `-f` Force a hard link to a directory. This option is only available to the super-user, and should be used with extreme caution.
- `-s` Create a symbolic link or links.

**Usage**
See `largefile(5)` for the description of the behavior of `ln` when encountering files greater than or equal to 2 Gbyte ($2^{31}$ bytes).

**Examples**

**EXAMPLE 1** The `/usr/ucb/ln` command

The commands below illustrate the effects of the different forms of the `/usr/ucb/ln` command:

```bash
example% /usr/ucb/ln file link
example% ls -F file link
  file  link
example% /usr/ucb/ln -s file symlink
example% ls -F file symlink
  file  symlink@
example% ls -li file link symlink
  10606  -rw-r--r--   2  user  0  Jan 12 00:06  file
  10606  -rw-r--r--   2  user  0  Jan 12 00:06  link
  10607  lrwxrwxrwx   1  user  4  Jan 12 00:06  symlink  →  file
example% /usr/ucb/ln -s nonesuch devoid
example% ls -F devoid
  devoid@
example% cat devoid
devoid: No such file or directory
example% /usr/ucb/ln -s /proto/bin/* /tmp/bin
example% ls -F /proto/bin /tmp/bin
/proto/bin:
  x*  y*  z*
/tmp/bin:
  x@  y@  z@
```

**Attributes**
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>
See Also  cp(1), ls(1), mv(1), rm(1), link(2), readlink(2), stat(2), symlink(2), attributes(5), largefile(5)

Notes  When the last argument is a directory, simple basenames should not be used for pathname arguments. If a basename is used, the resulting symbolic link points to itself:

```
example% /usr/ucb/ln -s file /tmp
example% ls -l /tmp/file
lrwxrwxrwx 1 user 4 Jan 12 00:16 /tmp/file → file
example% cat /tmp/file
/tmp/file: Too many levels of symbolic links
```

To avoid this problem, use full pathnames, or prepend a reference to the PWD variable to files in the working directory:

```
example% rm /tmp/file
example% /usr/ucb/ln -s $PWD/file /tmp
lrwxrwxrwx 1 user 4 Jan 12 00:16 /tmp/file →
/home/user/subdir/file
```
loadkeys(1)

Name    loadkeys, dumpkeys – load and dump keyboard translation tables

Synopsis loadkeys  [filename]

dumpkeys

Description loadkeys reads the file specified by filename, and modifies the keyboard streams module's translation tables. If no file is specified, loadkeys loads the file:/usr/share/lib/keytables/type_tt/layout_dd, where tt is the value returned by the KIOCTYPE ioctl, and dd is the value returned by the KIOCLAYOUT ioctl (see kb(7M)). These keytable files specify only the entries that change between the specified layout and the default layout for the particular keyboard type. On self-identifying keyboards, the value returned by the KIOCLAYOUT ioctl is set from the DIP switches.

dumpkeys writes the current contents of the keyboard streams module’s translation tables, in the format specified by keytables(4), to the standard output.

Files    /usr/share/lib/keytables/layout_dd    default keytable files

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  kbd(1), keytables(4), attributes(5), kb(7M), usbkbm(7M)
locale(1)

Name  locale – get locale-specific information

Synopsis  locale [-a | -m]
            locale [-ck] name...

Description  The `locale` utility writes information about the current locale environment, or all public locales, to the standard output. For the purposes of this section, a public locale is one provided by the implementation that is accessible to the application.

When `locale` is invoked without any arguments, it summarizes the current locale environment for each locale category as determined by the settings of the environment variables.

When invoked with operands, it writes values that have been assigned to the keywords in the locale categories, as follows:

- Specifying a keyword name selects the named keyword and the category containing that keyword.
- Specifying a category name selects the named category and all keywords in that category.

Options  The following options are supported:

- `-a` Writes information about all available public locales. The available locales include POSIX, representing the POSIX locale.
- `-c` Writes the names of selected locale categories. The `-c` option increases readability when more than one category is selected (for example, via more than one keyword name or via a category name). It is valid both with and without the `-k` option.
- `-k` Writes the names and values of selected keywords. The implementation may omit values for some keywords; see OPERANDS.
- `-m` Writes names of available charmaps; see `localedef(1)`.

Operands  The following operand is supported:

name  The name of a locale category, the name of a keyword in a locale category, or the reserved name charmap. The named category or keyword is selected for output. If a single `name` represents both a locale category name and a keyword name in the current locale, the results are unspecified; otherwise, both category and keyword names can be specified as `name` operands, in any sequence.

Examples  EXAMPLE 1  Examples of the locale utility

In the following examples, the assumption is that locale environment variables are set as follows:

```
LANG=locale_x LC_COLLATE=locale_y
```

The command `locale` would result in the following output:
EXAMPLE 1   Examples of the locale utility  (Continued)

LANG=locale_x
LC_CTYPE="locale_x"
LC_NUMERIC="locale_x"
LC_TIME="locale_x"
LC_COLLATE=locale_y
LC_MONETARY="locale_x"
LC_MESSAGES="locale_x"
LC_ALL=

The command

LC_ALL=POSIX locale -ck decimal_point

would produce:

LC_NUMERIC
decimal_point="."

The following command shows an application of locale to determine whether a
user-supplied response is affirmative:

if printf "%s\n" "$response" | /usr/xpg4/bin/grep -Eq
    "$(locale yesexpr)"
then
    affirmative processing goes here
else
    non-affirmative processing goes here
fi

Environment Variables

See environ(5) for the descriptions of LANG, LC_ALL, LC_CTYPE, LCMESSAGES, and NLSPATH.
The LANG, LC_*, and NLSPATH environment variables must specify the current locale
environment to be written out. These environment variables are used if the -a option is not
specified.

Exit Status

The following exit values are returned:

0     All the requested information was found and output successfully.
>0    An error occurred.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>text/locale</td>
</tr>
<tr>
<td>ATTRIBUTE TYPE</td>
<td>ATTRIBUTE VALUE</td>
</tr>
<tr>
<td>----------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also  localedef(1), attributes(5), charmap(5), environ(5), locale(5), locale_alias(5), standards(5)

Notes  If LC_CTYPE or keywords in the category LC_CTYPE are specified, only the values in the range 0x00-0x7f are written out.

If LC_COLLATE or keywords in the category LC_COLLATE are specified, no actual values are written out.

The locale names shown at locale -a output are restricted to canonical locale names. For the accepted and supported locale name aliases, see locale_alias(5)
localedef – define locale environment

Synopsis

localedef [-c] [-C compiler_options] [-f charmap]
           [-i sourcefile] [-L linker_options] [-m model]
           [-u code_set_name] [-W cc, arg] [-x extensions_file] localename

Description

The localedef utility converts source definitions for locale categories into a format usable by
the functions and utilities whose operational behavior is determined by the setting of the
locale environment variables; see environ(5).

The utility reads source definitions for one or more locale categories belonging to the same
locale from the file named in the -i option (if specified) or from standard input.

Each category source definition is identified by the corresponding environment variable name
and terminated by an END category-name statement. The following categories are supported.

LC_CTYPE        Defines character classification and case conversion.
LC_COLLATE       Defines collation rules.
LC_MONETARY      Defines the format and symbols used in formatting of monetary
                 information.
LC_NUMERIC      Defines the decimal delimiter, grouping and grouping symbol for
                 non-monetary numeric editing.
LC_TIME         Defines the format and content of date and time information.
LC_MESSAGES     Defines the format and values of affirmative and negative responses.

Options

The following options are supported:

- c             Creates permanent output even if warning messages have been
                issued.
- C compiler_options   Passes the compiler_options to the C compiler (cc). If more than one
                      option is specified, then the options must be enclosed in quotes (" ").
                      This is an old option. Use the -W cc, arg option instead.
- f charmap       Specifies the pathname of a file containing a mapping of character
                 symbols and collating element symbols to actual character encodings.
                 This option must be specified if symbolic names (other than collating
                 symbols defined in a collating-symbol keyword) are used. If the -f
                 option is not present, the default character mapping will be used.
- i sourcefile    The path name of a file containing the source definitions. If this
                 option is not present, source definitions will be read from standard
                 input.
-L linker_options

Passes the *linker_options* to the C compiler (cc) that follows the C source filename. If more than one option is specified, then the options must be enclosed in quotes (" ").

This is an old option. Use the -W cc, arg option instead.

-m model

Specifies whether *localedef* will generate a 64-bit or a 32-bit locale object.

Specify *model* as 1p32 to generate a 32-bit locale object. Specify 1p64 to generate a 64-bit locale object. If the -m option is not specified, *localedef* generates a 32-bit locale object. And if no other options than -c, -f, and -i options are specified and if the system running *localedef* supports the 64-bit environment, *localedef* additionally generates a 64-bit locale object.

-u code_set_name

Specifies the name of a codeset used as the target mapping of character symbols and collating element symbols whose encoding values are defined in terms of the ISO/IEC 10646-1: 2000 standard position constant values. See NOTES.

-W cc, arg

Passes arg options to the C compiler. Each argument must be separated from the preceding by only a comma. A comma can be part of an argument by escaping it within immediately preceding backslash character; the backslash is removed from the resulting argument.

Use this option instead of the -C and -L options.

-x extensions_file

Specifies the name of an extension file where various *localedef* options are listed. See *locale*(5).

**Operands**

The following operand is supported:

localename

Identifies the locale. If the name contains one or more slash characters, *localename* will be interpreted as a path name where the created locale definitions will be stored. This capability may be restricted to users with appropriate privileges. *(As a consequence of specifying one *localename*, although several categories can be processed in one execution, only categories belonging to the same locale can be processed.)*

**Output**

*localedef* creates a temporary C source file that represents the locale's data. *localedef* then calls the C compiler to compile this C source file into a shared object.

If the -m 1p32 option is specified, *localedef* calls the C compiler for generating 32-bit objects and generates a 32-bit locale object. If the -m 1p64 option is specified, *localedef* calls the C compiler for generating 64-bit objects and generates a 64-bit locale object.
If the `-m` option is not specified, `localedef` calls the C compiler for generating 32-bit objects and generates a 32-bit locale object. If no other options than `-c`, `-f`, and `-i` options are specified and if the system running `localedef` supports the 64-bit environment, `localedef` additionally calls the C compiler for generating 64-bit objects and generates a 64-bit locale object.

If no option to the C compiler is explicitly specified using the `-W`, `-C`, or `-L` options, `localedef` calls the C compiler with appropriate C compiler options to generate a locale object or objects.

If the `-m ilp32` option is specified, `localedef` generates a 32-bit locale object named:

`localename.so.version_number`

If the `-m lp64` option is specified, `localedef` generates a 64-bit locale object named:

`localename.so.version_number`

If the `-m` option is not specified, `localedef` generates a 32-bit locale object named:

`localename.so.version_number`

and, if appropriate, generates a 64-bit locale object named:

`64-bit_architecture_name/localename.so.version_number`

The shared object for the 32-bit environment must be moved to:

`/usr/lib/locale/localename/localename.so.version_number`

The shared object for the 64-bit environment on SPARC must be moved to:

`/usr/lib/locale/localename/sparcv9/localename.so.version_number`

The shared object for the 64-bit environment on AMD64 must be moved to:

`/usr/lib/locale/<localename>/amd64/<localename>.so.<version_number>`

`localedef` also generates a text file named `localename` that is used for information only.

### Environment Variables

See `environ(5)` for definitions of the following environment variables that affect the execution of `localedef`: `LANG`, `LC_ALL`, `LC_COLLATE`, `LC_CTYPE`, `LC_MESSAGES`, and `NLSPATH`.

### Exit Status

The following exit values are returned:

- 0  No errors occurred and the locales were successfully created.
- 1  Warnings occurred and the locales were successfully created.
The locale specification exceeded implementation limits or the coded character set or sets used were not supported by the implementation, and no locale was created.

The capability to create new locales is not supported by the implementation.

>3 Warnings or errors occurred and no output was created.

If an error is detected, no permanent output will be created.

Files

/usr/lib/localedef/extensions/generic_eucbc.x
Describes what a generic EUC locale uses in the system. This file is used by default.

/usr/lib/localedef/extensions/single_byte.x
Describes a generic single-byte file used in the system.

/usr/lib/locale/localename/localename.so.version_number
The shared object for the 32-bit environment.

/usr/lib/locale/localename/sparcv9/localename.so.version_number
The shared object for the 64-bit environment on SPARC.

/usr/lib/locale/localename/amd64/localename.so.<version_number>
The shared object for the 64-bit environment on AMD64.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also locale(1), iconv_open(3C), nl_langinfo(3C), strftime(3C), attributes(5), charmap(5), environ(5), extensions(5), locale(5), standards(5)

Warnings

If warnings occur, permanent output will be created if the -c option was specified. The following conditions will cause warning messages to be issued:

- If a symbolic name not found in the charmap file is used for the descriptions of the LC_CTYPE or LC_COLLATE categories (for other categories, this will be an error conditions).
- If optional keywords not supported by the implementation are present in the source.

Notes

When the -u option is used, the code_set_name option-argument is interpreted as a name of a codeset to which the ISO/IEC 10646-1:2000 standard position constant values are converted. Both the ISO/IEC 10646-1:2000 standard position constant values and other formats (decimal, hexadecimal, or octal) are valid as encoding values within the charmap file. The codeset can be any codeset that is supported by the iconv_open(3C) function on the system.
When conflicts occur between the charmap specification of `code_set_name`, `mb_cur_max`, or `mb_cur_min` and the corresponding value for the codeset represented by the `-u` option-argument `code_set_name`, the `localedef` utility fails as an error.

When conflicts occur between the charmap encoding values specified for symbolic names of characters of the portable character set and the character encoding values defined by the US-ASCII, the result is unspecified.

If a non-printable character in the charmap has a width specified that is not -1, `localedef` generates a warning.
logger (1)

**Name**
logger - add entries to the system log

**Synopsis**
logger [-i] [-f file] [-p priority] [-t tag] [message] ...

**Description**
The logger command provides a method for adding one-line entries to the system log file from the command line. One or more message arguments can be given on the command line, in which case each is logged immediately. If this is unspecified, either the file indicated with -f or the standard input is added to the log. Otherwise, a file can be specified, in which case each line in the file is logged. If neither is specified, logger reads and logs messages on a line-by-line basis from the standard input.

**Options**
The following options are supported:

- `-f file`
  Uses the contents of file as the message to log.

- `-i`
  Logs the process ID of the logger process with each line.

- `-p priority`
  Enters the message with the specified priority. The message priority can be specified numerically, or as a facility.level pair. For example, `-p local3.info` assigns the message priority to the info level in the local3 facility. The default priority is user.notice.

- `-t tag`
  Marks each line added to the log with the specified tag.

**Operands**
The following operand is supported:

- `message`
  One of the string arguments whose contents are concatenated together, in the order specified, separated by single space characters.

**Examples**

**EXAMPLE 1**
Examples of the logger command

The following example:

```
example% logger System rebooted
```

logs the message 'System rebooted' to the default priority level notice to be treated by syslogd as are other messages to the facility user.

The next example:

```
example% logger -p local0.notice -t HOSTIDM -f /dev/idmc
```

reads from the file /dev/idmc and logs each line in that file as a message with the tag 'HOSTIDM' at priority level notice to be treated by syslogd as are other messages to the facility local0.

**Environment Variables**
See environ(5) for descriptions of the following environment variables that affect the execution of logger: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

**Exit Status**
The following exit values are returned:

- `0`
  Successful completion.
>0 An error occurred.

**Attributes**  See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
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<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See <code>standards(5)</code>.</td>
</tr>
</tbody>
</table>

**See Also**  `mailx(1), write(1), syslogd(1M), syslog(3C), attributes(5), environ(5), standards(5)`
logger(1B)

Name  logger – add entries to the system log

Synopsis  /usr/ucb/logger [-f filename] [-i] [-p priority] [-t tag] mm
          [message]...

Description  The logger utility provides a method for adding one-line entries to the system log file from
              the command line. One or more message arguments can be given on the command line, in
              which case each is logged immediately. If message is unspecified, either the file indicated with
              -f or the standard input is added to the log. Otherwise, a filename can be specified, in which
              case each line in the file is logged. If neither is specified, logger reads and logs messages on a
              line-by-line basis from the standard input.

Options  The following options are supported:

- i      Log the process ID of the logger process with each line.
- f filename  Use the contents of filename as the message to log.
- p priority  Enter the message with the specified priority. The message priority can be
              specified numerically, or as a facility.level pair. For example, ‘-p
              local3.info’ assigns the message priority to the info level in the local3
              facility. The default priority is user.notice.
- t tag  Mark each line added to the log with the specified tag.

Examples  EXAMPLE 1  Logging a message

The command:

example% logger System rebooted

will log the message 'System rebooted' to the facility at priority notice to be treated by
syslogd as other messages to the facility notice are.

EXAMPLE 2  Logging messages from a file

The command:

example% logger -p local0.notice -t HOSTIDM -f /dev/idmc

will read from the file /dev/idmc and will log each line in that file as a message with the tag
'HOSTIDM' at priority notice to be treated by syslogd as other messages to the facility local0
are.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>
See Also  syslogd(1M), syslog(3C), attributes(5)
**Name**
login – sign on to the system

**Synopsis**
```
login [-p] [-d device] [-R repository] [-s service]
   [-t terminal] [-u identity] [-U ruser]
   [-h hostname [terminal] | -r hostname]
   [name | environ]...
```

**Description**
The `login` command is used at the beginning of each terminal session to identify oneself to
the system. `login` is invoked by the system when a connection is first established, after the
previous user has terminated the login shell by issuing the `exit` command.

Login cannot be invoked as a command, except by the superuser.

If `login` is invoked as a command, it must replace the initial command interpreter. To invoke
`login` in this fashion, type:

```
exec login
```

from the initial shell. The C shell and Korn shell have their own built-ins of `login`. See `ksh(1),
ksh88(1), and csh(1)` for descriptions of login built-ins and usage.

`login` asks for your user name, if it is not supplied as an argument, and your password, if
appropriate. Where possible, echoing is turned off while you type your password, so it does
not appear on the written record of the session.

If you make any mistake in the login procedure, the message:

```
Login incorrect
```

is printed and a new login prompt appears. If you make five incorrect login attempts, all five
can be logged in `/var/adm/loginlog`, if it exists. The TTY line is dropped.

If password aging is turned on and the password has aged (see `passwd(1)` for more
information), the user is forced to change the password. In this case the `/etc/nsswitch.conf`
file is consulted to determine password repositories (see `nsswitch.conf(4)`). The password
update configurations supported are limited to the following five cases.

- `passwd`: files
- `passwd`: files nis
- `passwd`: compat (==> files nis)

Failure to comply with the configurations prevents the user from logging onto the system
because `passwd(1)` fails. If you do not complete the login successfully within a certain period
of time, it is likely that you are silently disconnected.

After a successful login, accounting files are updated. Device owner, group, and permissions
are set according to the contents of the `/etc/logindevperm` file, and the time you last logged
in is printed (see `logindevperm(4)`).

The user-ID, group-ID, supplementary group list, and working directory are initialized, and
the command interpreter is started.
The basic environment is initialized to:

- `HOME=your-login-directory`
- `LOGNAME=your-login-name`
- `PATH=/usr/bin:
- `SHELL=last-field-of-passwd-entry`
- `MAIL=/var/mail/
- `TZ=timezone-specification`

For Bourne shell and Korn shell logins, the shell executes `/etc/profile` and `$HOME/.profile`, if it exists.

For the ksh Korn shell, an interactive shell then executes `/etc/ksh.kshrc`, followed by the file specified by the `ENV` environment variable. If `ENV` is not set, this defaults to `$HOME/.kshrc`. For the ksh and `/usr/xpg4/bin/sh` Korn Shell, an interactive shell executes the file named by `ENV` (no default).

For C shell logins, the shell executes `/etc/.login`, `$HOME/.cshrc`, and `$HOME/.login`. The default `/etc/profile` and `/etc/.login` files check quotas (see `quota(1M)`), print `/etc/motd`, and check for mail. None of the messages are printed if the file `$HOME/.hushlogin` exists. The name of the command interpreter is set to `-` (dash), followed by the last component of the interpreter’s path name, for example, `-sh`.

If the `login-shell` field in the password file (see `passwd(4)`) is empty, then the default command interpreter, `/usr/bin/sh`, is used. If this field is `*` (asterisk), then the named directory becomes the root directory. At that point, `login` is re-executed at the new level, which must have its own root structure.

The environment can be expanded or modified by supplying additional arguments to `login`, either at execution time or when `login` requests your login name. The arguments can take either the form `xxx` or `xxx=yyy`. Arguments without an `=` (equal sign) are placed in the environment as:

```
Lnn=xxx
```

where `n` is a number starting at 0 and is incremented each time a new variable name is required. Variables containing an `=` (equal sign) are placed in the environment without modification. If they already appear in the environment, then they replace the older values.

There are two exceptions: The variables `PATH` and `SHELL` cannot be changed. This prevents people logged into restricted shell environments from spawning secondary shells that are not restricted. `login` understands simple single-character quoting conventions. Typing a `\` (backslash) in front of a character quotes it and allows the inclusion of such characters as spaces and tabs.

Alternatively, you can pass the current environment by supplying the `-p` flag to `login`. This flag indicates that all currently defined environment variables should be passed, if possible, to
the new environment. This option does not bypass any environment variable restrictions mentioned above. Environment variables specified on the login line take precedence, if a variable is passed by both methods.

To enable remote logins by root, edit the /etc/default/login file by inserting a # (pound sign) before the CONSOLE=/dev/console entry. See FILES.

**Security** For accounts in the files (passwd(4) and shadow(4)) name service, or the ldap name service, when configured with enableShadowUpdate true, the account can be configured to be automatically locked if successive failed login attempts equals or exceeds the configured value. See ldapclient(1M), user_attr(4), policy.conf(4), and pam_unix_auth(5).

The login command uses pam(3PAM) for authentication, account management, session management, and password management. The PAM configuration policy, listed in either /etc/pam.conf or /etc/pam.d/login, specifies the modules to be used for login. Here is a partial pam.conf file with entries for the login command using the UNIX authentication, account management, and session management modules:

```
login auth  required  pam_authtok_get.so.1
login auth  required  pam_dhkeys.so.1
login auth  required  pam_unix_auth.so.1
login auth  required  pam_dial_auth.so.1

login account requisite  pam_roles.so.1
login account required    pam_unix_account.so.1

login session required   pam_unix_session.so.1
```

The equivalent PAM configuration in /etc/pam.d/ would be the following entries in /etc/pam.d/login:

```
auth   required  pam_authtok_get.so.1
auth   required  pam_dhkeys.so.1
auth   required  pam_unix_auth.so.1
auth   required  pam_dial_auth.so.1
account requisite  pam_roles.so.1
account required    pam_unix_account.so.1

session required pam_unix_session.so.1
```

The Password Management stack in /etc/pam.conf typically looks like the following:

```
other password required  pam_dhkeys.so.1
other password requisite pam_authtok_get.so.1
other password requisite pam_authtok_check.so.1
other password required  pam_authtok_store.so.1
```

If there are no entries for a PAM service in /etc/pam.conf and /etc/pam.d/service then the entries for the "other" service in /etc/pam.conf are used. If there are not any entries in
/etc/pam.conf for the "other" service, then the entries in /etc/pam.d/other will be used. If multiple authentication modules are listed, then the user can be prompted for multiple passwords.

When login is invoked through rlogin or telnetd, the service name used by PAM is rlogin or telnet, respectively.

**Options** The following options are supported:

- `-d device`
  
  `login` accepts a device option, *device*. *device* is taken to be the path name of the TTY port `login` is to operate on. The use of the device option can be expected to improve `login` performance, since `login` does not need to call `ttyname(3C)`. The `-d` option is available only to users whose UID and effective UID are root. Any other attempt to use `-d` causes `login` to quietly exit.

- `-h hostname [terminal]`
  
  Used by `in.telnetd(1M)` to pass information about the remote host and terminal type. Terminal type as a second argument to the `-h` option should not start with a hyphen (-).

- `-p`
  
  Used to pass environment variables to the login shell.

- `-r hostname`
  
  Used by `in.rlogind(1M)` to pass information about the remote host.

- `-R repository`
  
  Used to specify the PAM repository that should be used to tell PAM about the "identity" (see option `-u` below). If no "identity" information is passed, the repository is not used.

- `-s service`
  
  Indicates the PAM service name that should be used. Normally, this argument is not necessary and is used only for specifying alternative PAM service names. For example: "ktelnet" for the Kerberized telnet process.

- `-u identity`
  
  Specifies the "identity" string associated with the user who is being authenticated. This usually is not the same as that user's Unix login name. For Kerberized login sessions, this is the Kerberos principal name associated with the user.

- `-U ruser`
  
  Indicates the name of the person attempting to login on the remote side of the rlogin connection. When `in.rlogind(1M)` is operating in Kerberized mode, that daemon processes the terminal and remote user name information prior to invoking `login`, so the "ruser" data is indicated using this command line parameter. Normally (non-Kerberos authenticated rlogin), the `login` daemon reads the remote user information from the client.
Exit Status  The following exit values are returned:

0  Successful operation.
non-zero  Error.

Files

$HOME/.cshrc  
Initial commands for each csh.

$HOME/.hushlogin  
Suppresses login messages.

$HOME/.kshrc  
User's commands for interactive ksh, if $ENV is unset; executes after /etc/ksh.kshrc.

$HOME/.login  
User's login commands for csh.

$HOME/.profile  
User's login commands for sh and ksh.

$HOME/.rhosts  
Private list of trusted hostname/username combinations.

/etc/.login  
System-wide csh login commands.

/etc/issue  
Issue or project identification.

/etc/ksh.kshrc  
System-wide commands for interactive ksh.

/etc/logindevperm  
Login-based device permissions.

/etc/motd  
Message-of-the-day.

/etc/nologin  
Message displayed to users attempting to login during machine shutdown.

/etc/passwd  
Password file.

/etc/profile  
System-wide sh and ksh login commands.

/etc/shadow  
List of users' encrypted passwords.
/usr/bin/sh
User's default command interpreter.

/var/adm/lastlog
Time of last login.

/var/adm/loginlog
Record of failed login attempts.

/var/adm/utmpx
Accounting.

/var/adm/wtmpx
Accounting.

/var/mail/your-name
Mailbox for user your-name.

/etc/default/login
Default value can be set for the following flags in /etc/default/login. Default values are specified as comments in the /etc/default/login file, for example, TIMEZONE=EST5EDT.

TIMEZONE
Sets the TZ environment variable of the shell (see environ(5)).

HZ
Sets the HZ environment variable of the shell.

ULIMIT
Sets the file size limit for the login. Units are disk blocks. Default is zero (no limit).

CONSOLE
If set, root can login on that device only. This does not prevent execution of remote commands with rsh(1). Comment out this line to allow login by root.

PASSREQ
Determines if login requires a non-null password.

ALTSHELL
Determines if login should set the SHELL environment variable.

PATH
Sets the initial shell PATH variable.

SUPATH
Sets the initial shell PATH variable for root.

TIMEOUT
Sets the number of seconds (between 0 and 900) to wait before abandoning a login session.

UMASK
Sets the initial shell file creation mode mask. See umask(1).
SYSLOG
Determines whether the syslog(3C) LOG_AUTH facility should be used to log all root logins at level LOG_NOTICE and multiple failed login attempts at LOG_CRIT.

DISABLETIME
If present, and greater than zero, the number of seconds that login waits after RETRIES failed attempts or the PAM framework returns PAM_ABORT. Default is 20 seconds. Minimum is 0 seconds. No maximum is imposed.

SLEEPTIME
If present, sets the number of seconds to wait before the login failure message is printed to the screen. This is for any login failure other than PAM_ABORT. Another login attempt is allowed, providing RETRIES has not been reached or the PAM framework is returned PAM_MAXTRIES. Default is 4 seconds. Minimum is 0 seconds. Maximum is 5 seconds.

Both su(1M) and sulogin(1M) are affected by the value of SLEEPTIME.

RETRIES
Sets the number of retries for logging in (see pam(3PAM)). The default is 5. The maximum number of retries is 15. For accounts configured with automatic locking (see SECURITY above), the account is locked and login exits. If automatic locking has not been configured, login exits without locking the account.

SYSLOG_FAILED_LOGINS
Used to determine how many failed login attempts are allowed by the system before a failed login message is logged, using the syslog(3C) LOG_NOTICE facility. For example, if the variable is set to 0, login logs all failed login attempts.

Of the flags listed in /etc/default/login, sshd(1M) (which see) uses:
- TIMEZONE
- HZ
- ALTShell
- PATH
- SUPATH
- CONSOLE
- PASSREQ
- UMASK
- ULIMIT
- RETRIES
- SYSLOG_AFTER_FAILED_LOGINS

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>
## See Also

csh(1), exit(1), ksh(1), ksh88(1), mail(1), mailx(1), newgrp(1), passwd(1), rlogin(1), rsh(1), sh(1), shell.builtins(1), telnet(1), umask(1), in.rlogind(1M), in.telnetd(1M), user_attr(4) and policy.conf(4), logins(1M), quota(1M), sshd(1M), su(1M), sulogin(1M), syslogd(1M), useradd(1M), userdel(1M), pam(3PAM), rcmd(3SOCKET), syslog(3C), ttyname(3C), auth_attr(4), exec_attr(4), hosts.equiv(4), issue(4), logindевперм(4), loginlog(4), nologin(4), nsswitch.conf(4), pam.conf(4), passwd(4), policy.conf(4), profile(4), shadow(4), user_attr(4), utmpx(4), wtmpx(4), attributes(5), environ(5), pam_unix_account(5), pam_unix_auth(5), pam_unix_session(5), pam_authtok_check(5), pam_authtok_get(5), pam_authtok_store(5), pam_dhkeys(5), pam_passwd_auth(5), termio(7I)

## Diagnostics

Login incorrect

The user name or the password cannot be matched.

Not on system console

Root login denied. Check the CONSOLE setting in /etc/default/login.

No directory! Logging in with home=/

The user’s home directory named in the passwd(4) database cannot be found or has the wrong permissions. Contact your system administrator.

No shell

Cannot execute the shell named in the passwd(4) database. Contact your system administrator.

NO LOGINS: System going down in $N$ minutes

The machine is in the process of being shut down and logins have been disabled.

## Warnings

Users with a UID greater than 76695844 are not subject to password aging, and the system does not record their last login time.

If you use the CONSOLE setting to disable root logins, you should arrange that remote command execution by root is also disabled. See rsh(1), rcmd(3SOCKET), and hosts.equiv(4) for further details.
logname – return user’s login name

**Synopsis**

/usr/bin/logname

**Description**

logname writes the user’s login name to standard output. The login name is the string that is returned by the `getlogin(3C)` function. If `getlogin()` does not return successfully, the name corresponding to the real user ID of the calling process is used instead.

**Environment Variables**

See `environ(5)` for descriptions of the following environment variables that affect the execution of `logname`: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

**Exit Status**

The following error values are returned:

- `0`  Successful completion.
- `>0`  An error occurred.

**Files**

/etc/profile  Environment for user at login time

/var/adm/utmpx  User and accounting information

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See <code>standards(5)</code>.</td>
</tr>
</tbody>
</table>

**See Also**

`env(1), login(1), getlogin(3C), utmpx(4), attributes(5), environ(5), standards(5)`
**Name**  logout – shell built-in function to exit from a login session

**Synopsis**

csh logout

**Description**

csh Terminate a login shell.

**Attributes**  See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

**See Also**  `csh(1), login(1), attributes(5)`
**Name**  
`look` – find words in the system dictionary or lines in a sorted list

**Synopsis**  
`/usr/bin/look [-d] [-f] [-tc] string [filename]`

**Description**  
The `look` command consults a sorted `filename` and prints all lines that begin with `string`.

If no `filename` is specified, `look` uses `/usr/share/lib/dict/words` with collating sequence `-df`.

`look` limits the length of a word to search for to 256 characters.

**Options**  
- `-d`  
  Dictionary order. Only letters, digits, TAB and SPACE characters are used in comparisons.

- `-f`  
  Fold case. Upper case letters are not distinguished from lower case in comparisons.

- `-tc`  
  Set termination character. All characters to the right of `c` in `string` are ignored.

**Files**  
`/usr/share/lib/dict/words`  
spelling list

**Attributes**  
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/extended-system-utilities</td>
</tr>
</tbody>
</table>

**See Also**  
grep(1), sort(1), attributes(5)
A bibliographic reference is a set of lines, constituting fields of bibliographic information. Each field starts on a line beginning with a ‘%’, followed by a key-letter, then a blank, and finally the contents of the field, which may continue until the next line starting with ‘%’.

The `lookbib` utility uses an inverted index made by `indxbib` to find sets of bibliographic references. It reads keywords typed after the ‘>’ prompt on the terminal, and retrieves records containing all these keywords. If nothing matches, nothing is returned except another ‘>’ prompt.

It is possible to search multiple databases, as long as they have a common index made by `indxbib(1)`. In that case, only the first argument given to `indxbib` is specified to `lookbib`.

If `lookbib` does not find the index files (the `.i[abc]` files), it looks for a reference file with the same name as the argument, without the suffixes. It creates a file with a `.ig` suffix, suitable for use with `fgrep` (see `grep(1)`). `lookbib` then uses this `fgrep` file to find references. This method is simpler to use, but the `.ig` file is slower to use than the `.i[abc]` files, and does not allow the use of multiple reference files.

### Files
- `x.ia`
- `x.ib`
- `x.ic`  index files
- `x.ig`  reference file

### Attributes
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>text/doctools</td>
</tr>
</tbody>
</table>

### See Also
- `addbib(1)`, `grep(1)`, `indxbib(1)`, `refer(1)`, `roffbib(1)`, `sortbib(1)`, `attributes(5)`

### Bugs
Probably all dates should be indexed, since many disciplines refer to literature written in the 1800s or earlier.
**lorder(1)**

**Name**
lorder – find ordering relation for an object or library archive

**Synopsis**
```bash
lorder filename...
```

**Description**
The input is one or more object or library archive filenames (see ar(1)). The standard output is a list of pairs of object file or archive member names; the first file of the pair refers to external identifiers defined in the second. The output may be processed by tsort(1) to find an ordering of a library suitable for one-pass access by ld. Note that the link editor ld is capable of multiple passes over an archive in the portable archive format (see ar.h(3HEAD)) and does not require that lorder be used when building an archive. The usage of the lorder command may, however, allow for a more efficient access of the archive during the link edit process.

The following example builds a new library from existing .o files.

```bash
ar -cr library 'lorder *.o | tsort'
```

**Files**

- `TMPDIR/*symref` temporary files
- `TMPDIR/*symdef` temporary files
- `TMPDIR` usually /var/tmp but can be redefined by setting the environment variable TMPDIR. See tmpnam() in tmpnam(3C).

**Attributes**
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/base-developer-utilities</td>
</tr>
</tbody>
</table>

**See Also**
ar(1), ld(1), tsort(1), tmpnam(3C), ar.h(3HEAD), attributes(5)

**Notes**
lorder will accept as input any object or archive file, regardless of its suffix, provided there is more than one input file. If there is but a single input file, its suffix must be .o.

The length of the filename for TMPDIR is limited to whatever sed allows.
ls(1)

Name ls – list contents of directory

Synopsis

```
ls [-aAbcCdeEfFghHiklLmnopqrRsStuUwvX@]
    [-/c | -/v] [-% atime | ctime | mtime | all]
    [--block-size size] [--color[=when]] [--file-type]
    [--si] [--time-style style] [file]...
```

For each file that is a directory, ls lists the contents of the directory. For each file that is an ordinary file, ls repeats its name and any other information requested. The output is sorted alphabetically by default. When no argument is given, the current directory (.) is listed. When several arguments are given, the arguments are first sorted appropriately, but file arguments appear before directories and their contents.

There are three major listing formats. The default format for output directed to a terminal is multi−column with entries sorted down the columns. The -1 option allows single column output and -m enables stream output format. In order to determine output formats for the -C, -x, and -m options, ls uses an environment variable, COLUMNS, to determine the number of character positions available on one output line. If this variable is not set, the terminfo(4) database is used to determine the number of columns, based on the environment variable, TERM. If this information cannot be obtained, 80 columns are assumed. If the -w option is used, the argument overrides any other column width.

The mode printed when the -e, -E, -g, -l, -n, -o, -v, -V, or -@ option is in effect consists of eleven characters. The first character can be one of the following:

- d: The entry is a directory.
- D: The entry is a door.
- l: The entry is a symbolic link.
- b: The entry is a block special file.
- c: The entry is a character special file.
The entry is a FIFO (or "named pipe") special file.

The entry is an event port.

The entry is an AF_UNIX address family socket.

The entry is an ordinary file.

The next 9 characters are interpreted as three sets of three bits each. The first set refers to the owner's permissions; the next to permissions of others in the user-group of the file; and the last to all others. Within each set, the three characters indicate permission to read, to write, and to execute the file as a program, respectively. For a directory, execute permission is interpreted to mean permission to search the directory for a specified file. The character after permissions is an ACL or extended attributes indicator. This character is an @ if extended attributes are associated with the file and the -@ option is in effect. Otherwise, this character is a plus sign (+) character if a non-trivial ACL is associated with the file or a space character if not.

If -/ and/or -% are in effect, then the extended system attributes are printed when filesystem supports extended system attributes. The display looks as follows:

```bash
$ ls -/ c file
-rw-r--r-- 1 root root 0 May 10 14:17 file
{AHRSadim-u}
```

```bash
$ ls -/ v file
-rw-r--r-- 1 root root 0 May 10 14:17 file
{archive,hidden,readonly,system,appendonly
 nodump,immutable, av_modified,\
 noav_quarantined,nounlink}
```

```bash
$ ls -l -% all file
-rw-r--r-- 1 root root 0 May 10 14:17 file
<timestamp: mtime May 10 14:17:56 2007>
<timestamp: crtime May 10 14:17:56 2007>
```

See the option descriptions of the -/ and -% option for details.

`ls -l` (the long list) prints its output as follows for the POSIX locale:

```bash
-rwxrwxrwx+ 1 smith dev 10876 May 16 9:42 part2
```

Reading from right to left, you see that the current directory holds one file, named part2. Next, the last time that file's contents were modified was 9:42 A.M. on May 16. The file contains 10,876 characters, or bytes. The owner of the file, or the user, belongs to the group
dev (perhaps indicating development), and his or her login name is smith. The number, in this case 1, indicates the number of links to file part2 (see cp(1)). The plus sign indicates that there is an ACL associated with the file. If the -@ option has been specified, the presence of extended attributes supersedes the presence of an ACL and the plus sign is replaced with an 'at' sign (@). Finally, the dash and letters tell you that user, group, and others have permissions to read, write, and execute part2.

The execute (x) symbol occupies the third position of the three-character sequence. A – in the third position would have indicated a denial of execution permissions.

The permissions are indicated as follows:

r
  The file is readable.

w
  The file is writable.

x
  The file is executable.

–
  The indicated permission is not granted.

s
  The set-user-ID or set-group-ID bit is on, and the corresponding user or group execution bit is also on.

S
  Undefined bit-state (the set-user-ID or set-group-id bit is on and the user or group execution bit is off). For group permissions, this applies only to non-regular files.

t
  The 1000 (octal) bit, or sticky bit, is on (see chmod(1)), and execution is on.

T
  The 1000 bit is turned on, and execution is off (undefined bit-state).

l
  Mandatory locking occurs during access (on a regular file, the set-group-ID bit is on and the group execution bit is off).

L
  Mandatory locking occurs during access (on a regular file, the set-group-ID bit is on and the group execution bit is off).

For user and group permissions, the third position is sometimes occupied by a character other than x or -. s or S also can occupy this position, referring to the state of the set-ID bit, whether
it be the user's or the group's. The ability to assume the same ID as the user during execution
is, for example, used during login when you begin as root but need to assume the identity of
the user you login as.

In the case of the sequence of group permissions, 1 can occupy the third position. 1 refers to
mandatory file and record locking. This permission describes a file's ability to allow other files
to lock its reading or writing permissions during access.

For others permissions, the third position can be occupied by t or T. These refer to the state of
the sticky bit and execution permissions.

Options

The following options are supported:

The following options are supported for all three versions:

-a
   --all
      Lists all entries, including those that begin with a dot (.), which are normally not listed.

-A
   --almost-all
      Lists all entries, including those that begin with a dot (.), with the exception of the working
directory (.) and the parent directory (..).

-b
   --escape
      Forces printing of non-printable characters to be in the octal \ddd notation.

-B
   --ignore-backups
      Do not display any files ending with a tilde (~).

-c
   -c
      Uses time of last modification of the i-node (file created, mode changed, and so forth) for
sorting (-t) or printing (-l or -n).

-C
   -C
      Multi-column output with entries sorted down the columns. This is the default output
format.

-d
   -d
      If an argument is a directory, lists only its name (not its contents). Often used with -l to get
the status of a directory.

-e
   -e
      The same as -l, except displays time to the second, and with one format for all files
regardless of age: mmm dd hh:mm:ss yyyy.
-E
The same as -l, except displays time to the nanosecond and with one format for all files regardless of age: yyyy-mm-dd hh:mm:ss.nnnnnnnn (ISO 8601:2000 format).

In addition, this option displays the offset from UTC in ISO 8601:2000 standard format (+hhmm or -hhmm) or no characters if the offset is indeterminable. The offset reflects the appropriate standard or alternate offset in force at the file's displayed date and time, under the current timezone.

-f
Forces each argument to be interpreted as a directory and list the name found in each slot. This option turns off -l, -t, -s, -S, and -r, and turns on -a. The order is the order in which entries appear in the directory.

-F
--classify
Append a symbol after certain types of files to indicate the file type. The following symbols are used:

/ Directory
> Door file
| Named pipe (FIFO)
@ Symbolic link
= Socket
* Executable

-g
The same as -l, except that the owner is not printed.

-h
--human-readable
All sizes are scaled to a human readable format, for example, 14K, 234M, 2.7G, or 3.0T. Scaling is done by repetitively dividing by 1024. The last --si or --h option determines the divisor used.

-H
--dereference-command-line
If an argument is a symbolic link that references a directory, this option evaluates the file information and file type of the directory that the link references, rather than those of the link itself. However, the name of the link is displayed, rather than the referenced directory.

-1
--inode
For each file, prints the i-node number in the first column of the report.

-k
All sizes are printed in kbytes. Equivalent to --block-size=1024.

-l
Lists in long format, giving mode, ACL indication, number of links, owner, group, size in bytes, and time of last modification for each file (see above). If the file is a special file, the size field instead contains the major and minor device numbers. If the time of last modification is greater than six months ago, it is shown in the format ‘month date year’ for the POSIX locale. When the LC_TIME locale category is not set to the POSIX locale, a different format of the time field can be used. Files modified within six months show ’month date time’. If the file is a symbolic link, the filename is printed followed by “→” and the path name of the referenced file.

-L
--dereference
If an argument is a symbolic link, this option evaluates the file information and file type of the file or directory that the link references, rather than those of the link itself. However, the name of the link is displayed, rather than the referenced file or directory.

-m
Streams output format. Files are listed across the page, separated by commas.

-n
--numeric-uid-gid
The same as -l, except that the owner’s UID and group’s GID numbers are printed, rather than the associated character strings.

-o
--no-group
The same as -l, except that the group is not printed.

-p
Puts a slash (/) after each filename if the file is a directory.

-q
--hide-control-chars
Forces printing of non-printable characters in file names as the character question mark (?)..

-r
--reverse
Reverses the order of sort to get reverse alphabetic, oldest first, or smallest file size first as appropriate.

-R
-recursive

Recursively lists subdirectories encountered.

-s
-size

Indicate the total number of file system blocks consumed by each file displayed.

-S

Sort by file size (in decreasing order) and for files with the same size by file name (in increasing alphabetic order) instead of just by name.

-t

Sorts by time stamp (latest first) instead of by name. The default is the last modification time. See -c, -u and -%. 

-u

Uses time of last access instead of last modification for sorting (with the -t option) or printing (with the -l option).

-U

Output is unsorted.

-v

The same as -l, except that verbose ACL information is displayed as well as the -l output. ACL information is displayed even if the file or directory doesn’t have an ACL.

-\V

The same as -l, except that compact ACL information is displayed after the -l output.

The -\V option is only applicable to file systems that support NFSv4 ACLs, such as the Solaris ZFS file system.

The format of the displayed ACL is as follows:

entry_type : permissions : inheritance_flags : access_type

entry_type is displayed as one of the following:

user:username

Additional user access for username.

group:groupname

Additional group access for group groupname.

owner@

File owner.
group@
  File group owner.

everyone@
  Everyone access, including file owner and file group owner. This is not equivalent to the
  POSIX other class.

The following permissions, supported by the NFSv4 ACL model, are displayed by using the
-v or -V options:

read_data (r)
  Permission to read the data of a file.

list_directory (r)
  Permission to list the contents of a directory.

write_data (w)
  Permission to modify a file's data. anywhere in the file's offset range.

add_file (w)
  Permission to add a new file to a directory.

append_data (p)
  The ability to modify a file's data, but only starting at EOF.

add_subdirectory (p)
  Permission to create a subdirectory to a directory.

read_xattr (R)
  Ability to read the extended attributes of a file.

write_xattr (w)
  Ability to create extended attributes or write to the extended attribute directory.

execute (x)
  Permission to execute a file.

read_attributes (a)
  The ability to read basic attributes (non-ACLs) of a file.

write_attributes (A)
  Permission to change basic attributes (non-ACLs) of a file.

delete (d)
  Permission to delete a file.

delete_child (D)
  Permission to delete a file within a directory.

read_acl (c)
  Permission to read the ACL of a file.
write_acl (C)
  Permission to write the ACL of a file.

write_owner (o)
  Permission to change the owner of a file.

synchronize (s)
  Permission to access file locally at server with synchronize reads and writes.

-No permission granted

The following inheritance flags, supported by the NFSv4 ACL model, are displayed by using the -v or -V options:

file_inherit (f)
  Inherit to all newly created files.

dir_inherit (d)
  Inherit to all newly created directories.

inherit_only (i)
  When placed on a directory, do not apply to the directory, only to newly created files and directories. This flag requires that either file_inherit and or dir_inherit is also specified.

no_propagate (n)
  Indicates that ACL entries should be inherited to objects in a directory, but inheritance should stop after descending one level. This flag is dependent upon either file_inherit and or dir_inherit also being specified.

successful_access (S)
  Indicates if an alarm or audit record should be initiated upon successful accesses. Used with audit/alarm ACE types.

failed_access (F)
  Indicates if an alarm or audit record should be initiated when access fails. Used with audit/alarm ACE types.

inherited (I)
  ACE was inherited.

-No permission granted.

access_type is displayed as one of the following types:

alarm  Permission field that specifies permissions that should trigger an alarm.
allow  Permission field that specifies allow permissions.
audit  Permission field that specifies permissions that should be audited.
deny  Permission field that specifies deny permissions.

For example:

```bash
$ ls -dV /sandbox/dir.1
drwxr-xr-x+ 2 root root 2 Jan 17 15:09 dir.1
  user:marks:r------------:fd----:allow
  owner@:---------------:-------:deny
  owner@:rwxp-A-W-Co:------:allow
  group@:-w-p----------:-------:deny
  group@:r-x-----------:-------:allow
  everyone@:-w-p-A-W-Co:-----:deny
  everyone@:r-x-a-R-c-s:----:allow
$```

Multi-column output where the column width is forced to `cols`.

```
-w cols
```

Multi-column output with entries sorted across rather than down the page.

```
-x
```

Prints one entry per line of output.
The same as -l, except that extended attribute information overrides ACL information. An @ is displayed after the file permission bits for files that have extended attributes.

The -/ option supports two option arguments c (compact mode) and v (verbose mode). Displays the long listing, same as -l. In addition, displays the extended system attributes associated with the file when extended system attributes are fully supported by the underlying file system.

appendonly
    Allows a file to be modified only at offset EOF. Attempts to modify a file at a location other than EOF fails with EPERM.

archive
    Indicates if a file has been modified since it was last backed up. Whenever the modification time (mtime) of a file is changed the archive attribute is set.

av_modified
    ZFS sets the anti-virus attribute which whenever a file's content or size changes or when the file is renamed.

av_quarantined
    Anti-virus software sets to mark a file as quarantined.

crtime
    Timestamp when a file is created.

hidden
    Marks a file as hidden.

immutable
    Prevents the content of a file from being modified. Also prevents all metadata changes, except for access time updates. When placed on a directory, prevents the deletion and creation of files in the directories. Attempts to modify the content of a file or directory marked as immutable fail with EPERM. Attempts to modify any attributes (with the exception of access time and, with the proper privileges, the immutable) of a file marked as immutable fails with EPERM.

nodump
    Solaris systems have no special semantics for this attribute.

nounlink
    Prevents a file from being deleted. On a directory, the attribute also prevents any changes to the contents of the directory. That is, no files within the directory can be removed or renamed. The errno EPERM is returned when attempting to unlink or rename files and directories that are marked as nounlink.
readonly
Marks a file as readonly. Once a file is marked as readonly the content data of the file cannot be modified. Other metadata for the file can still be modified.

sparse
This attribute is available to users and applications to indicate that a file can be interpreted as sparse. It does not indicate whether or not the file is actually sparse and it has no special semantics on the Solaris operating system. The sparse attribute will be cleared if the file is truncated to zero length.

system
Solaris systems have no special semantics for this attribute.

The display characters used in compact mode (-/c) are as follows:

<table>
<thead>
<tr>
<th>Attribute Name</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>archive</td>
<td>A</td>
</tr>
<tr>
<td>hidden</td>
<td>H</td>
</tr>
<tr>
<td>readonly</td>
<td>R</td>
</tr>
<tr>
<td>system</td>
<td>S</td>
</tr>
<tr>
<td>appendonly</td>
<td>a</td>
</tr>
<tr>
<td>nodump</td>
<td>d</td>
</tr>
<tr>
<td>immutable</td>
<td>i</td>
</tr>
<tr>
<td>av_modified</td>
<td>m</td>
</tr>
<tr>
<td>av_quarantined</td>
<td>q</td>
</tr>
<tr>
<td>sparse</td>
<td>s</td>
</tr>
<tr>
<td>nounlink</td>
<td>u</td>
</tr>
</tbody>
</table>

The display in verbose mode (-/v) uses full attribute names when it is set and the name prefixed by `no` when it is not set.

The attribute name `ctime` and all other timestamps are handled by the option `-%` with the respective timestamp option arguments and also with all option argument. The display positions are as follows: The display in verbose mode (-/v) uses full attribute names when it is set and the name prefixed by `no` when it is not set. The attribute name `ctime` and all other timestamps are handled by the option `-%` with the respective timestamp option arguments and also with all option argument.

The display positions are as follows:

```
{|||------||}+ s (sparse)
|||------||+-- O (offline)
|||------||+-- u (nounlink)
|||------|++++ q (av_quarantined)
|||------|++++ m (av_modified)
|||------|++++ i (immutable)
|||------|++++ d (nodump)
|||------|++++ a (appendonly)
```
ls(1)

-+-------- S (system)
-+-------- R (readonly)
-+-------- H (hidden)
-+-------- A (archive)

-% atime | crtime | ctime | mtime | all

atime
   Equivalent to -u.

crtime
   Uses the creation time of the file for sorting or printing.

ctime
   Equivalent to -c.

mtime
   Uses the last modification time of the file contents for sorting or printing.

If extended system attributes are not supported or if the user does not have read permission on the file or if the crtime extended attribute is not set, crtime is treated as a synonym for mtime.

When option argument -all is specified, all available timestamps are printed which includes -atime, -ctime, -mtime and on the extended system attribute supporting file systems, -crtime (create time). The option -% all does not effect which timestamp is displayed in long format and does not affect sorting.

--block-size size
   Display sizes in multiples of size. Size can be scaled by suffixing one of YyZzEePpTtGgMmKk. Additionally, a B can be placed at the end to indicate powers of 10 instead of 2. For example, 10mB means blocks of 10000000 bytes while 10m means blocks of 10*2^20 -- 10485760 bytes. This is mutually exclusive with the -h option.

--color [=when]
--colour [=when]
   Display filenames using color on color-capable terminals. when is an optional argument that determines when to display color output.

Possible values for when are:
always
yes
force
   Always use color.
auto
tty
if-tty
   Use color if a terminal is present.
no
never
none

Never use color. This is the default

See the Color Output section of this manual page for information on how to control the output colors.

--file-type
Display a suffix after a file depending on its type, similar to the -F option, except * is not appended to executable files.

--si
Display human scaled sizes similar to the -h option, except values are repeatedly divided by 1000 instead of 1024. The last option --si or -h determines the divisor used.

--time-style style
Display times using the specified style. This does not effect the times displayed for extended attributes (.-).

Possible values for style are:

full-iso
Equivalent to --E.

long-iso
Display in YYYY-MM-DD HH:MM for all files.

iso
Display older files using YYYY-MM-DD and newer files with MM-DD HH:MM.

locale
Use the default locale format for old and new files. This is the default.

+FORMAT
Use a custom format. Values are the same as described in strftime(3C). If a NEWLINE appears in the string, the first line is used for older files and the second line is used for newer files. Otherwise, the given format is used for all files.

/usr/bin/ls -F
Marks directories with a trailing slash (/), doors with a trailing greater-than sign (>), executable files with a trailing asterisk (*), FIFOs with a trailing vertical bar (|), symbolic links with a trailing "at" sign (@), and AF_UNIX address family sockets with a trailing equals sign (=). Follows symlinks named as operands.

--file-type
Marks entries as with -F with the exception of executable files. Executable files are not marked. Follows symlinks named as operands.
Specifying more than one of the options in the following mutually exclusive pairs is not considered an error: `-C` and `-l (ell)`, `-m and `-l (ell)`, `-x and `-l (ell)`, `-@ and `-l (ell)`. The `-l` option overrides the other option specified in each pair.

Specifying more than one of the options in the following mutually exclusive groups is not considered an error: `-C` and `-l (one)`, `-H` and `-L`, `-c and `-u`, and `-e and `-E`, and `-t and `-S`. The last option specifying a specific timestamp (`-c`, `-u`, `-% atime`, `-% crtime`, `-% ctime`, and `-% mtime`) determines the timestamps used for sorting or in long format listings. The last option `-t`, `-S`, or `-U` determines the sorting behavior.

```
/usr/xpg4/bin/ls -F
Marks directories with a trailing slash (/), doors with a trailing greater-than sign (>), executable files with a trailing asterisk (*), FIFOs with a trailing vertical bar (|), symbolic links with a trailing "at" sign (@), and AF_UNIX address family sockets with a trailing equals sign (=). Follows symlinks named as operands.

--file-type
Marks entries as with -F with the exception of executable files. Executable files are not marked. Follows symlinks named as operands.
```

Specifying more than one of the options in the following groups of mutually exclusive options is not considered an error: `-C` and `-l (ell)`, `-m and `-l (ell)`, `-x and `-l (ell)`, `-@ and `-l (ell)`, `-C` and `-l (one)`, `-H` and `-L`, `-c` and `-u`, `-e` and `-E`, `-t` and `-S` and `-U`. The last option specifying a specific timestamp (`-c`, `-u`, `-% atime`, `-% crtime`, `-% ctime`, and `-% mtime`) determines the timestamps used for sorting or in long format listings. The last `-t`, `-S`, or `-U` option determines the sorting behavior.

```
/usr/xpg6/bin/ls -F
Marks directories with a trailing slash (/), doors with a trailing greater-than sign (>), executable files with a trailing asterisk (*), FIFOs with a trailing vertical bar (|), symbolic links with a trailing "at" sign (@), and AF_UNIX address family sockets with a trailing equals sign (=). Does not follow symlinks named as operands unless the `-H` or `-L` option is specified.

--file-type
Marks entries as with -F with the exception of executable files. Executable files are not marked. Does not follow symlinks named as operands unless the `-H` or `-L` option is specified.
```

Specifying more than one of the options in the following mutually exclusive pairs is not considered an error: `-C` and `-l (ell)`, `-m and `-l (ell)`, `-x and `-l (ell)`, `-@ and `-l (ell)`, `-C` and `-l (one)`, `-H` and `-L`, `-c` and `-u`, `-e` and `-E`, `-t` and `-S` and `-U`. The last option specifying a specific timestamp (`-c`, `-u`, `-% atime`, `-% crtime`, `-% ctime`, and `-% mtime`) determines the timestamps used for sorting or in long format listings. The last `-t`, `-S`, or `-U` option determines the sorting behavior.
Operands  The following operand is supported:

    file
        A path name of a file to be written. If the file specified is not found, a diagnostic message
        is output on standard error.

Color Output  If color output is enabled, the environment variable LS_COLORS is checked. If it exists, its
contents are used to control the colors used to display filenames. If it is not set, a default list of
colors is used. The format of LS_COLORS is a colon separated list of attribute specifications.
Each attribute specification is of the format

    filespec=attr[;attr ..]

filespec is either of the form *.SUFFIX, for example, *.jar or *.Z, or one of the following file
types:

    no Normal file
    fi Regular file
    di Directory
    ln Symbolic link
    pi FIFO or named pipe
    so Socket
    do Door file
    bd Block device
    cd Character device
    ex Execute bit (either user, group, or other) set
    po Event port
    st Sticky bit set
    or Orphaned symlink
    sg setgid binary
    su setuid binary
    ow world writable
    tw Sticky bit and world writable

attr is a semicolon delimited list of color and display attributes which are combined to
determine the final output color. Any combination of attr values can be specified. Possible attr
values are:

    00 All attributes off (default terminal color)
01 Display text in bold
04 Display text with an underscore
05 Display text in bold
07 Display text with foreground and background colors reversed
08 Display using concealed text.

One of the following values can be chosen. If multiple values are specified, the last specified value is used.

30 Set foreground to black.
31 Set foreground to red.
32 Set foreground to green.
33 Set foreground to yellow.
34 Set foreground to blue.
35 Set foreground to magenta (purple).
36 Set foreground to cyan.
37 Set foreground to white.
39 Set foreground to default terminal color.

One of the following can be specified. If multiple values are specified, the last value specified is used.

40 Set foreground to black.
41 Set foreground to red.
42 Set foreground to green.
43 Set foreground to yellow.
44 Set foreground to blue.
45 Set foreground to magenta (purple).
46 Set foreground to cyan.
47 Set foreground to white.
49 Set foreground to default terminal color.
On some terminals, setting the bold attribute causes the foreground colors to be high-intensity, that is, brighter. In such cases the low-intensity yellow is often displayed as a brown or orange color.

At least one attribute must be listed for a file specification.

The appropriate color codes are chosen by selecting the most specific match, starting with the file suffixes and proceeding with the file types until a match is found. The no (normal file) type matches any file.

Usage  See largefile(5) for the description of the behavior of ls when encountering files greater than or equal to 2 Gbyte ($2^{31}$ bytes).

Examples  EXAMPLE 1  Viewing File Permissions

The following example shows how to display detailed information about a file.

% ls -l file.1
-rw-r--r-- 1 gozer staff 206663 Mar 14 10:15 file.1

The permissions string above (-rw-r--r--) describes that the file owner has read and write permissions, the owning group has read permissions, and others have read permissions.

The following example shows how to display detailed information about a directory.

% ls -ld test.dir
drwxr-xr-x 2 gozer staff 2 Mar 14 10:17 test.dir

The permissions string above (drwxr-xr-x) describes that the directory owner has read, write, and search permissions, the owning group has read and search permissions, and others have read and search permissions.

Another example of listing file permissions is as follows:

% ls -l file.2
-rw-rw---- 1 gozer staff 206663 Mar 14 10:47 file.2

The permissions string above (-rw-rw----) describes that the file owner has read and write permissions, the owning group has read and write permissions, and the file can be locked during access.

EXAMPLE 2  Displaying ACL Information on Files and Directories

The following example shows how to display verbose ACL information on a ZFS file.

% ls -v file.1
-rw-r--r-- 1 marks staff 206663 Mar 14 10:15 file.1
0:owner@:execute:deny
1:owner@:read_data/write_data/append_data/write_xattr/write_attributes/write_acl/write_owner:allow
EXAMPLE 2  Displaying ACL Information on Files and Directories  (Continued)

2:group@:write_data/append_data/execute:deny
3:group@:read_data:allow
4:everyone@:write_data/append_data/write_xattr/execute/write_attributes
/write_acl/write_owner:deny
5:everyone@:read_data/read_xattr/read_attributes/read_acl/synchronize
:allow

The following example shows how to display compact ACL information on a ZFS directory.

```
% ls -dV test.dir
drwxr-xr-x 2 marks staff 2 Mar 14 10:17 test.dir
```

owner@:--------------:------:deny
owner@:rwxp---A-W-Co-:------:allow

group@:-w-p----------:------:deny
group@:r-x-----------:------:allow
everyone@:-w-p--A-W-Co:-:------:deny
everyone@:r-x---a-R-c--s:------:allow

The following example illustrates the `ls -v` behavior when listing ACL information on a UFS file.

```
$ ls -v file.3
-rw-r--r-- 1 root root 2703 Mar 14 10:59 file.3
```

0:user::rw-
1:group::r-- #effective:r--
2:mask:r--
3:other:r--

EXAMPLE 3  Printing the Names of All Files

The following example prints the names of all files in the current directory, including those that begin with a dot (.), which normally do not print:

```
example% ls -a
```

EXAMPLE 4  Providing File Information

The following example provides file information:

```
example% ls -aisn
```

This command provides information on all files, including those that begin with a dot (a), the i-number, the memory address of the i-node associated with the file—printed in the left-hand column (i); the size (in blocks) of the files, printed in the column to the right of the i-numbers (s); finally, the report is displayed in the numeric version of the long list, printing the UID (instead of user name) and GID (instead of group name) numbers associated with the files.
EXAMPLE 4 Providing File Information  (Continued)

When the sizes of the files in a directory are listed, a total count of blocks, including indirect blocks, is printed.

EXAMPLE 5 Providing Extended System Attributes Information

```
example% ls -/ c file (extended system attribute in compact mode)
-rw-r--r-- 1 root root 0 May 10 14:17 file
   {AHRSadim-u}
```

In this example, av_quarantined is not set.

```
example% ls -/ v file (extended system attribute in verbose mode)
-rw-r--r-- 1 root root 0 May 10 14:17 file
   {archive,hidden,readonly,system,appendonly,\
    nodump,immutable,av_modified,\
    noav_quarantined,nounlink}
```

```
example% ls -/ v file (no extended system attribute)
-rw-r--r-- 1 root staff 0 May 16 14:48 file
   {}
```

```
example% ls -/ c file (extended system attribute supported file system)
-rw-r--r-- 1 root staff 3 Jun 4 22:04 file
   {A------m--} archive and av_modified attributes are set by default on an extended system attribute supported file.
```

```
example% ls -/ c -%crtime file
-rw-r--r-- root root 0 May 10 14:17 file
   {AHRSadim-u}
```

This example displays the timestamp as the creation time:

```
example% ls -l -%all file
-rw-r--r-- 1 root root 0 May 10 14:17 file
   timestamp: atime  Jun 14 08:47:37 2007
timestamp: mtime  May 10 14:17:56 2007
timestamp: crtime  May 10 14:17:56 2007
```

```
example% ls -%crtime -tl file*
```
In this example the files are sorted by creation time.

### Environment Variables

See `environ(5)` for descriptions of the following environment variables that affect the execution of `ls`: `LANG`, `LC_ALL`, `LC_COLLATE`, `LC_CTYPE`, `LC_TIME`, `LC_MESSAGES`, `NLSPATH`, and `TZ`.

**COLUMNs**

Determine the user’s preferred column position width for writing multiple text-column output. If this variable contains a string representing a decimal integer, the `ls` utility calculates how many path name text columns to write (see `-c`) based on the width provided. If `COLUMNs` is not set or is invalid, 80 is used. The column width chosen to write the names of files in any given directory is constant. File names are not be truncated to fit into the multiple text-column output.

**LS_COLORS**

Determine the coloring scheme used when displaying color output. If not set and color output is specified, a default scheme is used. If `TERM` is not set, no color output is used.

**TERM**

Determine the terminal type. If this variable is unset or NULL, no color output is generated regardless of the value of the `--color` option.

### Exit Status

0     All information was written successfully.
>0    An error occurred.

### Files

<table>
<thead>
<tr>
<th>Path</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>/etc/group</code></td>
<td>group IDs for <code>ls -l</code> and <code>ls -g</code></td>
</tr>
<tr>
<td><code>/etc/passwd</code></td>
<td>user IDs for <code>ls -l</code> and <code>ls -o</code></td>
</tr>
<tr>
<td><code>/usr/share/lib/terminfo/*</code></td>
<td>terminal information database</td>
</tr>
</tbody>
</table>

### Attributes

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>Path</th>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>/usr/bin/ls</code></td>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td></td>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td></td>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td></td>
<td>Standard</td>
<td>See below.</td>
</tr>
</tbody>
</table>
For all options except `-A`, `-b`, `-e`, `-h`, `-S`, `-U` `-v`, `-@`, `-%/`, `-%`, `--all`, `--almost-all`, `--block-size`, `--classify`, `--color`, `--colour`, `--dereference`, `--dereference-command-line`, `--escape`, `--file-type`, `--full-time`, `--human-readable`, `--ignore-backups`, `--inode`, `--no-group`, `--numeric-uid-gid`, `--reverse`, `--recursive`, `--si`, `--size`, and `--time-style`, see `standards(5)`.

```
ATTRIBUTETYPE ATTRIBUTEVALUE
Availability system/xopen/xcu4
CSI Enabled
Interface Stability Committed
Standard See below.
```

For all options except `-A`, `-b`, `-e`, `-h`, `-S`, `-U` `-v`, `-@`, `-%/`, `-%`, `--all`, `--almost-all`, `--block-size`, `--classify`, `--color`, `--colour`, `--dereference`, `--dereference-command-line`, `--escape`, `--file-type`, `--full-time`, `--human-readable`, `--ignore-backups`, `--inode`, `--no-group`, `--numeric-uid-gid`, `--reverse`, `--recursive`, `--si`, `--size`, and `--time-style`, see `standards(5)`.

```
ATTRIBUTETYPE ATTRIBUTEVALUE
Availability system/xopen/xcu6
CSI Enabled
Interface Stability Committed
Standard See below.
```

For all options except `-A`, `-b`, `-e`, `-h`, `-S`, `-U` `-v`, `-@`, `-%/`, `-%`, `--all`, `--almost-all`, `--block-size`, `--classify`, `--color`, `--colour`, `--dereference`, `--dereference-command-line`, `--escape`, `--file-type`, `--full-time`, `--human-readable`, `--ignore-backups`, `--inode`, `--no-group`, `--numeric-uid-gid`, `--reverse`, `--recursive`, `--si`, `--size`, and `--time-style`, see `standards(5)`.

**See Also**

`chmod(1)`, `cp(1)`, `setfacl(1)`, `fgetattr(3C)`, `strftime(3C)`, `terminfo(4)`, `acl(5)`, `attributes(5)`, `environ(5)`, `fsattr(5)`, `largefile(5)`, `standards(5)`

**Notes**

Unprintable characters in file names can confuse the columnar output options.

The total block count is incorrect if there are hard links among the files.

The sort order of `ls` output is affected by the locale and can be overridden by the `LC_COLLATE` environment variable. For example, if `LC_COLLATE` equals `C`, dot files appear first, followed by
names beginning with upper-case letters, then followed by names beginning with lower-case letters. But if LC_COLLATE equals en_US.ISO8859-1, then leading dots as well as case are ignored in determining the sort order.
ls – list the contents of a directory

Synopsis  /usr/ucb/ls [-aAcDfGgiLqrRstu1] file...

Description For each filename that is a directory, ls lists the contents of the directory; for each filename that is a file, ls repeats its name and any other information requested. By default, the output is sorted alphabetically. When no argument is given, the current directory is listed. When several arguments are given, the arguments are first sorted appropriately, but file arguments are processed before directories and their contents.

Permissions Field The mode printed under the -l option contains 10 characters interpreted as follows. If the first character is:

d  Entry is a directory.
D  Entry is a door.
b  Entry is a block-type special file.
c  Entry is a character-type special file.
\  Entry is a symbolic link.
p  Entry is a FIFO (also known as “named pipe”) special file.
s  Entry is an AF_UNIX address family socket.
–  Entry is a plain file.

The next 9 characters are interpreted as three sets of three bits each. The first set refers to owner permissions; the next refers to permissions to others in the same user-group; and the last refers to all others. Within each set, the three characters indicate permission respectively to read, to write, or to execute the file as a program. For a directory, “execute” permission is interpreted to mean permission to search the directory. The permissions are indicated as follows:

r  The file is readable.
w  The file is writable.
x  The file is executable.
–  The indicated permission is not granted.

The group-execute permission character is given as s if the file has the set-group-id bit set; likewise the owner-execute permission character is given as s if the file has the set-user-id bit set.

The last character of the mode (normally x or ‘–’) is true if the 1000 bit of the mode is on. See chmod(1) for the meaning of this mode. The indications of set-ID and 1000 bits of the mode are capitalized (S and T, respectively) if the corresponding execute permission is not set.
A plus sign (+) appended to the list of permissions indicates that an ACL is associated with the file.

When the sizes of the files in a directory are listed, a total count of blocks, including indirect blocks, is printed.

**Options**  The following options are supported:

- `-a` Lists all entries; in the absence of this option, entries whose names begin with a ‘.’ are not listed (except for the privileged user, for whom `ls` normally prints even files that begin with a ‘.’).
- `-A` Same as `-a`, except that ‘.’ and ‘. ’ are not listed.
- `-c` Uses time of last edit (or last mode change) for sorting or printing.
- `-C` Forces multi-column output, with entries sorted down the columns; for `ls`, this is the default when output is to a terminal.
- `-d` If argument is a directory, lists only its name (not its contents); often used with `-l` to get the status of a directory.
- `-f` Forces each argument to be interpreted as a directory and lists the name found in each slot. This option turns off `-l`, `-t`, `-s`, and `-r`, and turns on `-a`; the order is the order in which entries appear in the directory.
- `-F` Marks directories with a trailing slash (/), doors with a trailing greater-than sign (>), executable files with a trailing asterisk (*), FIFOs with a trailing vertical bar (|), symbolic links with a trailing at-sign (@), and AF_UNIX address family sockets with a trailing equals sign (=).
- `-g` For `ls`, shows the group ownership of the file in a long output.
- `-i` For each file, prints the i-node number in the first column of the report.
- `-l` Lists in long format, giving mode, ACL indication, number of links, owner, size in bytes, and time of last modification for each file. If the file is a special file the size field will instead contain the major and minor device numbers. If the time of last modification is greater than six months ago, it is shown in the format ‘month date year’; files modified within six months show ‘month date time’. If the file is a symbolic link, the pathname of the linked-to file is printed preceded by ‘→’.
- `-L` If argument is a symbolic link, lists the file or directory the link references rather than the link itself.
- `-q` Displays non-graphic characters in filenames as the character ‘?; for `ls`, this is the default when output is to a terminal.
- `-r` Reverses the order of sort to get reverse alphabetic or oldest first as appropriate.
- `-R` Recursively lists subdirectories encountered.
-s  Indicate the total number of file system blocks consumed by each file displayed.
-t  Sorts by time modified (latest first) instead of by name.
-u  Uses time of last access instead of last modification for sorting (with the -t option) and/or printing (with the -l option).
-l  Forces one entry per line output format; this is the default when output is not to a terminal.

Operands
The following operand is supported:

file  A path name of a file to be listed. If the file specified is not found, a diagnostic message is output on standard error.

Usage
See largefile(5) for the description of the behavior of ls when encountering files greater than or equal to 2 Gbyte (2^31 bytes).

Files
/etc/group  to get group ID for 'ls -g'
/etc/passwd  to get user IDs for 'ls -l' and 'ls -o'

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>

See Also  ls(1), attributes(5), largefile(5)

Notes
NEWLINE and TAB are considered printing characters in filenames.

The output device is assumed to be 80 columns wide.

The option setting based on whether the output is a teletype is undesirable as 'ls -s' is much different than 'ls -s | lpr'. On the other hand, not doing this setting would make old shell scripts which used ls almost certain losers.

Unprintable characters in file names can confuse the columnar output options.
**Name**
m4 – macro processor

**Synopsis**
```
/usr/bin/m4 [-e] [-s] [-B int] [-H int] [-S int]
   [-T int] [-D name [=val]] ... [-U name] ... [file]...
```

```
/usr/xpg4/bin/m4 [-e] [-s] [-B int] [-H int] [-S int]
   [-T int] [-D name [=val]] [-U name] ... [file]...
```

**Description**
The m4 utility is a macro processor intended as a front end for C, assembler, and other languages. Each of the argument files is processed in order. If there are no files, or if a file is -, the standard input is read. The processed text is written on the standard output. *Note:* m4 cannot include more than nine nested files and writes a diagnostic message if that number is exceeded.

**Macro Syntax**
Macro calls have the form:
```
name(arg1, arg2, ..., argn)
```

The open parenthesis character, (, must immediately follow the name of the macro. If the name of a defined macro is not followed by a (, it is deemed to be a call of that macro with no arguments. Potential macro names consist of alphanumeric characters and underscore (_), where the first character is not a digit.

Leading unquoted blanks, TABs, and NEWLINEs are ignored while collecting arguments. Left and right single quotes are used to quote strings. The value of a quoted string is the string stripped of the quotes.

**Macro Processing**
When a macro name is recognized, its arguments are collected by searching for a matching right parenthesis. If fewer arguments are supplied than are in the macro definition, the trailing arguments are taken to be NULL. Macro evaluation proceeds normally during the collection of the arguments, and any commas or right parentheses that happen to turn up within the value of a nested call are as effective as those in the original input text. After argument collection, the value of the macro is pushed back onto the input stream and rescanned.

**Options**
The options and their effects are as follows:

- **-B int** Changes the size of the push-back and argument collection buffers from the default of 4,096. Values of size less than or equal to zero are ignored and the default value is used.

- **-e** Operates interactively. Interrupts are ignored and the output is unbuffered.

- **-H int** Changes the size of the symbol table hash array from the default of 199. For better performance, the size should be prime. Values of size less than or equal to zero are ignored and the default value is used.

- **-s** Enables line sync output for the C preprocessor (#line . . )

- **-S int** Changes the size of the call stack from the default of 100 slots. Macros take three slots, and non-macro arguments take one. Values of size less than or equal to zero are ignored and the default value is used.
-Tint  Changes the size of the token buffer from the default of 512 bytes. Values of size less than or equal to zero are ignored and the default value is used.

To be effective, the above flags must appear before any file names and before any -D or -U flags:

-D name[=val]  Defines name to val or to NULL in val's absence.
-U name  Undefines name.

Operands

The following operand is supported:

file  A path name of a text file to be processed. If no file is given, or if it is −, the standard input is read.

Usage

The m4 utility makes available the following built-in macros. These macros can be redefined, but once this is done the original meaning is lost. Their values are NULL unless otherwise stated.

changequote  Change quote symbols to the first and second arguments. The symbols can be up to five characters long. changequote without arguments restores the original values (that is, ‘ ’).

changecom  Change left and right comment markers from the default # and NEWLINE. With no arguments, the comment mechanism is effectively disabled. With one argument, the left marker becomes the argument and the right marker becomes NEWLINE. With two arguments, both markers are affected. Comment markers can be up to five characters long.

decr  Returns the value of its argument decremented by 1.

define  The second argument is installed as the value of the macro whose name is the first argument. Each occurrence of $n in the replacement text, where n is a digit, is replaced by the n-th argument. Argument 0 is the name of the macro; missing arguments are replaced by the null string; $# is replaced by the number of arguments; $* is replaced by a list of all the arguments separated by commas; $@ is like $*, but each argument is quoted (with the current quotes).

defn  Returns the quoted definition of its argument(s). It is useful for renaming macros, especially built-ins.

divert  m4 maintains 10 output streams, numbered 0-9. The final output is the concatenation of the streams in numerical order. Initially stream 0 is the current stream. The divert macro changes the current output stream to its (digit-string) argument. Output diverted to a stream other than 0 through 9 is discarded.

divnum  Returns the value of the current output stream.

dnl  Reads and discards characters up to and including the next NEWLINE.
dumpdef  Prints current names and definitions, for the named items, or for all if no arguments are given.
errprint  Prints its argument on the diagnostic output file.
ifdef    If the first argument is defined, the value is the second argument, otherwise the third. If there is no third argument, the value is NULL. The word unix is predefined.
ifelse   This macro has three or more arguments. If the first argument is the same string as the second, then the value is the third argument. If not, and if there are more than four arguments, the process is repeated with arguments 4, 5, 6 and 7. Otherwise, the value is either the fourth string, or, if it is not present, NULL.
include  Returns the contents of the file named in the argument.
incr     Returns the value of its argument incremented by 1. The value of the argument is calculated by interpreting an initial digit-string as a decimal number.
index    Returns the position in its first argument where the second argument begins (zero origin), or −1 if the second argument does not occur.
len      Returns the number of characters in its argument.
m4exit   This macro causes immediate exit from m4. Argument 1, if given, is the exit code; the default is 0.
m4wrap   Argument 1 is pushed back at final EOF. Example: m4wrap('cleanup( )')
maketemp Fills in a string of "X" characters in its argument with the current process ID.
popdef   Removes current definition of its argument(s), exposing the previous one, if any.
pushdef  Like define, but saves any previous definition.
shift    Returns all but its first argument. The other arguments are quoted and pushed back with commas in between. The quoting nullifies the effect of the extra scan that is subsequently be performed.
sinclude This macro is identical to include, except that it says nothing if the file is inaccessible.
substr   Returns a substring of its first argument. The second argument is a zero origin number selecting the first character; the third argument indicates the length of the substring. A missing third argument is taken to be large enough to extend to the end of the first string.
syscmd  This macro executes the command given in the first argument. No value is returned.

sysval  This macro is the return code from the last call to syscmd.

translit Transliterates the characters in its first argument from the set given by the second argument to the set given by the third. No abbreviations are permitted.

traceon This macro with no arguments, turns on tracing for all macros (including built-ins). Otherwise, turns on tracing for named macros.

traceoff Turns off trace globally and for any macros specified.

undefine Removes the definition of the macro named in its argument.

undivert This macro causes immediate output of text from diversions named as arguments, or all diversions if no argument. Text can be undiverted into another diversion. Undiverting discards the diverted text.

/usr/bin/m4  eval  Evaluates its argument as an arithmetic expression, using 32-bit signed-integer arithmetic. The following operators are supported: parentheses, unary -, unary +, !, ~, *, /, %, +, -, relational, bitwise &, |, &&, and ||. Octal and hex numbers can be specified as in C. The second argument specifies the radix for the result; the default is 10. The third argument can be used to specify the minimum number of digits in the result.

/usr/xpg4/bin/m4  eval  Evaluates its argument as an arithmetic expression, using 32-bit signed-integer arithmetic. The following operators are supported: parentheses, unary -, unary +, !, ~, *, /, %, +, -, relational, bitwise &, |, &&, and ||. Precedence and associativity are as in C. Octal and hex numbers can also be specified as in C. The second argument specifies the radix for the result; the default is 10. The third argument can be used to specify the minimum number of digits in the result.

Examples  

EXAMPLE 1  Examples of m4 files

If the file m4src contains the lines:

The value of VER is VER.
ifdef(VER, "VER" is defined to be VER., VER is not defined.)
ifelse(VER, 1, "VER" is VER.)
ifelse(VER, 2, "VER" is VER., "VER" is not 2.)
end

then the command:

m4 m4src

or the command:

m4 -U VER m4src
EXAMPLE 1  Examples of m4 files  (Continued)

produces the output:

The value of VER is "VER".
   VER is not defined.
       VER is not 2.
   end

The command:

m4 -D VER m4src

produces the output:

The value of VER is "".
   VER is defined to be " .
       VER is not 2.
   end

The command:

m4 -D VER=1 m4src

produces the output:

The value of VER is "1".
   VER is defined to be 1.
       VER is 1.
       VER is not 2.
   end

The command:

m4 -D VER=2 m4src

produces the output:

The value of VER is "2".
   VER is defined to be 2.
       VER is 2.
   end

Environment Variables
See environ(5) for descriptions of the following environment variables that affect the
execution of m4: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.
Exit Status  The following exit values are returned:

0      Successful completion.
>0     An error occurred

If the \texttt{m4} exit macro is used, the exit value can be specified by the input file.

Attributes  See \texttt{attributes(5)} for descriptions of the following attributes:

\begin{verbatim}
<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>
\end{verbatim}

\begin{verbatim}
<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/xopen/xcu4</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See \texttt{standards(5)}.</td>
</tr>
</tbody>
</table>
\end{verbatim}

See Also  \texttt{as(1), attributes(5), environ(5), standards(5)}
Name   mac – calculate message authentication codes of the input

Synopsis /usr/bin/mac -l

/usr/bin/mac [-v] -a algorithm
   [-k keyfile | -K key_label [-T token_spec]] [file]...

Description The mac utility calculates the message authentication code (MAC) of the given file or files or stdin using the algorithm specified.

If more than one file is given, each line of output is the MAC of a single file.

Options The following options are supported:

   -a algorithm Specifies the name of the algorithm to use during the encryption or decryption process. See USAGE, Algorithms for details. Note: Algorithms for producing general length MACs are not supported.

   -k keyfile Specifies the file containing the key value for the encryption algorithm. Each algorithm has specific key material requirements, as stated in the PKCS#11 specification. If -k is not specified, mac prompts for key material using getpassphrase(3C).

   For information on generating a key file, see pktool(1), dd(1M) or the Oracle Solaris 11.1 Administration: Security Services.

   -K key_label Specify the label of a symmetric token key in a PKCS#11 token.

   -l Displays the list of algorithms available on the system. This list can change depending on the configuration of the cryptographic framework. The keysizes are displayed in bits.

   -T token_spec Specify a PKCS#11 token other than the default soft token object store when the -k is specified.

   token_spec has the format of:

   token_name [:manuf_id [:serial_no]]

   When a token label contains trailing spaces, this option does not require them to be typed as a convenience to the user.

   Colon separates token identification string. If any of the parts have a literal colon (:) character, it must be escaped by a backslash (\). If a colon (:) is not found, the entire string (up to 32 characters) is taken as the token label. If only one colon (:) is found, the string is the token label and the manufacturer.

   -v Provides verbose information.
Usage

Algorithms The supported algorithms are displayed with the -l option. These algorithms are provided by
the cryptographic framework. Each supported algorithm is an alias to the most commonly
used and least restricted version of a particular algorithm type. For example, md5_hmac is an
alias to CKM_MD5_HMAC.

These aliases are used with the -a option and are case-sensitive.

Passphrase When the -k option is not used during encryption and decryption tasks, the user is prompted
for a passphrase. The passphrase is manipulated into a more secure key using the PBKDF2
algorithm specified in PKCS #5.

Examples  EXAMPLE 1  Listing Available Algorithms
The following example lists available algorithms:

```
example$ mac -l
Algorithm  Keysize: Min  Max
-----------------------------------
des_mac    64  64
sha1_hmac  8  512
md5_hmac   8  512
sha224_hmac 8  512
sha256_hmac 8  512
sha384_hmac 8 1024
sha512_hmac 8 1024
```

EXAMPLE 2  Getting the Message Authentication Code
The following example gets the message authentication code for a file:

```
example$ mac -v -k mykey -a sha1_hmac /export/foo
sha1_hmac (/export/foo) = 913ced311df1f0f18780d9848641ca8992f4718057
```

EXAMPLE 3  Getting the Message Authentication Code with a Token Key
The following example gets the message authentication code with a generic token key in the
soft token keystore. The generic token key can be generated with pktool(1):

```
encrypt -v -a sha1_hmac -K my_generic_key \  
-T "Sun Software PKCS#11 softtoken" /export/foo
Enter pin for Sun Software PKCS#11 softtoken:
sha1_hmac (/etc/foo) = c2ba5c38458c092a8992f4718057
```

Exit Status The following exit values are returned:

- 0 Successful completion.
- >0 An error occurred.
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  digest(1), pktool(1), dd(1M), getpassphrase(3C), libpkcs11(3LIB), attributes(5), pkcs11_softtoken(5)

Oracle Solaris 11.1 Administration: Security Services

RSA PKCS#11 v2.20 and RSA PKCS#5 v2.0, http://www.rsasecurity.com
Name mach – display the processor type of the current host

Synopsis mach

Description The mach command displays the processor-type of the current host.

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also arch(1), uname(1), attributes(5)

Notes mach and uname -p return equivalent values; therefore, Independent Software Vendors (ISV) and others who need to ascertain processor type are encouraged to use uname with the -p option instead of the mach command. The mach command is provided for compatibility with previous releases, but generally its use is discouraged.
### Name
machid, sun, i386, i486, sparc – get processor type truth value

### Synopsis
sun

i386

sparc

### Description
The following commands will return a true value (exit code of 0) if you are using an instruction set that the command name indicates.

- **sun**: True if you are on a Sun system.
- **i386**: True if you are on a computer using an iAPX386 processor.
- **sparc**: True if you are on a computer using a SPARC-family processor.

The commands that do not apply will return a false (non-zero) value. These commands are often used within makefiles (see `make(1S)`) and shell scripts (see `sh(1)`) to increase portability.

### Attributes
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

### See Also
`make(1S), sh(1), test(1), true(1), uname(1), attributes(5)`

### Notes
The `machid` family of commands is obsolete. Use `uname -p` and `uname -m` instead.
madv.so.1 – madv library

/usr/lib/madv.so.1

The madv.so.1 shared object provides a means by which the VM advice can be selectively configured for a launched process (or processes) and its descendants. To enable madv.so.1, the following string needs to be present in the environment (see ld.so.1) along with one or more MADV environment variables:

LD_PRELOAD=$LD_PRELOAD:madv.so.1

Environment Variables

If the madv.so.1 shared object is specified in the LD_PRELOAD list, the following environment variables are read by the madv shared object to determine to which created process(es) to apply the specified advice.

MADV=advice

MADV specifies the VM advice to use for all heap, shared memory, and mmap regions in the process address space. This advice is applied to all created processes.

Values for advice correspond to values in <sys/mman.h> used in madvise(3C) to specify memory access patterns:

normal
random
sequential
access_lwp
access_many
access_many_pset
access_default

MADVCFGFILE=config-file

config-file is a text file which contains one or more madv configuration entries of the form:

exec-name exec-args:advice-opts

Advice specified in config-file takes precedence over that specified by the MADV environment variable. When MADVCFGFILE is not set, advice is taken from file /etc/madv.conf if it exists.

exec-name specifies the name of an application or executable. The corresponding advice is set for newly created processes (see getexecname(3C)) that match the first exec-name found in the file.

exec-name can be a full pathname, a base name, or a pattern string. See File Name Generation in sh(1) for a discussion of pattern matching.
exec-args is an optionally specified pattern string to match against arguments. Advice is set only if exec-args is not specified or occurs within the arguments to exec-name.

advice-opts is a comma-separated list specifying the advice for various memory region(s):

- **madv=advice**: Applies to all heap, shared memory, and mmap regions in the process address space.
- **heap=advice**: The heap is defined to be the brk area (see brk(2)). Applies to the existing heap and for any additional heap memory allocated in the future.
- **shm=advice**, **ism=advice**, **dism=advice**: Shared memory segments (see shmat(2)) attached using any flags, flag SHM_SHARE_MMU, or flag SHM_PAGEABLE respectively. Options ism and dism take precedence over option shm.
- **map=advice**, **mapshared=advice**, **mapprivate=advice**, **mapanon=advice**: Mappings established through mmap(2) using any flags, flag MAP_SHARED, flag MAP_PRIVATE, or flag MAP_ANON, respectively. Options mapshared, mapprivate, and mapanon take precedence over option map. Option mapanon takes precedence over mapshared and mapprivate.

**MADVERRFILE=pathname** By default, error messages are logged via syslog(3C) using level LOG_ERR and facility LOG_USER. If MADVERRFILE contains a valid pathname (such as /dev/stderr), error messages will be logged there instead.

**Examples**

**EXAMPLE 1** Applying Advice to All ISM Segments

The following configuration applies advice to all ISM segments for application /usr/bin/foo:

```
example$ LD_PRELOAD=$LD_PRELOAD:madv.so.1
example$ MADVCFGFILE=madvcfg
example$ export LD_PRELOAD MADVCFGFILE
```
EXAMPLE 1  Applying Advice to All ISM Segments  (Continued)

```bash
example$ cat $MADVCFGFILE
   /usr/bin/foo:ism=access_lwp
```

EXAMPLE 2  Setting Advice for All Applications with Exception

The following configuration sets advice for all applications with the exception of `ls`.

```bash
example$ LD_PRELOAD=$LD_PRELOAD:madv.so.1
example$ MADV=access_many
example$ MADVCFGFILE=madvcfg
example$ export LD_PRELOAD MADV MADVCFGFILE
example$ cat $MADVCFGFILE
   ls:
```

EXAMPLE 3  Precedence Rules (continuation from Example 2)

Because `MADVCFGFILE` takes precedence over `MADV`, specifying `*` (pattern match all) for the `exec-name` of the last `madv` configuration entry would be equivalent to setting `MADV`. The following is equivalent to example 2:

```bash
example$ LD_PRELOAD=$LD_PRELOAD:madv.so.1
example$ MADVCFGFILE=madvcfg
example$ export LD_PRELOAD MADV MADVCFGFILE
example$ cat $MADVCFGFILE
   ls:
      *:madv=access_many
```

EXAMPLE 4  Applying Advice for Different Regions

The following configuration applies one type of advice for `mmap` regions and different advice for heap and shared memory regions for a select set of applications with exec names that begin with `foo`:

```bash
example$ LD_PRELOAD=$LD_PRELOAD:madv.so.1
example$ MADVCFGFILE=madvcfg
example$ export LD_PRELOAD MADV MADVCFGFILE
example$ cat $MADVCFGFILE
   foo*:madv=access_many,heap=sequential,shm=access_lwp
```

EXAMPLE 5  Applying Advice Selectively

The following configuration applies advice for the heap of applications beginning with `ora` that have `ora1` as an argument:

```bash
example$ LD_PRELOAD=$LD_PRELOAD:madv.so.1
example$ MADVCFGFILE=madvcfg
example$ export LD_PRELOAD MADV MADVCFGFILE
example$ cat $MADVCFGFILE
```
EXAMPLE 5  Applying Advice Selectively  (Continued)

ora* ora:heap=access_many

Files  /etc/madv.conf   Configuration file

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/extended-system-utilities)</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Uncommitted</td>
</tr>
</tbody>
</table>

See Also  cat(1), ld.so.1(1), proc(1), sh(1), brk(2), exec(2), fork(2), mmap(2), memcntl(2), shmat(2), getexecname(3C), madvise(3C), syslog(3C), proc(4), attributes(5)

Notes  The advice is inherited. A child process has the same advice as its parent. On exec() (see exec(2)), the advice is set back to the default system advice unless different advice has been configured via the madv shared object.

Advice is only applied to mmap regions explicitly created by the user program. Those regions established by the run-time linker or by system libraries making direct system calls (for example, libthread allocations for thread stacks) are not affected.
mail(1)

Name
mail, rmail – read mail or send mail to users

Synopsis
Sending Mail
mail [-tw] [-m message_type] recipient...
rmail [-tw] [-m message_type] recipient...

Reading Mail
mail [-ehPqr] [-f file]

Debugging
mail [-x debug_level] [other_mail_options] recipient...

Description
A recipient is usually a domain style address ("user@machine") or a user name recognized by login(1). When recipients are named, mail assumes a message is being sent. It reads from the standard input up to an end-of-file (Control-d) or, if reading from a terminal device, until it reads a line consisting of just a period. When either of those indicators is received, mail adds the letter to the mailfile for each recipient.

A letter is composed of some header lines followed by a blank line followed by the message content. The header lines section of the letter consists of one or more UNIX postmarks:

From sender date_and_time [remote from remote_system_name]

followed by one or more standardized message header lines of the form:

keyword-name: [printable text]

where keyword-name is comprised of any printable, non-whitespace characters other than colon (‘:’). A MIME-version: header line indicates that the message is formatted as described in RFC 2045. A Content-Length: header line, indicating the number of bytes in the message content, is always present unless the letter consists of only header lines with no message content. A Content-Type: header line that describes the type of the message content (such as text/plain, application/octet-stream, and so on) is also present, unless the letter consists of only header lines with no message content. Header lines may be continued on the following line if that line starts with white space.

Options
Sending Mail
The following command-line arguments affect sending mail:

- m message_type A Message-Type: line is added to the message header with the value of message_type.
- t A To: line is added to the message header for each of the intended recipients.
- w A letter is sent to a remote recipient without waiting for the completion of the remote transfer program.

If a letter is found to be undeliverable, it is returned to the sender with diagnostics that indicate the location and nature of the failure. If mail is interrupted during input, the message is saved in the file dead.letter to allow editing and resending. dead.letter is always
appended to, thus preserving any previous contents. The initial attempt to append to (or create) dead.letter is in the current directory. If this fails, dead.letter is appended to (or created in) the user's login directory. If the second attempt also fails, no dead.letter processing is done.

rmail only permits the sending of mail; uucp(1C) uses rmail as a security precaution. Any application programs that generate mail messages should be sure to invoke rmail rather than mail for message transport and/or delivery.

If the local system has the Basic Networking Utilities installed, mail can be sent to a recipient on a remote system. There are numerous ways to address mail to recipients on remote systems depending on the transport mechanisms available to the local system. The two most prevalent addressing schemes are Domain-style and UUCP-style.

Domain-style addressing
Remote recipients are specified by appending an '@' and domain (and possibly sub-domain) information to the recipient name (such as user@sf.att.com). (The local system administrator should be consulted for details on which addressing conventions are available on the local system.)

UUCP-style addressing
Remote recipients are specified by prefixing the recipient name with the remote system name and an exclamation point, such as sysa!user. If csh(1) is the default shell, sysa!user should be used. A series of system names separated by exclamation points can be used to direct a letter through an extended network (such as sysa!sysb!sysc!user or sysa\!sysb\!sysc\!user).

Reading Mail
The following command-line arguments affect reading mail:

- e    Test for the presence of mail. mail prints nothing.

An exit status of 0 is returned if the user has mail. Otherwise, an exit status of 1 is returned.

- E    Similar to -e, but tests only for the presence of new mail.

An exit status of 0 is returned if the user has new mail to read, an exit status of 1 is returned if the user has no mail, or an exit status of 2 is returned if the user has mail which has already been read.

- h    A window of headers are initially displayed rather than the latest message. The display is followed by the ? prompt.

- p    All messages are printed without prompting for disposition.

- P    All messages are printed with all header lines displayed, rather than the default selective header line display.
mail terminates after interrupts. Normally an interrupt causes only the termination of the message being printed.

- r Messages are printed in first-in, first-out order.

- f file mail uses file (such as mbox) instead of the default mailfile.

mail, unless otherwise influenced by command-line arguments, prints a user's mail messages in last-in, first-out order. The default mode for printing messages is to display only those header lines of immediate interest. These include, but are not limited to, the UNIX From and >From postmarks, From:, Date:, Subject:, and Content-Length: header lines, and any recipient header lines such as To:, Cc:, Bcc:, and so forth. After the header lines have been displayed, mail displays the contents (body) of the message only if it contains no unprintable characters. Otherwise, mail issues a warning statement about the message having binary content and not display the content. This can be overridden by means of the p command.

For each message, the user is prompted with a ? and a line is read from the standard input. The following commands are available to determine the disposition of the message:

#  Print the number of the current message.

-  Print previous message.

<new-line>, +, or n  Print the next message.

! command  Escape to the shell to do command.

a  Print message that arrived during the mail session.

d, or dp  Delete the current message and print the next message.

d n  Delete message number n. Do not go on to next message.

dq  Delete message and quit mail.

h  Display a window of headers around current message.

hn  Display a window of headers around message number n.

h a  Display headers of all messages in the user's mailfile.

h d  Display headers of messages scheduled for deletion.

m [ persons ]  Mail (and delete) the current message to the named persons.

n  Print message number n.

p  Print current message again, overriding any indications of binary (that is, unprintable) content.

P  Override default brief mode and print current message again, displaying all header lines.
q, or Control-d  Put undeleted mail back in the *mailfile* and quit *mail*.

r [ users ]  Reply to the sender, and other *users*, then delete the message.

s [ files ]  Save message in the named *files* (*mbox* is default) and delete the message.

u [ n ]  Undelete message number *n* (default is last read).

w [ files ]  Save message contents, without any header lines, in the named *files* (*mbox* is default) and delete the message.

x  Put all mail back in the *mailfile* unchanged and exit *mail*.

y [ files ]  Same as -w option.

?  Print a command summary.

When a user logs in, the presence of mail, if any, is usually indicated. Also, notification is made if new mail arrives while using *mail*.

The permissions of *mailfile* can be manipulated using *chmod(1)* in two ways to alter the function of *mail*. The other permissions of the file can be read-write (0666), read-only (0664), or neither read nor write (0660) to allow different levels of privacy. If changed to other than the default (mode 0660), the file is preserved even when empty to perpetuate the desired permissions. (The administrator can override this file preservation using the DEL_EMPTY_MAILFILE option of *mailcnfg*.)

The group ID of the mailfile must be *mail* to allow new messages to be delivered, and the mailfile must be writable by group *mail*.

Debugging  The following command-line arguments cause *mail* to provide debugging information:

-x debug_level  *mail* creates a trace file containing debugging information.

The -x option causes *mail* to create a file named /tmp/MLOGProcess_id that contains debugging information relating to how *mail* processed the current message. The absolute value of debug_level controls the verboseness of the debug information. 0 implies no debugging. If debug_level is greater than 0, the debug file is retained only if *mail* encountered some problem while processing the message. If debug_level is less than 0, the debug file is always retained. The debug_level specified via -x overrides any specification of DEBUG in /etc/mail/mailcnfg. The information provided by the -x option is esoteric and is probably only useful to system administrators.

Delivery Notification  Several forms of notification are available for mail by including one of the following lines in the message header.

Transport-Options: [...]
Default-Options: [/options]

>To: recipient [ /options ]

Where the “/options” can be one or more of the following:

/delivery        Inform the sender that the message was successfully delivered to the receiver’s mailbox.

/nodelivery      Do not inform the sender of successful deliveries.

/ignore           Do not inform the sender of failed deliveries.

//return           Inform the sender if mail delivery fails. Return the failed message to the sender.

/report           Same as /return except that the original message is not returned.

The default is /nodelivery//return. If contradictory options are used, the first is recognized and later, conflicting, terms are ignored.

Operands The following operand is supported for sending mail:

recipient       A domain style address (“user@machine”) or user login name recognized by login(1).

Usage See largefile(5) for the description of the behavior of mail and rmail when encountering files greater than or equal to 2 Gbyte ($2^{31}$ bytes).

Environment Variables See environ(5) for descriptions of the following environment variables that affect the execution of mail: LC_CTYPE, LC_MESSAGES, and NLSPATH.

TZ            Determine the timezone used with date and time strings.

Exit Status The following exit values are returned:

0   Successful completion when the user had mail.
1   The user had no mail or an initialization error occurred.
>1  An error occurred after initialization.

Files  dead.letter   unmailable text
/etc/passwd    to identify sender and locate recipients
$HOME/mbox     saved mail
$MAIL          variable containing path name of mailfile
/tmp/MLDBG*    debug trace file
/var/mail/*.*  lock for mail directory
/var/mail/:saved directory for holding temp files to prevent loss of data in the event of a system crash
/var/mail/user incoming mail for user; that is, the mail file
/var/tmp/mails* temporary file

**Attributes** See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

**See Also** chmod(1), csh(1), login(1), mailx(1), uucp(1C), uuencode(1C), vacation(1), write(1), attributes(5), environ(5), largefile(5)

**Solaris Advanced User's Guide**

**Notes** The interpretation and resulting action taken because of the header lines described in the Delivery Notifications section only occur if this version of mail is installed on the system where the delivery (or failure) happens. Earlier versions of mail might not support any types of delivery notification.

Conditions sometimes result in a failure to remove a lock file.

After an interrupt, the next message might not be printed. Printing can be forced by typing a p.
**Name**  
mail, Mail – interactive message processing system

**Synopsis**  
/usr/ucb/mail ...

/usr/ucb/Mail ...

**Description**  
/usr/ucb/mail and /usr/ucb/Mail are provided as links to /usr/bin/mailx. See mailx(1) for more information on the usage of these commands.

**Attributes**  
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>/usr/ucb/mail</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td></td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>/usr/ucb/Mail</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td></td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>

**See Also**  
mailx(1), attributes(5)
mailcompat – provide SunOS compatibility for Solaris mailbox format

mailcompat is a program to provide SunOS 4.x compatibility for the Solaris mailbox format. You would typically run mailcompat to be able to read mail on a workstation running SunOS 4.x when your mail server is running Solaris.

Enabling mailcompat creates an entry in your .forward file, if it exists. If this file does not exist, mailcompat will create it. Disabling mailcompat will remove the entry from the .forward file, and if this was the only entry, will remove the entire file.

To execute mailcompat, log onto the Solaris mail server and enter mailcompat on the command line. Answer the queries provided by the program.

Usage

See largefile(5) for the description of the behavior of mailcompat when encountering files greater than or equal to 2 Gbyte (2^31 bytes).

Depending on the security settings in your system, mailcompat can fail to create a .forward file. If you encounter such a failure, take the steps outlined below.

As root user or user with comparable privileges, enter:

```bash
% sendmail -bv $USER
```

You receive one of the following two messages. The string fwtest is for example purposes only.

```
fwtest... deliverable: mailer local, user fwtest

"!/usr/bin/mailcompat fwtest"... deliverable: mailer prog,\user "/usr/bin/mailcompat fwtest"
```

The first message, with the local designation, indicates that mailcompat was not able to create the .forward file. The second message, with the prog designation, means that mailcompat succeeded in creating .forward.

As a further check, invoke:

```bash
% check-permissions $USER
```

You should get the message:

```
No unsafe directories found.
```

If you get a message different from this, it might indicate a reason for mailcompat failure. You should correct any conditions pointed out by the message before retrying mailcompat.

Examples

**Example 1** Examples of the mailcompat feature.

The following example enables the mailcompat feature for the user john.

example% mailcompat

This program can be used to store your mail in a format that you can read with SunOS 4.X based mail readers.
EXAMPLE 1  Examples of the mailcompat feature. (Continued)

To enable the mailcompat feature a "forward" file is created. Would you like to enable the mailcompat feature? Y
Mailcompat feature ENABLED. Run mailcompat with no arguments to remove it
example%

The following example disables the mailcompat feature for the user john.
example% mailcompat
This program can be used to store your mail in a format that you can read with SunOS 4.X based mail readers.
You have a .forward file in your home directory containing:
  "|/usr/bin/mailcompat johns"
Would you like to remove it and disable the mailcompat feature? y
Back to normal reception of mail.
example%

Files  ~/.forward    list of recipients for forwarding messages

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  mailx(1), attributes(5), largefile(5)
Name  mailp, digestp, filep, newsp, filofaxp, franklinp, timemanp, timesysp – frontends to the mp
Text to PDL (Printer Description Language) pretty print filter

Synopsis  mailp [options] filename...
           newsp [options] filename...
           digestp [options] filename...
           filep [options] filename...
           filofaxp [options] filename...
           franklinp [options] filename...
           timemanp [options] filename...
           timesysp [options] filename...

Description  The mailp utility is a frontend to the mp(1) program. It uses different names to provide various
mp options:
           mailp     Prints out mail messages.
           newsp     Prints out USENET news articles.
           digestp   Prints out USENET digest files.
           filep     Prints out ordinary ASCII files.
           filofaxp  Prints out in Filofax personal organiser format.
           franklinp Prints out in Franklin Planner personal organiser format.
           timemanp  Prints out in Time Manager personal organiser format.
           timesysp  Prints out in Time/System International personal organiser format.

           mailp and the associated programs read each filename in sequence and generate a prettified
version of the contents. If no filename arguments are provided, mailp reads the standard
input.

           mailp works in two ways. With the -D option, it will work as an X print server client to
produce the PDL of the target printer and spool it. With the -d or -P option, it will generate
and spool PostScript™ output.

Options  The following options are supported:
           -d printer  Sends output to the named printer. Otherwise, sends output to the printer
                       named in the PRINTER environment variable.
           -D          Generates the PDL for the target printer and spools it to the printer.
Instead of printing who the mail article is for, the top header will contain who the mail article is from. This is a useful option for people with their own personal printer.

Banner printing is disabled. Most of the information that typically appears on the banner sheet is output in the mp banners.

Formats output in landscape mode. Two pages of text will be printed per sheet of paper.

Same as -d option.

Uses subject as the new subject for the printout. If you are printing ordinary ASCII files which have been specified on the command line, the subject will default to the name of each of these files.

The following operand is supported:

filename The name of the file to be read.

If none of the -d, -D, or -P options is used, mailp uses the PRINTER environment variable to determine the printer to which the output from the mp(1) program is sent. If the PRINTER variable is not found, the default destination is the PostScript™ printer.

The following exit values are returned:

0 Successful completion.

1 An error occurred.

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>print/mp</td>
</tr>
</tbody>
</table>

See Also mailp(1), attributes(5)

Notes The -P option, which spools the PDL directly to the target printer in mp(1), produces PostScript™ when used in mailp so as to be backward compatible.
mailq(1)

Name
mailq – print the mail queue

Synopsis
/usr/bin/mailq [-Ac] [-q subarg] [-v]

Description
The mailq utility displays a summary of the mail messages queued for future delivery.

The first line displayed for each mail message shows the internal identifier used on this host for the message, the size of the message in bytes, the date and time the message was accepted into the queue, and the envelope sender of the message. The second line of the display shows the error message that caused this message to be retained in the queue. This line will not be displayed if the message is being processed for the first time.

The mailq utility used to be identical to sendmail -bp. Now it checks for the authorization attribute, solaris.mail.mailq. If the check for the invoking user succeeds, sendmail -bp is executed with the remaining argument vector. Otherwise, an error message is printed. This authorization attribute is by default enabled for all users. It can be disabled by modifying the Basic Solaris User entry in prof_attr(4).

Options
The following options are supported:

- **-Ac**
  Like sendmail(1M), this flag tells mailq to use submit.cf rather than sendmail.cf even if the operation mode does not indicate an initial mail submission. This will result in the client queue /var/spool/clientmqueue being displayed rather than the default server queue /var/spool/mqueue.

- **-qp[time]**
  Similar to -qtime, except that instead of periodically forking a child to process the queue, sendmail forks a single persistent child for each queue that alternates between processing the queue and sleeping. The sleep time is given as the argument. The sleep time default is 1 second. The process will always sleep at least 5 seconds if the queue was empty in the previous queue run.

- **-qf**
  Processes saved messages in the queue once and does not fork(), but runs in the foreground.

- **-qG name**
  Processes jobs in the queue group called name only.

- **-q[!I]I substr**
  Limits processed jobs to those containing substr as a substring of the queue id, or not when ! is specified.

- **-q[!R]R substr**
  Limits processed jobs to those containing substr as a substring of one of the recipients, or not when ! is specified.

- **-q[!S] substr**
  Limits processed jobs to those containing substr as a substring of the sender, or not when ! is specified.

- **-v**
  Prints verbose information. This adds the priority of the message and a single character indicator (+ or blank) indicating whether a warning message has been sent on the first line of the message. Additionally, extra lines may be intermixed with the recipients that indicate the “controlling user”
information. This shows who will own any programs that are executed on behalf of this message and the name of the alias this command is expanded from, if any.

**Exit Status**

- `0` Successful completion.
- `>0` An error occurred.

**Files**

- `/etc/security/prof_attr` local source for execution profile attributes
- `/var/spool/mqueue` default server queue
- `/var/spool/clientmqueue` client queue

**Attributes**

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/smtp/sendmail</td>
</tr>
</tbody>
</table>

**See Also**

sendmail(1M), prof_attr(4), attributes(5)
mailstats(1)

Name  mailstats – print statistics collected by sendmail

Synopsis  mailstats [-o] [-c ] [-C configfile] [-f statisticsfile]
         [-p] [-P]

Description  The mailstats utility prints out the statistics collected by the sendmail(1M) program on mailer usage. These statistics are collected if the file indicated by the StatusFile configuration option of sendmail (defined in /etc/mail/sendmail.cf) exists. The default statistics file is /etc/mail/statistics.

To enable mailstats, you must, as root, touch /etc/mail/statistics. See the StatusFile processing option in sendmail(1M).

mailstats first prints the time that the statistics file was created and the last time it was modified. Then, the statistics for each mailer are displayed on a single line, each with the following whitespace-separated fields:

- M  The mailer number.
- msgsfr  Number of messages from the mailer.
- bytes_from  Kbytes from the mailer.
- msgsto  Number of messages to the mailer.
- bytes_to  Kbytes to the mailer.
- msgsrej  Number of messages rejected by the mailer.
- msgsdis  Number of messages discarded by the mailer.
- msgsqure  Number of messages quarantined by the mailer.
- Mailer  The name of the mailer.

The display of statistics described above is followed by a separation line containing only equal sign (=) characters. After the separation line, a line preceded with a “T” and totaling the values for all of the mailers is displayed. This is followed by another line preceded with a “C” that lists the number of TCP connections.

To reinitialize the statistics file once a night, add an entry to root's crontab(1):

mailstats -p > /dev/null

Options  The following options are supported:

- -c  Try to use submit.cf instead of the default sendmail configuration file.
- -C configfile  Specify a sendmail configuration file.
- -f statisticsfile  Specify a sendmail statistics file.
- -o  Do not display the name of the mailer in the output.
mailstats(1)

-p Output information in program-readable mode and clear statistics.

-p Output information in program-readable mode without clearing statistics.

Usage
See largefile(5) for the description of the behavior of mailstats when encountering files greater than or equal to 2 Gbyte (2^31 bytes).

Files
/dev/null Zero-lined file
/etc/mail/statistics Default sendmail statistics file
/etc/mail/sendmail.cf Default sendmail configuration file

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/smtp/sendmail</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>The output is uncommitted.</td>
</tr>
</tbody>
</table>

See Also crontab(1), cron(1M), sendmail(1M), attributes(5), largefile(5)
Name          mailx – interactive message processing system

Synopsis       mailx [-BdeHiInNURv~] [-f [file | +folder]] [-T file]
               [-u user]
               mailx [-BdFintUv~] [-b bcc] [-c cc] [-h number]
               [-r address] [-s subject] recipient...
               /usr/ucb/mail ... 
               /usr/ucb/Mail ...

Description    The mail utilities listed above provide a comfortable, flexible environment for sending and
                receiving mail messages electronically.

                When reading mail, the mail utilities provide commands to facilitate saving, deleting, and
                responding to messages. When sending mail, the mail utilities allow editing, reviewing and
                other modification of the message as it is entered.

                Incoming mail is stored in a standard file for each user, called the mailbox for that user. When
                the mail utilities are called to read messages, the mailbox is the default place to find them. As
                messages are read, they are marked to be moved to a secondary file for storage, unless specific
                action is taken, so that the messages need not be seen again. This secondary file is called the
                mbox and is normally located in the user's HOME directory (see MBOX in ENVIRONMENT
                VARIABLES for a description of this file). Messages can be saved in other secondary files
                named by the user. Messages remain in a secondary file until forcibly removed.

                The user can access a secondary file by using the -f option. Messages in the secondary file can
                then be read or otherwise processed using the same Commands as in the primary mailbox. This
                gives rise within these pages to the notion of a current mailbox.

Options        On the command line options start with a dash (-). Any other arguments are taken to be
                destinations (recipients). If no recipients are specified, mailx attempts to read messages from
                the mailbox.

                -B          Do not buffer standard input or standard output.
                -b bcc      Set the blind carbon copy list to bcc. bcc should be enclosed in quotes if it
                            contains more than one name.
                -c cc       Set the carbon copy list to cc. cc should be enclosed in quotes if it contains
                            more than one name.
                -d          Turn on debugging output. (Neither particularly interesting nor
                            recommended.)
                -e          Test for the presence of mail. mailx prints nothing and exits with a successful
                            return code if there is mail to read.
                -F          Record the message in a file named after the first recipient. Overrides the
                            record variable, if set (see Internal Variables).
-f [file]  Read messages from file instead of mailbox. If no file is specified, the mbox is used.

- t [+folder]  Use the file folder in the folder directory (same as the folder command). The name of this directory is listed in the folder variable.

-H  Print header summary only.

-h number  The number of network "hops" made so far. This is provided for network software to avoid infinite delivery loops. This option and its argument are passed to the delivery program.

-I  Include the newsgroup and article-id header lines when printing mail messages. This option requires the -f option to be specified.

-i  Ignore interrupts. See also ignore in Internal Variables.

-N  Do not print initial header summary.

-n  Do not initialize from the system default mailx.rc or Mail.rc file. See USAGE.

-r address  Use address as the return address when invoking the delivery program. All tilde commands are disabled. This option and its argument is passed to the delivery program.

-s subject  Set the Subject header field to subject. subject should be enclosed in quotes if it contains embedded white space.

-T file  Message-id and article-id header lines are recorded in file after the message is read. This option also sets the -I option.

-t  Scan the input for To:,Cc:, and Bcc: fields. Any recipients on the command line will be ignored.

-U  Convert UUCP-style addresses to internet standards. Overrides the conv environment variable.

-u user  Read user's mailbox. This is only effective if user's mailbox is not read protected.

-V  Print the mailx version number and exit.

-v  Pass the -v flag to sendmail(1M).

--~  Interpret tilde escapes in the input even if not reading from a tty.

Operands  The following operands are supported:

recipient  Addressee of message.
Starting Mail

At startup time, `mailx` executes the system startup file `/etc/mail/mailx.rc`. If invoked as `mail` or `Mail`, the system startup file `/etc/mail/Mail.rc` is used instead.

The system startup file sets up initial display options and alias lists and assigns values to some internal variables. These variables are flags and valued parameters which are set and cleared using the `set` and `unset` commands. See Internal Variables.

With the following exceptions, regular commands are legal inside startup files: `!`, Copy, edit, followup, Followup, hold, mail, preserve, reply, Reply, shell, and visual. An error in the startup file causes the remaining lines in the file to be ignored.

After executing the system startup file, the mail utilities execute the optional personal startup file `$HOME/.mailrc`, wherein the user can override the values of the internal variables as set by the system startup file.

If the `-n` option is specified, however, the mail utilities do not execute the system startup file.

Many system administrators include the commands

```bash
set appenddeadletter
unset replyall
unset pipeignore
```

in the system startup files (to be compatible with past Solaris behavior), but this does not meet standards requirements for `mailx`. To get standard behavior for `mailx`, users should use the `-n` option or include the following commands in a personal startup file:

```bash
unset appenddeadletter
set replyall
set pipeignore
```

When reading mail, the mail utilities are in command mode. A header summary of the first several messages is displayed, followed by a prompt indicating the mail utilities can accept regular commands (see Commands below). When sending mail, the mail utilities are in input mode. If no subject is specified on the command line, and the asksub variable is set, a prompt for the subject is printed.

As the message is typed, the mail utilities read the message and store it in a temporary file. Commands may be entered by beginning a line with the tilde (~) escape character followed by a single command letter and optional arguments. See Tilde Escapes for a summary of these commands.

Reading Mail

Each message is assigned a sequential number, and there is at any time the notion of a current message, marked by a right angle bracket (>) in the header summary. Many commands take
an optional list of messages (message-list) to operate on. In most cases, the current message is set to the highest-numbered message in the list after the command is finished executing.

The default for message-list is the current message. A message-list is a list of message identifiers separated by spaces, which may include:

- $ Message number n.
- . The current message.
- ^ The first undeleted message.
- $ The last message.
- * All messages.
- + The next undeleted message.
- − The previous undeleted message.
- n–m An inclusive range of message numbers.
- user All messages from user.
- /string All messages with string in the Subject line (case ignored).
- :c All messages of type c, where c is one of:
  - d deleted messages
  - n new messages
  - o old messages
  - r read messages
  - u unread messages

Notice that the context of the command determines whether this type of message specification makes sense.

Other arguments are usually arbitrary strings whose usage depends on the command involved. Filenames, where expected, are expanded using the normal shell conventions (see sh(1)). Special characters are recognized by certain commands and are documented with the commands below.

Sending Mail Recipients listed on the command line may be of three types: login names, shell commands, or alias groups. Login names may be any network address, including mixed network addressing. If mail is found to be undeliverable, an attempt is made to return it to the sender’s mailbox. If the recipient name begins with a pipe symbol ( | ), the rest of the name is taken to be a shell command to pipe the message through. This provides an automatic interface with any
program that reads the standard input. Groups are set by the alias command (see Commands below) or in a system startup file (for example, $HOME/.mailrc). Aliases are lists of recipients of any type.

Forwarding Mail To forward a specific message, include it in a message to the desired recipients with the ~f or ~m tilde escapes. See Tilde Escapes below. To forward mail automatically, add a comma-separated list of addresses for additional recipients to the .forward file in your home directory. This is different from the format of the alias command, which takes a space-separated list instead. Note: Forwarding addresses must be valid, or the messages will “bounce.” You cannot, for instance, reroute your mail to a new host by forwarding it to your new address if it is not yet listed in the NIS aliases domain.

Commands Regular commands are of the form

\[
\text{[ command ] [ message-list ] [ arguments ]}
\]

In input mode, commands are recognized by the escape character, tilde (~), and lines not treated as commands are taken as input for the message. If no command is specified in command mode, next is assumed. The following is a complete list of mailx commands:

!shell-command Escape to the shell. See SHELL in ENVIRONMENT VARIABLES.

# comment NULL command (comment). Useful in mailrc files.

= Print the current message number.

? Prints a summary of commands.

alias alias name . . . Declare an alias for the given names. The names are substituted when alias is used as a recipient. Useful in the mailrc file. With no arguments, the command displays the list of defined aliases.

group alias name . . .

alternates name . . . Declare a list of alternate names for your login. When responding to a message, these names are removed from the list of recipients for the response. With no arguments, print the current list of alternate names. See also altnet in Internal Variables.
cd [directory]
chdir [directory]

Change directory. If directory is not specified, $HOME is used.

copy [file]
copy [message-list] file

Copy messages to the file without marking the messages as saved. Otherwise equivalent to the save command.

Copy [message-list]

Save the specified messages in a file whose name is derived from the author of the message to be saved, without marking the messages as saved. Otherwise equivalent to the Save command.

delete [message-list]

delete messages from the mailbox. If autoprint is set, the next message after the last one deleted is printed (see Internal Variables).

discard [header-field...] ignore [header-field...]

Suppress printing of the specified header fields when displaying messages on the screen. Examples of header fields to ignore are Status and Received. The fields are included when the message is saved, unless the alwaysignore variable is set. The More, Page, Print, and Type commands override this command. If no header is specified, the current list of header fields being ignored is printed. See also the undiscard and unignore commands.

dp [message-list]
dt [message-list]

delete the specified messages from the mailbox and print the next message after the last one deleted. Roughly equivalent to a delete command followed by a print command.

echo string...

Echo the given strings (like echo(1)).

edit [message-list]

Edit the given messages. Each message is placed in a temporary file and the
program named by the EDITOR variable is invoked to edit it (see ENVIRONMENT VARIABLES). Default editor is ed(1).

**exit**

Exit from mailx, without changing the mailbox. No messages are saved in the mbox (see also quit).

**field [message-list] header-file**

Display the value of the header field in the specified message.

**file [file]**

Quit from the current file of messages and read in the specified file. Several special characters are recognized when used as file names:

- `%` the current mailbox.
- `%user` the mailbox for user.
- `#` the previous mail file.
- `&` the current mbox.
- `+file` The named file in the folder directory (listed in the folder variable).

With no arguments, print the name of the current mail file, and the number of messages and characters it contains.

**folders**

Print the names of the files in the directory set by the folder variable (see Internal Variables).

**Followup [message]**

Respond to a message, recording the response in a file whose name is derived from the author of the message. Overrides the record variable, if set. If the replyall variable is set, the actions of followup and followup are reversed. See also the followup, Save, and Copy commands and outfolder in Internal Variables, and the Starting Mail section in USAGE above.
followup [message-list]

Respond to the first message in the message-list, sending the message to the author of each message in the message-list. The subject line is taken from the first message and the response is recorded in a file whose name is derived from the author of the first message. If the replyall variable is set, the actions of followup and Followup are reversed. See also the Followup, Save, and Copy commands and outfolder in Internal Variables, and the Starting Mail section in USAGE above.

from [message-list]

Print the header summary for the specified messages. If no messages are specified, print the header summary for the current message.

group alias name...
alias alias name...

Declare an alias for the given names. The names are substituted when alias is used as a recipient. Useful in the mailrc file.

headers [message]

Print the page of headers which includes the message specified. The screen variable sets the number of headers per page (see Internal Variables). See also the z command.

help

Print a summary of commands.

hold [message-list]
preserve [message-list]

Hold the specified messages in the mailbox.

if $ s r t
mailCommands
else
mailCommands
endif

Conditional execution, where s executes following mailCommands, up to an else or endif, if the program is in send mode, r causes the mailCommands to be
executed only in receive mode, and t causes the mail-commands to be executed only if mailx is being run from a terminal. Useful in the mailrc file.

**inc**

Incorporate messages that arrive while you are reading the system mailbox. The new messages are added to the message list in the current mail session. This command does not commit changes made during the session, and prior messages are not renumbered.

**ignore [header-field...]**

**discard [header-field...]**

Suppress printing of the specified header fields when displaying messages on the screen. Examples of header fields to ignore are Status and Cc. All fields are included when the message is saved. The More, Page, Print and Type commands override this command. If no header is specified, the current list of header fields being ignored is printed. See also the undiscard and unignore commands.

**list**

Print all commands available. No explanation is given.

**load**

`[message] file` The specified message is replaced by the message in the named file. file should contain a single mail message including mail headers (as saved by the save command).

**mail recipient...**

Mail a message to the specified recipients.

**Mail recipient**

Mail a message to the specified recipients, and record it in a file whose name is derived from the author of the message. Overrides the record variable, if set. See also the Save and Copy commands and outfolder in Internal Variables.
mbox [message-list]

Arrange for the given messages to end up in the standard mbox save file when mailx terminates normally. See MBOX in ENVIRONMENT VARIABLES for a description of this file. See also the exit and quit commands.

more [message-list]
page [message-list]

Print the specified messages. If c rt is set, the messages longer than the number of lines specified by the c rt variable are paged through the command specified by the PAGER variable. The default command is pg(1) or if the bsdcompat variable is set, the default is more(1). See ENVIRONMENT VARIABLES. Same as the print and type commands.

More [message-list]
Page [message-list]

Print the specified messages on the screen, including all header fields. Overrides suppression of fields by the ignore command. Same as the Print and Type commands.

new [message-list]

New [message-list]
unread [message-list]
Unread

[message-list] Take a message list and mark each message as not having been read.

next [message]

Go to the next message matching message. If message is not supplied, this command finds the next message that was not deleted or saved. A message-list may be specified, but in this case the first valid message in the list is the only one used. This is useful for jumping to the next message from a specific user, since the name would be taken as a command in the absence of a real command. See
Pipe the message through the given `shell-command`. The message is treated as if it were read. If no arguments are given, the current message is piped through the command specified by the value of the `cmd` variable. If the `page` variable is set, a form feed character is inserted after each message (see `Internal Variables`).

`pipe [message-list] [shell-command]` | `pipe [message-list] [shell-command]`

Preserve the specified messages in the mailbox.

`preserve [message-list]`

`hold [message-list]`

Print the specified messages. If `crt` is set, the messages longer than the number of lines specified by the `crt` variable are paged through the command specified by the `PAGER` variable. The default command is `pg(1)` or if the `bsdcompat` variable is set, the default is `more(1)`. See `ENVIRONMENT VARIABLES`. Same as the more and page commands.

`print [message-list]`

`type [message-list]`

Print the specified messages on the screen, including all header fields. Overrides suppression of fields by the `ignore` command. Same as the `more` and `page` commands.

`print [message-list]`

`Type [message-list]`

Save the specified message in the given file. Use the same conventions as the print command for which header fields are ignored.

`put [file]`

`put [message-list] file`
Put [file]
Put [message-list] file

Save the specified message in the given file. Overrides suppression of fields by the ignore command.

quit

Exit from mailx, storing messages that were read in mbox and unread messages in the mailbox. Messages that have been explicitly saved in a file are deleted unless the keepsave variable is set.

reply [message-list]
respond [message-list]
replysender [message-list]

Send a response to the author of each message in the message-list. The subject line is taken from the first message. If record is set to a file, a copy of the reply is added to that file. If the replyall variable is set, the actions of Reply/Respond and reply/respond are reversed. The replysender command is not affected by the replyall variable, but sends each reply only to the sender of each message. See the Starting Mail section in USAGE above.

Reply [message]
Respond [message]
replyall [message]

Reply to the specified message, including all other recipients of that message. If the variable record is set to a file, a copy of the reply added to that file. If the replyall variable is set, the actions of Reply/Respond and reply/respond are reversed. The replyall command is not affected by the replyall variable, but always sends the reply to all recipients of the message. See the Starting Mail section in USAGE above.

retain

Add the list of header fields named to the retained list. Only the header fields in the retain list are shown on your terminal when you print a message. All
other header fields are suppressed. The set of retained fields specified by the retain command overrides any list of ignored fields specified by the ignore command. The Type and Print commands can be used to print a message in its entirety. If retain is executed with no arguments, it lists the current set of retained fields.

`Save [message-list]`  
Save the specified messages in a file whose name is derived from the author of the first message. The name of the file is taken to be the author's name with all network addressing stripped off. See also the Copy, followup, and Followup commands and outfolder in Internal Variables.

`save [file]  
save [message-list] file`  
Save the specified messages in the given file. The file is created if it does not exist. The file defaults to mbox. The message is deleted from the mailbox when mailx terminates unless keepsave is set (see also Internal Variables and the exit and quit commands).

`set  
set variable  
set variable=string  
set variable=number`  
Define a variable. To assign a value to variable, separate the variable name from the value by an '=' (there must be no space before or after the '='). A variable may be given a null, string, or numeric value. To embed SPACE characters within a value, enclose it in quotes.

With no arguments, set displays all defined variables and any values they might have. See Internal Variables for a description of all predefined mail variables.
<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>shell</td>
<td>Invoke an interactive shell. See also SHELL in ENVIRONMENT VARIABLES.</td>
</tr>
<tr>
<td>size [message-list]</td>
<td>Print the size in characters of the specified messages.</td>
</tr>
<tr>
<td>source file</td>
<td>Read commands from the given file and return to command mode.</td>
</tr>
<tr>
<td>top [message-list]</td>
<td>Print the top few lines of the specified messages. If the toplines variable is set, it is taken as the number of lines to print (see Internal Variables). The default is 5.</td>
</tr>
<tr>
<td>touch [message-list]</td>
<td>Touch the specified messages. If any message in message-list is not specifically saved in a file, it is placed in the mbox, or the file specified in the MBOX environment variable, upon normal termination. See exit and quit.</td>
</tr>
<tr>
<td>Type [message-list]</td>
<td>Print the specified messages on the screen, including all header fields. Overrides suppression of fields by the ignore command.</td>
</tr>
<tr>
<td>Print [message-list]</td>
<td>Print the specified messages. If crt is set, the messages longer than the number of lines specified by the crt variable are paged through the command specified by the PAGER variable. The default command is pg(1). See ENVIRONMENT VARIABLES.</td>
</tr>
<tr>
<td>type [message-list]</td>
<td>Print the specified messages. If crt is set, the messages longer than the number of lines specified by the crt variable are paged through the command specified by the PAGER variable. The default command is pg(1). See ENVIRONMENT VARIABLES.</td>
</tr>
<tr>
<td>print [message-list]</td>
<td>Print the specified messages. If crt is set, the messages longer than the number of lines specified by the crt variable are paged through the command specified by the PAGER variable. The default command is pg(1). See ENVIRONMENT VARIABLES.</td>
</tr>
<tr>
<td>unalias [alias]...</td>
<td>Remove the definitions of the specified aliases.</td>
</tr>
<tr>
<td>ungroup [alias]...</td>
<td>Remove the definitions of the specified aliases.</td>
</tr>
<tr>
<td>undelete [message-list]</td>
<td>Restore the specified deleted messages. Will only restore messages deleted in the current mail session. If autoprint is set, the last message of those restored is printed (see Internal Variables).</td>
</tr>
</tbody>
</table>
-Mailx(1)

User Commands

undi
scard [header-field ...]

Remove the specified header fields from
the list being ignored. If no header fields
are specified, all header fields are
removed from the list being ignored.

uni
gnore [header-field ...]

Remove the specified header fields from
the list being ignored. If no header fields
are specified, all header fields are
removed from the list being ignored.

unre
tain [header-field ...]

Remove the specified header fields from
the list being retained. If no header
fields are specified, all header fields are
removed from the list being retained.

unre
ad [message-list]

Unread [message-list] Same as the new command.

unse
et variable . . .

Erase the specified variables. If the
variable was imported from the
environment (that is, an environment
variable or exported shell variable), it
cannot be unset from within mailx.

ver
sion

Print the current version and release
date of the mailx utility.

vis
ual [message-list]

Edit the given messages with a screen
editor. Each messages is placed in a
temporary file and the program named
by the VISUAL variable is invoked to edit
it (see ENVIRONMENT VARIABLES).
Notice that the default visual editor is
vi.

wri
te [message-list] file

Write the given messages on the
specified file, minus the header and
trailing blank line. Otherwise equivalent
to the save command.

x
it

Exit from mailx, without changing the
mailbox. No messages are saved in the
mbox (see also quit).

z[+ | −]

Scroll the header display forward or
backward one screen–full. The number
of headers displayed is set by the screen
variable (see Internal Variables).
Tilde Escapes  The following tilde escape commands can be used when composing mail to send. These may be entered only from input mode, by beginning a line with the tilde escape character (~). See escape in Internal Variables for changing this special character. The escape character can be entered as text by typing it twice.

~ !shell-command  Escape to the shell. If present, run shell-command.

~.  Simulate end of file (terminate message input).

~ : mail-command  Perform the command-level request. Valid only when sending a message while reading mail.

~?  Print a summary of tilde escapes.

~A  Insert the autograph string Sign into the message (see Internal Variables).

~a  Insert the autograph string sign into the message (see Internal Variables).

~b name ...  Add the names to the blind carbon copy (Bcc) list. This is like the carbon copy (Cc) list, except that the names in the Bcc list are not shown in the header of the mail message.

~c name ...  Add the names to the carbon copy (Cc) list.

~d  Read in the dead-letter file. See DEAD in ENVIRONMENT VARIABLES for a description of this file.

~e  Invoke the editor on the partial message. See also EDITOR in ENVIRONMENT VARIABLES.

~f [message-list]  Forward the specified message, or the current message being read. Valid only when sending a message while reading mail. The messages are inserted into the message without alteration (as opposed to the ~m escape).

~F [message-list]  Forward the specified message, or the current message being read, including all header fields. Overrides the suppression of fields by the ignore command.

~h  Prompt for Subject line and To, Cc, and Bcc lists. If the field is displayed with an initial value, it may be edited as if you had just typed it.

~i variable  Insert the value of the named variable into the text of the message. For example, ~A is equivalent to ‘~i Sign.’ Environment variables set and exported in the shell are also accessible by ~i.
~m [message-list] Insert the listed messages, or the current message being read into the letter. Valid only when sending a message while reading mail. The text of the message is shifted to the right, and the string contained in the indentprefix variable is inserted as the leftmost characters of each line. If indentprefix is not set, a TAB character is inserted into each line.

~M [message-list] Insert the listed messages, or the current message being read, including the header fields, into the letter. Valid only when sending a message while reading mail. The text of the message is shifted to the right, and the string contained in the indentprefix variable is inserted as the leftmost characters of each line. If indentprefix is not set, a TAB character is inserted into each line. Overrides the suppression of fields by the ignore command.

~p Print the message being entered.

~q Quit from input mode by simulating an interrupt. If the body of the message is not null, the partial message is saved in dead-letter. See DEAD in ENVIRONMENT VARIABLES for a description of this file.

~R Mark message for return receipt.

~r file ~< file ~< ! shell-command Read in the specified file. If the argument begins with an exclamation point (!), the rest of the string is taken as an arbitrary shell command and is executed, with the standard output inserted into the message.

~s string . . . Set the subject line to string.

~t name . . . Add the given names to the To list.

~v Invoke a preferred screen editor on the partial message. The default visual editor is vi(1). See also VISUAL in ENVIRONMENT VARIABLES.

~w file Write the message into the given file, without the header.

~x Exit as with ~q except the message is not saved in dead-letter.

~| shell-command Pipe the body of the message through the given shell-command. If the shell-command returns a successful exit status, the output of the command replaces the message.

Internal Variables The following variables are internal variables. They may be imported from the execution environment or set using the set command at any time. The unset command may be used to erase variables.
**allnet**

All network names whose last component (login name) match are treated as identical. This causes the *message-list* message specifications to behave similarly. Disabled by default. See also the alternates command and the metoo and fuzzymatch variables.

**alwaysignore**

Ignore header fields with ignore everywhere, not just during print or type. Affects the save, Save, copy, Copy, top, pipe, and write commands, and the ~m and ~t tilde escapes. Enabled by default.

**append**

Upon termination, append messages to the end of the *mbox* file instead of prepending them. Although disabled by default, append is set in the system startup file (which can be suppressed with the -n command line option).

**appenddeadletter**

Append to the deadletter file rather than overwrite it. Although disabled by default, appenddeadletter is frequently set in the system startup file. See Starting Mail in USAGE above.

**askbcc**

Prompt for the Bcc list after the Subject is entered if it is not specified on the command line with the -b option. Disabled by default.

**askcc**

Prompt for the Cc list after the Subject is entered if it is not specified on the command line with the -c option. Disabled by default.

**asksub**

Prompt for subject if it is not specified on the command line with the -s option. Enabled by default.

**autoinc**

Automatically incorporate new messages into the current session as they arrive. This has an affect similar to issuing the inc command every time the command prompt is displayed. Disabled by default, but autoinc is set in the default system startup file for *mailx*; it is not set for /usr/ucb/mail or /usr/ucb/Mail.

**autoprint**

Enable automatic printing of messages after delete and undelete commands. Disabled by default.

**bang**

Enable the special-casing of exclamation points (!) in shell escape command lines as in *vi*(1). Disabled by default.

**bsdcompat**

Set automatically if *mailx* is invoked as *mail* or *Mail*. Causes *mailx* to use /etc/mail/Mail.rc as the system startup file. Changes the default pager to *more*(1).
<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>cmd=shell-command</code></td>
<td>Set the default command for the <code>pipe</code> command. No default value.</td>
</tr>
<tr>
<td><code>conv=conversion</code></td>
<td>Convert uucp addresses to the specified address style, which can be either:</td>
</tr>
<tr>
<td><code>internet</code></td>
<td>This requires a mail delivery program conforming to the RFC822 standard for electronic mail addressing.</td>
</tr>
<tr>
<td><code>optimize</code></td>
<td>Remove loops in <code>uucp(1C)</code> address paths (typically generated by the <code>reply</code> command). No rerouting is performed; <code>mail</code> has no knowledge of UUCP routes or connections. Conversion is disabled by default. See also <code>sendmail(1M)</code> and the <code>-U</code> command-line option.</td>
</tr>
<tr>
<td><code>crt[number]</code></td>
<td>Pipe messages having more than <code>number</code> lines through the command specified by the value of the <code>PAGER</code> variable (<code>pg(1)</code> or <code>more(1)</code> by default). If <code>number</code> is not specified, the current window size is used. Disabled by default.</td>
</tr>
<tr>
<td><code>debug</code></td>
<td>Enable verbose diagnostics for debugging. Messages are not delivered. Disabled by default.</td>
</tr>
<tr>
<td><code>dot</code></td>
<td>Take a period on a line by itself, or EOF during input from a terminal as end-of-file. Disabled by default, but <code>dot</code> is set in the system startup file (which can be suppressed with the <code>-n</code> command-line option).</td>
</tr>
<tr>
<td><code>fcc</code></td>
<td>By default, <code>mailx</code> will treat any address containing a slash (/) character as a local send to file address. By unsetting this option, this behavior is disabled. Enabled by default.</td>
</tr>
<tr>
<td><code>flipr</code></td>
<td>Reverse the effect of the <code>followup/Followup</code> and <code>reply/Reply</code> command pairs. If both <code>flipr</code> and <code>replyall</code> are set, the effect is as if neither was set.</td>
</tr>
<tr>
<td><code>from</code></td>
<td>Extract the author listed in the header summary from the <code>From:</code> header instead of the UNIX <code>From</code> line. Enabled by default.</td>
</tr>
<tr>
<td><code>fuzzymatch</code></td>
<td>The <code>from</code> command searches for messages from the indicated sender. By default, the full sender address must be specified. By setting this option, only a sub-string of the sender address needs to be specified. Disabled by default.</td>
</tr>
</tbody>
</table>
### Mailx Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>escape=c</td>
<td>Substitute c for the ~ escape character. Takes effect with next message sent.</td>
</tr>
</tbody>
</table>
| folder=directory | The directory for saving standard mail files. User-specified file names beginning with a plus (+) are expanded by preceding the file name with this directory name to obtain the real file name.  
If `directory` does not start with a slash (/), `$HOME` is prepended to it. There is no default for the `folder` variable. See also `outfolder` below. |
| header       | Enable printing of the header summary when entering `mailx`. Enabled by default.                                                                |
| hold         | Preserve all messages that are read in the `mailbox` instead of putting them in the standard `mbox save` file. Disabled by default.           |
| ignore       | Ignore interrupts while entering messages. Handy for noisy dial-up lines. Disabled by default.                                               |
| ignoreeof    | Ignore end-of-file during message input. Input must be terminated by a period (.) on a line by itself or by the ~ command. See also `dot` above.  |
| indentprefix=string | When `indentprefix` is set, `string` is used to mark indented lines from messages included with ~m. The default is a TAB character.             |
| keep         | When the `mailbox` is empty, truncate it to zero length instead of removing it. Disabled by default.                                          |
| iprompt=string | The specified prompt string is displayed before each line on input is requested when sending a message.                                        |
| keepsave     | Keep messages that have been saved in other files in the `mailbox` instead of deleting them. Disabled by default.                          |
| makeremote   | When replying to all recipients of a message, if an address does not include a machine name, it is assumed to be relative to the sender of the message. Normally not needed when dealing with hosts that support RFC822. |
| metoo        | If your login appears as a recipient, do not delete it from the list. Disabled by default.                                                   |
| mustbang     | Force all mail addresses to be in bang format.                                                                                               |
| onehop       | When responding to a message that was originally sent to several recipients, the other recipient addresses are normally forced to be relative to the originating author's machine for the response. This flag disables alteration of the recipients' |
addresses, improving efficiency in a network where all
machines can send directly to all other machines (that is, one
hop away). Disabled by default.

**outfolder**
Locate the files used to record outgoing messages in the
directory specified by the `folder` variable unless the path name
is absolute. Disabled by default. See `folder` above and the Save,
Copy, followup, and Followup commands.

**page**
Used with the pipe command to insert a form feed after each
message sent through the pipe. Disabled by default.

**pipeignore**
Omit ignored header when outputting to the pipe command.
Although disabled by default, `pipeignore` is frequently set in
the system startup file. See Starting Mail in USAGE above.

**postmark**
Your real name to be included in the From line of messages
you send. By default this is derived from the comment field in
your `passwd` file entry.

**prompt=string**
Set the command mode prompt to `string`. Default is “?”, unless
the `bsdcompat` variable is set, then the default is “&”.

**quiet**
Refrain from printing the opening message and version when
entering mailx. Disabled by default.

**record=file**
Record all outgoing mail in file. Disabled by default. See also
`outfolder` above.

**replyall**
Reverse the effect of the reply and Reply and followup and
Followup commands. Although set by default, `replyall` is
frequently unset in the system startup file. See `flplr` and
Starting Mail in USAGE above.

**returnaddr=string**
The default sender address is that of the current user. This
variable can be used to set the sender address to any arbitrary
value. Set with caution.

**save**
Enable saving of messages in dead-letter on interrupt or
delivery error. See DEAD for a description of this file. Enabled by
default.

**screen=number**
Sets the number of lines in a screen-full of headers for the
headers command. `number` must be a positive number.

The default is set according to baud rate or window size. With a
baud rate less than 1200, `number` defaults to 5, if baud rate is
exactly 1200, it defaults to 10. If you are in a window, number defaults to the default window size minus 4. Otherwise, the default is 20.

**sendmail=shell-command**

Alternate command for delivering messages. Note: In addition to the expected list of recipients, mail also passes the -i and -m, flags to the command. Since these flags are not appropriate to other commands, you may have to use a shell script that strips them from the arguments list before invoking the desired command. Default is /usr/bin/rmail.

**sendwait**

Wait for background mailer to finish before returning. Disabled by default.

**showname**

Causes the message header display to show the sender’s real name (if known) rather than their mail address. Disabled by default, but showname is set in the /etc/mail/mailx.rc system startup file for mailx.

**showto**

When displaying the header summary and the message is from you, print the recipient’s name instead of the author’s name.

**sign=string**

The variable inserted into the text of a message when the ~a (autograph) command is given. No default (see also ~i in Tilde Escapes).

**Sign=string**

The variable inserted into the text of a message when the ~A command is given. No default (see also ~i in Tilde Escapes).

**toplines=number**

The number of lines of header to print with the top command. Default is 5.

**verbose**

Invoke sendmail(1M) with the -v flag.

**translate**

The name of a program to translate mail addresses. The program receives mail addresses as arguments. The program produces, on the standard output, lines containing the following data, in this order:

- the postmark for the sender (see the postmark variable)
- translated mail addresses, one per line, corresponding to the program’s arguments. Each translated address will replace the corresponding address in the mail message being sent.
- a line containing only y or n. if the line contains y the user will be asked to confirm that the message should be sent.
The translate program will be invoked for each mail message to be sent. If the program exits with a non-zero exit status, or fails to produce enough output, the message is not sent.

**Large File Behavior**
See `largefile(5)` for the description of the behavior of `mailx` when encountering files greater than or equal to 2 Gbyte ($2^{31}$ bytes).

**Environment Variables**
See `environ(5)` for descriptions of the following environment variables that affect the execution of `mailx`: `HOME`, `LANG`, `LC_TYPE`, `LC_TIME`, `LC_MESSAGES`, `NLSPATH`, and `TERM`.

- **DEAD**
  The name of the file in which to save partial letters in case of untimely interrupt. Default is `~/dead.letter`.

- **EDITOR**
  The command to run when the `edit` or `-e` command is used. Default is `ed(1)`.

- **LISTER**
  The command (and options) to use when listing the contents of the `folder` directory. The default is `ls(1)`.

- **MAIL**
  The name of the initial mailbox file to read (in lieu of the standard system mailbox). The default is `/var/mail/username`.

- **MAILRC**
  The name of the startup file. Default is `$HOME/.mailrc`.

- **MAILX_HEAD**
  The specified string is included at the beginning of the body of each message that is sent.

- **MAILX_TAIL**
  The specified string is included at the end of the body of each message that is sent.

- **MBOX**
  The name of the file to save messages which have been read. The exit command overrides this function, as does saving the message explicitly in another file. Default is `$HOME/mbox`.

- **PAGER**
  The command to use as a filter for paginating output. This can also be used to specify the options to be used. Default is `pg(1)`, or if the `bsdcompat` variable is set, the default is `more(1)`. See Internal Variables.

- **SHELL**
  The name of a preferred command interpreter. Default is `sh(1)`.

- **VISUAL**
  The name of a preferred screen editor. Default is `vi(1)`.

**Exit Status**
When the `-e` option is specified, the following exit values are returned:

- 0  Mail was found.
- >0  Mail was not found or an error occurred.

Otherwise, the following exit values are returned:

- 0  Successful completion. Notice that this status implies that all messages were sent, but it gives no assurances that any of them were actually delivered.
An error occurred

Files

- $HOME/.mailrc: personal startup file
- $HOME/mbox: secondary storage file
- $HOME/.Maillock: lock file to prevent multiple writers of system mailbox
- /etc/mail/mailx.rc: optional system startup file for mailx only
- /etc/mail/Mail.rc: BSD compatibility system-wide startup file for /usr/ucb/mail and /usr/ucb/Mail
- /tmp/R[emqsx]*: temporary files
- /usr/share/lib/mailx/mailx.help*: help message files
- /var/mail/*: post office directory

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also

biff(1B), echo(1), ed(1), ex(1), fmt(1), ls(1), mail(1), mail(1B), mailcompat(1), more(1),
pg(1), sh(1), uucp(1C), vacation(1), vi(1), newaliases(1M), sendmail(1M), aliases(4),
passwd(4), attributes(5), environ(5), largefile(5), standards(5)

Notes

Where shell-command is shown as valid, arguments are not always allowed. Experimentation is recommended.

Internal variables imported from the execution environment cannot be unset.

The full internet addressing is not fully supported by mailx. The new standards need some time to settle down.

Replies do not always generate correct return addresses. Try resending the errant reply with onehop set.

mailx does not lock your record file. So, if you use a record file and send two or more messages simultaneously, lines from the messages may be interleaved in the record file.

The format for the alias command is a space-separated list of recipients, while the format for an alias in either the .forward or /etc/aliases is a comma-separated list.
To read mail on a workstation running Solaris 1.x when your mail server is running Solaris 2.x, first execute the `mailcompat(1)` program.
The **make** utility executes a list of shell commands associated with each *target*, typically to create or update a file of the same name. **makefile** contains entries that describe how to bring a target up to date with respect to those on which it depends, which are called **dependencies**. Since each dependency is a target, it can have dependencies of its own. Targets, dependencies, and sub-dependencies comprise a tree structure that **make** traces when deciding whether or not to rebuild a **target**.

The **make** utility recursively checks each **target** against its dependencies, beginning with the first target entry in **makefile** if no **target** argument is supplied on the command line. If, after processing all of its dependencies, a target file is found either to be missing, or to be older than any of its dependencies, **make** rebuilds it. Optionally with this version of **make**, a target can be treated as out-of-date when the commands used to generate it have changed since the last time the target was built.

To build a given target, **make** executes the list of commands, called a **rule**. This rule can be listed explicitly in the target’s **makefile** entry, or it can be supplied implicitly by **make**.

If no **target** is specified on the command line, **make** uses the first target defined in **makefile**.

If a **target** has no **makefile** entry, or if its entry has no rule, **make** attempts to derive a rule by each of the following methods, in turn, until a suitable rule is found. Each method is described under **Usage** below.

- Pattern matching rules.
- Implicit rules, read in from a user-supplied **makefile**.
- Standard implicit rules (also known as suffix rules), typically read in from the file
  /usr/share/lib/make/make.rules.
- SCCS retrieval. **make** retrieves the most recent version from the SCCS history file (if any). See the description of the .SCCS_GET: special-function target for details.
- The rule from the .DEFAULT: **target** entry, if there is such an entry in the **makefile**.

If there is no **makefile** entry for a **target**, if no rule can be derived for building it, and if no file by that name is present, **make** issues an error message and halts.
The following options are supported:

- **d**  Displays the reasons why `make` chooses to rebuild a target. `make` displays any and all dependencies that are newer. In addition, `make` displays options read in from the `MAKEFLAGS` environment variable.

- **dd** Displays the dependency check and processing in vast detail.

- **D**  Displays the text of the `make` files read in.

- **DD** Displays the text of the `make` files, `make.rules` file, the state file, and all hidden-dependency reports.

- **e**  Environment variables override assignments within `make` files.

- **-f makefile** Uses the description file `makefile`. A – as the `makefile` argument denotes the standard input. The contents of `makefile`, when present, override the standard set of implicit rules and predefined macros. When more than one `-f makefile` argument pair appears, `make` uses the concatenation of those files, in order of appearance.

When no `makefile` is specified, `usr/bin/make` tries the following in sequence, except when in POSIX mode (see .POSIX in Usage):

- If there is a file named `makefile` in the working directory, `make` uses that file. If, however, there is an SCCS history file (`SCCS/s.makefile`) which is newer, `make` attempts to retrieve and use the most recent version.

- In the absence of the above file(s), if a file named `Makefile` is present in the working directory, `make` attempts to use it. If there is an SCCS history file (`SCCS/s.Makefile`) that is newer, `make` attempts to retrieve and use the most recent version.

When no `makefile` is specified, `usr/bin/make` in POSIX mode and `usr/xpg4/bin/make` try the following files in sequence:

- `./makefile`, `.Makefile`
- `s.makefile`, `SCCS/s.makefile`
- `s.Makefile`, `SCCS/s.Makefile`

- **i**  Ignores error codes returned by commands. Equivalent to the special-function target .IGNORE:.

- **k**  When a nonzero error status is returned by a rule, or when `make` cannot find a rule, abandons work on the current target, but continues with other dependency branches that do not depend on it.

- **K statefile** Uses the state file `statefile`. A – as the `statefile` argument denotes the standard input. The contents of `statefile`, when present, override the standard set of implicit rules and predefined macros. When more than one `-K statefile`
argument pair appears, make uses the concatenation of those files, in order of appearance. (See also .KEEP_STATE and .KEEP_STATE_FILE in the Special-Function Targets section).

- **n**
  No execution mode. Prints commands, but does not execute them. Even lines beginning with an @ are printed. However, if a command line contains a reference to the $(MAKE) macro, that line is always executed (see the discussion of MAKEFLAGS in Reading Makefiles and the Environment). When in POSIX mode, lines beginning with a “+” are executed.

- **p**
  Prints out the complete set of macro definitions and target descriptions.

- **P**
  Merely reports dependencies, rather than building them.

- **q**
  Question mode. make returns a zero or nonzero status code depending on whether or not the target file is up to date. When in POSIX mode, lines beginning with a “+” are executed.

- **r**
  Does not read in the default makefile /usr/share/lib/make/make.rules.

- **s**
  Silent mode. Does not print command lines before executing them. Equivalent to the special-function target .SILENT:.

- **S**
  Undoes the effect of the -k option. Stops processing when a non-zero exit status is returned by a command.

- **t**
  Touches the target files (bringing them up to date) rather than performing their rules. Warning: This can be dangerous when files are maintained by more than one person. When the .KEEP_STATE: target appears in the makefile, this option updates the state file just as if the rules had been performed. When in POSIX mode, lines beginning with a “+” are executed.

- **u**
  Unconditional build of targets. Even if a target is up to date, it is rebuilt. This might be useful for rebuilding all targets without cleaning.

- **V**
  Puts make into SysV mode. Refer to sysV-make(1) for respective details.

- **w**
  Print a message containing the working directory before and after other processing. This can be useful for tracking down errors from complicated nests of recursive make commands.

- **x**
  Puts make into the specified compatibility mode. The following compatibility modes are supported:

  1. Compatibility with POSIX:
     - **x SUN_MAKE_COMPAT_MODE=POSIX**

  2. Compatibility with SUN make:
     - **x SUN_MAKE_COMPAT_MODE=SUN**
3. Compatibility with GNU `make` (partially supported):
   -x SUN_MAKE_COMPAT_MODE=GNU

4. Compatibility with `/usr/lib/svr4.make`:
   -x SUN_MAKE_COMPAT_MODE=SVR4

Operands

The following operands are supported:

```
target
```
Target names, as defined in Usage.

```
macro=value
```
Macro definition. This definition overrides any regular definition for the
specified macro within the makefile itself, or in the environment. However,
this definition can still be overridden by conditional macro assignments.

Usage

The usage of `make` is described below:

When `make` first starts, it reads the `MAKEFLAGS` environment variable to obtain any of the
following options specified present in its value: `-d`, `-D`, `-e`, `-i`, `-k`, `-n`, `-p`, `-q`, `-r`, `-s`, `-S`, or `-t`. Due to the implementation of POSIX.2 (see `POSIX.2(5)`), the `MAKEFLAGS` values contain a leading — character. The `make` utility then reads the command line for additional options, which also take effect.

Next, `make` reads in a default makefile that typically contains predefined macro definitions, target entries for implicit rules, and additional rules, such as the rule for retrieving SCCS files. If present, `make` uses the file `make.rules` in the current directory; otherwise it reads the file `/usr/share/lib/make/make.rules`, which contains the standard definitions and rules. Use the directive:

```
include /usr/share/lib/make/make.rules
```
in your local `make.rules` file to include them.

Next, `make` imports variables from the environment (unless the `-e` option is in effect), and treats them as defined macros. Because `make` uses the most recent definition it encounters, a macro definition in the makefile normally overrides an environment variable of the same name. When `-e` is in effect, however, environment variables are read in after all makefiles have been read. In that case, the environment variables take precedence over definitions in the makefile.

Next, `make` reads any makefiles you specify with `-f`, or one of `makefile` or `Makefile` as described above and then the state file, in the local directory if it exists. If the makefile contains a `.KEEP_STATE_FILE` target, then it reads the state file that follows the target. Refer to special target `.KEEP_STATE_FILE` for details.

Next (after reading the environment if `-e` is in effect), `make` reads in any macro definitions supplied as command line arguments. These override macro definitions in the makefile and the environment both, but only for the `make` command itself.
make exports environment variables, using the most recently defined value. Macro definitions supplied on the command line are not normally exported, unless the macro is also an environment variable.

make does not export macros defined in the makefile. If an environment variable is set, and a macro with the same name is defined on the command line, make exports its value as defined on the command line. Unless -e is in effect, macro definitions within the makefile take precedence over those imported from the environment.

The macros 

- MAKEFLAGS
- MAKE
- SHELL
- HOST_ARCH
- HOST_MACH
- TARGET_MACH

are special cases. See Special-Purpose Macros below for details.

Makefile Target Entries

A target entry has the following format:

```
target [ :: ] [ dependency ] [ ; command ] [ command ] ...
```

The first line contains the name of a target, or a space-separated list of target names, terminated with a colon or double colon. If a list of targets is given, this is equivalent to having a separate entry of the same form for each target. The colon(s) can be followed by a dependency, or a dependency list. make checks this list before building the target. The dependency list can be terminated with a semicolon (;), which in turn can be followed by a single Bourne shell command. Subsequent lines in the target entry begin with a TAB and contain Bourne shell commands. These commands comprise the rule for building the target.

Shell commands can be continued across input lines by escaping the NEWLINE with a backslash (\). The continuing line must also start with a TAB.

To rebuild a target, make expands macros, strips off initial TAB characters and either executes the command directly (if it contains no shell metacharacters), or passes each command line to a Bourne shell for execution.

The first non-empty line that does not begin with a TAB or # begins another target or macro definition.

Special Characters

Special characters are defined below.

<table>
<thead>
<tr>
<th>Global</th>
<th>Start a comment. The comment ends at the next NEWLINE. If the # follows the TAB in a command line, that line is passed to the shell (which also treats # as the start of a comment).</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>include filename</code></td>
<td>If the word <code>include</code> appears as the first seven letters of a line and is followed by a SPACE or TAB, the string that follows is taken as a filename to interpolate at that line.</td>
</tr>
</tbody>
</table>

`include` files can be nested to a depth of no more than about 16. If `filename` is a macro reference, it is expanded. If `filename` is surrounded by double quotes, make searches for a `filename` with relation to current
make(1S)

Targets and Dependencies

Targets and Dependencies

: Target list terminator. Words following the colon are added to the
dependency list for the target or targets. If a target is named in more
than one colon-terminated target entry, the dependencies for all its
entries are added to form that target's complete dependency list.

:: Target terminator for alternate dependencies. When used in place of
a : the double-colon allows a target to be checked and updated with
respect to alternate dependency lists. When the target is out-of-date
with respect to dependencies listed in the first alternate, it is built
according to the rule for that entry. When out-of-date with respect to
dependencies in another alternate, it is built according the rule in
that other entry. Implicit rules do not apply to double-colon targets;
you must supply a rule for each entry. If no dependencies are
specified, the rule is always performed.

target [+ target. . . ]: Target group. The rule in the target entry builds all the indicated
targets as a group. It is normally performed only once per make run,
but is checked for command dependencies every time a target in the
group is encountered in the dependency scan.

% Pattern matching wild card metacharacter. Like the * shell wild card,
% matches any string of zero or more characters in a target name or
dependency, in the target portion of a conditional macro definition,
or within a pattern replacement macro reference. Notice that only
one % can appear in a target, dependency-name, or
pattern-replacement macro reference.

./pathname make ignores the leading ./ characters from targets with names given
as pathnames relative to "dot," the working directory.

Macros =

Macro definition. The word to the left of this character is the macro name; words to
the right comprise its value. Leading and trailing white space characters are stripped
from the value. A word break following the = is implied.

$ Macro reference. The following character, or the parenthesized or bracketed string,
is interpreted as a macro reference: make expands the reference (including the $) by
replacing it with the macro’s value.

( )
{ } Macro-reference name delimiters. A parenthesized or bracketed word appended to
a $ is taken as the name of the macro being referred to. Without the delimiters, make
recognizes only the first character as the macro name.

$$ A reference to the dollar-sign macro, the value of which is the character $. Used to
pass variable expressions beginning with $ to the shell, to refer to environment
variables which are expanded by the shell, or to delay processing of dynamic macros within the dependency list of a target, until that target is actually processed.

\$  Escaped dollar-sign character. Interpreted as a literal dollar sign within a rule.

+=  When used in place of =, appends a string to a macro definition (must be surrounded by white space, unlike =).

:=  Conditional macro assignment. When preceded by a list of targets with explicit target entries, the macro definition that follows takes effect when processing only those targets, and their dependencies.

:sh =  Define the value of a macro to be the output of a command (see Command Substitutions below).

:sh  In a macro reference, execute the command stored in the macro, and replace the reference with the output of that command (see Command Substitutions below).

Rules  
+  make always executes the commands preceded by a "+", even when -n is specified.

−  make ignores any nonzero error code returned by a command line for which the first non-TAB character is a −. This character is not passed to the shell as part of the command line. make normally terminates when a command returns nonzero status, unless the -i or -k options, or the .IGNORE : special-function target is in effect.

@  If the first non-TAB character is a @, make does not print the command line before executing it. This character is not passed to the shell.

?  Escape command-dependency checking. Command lines starting with this character are not subject to command dependency checking.

!  Force command-dependency checking. Command-dependency checking is applied to command lines for which it would otherwise be suppressed. This checking is normally suppressed for lines that contain references to the ? dynamic macro (for example, $?).

When any combination of +, −, @, ?, or ! appear as the first characters after the TAB, all that are present apply. None are passed to the shell.

Special-Function Targets  
When incorporated in a makefile, the following target names perform special-functions:

.DEfault: If it has an entry in the makefile, the rule for this target is used to process a target when there is no other entry for it, no rule for building it, and no SCCS history file from which to retrieve a current version. make ignores any dependencies for this target.

.Done: If defined in the makefile, make processes this target and its dependencies after all other targets are built. This target is also performed when make halts with an error, unless the .FAILED target is defined.
<table>
<thead>
<tr>
<th>Target</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>.FAILED:</td>
<td>This target, along with its dependencies, is performed instead of .DONE when defined in the makefile and make halts with an error.</td>
</tr>
<tr>
<td>.GET_POSIX:</td>
<td>This target contains the rule for retrieving the current version of an SCCS file from its history file in the current working directory. make uses this rule when it is running in POSIX mode.</td>
</tr>
<tr>
<td>.IGNORE:</td>
<td>Ignore errors. When this target appears in the makefile, make ignores non-zero error codes returned from commands. When used in POSIX mode, .IGNORE could be followed by target names only, for which the errors is ignored.</td>
</tr>
<tr>
<td>.INIT:</td>
<td>If defined in the makefile, this target and its dependencies are built before any other targets are processed.</td>
</tr>
<tr>
<td>.KEEP_STATE:</td>
<td>If this target is in effect, make updates the state file, .make.state, in the current directory. This target also activates command dependencies, and hidden dependency checks. If either the .KEEP_STATE: target appears in the makefile, or the environment variable KEEP_STATE is set (setenv KEEP_STATE), make rebuilds everything in order to collect dependency information, even if all the targets were up to date due to previous make runs. See also the Environment Variables section. This target has no effect if used in POSIX mode.</td>
</tr>
<tr>
<td>.KEEP_STATE_FILE:</td>
<td>This target has no effect if used in POSIX mode. This target implies .KEEP_STATE. If the target is followed by a filename, make uses it as the state file. If the target is followed by a directory name, make looks for a .make.state file in that directory. If the target is not followed by any name, make looks for .make.state file in the current working directory.</td>
</tr>
<tr>
<td>.MAKE_VERSION:</td>
<td>A target-entry of the form: .MAKE_VERSION: VERSION=number enables version checking. If the version of make differs from the version indicated by a string like VERSION=1.8, make issues a warning message.</td>
</tr>
<tr>
<td>.NO_PARALLEL:</td>
<td>Currently, this target has no effect, it is, however, reserved for future use.</td>
</tr>
<tr>
<td>.PARALLEL:</td>
<td>Currently of no effect, but reserved for future use.</td>
</tr>
<tr>
<td>.POSIX:</td>
<td>This target enables POSIX mode.</td>
</tr>
<tr>
<td>.PRECIOUS:</td>
<td>List of files not to delete. make does not remove any of the files listed as dependencies for this target when interrupted. make normally</td>
</tr>
</tbody>
</table>
removesthecurrenttargetwhenitreceivesaninterrupt. When used in POSIX mode, if the target is not followed by a list of files, all the file are assumed precious.

.SCCS_GET: This target contains the rule for retrieving the current version of an SCCS file from its history file. To suppress automatic retrieval, add an entry for this target with an empty rule to your makefile.

.SCCS_GET_POSIX: This target contains the rule for retrieving the current version of an SCCS file from its history file. make uses this rule when it is running in POSIX mode.

.SILENT: Run silently. When this target appears in the makefile, make does not echo commands before executing them. When used in POSIX mode, it could be followed by target names, and only those are executed silently.

.SUFFIXES: The suffixes list for selecting implicit rules (see The Suffixes List).

.WAIT: Currently of no effect, but reserved for future use.

Clearing Special Targets

In this version of make, you can clear the definition of the following special targets by supplying entries for them with no dependencies and no rule:

.DEFAULT, .SCCS_GET, and .SUFFIXES

Command Dependencies

When the .KEEP_STATE: target is effective, make checks the command for building a target against the state file. If the command has changed since the last make run, make rebuilds the target.

Hidden Dependencies

When the .KEEP_STATE: target is effective, make reads reports from cpp(1) and other compilation processors for any "hidden" files, such as #include files. If the target is out of date with respect to any of these files, make rebuilds it.

Macros

Entries of the form

macro=value

define macros. macro is the name of the macro, and value, which consists of all characters up to a comment character or unescaped NEWLINE, is the value. make strips both leading and trailing white space in accepting the value.

Subsequent references to the macro, of the forms $ (name) or $ (name) are replaced by value. The parentheses or brackets can be omitted in a reference to a macro with a single-character name.

Macro references can contain references to other macros, in which case nested references are expanded first.
Substitutions within macros can be made as follows:

\[$(\text{name}: \text{string1}=\text{string2})\]

where \text{string1} is either a suffix, or a word to be replaced in the macro definition, and \text{string2} is the replacement suffix or word. Words in a macro value are separated by \text{SPACE}, \text{TAB}, and escaped \text{NEWLINE} characters.

Pattern matching replacements can also be applied to macros, with a reference of the form:

\[$(\text{name}: \text{op}%=\text{np}%\text{ns})\]

where \text{op} is the existing (old) prefix and \text{os} is the existing (old) suffix, \text{np} and \text{ns} are the new prefix and new suffix, respectively, and the pattern matched by \% (a string of zero or more characters), is carried forward from the value being replaced. For example:

\[
\text{PROGRAM}=\text{fabricate} \\
\text{DEBUG}= $(\text{PROGRAM}:%=\text{tmp/}%=\text{g})
\]

sets the value of \text{DEBUG} to \text{tmp/fabricate-g}.

Notice that pattern replacement macro references cannot be used in the dependency list of a pattern matching rule; the \% characters are not evaluated independently. Also, any number of \% metacharacters can appear after the equal-sign.

Words can be appended to macro values as follows:

\[\text{macro += word . . .}\]

When the \text{MAKEFLAGS} variable is present in the environment, \text{make} takes options from it, in combination with options entered on the command line. \text{make} retains this combined value as the \text{MAKEFLAGS} macro, and exports it automatically to each command or shell it invokes.

Notice that flags passed by way of \text{MAKEFLAGS} are only displayed when the -d, or -dd options are in effect.

The \text{MAKE} macro is another special case. It has the value \text{make} by default, and temporarily overrides the -n option for any line in which it is referred to. This allows nested invocations of \text{make} written as:

\[$(\text{MAKE}) . . .\]

to run recursively, with the -n flag in effect for all commands but make. This lets you use \text{make} -n to test an entire hierarchy of makefiles.

For compatibility with the 4.2 BSD \text{make}, the \text{MFLAGS} macro is set from the \text{MAKEFLAGS} variable by prepending a -. \text{MFLAGS} is not exported automatically.
The SHELL macro, when set to a single-word value such as `/usr/bin/csh`, indicates the name of an alternate shell to use. The default is `/bin/sh`. Notice that make executes commands that contain no shell metacharacters itself. Built-in commands, such as `dirs` in the C shell, are not recognized unless the command line includes a metacharacter (for instance, a semicolon). This macro is neither imported from, nor exported to the environment, regardless of `-e`. To be sure it is set properly, you must define this macro within every makefile that requires it.

The syntax of the VPATH macro is:

```bash
VPATH = [ pathname [ : pathname ] ... ]
```

VPATH specifies a list of directories to search for the files, which are targets or dependencies, when make is executed. VPATH is also used in order to search for the `include` files mentioned in the particular makefile.

When processing a target or a dependency or an include directive, make checks the existence of the file with the same name in the current directory. If the file is found to be missing, make searches for this file in the list of directories presented in VPATH (like the PATH variable in the shell). Unlike the PATH variable, VPATH is used in order to search for the files with relative pathnames. When make attempts to apply implicit rules to the target, it also searches for the dependency files using VPATH.

When the file is found using VPATH, internal macros `$@`, `$<`, `$?`, `$*`, and their alternative forms (with `D` or `F` appended) are set in accordance with the name derived from VPATH. For instance, if the target `subdir/foo.o` is found in the directory `/aaa/bbb` using VPATH, then the value of the internal macro `$@` for this target is `/aaa/bbb/subdir/foo.o`.

If a target or a dependency file is found using VPATH, then any occurrences of the word that is the same as the target name in the subsequent rules are replaced with the actual name of the target derived from VPATH.

For example:

```bash
VPATH=./subdir
file.o : file.c
  cc -c file.c -o file.o
```

If `file.c` is found in `./subdir`, then the command

```bash
cc -c ./subdir/file.c -o file.o
```

are executed.

The following macros are provided for use with cross-compilation:

**HOST_ARCH** The processor type of the host system. By default, this is the output of the `mach(1)` command, prepended with `-`. Under normal circumstances, this value should never be altered by the user.
HOST_MACH  The machine architecture of the host system. By default, this is the output of the `arch(1)` command, prepended with `-`. Under normal circumstances, this value should never be altered by the user.

TARGET_ARCH  The processor type of the target system. By default, the output of `mach`, prepended with `-`.

Dynamic Macros

There are several dynamically maintained macros that are useful as abbreviations within rules. They are shown here as references; if you were to define them, `make` would simply override the definition.

$*  The basename of the current target, derived as if selected for use with an implicit rule.

$<  The name of a dependency file, derived as if selected for use with an implicit rule.

$@  The name of the current target. This is the only dynamic macro whose value is strictly determined when used in a dependency list. (In which case it takes the form $$@.)

$?  The list of dependencies that are newer than the target. Command-dependency checking is automatically suppressed for lines that contain this macro, just as if the command had been prefixed with a `?`. See the description of `?`, under Special Character Rules above. You can force this check with the `!` command-line prefix.

$%  The name of the library member being processed. (See Library Maintenance below.)

To refer to the $@ dynamic macro within a dependency list, precede the reference with an additional $ character (as in, $$@). Because `make` assigns $< and $* as it would for implicit rules (according to the suffixes list and the directory contents), they can be unreliable when used within explicit target entries.

These macros can be modified to apply either to the filename part, or the directory part of the strings they stand for, by adding an upper case `F` or `D`, respectively (and enclosing the resulting name in parentheses or braces). Thus, $ (@D) refers to the directory part of the string $@; if there is no directory part, . is assigned. $ (@F) refers to the filename part.

Conditional Macro Definitions

A macro definition of the form:

```
target-list := macro = value
```

indicates that when processing any of the targets listed and their dependencies, `macro` is to be set to the `value` supplied. Notice that if a conditional macro is referred to in a dependency list, the $ must be delayed (use $$ instead). Also, `target-list` can contain a `%` pattern, in which case the macro is conditionally defined for all targets encountered that match the pattern. A pattern replacement reference can be used within the `value`.

You can temporarily append to a macros value with a conditional definition of the form:

```
target-list := macro += value
```
Predefined Macros

`make` supplies the macros shown in the table that follows for compilers and their options, host architectures, and other commands. Unless these macros are read in as environment variables, their values are not exported by `make`. If you run `make` with any of these set in the environment, it is a good idea to add commentary to the makefile to indicate what value each is expected to take. If `-r` is in effect, `make` does not read the default makefile (`./make.rules` or `/usr/share/lib/make/make.rules`) in which these macro definitions are supplied.

### Table of Predefined Macros

<table>
<thead>
<tr>
<th>Use</th>
<th>Macro</th>
<th>DefaultValue</th>
</tr>
</thead>
<tbody>
<tr>
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<td>AR</td>
<td>ar</td>
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<tr>
<td>Archives</td>
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<td>Commands</td>
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<td>COMPILE.s</td>
<td>$(AS) $(ASFLAGS) $(CPPFLAGS) -c</td>
</tr>
<tr>
<td></td>
<td>COMPILE.S</td>
<td>$(CC) $(ASFLAGS) $(CPPFLAGS) -c</td>
</tr>
<tr>
<td>C Compiler</td>
<td>CC</td>
<td>cc</td>
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<tr>
<td></td>
<td>CFLAGS</td>
<td>$(CC) $(CFLAGS) $(CPPFLAGS) -c</td>
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<tr>
<td></td>
<td>COMPILE.c</td>
<td>$(CC) $(CFLAGS) $(CPPFLAGS) -c</td>
</tr>
<tr>
<td></td>
<td>LINK.c</td>
<td>$(CC) $(CFLAGS) $(CPPFLAGS) $(LDFLAGS)</td>
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<tr>
<td>C++ Compiler</td>
<td>CCC</td>
<td>CC</td>
</tr>
<tr>
<td></td>
<td>CCFLAGS</td>
<td>$(CC) $(CCFLAGS) $(CPPFLAGS) -c</td>
</tr>
<tr>
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<td>$(CC) $(CCFLAGS) $(CPPFLAGS) -c</td>
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<td>$(CC) $(CCFLAGS) $(CPPFLAGS) $(LDFLAGS)</td>
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<td>COMPILE.C</td>
<td>$(CC) $(CCFLAGS) $(CPPFLAGS) -c</td>
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<tr>
<td></td>
<td>LINK.C</td>
<td>$(CC) $(CCFLAGS) $(CPPFLAGS) $(LDFLAGS)</td>
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</table>
### Table of Predefined Macros

<table>
<thead>
<tr>
<th>Use</th>
<th>Macro</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
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<td><strong>FORTRAN 77</strong></td>
<td>FC</td>
<td>f77</td>
</tr>
<tr>
<td>Compiler</td>
<td>FFLAGS</td>
<td></td>
</tr>
<tr>
<td>Commands</td>
<td>COMPILE.f</td>
<td>$(FC) $(FFLAGS) -c</td>
</tr>
<tr>
<td></td>
<td>LINK.f</td>
<td>$(FC) $(FFLAGS) $(LDFLAGS)</td>
</tr>
<tr>
<td></td>
<td>COMPILE.F</td>
<td>$(FC) $(FFLAGS) $(CPPFLAGS) -c</td>
</tr>
<tr>
<td></td>
<td>LINK.F</td>
<td>$(FC) $(FFLAGS) $(CPPFLAGS) $(LDFLAGS)</td>
</tr>
<tr>
<td><strong>FORTRAN 90</strong></td>
<td>FC</td>
<td>f90</td>
</tr>
<tr>
<td>Compiler</td>
<td>F90FLAGS</td>
<td></td>
</tr>
<tr>
<td>Commands</td>
<td>COMPILE.f90</td>
<td>$(F90C) $(F90FLAGS) -c</td>
</tr>
<tr>
<td></td>
<td>LINK.f90</td>
<td>$(F90C) $(F90FLAGS) $(LDFLAGS)</td>
</tr>
<tr>
<td></td>
<td>COMPILE.ftn</td>
<td>$(F90C) $(F90FLAGS) $(CPPFLAGS) -c</td>
</tr>
<tr>
<td></td>
<td>LINK.ftn</td>
<td>$(F90C) $(F90FLAGS) $(CPPFLAGS) $(LDFLAGS)</td>
</tr>
<tr>
<td><strong>Link Editor</strong></td>
<td>LD</td>
<td>ld</td>
</tr>
<tr>
<td>Command</td>
<td>LDFLAGS</td>
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</tr>
<tr>
<td><strong>lex</strong></td>
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<td>lex</td>
</tr>
<tr>
<td>Command</td>
<td>LFLAGS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LEX.l</td>
<td>$(LEX) $(LFLAGS) -t</td>
</tr>
<tr>
<td><strong>lint</strong></td>
<td>LINT</td>
<td>lint</td>
</tr>
<tr>
<td>Command</td>
<td>LINTFLAGS</td>
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</tr>
<tr>
<td></td>
<td>LINT.c</td>
<td>$(LINT) $(LINTFLAGS) $(CPPFLAGS)</td>
</tr>
<tr>
<td><strong>Modula 2</strong></td>
<td>M2C</td>
<td>m2c</td>
</tr>
<tr>
<td>Commands</td>
<td>M2FLAGS</td>
<td></td>
</tr>
</tbody>
</table>
## Table of Predefined Macros

<table>
<thead>
<tr>
<th>Use</th>
<th>Macro</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MODFLAGS</td>
<td>$(M2C) $(M2FLAGS) $(DEFFLAGS)</td>
</tr>
<tr>
<td></td>
<td>DEFFLAGS</td>
<td>$(M2C) $(M2FLAGS) $(DEFFLAGS)</td>
</tr>
<tr>
<td></td>
<td>COMPILE.def</td>
<td>$(M2C) $(M2FLAGS) $(DEFFLAGS)</td>
</tr>
<tr>
<td></td>
<td>COMPILE.mod</td>
<td>$(M2C) $(M2FLAGS) $(MODFLAGS)</td>
</tr>
<tr>
<td>Pascal</td>
<td>PC</td>
<td>pc</td>
</tr>
<tr>
<td>Compiler</td>
<td>PFLAGS</td>
<td></td>
</tr>
<tr>
<td>Commands</td>
<td>COMPILE.p</td>
<td>$(PC) $(PFLAGS) $(CPPFLAGS) -c</td>
</tr>
<tr>
<td></td>
<td>LINK.p</td>
<td>$(PC) $(PFLAGS) $(CPPFLAGS) $(LDFLAGS)</td>
</tr>
<tr>
<td>Ratfor</td>
<td>RFLAGS</td>
<td></td>
</tr>
<tr>
<td>Compilation</td>
<td>COMPILE.r</td>
<td>$(FC) $(FFLAGS) $(RFLAGS) -c</td>
</tr>
<tr>
<td>Commands</td>
<td>LINK.r</td>
<td>$(FC) $(FFLAGS) $(RFLAGS) $(LDFLAGS)</td>
</tr>
<tr>
<td>rm Command</td>
<td>RM</td>
<td>rm -f</td>
</tr>
<tr>
<td>sccs</td>
<td>SCCSFLAGS</td>
<td></td>
</tr>
<tr>
<td>Command</td>
<td>SCCSGETFLAGS</td>
<td>-s</td>
</tr>
<tr>
<td>yacc</td>
<td>YACC</td>
<td>yacc</td>
</tr>
<tr>
<td>Command</td>
<td>YFLAGS</td>
<td>$(YACC) $(YFLAGS)</td>
</tr>
<tr>
<td></td>
<td>YACC.y</td>
<td>$(YACC) $(YFLAGS)</td>
</tr>
</tbody>
</table>
When a target has no entry in the makefile, make attempts to determine its class (if any) and apply the rule for that class. An implicit rule describes how to build any target of a given class, from an associated dependency file. The class of a target can be determined either by a pattern, or by a suffix; the corresponding dependency file (with the same basename) from which such a target might be built. In addition to a predefined set of implicit rules, make allows you to define your own, either by pattern, or by suffix.

A target entry of the form:

```
tp%ts: dp%ds
  rule
```

is a pattern matching rule, in which `tp` is a target prefix, `ts` is a target suffix, `dp` is a dependency prefix, and `ds` is a dependency suffix (any of which can be null). The `%` stands for a basename of zero or more characters that is matched in the target, and is used to construct the name of a dependency. When make encounters a match in its search for an implicit rule, it uses the rule in that target entry to build the target from the dependency file. Pattern-matching implicit rules typically make use of the `@` and `<` dynamic macros as placeholders for the target and dependency names. Other, regular dependencies can occur in the dependency list; however, none of the regular dependencies can contain a `%`. An entry of the form:

```
tp%ts: [dependency... ] dp%ds [dependency... ]
  rule
```

is a valid pattern matching rule.

When no pattern matching rule applies, make checks the target name to see if it ends with a suffix in the known suffixes list. If so, make checks for any suffix rules, as well as a dependency file with same root and another recognized suffix, from which to build it.

The target entry for a suffix rule takes the form:

```
DsTs:  rule
```

where `Ts` is the suffix of the target, `Ds` is the suffix of the dependency file, and `rule` is the rule for building a target in the class. Both `Ds` and `Ts` must appear in the suffixes list. (A suffix need not begin with a `.` to be recognized.)

A suffix rule with only one suffix describes how to build a target having a null (or no) suffix from a dependency file with the indicated suffix. For instance, the `.c` rule could be used to build an executable program named `file` from a C source file named `file.c`. If a target with a null suffix has an explicit dependency, make omits the search for a suffix rule.

<table>
<thead>
<tr>
<th>Implicit Rule Name</th>
<th>Command Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>.s.o</td>
<td><code>$(COMPILE.s) -o $@ </code>&lt;</td>
</tr>
</tbody>
</table>

When a target has no entry in the makefile, make attempts to determine its class (if any) and apply the rule for that class. An implicit rule describes how to build any target of a given class, from an associated dependency file. The class of a target can be determined either by a pattern, or by a suffix; the corresponding dependency file (with the same basename) from which such a target might be built. In addition to a predefined set of implicit rules, make allows you to define your own, either by pattern, or by suffix.

A target entry of the form:

```
tp%ts: dp%ds
  rule
```

is a pattern matching rule, in which `tp` is a target prefix, `ts` is a target suffix, `dp` is a dependency prefix, and `ds` is a dependency suffix (any of which can be null). The `%` stands for a basename of zero or more characters that is matched in the target, and is used to construct the name of a dependency. When make encounters a match in its search for an implicit rule, it uses the rule in that target entry to build the target from the dependency file. Pattern-matching implicit rules typically make use of the `@` and `<` dynamic macros as placeholders for the target and dependency names. Other, regular dependencies can occur in the dependency list; however, none of the regular dependencies can contain a `%`. An entry of the form:

```
tp%ts: [dependency... ] dp%ds [dependency... ]
  rule
```

is a valid pattern matching rule.

When no pattern matching rule applies, make checks the target name to see if it ends with a suffix in the known suffixes list. If so, make checks for any suffix rules, as well as a dependency file with same root and another recognized suffix, from which to build it.

The target entry for a suffix rule takes the form:

```
DsTs:  rule
```

where `Ts` is the suffix of the target, `Ds` is the suffix of the dependency file, and `rule` is the rule for building a target in the class. Both `Ds` and `Ts` must appear in the suffixes list. (A suffix need not begin with a `.` to be recognized.)

A suffix rule with only one suffix describes how to build a target having a null (or no) suffix from a dependency file with the indicated suffix. For instance, the `.c` rule could be used to build an executable program named `file` from a C source file named `file.c`. If a target with a null suffix has an explicit dependency, make omits the search for a suffix rule.

<table>
<thead>
<tr>
<th>Implicit Rule Name</th>
<th>Command Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>.s.o</td>
<td><code>$(COMPILE.s) -o $@ </code>&lt;</td>
</tr>
</tbody>
</table>
### Table of Standard Implicit (Suffix) Rules for Assembly Files

<table>
<thead>
<tr>
<th>Implicit Rule Name</th>
<th>CommandLine</th>
</tr>
</thead>
</table>
| .s.a               | $(COMPILE.s) -o $% $<  
|                    | $(AR) $(ARFLAGS) $@ $%  
|                    | $(RM) $% |
| .s..o              | $(GET) $(GFLAGS) -p $< > $*.s  
|                    | $(COMPILE.s) -o $@ $*.s |
| .S.o               | $(COMPILE.S) -o $@ $< |
| .S.a               | $(COMPILE.S) -o $% $<  
|                    | $(AR) $(ARFLAGS) $@ $%  
|                    | $(RM) $% |
| .S..o              | $(GET) $(GFLAGS) -p $< > $*.S  
|                    | $(COMPILE.S) -o $@ $*.S |
| .S..a              | $(GET) $(GFLAGS) -p $< > $*.S  
|                    | $(COMPILE.S) -o $% $*.S  
|                    | $(AR) $(ARFLAGS) $@ $%  
|                    | $(RM) $% |

### Table of Standard Implicit (Suffix) Rules for C Files

<table>
<thead>
<tr>
<th>Implicit Rule Name</th>
<th>CommandLine</th>
</tr>
</thead>
<tbody>
<tr>
<td>.c</td>
<td>$(LINK.c) -o $@ $&lt; $(LDLIBS)</td>
</tr>
<tr>
<td>.c.ln</td>
<td>$(LINT.c) $(OUTPUT_OPTION) -i $&lt;</td>
</tr>
</tbody>
</table>
### Table of Standard Implicit (Suffix) Rules for C Files

<table>
<thead>
<tr>
<th>Implicit Rule Name</th>
<th>CommandLine</th>
</tr>
</thead>
<tbody>
<tr>
<td>.c.o</td>
<td>$(COMPILE.c) $(OUTPUT_OPTION) $&lt;</td>
</tr>
<tr>
<td>.c.a</td>
<td>$(COMPILE.c) -o $% $&lt;</td>
</tr>
<tr>
<td></td>
<td>$(AR) $(ARFLAGS) $@ $%</td>
</tr>
<tr>
<td></td>
<td>$(RM) $%</td>
</tr>
<tr>
<td>.c~</td>
<td>$(GET) $(GFLAGS) -p $&lt; &gt; $*.c</td>
</tr>
<tr>
<td></td>
<td>$(CC) $(CFLAGS) $(LDFLAGS) -o $@ $*.c</td>
</tr>
<tr>
<td>.c~.o</td>
<td>$(GET) $(GFLAGS) -p $&lt; &gt; $*.c</td>
</tr>
<tr>
<td></td>
<td>$(CC) $(CFLAGS) -c $*.c</td>
</tr>
<tr>
<td>.c~.ln</td>
<td>$(GET) $(GFLAGS) -p $&lt; &gt; $*.c</td>
</tr>
<tr>
<td></td>
<td>$(LINT.c) $(OUTPUT_OPTION) -c $*.c</td>
</tr>
<tr>
<td>.c~.a</td>
<td>$(GET) $(GFLAGS) -p $&lt; &gt; $*.c</td>
</tr>
<tr>
<td></td>
<td>$(COMPILE.c) -o $% $*.c</td>
</tr>
<tr>
<td></td>
<td>$(AR) $(ARFLAGS) $@ $%</td>
</tr>
<tr>
<td></td>
<td>$(RM) $%</td>
</tr>
</tbody>
</table>

### Table of Standard Implicit (Suffix) Rules for C++ Files

<table>
<thead>
<tr>
<th>Implicit Rule Name</th>
<th>CommandLine</th>
</tr>
</thead>
<tbody>
<tr>
<td>.cc</td>
<td>$(LINK.cc) -o $@ $&lt; $(LDLIBS)</td>
</tr>
<tr>
<td>.cc.o</td>
<td>$(COMPILE.cc) $(OUTPUT_OPTION) $&lt;</td>
</tr>
<tr>
<td>Implicit Rule Name</td>
<td>Command Line</td>
</tr>
<tr>
<td>--------------------</td>
<td>--------------</td>
</tr>
</tbody>
</table>
| .cc.a              | $(COMPILE.cc) -o % $<  
|                    | $(AR) $(ARFLAGS) $@ %  
|                    | $(RM) % |
| .cc-              | $(GET) $(GFLAGS) -p $< > $*.cc  
|                    | $(LINK.cc) -o $@ $*.cc $(LDLIBS) |
| .cc.o            | $(COMPILE.cc) $(OUTPUT_OPTION) $<  |
| .cc-.o           | $(GET) $(GFLAGS) -p $< > $*.cc  
|                    | $(COMPILE.cc) $(OUTPUT_OPTION) $*.cc |
| .cc.a            | $(COMPILE.cc) -o % $<  
|                    | $(AR) $(ARFLAGS) $@ %  
|                    | $(RM) % |
| .cc-.a           | $(GET) $(GFLAGS) -p $< > $*.cc  
|                    | $(COMPILE.cc) -o % $*.cc  
|                    | $(AR) $(ARFLAGS) $@ %  
|                    | $(RM) % |
| .C                | $(LINK.C) -o $@ $< $(LDLIBS) |
| .C-               | $(GET) $(GFLAGS) -p $< > $*.C  
<p>|                    | $(LINK.C) -o $@ $*.C $(LDLIBS) |
| .C.o             | $(COMPILE.C) $(OUTPUT_OPTION) $&lt;  |</p>
<table>
<thead>
<tr>
<th>Implicit Rule Name</th>
<th>Command Line</th>
</tr>
</thead>
</table>
| `.C~.o`           | $(GET) $(GFLAGS) -p << > $*.C  
|                   | $(COMPILE.C) $(OUTPUT_OPTION) $*.C |
| `.C.a`            | $(COMPILE.C) -o % $<  
|                   | $(AR) $(ARFLAGS) @ %  
|                   | $(RM) % |
| `.C~.a`           | $(GET) $(GFLAGS) -p << > $*.C  
|                   | $(COMPILE.C) -o % $*.C  
|                   | $(AR) $(ARFLAGS) @ %  
|                   | $(RM) % |

<table>
<thead>
<tr>
<th>Implicit Rule Name</th>
<th>Command Line</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>.f</code></td>
<td>$(LINK.f) -o @ &lt;&lt; $(LDLIBS)</td>
</tr>
<tr>
<td><code>.f.o</code></td>
<td>$(COMPILE.f) $(OUTPUT_OPTION) $&lt;</td>
</tr>
</tbody>
</table>
| `.f.a`            | $(COMPILE.f) -o % $<  
|                   | $(AR) $(ARFLAGS) @ %  
|                   | $(RM) % |
| `.f`              | $(LINK.f) -o @ << $(LDLIBS) |
| `.f~`             | $(GET) $(GFLAGS) -p << > $*.f  
<p>|                   | $(FC) $(FFLAGS) $(LDFLAGS) -o @ $*.f |</p>
<table>
<thead>
<tr>
<th>Implicit Rule Name</th>
<th>Command Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>.f~.o</td>
<td>$(GET) $(GFLAGS) -p $&lt; &gt; $*.f</td>
</tr>
<tr>
<td></td>
<td>$(FC) $(FFLAGS) -c $*.f</td>
</tr>
<tr>
<td>.f~.a</td>
<td>$(GET) $(GFLAGS) -p $&lt; &gt; $*.f</td>
</tr>
<tr>
<td></td>
<td>$(COMPILE.f) -o $% $*.f</td>
</tr>
<tr>
<td></td>
<td>$(AR) $(ARFLAGS) $@ $%</td>
</tr>
<tr>
<td></td>
<td>$(RM) $%</td>
</tr>
<tr>
<td>.F</td>
<td>$(LINK.F) -o $@ $&lt; $(LDLIBS)</td>
</tr>
<tr>
<td>.F.o</td>
<td>$(COMPILE.F) $(OUTPUT_OPTION) $&lt;</td>
</tr>
<tr>
<td>.F.a</td>
<td>$(COMPILE.F) -o $% $&lt;</td>
</tr>
<tr>
<td></td>
<td>$(AR) $(ARFLAGS) $@ $%</td>
</tr>
<tr>
<td></td>
<td>$(RM) $%</td>
</tr>
<tr>
<td>.F~</td>
<td>$(GET) $(GFLAGS) -p $&lt; &gt; $*.F</td>
</tr>
<tr>
<td></td>
<td>$(FC) $(FFLAGS) $(LDFLAGS) -o $@ $*.F</td>
</tr>
<tr>
<td>.F~.o</td>
<td>$(GET) $(GFLAGS) -p $&lt; &gt; $*.F</td>
</tr>
<tr>
<td></td>
<td>$(FC) $(FFLAGS) -c $*.f</td>
</tr>
<tr>
<td>.F~.a</td>
<td>$(GET) $(GFLAGS) -p $&lt; &gt; $*.F</td>
</tr>
<tr>
<td></td>
<td>$(COMPILE.F) -o $% $*.f</td>
</tr>
<tr>
<td></td>
<td>$(AR) $(ARFLAGS) $@ $%</td>
</tr>
<tr>
<td></td>
<td>$(RM) $%</td>
</tr>
</tbody>
</table>
### Table of Standard Implicit (Suffix) Rules for FORTRAN 90 Files

<table>
<thead>
<tr>
<th>Implicit Rule Name</th>
<th>Command Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>.f90</td>
<td>$(LINK.f90) -o $@ $&lt; $(LDLIBS)</td>
</tr>
<tr>
<td>.f90-</td>
<td>$(GET) $(GFLAGS) -p $&lt; &gt; *f0</td>
</tr>
<tr>
<td></td>
<td>$(LINK.f90) -o $@ *f0 $(LDLIBS)</td>
</tr>
<tr>
<td>.f90.o</td>
<td>$(COMPILE.f90) $(OUTPUT_OPTION) $&lt;</td>
</tr>
<tr>
<td>.f90-.o</td>
<td>$(GET) $(GFLAGS) -p $&lt; &gt; *f0</td>
</tr>
<tr>
<td></td>
<td>$(COMPILE.f90) $(OUTPUT_OPTION) *f0</td>
</tr>
<tr>
<td>.f90.a</td>
<td>$(COMPILE.f90) -o $% $&lt;</td>
</tr>
<tr>
<td></td>
<td>$(AR) $(ARFLAGS) $@ $%</td>
</tr>
<tr>
<td></td>
<td>$(RM) $%</td>
</tr>
<tr>
<td>.f90-.a</td>
<td>$(GET) $(GFLAGS) -p $&lt; &gt; *f0</td>
</tr>
<tr>
<td></td>
<td>$(COMPILE.f90) -o $% *f0</td>
</tr>
<tr>
<td></td>
<td>$(AR) $(ARFLAGS) $@ $%</td>
</tr>
<tr>
<td></td>
<td>$(RM) $%</td>
</tr>
<tr>
<td>.ftn</td>
<td>$(LINK.ftn) -o $@ $&lt; $(LDLIBS)</td>
</tr>
<tr>
<td>.ftn-</td>
<td>$(GET) $(GFLAGS) -p $&lt; &gt; *ftn</td>
</tr>
<tr>
<td></td>
<td>$(LINK.ftn) -o $@ *ftn $(LDLIBS)</td>
</tr>
<tr>
<td>.ftn.o</td>
<td>$(COMPILE.ftn) $(OUTPUT_OPTION) $&lt;</td>
</tr>
<tr>
<td>.ftn-.o</td>
<td>$(GET) $(GFLAGS) -p $&lt; &gt; *ftn</td>
</tr>
</tbody>
</table>
### Table of Standard Implicit (Suffix) Rules for FORTRAN 90 Files

<table>
<thead>
<tr>
<th>Implicit Rule Name</th>
<th>Command Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>.ftn.a</td>
<td>$(COMPILE.frn) -o $% $&lt;  &lt;br&gt; $(AR) $(ARFLAGS) $@ $%  &lt;br&gt; $(RM) $%</td>
</tr>
<tr>
<td>.ftn-.a</td>
<td>$(GET) $(GFLAGS) -p $&lt; &gt; $<em>.ftn  &lt;br&gt; $(COMPILE.frn) -o $% $</em>.ftn  &lt;br&gt; $(AR) $(ARFLAGS) $@ $%  &lt;br&gt; $(RM) $%</td>
</tr>
</tbody>
</table>

### Table of Standard Implicit (Suffix) Rules for lex Files

<table>
<thead>
<tr>
<th>Implicit Rule Name</th>
<th>Command Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>.l</td>
<td>$(RM) $<em>.c  &lt;br&gt; $(LEX.l) $&lt; &gt; $</em>.c  &lt;br&gt; $(LINK.c) -o $@ $<em>.c $(LDLIBS)  &lt;br&gt; $(RM) $</em>.c</td>
</tr>
<tr>
<td>.l.c</td>
<td>$(RM) $@  &lt;br&gt; $(LEX.l) $&lt; &gt; $@</td>
</tr>
<tr>
<td>.l.ln</td>
<td>$(RM) $<em>.c  &lt;br&gt; $(LEX.l) $&lt; &gt; $</em>.c  &lt;br&gt; $(LINT.c) -o $@ -i$<em>.c  &lt;br&gt; $(RM) $</em>.c</td>
</tr>
<tr>
<td>.l.o</td>
<td>$(RM) $*.c</td>
</tr>
</tbody>
</table>
Table of Standard Implicit (Suffix) Rules for lex Files

<table>
<thead>
<tr>
<th>Implicit Rule Name</th>
<th>Command Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>.l~</td>
<td>$(GET) $(GFLAGS) -p $&lt; &gt; $<em>.l $(LEX) $(LFLAGS) $</em>.l $(CC) $(CFLAGS) -c lex.yy.c rm -f lex.yy.c mv lex.yy.c $@</td>
</tr>
<tr>
<td>.l~.c</td>
<td>$(GET) $(GFLAGS) -p $&lt; &gt; $<em>.l $(LEX) $(LFLAGS) $</em>.l mv lex.yy.c $@</td>
</tr>
<tr>
<td>.l~.ln</td>
<td>$(GET) $(GFLAGS) -p $&lt; &gt; $<em>.l $(RM) $</em>.c $(LEX.l) $<em>.l &gt; $</em>.c $(LINT.c) -o $@ -i $<em>.c $(RM) $</em>.c</td>
</tr>
<tr>
<td>.l~.o</td>
<td>$(GET) $(GFLAGS) -p $&lt; &gt; $<em>.l $(LEX) $(LFLAGS) $</em>.l $(CC) $(CFLAGS) -c lex.yy.c rm -f lex.yy.c mv lex.yy.c $@</td>
</tr>
</tbody>
</table>
### Table of Standard Implicit (Suffix) Rules for Modula 2 Files

<table>
<thead>
<tr>
<th>Implicit Rule Name</th>
<th>CommandLine</th>
</tr>
</thead>
<tbody>
<tr>
<td>.mod</td>
<td>${COMPILE.mod} -o $@ -e $@ $&lt;</td>
</tr>
<tr>
<td>.mod.o</td>
<td>${COMPILE.mod} -o $@ $&lt;</td>
</tr>
<tr>
<td>.def.sym</td>
<td>${COMPILE.def} -o $@ $&lt;</td>
</tr>
</tbody>
</table>
| .def-.sym          | $(GET) $(GFLAGS) -p $< > $*.def  
                     | $(COMPILE.def) -o$@ $*.def |
| .mod-              | $(GET) $(GFLAGS) -p $< > $*.mod  
                     | $(COMPILE.mod) -o $@ -e $@ $*.mod |
| .mod-.o            | $(GET) $(GFLAGS) -p $< > $*.mod  
                     | $(COMPILE.mod) -o $@ $*.mod |
| .mod-.a            | $(GET) $(GFLAGS) -p $< > $*.mod  
                     | $(COMPILE.mod) -o $% $*.mod  
                     | $(AR) $(ARFLAGS) $% $%  
                     | $(RM) $% |

### Table of Standard Implicit (Suffix) Rules for NeWS Files

<table>
<thead>
<tr>
<th>Implicit Rule Name</th>
<th>CommandLine</th>
</tr>
</thead>
<tbody>
<tr>
<td>.cps.h</td>
<td>cps $*.cps</td>
</tr>
</tbody>
</table>
| .cps-.h            | $(GET) $(GFLAGS) -p $< > $*.cps  
                     | $(CPS) $(CPSFLAGS) $*.cps |
### Table of Standard Implicit (Suffix) Rules for Pascal Files

<table>
<thead>
<tr>
<th>Implicit Rule Name</th>
<th>Command Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>.p</td>
<td>$(LINK.p) -o $@ $&lt; $(LDLIBS)</td>
</tr>
<tr>
<td>.p.o</td>
<td>$(COMPILE.p) $(OUTPUT_OPTION) $&lt;</td>
</tr>
<tr>
<td>.p~</td>
<td>$(GET) $(GFLAGS) -p $&lt; &gt; $<em>.p $(LINK.p) -o $@ $</em>.p $(LDLIBS)</td>
</tr>
<tr>
<td>.p~.o</td>
<td>$(GET) $(GFLAGS) -p $&lt; &gt; $<em>.p $(COMPILE.p) $(OUTPUT_OPTION) $</em>.p</td>
</tr>
<tr>
<td>.p~.a</td>
<td>$(GET) $(GFLAGS) -p $&lt; &gt; $<em>.p $(COMPILE.p) -o $% $</em>.p $(AR) $(ARFLAGS) $@ $% $(RM) $%</td>
</tr>
<tr>
<td>.p~.a</td>
<td>$(AR) $(ARFLAGS) $@ $% $(RM) $%</td>
</tr>
</tbody>
</table>

### Table of Standard Implicit (Suffix) Rules for Ratfor Files

<table>
<thead>
<tr>
<th>Implicit Rule Name</th>
<th>Command Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>.r</td>
<td>$(LINK.r) -o $@ $&lt; $(LDLIBS)</td>
</tr>
<tr>
<td>.r.o</td>
<td>$(COMPILE.r) $(OUTPUT_OPTION) $&lt;</td>
</tr>
<tr>
<td>.r.a</td>
<td>$(COMPILE.r) -o $% $&lt; $(AR) $(ARFLAGS) $@ $% $(RM) $%</td>
</tr>
<tr>
<td>.r~</td>
<td>$(GET) $(GFLAGS) -p $&lt; &gt; $<em>.r $(LINK.r) -o $@ $</em>.r $(LDLIBS)</td>
</tr>
</tbody>
</table>
### Table of Standard Implicit (Suffix) Rules for Bats for Files

<table>
<thead>
<tr>
<th>Implicit Rule Name</th>
<th>CommandLine</th>
</tr>
</thead>
<tbody>
<tr>
<td>.r~.o</td>
<td>$(GET) $(GFLAGS) -p $&lt; &gt; $*.r</td>
</tr>
<tr>
<td></td>
<td>$(COMPILE.r) $(OUTPUT_OPTION) $*.r</td>
</tr>
<tr>
<td>.r~.a</td>
<td>$(GET) $(GFLAGS) -p $&lt; &gt; $*.r</td>
</tr>
<tr>
<td></td>
<td>$(COMPILE.r) -o $% $*.r</td>
</tr>
<tr>
<td></td>
<td>$(AR) $(ARFLAGS) $@ $%</td>
</tr>
<tr>
<td></td>
<td>$(RM) $%</td>
</tr>
</tbody>
</table>

### Table of Standard Implicit (Suffix) Rules for SCCS Files

<table>
<thead>
<tr>
<th>Implicit Rule Name</th>
<th>CommandLine</th>
</tr>
</thead>
<tbody>
<tr>
<td>.SCCS_GET</td>
<td>sccs $(SCCSFLAGS) get $(SCCSGETFLAGS) $@ -G$@</td>
</tr>
<tr>
<td>.SCCS_GET_POSIX</td>
<td>sccs $(SCCSFLAGS) get $(SCCSGETFLAGS) $@</td>
</tr>
<tr>
<td>.GET_POSIX</td>
<td>$(GET) $(GFLAGS) s.$@</td>
</tr>
</tbody>
</table>

### Table of Standard Implicit (Suffix) Rules for Shell Scripts

<table>
<thead>
<tr>
<th>Implicit Rule Name</th>
<th>CommandLine</th>
</tr>
</thead>
<tbody>
<tr>
<td>.sh</td>
<td>cat $&lt; &gt;$@</td>
</tr>
<tr>
<td></td>
<td>chmod +x $@</td>
</tr>
<tr>
<td>.sh~</td>
<td>$(GET) $(GFLAGS) -p $&lt; &gt; $*.sh</td>
</tr>
<tr>
<td></td>
<td>cp $*.sh $@</td>
</tr>
<tr>
<td></td>
<td>chmod a+x $@</td>
</tr>
<tr>
<td>Implicit Rule Name</td>
<td>Command Line</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------</td>
</tr>
</tbody>
</table>
| `.y`              | $(YACC.y) $<  
$(LINK.c) -o $@ y.tab.c $(LDLIBS)  
$(RM) y.tab.c |
| `.y.c`            | $(YACC.y) $<  
mv y.tab.c $@ |
| `.y.ln`           | $(YACC.y) $<  
$(LINT.c) -o $@ -i y.tab.c  
$(RM) y.tab.c |
| `.y.o`            | $(YACC.y) $<  
$(COMPILE.c) -o $@ y.tab.c  
$(RM) y.tab.c |
| `.y~`             | $(GET) $(GFLAGS) -p $< > $*.y  
$(YACC) $(YFLAGS) $*.y  
$(COMPILE.c) -o $@ y.tab.c  
$(RM) y.tab.c |
| `.y~.c`           | $(GET) $(GFLAGS) -p $< > $*.y  
$(YACC) $(YFLAGS) $*.y  
mv y.tab.c $@ |
| `.y~.ln`          | $(GET) $(GFLAGS) -p $< > $*.y  
$(YACC.y) $*.y  
$(LINT.c) -o $@ -i y.tab.c |
make reads in the standard set of implicit rules from the file
/usr/share/lib/make/make.rules, unless -r is in effect, or there is a make.rules file in the
local directory that does not include that file.

### The Suffixes List

The suffixes list is given as the list of dependencies for the .SUFFIXES: special-function target.
The default list is contained in the SUFFIXES macro (See Table of Predefined Macros for the
standard list of suffixes). You can define additional .SUFFIXES targets; a .SUFFIXES target
with no dependencies clears the list of suffixes. Order is significant within the list; make selects
a rule that corresponds to the target's suffix and the first dependency-file suffix found in the
list. To place suffixes at the head of the list, clear the list and replace it with the new suffixes,
followed by the default list:

```
.SUFFIXES:
.SUFFIXES: suffixes $(SUFFIXES)
```

A tilde (~) indicates that if a dependency file with the indicated suffix (minus the ~) is under
SCCS its most recent version should be retrieved, if necessary, before the target is processed.

### Library Maintenance

A target name of the form:
```
lib(member ...)
```

refers to a member, or a space-separated list of members, in an ar(1) library.

The dependency of the library member on the corresponding file must be given as an explicit
entry in the makefile. This can be handled by a pattern matching rule of the form:
```
lib(%.s): %.s
```

where .s is the suffix of the member; this suffix is typically .o for object libraries.

A target name of the form:
```
lib((symbol))
```
refers to the member of a randomized object library that defines the entry point named symbol.

Command Execution

Command lines are executed one at a time, each by its own process or shell. Shell commands, notably cd, are ineffectual across an unescaped NEWLINE in the makefile. A line is printed (after macro expansion) just before being executed. This is suppressed if it starts with a @, if there is a .SILENT: entry in the makefile, or if make is run with the -s option. Although the -n option specifies printing without execution, lines containing the macro $(MAKE) are executed regardless, and lines containing the @ special character are printed. The -t (touch) option updates the modification date of a file without executing any rules. This can be dangerous when sources are maintained by more than one person.

make invokes the shell with the -e (exit-on-errors) argument. Thus, with semicolon-separated command sequences, execution of the later commands depends on the success of the former. This behavior can be overridden by starting the command line with a -, or by writing a shell script that returns a non-zero status only as it finds appropriate.

To use the Bourne shell if control structure for branching, use a command line of the form:

```
if expression ; \
then command ; \
... ; \
else command; \
... ; \
fi
```

Although composed of several input lines, the escaped NEWLINE characters insure that make treats them all as one (shell) command line.

To use the Bourne shell for control structure for loops, use a command line of the form:

```
for var in list ; \
do command; \
... ; \done
```

To refer to a shell variable, use a double-dollar-sign ($$). This prevents expansion of the dollar-sign by make.

To incorporate the standard output of a shell command in a macro, use a definition of the form:

```
MACRO :sh =command
```

The command is executed only once, standard error output is discarded, and NEWLINE characters are replaced with SPACES. If the command has a non-zero exit status, make halts with an error.

To capture the output of a shell command in a macro reference, use a reference of the form: $(MACRO :sh)
where *MACRO* is the name of a macro containing a valid Bourne shell command line. In this case, the command is executed whenever the reference is evaluated. As with shell command substitutions, the reference is replaced with the standard output of the command. If the command has a non-zero exit status, *make* halts with an error.

In contrast to commands in rules, the command is not subject for macro substitution; therefore, a dollar sign ($) need not be replaced with a double dollar sign ($$).

### Signals

**INT**, **SIGTERM**, and **QUIT** signals received from the keyboard halt *make* and remove the target file being processed unless that target is in the dependency list for **.PRECIOUS**.

### Compatibility with GNU make

The compatibility mode with GNU *make* changes Oracle Solaris *make*’s behavior with respect to the dynamic macro **$<**. By default the Oracle Solaris *make* treats this macro as the name of a dependency file, derived as if selected for use with an implicit rule.

GNU *make* treats this macro as the name of a dependency, even if it is not a file. If the **-x** option is passed to the Oracle Solaris *make*, it behaves as GNU *make* in this particular case.

### Examples

**EXAMPLE 1**  Defining dependencies

This makefile says that *pgm* depends on two files *a.o* and *b.o*, and that they in turn depend on their corresponding source files (*a.c* and *b.c*) along with a common file *incl.h*:

```make
pgm:   a.o  b.o
       $(LINK.c) -o $@a.o  b.o
a.o:   incl.h  a.c
       cc -c a.c
b.o:   incl.h  b.c
       cc -c b.c
```

**EXAMPLE 2**  Using implicit rules

The following makefile uses implicit rules to express the same dependencies:

```make
pgm:   a.o  b.o
       cc a.o  b.o  -o pgm
a.o  b.o:  incl.h
```

### Environment Variables

See *environ* for descriptions of the following environment variables that affect the execution of *make*: **LANG**, **LC_ALL**, **LC_CTYPE**, **LC_MESSAGES**, and **NLSPATH**.

**KEEP_STATE**  This environment variable has the same effect as the .KEEP_STATE: special-function target. It enables command dependencies, hidden dependencies and writing of the state file.

**USE_SVR4_MAKE**  This environment variable causes *make* to invoke the generic System V version of *make* (/usr/lib/svr4.make). See *sysV-make(1)*.
MAKFLAGS

This variable is interpreted as a character string representing a series of option characters to be used as the default options. The implementation accepts both of the following formats (but need not accept them when intermixed):

1. The characters are option letters without the leading hyphens or blank character separation used on a command line.
2. The characters are formatted in a manner similar to a portion of the make command line: options are preceded by hyphens and blank-character-separated. The \texttt{macro=\textit{name}} macro definition operands can also be included. The difference between the contents of \texttt{MAKEFLAGS} and the command line is that the contents of the variable is not subjected to the word expansions associated with parsing the command line values. See \texttt{wordexp(3C)}.

When the command-line options -f or -p are used, they take effect regardless of whether they also appear in \texttt{MAKEFLAGS}. If they otherwise appear in \texttt{MAKEFLAGS}, the result is undefined.

The \texttt{MAKEFLAGS} variable is accessed from the environment before the makefile is read. At that time, all of the options (except -f and -p) and command-line macros not already included in \texttt{MAKEFLAGS} are added to the \texttt{MAKEFLAGS} macro. The \texttt{MAKEFLAGS} macro is passed into the environment as an environment variable for all child processes. If the \texttt{MAKEFLAGS} macro is subsequently set by the makefile, it replaces the \texttt{MAKEFLAGS} variable currently found in the environment.

PROJECTDIR

Provides a directory to be used to search for SCCS files not found in the current directory. In all of the following cases, the search for SCCS files is made in the directory SCCS in the identified directory. If the value of \texttt{PROJECTDIR} begins with a slash, it shall be considered an absolute pathname. Otherwise, the value of \texttt{PROJECTDIR} is treated as a user name and that user’s initial working directory shall be examined for a subdirectory src or source. If such a directory is found, it shall be used. Otherwise, the value is used as a relative pathname.

If \texttt{PROJECTDIR} is not set or has a null value, the search for SCCS files shall be made in the directory SCCS in the current directory. The setting of \texttt{PROJECTDIR} affects all files listed in the remainder of this utility description for files with a component named SCCS.
SUN_MAKE_COMPAT_MODE  Causes make to change behavior according to the specified compatibility mode. Examples:

SUN_MAKE_COMPAT_MODE="POSIX"
   Support POSIX makefiles and compatibility with 
   /usr/xpg4/bin/make

SUN_MAKE_COMPAT_MODE="SUN"
   Support Sun makefiles and compatibility with Oracle Solaris 
   /usr/bin/make

SUN_MAKE_COMPAT_MODE="GNU"
   Support GNU makefiles and GNU make behavior (partially supported)

SUN_MAKE_COMPAT_MODE="SVR4"
   Support SVR4 makefiles and compatibility with 
   /usr/lib/svr4.make

Exit Status  When the -q option is specified, the make utility exits with one of the following values:

0   Successful completion.
1   The target was not up-to-date.
>1  An error occurred.

When the -q option is not specified, the make utility exits with one of the following values:

0   Successful completion
>0  An error occurred

Files  makefile                      current version(s) of make description file
Makefile                               
s.makefile
s.Makefile                             SCCS history files for the above makefile(s) in the current directory
SCCS/s.makefile
SCCS/s.Makefile
make.rules                             default file for user-defined targets, macros, and implicit rules
/usr/share/lib/make/make.rules
.make.state                            state file in the local directory
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/build/make</td>
</tr>
<tr>
<td></td>
<td>developer/xopen/xcu4</td>
</tr>
</tbody>
</table>

Interface Stability  Committed
Standard  See standards(5).

See Also  ar(1), arch(1), cd(1), cpp(1), lex(1), mach(1), sccs-get(1), sh(1), sysV-make(1), yacc(1), wordexp(3C), passwd(4), attributes(5), environ(5), POSIX.2(5), standards(5)

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Diagnostics  Don’t know how to make target target

There is no makefile entry for target, and none of make’s implicit rules apply (there is no dependency file with a suffix in the suffixes list, or the target’s suffix is not in the list).

*** target removed.

make was interrupted while building target. Rather than leaving a partially-completed version that is newer than its dependencies, make removes the file named target.

*** target not removed.

make was interrupted while building target and target was not present in the directory.

*** target could not be removed, reason

make was interrupted while building target, which was not removed for the indicated reason.

Read of include file file failed

The makefile indicated in an include directive was not found, or was inaccessible.

Loop detected when expanding macro value macro’

A reference to the macro being defined was found in the definition.

Could not write state file file

You used the .KEEP_STATE: target, but do not have write permission on the state file.

***Error code n

The previous shell command returned a nonzero error code.

*** signal message

The previous shell command was aborted due to a signal. If – core dumped appears after the message, a core file was created.
Conditional macro conflict encountered
Displayed only when -d is in effect, this message indicates that two or more parallel targets currently being processed depend on a target which is built differently for each by virtue of conditional macros. Since the target cannot simultaneously satisfy both dependency relationships, it is conflicted.

Bugs
Some commands return nonzero status inappropriately; to overcome this difficulty, prefix the offending command line in the rule with a −.

Filenames with the characters =, :, or @, do not work.
You cannot build file.o from lib(file.o).
Options supplied by MAKEFLAGS should be reported for nested make commands. Use the -d option to find out what options the nested command picks up from MAKEFLAGS.

This version of make is incompatible in certain respects with previous versions:
■ The -d option output is much briefer in this version. −dd now produces the equivalent voluminous output.
■ make attempts to derive values for the dynamic macros $*, $<, and $?, while processing explicit targets. It uses the same method as for implicit rules; in some cases this can lead either to unexpected values, or to an empty value being assigned. (Actually, this was true for earlier versions as well, even though the documentation stated otherwise.)
■ make no longer searches for SCCS history (s.) files.
■ Suffix replacement in macro references are now applied after the macro is expanded.

There is no guarantee that makefiles created for this version of make works with earlier versions.

If there is no make.rules file in the current directory, and the file /usr/share/lib/make/make.rules is missing, make stops before processing any targets. To force make to run anyway, create an empty make.rules file in the current directory.

Once a dependency is made, make assumes the dependency file is present for the remainder of the run. If a rule subsequently removes that file and future targets depend on its existence, unexpected errors can result.

When hidden dependency checking is in effect, the $? macro’s value includes the names of hidden dependencies. This can lead to improper filename arguments to commands when $? is used in a rule.

Pattern replacement macro references cannot be used in the dependency list of a pattern matching rule.

Unlike previous versions, this version of make strips a leading ./ from the value of the $@ dynamic macro.
With automatic SCCS retrieval, this version of `make` does not support tilde suffix rules.

The only dynamic macro whose value is strictly determined when used in a dependency list is `$@` (takes the form `$@`).

`make` invokes the shell with the `-e` argument. This cannot be inferred from the syntax of the rule alone.
makekey – generate encryption key

Synopsis /usr/lib/makekey

Description makekey improves the usefulness of encryption schemes that depend on a key by increasing the amount of time required to search the key space. It attempts to read 8 bytes for its key (the first eight input bytes), then it attempts to read 2 bytes for its salt (the last two input bytes). The output depends on the input in a way intended to be difficult to compute (that is, to require a substantial fraction of a second).

The first eight input bytes (the input key) can be arbitrary ASCII characters. The last two (the salt) are best chosen from the set of digits, . , /, upper- and lower-case letters. The salt characters are repeated as the first two characters of the output. The remaining 11 output characters are chosen from the same set as the salt and constitute the output key.

The transformation performed is essentially the following: the salt is used to select one of 4,096 cryptographic machines all based on the National Bureau of Standards DES algorithm, but broken in 4,096 different ways. Using the input key as key, a constant string is fed into the machine and recirculated a number of times. The 64 bits that come out are distributed into the 66 output key bits in the result.

makekey is intended for programs that perform encryption. Usually, its input and output will be pipes.

See Also ed(1), vi(1), passwd(4)

Notes makekey can produce different results depending upon whether the input is typed at the terminal or redirected from a file.
**Name**  
man – find and display reference manual pages

**Synopsis**  
man [-] [-adFlrt] [-M path] [-T macro-package] [-s section] name...

  man [-M path] [-s section] -k query...

  man [-M path] -f file...

  man [-M path] [-s section] -K query...

**Description**  
The man command displays information from the reference manuals. It displays complete manual pages that you select by name, or one-line summaries selected either by query (-k or -K), or by the name of an associated file (-f). If no manual page is located, man prints an error message.

**Source Format**  
Reference Manual pages are marked up with either nroff (see nroff(1)) or SGML (Standard Generalized Markup Language) tags (see sgml(5)). The man command recognizes the type of markup and processes the file accordingly. The various source files are kept in separate directories depending on the type of markup.

**Location of Manual Pages**  
The online Reference Manual page directories are conventionally located in /usr/share/man. The nroff sources are located in the /usr/share/man/man* directories. The SGML sources are located in the /usr/share/man/sman* directories. Each directory corresponds to a section of the manual. Since these directories are optionally installed, they might not reside on your host. You might have to mount /usr/share/man from a host on which they do reside.

If there are preformatted, up-to-date versions in the corresponding cat* or fmt* directories, man simply displays or prints those versions. If the preformatted version of interest is out of date or missing, man reformats it prior to display and stores the preformatted version if cat* or fmt* is writable. The index files are not updated. See catman(1M). If directories for the preformatted versions are not provided, man reformats a page whenever it is requested. man uses a temporary file to store the formatted text during display.

If the standard output is not a terminal, or if the `-' flag is given, man pipes its output through cat(1). Otherwise, man pipes its output through more(1) to handle paging and underlining on the screen.

**Query Strings**  
Using -k or -K options, manual pages can be searched with query, one or more terms or phrases. It supports index-file-based, full text searching, stemming, and section matching. For information regarding how to generate the index files, refer to catman(1M) and man(5).

Stemming for English, for example, identifies the string cats, catlike, catty, and so forth, based on the root cat. It identifies stemmer, stemming, and stemmed based on stem. A stemming algorithm reduces the words fishing, fished, fish, and fisherto the root word, fish.

Matching is done in case-insensitive manner. Stemming is done for English manual pages only.
Matched manual pages are sorted and presented based on the score of the query matches in ascending order.

Oracle Solaris manual pages are divided into sections such as NAME, SYNOPSIS, DESCRIPTION, and so forth. Users can specify the scope of search into a section as details described in the -K option.

**Options**

The following options are supported:

- **-a**
  Shows all manual pages matching name within the MANPATH search path. Manual pages are displayed in the order found.

- **-d**
  Debugs. Displays what a section-specifier evaluates to, method used for searching, and paths searched by man.

- **-f file**...
  man attempts to locate manual pages related to any of the given files. It strips the leading path name components from each file, and then prints one-line summaries containing the resulting basename or names.

  This option uses the index files. Refer to catman(1M) and man(5) for details on how index files are generated.

- **-F**
  Forces man to search all directories specified by MANPATH or the man.cf file, rather than using the index lookup files. This option is useful if the index files are not up to date and they have been made the default behavior of the man command. The option therefore does not have to be invoked and is documented here for reference only.

- **-k query**...
  Prints out one-line summaries from the index files.

  See the -K option for information regarding how the index files are generated. If there are no index files, manual page files are directly looked up, therefore yielding slower response time than cases where index files exist.

- **-K query**...
  Search for the specified query from the index files. If there are no index files, search is directly done on the manual pages, which causes a much slower search.

  If you supply a section name ending with a colon (:) at the query option argument as the first text from left, just as section name:query, the search for the query string is done on the specified section only. If the specified section name does not exist, it will list all the supported section name for users.

  The index files in /usr/share/man and /usr/gnu/share/man used by -f, -k, and -K are automatically generated when man pages in those directories are installed or updated and
the packages delivering them have tagged the files with
restart_fmri=svc:/application/man-index:default as specified in pkg(5). They may
also be generated by running svcadm restart application/man-index manually, or
running catman(1M) with the -w.

-1
Lists all manual pages found matching name within the search path.

-M path
Specifies an alternate search path for manual pages. path is a colon-separated list of
directories that contain manual page directory subtrees. For example, if path is
/usr/share/man:/usr/local/man, man searches for name in the standard location, and
then /usr/local/man. When used with the -f, -k or -K options, the -M option must appear
first. Each directory in the path is assumed to contain subdirectories of the form man* or
sman*, one for each section. This option overrides the MANPATH environment variable.

-r
Reformats the manual page, but does not display it. This replaces the man - -t name
combination.

-s section...
Specifies sections of the manual for man to search. The directories searched for name are
limited to those specified by section. section can be a numerical digit, perhaps followed by
one or more letters to match the desired section of the manual, for example, “3lib”. Also,
section can be a word, for example, local, new, old, public. section can also be a letter. To
specify multiple sections, separate each section with a comma. This option overrides the
MANPATH environment variable and the man . cf file. See Search Path below for an
explanation of how man conducts its search.

-t
man arranges for the specified manual pages to be troffed to a suitable raster output device
(see troff(1)). If both the - and -t flags are given, man updates the troffed versions of
each named name (if necessary), but does not display them.

-T macro-package
Formats manual pages using macro-package rather than the standard -man macros defined
in /usr/share/Lib/tmac/an. See Search Path under USAGE for a complete explanation
of the default search path order.

Operands
The following operand is supported:

name
The name of a standard utility or a keyword.

Usage
The usage of man is described below:
Entries in the reference manuals are organized into sections. A section name consists of a major section name, typically a single digit, optionally followed by a subsection name, typically one or more letters. An unadorned major section name, for example, “9”, does not act as an abbreviation for the subsections of that name, such as “9e”, “9f”, or “9s”. That is, each subsection must be searched separately by man -s. Each section contains descriptions apropos to a particular reference category, with subsections refining these distinctions. See the intro manual pages for an explanation of the classification used in this release.

The following contains a brief description of each manual page section and the information it references:

- Section 1 describes, in alphabetical order, commands available with the operating system.
- Section 1M describes, in alphabetical order, commands that are used chiefly for system maintenance and administration purposes.
- Section 2 describes all of the system calls. Most of these calls have one or more error returns. An error condition is indicated by an otherwise impossible returned value.
- Section 3 describes functions found in various libraries, other than those functions that directly invoke UNIX system primitives, which are described in Section 2.
- Section 4 outlines the formats of various files. The C structure declarations for the file formats are given where applicable.
- Section 5 contains miscellaneous documentation such as character-set tables.
- Section 7 describes various special files that refer to specific hardware peripherals and device drivers. STREAMS software drivers, modules and the STREAMS-generic set of system calls are also described.
- Section 9E describes the DDI (Device Driver Interface)/DKI (Driver/Kernel Interface), DDI-only, and DKI-only entry-point routines a developer can include in a device driver.
- Section 9F describes the kernel functions available for use by device drivers.
- Section 9S describes the data structures used by drivers to share information between the driver and the kernel.

Before searching for a given name, man constructs a list of candidate directories and sections. man searches for name in the directories specified by the MANPATH environment variable.

In the absence of MANPATH, man constructs its search path based upon the PATH environment variable, primarily by substituting man for the last component of the PATH element. Special provisions are added to account for unique characteristics of directories such as /sbin, /usr/ucb, /usr/xpg4/bin, and others. If the file argument contains a / character, the dirname portion of the argument is used in place of PATH elements to construct the search path.

Within the manual page directories, man confines its search to the sections specified in the following order:

- sections specified on the command line with the -s option
sections embedded in the MANPATH environment variable

sections specified in the man.cf file for each directory specified in the MANPATH environment variable

If none of the above exist, man searches each directory in the manual page path, and displays the first matching manual page found.

The man.cf file has the following format:

```
MANSECTS=section[, section]...
```

Lines beginning with ‘#’ and blank lines are considered comments, and are ignored. Each directory specified in MANPATH can contain a manual page configuration file, specifying the default search order for that directory.

Formatting Manual Pages

Manual pages are marked up in nroff(1) or sgml(5). nroff manual pages are processed by nroff(1) or troff(1) with the -man macro package. Please refer to man(5) for information on macro usage. SGML—tagged manual pages are processed by an SGML parser and passed to the formatter.

Preprocessing nroff Manual Pages

When formatting an nroff manual page, man examines the first line to determine whether it requires special processing. If the first line is a string of the form:

```
\" X
```

where X is separated from the “” by a single SPACE and consists of any combination of characters in the following list, man pipes its input to troff(1) or nroff(1) through the corresponding preprocessors.

```
e eqn(1), or neqn for nroff
r refer(1)
t tbl(1)
v vgrind(1)
```

If eqn or neqn is invoked, it automatically reads the file /usr/pub/eqnchar (see eqnchar(5)). If nroff(1) is invoked, col(1) is automatically used.

Refting to Other nroff Manual Pages

If the first line of the nroff manual page is a reference to another manual page entry fitting the pattern:

```
.so man*/sourcefile
```

man processes the indicated file in place of the current one. The reference must be expressed as a path name relative to the root of the manual page directory subtree.
When the second or any subsequent line starts with .so, man ignores it; troff(1) or nroff(1) processes the request in the usual manner.

Processing SGML Manual Pages
Manual pages are identified as being marked up in SGML by the presence of the string <!DOCTYPE. If the file also contains the string SHADOW_PAGE, the file refers to another manual page for the content. The reference is made with a file entity reference to the manual page that contains the text. This is similar to the .so mechanism used in the nroff formatted manual pages.

Environment Variables
See environ(5) for descriptions of the following environment variables that affect the execution of man: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

MANPATH
A colon-separated list of directories; each directory can be followed by a comma-separated list of sections. If set, its value overrides /usr/share/man as the default directory search path, and the man.cf file as the default section search path. The -M and -s flags, in turn, override these values.)

PAGER
A program to use for interactively delivering man's output to the screen. If not set, 'more -s' is used. See more(1).

TCAT
The name of the program to use to display troffed manual pages.

TROFF
The name of the formatter to use when the -t flag is given. If not set, troff(1) is used.

Examples
EXAMPLE 1 Creating a Text Version of a Manual Page
The following example creates the pipe(2) manual page in ascii text:

% man pipe.2 | col -x -b > pipe.text

This is an alternative to using man -t, which sends the manual page to the default printer, if the user wants a text file version of the manual page.

EXAMPLE 2 Getting a List of Manual Pages that Match One or More Terms
The following example gets a list of manual pages that match for the term zfs or create:

% man -K zfs create

EXAMPLE 3 Getting a List of Manual Pages that Match One or More Phrases
The following example gets a list of manual pages that match for the quote-enclosed phrases, "zfs create" or "storage pool".

% man -K 'zfs create' "storage pool"
EXAMPLE 4  Getting a List of Manual Pages that Match Terms or Phrases in a Section

The following example gets a list of manual pages that have the term zfs in the SEE ALSO section:

```
% man -K see also: zfs
```

The following example gets a list of manual pages that have the phrase “zfs create” in the Examples section:

```
% man -K examples: "zfs create"
```

**Exit Status**  The following exit values are returned:

- 0  
   Successful completion.

- >0  
   An error occurred.

**Files**  /usr/share/man  
Root of the standard manual page directory subtree

- /usr/share/man/man?/*  
  Unformatted nroff manual entries

- /usr/share/man/man_index/*  
  Table of Contents and keyword database.

  Generated files include:

  - /usr/share/man/man-index/man.idx
  - /usr/share/man/man-index/man.dic
  - /usr/share/man/man-index/man.req
  - /usr/share/man/man-index/man.pos
  - /usr/share/man/man-index/man.doc

- /usr/share/man/sman?/*  
  Unformatted SGML manual entries

- /usr/share/man/cat?/*  
  nroffed manual entries

- /usr/share/man/fmt?/*  
  troffed manual entries

- /usr/share/lib/tmac/an  
  Standard –man macro package

- /usr/share/lib/sgml/locale/C/dtd/*  
  SGML document type definition files
The -f, -k, and -K options use the index files which are created by the SMF service as specified in man(5), or by manually using catman(1M) with the -w option.

The windex database file is no longer used. The windex database file has replaced with the new index files.

The man command is CSI-capable. However, some utilities invoked by the man command, namely, troff, eqn, neqn, refer, tbl, and vgrind, are not verified to be CSI-capable. Because of this, the man command with the -t option can not handle non-EUC data. Also, using the man command to display manual pages that require special processing through eqn, neqn, refer, tbl, or vgrind can not be CSI-capable.

The manual is supposed to be reproducible either on a phototypesetter or on an ASCII terminal. However, on a terminal some information (indicated by font changes, for instance) is lost.

Some dumb terminals cannot process the vertical motions produced by the e (see eqn(1)) preprocessing flag. To prevent garbled output on these terminals, when you use e, also use t, to invoke col(1) implicitly. This workaround has the disadvantage of eliminating superscripts and subscripts, even on those terminals that can display them. Control-q clears a terminal that gets confused by eqn(1) output.
mconnect(1)

Name mconnect – connect to SMTP mail server socket

Synopsis mconnect [-p port] [-r] [hostname]

Description The mconnect utility opens a connection to the mail server on a given host, so that it can be tested independently of all other mail software. If no host is given, the connection is made to the local host. Servers expect to speak the Simple Mail Transfer Protocol (SMTP) on this connection. Exit by typing the quit command. Typing EOF sends an end of file to the server. An interrupt closes the connection immediately and exits.

Options The following options are supported:

- pport Specify the port number instead of the default SMTP port (number 25) as the next argument.
- r Raw mode: disable the default line buffering and input handling. This produces an effect similar to telnet(1) to port number 25.

Operands The following operand is supported:

hostname The name of a given host.

Usage The mconnect command is IPv6–enabled. See ip6(7P).

Files /etc/mail/sendmail.hf Help file for SMTP commands

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/smtp/sendmail</td>
</tr>
</tbody>
</table>

See Also telnet(1), sendmail(1M), attributes(5), ip6(7P)

Postel, Jonathan B., RFC 821, Simple Mail Transfer Protocol, Information Sciences Institute, University of Southern California, August 1982.
The mcs command is used to display, compress, or append content to comment sections in an ELF object file. It can also be used to delete comment or non-comment sections, and to zero SHT_PROGBITS sections. Unless otherwise specified, the section named .comment is manipulated. mcs cannot modify or delete a section that is contained within a segment.

If the input file is an archive (see ar.h(3HEAD)), the archive is treated as a set of individual files. For example, if the -a option is specified, the string is appended to the comment section of each object file in the archive; if the archive member is not an object file, then it is left unchanged.

mcs must be given one or more of the options described below. It applies each option, in the order given, to each file.

For append operations, if the object does not already contain a section with the specified name, mcs will create a new empty section with that name before performing the append operation.

The following options are supported:

- **-A file**
  Appends the contents of the given file to the comment section of the object files.

- **-a string**
  Appends string to the comment section of the object files.

- **-c**
  Compresses the contents of the comment section of the object files. All duplicate entries are removed. The ordering of the remaining entries is not disturbed.

- **-d**
  Deletes the specified section from the object files.

- **-H**
  When -p is used, suppress the output of the name of the file, as well as any blank lines normally inserted between the output for each file.

- **-n name**
  Specifies the name of the section to access if other than .comment. By default, mcs deals with the section named .comment. mcs can take multiple -n options to allow for specification of multiple sections. mcs always manipulations sections assuming that they have the format of a comment section.

- **-p**
  Prints the contents of the comment section on the standard output. Unless used with -H, each section printed is prefixed with the name of the file from which it was extracted, using the format file[member_name]: for archive files and file: for other files.

- **-V**
  Prints a message on standard error giving information about the version of mcs.

- **-z**
  Replaces any SHT_PROGBITS sections with zeros while retaining the original attributes of the sections.
**Examples**  

**EXAMPLE 1**  
Printing a file's comment section  
The following entry  
exampel% mcs -p elf.file  
prints the comment section of the file elf.file.

**EXAMPLE 2**  
Appending a string to a comment section  
The following entry  
exampel% mcs -a xyz elf.file  
appends string xyz to elf.file's comment section.

**EXAMPLE 3**  
Stripping a specified non-allocable section  
Although used primarily with comment sections, mcs can operate on any non-allocable section. In contrast to the strip command, which removes a predefined selection of non-allocable sections, mcs can be used to delete a specific section. The following entry  
exampel% mcs -d -n .annotate elf.file  
removes the section named .annotate from the file elf.file.

**Files**  
```
/tmp/mcs* temporary files
```

**Attributes**  
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/base-developer-utilities</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

**See Also**  
ar(1), as(1), ld(1), strip(1), ar.h(3HEAD), elf(3ELF), a.out(4), attributes(5)

**Notes**  
When mcs deletes a section using the -d option, it tries to bind together sections of type SHT_REL and target sections pointed to by the sh_info section header field. If one is to be deleted, mcs attempts to delete the other of the pair.

The -z option removes the contents of SHT_PROGBITS sections while retaining the original ELF structure of the object. The need for use of the -z option is limited. However, the option can be used to deliver an object file when the contents of SHT_PROGBITS sections are not relevant.
mdb – modular debugger

Synopsis

mdb [-fkmuwAFKMSUW] [± option] [-p pid] [-s distance]
        [-I path] [-L path] [-P prompt] [-R root]
        [-V dis-version] [object [core] | core | suffix]

Description

Introduction

The mdb utility is an extensible utility for low-level debugging and editing of the live operating system, operating system crash dumps, user processes, user process core dumps, and object files. For a more detailed description of mdb features, refer to the manual, Oracle Solaris Modular Debugger Guide.

Debugging is the process of analyzing the execution and state of a software program in order to remove defects. Traditional debugging tools provide facilities for execution control so that programmers can re-execute programs in a controlled environment and display the current state of program data or evaluate expressions in the source language used to develop the program.

Unfortunately, these techniques are often inappropriate for debugging complex software systems such as an operating system, where bugs might not be reproducible and program state is massive and distributed, for programs that are highly optimized, have had their debug information removed, or are themselves low-level debugging tools, or for customer situations where the developer can only access post-mortem information.

mdb provides a completely customizable environment for debugging these programs and scenarios, including a dynamic module facility that programmers can use to implement their own debugging commands to perform program-specific analysis. Each mdb module can be used to examine the program in several different contexts, including live and post-mortem.

Definitions

The target is the program being inspected by the debugger. mdb currently provides support for the following types of targets: user processes, user process core files, the live operating system (via /dev/kmem and /dev/ksyms), operating system crash dumps, user process images recorded inside an operating system crash dump, ELF object files, and raw binary files. Each target exports a standard set of properties, including one or more address spaces, one or more symbol tables, a set of load objects, and a set of threads that can be examined using the debugger commands described below.

A debugger command, or dcmd (pronounced dee-command) in mdb terminology, is a routine in the debugger that can access any of the properties of the current target. mdb parses commands from standard input, and then executes the corresponding dcmds. Each dcmd can also accept a list of string or numerical arguments, as shown in the syntax description below. mdb contains a set of built-in dcmds, described below, that are always available. You can also extend the capabilities of mdb itself by writing your own dcmds, as described in the Oracle Solaris Modular Debugger Guide.
A **walker** is a set of routines that describe how to walk, or iterate, through the elements of a particular program data structure. A walker encapsulates the data structure’s implementation from dcmds and from mdb itself. You can use walkers interactively, or use them as a primitive to build other dcmds or walkers. As with dcmds, you can extend mdb by implementing your own walkers as part of a debugger module.

A debugger module, or **dmod** (pronounced dee-mod), is a dynamically loaded library containing a set of dcmds and walkers. During initialization, mdb attempts to load dmods corresponding to the load objects present in the target. You can subsequently load or unload dmods at any time while running mdb. mdb ships with a set of standard dmods for debugging the Solaris kernel. The Oracle Solaris Modular Debugger Guide contains more information on developing your own debugger modules.

A **macro file** is a text file containing a set of commands to execute. Macro files are typically used to automate the process of displaying a simple data structure. mdb provides complete backward compatibility for the execution of macro files written for adb(1), and the Solaris installation includes a set of macro files for debugging the Solaris kernel that can be used with either tool.

**Syntax**

The debugger processes commands from standard input. If standard input is a terminal, mdb provides terminal editing capabilities. mdb can also process commands from macro files and from dcmd pipelines, described below. The language syntax is designed around the concept of computing the value of an expression (typically a memory address in the target), and then applying a dcmd to that address. The current address location is referred to as **dot**, and its value is referenced using “.".

A **metacharacter** is one of the following characters:

```
[ ] | ! / \ ? = > $ : ;
NEWLINE SPACE TAB
```

A **blank** is a TAB or a SPACE. A **word** is a sequence of characters separated by one or more non-quoted metacharacters. Some of the metacharacters only function as delimiters in certain contexts, as described below. An **identifier** is a sequence of letters, digits, underscores, periods, or backquotes beginning with a letter, underscore, or period. Identifiers are used as the names of symbols, variables, dcmds, and walkers. Commands are delimited by a NEWLINE or semicolon ( ;).

A **dcmd** is denoted by one of the following words or metacharacters:

```
/ \ ? = > $character :character ::identifier
```

dcmds named by metacharacters or prefixed by a single $ or : are provided as built-in operators, and implement complete compatibility with the command set of the legacy adb(1) utility. Once a dcmd has been parsed, the /, \, ?, =, >, $, and : characters are no longer recognized as metacharacters until the termination of the argument list.
A simple-command is a dcmd followed by a sequence of zero or more blank-separated words. The words are passed as arguments to the invoked dcmd, except as specified under Quoting and Arithmetic Expansion below. Each dcmd returns an exit status that indicates it was either successful, failed, or was invoked with invalid arguments.

A pipeline is a sequence of one or more simple commands separated by |. Unlike the shell, dcmds in mdb pipelines are not executed as separate processes. After the pipeline has been parsed, each dcmd is invoked in order from left to right. Each dcmd's output is processed and stored as described under dcmd Pipelines below. Once the left-hand dcmd is complete, its processed output is used as input for the next dcmd in the pipeline. If any dcmd does not return a successful exit status, the pipeline is aborted.

An expression is a sequence of words that is evaluated to compute a 64-bit unsigned integer value. The words are evaluated using the rules described under Arithmetic Expansion below.

Commands

A command is one of the following:

pipeline [! word...] [ ; ]
A simple-command or pipeline can be optionally suffixed with the ! character, indicating that the debugger should open a pipe(2) and send the standard output of the last dcmd in the mdb pipeline to an external process created by executing $SHELL -c followed by the string formed by concatenating the words after the ! character. For more details, refer to Shell Escapes below.

expression pipeline [! word...] [ ; ]
A simple-command or pipeline can be prefixed with an expression. Before execution of the pipeline, the value of dot (the variable denoted by ".") is set to the value of the expression.

equation, expression pipeline [! word...] [ ; ]
A simple-command or pipeline can be prefixed with two expressions. The first is evaluated to determine the new value of dot, and the second is evaluated to determine a repeat count for the first dcmd in the pipeline. This dcmd is executed count times before the next dcmd in the pipeline is executed. The repeat count only applies to the first dcmd in the pipeline.

, expression pipeline [! word...] [ ; ]
If the initial expression is omitted, dot is not modified but the first dcmd in the pipeline is repeated according to the value of the expression.

expression [! word...] [ ; ]
A command can consist only of an arithmetic expression. The expression is evaluated and the dot variable is set to its value, and then the previous dcmd and arguments are executed using the new value of dot.

expression, expression [! word...] [ ; ]
A command can consist only of a dot expression and repeat count expression. After dot is set to the value of the first expression, the previous dcmd and arguments are repeatedly executed the number of times specified by the value of the second expression.
If the initial expression is omitted, dot is not modified but the previous dcmd and arguments are repeatedly executed the number of times specified by the value of the count expression.

! word . . . [ ; ]
If the command begins with the ! character, no dcmds are executed and the debugger simply executes $SHELL -c followed by the string formed by concatenating the words after the ! character.

Comments
A word beginning with // causes that word and all the subsequent characters up to a NEWLINE to be ignored.

Arithmetic Expansion
Arithmetic expansion is performed when an mdb command is preceded by an optional expression representing a start address, or a start address and a repeat count. Arithmetic expansion can also be performed to compute a numerical argument for a dcmd. An arithmetic expression can appear in an argument list enclosed in square brackets preceded by a dollar sign (${ expression }), and is replaced by the value of the expression.

Expressions can contain any of the following special words:

integer
The specified integer value. Integer values can be prefixed with 0i or 0I to indicate binary values, 0o or 0O to indicate octal values, 0t or 0T to indicate decimal values, and 0x or 0X to indicate hexadecimal values (the default).

0[tT][0-9]+.[0-9]++
The specified decimal floating point value, converted to its IEEE double-precision floating point representation.

'cccccccc'
The integer value computed by converting each character to a byte equal to its ASCII value. Up to eight characters can be specified in a character constant. Characters are packed into the integer in reverse order (right-to-left) beginning at the least significant byte.

<identifier
The value of the variable named by identifier.

identifier
The value of the symbol named by identifier.

(expression)
The value of expression.

.
The value of dot.
&
The most recent value of dot used to execute a dcmd.
The value of dot incremented by the current increment.

The value of dot decremented by the current increment.

The increment is a global variable that stores the total bytes read by the last formatting dcmd. For more information on the increment, refer to the discussion of Formatting dcmds below.

Unary operators are right associative and have higher precedence than binary operators. The unary operators are:

- `#expression`
  Logical negation.

- `~expression`
  Bitwise complement.

- `-expression`
  Integer negation.

- `%expression`
  The value of a pointer-sized quantity at the object file location corresponding to virtual address `expression` in the target’s virtual address space.

- `%/csil]/expression`
  The value of a char, short, int, or long-sized quantity at the object file location corresponding to virtual address `expression` in the target’s virtual address space.

- `%/[1248]/expression`
  The value of a one, two, four, or eight-byte quantity at the object file location corresponding to virtual address `expression` in the target’s virtual address space.

- `*expression`
  The value of a pointer-sized quantity at virtual address `expression` in the target’s virtual address space.

- `*/csil]/expression`
  The value of a char, short, int, or long-sized quantity at virtual address `expression` in the target’s virtual address space.

- `*/[1248]/expression`
  The value of a one, two, four, or eight-byte quantity at virtual address `expression` in the target’s virtual address space.

Binary operators are left associative and have lower precedence than unary operators. The binary operators, in order of precedence from highest to lowest, are:

- `*`
  Integer multiplication.
% Integer division.
#
Left-hand side rounded up to next multiple of right-hand side.
+
Integer addition.
-
Integer subtraction.
<<
Bitwise shift left.
>>
Bitwise shift right.
==
Logical equality.
!=
Logical inequality.
&
Bitwise AND.
^)
Bitwise exclusive OR.
|
Bitwise inclusive OR.

Quoting
Each metacharacter described above (see Syntax) terminates a word unless quoted.
Characters can be quoted (forcing mdb to interpret each character as itself without any special
significance) by enclosing them in a pair of single (' ') or double (" ") quote marks. A single
quote cannot appear within single quotes. Inside double quotes, mdb recognizes the C
programming language character escape sequences.

Shell Escapes
The ! character can be used to create a pipeline between an mdb command and the user's shell.
If the $SHELL environment variable is set, mdb forks and execs this program for shell escapes;
otherwise /bin/sh is used. The shell is invoked with the -c option followed by a string formed
by concatenating the words after the ! character. The ! character takes precedence over all
other metacharacters, except semicolon (;) and NEWLINE. Once a shell escape is detected, the
remaining characters up to the next semicolon or NEWLINE are passed as is to the shell. The
output of shell commands can not be piped to mdb dcmds. Commands executed by a shell
escape have their output sent directly to the terminal, not to mdb.
A variable is a variable name, a corresponding integer value, and a set of attributes. A variable name is a sequence of letters, digits, underscores, or periods. A variable can be assigned a value using the `>` dcmd or `::typeset` dcmd, and its attributes can be manipulated using the `::typeset` dcmd. Each variable's value is represented as a 64-bit unsigned integer. A variable can have one or more of the following attributes: read-only (cannot be modified by the user), persistent (cannot be unset by the user), and tagged (user-defined indicator).

The following variables are defined as persistent:

0
The most recent value printed using the `/`, `-`, `?`, or `= dcmd.

9
The most recent count used with the `$< dcmd.

b
The virtual address of the base of the data section.

d
The size of the data section in bytes.

e
The virtual address of the entry point.

m
The initial bytes (magic number) of the target's primary object file, or zero if no object file has been read yet.

t
The size of the text section in bytes.

hits
The count of the number of times the matched software event specifier has been matched. See Event Callbacks, below.

thread
The thread identifier of the current representative thread. The value of the identifier depends on the threading model used by the current target. See Thread Support, below.

In addition, the `mdb` kernel and process targets export the current values of the representative thread's register set as named variables. The names of these variables depend on the target's platform and instruction set architecture.

As explained in the Syntax description above, a symbol identifier present in an expression context evaluates to the value of this symbol. The value typically denotes the virtual address of the storage associated with the symbol in the target's virtual address space. A target can support multiple symbol tables including, but not limited to, a primary executable symbol table, a primary dynamic symbol table, a run-time link-editor symbol table, and standard and dynamic symbol tables for each of a number of load objects (such as shared libraries in a user process, or kernel modules in the Solaris kernel). The target typically searches the primary
executable's symbol tables first, and then one or more of the other symbol tables. Notice that
ELF symbol tables only contain entries for external, global, and static symbols; automatic
symbols do not appear in the symbol tables processed by mdb.

Additionally, mdb provides a private user-defined symbol table that is searched prior to any of
the target symbol tables. The private symbol table is initially empty, and can be manipulated
using the ::nmadd and ::nmdel dcms. The ::nm -P option can be used to display the contents
of the private symbol table. The private symbol table allows the user to create symbol
definitions for program functions or data that were either missing from the original program
or stripped out. These definitions are then used whenever mdb converts a symbolic name to an
address, or an address to the nearest symbol.

As targets contain multiple symbol tables, and each symbol table can include symbols from
multiple object files, different symbols with the same name can exist. mdb uses the backquote
(´) character as a symbol name scoping operator to allow the programmer to obtain the value
of the desired symbol in this situation. The programmer can specify the scope used to resolve a
symbol name as either: object name, or file name, or object file name. The object identifier
refers to the name of a load object. The file identifier refers to the basename of a source file that
has a symbol of type STT_FILE in the specified object's symbol table. The object identifier's
interpretation depends on the target type.

The mdb kernel target expects object to specify the basename of a loaded kernel module. For
example, the symbol name
specfs_init
evaluates to the value of the _init symbol in the specfs kernel module.

The mdb process target expects object to specify the name of the executable or of a loaded
shared library. It can take any of the following forms:
1. An exact match (that is, a full pathname): /usr/lib/libc.so.1
2. An exact basename match: libc.so.1
3. An initial basename match up to a"." suffix: libc.so or libc
4. The literal string a.out is accepted as an alias for the executable.

The process target also accepts any of the four forms described above preceded by an optional
link-map id (lmid). The lmid prefix is specified by an initial "LM" followed by the link-map id
in hexadecimal followed by an additional backquote. For example, the symbol name
LM0'libc.so.1'_init
evaluates to the value of the _init symbol in the libc.so.1 library that is loaded on link-map
0 (LM_ID_BASE). The link-map specifier can be necessary to resolve symbol naming conflicts in
the event that the same library is loaded on more than one link map. For more information on
link maps, refer to the Linker and Libraries Guide and dlopen(3C). Link-map identifiers are
displayed when symbols are printed according to the setting of the showlmid option, as
described under OPTIONS.
In the case of a naming conflict between symbols and hexadecimal integer values, `mdb` attempts to evaluate an ambiguous token as a symbol first, before evaluating it as an integer value. For example, the token `f` can either refer to the decimal integer value 15 specified in hexadecimal (the default base), or to a global variable named `f` in the target’s symbol table. If a symbol with an ambiguous name is present, the integer value can be specified by using an explicit `0x` or `0X` prefix.

As described earlier, each `mdb` dmod provides a set of dcmds and walkers. dc cmds and walkers are tracked in two distinct, global namespaces. `mdb` also keeps track of a d cmd and walker namespace associated with each dmod. Identically named dc cmds or walkers within a given dmod are not allowed: a dmod with this type of naming conflict fails to load. Name conflicts between dc cmds or walkers from different dmods are allowed in the global namespace. In the case of a conflict, the first d cmd or walker with that particular name to be loaded is given precedence in the global namespace. Alternate definitions are kept in a list in load order. The backquote character (``) can be used in a d cmd or walker name as a scoping operator to select an alternate definition. For example, if dmods `m1` and `m2` each provide a d cmd `d`, and `m1` is loaded prior to `m2`, then:

```plaintext
::d
Executes m1's definition of d.
::m1'd
Executes m1's definition of d.
::m2'd
Executes m2's definition of d.
```

If module `m1` were now unloaded, the next d cmd on the global definition list (`m2'd`) would be promoted to global visibility. The current definition of a d cmd or walker can be determined using the `::which d cmd`, described below. The global definition list can be displayed using the `::which -v` option.

dcmd Pipelines

dcmds can be composed into a pipeline using the `|` operator. The purpose of a pipeline is to pass a list of values, typically virtual addresses, from one d cmd or walker to another. Pipeline stages might be used to map a pointer from one type of data structure to a pointer to a corresponding data structure, to sort a list of addresses, or to select the addresses of structures with certain properties.

`mdb` executes each d cmd in the pipeline in order from left to right. The leftmost d cmd is executed using the current value of dot, or using the value specified by an explicit expression at the start of the command. When a `|` operator is encountered, `mdb` creates a pipe (a shared buffer) between the output of the d cmd to its left and the `mdb` parser, and an empty list of values. As the d cmd executes, its standard output is placed in the pipe and then consumed and evaluated by the parser, as if `mdb` were reading this data from standard input. Each line must consist of an arithmetic expression terminated by a `NEWLINE` or semicolon (`;`). The value of the expression is appended to the list of values associated with the pipe. If a syntax error is detected, the pipeline is aborted.
When the dcmd to the left of a | operator completes, the list of values associated with the pipe is then used to invoke the dcmd to the right of the | operator. For each value in the list, dot is set to this value and the right-hand dcmd is executed. Only the rightmost dcmd in the pipeline has its output printed to standard output. If any dcmd in the pipeline produces output to standard error, these messages are printed directly to standard error and are not processed as part of the pipeline.

Signal Handling The debugger ignores the PIPE and QUIT signals. The INT signal aborts the command that is currently executing. The debugger intercepts and provides special handling for the ILL, TRAP, EMT, FPE, BUS, and SEGV signals. If any of these signals are generated asynchronously (that is, delivered from another process using kill(2)), mdb restores the signal to its default disposition and dump core. However, if any of these signals are generated synchronously by the debugger process itself and a dcmd from an externally loaded dmod is currently executing, and standard input is a terminal, mdb provides a menu of choices allowing the user to force a core dump, quit without producing a core dump, stop for attach by a debugger, or attempt to resume. The resume option aborts all active commands and unload the dmod whose dcmd was active at the time the fault occurred. It can then be subsequently re-loaded by the user. The resume option provides limited protection against buggy dcmds. Refer to WARNINGS, Use of the Error Recovery Mechanism, below for information about the risks associated with the resume option.

Command Re-entry The text of the last HISTSIZE (default 128) commands entered from a terminal device are saved in memory. The in-line editing facility, described next, provides key mappings for searching and fetching elements from the history list.

In-line Editing If standard input is a terminal device, mdb provides some simple emacs-style facilities for editing the command line. The search, previous, and next commands in edit mode provide access to the history list. Only strings, not patterns, are matched when searching. In the table below, the notation for control characters is caret (^) followed by a character shown in upper case. The notation for escape sequences is M- followed by a character. For example, M-\f (pronounced meta-eff) is entered by depressing ESC followed by ‘f’, or by depressing Meta followed by ‘f’ on keyboards that support a Meta key. A command line is committed and executed using RETURN or NEWLINE. The edit commands are:

- ^F
  Move cursor forward (right) one character.

- M-f
  Move cursor forward one word.

- ^B
  Move cursor backward (left) one character.

- M-b
  Move cursor backward one word.

- ^A
  Move cursor to start of line.
Move cursor to end of line.

Delete current character, if the current line is not empty. If the current line is empty, \^D denotes EOF and the debugger exits.

(Meta-backspace) Delete previous word.

Delete from the cursor to the end of the line.

Clear the screen and reprint the current line.

Transpose current character with next character.

Fetch the next command from the history. Each time \^N is entered, the next command forward in time is retrieved.

Fetch the previous command from the history. Each time \^P is entered, the next command backward in time is retrieved.

Search backward in the history for a previous command line containing string. The string should be terminated by a RETURN or NEWLINE. If string is omitted, the previous history element containing the most recent string is retrieved.

The editing mode also interprets the following user-defined sequences as editing commands. User defined sequences can be read or modified using the stty(1) command.

User defined erase character (usually \^H or \?). Delete previous character.

User defined interrupt character (usually \^C). Abort the current command and print a new prompt.

User defined kill character (usually \^U). Kill the entire current command line.

User defined quit character (usually \^\). Quit the debugger.

User defined suspend character (usually \^Z). Suspend the debugger.
werase
  User defined word erase character (usually `^W`). Erase the preceding word.

On keyboards that support an extended keypad with arrow keys, `mdb` interprets these keystrokes as editing commands:

up-arrow
  Fetch the previous command from the history (same as `^P`).

down-arrow
  Fetch the next command from the history (same as `^N`).

left-arrow
  Move cursor backward one character (same as `^B`).

right-arrow
  Move cursor forward one character (same as `^F`).

Output Pager

`mdb` provides a built-in output pager. The output pager is enabled if the debugger’s standard output is a terminal device. Each time a command is executed, `mdb` pauses after one screenful of output is produced and displays a pager prompt:

```
>> More [<space>, <cr>, q, n, c, a] ?
```

The following key sequences are recognized by the pager:

SPACE
  Display the next screenful of output.

a, A
  Abort the current top-level command and return to the prompt.

c, C
  Continue displaying output without pausing at each screenful until the current top-level command is complete.

n, N, NEWLINE, RETURN
  Display the next line of output.

q, Q, `^C`, `\`
  Quit (abort) the current dcmd only.

Formatting dcmds

The `/`, `\`, `?`, and `=` metacharacters are used to denote the special output formatting dcmds. Each of these dcmds accepts an argument list consisting of one or more format characters, repeat counts, or quoted strings. A format character is one of the ASCII characters shown in the table below. Format characters are used to read and format data from the target. A repeat count is a positive integer preceding the format character that is always interpreted in base 10 (decimal). A repeat count can also be specified as an expression enclosed in square brackets preceded by a dollar sign (`$`). A string argument must be enclosed in double-quotes (`""`). No blanks are necessary between format arguments.
The formatting dcmds are:

```
/  
\  
?  
=  
```

Display data from the target's virtual address space starting at the virtual address specified by dot.

Display data from the target's physical address space starting at the physical address specified by dot.

Display data from the target's primary object file starting at the object file location corresponding to the virtual address specified by dot.

Display the value of dot itself in each of the specified data formats. The = dcmd is therefore useful for converting between bases and performing arithmetic.

In addition to dot, mdb keeps track of another global value called the increment. The increment represents the distance between dot and the address following all the data read by the last formatting dcmd. For example, if a formatting dcmd is executed with dot equal to address A, and displays a 4-byte integer, then after this dcmd completes, dot is still A, but the increment is set to 4. The + character (described under Arithmetic Expansion above) would now evaluate to the value A + 4, and could be used to reset dot to the address of the next data object for a subsequent dcmd.

Most format characters increase the value of the increment by the number of bytes corresponding to the size of the data format, shown in the table. The table of format characters can be displayed from within mdb using the ::formats dcmd. The format characters are:

```
+    increment dot by the count (variable size)
-    decrement dot by the count (variable size)
B    hexadecimal int (1 byte)
C    character using C character notation (1 byte)
D    decimal signed int (4 bytes)
E    decimal unsigned long long (8 bytes)
F    double (8 bytes)
G    octal unsigned long long (8 bytes)
H    swap bytes and shorts (4 bytes)
I    address and disassembled instruction (variable size)
J    hexadecimal long long (8 bytes)
```
K hexadecimal uintptr_t (4 or 8 bytes)
N newline
O octal unsigned int (4 bytes)
P symbol (4 or 8 bytes)
Q octal signed int (4 bytes)
R binary int (8 bytes)
S string using C string notation (variable size)
T horizontal tab
U decimal unsigned int (4 bytes)
V decimal unsigned int (1 byte)
W default radix unsigned int (4 bytes)
X hexadecimal int (4 bytes)
Y decoded time32_t (4 bytes)
Z hexadecimal long long (8 bytes)
^ decrement dot by increment * count (variable size)
a dot as symbol+offset
b octal unsigned int (1 byte)
c character (1 byte)
d decimal signed short (2 bytes)
e decimal signed long long (8 bytes)
f float (4 bytes)
g octal signed long long (8 bytes)
h swap bytes (2 bytes)
i disassembled instruction (variable size)
n newline
o octal unsigned short (2 bytes)
p symbol (4 or 8 bytes)
q octal signed short (2 bytes)
r whitespace
The /, \, and ? formatting dcmds can also be used to write to the target's virtual address space, physical address space, or object file by specifying one of the following modifiers as the first format character, and then specifying a list of words that are either immediate values or expressions enclosed in square brackets preceded by a dollar sign ($[ ]).

The write modifiers are:

**v**
Write the lowest byte of the value of each expression to the target beginning at the location specified by dot.

**w**
Write the lowest two bytes of the value of each expression to the target beginning at the location specified by dot.

**W**
Write the lowest 4 bytes of the value of each expression to the target beginning at the location specified by dot.

**Z**
Write the complete 8 bytes of the value of each expression to the target beginning at the location specified by dot.

The /, \, and ? formatting dcmds can also be used to search for a particular integer value in the target's virtual address space, physical address space, and object file, respectively, by specifying one of the following modifiers as the first format character, and then specifying a value and optional mask. The value and mask are each specified as either immediate values or expressions enclosed in square brackets preceded by a dollar sign. If only a value is specified, mdb reads integers of the appropriate size and stops at the address containing the matching value. If a value V and mask M are specified, mdb reads integers of the appropriate size and stops at the address containing a value X where (X & M) == V. At the completion of the dcmd, dot is updated to the address containing the match. If no match is found, dot is left at the last address that was read.

The search modifiers are:
Search for the specified 2-byte value.
L Search for the specified 4-byte value.
M Search for the specified 8-byte value.

Notice that for both user and kernel targets, an address space is typically composed of a set of discontiguous segments. It is not legal to read from an address that does not have a corresponding segment. If a search reaches a segment boundary without finding a match, it aborts when the read past the end of the segment boundary fails.

mdb provides facilities for controlling and tracing the execution of a live running program. Currently, only the user process target provides support for execution control. mdb provides a simple model of execution control: a target process can be started from within the debugger using ::run, or mdb can attach to an existing process using :A, ::attach, or the -p command-line option, as described below. A list of traced software events can be specified by the user. Each time a traced event occurs in the target process, all threads in the target stop, the thread that triggered the event is chosen as the representative thread, and control returns to the debugger. Once the target program is set running, control can be asynchronously returned to the debugger by typing the user-defined interrupt character (typically ^C).

A software event is a state transition in the target program that is observed by the debugger. For example, the debugger can observe the transition of a program counter register to a value of interest (a breakpoint) or the delivery of a particular signal.

A software event specifier is a description of a class of software events that is used by the debugger to instrument the target program in order to observe these events. The ::events dcmd is used to list the software event specifiers. A set of standard properties is associated with each event specifier, as described under ::events, below.

The debugger can observe a variety of different software events, including breakpoints, watchpoints, signals, machine faults, and system calls. New specifiers can be created using ::bp, ::fltbp, ::sigbp, ::sysbp, or ::wp. Each specifier has an associated callback (an mdb command string to execute as if it had been typed at the command prompt) and a set of properties, as described below. Any number of specifiers for the same event can be created, each with different callbacks and properties. The current list of traced events and the properties of the corresponding event specifiers can be displayed using the ::events dcmd. The event specifier properties are defined as part of the description of the ::events and ::evset dcmds, below.

The execution control built-in dcmds, described below, are always available, but issues an error message indicating they are not supported if applied to a target that does not support execution control. For more information about the interaction of exec, attach, release, and job control with debugger execution control, refer to NOTES, below.
Event Callbacks

The :evset dcmd and event tracing dcmds allow you to associate an event callback (using the -c option) with each event specifier. The event callbacks are strings that represent mdb commands to execute when the corresponding event occurs in the target. These commands are executed as if they had been typed at the command prompt. Before executing each callback, the dot variable is set to the value of the representative thread’s program counter and the “hits” variable is set to the number of times this specifier has been matched, including the current match.

If the event callbacks themselves contain one or more commands to continue the target (for example, ::cont or ::step), these commands do not immediately continue the target and wait for it to stop again. Instead, inside of an event callback, the continue dcmds note that a continue operation is now pending, and then return immediately. Therefore, if multiple dcmds are included in an event callback, the step or continue dcmd should be the last command specified. Following the execution of all event callbacks, the target immediately resumes execution if all matching event callbacks requested a continue. If conflicting continue operations are requested, the operation with the highest precedence determines what type of continue occurs. The order of precedence from highest to lowest is: step, step-over (next), step-out, continue.

Thread Support

mdb provides facilities to examine the stacks and registers of each thread associated with the target. The persistent “thread” variable contains the current representative thread identifier. The format of the thread identifier depends on the target. The :regs and ::fregs dcmds can be used to examine the register set of the representative thread, or of another thread if its register set is currently available. In addition, the register set of the representative thread is exported as a set of named variables. The user can modify the value of one or more registers by applying the > dcmd to the corresponding named variable.

The mdb kernel target exports the virtual address of the corresponding internal thread structure as the identifier for a given thread. The Oracle Solaris Modular Debugger Guide provides more information on debugging support for threads in the Solaris kernel. The mdb process target provides proper support for examination of multi-threaded user processes that use the native lwp_* interfaces, /usr/lib/libthread.so or /usr/lib/lwp/libthread.so. When debugging a live user process, mdb detects if a single threaded process dlopen or closes libthread and automatically adjusts its view of the threading model on-the-fly. The process target thread identifiers corresponds to either the lwpid_t, thread_t, or pthread_t of the representative, depending on the threading model used by the application.

If mdb is debugging a user process target and the target makes use of compiler-supported thread-local storage, mdb automatically evaluates symbol names referring to thread-local storage to the address of the storage corresponding to the current representative thread. The ::tls built-in dcmd can be used to display the value of the symbol for threads other than the representative thread.
mdb provides a set of built-in dcmds that are always defined. Some of these dcmds are only applicable to certain targets: if a dcmd is not applicable to the current target, it fails and prints a message indicating "command is not supported by current target". In many cases, mdb provides a mnemonic equivalent (::identifier) for the legacy adb(1) dcmd names. For example, ::quit is provided as the equivalent of $q. Programmers who are experienced with adb(1) or who appreciate brevity or arcana can prefer the $ or : forms of the built-ins. Programmers who are new to mdb might prefer the more verbose :: form. The built-ins are shown in alphabetical order. If a $ or : form has a ::identifier equivalent, it is shown underneath the ::identifier form. The built-in dcmds are:

> variable-name
> / modifier/variable-name
Assign the value of dot to the specified named variable. Some variables are read-only and can not be modified. If the > is followed by a modifier character surrounded by //, then the value is modified as part of the assignment. The modifier characters are:

c  unsigned char quantity (1-byte)

s  unsigned short quantity (2-byte)

i  unsigned int quantity (4-byte)

\  unsigned long quantity (4-byte in 32-bit, 8-byte in 64-bit)

Notice that these operators do not perform a cast. Instead, they fetch the specified number of low-order bytes (on little-endian architectures) or high-order bytes (big-endian architectures). Modifiers are provided for backwards compatibility; the mdb */modifier/ and %/modifier/ syntax should be used instead.

$< macro-name
Read and execute commands from the specified macro file. The filename can be given as an absolute or relative path. If the filename is a simple name (that is, if it does not contain a '/'), mdb searches for it in the macro file include path. If another macro file is currently being processed, this file is closed and replaced with the new file.

$<< macro-name
Read and execute commands from the specified macro file (as with $<), but do not close the current open macro file.

$?  Print the process-ID and current signal of the target if it is a user process or core file, and then print the general register set of the representative thread.
[ address ] \$C [ count ]
Print a C stack backtrace, including stack frame pointer information. If the dcmd is
preceded by an explicit address, a backtrace beginning at this virtual memory address is
displayed. Otherwise the stack of the representative thread is displayed. If an optional
count value is given as an argument, no more than count arguments are displayed for each
stack frame in the output.

[ base ] \$d
Get or set the default output radix. If the dcmd is preceded by an explicit expression, the
default output radix is set to the given base; otherwise the current radix is printed in base 10
(decimal). The default radix is base 16 (hexadecimal).

\$e
Print a list of all known external (global) symbols of type object or function, the value of the
symbol, and the first 4 (32-bit \$db) or 8 (64-bit \$db) bytes stored at this location in the
target’s virtual address space. The \$nm dcmd provides more flexible options for displaying
symbol tables.

\$P prompt-string
Set the prompt to the specified prompt-string. The default prompt is ‘>’. The prompt can
also be set using \$ set -P or the -P command-line option.

distance \$s
Get or set the symbol matching distance for address-to-symbol-name conversions. The
symbol matching distance modes are discussed along with the -s command-line option
under OPTIONS. The symbol matching distance can also be modified using the \$ set -s
option. If no distance is specified, the current setting is displayed.

\$v
Print a list of the named variables that have non-zero values. The \$ vars dcmd provides
other options for listing variables.

width \$w
Set the output page width to the specified value. Typically, this command is not necessary
as \$db queries the terminal for its width and handles resize events.

\$W
Re-open the target for writing, as if \$db had been executed with the -w option on the
command line. Write mode can also be enabled with the \$ set -w option.

[ pid ] \$A [ core ] pid ]
If the user process target is active, attach to and debug the specified process-ID or core file.
The core file pathname should be specified as a string argument. The process-ID can be
specified as the string argument, or as the value of the expression preceding the dcmd.
Recall that the default base is hexadecimal, so decimal PIDs obtained using \$grep(1) or
\$ps(1) should be preceded with “0t” when specified as expressions.
Set a breakpoint at the specified locations. The :bp dcmd sets a breakpoint at each address or symbol specified, including an optional address specified by an explicit expression preceding the dcmd, and each string or immediate value following the dcmd. The arguments can either be symbol names or immediate values denoting a particular virtual address of interest. If a symbol name is specified, it can refer to a symbol that cannot yet be evaluated in the target process. That is, it can consist of an object name and function name in a load object that has not yet been opened. In this case, the breakpoint is deferred and is not active in the target until an object matching the given name is loaded. The breakpoint is automatically enabled when the load object is opened. Breakpoints on symbols defined in a shared library should always be set using a symbol name and not using an address expression, as the address can refer to the corresponding Procedure Linkage Table (PLT) entry instead of the actual symbol definition. Breakpoints set on PLT entries can be overwritten by the run-time link-editor when the PLT entry is subsequently resolved to the actual symbol definition. The -d, -D, -e, -s, -t, -T, -c, and -n options have the same meaning as they do for the :evset dcmd, as described below. If the :b form of the dcmd is used, a breakpoint is only set at the virtual address specified by the expression preceding the dcmd. The arguments following the :b dcmd are concatenated together to form the callback string. If this string contains meta-characters, it must be quoted.

Concatenate and display files. Each filename can be specified as a relative or absolute pathname. The file contents are printed to standard output, but are not passed to the output pager. This dcmd is intended to be used with the | operator; the programmer can initiate a pipeline using a list of addresses stored in an external file.

Suspend the debugger, continue the target program, and wait for it to terminate or stop following a software event of interest. If the target is already running because the debugger was attached to a running program with the -o nos top option enabled, this dcmd simply waits for the target to terminate or stop after an event of interest. If an optional signal name or number (see signal.h(3HEAD)) is specified as an argument, the signal is immediately delivered to the target as part of resuming its execution. If the SIGINT signal is traced, control can be asynchronously returned to the debugger by typing the user-defined interrupt character (usually ^C). This SIGINT signal is automatically cleared and is not observed by the target the next time it is continued. If no target program is currently running, :cont starts a new program running as if by :run.

Context switch to the specified process. A context switch operation is only valid when using the kernel target. The process context is specified using the address of its proc structure in the kernel’s virtual address space. The special context address “0” is used to denote the context of the kernel itself. mdb can only perform a context switch when
examining a crash dump if the dump contains the physical memory pages of the specified user process (as opposed to just kernel pages). The kernel crash dump facility can be configured to dump all pages or the pages of the current user process using `dumpadm(1M)`. The `::status` dcmd can be used to display the contents of the current crash dump.

When the user requests a context switch from the kernel target, `mdb` constructs a new target representing the specified user process. Once the switch occurs, the new target interposes its dcmds at the global level: thus the `/dcmd now formats and displays data from the virtual address space of the user process, the `::mappings` dcmd displays the mappings in the address space of the user process, and so on. The kernel target can be restored by executing `::context`.

`:dcmds`  
List the available dcmds and print a brief description for each one.

```
[ address ] ::delete [ id | all ]
[ address ] ::dis [ -fw ] [ -n count ] [ address ]
```

Delete the event specifiers with the given id number. The id number argument is interpreted in decimal by default. If an optional address is specified preceding the dcmd, all event specifiers that are associated with the given virtual address are deleted (for example, all breakpoints or watchpoints affecting that address). If the special argument "all" is given, all event specifiers are deleted, except those that are marked sticky (`T` flag). The `::events` dcmd displays the current list of event specifiers.

```
[ address ] ::disas [ -fw ] [ -n count ] [ address ]
```

Disassemble starting at or around the address specified by the final argument, or the current value of dot. If the address matches the start of a known function, the entire function is disassembled. Otherwise, a "window" of instructions before and after the specified address is printed in order to provide context. By default, instructions are read from the target's virtual address space. If the `-f` option is present, instructions are read from the target's object file instead. The `-f` option is enabled by default if the debugger is not currently attached to a live process, core file, or crash dump. The `-w` option can be used to force "window"-mode, even if the address is the start of a known function. The size of the window defaults to ten instructions; the number of instructions can be specified explicitly using the `-n` option.

`:disasms`  
List the available disassembler modes. When a target is initialized, `mdb` attempts to select the appropriate disassembler mode. The user can change the mode to any of the modes listed using the `::dismode` dcmd.

```
::dismode [ mode ]
```

Get or set the disassembler mode. If no argument is specified, print the current disassembler mode. If a `mode` argument is specified, switch the disassembler to the specified mode. The list of available disassemblers can be displayed using the `::disasms` dcmd.
mdb(1)

::dmods [-l] [module-name]
List the loaded debugger modules. If the -l option is specified, the list of the dcmds and
walkers associated with each dmod is printed below its name. The output can be restricted
to a particular dmod by specifying its name as an additional argument.

[address] ::dump [-eqrstu] [-f|-p]
[-g bytes] [-w paragraphs]
Print a hexadecimal and ASCII memory dump of the 16-byte aligned region of memory
containing the address specified by dot. If a repeat count is specified for ::dump, this is
interpreted as a number of bytes to dump rather than a number of iterations. The ::dump
dcmd also recognizes the following options:

-e
Adjusts for endianness. The -e option assumes 4-byte words. The -g option can be
used to change the default word size.

-f
Reads data from the object file location corresponding to the given virtual address
instead of from the target’s virtual address space. The -f option is enabled by default if
the debugger is not currently attached to a live process, core file, or crash dump.

-g bytes
Displays bytes in groups of bytes. The default group size is 4 bytes. The group size must
be a power of two that divides the line width.

-p
Interprets address as a physical address location in the target’s address space instead of a
virtual address.

-q
Does not print an ASCII decoding of the data.

-r
Numbers lines relative to the start address instead of with the explicit address of each
line. This option implies the -u option.

-s
Elides repeated lines.

-t
Only reads from and displays the contents of the specified addresses, instead of reading
and printing entire lines.

-u
Unaligns output instead of aligning the output at a paragraph boundary.

-w paragraphs
Displays paragraphs at 16-byte paragraphs per line. The default number of paragraphs is
one. The maximum value accepted for -w is 16.
::echo [ string | value ...]
Print the arguments separated by blanks and terminated by a NEWLINE to standard output.
Expressions enclosed in ${ } is evaluated to a value and printed in the default base.

::eval command
Evaluate and execute the specified string as a command. If the command contains
metacharacters or whitespace, it should be enclosed in double or single quotes.

::events [-av]
$b [-av]
Display the list of software event specifiers. Each event specifier is assigned a unique ID
number that can be used to delete or modify it at a later time. The debugger can also have
its own internal events enabled for tracing. These events are only be displayed if the -a
option is present. If the -v option is present, a more verbose display, including the reason
for any specifier inactivity, are shown. Here is some sample output:

> ::events
<table>
<thead>
<tr>
<th>ID</th>
<th>S</th>
<th>TA</th>
<th>HT</th>
<th>LM</th>
<th>Description</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ 1 ]</td>
<td>T</td>
<td>1 0</td>
<td>stop on SIGINT</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[ 2 ]</td>
<td>T</td>
<td>0 0</td>
<td>stop on SIGQUIT</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[ 3 ]</td>
<td>T</td>
<td>0 0</td>
<td>stop on SIGILL</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[ 11]</td>
<td>T</td>
<td>0 0</td>
<td>stop on SIGXCPU</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[ 12]</td>
<td>T</td>
<td>0 0</td>
<td>stop on SIGXFSD</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[ 13]</td>
<td>2 0</td>
<td>stop at libc.printf</td>
<td>:echo printf</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following table explains the meaning of each column. A summary of this information
is available using :help events.

ID
The event specifier identifier. The identifier is shown in square brackets [ ] if the
specifier is enabled, in parentheses ( ) if the specifier is disabled, or in angle brackets <>
if the target program is currently stopped on an event that matches the given specifier.

S
The event specifier state. The state is one of the following symbols:

- The event specifier is idle. When no target program is running, all specifiers are idle.
When the target program is running, a specifier can be idle if it cannot be evaluated
(for example, a deferred breakpoint in a shared object that is not yet loaded).

+ The event specifier is active. When the target is continued, events of this type is
detected by the debugger.
**The event specifier is armed.** This state means that the target is currently running with instrumentation for this type of event. This state is only visible if the debugger is attached to a running program with the `-o nostop` option.

*The event specifier was not armed due to an operating system error.* The `::events -v` option can be used to display more information about the reason the instrumentation failed.

**TA**
The Temporary, Sticky, and Automatic event specifier properties. One or more of the following symbols can be shown:

- **t**
The event specifier is temporary, and is deleted the next time the target stops, regardless of whether it is matched.

- **T**
The event specifier is sticky, and is not be deleted by `::delete all` or `:z`. The specifier can be deleted by explicitly specifying its id number to `::delete`.

- **d**
The event specifier is automatically disabled when the hit count is equal to the hit limit.

- **D**
The event specifier is automatically deleted when the hit count is equal to the hit limit.

- **s**
The target automatically stops when the hit count is equal to the hit limit.

**HT**
The current hit count. This column displays the number of times the corresponding software event has occurred in the target since the creation of this event specifier.

**LM**
The current hit limit. This column displays the limit on the hit count at which the auto-disable, auto-delete, or auto-stop behavior takes effect. These behaviors can be configured using the `::evset dcmd`, described below.

**Description**
A description of the type of software event that is matched by the given specifier.

**Action**
The callback string to execute when the corresponding software event occurs. This callback is executed as if it had been typed at the command prompt.
Modify the properties of one or more software event specifiers. The properties are set for each specifier identified by the optional expression preceding the dcmd and an optional list of arguments following the dcmd. The argument list is interpreted as a list of decimal integers, unless an explicit radix is specified. The : :evset dcmd recognizes the following options:

- **d**
  Disables the event specifier when the hit count reaches the hit limit. If the -d form of the option is given, this behavior is disabled. Once an event specifier is disabled, the debugger removes any corresponding instrumentation and ignores the corresponding software events until the specifier is subsequently re-enabled. If the -n option is not present, the specifier is disabled immediately.

- **D**
  Deletes the event specifier when the hit count reaches the hit limit. If the -D form of the option is given, this behavior is disabled. The -D option takes precedence over the -d option. The hit limit can be configured using the -n option.

- **e**
  Enables the event specifier. If the -e form of the option is given, the specifier is disabled.

- **s**
  Stops the target program when the hit count reaches the hit limit. If the -s form of the option is given, this behavior is disabled. The -s behavior tells the debugger to act as if the : :cont were issued following each execution of the specifier's callback, except for the Nth execution, where N is the current value of the specifier's hit limit. The -s option takes precedence over both the -D option and the -d option.

- **t**
  Marks the event specifier as temporary. Temporary specifiers are automatically deleted the next time the target stops, regardless of whether it stopped as the result of a software event corresponding to the given specifier. If the -t form of the option is given, the temporary marker is removed. The -t option takes precedence over the -T option.

- **T**
  Marks the event specifier as sticky. Sticky specifiers are not deleted by : :delete all or : :z. They can be deleted by specifying the corresponding specifier ID as an explicit argument to : :delete. If the -T form of the option is given, the sticky property is removed. The default set of event specifiers are all initially marked sticky.

- **c**
  Executes the specified cmd string each time the corresponding software event occurs in the target program. The current callback string can be displayed using : :events.

- **n**
  Sets the current value of the hit limit to count. If no hit limit is currently set and the -n option does not accompany -s or D, the hit limit is set to one.
A summary of this information is available using ::help evset.

::files
$f
Print a list of the known source files (symbols of type STT_FILE present in the various target symbol tables).

::fltbp
fltbp [-/ -D bestT] [-c cmd] [-n count] flt ...
Trace the specified machine faults. The faults are identified using an optional fault number preceding the dcmd, or a list of fault names or numbers (see <sys/fault.h>) following the dcmd. The -d, -D, -e, -s, -t, -T, -c, and -n options have the same meaning as they do for the ::evset dcmd.

::fpregs
thread ::fpregs
thread $x, $X, $y, $Y
Print the floating-point register set of the representative thread. If a thread is specified, the floating point registers of that thread are displayed. The thread expression should be one of the thread identifiers described under Thread Support, above.

::formats
List the available output format characters for use with the /, \, ?, and = formatting dcmds. The formats and their use is described under Formatting dcmds, above.

::grep command
Evaluate the specified command string, and then print the old value of dot if the new value of dot is non-zero. If the command contains whitespace or metacharacters, it must be quoted. The ::grep dcmd can be used in pipelines to filter a list of addresses.

::help [ dcmd-name ]
With no arguments, the ::help dcmd prints a brief overview of the help facilities available in mdb. If a dcmd-name is specified, mdb prints a usage summary for that dcmd.

signal : i
If the target is a live user process, ignore the specified signal and allow it to be delivered transparently to the target. All event specifiers that are tracing delivery of the specified signal is deleted from the list of traced events. By default, the set of ignored signals is initialized to the complement of the set of signals that cause a process to dump core by default (see signal.h(3HEAD)), except for SIGINT, which is traced by default.

::if
$ if
Display the list of signals that are ignored by the debugger and that is handled directly by the target. More information on traced signals can be obtained using the ::events dcmd.

::if [-p] [type member tests] [type] [at off] test
Evaluate the tests and then print the old value of dot if the tests are true.

- p
Use physical rather than virtual addresses.
There are two kinds of tests. The first allows you to test the value of a member of a structure or union. The second allows you to test an offset from dot. These tests can then be joined with AND or OR to build more complex tests.

Start with an example of testing a member of a structure:

```
::if "struct foo" namep <> 0
```

This statement would print the old value of dot if the element namep in structure foo were not 0.

```
::if "struct foo" namep <> 0 AND namep->name <> 0 AND namep->name streq "bar"
```

The preceding statement would print the old value of dot if the element name in structure pointed to by namep in foo were not 0 and pointed to a string that contained the string bar.

```
::if "struct foo" name <> 0 AND name streq "bar" and value = 0x123
```

The preceding statement would print only if the name were bar and value was 0x123.

The second form tests to see if the type at the given offset has the given value. Here is an example:

```
::if uint_t at 0x34 = 0x123
```

This will print if the value of an uint_t at offset 0x34 is 0x123. Again this can be joined with other tests using AND or OR. With this form, ::if has a number of built-in types that are internal that can be used even when there is no symbolic type information. These types are:

- char, uchar, short, ushort, int, uint, long, ulong,
- longlong, ulonglong, pointer, addr

If the type is addr, then, rather than the value at that address, the actual address is tested. So, the statement:

```
::if addr at 0x34 = 0x100034
```

...would report the value of dot only if dot+0x34 was 0x100034, whereas:

```
::if pointer at 0x34 = 0x100034
```

...would print only if the value at dot+0x34.

More usefully, the statement:

```
::if "char *" at 0x34 streq "foo"
```

...will print the old value of dot if the string pointed to at offset 0x34 is foo.

Possible tests are:

- = - True if the values are equal.
- <> - True if the values are not equal.
- < - True if the value is less than the right hand value.
The right hand side of a test can be any one of the following:

- An element in the structure or union.
- The value from a symbol.
- An absolute value.
- $<var$ — the value of the variable var.
- $expr$ - the value of dot after mdb expression expr is evaluated. This must be quoted using double quotation marks (""). For example:

  "$<var=J"

  ...would get the value of variable var.

::kill
:k

Forcibly terminate the target if it is a live user process. The target is also forcibly terminated when the debugger exits if it was created by the debugger using ::run.

$\l$

Print the LWID of the representative thread, if the target is a user process.

$\L$

Print the LWIDs of each LWP in the target, if the target is a user process.

[ address ] ::list [-b back_member][-p][-L] [type] member [ variable-name ]

Walk through the elements of a linked list data structure and print the address of each element in the list. The address of the first element in the list can be specified using an optional address. Otherwise, the list is assumed to start at the current value of dot. The type parameter must name a C struct or union type and is used to describe the type of the list elements so that mdb can read in objects of the appropriate size. If ::list can determine the type then type can be omitted. The member parameter is used to name the member of type
that contains a pointer to the next list element. The ::list dcmd continues iterating until a NULL pointer is encountered, the first element is reached again (a circular list), a loop is detection is enabled (-L) and a loop is detected, back member checking is enabled (-b) and a bad back pointer is detected, or an error occurs while reading an element. If the optional variable-name is specified, the specified variable is assigned the value returned at each step of the walk when mdb invokes the next stage of a pipeline.

-b back_member
  Verify that back_member points to the previous member of the list. The first member of the list is allowed to have a NULL back pointer.

-L
  Check for loops in the list. Will print every element in the list once.

-p
  Read from physical rather than virtual addresses.

The ::list dcmd can only be used with objects that contain symbolic debugging information designed for use with mdb. Refer to NOTES, “Symbolic Debugging Information,” below for more information.

::load [ -s ] module-name
  Load the specified dmod. The module name can be given as an absolute or relative path. If module-name is a simple name (that is, does not contain a ‘/’), mdb searches for it in the module library path. Modules with conflicting names cannot be loaded; the existing module must be unloaded first. If the -s option is present, mdb remains silent and does not issue any error messages if the module is not found or could not be loaded.

::log [ -d | [ -e ] filename ]
  Enable or disable the output log. mdb provides an interactive logging facility where both the input commands and standard output can be logged to a file while still interacting with the user. The -e option enables logging to the specified file, or re-enables logging to the previous log file if no filename is given. The -d option disables logging. If the $> dcmd is used, logging is enabled if a filename argument is specified; otherwise, logging is disabled. If the specified log file already exists, mdb appends any new log output to the file.

::map command
  Map the value of dot to a corresponding value using the command specified as a string argument, and then print the new value of dot. If the command contains whitespace or metacharacters, it must be quoted. The ::map dcmd can be used in pipelines to transform the list of addresses into a new list of addresses.

[ address ] ::mappings [ name ]
[ address ] $m [ name ]
  Print a list of each mapping in the target’s virtual address space, including the address, size, and description of each mapping. If the dcmd is preceded by an address, mdb only shows the
mapping that contains the given address. If a string name argument is given, mdb only shows the mapping matching that description.

::next [ SIG ]
:e [ SIG ]

Step the target program one instruction, but step over subroutine calls. If an optional signal name or number (see signal.h(3HEAD)) is specified as an argument, the signal is immediately delivered to the target as part of resuming its execution. If no target program is currently running, ::next starts a new program running as if by ::run and stop at the first instruction.

[ address ] ::nm [ -DPdhnopuvx ] [ -t types ]
[ -f format ] [ object ]

Print the symbol tables associated with the current target. If an optional address preceding the dcmd is specified, only the symbol table entry for the symbol corresponding to address is displayed. If an object is specified, only the symbol table for this load object is displayed. The ::nm dcmd also recognizes the following options:

-D
Prints .dynsym (dynamic symbol table) instead of .symtab.

-P
Prints the private symbol table instead of .symtab.

-d
Prints value and size fields in decimal.

-g
Prints only global symbols.

-h
Suppresses the header line.

-n
Sorts symbols by name.

-o
Prints value and size fields in octal.

-p
Prints symbols as a series of ::nmadd commands. This option can be used with -P to produce a macro file that can be subsequently read into the debugger with $<.

-u
Prints only undefined symbols.

-v
Sorts symbols by value.

-x
Prints value and size fields in hexadecimal.
-t type[type ... ]
Prints only symbols of the specified type(s). The valid type argument strings are:

  not
    STT_NOTYPE

  obj
    STT_OBJECT

  func
    STT_FUNC

  sect
    STT_SECTION

  file
    STT_FILE

  comm
    STT_COMMON

  tls
    STT_TLS

  regi
    STT_SPARC_REGISTER

-f format[format ... ]
Prints only the specified symbol information. The valid format argument strings are:

  ndx
    symbol table index

  val
    symbol value

  size
    size in bytes

  type
    symbol type

  bind
    binding

  oth
    other

  shndx
    section index

  name
    symbol name
ctype
  C type for symbol (if known)

obj
  object which defines symbol

value ::nmadd [-fo] [-e end] [-s size] name
  Add the specified symbol name to the private symbol table. mdb provides a private,
  configurable symbol table that can be used to interpose on the target's symbol table, as
  described under Symbol Name Resolution above. The ::nmadd dcmd also recognizes the
  following options:
  -e
    Sets the size of the symbol to end - value.
  -f
    Sets the type of the symbol to STT_FUNC.
  -o
    Sets the type of the symbol to STT_OBJECT.
  -s
    Sets the size of the symbol to size.

::nmdel name
  Delete the specified symbol name from the private symbol table.

::objects [-v]
  Print a map of the target's virtual address space, showing only those mappings that
  correspond to the primary mapping (usually the text section) of each of the known load
  objects. The -v option displays the version of each load object. Version information is not
  available for all load objects. Load objects without version information is listed as having a
  version of “Unknown” in the output for the -v option.

::offsetof member
  Print the offset of the specified member of the specified type. The type should be the name
  of a C structure. If no member is specified all the members for this type are reported.
  The offset is printed in bytes, unless the member is a bit-field, in which case the offset can be
  printed in bits. The output is always suffixed with the appropriate units for clarity. The type
  name can use the backquote (') scoping operator described under Symbol Name
  Resolution, above. The ::offsetof dcmd can only be used with objects that contain
  symbolic debugging information designed for use with mdb. Refer to NOTES, Symbolic
  Debugging Information, below for more information.

address ::print [-acdiLptx] [-c lim] [-l lim] [type [member ...]]
  Print the data structure at the specified virtual address using the given type information.
  The type parameter can name a C struct, union, enum, fundamental integer type, or a
  pointer to any of these types. If the type name contains whitespace (for example, “struct
foo”), it must be enclosed in single or double quotes. The type name can use the backquote (‘) scoping operator described under Symbol Name Resolution, above. If the type is a structured type, the ::print dcmd recursively prints each member of the struct or union. If the type argument is not present and a static or global STT_OBJECT symbol matches the address, ::print infers the appropriate type automatically. If the type argument is specified, it can be followed by an optional list of member expressions, in which case only those members and submembers of the specified type are displayed. If type contains other structured types, each member string can refer to a sub-structure element by forming a list of member names separated by period (‘.’) delimiters. The ::print dcmd can only be used with objects that contain symbolic debugging information designed for use with mdb. Refer to NOTES, Symbolic Debugging Information, below for more information. After displaying the data structure, ::print increments dot by the size of type in bytes.

If the -a option is present, the address of each member is displayed. If the -p option is present, ::print interprets address as a physical memory address instead of a virtual memory address. If the -t option is present, the type of each member is displayed. If the -d or -x options are present, all integers are displayed in decimal (-d) or hexadecimal (-x). By default, a heuristic is used to determine if the value should be displayed in decimal or hexadecimal. The number of characters in a character array that is read and displayed as a string can be limited with the -c option. If the -c option is present, no limit is enforced. The number of elements in a standard array that is read and displayed can be limited with the -l option. If the -l option is present, no limit is enforced and all array elements are shown. The default values for -c and -l can be modified using ::set or the -o command-line option as described under OPTIONS.

If the -i option is specified, the address value is interpreted as an immediate value to be printed. You must give a type with which to interpret the value. If the type is smaller than 64 bits, the immediate value is interpreted as if it were the size of the type. The -i option cannot be used in conjunction with the -p option. If the -a option is given, the addresses shown are byte offsets starting at zero.

::quit
$q
Quit the debugger.

[ thread ] ::regs
[ thread ] $r
Print the general purpose register set of the representative thread. If a thread is specified, the general purpose register set of that thread is displayed. The thread expression should be one of the thread identifiers described under Thread Support, above.

::release [-a]
:R [-a]
Release the previously attached process or core file. If the -a option is present, the process is released and left stopped and abandoned. It can subsequently be continued by prun(1) (see proc(1)) or it can be resumed by applying mdb or another debugger. By default, a released
Process is forcibly terminated if it was created by \texttt{mdb} using \texttt{::run}, or it is released and set running if it was attached to by \texttt{mdb} using the -p option or using the \texttt{::attach} or \texttt{::dcmds}.

\texttt{::run} [ \textit{args} ... ]

Start a new target program running with the specified arguments and attach to it. The arguments are not interpreted by the shell. If the debugger is already examining a live running program, it first detaches from this program as if by \texttt{::release}.

\texttt{::set} [ \texttt{-F} ] [ \texttt{-/o option} ] [ \texttt{-s distance} ] [ \texttt{-I path} ]

Get or set miscellaneous debugger properties. If no options are specified, the current set of debugger properties is displayed. The \texttt{::set dcmd} recognizes the following options:

\texttt{-F}
Forcibly takes over the next user process that \texttt{::attach} is applied to, as if \texttt{mdb} had been executed with the -F option on the command line.

\texttt{-I}
Sets the default path for locating macro files. The path argument can contain any of the special tokens described for the -I command-line option under OPTIONS.

\texttt{-L}
Sets the default path for locating debugger modules. The path argument can contain any of the special tokens described for the -I command-line option under OPTIONS.

\texttt{-o}
Enables the specified debugger option. If the -o form is used, the option is disabled. The option strings are described along with the -o command-line option under OPTIONS.

\texttt{-P}
Sets the command prompt to the specified prompt string.

\texttt{-s}
Sets the symbol matching distance to the specified distance. Refer to the description of the -s command-line option under OPTIONS for more information.

\texttt{-w}
Re-opens the target for writing, as if \texttt{mdb} had been executed with the -w option on the command line.

\texttt{::showrev} [ \texttt{-pv} ]

Display revision information for the hardware and software. With no options specified, general system information is displayed. The -v option displays version information for all load objects, whereas the -p option displays the version information only for the load objects that have been installed on the system as part of a patch. Version information is not available for all load objects. Load objects without version information is omitted from the output for the -p option and is listed as having a version of "Unknown" in the output for the -v option.
::sigbp [-/ddestT] [-c cmd] [-n count] SIG ...

::t [-/ddestT] [-c cmd] [-n count] SIG ...

Trace delivery of the specified signals. The signals are identified using an optional signal number preceding the dcmd, or a list of signal names or numbers (see signal.h(3HEAD)) following the dcmd. The -d, -D, -e, -s, -t, -T, -c, and -n options have the same meaning as they do for the ::evset dcmd. Initially, the set of signals that cause the process to dump core by default (see signal.h(3HEAD)) and SIGINT are traced.

::sizeof [-s size] [-r min max] [type [member ...]]

Options are as follows:

-s size
Show types for entries of this size.

-r min max
Show types for entries in range of sizes.

Print the size of the specified type in bytes. The type parameter can name a C struct, union, enum, fundamental integer type, or a pointer to any of these types. The type name can use the backquote (’’) scoping operator described under Symbol Name Resolution, above. member can be specified with standard C syntax using the array indexing operator “[index]”, structure member operator “.”.

The ::sizeof dcmd can only be used with objects that contain symbolic debugging information designed for use with mdb. Refer to NOTES, Symbolic Debugging Information, below for more information.

::stack [count]
::sc [count]
Print a C stack backtrace. If the dcmd is preceded by an explicit address, a backtrace beginning at this virtual memory address is displayed. Otherwise the stack of the representative thread is displayed. If an optional count value is given as an argument, no more than count arguments are displayed for each stack frame in the output.

::status
Print a summary of information related to the current target.

::step [over | out] [SIG]
::s [SIG]
::u [SIG]
Step the target program one instruction. If an optional signal name or number (see signal.h(3HEAD)) is specified as an argument, the signal is immediately delivered to the target as part of resuming its execution. If the optional "over" argument is specified, ::step steps over subroutine calls. The ::step over argument is the same as the ::next dcmd. If the optional "out" argument is specified, the target program continues until the representative thread returns from the current function. If no target program is currently running, ::step out starts a new program running as if by ::run and stop at the first instruction. The ::s dcmd is the same as ::step. The ::u dcmd is the same as ::step out.
::syscall

Trace entry to or exit from the specified system calls. The system calls are identified using
an optional system call number preceding the dcmd, or a list of system call names or
numbers (see <sys/syscall.h>) following the dcmd. If the -i option is specified (the
default), the event specifiers trigger on entry into the kernel for each system call. If the -o
option is specified, the event specifiers trigger on exit out from the kernel. The -d, -D, -e,
-s, -t, -T, -c, and -n options have the same meaning as they do for the ::evset dcmd.

::thread

Print the address of the storage for the specified thread-local storage (TLS) symbol in the
context of the specified thread. The thread expression should be one of the thread
identifiers described under Thread Support, above. The symbol name can use any of the
scoping operators described under Symbol Name Resolution, above.

::typeset

Set attributes for named variables. If one or more variable names are specified, they are
defined and set to the value of dot. If the -t option is present, the user-defined tag
associated with each variable is set. If the -t option is present, the tag is cleared. If no
variable names are specified, the list of variables and their values is printed.

::unload

Unload the specified dmod. The list of active dmods can be printed using the ::dmods
dcmd. Built-in modules can not be unloaded. Modules that are busy (that is, provide
dcmds that are currently executing) can not be unloaded.

::unset

Unset (remove) the specified variable(s) from the list of defined variables. Some variables
exported by mdb are marked as persistent, and can not be unset by the user.

::vars

Print a listing of named variables. If the -n option is present, the output is restricted to
variables that currently have non-zero values. If the -p option is present, the variables are
printed in a form suitable for re-processing by the debugger using the $< dcmd. This option
can be used to record the variables to a macro file and then restore these values later. If the
-t option is present, only the tagged variables are printed. Variables can be tagged using the
-t option of the ::typeset dcmd.

::version

Print the debugger version number.

::address

Print the physical address mapping for the specified virtual address, if possible. The ::vtop
dcmd is only available when examining a kernel target, or when examining a user process
inside a kernel crash dump (after a ::context dcmd has been issued).

When examining a kernel target from the kernel context, the -a option can be used to
specify the address (as) of an alternate address space structure that should be used for the
virtual to physical translation. By default, the kernel's address space is used for translation. This option is available for active address spaces even when the dump content only contains kernel pages.

```
[ address ] ::walk walker-name [ variable-name ]
```

Walk through the elements of a data structure using the specified walker. The available walkers can be listed using the ::walkers dcmd. Some walkers operate on a global data structure and do not require a starting address. For example, walk the list of proc structures in the kernel. Other walkers operate on a specific data structure whose address must be specified explicitly. For example, given a pointer to an address space, walk the list of segments. When used interactively, the ::walk dcmd prints the address of each element of the data structure in the default base. The dcmd can also be used to provide a list of addresses for a pipeline. The walker name can use the backquote (') scoping operator described under dcmd and Walker Name Resolution, above. If the optional variable-name is specified, the specified variable is assigned the value returned at each step of the walk when mdb invokes the next stage of the pipeline.

```
::walkers
```

List the available walkers and print a brief description for each one.

```
::whence [-v] name...
::which [-v] name...
```

Print the dmod that exports the specified dcmds and walkers. These dcmds can be used to determine which dmod is currently providing the global definition of the given dcmd or walker. Refer to the section on dcmd and Walker Name Resolution above for more information on global name resolution. The -v option causes the dcmd to print the alternate definitions of each dcmd and walker in order of precedence.

```
addr [ len ] ::wp [ -r -w -dxDestT ] [ -rwx ] [ -c cmd ]
[-n count ]
```

Set a watchpoint at the specified address. The length in bytes of the watched region can be set by specifying an optional repeat count preceding the dcmd. If no length is explicitly set, the default is one byte. The ::wp dcmd allows the watchpoint to be configured to trigger on any combination of read (-r option), write (-w option), or execute (-x option) access. The -d, -D, -e, -s, -t, -T, -c, and -n options have the same meaning as they do for the ::evset dcmd. The :a dcmd sets a read access watchpoint at the specified address. The :p dcmd sets an execute access watchpoint at the specified address. The :w dcmd sets a write access watchpoint at the specified address. The arguments following the :a, :p, and :w dcmds are concatenated together to form the callback string. If this string contains meta-characters, it must be quoted.

```
::xdata
```

List the external data buffers exported by the current target. External data buffers represent information associated with the target that can not be accessed through standard target
facilities (that is, an address space, symbol table, or register set). These buffers can be consumed by dcmds; for more information, refer to the Oracle Solaris Modular Debugger Guide.

:z
Delete all event specifiers from the list of traced software events. Event specifiers can also be deleted using ::delete.

**Options**
The following options are supported:

- **-A**
  Disables automatic loading of mdb modules. By default, mdb attempts to load debugger modules corresponding to the active shared libraries in a user process or core file, or to the loaded kernel modules in the live operating system or an operating system crash dump.

- **-f**
  Forces raw file debugging mode. By default, mdb attempts to infer whether the object and core file operands refer to a user executable and core dump or to a pair of operating system crash dump files. If the file type cannot be inferred, the debugger defaults to examining the files as plain binary data. The -f option forces mdb to interpret the arguments as a set of raw files to examine.

- **-F**
  Forcibly takes over the specified user process, if necessary. By default, mdb refuses to attach to a user process that is already under the control of another debugging tool, such as truss(1). With the -F option, mdb attaches to these processes anyway. This can produce unexpected interactions between mdb and the other tools attempting to control the process.

- **-I path**
  Sets default path for locating macro files. Macro files are read using the $< or $<< dcmds. The path is a sequence of directory names delimited by colon (:) characters. The -I include path and -L library path (see below) can also contain any of the following tokens:

  - **%i**
    Expands to the current instruction set architecture (ISA) name (‘sparc’, ‘sparcv9’, or ‘i386’).

  - **%o**
    Expands to the old value of the path being modified. This is useful for appending or prepending directories to an existing path.

  - **%p**
    Expands to the current platform string (either uname -i or the platform string stored in the process core file or crash dump).

  - **%r**
    Expands to the pathname of the root directory. An alternate root directory can be specified using the -R option. If no -R option is present, the root directory is derived
dynamically from the path to the `mdb` executable itself. For example, if `/bin/mdb` is executed, the root directory is `/`. If `/net/hostname/bin/mdb` were executed, the root directory would be derived as `/net/hostname`.

```
%t
```

Expands to the name of the current target. This is either be the literal string ‘proc’ (a user process or user process core file), ‘kvm’ (a kernel crash dump or the live operating system), or ‘raw’ (a raw file).

The default include path for 32-bit `mdb` is:

```
%r/usr/platform/%p/lib/adb:%r/usr/lib/adb
```

The default include path for 64-bit `mdb` is:

```
%r/usr/platform/%p/lib/adb/%i:%r/usr/lib/adb/%i
```

```
-k
```

Forces kernel debugging mode. By default, `mdb` attempts to infer whether the object and core file operands refer to a user executable and core dump, or to a pair of operating system crash dump files. The -k option forces `mdb` to assume these files are operating system crash dump files. If no object or core operand is specified, but the -k option is specified, `mdb` defaults to an object file of `/dev/ksyms` and a core file of `/dev/kmem`. Read access to `/dev/kmem` is restricted to group sys. Write access requires ALL privileges.

```
-K
```

Load `kmdb`, stop the live running operating system kernel, and proceed to the `kmdb` debugger prompt. This option should only be used on the system console, as the subsequent `kmdb` prompt appears on the system console.

```
-L path
```

Sets default path for locating debugger modules. Modules are loaded automatically on startup or using the `::load` dcmd. The path is a sequence of directory names delimited by colon (`:`) characters. The -L library path can also contain any of the tokens shown for -I above.

```
-m
```

Disables demand-loading of kernel module symbols. By default, `mdb` processes the list of loaded kernel modules and performs demand loading of per-module symbol tables. If the -m option is specified, `mdb` does not attempt to process the kernel module list or provide per-module symbol tables. As a result, `mdb` modules corresponding to active kernel modules are not loaded on startup.

```
-M
```

Preloads all kernel module symbols. By default, `mdb` performs demand-loading for kernel module symbols: the complete symbol table for a module is read when an address is that module’s text or data section is referenced. With the -M option, `mdb` loads the complete symbol table of all kernel modules during startup.
-o option
Enables the specified debugger option. If the -o form of the option is used, the specified option is disabled. Unless noted below, each option is off by default. mdb recognizes the following option arguments:

adb
Enables stricter adb(1) compatibility. The prompt is set to the empty string and many mdb features, such as the output pager, is disabled.

array_mem_limit=limit
Sets the default limit on the number of array members that ::print displays. If limit is the special token none, all array members are displayed by default.

array_str_limit=limit
Sets the default limit on the number of characters that ::print attempts to display as an ASCII string when printing a char array. If limit is the special token none, the entire char array is displayed as a string by default.

follow_exec_mode=mode
Sets the debugger behavior for following an exec(2) system call. The mode should be one of the following named constants:

ask
If stdout is a terminal device, the debugger stops after the exec(2) system call has returned and then prompts the user to decide whether to follow the exec or stop. If stdout is not a terminal device, the ask mode defaults to stop.

follow
The debugger follows the exec by automatically continuing the target process and resetting all of its mappings and symbol tables based on the new executable. The follow behavior is discussed in more detail under NOTES, Interaction with Exec, below.

stop
The debugger stops following return from the exec system call. The stop behavior is discussed in more detail under NOTES, Interaction with Exec, below.

follow_fork_mode=mode
Sets the debugger behavior for following a fork(2), fork1(2), or vfork(2) system call. The mode should be one of the following named constants:

ask
If stdout is a terminal device, the debugger stops after the fork(2) system call has returned and then prompts the user to decide whether to follow the parent or child. If stdout is not a terminal device, the ask mode defaults to parent.

parent
The debugger follows the parent process, and detaches from the child process and sets it running.
child

The debugger follows the child process, and detaches from the parent process and sets it running.

ignore eof

The debugger does not exit when an EOF sequence (^D) is entered at the terminal. The ::quit dcmd must be used to quit.

nostop

Does not stop a user process when attaching to it when the -p option is specified or when the ::attach or :A dcmds are applied. The nostop behavior is described in more detail under NOTES, Process Attach and Release, below.

pager

Enables the output pager (default).

repeat last

If a NEWLINE is entered as the complete command at the terminal, mdb repeats the previous command with the current value of dot. This option is implied by -o adb.

show lmid

mdb provides support for symbol naming and identification in user applications that make use of link maps other than LM_ID_BASE and LM_ID_LDSO, as described in Symbol Name Resolution, above. Symbols on link maps other than LM_ID_BASE or LM_ID_LDSO is shown as LMmid’library’symbol, where lmid is the link-map ID in the default output radix (16). The user can optionally configure mdb to show the link-map ID scope of all symbols and objects, including those associated with LM_ID_BASE and LM_ID_LDSO, by enabling the show lmid option. Built-in dcmds that deal with object file names displays link-map IDs according to the value of show lmid above, including ::nm, ::mappings, $m, and ::objects.

-p pid

Attaches to and stops the specified process-id. mdb uses the /proc/pid/object/a.out file as the executable file pathname.

-P prompt

Sets the command prompt. The default prompt is ‘>’.

-R root

Sets root directory for pathname expansion. By default, the root directory is derived from the pathname of the mdb executable itself. The root directory is substituted in place of the %r token during pathname expansion.

-s distance

Sets the symbol matching distance for address-to-symbol-name conversions to the specified distance. By default, mdb sets the distance to zero, which enables a smart-matching mode. Each ELF symbol table entry includes a value V and size S, representing the size of the function or data object in bytes. In smart mode, mdb matches an address A with the
given symbol if A is in the range \([ V, V + S ]\). If any non-zero distance is specified, the same algorithm is used, but S in the expression above is always the specified absolute distance and the symbol size is ignored.

-\(S\)
Suppresses processing of the user’s \(-/.mdbrc\) file. By default, \(mdb\) reads and processes the macro file \(.mdbrc\) if one is present in the user’s home directory, as defined by \$HOME. If the \(-S\) option is present, this file is not read.

-\(u\)
Forces user debugging mode. By default, \(mdb\) attempts to infer whether the object and core file operands refer to a user executable and core dump, or to a pair of operating system crash dump files. The \(-u\) option forces \(mdb\) to assume these files are not operating system crash dump files.

-\(U\)
Unloads kmdb if it is loaded. You should unload kmdb when it is not in use to release the memory used by the kernel debugger back to the free memory available to the operating system.

-\(V\) version
Sets disassembler version. By default, \(mdb\) attempts to infer the appropriate disassembler version for the debug target. The disassembler can be set explicitly using the \(-V\) option. The \(::\text{disasm}\) dcmd lists the available disassembler versions.

-\(w\)
Opens the specified object and core files for writing.

-\(W\)
Permit access to memory addresses that are mapped to I/O devices. By default, \(mdb\) does not allow such access because many devices do not provide hardware protection against invalid software manipulations. Use this option only when debugging device drivers and with caution.

-\(y\)
Sends explicit terminal initialization sequences for tty mode. Some terminals, such as cmdtool(1), require explicit initialization sequences to switch into a tty mode. Without this initialization sequence, terminal features such as standout mode cannot be available to \(mdb\).

**Operands**
The following operands are supported:

-\(object\)
Specifies an ELF format object file to examine. \(mdb\) provides the ability to examine and edit ELF format executables (ET\_EXEC), ELF dynamic library files (ET\_DYN), ELF relocatable object files (ET\_REL), and operating system unix.X symbol table files.
core
Specifies an ELF process core file (ET_CORE), or an operating system crash dump vmcore.X file. If an ELF core file operand is provided without a corresponding object file, mdb attempts to infer the name of the executable file that produced the core using several different algorithms. If no executable is found, mdb still executes, but some symbol information can be unavailable.

suffix
Specifies the numerical suffix representing a pair of operating system crash dump files. For example, if the suffix is '3', mdb infers that it should examine the files 'unix.3' and 'vmcore.3'. If these files do not exist, but 'vmdump.3' does exist, then a message is printed indicating that savecore -f vmdump.3 must be run first in order to uncompress the dump file. The string of digits are not interpreted as a suffix if an actual file of the same name is present in the current directory.

Usage
mdb processes all input files (including scripts, object files, core files, and raw data files) in a large file aware fashion. See largefile(5) for more information about the processing of large files, which are files greater than or equal to 2 Gbytes (2^31 bytes).

Exit Status
The following exit values are returned:

0
Debugger completed execution successfully.

1
A fatal error occurred.

2
Invalid command line options were specified.

Environment Variables

HISTSIZE
This variable is used to determine the maximum length of the command history list. If this variable is not present, the default length is 128.

HOME
This variable is used to determine the pathname of the user's home directory, where a .mdbrc file can reside. If this variable is not present, no .mdbrc processing occurs.

SHELL
This variable is used to determine the pathname of the shell used to process shell escapes requested using the ! meta-character. If this variable is not present, /bin/sh is used.

Files

$HOME/.mdbrc
User mdb initialization file. The .mdbrc file, if present, is processed after the debug target has been initialized, but before module auto-loading is performed or any commands have been read from standard input.

/dev/kmem
Kernel virtual memory image device. This device special file is used as the core file when examining the live operating system.
/dev/ksyms
Kernel symbol table device. This device special file is used as the object file when examining the live operating system.

/proc/pid/*
Process information files that are read when examining and controlling user processes.

/usr/lib/adb
/usr/platform/platform-name/lib/adb
Default directories for macro files that are read with the $< and $<< dcmds. platform-name is the name of the platform, derived either from information in a core file or crash dump, or from the current machine as if by `uname -i` (see `uname(1)`).

/usr/lib/mdb
/usr/platform/platform-name/lib/mdb
Default directories for debugger modules that are loaded using the ::load dcmd. platform-name is the name of the platform, derived either from information in a core file or crash dump, or from the current machine as if by `uname -i` (see `uname(1)`).

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/debug/mdb</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also
adb(1), cmdtool(1), gcore(1), proc(1), pgrep(1), ps(1), stty(1), truss(1), uname(1), coreadm(1M), dumpadm(1M), largefile(5), savecore(1M), exec(2), fork(2), _lwp_self(2), pipe(2), vfork(2), dlopen(3C), elf(3ELF), libc_db(3LIB), libkvm(3LIB), libthread(3LIB), signal(3C), signal.h(3HEAD), thr_self(3C), core(4), proc(4), attributes(5), largefile(5), threads(5), ksym(7D), mem(7D)

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Warnings
Use of the Error Recovery Mechanism
The debugger and its dmodes execute in the same address space, and thus it is quite possible that a buggy dmod can cause mdb to dump core or otherwise misbehave. The mdb resume capability, described above under Signal Handling, provides a limited recovery mechanism for these situations. However, it is not possible for mdb to know definitively whether the dmod in question has corrupted only its own state, or the debugger’s global state. Therefore a resume operation cannot be guaranteed to be safe, or to prevent a subsequent crash of the debugger. The safest course of action following a resume is to save any important debug information, and then quit and restart the debugger.
The use of the debugger to modify (that is, write to) the address space of live running 
operating system is extremely dangerous, and can result in a system panic in the event the user 
damages a kernel data structure.

Notes

Limitations on Examining Process Core Files

mdb does not provide support for examining process core files that were generated by a release 
of Solaris preceding Solaris 2.6. When debugging core files generated by a release of Solaris 9 
or an earlier release, symbol information might not be available. Since the text section and 
read-only data is not present in those core files, the symbol information might not match the 
data present in the process at the time it dumped core. In releases later than Solaris 9, text 
sections and read-only data are included in core files by default. Users can configure their 
processes to exclude that information from core files using `coreadm(1M)`. Thus, the 
information presented by `mdb` for those core files can not match the data that was present at 
the time the process dumped core. Core files from Solaris x86 systems can not be examined on 
Solaris SPARC systems, and vice-versa.

Limitations on Examining Crash Dump Files

Crash dumps from Solaris 7 and earlier releases can only be examined with the aid of the 
libkvm from the corresponding operating system release. If a crash dump from one operating 
system release is examined using the dmods from a different operating system release, changes 
in the kernel implementation can prevent some dcmds or walkers from working properly. `mdb` 
issues a warning message if it detects this condition. Crash dumps from Solaris x86 systems 
can not be examined on Solaris SPARC systems, and vice-versa.

Relationship Between 32-bit and 64-bit Debugger

mdb provides support for debugging both 32-bit and 64-bit programs. Once it has examined 
the target and determined its data model, `mdb` automatically re-executes the `mdb` binary that 
has the same data model as the target, if necessary. This approach simplifies the task of writing 
debugger modules, because the modules that are loaded use the same data model as the 
primary target. Only the 64-bit debugger can be used to debug 64-bit target programs. The 
64-bit debugger can only be used on a system that is running the 64-bit operating 
environment.

The debugger can also need to re-execute itself when debugging a 32-bit process that execs a 
64-bit process, or vice-versa. The handling of this situation is discussed in more detail under 
Interaction with Exec, below.

Interaction with Exec

When a controlled process performs a successful `exec(2)`, the behavior of the debugger is 
controlled by the `: :set -o follow exec mode` option, as described above. If the debugger and 
victim process have the same data model, then the “stop” and “follow” modes determine 
whether `mdb` automatically continues the target or returns to the debugger prompt following 
the exec. If the debugger and victim process have a different data model, then the “follow” 
behavior causes `mdb` to automatically re-exec the `mdb` binary with the appropriate data model 
and to re-attach to the process, still stopped on return from the exec. Not all debugger state is 
preserved across this re-exec.
If a 32-bit victim process execs a 64-bit program, then “stop” returns to the command prompt, but the debugger is no longer able to examine the process because it is now using the 64-bit data model. To resume debugging, execute the ::release -a dcmd, quit mdb, and then execute mdb -p pid to re-attach the 64-bit debugger to the process.

If a 64-bit victim process execs a 32-bit program, then “stop” returns to the command prompt, but the debugger only provides limited capabilities for examining the new process. All built-in dcmds work as advertised, but loadable dcmds do not since they do not perform data model conversion of structures. The user should release and re-attach the debugger to the process as described above in order to restore full debugging capabilities.

**Interaction with Job Control**

If the debugger is attached to a process that is stopped by job control (that is, it stopped in response to SIGTSTP, SIGTTIN, or SIGTTOU), the process can not be able to be set running again when it is continued by a continue dcmd. If the victim process is a member of the same session (that is, it shares the same controlling terminal as mdb), mdb attempts to bring the associated process group to the foreground and to continue the process with SIGCONT to resume it from job control stop. When mdb is detached from such a process, it restores the process group to the background before exiting. If the victim process is not a member of the same session, mdb cannot safely bring the process group to the foreground, so it continues the process with respect to the debugger, but the process remains stopped by job control. mdb prints a warning in this case, and the user must issue an “fg” command from the appropriate shell in order to resume the process.

**Process Attach and Release**

When mdb attaches to a running process, the process is stopped and remains stopped until one of the contain objects dcmds is applied, or the debugger quits. If the -o nostop option is enabled prior to attaching the debugger to a process with -p, or prior to issuing an :attach or :A command, mdb attaches to the process but does not stop it. While the process is still running, it can be inspected as usual (albeit with inconsistent results) and breakpoints or other tracing flags might be enabled. If the :c or ::cont dcmds are executed while the process is running, the debugger waits for the process to stop. If no traced software events occur, the user can send an interrupt (^C) after :c or ::cont to force the process to stop and return control to the debugger.

mdb releases the current running process (if any) when the :R, ::release, :r, ::run, $q, or ::quit dcmds are executed, or when the debugger terminates as the result of an EOF or signal. If the process was originally created by the debugger using :r or ::run, it is forcibly terminated as if by SIGKILL when it is released. If the process was already running prior to attaching mdb to it, it is set running again when it is released. A process can be released and left stopped and abandoned using the ::release -a option.

**Symbolic Debugging Information**

The ::list, ::offsetof, ::print, and ::sizeof dcmds require that one or more load objects contain compressed symbolic debugging information suitable for use with mdb. This information is currently only available for certain Solaris kernel modules.
The *Oracle Solaris Modular Debugger Guide* provides a more detailed description of `mdb` features, as well as information for debugger module developers.

The header file `<sys/mdb_modapi.h>` contains prototypes for the functions in the MDB Module API, and the `/source/demo/mdb-examples` package provides source code for an example module in the directory `/usr/demo/mdb`. 
Name  mesg – permit or deny messages

Synopsis  mesg [-n | -y | n | y]

Description  The mesg utility will control whether other users are allowed to send messages via write(1), talk(1), or other utilities to a terminal device. The terminal device affected is determined by searching for the first terminal in the sequence of devices associated with standard input, standard output, and standard error, respectively. With no arguments, mesg reports the current state without changing it. Processes with appropriate privileges may be able to send messages to the terminal independent of the current state.

Options  The following options are supported:
  -n|n  Denies permission to other users to send message to the terminal. See write(1).
  -y|y  Grants permission to other users to send messages to the terminal.

Environment Variables  See environ(5) for descriptions of the following environment variables that affect the execution of mesg: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status  The following exit values are returned:
  0  if messages are receivable.
  1  if messages are not receivable.
  2  on error.

Files  /dev/tty*  terminal devices
       /dev/pts/*  terminal devices

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also  talk(1), write(1), attributes(5), environ(5), standards(5)
The `mkdir` command creates the named directories in mode 777 (possibly altered by the file mode creation mask `umask(1)`).

Standard entries in a directory (for instance, the files “.”, for the directory itself, and “..”, for its parent) are made automatically. `mkdir` cannot create these entries by name. Creation of a directory requires write permission in the parent directory.

The owner-ID and group-ID of the new directories are set to the process’s effective user-ID and group-ID, respectively. `mkdir` calls the `mkdir(2)` system call.

To change the setgid bit on a newly created directory, you must use `chmod g+s` or `chmod g-s` after executing `mkdir`.

The setgid bit setting is inherited from the parent directory.

### Options

- `-m mode` This option allows users to specify the mode to be used for new directories. Choices for modes can be found in `chmod(1)`.

- `-p` With this option, `mkdir` creates `dir` by creating all the non-existing parent directories first. The mode given to intermediate directories is the difference between 777 and the bits set in the file mode creation mask. The difference, however, must be at least 300 (write and execute permission for the user).

### Operands

The following operand is supported:

- `dir` A path name of a directory to be created.

### Usage

See `largefile(5)` for the description of the behavior of `mkdir` when encountering files greater than or equal to 2 Gbyte ($2^{31}$ bytes).

### Examples

#### EXAMPLE 1 Using `mkdir`

The following example:

```bash
example% mkdir -p ltr/jd/jan
```

creates the subdirectory structure `ltr/jd/jan`.

### Environment Variables

See `environ(5)` for descriptions of the following environment variables that affect the execution of `mkdir`: `LANG`, `LC_ALL`, `LC_CTYPE`, `LC_MESSAGES`, and `NLSPATH`.

### Exit Status

The following exit values are returned:

- `0` All the specified directories were created successfully or the `-p` option was specified and all the specified directories now exist.
>0 An error occurred.

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also chmod(1), rm(1), sh(1), umask(1), Intro(2), mkdir(2), attributes(5), environ(5), largefile(5), standards(5)
The `mkmsgs` utility is used to create a file of text strings that can be accessed using the text retrieval tools (see `gettext(1)`, `srchtxt(1)`, `exstr(1)`, and `gettext(3C)`). It will take as input a file of text strings for a particular geographic locale (see `setlocale(3C)`) and create a file of text strings in a format that can be retrieved by both `gettext(1)` and `gettext(3C)`. By using the `-i` option, you can install the created file under the `/usr/lib/locale/locale/LC_MESSAGES` directory (locale corresponds to the language in which the text strings are written).

`inputstrings` is the name of the file that contains the original text strings. `msgfile` is the name of the output file where `mkmsgs` writes the strings in a format that is readable by `gettext(1)` and `gettext(3C)`. The name of `msgfile` can be up to 14 characters in length, but may not contain either `\0` (null) or the ASCII code for `/` (slash) or `:` (colon).

The input file contains a set of text strings for the particular geographic locale. Text strings are separated by a newline character. Nongraphic characters must be represented as alphabetic escape sequences. Messages are transformed and copied sequentially from `inputstrings` to `msgfile`. To generate an empty message in `msgfile`, leave an empty line at the correct place in `inputstrings`.

Strings can be changed simply by editing the file `inputstrings`. New strings must be added only at the end of the file; then a new `msgfile` file must be created and installed in the correct place. If this procedure is not followed, the retrieval function will retrieve the wrong string and software compatibility will be broken.

The following options are supported:

- `-o` Overwrite `msgfile`, if it exists.
- `-i locale` Install `msgfile` in the `/usr/lib/locale/locale/LC_MESSAGES` directory. Only someone who is super user or a member of group `bin` can create or overwrite files in this directory. Directories under `/usr/lib/locale` will be created if they do not exist.

The following example shows an input message source file `C.str`:

```
File %s:\t cannot be opened
%s: Bad directory
.
.
write error
.
```

**Examples**

**EXAMPLE 1** Using the `mkmsgs` command.

The following example shows an input message source file `C.str`:
EXAMPLE 2  Using Input Strings From C.str to Create Text Strings in a File

The following command uses the input strings from C.str to create text strings in the appropriate format in the file UX in the current directory:

```
example% mkmsgs C.str UX
```

EXAMPLE 3  Using Input Strings From FR.str to Create Text Strings in a File

The following command uses the input strings from FR.str to create text strings in the appropriate format in the file UX in the directory /usr/lib/locale/fr/LC_MESSAGES:

```
example% mkmsgs -i fr FR.str UX
```

These text strings would be accessed if you had set the environment variable LC_MESSAGES=fr and then invoked one of the text retrieval tools listed at the beginning of the DESCRIPTION section.

Files  /usr/lib/locale/locale/LC_MESSAGES/*  message files created by `mkmsgs`

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>text/locale</td>
</tr>
</tbody>
</table>

See Also  `exstr(1), gettxt(1), srchtxt(1), gettxt(3C), setlocale(3C), attributes(5)`
mkstr (1B)

Name  mkstr – create an error message file by massaging C source files

Synopsis  /usr/ucb/mkstr [-] messagefile prefix filename...

Description  The mkstr utility creates files of error messages. You can use mkstr to make programs with large numbers of error diagnostics much smaller, and to reduce system overhead in running the program — as the error messages do not have to be constantly swapped in and out.

mkstr processes each of the specified filenames, placing a massaged version of the input file in a file with a name consisting of the specified prefix and the original source file name. A typical example of using mkstr would be:

mkstr pistrings processed *.c

This command would cause all the error messages from the C source files in the current directory to be placed in the file pistrings and processed copies of the source for these files to be placed in files whose names are prefixed with processed.

To process the error messages in the source to the message file, mkstr keys on the string ‘error(’ in the input stream. Each time it occurs, the C string starting at the ‘(’ is placed in the message file followed by a null character and a NEWLINE character; the null character terminates the message so it can be easily used when retrieved, the NEWLINE character makes it possible to sensibly cat the error message file to see its contents. The massaged copy of the input file then contains a lseek pointer into the file which can be used to retrieve the message, that is:

```c
char efilname[] = "/usr/lib/pi_strings";
int efil = -1;

error(a1, a2, a3, a4)
{

    char
    buf[256];
    if (efil < 0) {
        efil = open(efilname, 0);
        if (efil < 0) {
            oops:
                perror (efilname);
                exit (1);
        }
    }
    if (lseek(efil, (long) a1, 0) | | read(efil, buf, 256) <= 0)
        goto oops;
    printf(buf, a2, a3, a4);

```
Options  — Place error messages at the end of the specified message file for recompiling part of a large mkstred program.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>

See Also  xstr(1), attributes(5)
The `mktemp` utility makes a temporary filename. To do this, `mktemp` takes the specified filename template and overwrites a portion of it to create a unique filename. See OPERANDS.

The template is converted to a path name using the `mktemp(3C)`, `mkdtemp(3C)`, `mkstemp(3C)`, and `mkstemps(3C)` library functions.

If `mktemp` can successfully generate a unique filename, the file (or directory) is created with file permissions such that it is only readable and writable by its owner (unless the -u flag is given) and the filename is printed to standard output.

`mktemp` allows shell scripts to safely use temporary files. Traditionally, many shell scripts take the name of the program with the PID as a suffix and used that as a temporary filename. This kind of naming scheme is predictable and the race condition it creates is easy for an attacker to win. A safer, though still inferior approach is to make a temporary directory using the same naming scheme. While this guarantees that a temporary file is not subverted, it still allows a simple denial of service attack. Use `mktemp` instead.

The following options are supported:

- `-d`, `--directory`  
  Make a directory instead of a file.

- `-p directory`  
  Use the specified directory as a prefix when generating the temporary filename. The directory is overridden by the user’s `TMPDIR` environment variable if it is set. This option implies the -t flag.

- `-q`, `--quiet`  
  Fail silently if an error occurs. This is useful if a script does not want error output to go to standard error.

- `--suffix=suff`  
  Append `suff` to the template. `suff` must not contain a slash (`/`). This option is implied when the template ends in characters other than replaceable X characters, and does not remove the requirement to include such X characters.

- `--tmpdir=[dir]`  
  'template' is relative to `dir`. If `dir` is not specified, the user’s environment variable `TMPDIR` is used if set, else `/tmp` is used. This option does not support a template with an absolute name and unlike with the use of -t, a template may contain slashes.

- `-t`  
  Generate a path rooted in a temporary directory. This directory is chosen as follows: If the user’s `TMPDIR` environment variable is set, the directory contained therein is used.
Otherwise, if the `-p` flag was given the specified directory is used. If none of the above apply, /tmp is used. In this mode, the template (if specified) should be a directory component (as opposed to a full path) and thus should not contain any forward slashes.

`-u, --dry-run`

Operate in unsafe mode. The temp file is unlinked before `mktemp` exits. This is slightly better than `mktemp(3C)`, but still introduces a race condition. Use of this option is discouraged.

**Operands**
The following operands are supported:

- `template`

  `template` can be any filename with three to six Xs included in it, for example `/tmp/tfile.XXXXXX`.

  If `template` is not specified, a default of `tmp.XXXXXX` is used and the `-t` flag is implied.

  If `template` has multiple series of Xs, the final series is used for the replacement text, unless `--suffix` specifies otherwise.

  If `template` has characters after the final set of Xs, then the `--suffix` option is implied to be all such characters, unless explicitly specified.

**Examples**

**EXAMPLE 1** Using `mktemp`

The following example illustrates a simple use of `mktemp` in a `sh(1)` script. In this example, the script quits if it cannot get a safe temporary file.

```
TMPFILE=`mktemp /tmp/example.XXXXXX`
if [ -z "$TMPFILE" ]; then exit 1; fi
echo "program output" >> $TMPFILE
```

**EXAMPLE 2** Using `mktemp` to Support `TMPDIR`

The following example uses `mktemp` to support for a user's `TMPDIR` environment variable:

```
TMPFILE=`mktemp -t example.XXXXXX`
if [ -z "$TMPFILE" ]; then exit 1; fi
echo "program output" >> $TMPFILE
```

**EXAMPLE 3** Using `mktemp` Without Specifying the Name of the Temporary File

The following example uses `mktemp` without specifying the name of the temporary file. In this case the `-t` flag is implied.

```
TMPFILE=`mktemp`
if [ -z "$TMPFILE" ]; then exit 1; fi
echo "program output" >> $TMPFILE
```
EXAMPLE 4 Using mktemp with a Default Temporary Directory Other than /tmp

The following example creates the temporary file in /extra/tmp unless the user’s TMPDIR environment variable specifies otherwise:

TMPFILE=`mktemp -p /extra/tmp example.XXXXX`
if [ -z "$TMPFILE" ]; then exit 1; fi
echo "program output" >> $TMPFILE

EXAMPLE 5 Using mktemp to Remove a File

The following example attempts to create two temporary files. If creation of the second temporary file fails, mktemp removes the first file before exiting:

TMP1=`mktemp -t example.1.XXXXX`
if [ -z "$TMP1" ]; then exit 1; fi
TMP2=`mktemp -t example.2.XXXXX`
if [ -z "$TMP2" ]; then
   rm -f $TMP1
   exit 1
fi

EXAMPLE 6 Using mktemp

The following example does not exit if mktemp is unable to create the file. That part of the script has been protected.

TMPFILE=`mktemp -q -t example.XXXXX`
if [ ! -z "$TMPFILE" ]
then
   # Safe to use $TMPFILE in this block
   echo data > $TMPFILE
   ...
   rm -f $TMPFILE
fi

EXAMPLE 7 Using mktemp with Suffix Option

The following command illustrates the use of the suffix option. The effect of this command is to create the temporary file ex.q5N.SUFF.

# mktemp --suffix=.SUFF ex.XXXXX
ex.q5Nqid.SUFF

EXAMPLE 8 Using Suffix and Tmpdir Options

The following command illustrates the use of the suffix and tmpdir options.

# mktemp --tmpdir=$HOME --suffix=.bar foo.XXXXX
/root/foo.7Za0_N.bar
EXAMPLE 9  Using Directory and Suffix Options

The following command uses both the directory and suffix options.

```
# mktemp --directory --suffix=.bar foo.XXXXXX
```

```
foo.GSa03d.bar
```

```
# ls -l
```

```
-rwx------  2 root staff 512 Mar 19 2012 foo.GSa0.bar
```

EXAMPLE 10  Supporting a Template with Non-Trailing Xs

The following command shows the use of the directory option with non-trailing X characters. In this command, the --suffix=suff option is implied, where bar is used as the suffix.

```
# mktemp XXfooXXXXXXbar
XXfooaFY0N6bar
```

EXAMPLE 11  Using the Quiet and Tmpdir Options

The following command illustrates the use of the quiet and tmpdir options.

```
# mktemp --quiet --tmpdir=/tmp foo
```

[No diagnostic message is returned]

EXAMPLE 12  Using mktemp with Multiple Options

The following command combines the use of the dry-run, tmpdir, and suffix options.

```
# mktemp --dry-run --tmpdir=$HOME --suffix=SUFF
```

```
/root/tmp.qdaGcOSUFF
```

```
# ls -l /root/tmp.qdaGcOSUFF
```

```
/root/tmp.qdaGcOSUFF: No such file or directory
```

Environment Variables

See environ(5) for descriptions of the following environment variables that affect the execution of mktemp with the -t option: TMPDIR.

- `TMPDIR`  Name a directory used for creating temporary files to override system default; used by mktemp.

Exit Status  The following exit values are returned:

- `0`  Successful completion.
- `1`  An error occurred.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>
The `mktemp` utility appeared in OpenBSD 2.1. The Solaris implementation uses only as many 'Xs' as are significant for `mktemp(3C)`, `mkstemp(3C)`, and `mkstemps(3C)`. 

**Attributes**

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

**See Also**  
`sh(1), mkdtemp(3C), mkstemp(3C), mkstemps(3C), mktemp(3C), attributes(5), environ(5)`

**Notes**  
The `mktemp` utility appeared in OpenBSD 2.1. The Solaris implementation uses only as many 'Xs' as are significant for `mktemp(3C)`, `mkstemp(3C)`, and `mkstemps(3C)`.
moe – manifest the optimal expansion of a pathname

Synopsis

moe [-c] [-32 | -64] [-s | -v] path

Description

The `moe` utility manifests the optimal expansion of a pathname containing reserved runtime linker tokens. These tokens can be used to define dependencies, filters, and runpaths within dynamic objects. The expansion of these tokens at runtime, provides a flexible mechanism for selecting objects and search paths that perform best on this machine. See `ld.so.1(1)`.

For example, the token `$HWCAP` can be employed to represent filters and dependencies. The runtime interpretation of this token can result in a family of objects that are analyzed to determine their applicability for loading with a process. The objects are sorted based on the hardware capabilities that each object requires to execute. `moe` returns the name of the object optimally suited for execution on the current platform.

`moe` analyzes a pathname by passing the supplied `path` to `dlopen(3C)`, together with the `RTLD_FIRST` flag. Reserved token expansion is therefore carried out by `ld.so.1` as the expansion would occur in an executing process. Although multiple objects can be analyzed as a result of the `dlopen(1)` call, the `RTLD_FIRST` flag insures only the optimal object is processed.

By default, `moe` analyzes the specified `path` twice. The first analysis looks for 32–bit objects. The second analysis, if applicable, looks for 64–bit objects. Typically, 32–bit objects and 64–bit objects are isolated to different directories. These directories are frequently named to reflect the class of object the directory contains. The multiple passes of `moe` catch any instances where 32–bit objects and 64–bit objects occupy the same directory. Multiple passes also provide flexibility when the pathname that is specified does not convey to the user the class of object the directory might contain.

For a complete description of the reserved token expansion carried out by the runtime linker, refer to the `Linker and Libraries Guide`.

Options

The following options are supported:

- `-32` Only analyze 32–bit objects.
- `-64` Only analyze 64–bit objects.
- `-c` Prefix each pathname with the class of the object.
- `-s` Silent. No optimal name, or error diagnostics are displayed. Only an error return is made available. This option is only meaningful with the `32` and `64` options. The `-s` option can not be used with the `-v` option.
- `-v` Verbose. If no optimal expansion name can be determined, an error diagnostic is written to standard error. The `-v` option can not be used with the `-s` option.

Operands

The following operand is supported:

`path` The pathname to be expanded.
moe(1)

Examples  The following example uses `moe` to display the optimal expansion of objects in the directory `/usr/lib/libc`. This directory contains a family of Intel objects that are built to use various hardware capabilities.

% moe '/usr/lib/libc/$HWCAP'
/usr/lib/libc/libc_hwcap.so.1

The `-c` option can be used to clarify the class of the optimal object.

% moe -c '/usr/lib/libc/$HWCAP'
32-bit: /usr/lib/libc/libc_hwcap.so.1

The following example uses `moe` to display the optimal expansion of objects under the `/opt/ISV/cpu` directory hierarchy. These directories contain a family of SPARC objects that are built for various platforms.

% moe -c -64 '/opt/ISV/$ISALIST/isa.so.1'
64-bit: /opt/ISV/sparcv9/isa.so.1

The `-v` can be used to diagnose the instance where an optimal name is not returned. An attempt to inspect the previous pathname as a 32-bit object, would result in the following diagnostic being produced.

% moe -c -v -32 '/opt/ISV/$ISALIST/isa.so.1'
32-bit: /opt/ISV/sparcv9/isa.so.1: wrong ELF class: ELFCLASS64

Exit Status  When the `-32` or `-64` options are in effect, a successful optimal expansion returns 0, otherwise non-zero. Without the `-32` or `-64` options in effect, the return value is always 0.

Attributes  See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/linker</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  `ld.so.1(1), optisa(1), isalist(1), dlmalloc(3C), attributes(5)`

Linker and Libraries Guide
Name  more, page – browse or page through a text file

Synopsis
/usr/bin/more [-cdflrsuw] [-lines] [+ linenum] 
    [+ pattern] [file]...
/usr/bin/page [-cdflrsuw] [-lines] [+ linenum] 
    [+ pattern] [file]...
/usr/xpg4/bin/more [-cdeisu] [-n number] [-p command] 
    [-t tagstring] [file]...
/usr/xpg4/bin/more [-cdeisu] [-n number] [+ command] 
    [-t tagstring] [file]...

Description
The more utility is a filter that displays the contents of a text file on the terminal, one screenful at a time. It normally pauses after each screenful. /usr/bin/more then prints --More-- and /usr/xpg4/bin/more then prints file at the bottom of the screen. If more is reading from a file rather than a pipe, the percentage of characters displayed so far is also shown.

The more utility scrolls up to display one more line in response to a RETURN character. more displays another screenful in response to a SPACE character. Other commands are listed below.

The page utility clears the screen before displaying the next screenful of text. page only provides a one-line overlap between screens.

The more utility sets the terminal to NOECHO mode, so that the output can be continuous. Commands that you type do not normally show up on your terminal, except for the / and ! commands.

The /usr/bin/more utility exits after displaying the last specified file. /usr/xpg4/bin/more prompts for a command at the last line of the last specified file.

If the standard output is not a terminal, more acts just like cat(1), except that a header is printed before each file in a series.

Options
The following options are supported for both /usr/bin/more and /usr/xpg4/bin/more:

-c       Clears before displaying. Redraws the screen instead of scrolling for faster displays. This option is ignored if the terminal does not have the ability to clear to the end of a line.

-d       Displays error messages rather than ringing the terminal bell if an unrecognized command is used. This is helpful for inexperienced users.

-s       Squeeze. Replaces multiple blank lines with a single blank line. This is helpful when viewing nroff(1) output on the screen.

The following options are supported for /usr/bin/more only:

-f       Does not fold long lines. This is useful when lines contain nonprinting characters or escape sequences, such as those generated when nroff(1) output is piped through ul(1).
-l  Does not treat FORMFEED characters (Control-l) as page breaks. If -l is not used, more pauses to accept commands after any line containing a ^L character (Control-l). Also, if a file begins with a FORMFEED, the screen is cleared before the file is printed.

- r  Normally, more ignores control characters that it does not interpret in some way. The - r option causes these to be displayed as ^C where C stands for any such control character.

- u  Suppresses generation of underlining escape sequences. Normally, more handles underlining, such as that produced by nroff(1), in a manner appropriate to the terminal. If the terminal can perform underlining or has a stand-out mode, more supplies appropriate escape sequences as called for in the text file.

- w  Normally, more exits when it comes to the end of its input. With -w, however, more prompts and waits for any key to be struck before exiting.

-lines  Displays the indicated number of lines in each screenful, rather than the default (the number of lines in the terminal screen less two).

+linenumber  Start up at linenumbe.

+/pattern  Start up two lines above the line containing the regular expression pattern. Note: Unlike editors, this construct should not end with a '/'. If it does, then the trailing slash is taken as a character in the search pattern.

The following options are supported for /usr/xpg4/bin/more only:
- e  Exits immediately after writing the last line of the last file in the argument list.
- i  Performs pattern matching in searches without regard to case.
- n number  Specifies the number of lines per screenful. The number argument is a positive decimal integer. The -n option overrides any values obtained from the environment.

-p command +command  For each file examined, initially executes the more command in the command argument. If the command is a positioning command, such as a line number or a regular expression search, set the current position to represent the final results of the command, without writing any intermediate lines of the file. For example, the two commands:

more -p 1000j file
more -p 1000G file

are equivalent and start the display with the current position at line 1000, bypassing the lines that j would write and scroll off the screen if it had been
issued during the file examination. If the positioning command is unsuccessful, the first line in the file will be the current position.

-t tagstring  Writes the screenful of the file containing the tag named by the tagstring argument. See the ctags(1) utility.

-u  Treats a backspace character as a printable control character, displayed as a ^H (Control-h), suppressing backspacing and the special handling that produces underlined or standout-mode text on some terminal types. Also, does not ignore a carriage-return character at the end of a line.

If both the -t tagstring and -p command (or the obsolescent +command) options are given, the -t tagstring is processed first.

Usage

Environment  more uses the terminal’s terminfo(4) entry to determine its display characteristics.

more looks in the environment variable MORE for any preset options. For instance, to page through files using the -c mode by default, set the value of this variable to -c. (Normally, the command sequence to set up this environment variable is placed in the .login or .profile file).

Commands  The commands take effect immediately. It is not necessary to type a carriage return unless the command requires a file, command, tagstring, or pattern. Up to the time when the command character itself is given, the user may type the line kill character to cancel the numerical argument being formed. In addition, the user may type the erase character to redisplay the ‘-More - (xx%)’ or file message.

In the following commands, i is a numerical argument (1 by default).

!SPACE  Display another screenful, or i more lines if i is specified.

!RETURN  Display another line, or i more lines, if specified.

!b  (Control-b) Skip back i screenfuls and then print a screenful.

!d  (Control-d) Scroll forward one half screenful or i more lines. If i is specified, the count becomes the default for subsequent d and u commands.

!f  Skip i screens full and then print a screenful.

h  Help. Give a description of all the more commands.

^L  (Control-l) Refresh.

!n  Search for the i th occurrence of the last pattern entered.
q
Q
Exit from more.
is
Skip i lines and then print a screenful.
v
Drop into the vi editor at the current line of the current file.
iz
Same as SPACE, except that i, if present, becomes the new default number of
lines per screenful.
=
Display the current line number.
i/pattern
Search forward for the i th occurrence of the regular expression pattern. Display
the screenful starting two lines before the line that contains the i th match for the
regular expression pattern, or the end of a pipe, whichever comes first. If more is
displaying a file and there is no match, its position in the file remains unchanged.
Regular expressions can be edited using erase and kill characters. Erasing back
past the first column cancels the search command.
!command
Invoke a shell to execute command . The characters % and !, when used within
command are replaced with the current filename and the previous shell
command, respectively. If there is no current filename, % is not expanded.
Prepend a backslash to these characters to escape expansion.
:f
Display the current filename and line number.
i:n
Skip to the i th next filename given in the command line, or to the last filename
in the list if i is out of range.
i:p
Skip to the i th previous filename given in the command line, or to the first
filename if i is out of range. If given while more is positioned within a file, go to
the beginning of the file. If more is reading from a pipe, more simply rings the
terminal bell.
:q
:Q
Exit from more (same as q or Q).
/usr/bin/more The following commands are available only in /usr/bin/more:
'
Single quote. Go to the point from which the last search started. If no search has been
performed in the current file, go to the beginning of the file.
.
Dot. Repeat the previous command.
^\Halt a partial display of text. more stops sending output, and displays the usual
--More-- prompt. Some output is lost as a result.

/usr/xpg4/bin/more The following commands are available only in /usr/xpg4/bin/more:
i^F
(Control-f) Skip i screens full and print a screenful. (Same as if.)
^G (Control-g) Display the current line number (same as =).
ig Go to line number i with the default of the first line in the file.
iG Go to line number i with the default of the Last line in the file.
iJ Display another line, or i more lines, if specified. (Same as iRETURN.)
iK Scroll backwards one or i lines, if specified.
ml etter Mark the current position with the name letter.
N Reverse direction of search.
r Refresh the screen.
R Refresh the screen, discarding any buffered input.
iu i^U (Control-u) Scroll backwards one half a screen of i lines, if specified. If i is specified, the count becomes the new default for subsequent d and u commands.
ZZ Exit from more (same as q).
:e file Examine (display) a new file. If no file is specified, the current file is redisplayed.
:t tagstring Go to the tag named by the tagstring argument and scroll/rewrite the screen with the tagged line in the current position. See the ctags utility.
'letter Return to the position that was previously marked with the name letter.
'' Return to the position from which the last move of more than a screenful was made. Defaults to the beginning of the file.
i?![pattern] Search backward in the file for the i them containing the pattern. The ! specifies to search backward for the i line that does not contain the pattern.
i!/pattern Search forward in the file for the i line that does not contain the pattern.
i[command] Invokes a shell or the specified command.

Large File Behavior
See largefile(5) for the description of the behavior of more and page when encountering files greater than or equal to 2 Gbyte (2^{31} bytes).

Environment Variables
See environ(5) for descriptions of the following environment variables that affect the execution of more: LANG, LC_ALL, LC_COLLATE (/usr/xpg4/bin/more only), LC_CTYPE, LC_MESSAGES, NLSPATH, and TERM.

/usr/xpg4/bin/more The following environment variables also affect the execution of /usr/xpg4/bin/more:
COLUMNS Overrides the system selected horizontal screen size.
EDITOR Used by the `v` command to select an editor.

LINES Overrides the system selected vertical screen size. The `-n` option has precedence over LINES in determining the number of lines in a screen.

MORE A string specifying options as described in the OPTIONS section, above. As in a command line, the options must be separated by blank characters and each option specification must start with a `-`. Any command line options are processed after those specified in MORE as though the command line were: more $MORE options operands

Exit Status The following exit values are returned:

0 Successful completion.

>0 An error occurred.

Files `/usr/lib/more.help` help file for `/usr/bin/more` and `/usr/bin/page` only.

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>/usr/bin/more</th>
<th>/usr/bin/page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATTRIBUTE TYPE</td>
<td>ATTRIBUTE VALUE</td>
</tr>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Not enabled</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>/usr/xpg4/bin/more</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATTRIBUTE TYPE</td>
</tr>
<tr>
<td>Availability</td>
</tr>
<tr>
<td>CSI</td>
</tr>
<tr>
<td>Interface Stability</td>
</tr>
<tr>
<td>Standard</td>
</tr>
</tbody>
</table>

See Also `cat(1), csh(1), ctags(1), man(1), nroff(1), script(1), sh(1), ul(1), terminfo(4), attributes(5), environ(5), largefile(5), standards(5)`

Notes `/usr/bin/more` Skipping backwards is too slow on large files.
This utility will not behave correctly if the terminal is not set up properly.
The `mp` program, when called without the -D or -P option, reads each `filename` in sequence and generates a prettified version of the contents in PostScript™ format, sent to standard output. If no filename argument is provided, `mp` reads the standard input. If the standard input is a terminal, input is terminated by an EOF signal, usually Control-d.

The -D and -P options require the target printer name as an argument and produce the Page Description Language (PDL) of the target printer. The -D option causes the PDL to output to stdout and the -P option causes the PDL to be directly spooled to the printer. In the absence of these options, `mp` will produce default PostScript output.

The `mp` program accepts international text files of various Solaris locales and produces output which is proper for the specified locale. The output will also contain proper text layout. For instance, the output will contain bidirectional text rendering, and also shaping, since the complex text layout (CTL) is supported in `mp`.

Mail items, news articles, ordinary ASCII files, complete mail folders, and digests are all acceptable input formats for `mp`. The output format includes grayscale lozenges, or the outline of the same dimensions as the lozenges, containing banner information at the top and bottom of every page.

### Options

The following options are supported:

- **-a**
  Formats the file as a news article. The top banner contains the text: "Article from newsgroup", where newsgroup is the first news group found on the "Newsgroups:" line.

- **-A**
  Uses A4 paper size (8.26 x 11.69 inches).

- **-c chars**
  The maximum number of characters to extract from the gecos field of the user's `/etc/passwd` entry. The default is 18.

- **-C**
  Instead of using "$From" to denote the start of new mail messages, `mp` will look for (and use) the value of the `Content-Length` mail header. If the Content-Length doesn't take you to the next "$From", then it is wrong, and `mp` falls back to looking for the next "$From" in the mail folder.

- **-d**
  Formats the file as a digest.

---

**Name**

`mp` - text to PDL (Page Description Language) pretty print filter

**Synopsis**

-D target_printer_name  Produces the PDL for the target printer. Requires X Print Server connection. target_printer_name can be either printer_name@machine[:display_number] or just printer_name. In the first form, mp tries to connect to the X Print Server display machine[:display_number] with the target printer as printer_name.

-e  Assumes the ELM mail frontend intermediate file format. Used when printing messages from within ELM (using the "p" command), especially for printing tagged messages. This option must be specified in your ELM option setup.

-ff  Formats the file for use with a Filofax personal organizer.

-fp  Formats the file for use with a Franklin Planner personal organizer.

-F  Instead of printing who the mail article is for, the top header will contain who the mail article is from. A useful option for people with their own personal printer.

-ll  Formats output in landscape mode. One page of text will be printed per sheet of paper.

-L localename  Provides the locale of the file to be printed. If this command line option is not present, then mp looks for the MP_LANG environment variable. If that is not present, the LANG environment variable is used. If none of these options are present, mp tries to determine the locale it is running in. If it cannot determine the locale, mp assumes it is running in the C locale.

-m  Formats the file as a mail folder, printing multiple messages.

-M  Forces mp to use the mp.conf file for printing output even if a prologue.ps file exists for that locale. Useful when printing to non-native PostScript printers.

-n  Turns off the gray bars and associated information from header and footer. Used to get output similar to output of 'lp filename'.

-o  Formats the file as an ordinary ASCII file.

-p prologue  Employs the file prologue as the PostScript/Xprt prologue file, overriding any previously defined file names. This file specifies the format of the print output. For PostScript output, the prologue file
will have a .ps extension. For Xprt clients (when the -D option is specified), this file will have an .xpr extension. These files are defined in the SUPPLIED PROLOGUE FILES section below.

-P target_spool_printer  Spools the PDL to the target printer. No output is sent to stdout. Requires X Print Server connection. target_spool_printer can be either printer_name@machine[:display_number] or just printer_name. In the first form, mp tries to connect to the display machine[:display_number] with the target printer as printer_name.

-PS  If the mail or digest message just has PostScript as the text of the message, this is normally just passed straight through. Specifying this option causes PostScript to be printed as text.

-s subject  Uses subject as the new subject for the printout. If you are printing ordinary ASCII files that have been specified on the command line, the subject will default to the name of each of these files.

-tm  Formats the file for use with the Time Manager personal organizer.

ts  Formats the file for use with the Time/System International personal organizer.

-US  Uses US paper size (8.5 x 11 inches). This is the default paper size.

-u config_file_path  Specifies an alternate configuration file to the default file /usr/lib/lp/locale/locale_name/mp/mp.conf. The absolute file path name must be used.

-v  Prints the version number of this release of mp.

-w words  The maximum number of words to extract from the gecos field of the user's /etc/passwd entry. The default is 3.

-z point_size  Prints the output text in the point size specified by point_size. The internal default is 12 points for portrait printing and 9 points for landscape printing.

-?  Prints the usage line for mp. Notice that the ? character must be escaped if using csh(1).

Operands  The following operand is supported:

filename  The name of the file to be read.

Examples  The mp print filter can be used to print files in any locale that is installed in the user's machine.
EXAMPLE 1  Printing Japanese text files

Japanese text files encoded in the euc codeset can be printed in any non-Japanese PostScript printers by entering:

```
example%  mp -L ja_JP.eucJP -M ja_JP_eucJP.txt | lp
```

Here, the `-L` option specifies the locale and the `-M` option invokes the `mp.conf` configuration file instead of the default `prolog.ps` file. In the case of `ja_JP.eucJP`, both

```
/usr/lib/lp/locale/ja_JP.eucJP/mp/mp.conf and
/usr/openwin/lib/locale/ja_JP.eucJP/print/prolog.ps
```

files are present. Therefore, the `-M` option is used to override the precedence of the default `prolog.ps` file. Using `mp.conf` as the configuration file makes it possible to print to any PostScript printer.

The encoding of the locale specified by the `-L` option and that of the text file to be printed have to be the same. In the above Japanese file example, if the text file is encoded in Shift-JIS, use the following command, since the locale `ja_JP.PCK` is encoded in SJIS:

```
example%  mp -L ja_JP.PCK -M SJIS.txt | lp
```

EXAMPLE 2  Running in Xprt mode

If an X Print Server daemon (`/usr/openwin/bin/Xprt`) is running in any system in the network, `mp` can be invoked as follows, enabling it to output in any Page Description Language supported by Xprt (the default value of `display_number` is 2100):

```
example%  setenv XPSERVERLIST "machine1[:display_number1] \n           machine2[:display_number2] machine3[:display_number3]"
```

or

```
example%  setenv XPDISPLAY machine_name[:display_number]
```

Using the options `-D printer_name[@machine[:display_number]]` or `-P printer_name[@machine[:display_number]]` gives the greatest precedence and `mp` tries to connect to Xprt running on `machine[:display_number]` with `printer_name`. When not specified, the default `display_number` value is 2100. If this fails, `printer_name` is tried with an Xprt display obtained from the following logic. The following is also valid if you enter only `-D printer_name` or `-P printer_name` on the command line.

`mp` checks `XPSERVERLIST` for a list of space-separated Xprt servers until it finds one which supports the `printer_name` argument. If none is found, `mp` checks the `XPDISPLAY` environment variable, which is of the form `machine[:display_number]`. If that is also not set or not valid, `mp` tries to connect to the default display, :2100. If that is also not successful, `mp` exits with an error message.

To pipe the data to the target printer when `XPSERVERLIST` or `XPDISPLAY` is set, enter:
EXAMPLE 2  Running in Xprt mode  (Continued)

eample% mp -D printer_name -L ja_JP.eucJP \ 
   -M ja_JP_eucJP.txt | lp -d printer_name

For direct spooling when working in Xprt client mode, use the -P option:

eample% mp -P printer_name -L ja_JP.eucJP -M ja_JP_eucJP.txt

EXAMPLE 3  Turning off the header and footer

Use the -n option to turn off the mp header and footer:

eample% mp -n mytext.txt | lp

EXAMPLE 4  Printing long text lines

Use the -ll option to print text files with longer than 80 column lines in landscape mode:

eample% mp -ll mytext.txt | lp

EXAMPLE 5  Specifying print point size

Use the -z option to specify any point size, in this case, 20 points:

eample% mp -z 20 mytext.txt | lp

Environment Variables

XPSERVERLIST  If the arguments to -D or -P is of the form
  printer_name@machine[:display_number], XPSERVERLIST is used only if
  the machine[:display_number] does not support printer_name.

  XPSERVERLIST contains a space-separated list of Xprt displays to which
  to connect the printer. mp goes through the list sequentially to get an
  Xprt server that can support the given printer, exiting at the first
  instance where mp finds a display to which to connect. If this is not
  set, the environment variable XPDISPLAY is used instead.

XPDISPLAY  If the -D or -P option is specified in the command line with just the
  printer_name argument and no XPSERVERLIST variable is set in the
  environment, the XPDISPLAY variable is used to determine the
  machine[:display_number] running the X Print Server to connect the
  client. If XPDISPLAY is also not set, the print server startup script
  starts an Xprt server at port 2100 of the machine in which the client
  is running. The script terminates the print server once the job is
  over. If XPDISPLAY is set, the mp client tries to contact the print
  server running at XPDISPLAY. In this case, no attempt is made to start
  the server if it is not running.

MP_PROLOGUE  Used to determine the directory where the page formatting files (.xpr or
  .ps) are kept. These files determine page decorations, number of logical
pages per physical page, landscape or portrait format, and so forth. In the absence of `MP_PROLOGUE`, the default location of the directory is `/usr/lib/lp/locale/C/mp`.

**MP_LANG**

If neither of the `–D` or `–P` options is specified, a prologue file is prepended to the output to be printed. The prologue file is called

```
/usr/openwin/lib/locale/localename/print/prolog.ps or
/usr/lib/lp/locale/localename/mp/prolog.ps
```

where `localename` is the value of the `MP_LANG` or `LANG` environment variable, if present. If both variables are present, the file

```
/usr/openwin/lib/locale/localename/print/prolog.ps
```

is given preference due to backward compatibility reasons. If either of these files are not present, and the `–D` option is not specified, a configuration file of the locale called `/usr/lib/lp/locale/localename/mp/mp.conf` is used as the source of the configuration information that substitutes the prologue information for printing. The presence of `prolog.ps` disables `mp.conf` for backward compatibility.

**Exit Status**

The following exit values are returned:

- 0  Successful completion.
- 1  An error occurred.

**Supplied Prologue Files**

The following prologue files are provided. Files with `.ps` extensions are for the PostScript output. Files with `.xpr` extensions are for the Print Server client. `.xpr` files are created for 300dpi printers and will scale to other resolution values.

<table>
<thead>
<tr>
<th>File</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>mp.common.ps</td>
<td>Common prologue file for all other .ps files in this directory.</td>
</tr>
<tr>
<td>mp.pro.ps</td>
<td>Used by default.</td>
</tr>
<tr>
<td>mp.pro.xpr</td>
<td>Used by default.</td>
</tr>
<tr>
<td>mp.pro.ff.ps</td>
<td>Used if the <code>-ff</code> option is in effect.</td>
</tr>
<tr>
<td>mp.pro.ff.xpr</td>
<td>Used if the <code>-ff</code> option is in effect.</td>
</tr>
<tr>
<td>mp.pro.fp.ps</td>
<td>Used if the <code>-fp</code> option is in effect.</td>
</tr>
<tr>
<td>mp.pro.fp.xpr</td>
<td>Used if the <code>-fp</code> option is in effect.</td>
</tr>
<tr>
<td>mp.pro.tm.ps</td>
<td>Used if the <code>-tm</code> option is in effect.</td>
</tr>
<tr>
<td>mp.pro.tm.xpr</td>
<td>Used if the <code>-tm</code> option is in effect.</td>
</tr>
<tr>
<td>mp.pro.ts.ps</td>
<td>Used if the <code>-ts</code> option is in effect.</td>
</tr>
<tr>
<td>mp.pro.ts.xpr</td>
<td>Used if the <code>-ts</code> option is in effect.</td>
</tr>
<tr>
<td>mp.pro.alt.ps</td>
<td>An alternative modification of the default prologue file which outputs the page number in the right corner of the bottom banner.</td>
</tr>
<tr>
<td>mp.pro.alt.xpr</td>
<td>An alternative modification of the default prologue file which outputs the page number in the right corner of the bottom banner.</td>
</tr>
</tbody>
</table>
mp(1)

- mp.pro.l.ps
- mp.pro.l.xpr
  - Prologue file used for landscape outputs.

- mp.pro.ll.ps
- mp.pro.ll.xpr
  - Prologue file used for landscape outputs, when printing files with longer than normal lines.

- mp.pro.altl.ps
- mp.pro.altl.xpr
  - Alternate prologue file used for landscape outputs.

### Files

- .cshrc
  - Initialization file for csh(1).

- .mailrc
  - Initialization file for mail(1).

- /usr/bin/mp
  - Executable.

- /usr/lib/lp/locale/C/mp/mp.conf
  - Default configuration file.

- /usr/lib/lp/locale/C/mp/mp.common.ps
  - Common prologue file for all other .ps files in this directory. Not for .xpr files.

- /usr/lib/lp/locale/C/mp/mp.pro.ps
- /usr/lib/lp/locale/C/mp/mp.pro.xpr
  - Default prologue files for mail printing.

- /usr/lib/lp/locale/C/mp/mp.pro.l.ps
- /usr/lib/lp/locale/C/mp/mp.pro.l.xpr
  - Default prologue files for landscape format.

- /usr/lib/lp/locale/C/mp/mp.pro.ll.ps
- /usr/lib/lp/locale/C/mp/mp.pro.ll.xpr
  - Default prologue files for landscape format with one column per page. Useful when printing files with long lines.

- /usr/lib/lp/locale/C/mp/mp.pro.altl.ps
- /usr/lib/lp/locale/C/mp/mp.pro.altl.xpr
  - Alternate prologue files for landscape format.

- /usr/lib/lp/locale/C/mp/mp.pro.alt.ps
- /usr/lib/lp/locale/C/mp/mp.pro.alt.xpr
  - Alternative "default" prologue files. Insert page numbers in the bottom right corner of each page.

- /usr/lib/lp/locale/C/mp/mp.pro.ff.ps
- /usr/lib/lp/locale/C/mp/mp.pro.ff.xpr
  - Default prologue files for Filofax format.
/usr/lib/lp/locale/C/mp/mp.pro.fp.ps
/usr/lib/lp/locale/C/mp/mp.pro.fp.xpr
  Default prologue files for Franklin Planner format.

/usr/lib/lp/locale/C/mp/mp.pro.tm.ps
/usr/lib/lp/locale/C/mp/mp.pro.tm.xpr
  Default prologue files for Time Manager format.

/usr/lib/lp/locale/C/mp/mp.pro.ts.ps
/usr/lib/lp/locale/C/mp/mp.pro.ts.xpr
  Default prologue files for Time/System International format.

/usr/openwin/lib/locale/localename/print/prolog.ps
/usr/lib/lp/locale/localename/mp/prolog.ps
  Default locale-specific prologued file as an alternative to the mp.conf file. See ENVIRONMENT VARIABLES for more detail on the relationship.

The structure and format for mp.conf and .xpr files are documented in the International Language Environments Guide. Refer to this document if you need to use alternate fonts, including Printer Resident Fonts, or if you want to make changes to output format.

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>print/mp</td>
</tr>
</tbody>
</table>

See Also csh(1), mail(1), mailtool(1), attributes(5)

International Language Environments Guide
**mpss.so.1(1)**

**Name**  
mpss.so.1 – shared object for setting preferred page size

**Synopsis**  
mpss.so.1

**Description**  
The mpss.so.1 shared object provides a means by which the preferred stack and/or heap page size can be selectively configured for launched processes and their descendants. To enable mpss.so.1, the following string needs to be present in the environment (see ld.so.1(1)) along with one or more MPSS (Multiple Page Size Support) environment variables:

```
LD_PRELOAD=$LD_PRELOAD:mpss.so.1
```

Once preloaded, the mpss.so.1 shared object reads the following environment variables to determine any preferred page size requirements and any processes these may be specific to.

- **MPSSHREAD=** *size*  
  MPSSHREAD and MPSSSTACK specify the preferred page sizes for the heap and stack, respectively. The specified page size(s) are applied to all created processes.

  *size* must be a supported page size (see pagesize(1)) or 0, in which case the system will select an appropriate page size (see memcntl(2)).

  *size* can be qualified with K, M, G, or T to specify Kilobytes, Megabytes, Gigabytes, or Terabytes respectively.

- **MPSSSTACK=** *size*  

- **MPSSCFGFILE=** *config-file*  
  *config-file* is a text file which contains one or more mpss configuration entries of the form:

  `exec-name exec-args:heap-size:stack-size`

  `exec-name` specifies the name of an application or executable. The corresponding preferred page size(s) are set for newly created processes (see getexecname(3C)) that match the first `exec-name` found in the file.

  `exec-name` can be a full pathname, a base name or a pattern string. See File Name Generation in sh(1) for a discussion of pattern matching.

  `exec-args` is an optionally specified pattern string to match against arguments. Preferred page size(s) are set only if `exec-args` is not specified or occurs within the arguments to `exec-name`.

  If `heap-size` and/or `stack-size` are not specified, the corresponding preferred page size(s) will not be set.
MPSSCFGFILE takes precedence over MPSSHAP and MPSSSTACK. When MPSSCFGFILE is not set, preferred page size settings are taken from file /etc/mpss.conf if it exists.

**MPSSERRFILE=pathname**

By default, error messages are logged via syslog(3C) using level LOG_ERR and facility LOG_USER. If MPSSERRFILE contains a valid pathname (such as /dev/stderr), error messages will be logged there instead.

**Examples**

**Example 1** Configuring the Preferred Page Sizes Using MPSSCFGFILE

The following Bourne shell commands (see sh(1)) configure the preferred page sizes to a select set of applications with exec names that begin with foo, using the MPSSCFGFILE environment variable. The MPSS configuration file, mpsscfg, is assumed to have been previously created via a text editor like vi(1). The cat(1) command is only dumping out the contents.

```bash
example$ LD_PRELOAD=$LD_PRELOAD:mpss.so.1
example$ MPSSCFGFILE=mpsscfg
example$ export LD_PRELOAD MPSSCFGFILE
example$ cat $MPSSCFGFILE
foo*:512K:64K
```

Once the application has been started, pmap (see proc(1)) can be used to view the actual page sizes configured:

```bash
example$ foobar &
example$ pmap -s 'pgrep foobar'
```

If the desired page size is not configured (shown in the pmap output), it may be due to errors in the MPSS configuration file or environment variables. Check the error log (by default: /var/adm/messages) for errors.

If no errors can be found, resource or alignment constraints may be responsible. See the NOTES section.

**Example 2** Configuring the Preferred Page Sizes Using MPSSHAP and MPSSSTACK

The following Bourne shell commands configure 512K heap and 64K stack preferred page sizes for all applications using the MPSSHAP and MPSSSTACK environment variables.

```bash
example$ LD_PRELOAD=$LD_PRELOAD:mpss.so.1
example$ MPSSHAP=512K
example$ MPSSSTACK=64K
example$ export LD_PRELOAD MPSSHAP MPSSSTACK
```

**Example 3** Precedence Rules (a continuation of Example 2)

The preferred page size configuration in MPSSCFGFILE overrides MPSSHAP and MPSSSTACK. Appending the following commands to those in Example 2 would mean that all applications
will be configured with 512K heap and 64K stack preferred page sizes with the exception of those applications, the ls command, and all applications beginning with ora that have ora1 as an argument, in the configuration file.

```
example$ MPSSCFGFILE=mpsscfg2
example$ export MPSSCFGFILE
example$ cat $MPSSCFGFILE
ls::
ora* ora1:4m:4m
```

**Files**
- `/usr/lib/ld/map.bssalign` A template link-editor map file for aligning bss (see NOTES).
- `/etc/mpss.conf` Configuration file

**Attributes**
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/extended-system-utilities</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

**See Also**
cat(1), ld(1), ld.so.1(1), pagesize(1), ppgsz(1), proc(1), sh(1), vi(1), exec(2), fork(2), memcntl(2), getexecname(3C), getpagesize(3C), syslog(3C), proc(4), attributes(5)

**Notes**
The heap and stack preferred page sizes are inherited. A child process has the same preferred page sizes as its parent. On exec(2), the preferred page sizes are set back to the default system page size unless a preferred page size has been configured via the mpss shared object.

`ppgsz(1)`, a proc tool, can also be used to set the preferred stack and/or heap page sizes. It cannot selectively configure the page size for descendents based on name matches.

See also NOTES under `ppgsz(1)`. 
**Name**  msgcc – C language message catalog compiler

**Synopsis**  msgcc [-M-] [cc-options option] file...

**Description**  msgcc is a C language message catalog compiler. It accepts cc style options and arguments.

A msgcpp(1).mso file is generated for each input .c file. If the -c option is not specified then a gencat(1) format .msg file is generated from the input .mso and .msg files. If -c is not specified then a .msg suffix is appended to the -o file if it doesn’t already have a suffix. The default output is a .out .msg file if -c and -o are not specified.

If -M-new is not specified then messages are merged with those in the pre-existing -o file.

**Options**

The following options are supported:

- **cc-options** Specify cc style options and arguments.
- **-M-option** Set a msgcc option.

  Specify option as one of the following:
  
  - **mkmsgs**  The -o file is assumed to be in mkmsgs(1) format.
  - **new**  Create a new -o file.
  - **preserve**  Messages in the -o file that are not in new .msg file arguments are preserved. The default is to either reuse the message numbers with new message text that is similar to the old or to delete the message text, leaving an unused message number.
  - **set=number**  Set the message set number to number. The default is 1.
  - **similar=number**  The message text similarity message threshold. The similarity measure between old and new message text is:

\[
100 \times \frac{2 \times \text{gzip}(\text{old+new})}{\text{gzip}(\text{old})+\text{gzip}(\text{new})} - 1
\]

  where gzip(x) is the size of text x when compressed by gzip. The default threshold is \$_\text{similar}\_\$. A threshold of 0 turns off message replacement, but unused old messages are still deleted. Use -M-preserve to preserve all old messages.
  - **verbose**  Trace similar message replacements on the standard error.

**Operands**

The following operands are supported:

- **file**  Specifies the name of the file on which msgcc operates.
Successful completion.

>0  An error occurred.

**Examples**

**EXAMPLE 1** Using `msgcc`

The following example uses `msgcc` to extract localizable strings from the file `hello.c`, marked using `ERROR_dictionary()`, writes them to the file `hello.mso`, and creates a gencat format `xxx.msg` file:

```
example% cat hello.c
#include <stdio.h>
#include <stdlib.h>

/*
 * dummy macro to avoid including
 * libast headers
 */
#define ERROR_dictionary(x) x

int main(int ac, char *av[])
{
    puts( ERROR_dictionary("hello world") );
    return( EXIT_SUCCESS );
}
```

```
example% msgcc -o xxx -D__STDC__ -D__i386 hello.c
```

```
example% cat hello.mso
str "hello world"
```

```
example% cat xxx.msg
$ xxx message catalog
$translation msgcc 2007-09-25
$set 1
$quote *
1 "hello world"
```

**Authors**  Glenn Fowler, gsf@research.att.com

**Attributes**  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/astdev</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Volatile</td>
</tr>
</tbody>
</table>
See Also  cpp(1), gencat(1), mkmsgs(1), msggen(1), msgcpp(1), msgcvt(1), attributes(5)
**msgcpp**

**Name**
msgcpp – C language message catalog preprocessor

**Synopsis**
```
msgcpp [-ACEHMPVX] [-D name=value] [-I directory] [-U name]
[-T[|length]] [ -Y directory] [ input [ output ] ]
```

**Description**
msgcpp is a C language message catalog preprocessor. It accepts **cpp(1)** style options and arguments. msgcpp preprocesses an input C source file and emits keyed lines to the output, usually for further processing by **msgcc(1)**. msgcc output is in the **gencat(1)** syntax. Candidate message text is determined by arguments to the last `<error.h>` and `<option.h>` functions. The msgcpp keyed output lines are:

```plaintext
cmd command
```
cmd command is a candidate for `-??keys` option string generation. This is triggered by `b_command(int argc, in the input.

```plaintext
def name string
```
def name string is a candidate variable with string value string.

```plaintext
str string
```
str string should be entered into the catalog.

```plaintext
var name
```
var name If `def name` occurs then its string value should be entered into the catalog.

The input source file is preprocessed with the `pp:all|possible` option on. This enables non-C semantics. All source should first be compiled error-free with a real compiler before running msgcpp. The following changes are enabled for the top level files. Included file behavior is not affected.

1. All `#if`, `ifdef` and `ifndef` branches are enabled.
2. The first definition for a macro is retained, even when subsequent `define` statements would normally redefine the macro. `undef` must be used to redefine a macro.
3. Macro calls with an improper number of arguments are silently ignored.
4. `include` on non-existent headers are silently ignored.
5. Invalid C source characters are silently ignored.

`msgcat.h` is included if it exists. This file may contain macro definitions for functions that translate string arguments. If `foo` is a function that translates its string arguments then include the line `#define foo_TRANSLATE in msgcat.h`, or specify the option `-Dfoo=TRANSLATE`. If `bar` is a function that translates string arguments if the first argument is `stderr`, then use either `#define bar_STDIO_` or `-Dbar=STDIO_`.

The macro `_BLD_msgcat` is defined to be 1. As an alternative to `msgcat.h`, `_TRANSLATE_` definitions could be placed inside `#ifdef _BLD_msgcat ... #endif`.

**Options**
The following options are supported:

```
-A
-assert=assertion
```
Enter the assertion using `#assert` for system V compatibility.

```
-C
-comments
```
Pass comments to the output.
Comments are omitted by default.

**-D**

```
-define=name[=value]
```

Define the macro `name` to have `value`. This is the only portable way to pass options through `cc` to `cpp(1)`.
- If `value` is omitted, `value` is assumed to be 1.
- If `name` begins with `:`, then it is interpreted as a `\libpp

  #pragma pp: statement.
- If `name` begins with `%`, it is interpreted as a `\libpp #` directive
  statement.
- If `name` begins with `-` or `+`, it is interpreted as a `\libpp
  option.

  - turns the option on, + turns it off.
- Most options have a `#pragma` counterpart that is listed with
  the option definition.

**-D-C**

```
pp:compatibility
```

Preprocess for K&R C compatibility.

**-D-Dlevel**

```
pp:debug level level
```

Set the debug trace level.

Specify `level` as a number greater than or equal to 0. Higher
levels produce more output. Levels higher than 3 can only be
enabled in the -g compiled versions.

**-D-Fname**

Set the main input file name to `name`. This only affects the
error messages and the line sync output.

**-D-H**

```
pp:hosted
```

All directories are hosted. Compatibility warning messages
from the hosted directory headers are suppressed.

**-D-I**

```
pp:cdir
```

All directories contain C headers. This option is only used
only with -D-.

**-D-K**

```
pp:keargs
```

User Commands

msgcpp(1)
Enable the non-standard name=value macro argument mode.

-D-L[id]
pp:lineid [id]
Set the line sync directive id to id. If id is not specified, set to null.

-D-M
pp:nomultiple
Disable multiple include detection.

-D-P
pp:passthrough
Enable the non-standard passthrough mode. This can be useful for processing non-C input.

-D-Q
pp:dump
Dump macro definitions to the output so that the output may be passed through cpp again. This is used for generating precompiled headers.

-D-R
pp:transition
Enable the transition preprocessing mode. This is used for compilers that cannot make up their semantics between K&R and ISO C.

-D-S
pp:strict
Enable strict preprocessing semantics and warnings. This works with any mode (compatibility, transition, or the default ISO).

-D-T[est]
pp:test test
Enable implementation specific test code according to test.

-D-W
pp:warn
Enable pedantic warnings in non-hosted files.

-D-X[cc]
Preprocess for the cc compiler, which must be an executable path or an executable on $PATH.

-D-Z
pp:pool
Enable pool mode.
-D-d
List canonicalized `#define` statements for non-predefined macros in the output.

-D-m
List canonicalized `#define` statements for all macros. All other output is disabled.

-D+
`pp:plusplus`
Preprocess for the C++ dialect.

-E
`--preprocess`
Ignored; for compatibility with very old compilers.

-H
`--include-reference`
Emit `#include` filepath on the standard error, one per line, indented to show nesting.

-I
`--include[=directory]`
Append directory to the list of directories searched for `#include` files.

If directory is `-`:
1. -I directories before -I- are searched only for "..." include files
2. -I directories after -I- are searched for "..." and <...>
imclude files
3. the directory . is searched only if it is explicitly specified by an -I option

-I-C
`pp:cdir directory`
Mark directory as a C header directory. This option is used with `pp:plusplus`.

-I-D[file]
Read the default probe definitions from file, or ignore the default definitions if file is omitted.

-I-H
`pp:hostdir directory`
Mark directory as a hosted directory. Headers from hosted directories have compatibility warnings disabled.

-I-I
`pp:ignore header`
Add header to the list of ignored headers.
-I -file
    file contains a sequence of header [ = "map" ] lines, where
    header is either <name> or "name", and "map" is an explicit
    binding for header. header is ignored if = "map" is omitted.

-1 -file
    Include file but do not emit text or line syncs.

-1 -directory
    Add directory to the default standard include directory list.

-1 -file
    Include file and emit text to the output file. The option value
    can be omitted.

-M --dependencies
    Generate make(1S) dependencies. This option is not needed
    with nmake.

    The -M option can be followed by optional flags to change the
    dependency output styles.

    The following optional flags are supported:

    D         Generate dependencies in a separate .d file. Preprocessed
    output is still written to output, or the standard output if
    output is omitted.

    G         Also generate missing dependencies.

    M         Only generate local header dependencies. Hosted headers
    are omitted. Hosted headers are determined by the -I -H
    No special distinction is made between the "" and <>
    include styles.

-P --sync
    Emit line syncs.

    Line sync is turned on by default. -P means --nosync.

-T[length]
    If not gcc, truncate identifiers to length characters for
    compatibility with old AT&T compilers.

-U --undefine=name
    Remove the definition for the macro name.

-V --version
    Emit the libpp version.
-X
--argmode   Enable name=value macro arguments for easel compatibility.
-Y
--standard=directory   Add directory to the list searched for #include <...> files.

Operands  The following operands are supported:

   input       Specifies C source file to preprocess.

   output      Specifies output file.

Exit Status  0       Successful completion.
               >0       An error occurred.

Examples  EXAMPLE1  Using msgcpp to Extract Localizable Strings

The following example uses msgcpp to extract localizable strings from the file hello.c, marked using the ERROR_dictionary(), and writes them to the file hello.mso:

eexample% cat hello.c

#include <stdio.h>
#include <stdlib.h>

/*
 * dummy macro to avoid including
 * libast headers
 */
#define ERROR_dictionary(x) x

int main(int ac, char *av[])
{
   puts( ERROR_dictionary("hello world") );
   puts( ERROR_dictionary("hello all") );
   return( EXIT_SUCCESS );
}

eexample% msgcpp -D__STDC__ -D__i386 hello.c hello.mso

eexample% cat hello.mso
str "hello world"
str "hello all"

Authors  Glenn Fowler, gsf@research.att.com
msgcpp(1)

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
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</thead>
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</tr>
<tr>
<td>Interface Stability</td>
<td>Volatile</td>
</tr>
</tbody>
</table>

See Also  cpp(1), gencat(1), msgcc(1), msgcvt(1), msggen(1), make(1S), attributes(5)

**Name**  
msgcvt – convert message file to and from HTML

**Synopsis**  
msgcvt [-hmr]

**Description**  
msgcvt reads a `gencat(1)` format file on the standard input and converts it to HTML on the standard output. The input file must contain the control statement `$quote` and use the `*` character to quote message text. The output is in a form suitable for automatic translation by web sites such as `http://babelfish.yahoo.com`.

**Options**  
The following options are supported:

- `-h`  
  `-html`  
  Generate HTML from `gencat(1)` input.  
  This is the default.

- `-m`  
  `-msg`  
  Generate a `gencat(1)` message file from (presumably translated) HTML. Wide characters are UTF-8 encoded.

- `-r`  
  `-raw`  
  The message file is raw message text, one message per line, with no quoting or line numbering.

**Exit Status**  
0  
Successful completion.

>0  
One or more specified jobs does not exist.

**Examples**  
**EXAMPLE1**  
Generating a gencat Message Catalog File

The following example generates a `gencat(1)` message catalog file from an HTML file:

```
example% cat example.html | msgcvt -m > examplecat
```

**Authors**  
Glenn Fowler, gsf@research.att.com

**Attributes**  
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/astdev</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Volatile</td>
</tr>
</tbody>
</table>

**See Also**  
gencat(1), msgcc(1), msggen(1), attributes(5)
msgfmt(1)

**Name**  
msgfmt – create a message object from a message file

**Synopsis**  

**Description**  
The `msgfmt` utility creates message object files from portable object files (`filename.po`), without changing the portable object files.

The `.po` file contains messages displayed to users by system commands or by application programs. `.po` files can be edited. The messages in these files can be rewritten in any language supported by the system.

The `xgettext(1)` command can be used to create `.po` files from script or programs.

`msgfmt` interprets data as characters according to the current setting of the LC_CTYPE locale category or according to the codeset specified in the `.po` file.

**Options**  
The following options are supported:

- `-D dir`
  
  `---directory=dir`  
  Adds `dir` to the list for input files search.

- `-f`
  
  `---use-fuzzy`  
  Uses fuzzy entries in output. If this option is not specified, fuzzy entries are not included into the output. These options are ignored if Solaris message catalogs are processed.

- `-g`
  
  Directs the utility to generate the GNU-compatible message catalog file. This option cannot be specified with the `-s` option.

- `-o output-file`
  
  `---output-file=output-file`  
  Specifies the output file name as `output-file`. All domain directives and duplicate msgids in the `.po` file are ignored.

- `-s`
  
  Directs the utility to generate the Solaris message catalog file. This option cannot be specified with the `-g` option.

- `---strict`
  
  Directs the utility to append the suffix `.mo` to the generating message object file name if it doesn’t have this suffix. This option is ignored if Solaris message catalogs are processed.

- `-v`
  
  `---verbose`  
  Verbose. Lists duplicate message identifiers if Solaris message catalog files are processed. Message strings are not redefined.

  If GNU-compatible message files are processed, this option detects and diagnoses input file anomalies which might represent translation errors. The msgid and msgstr strings are studied and
compared. It is considered abnormal if one string starts or ends with a newline while the other does not. Also, if the string represents a format string used in a printf-like function, both strings should have the same number of % format specifiers, with matching types. If the flag c-format appears in the special comment ‘#’ for this entry, a check is performed.

**Usage** The format of portable object files (.po files) is defined as follows. Each .po file contains one or more lines, with each line containing either a comment or a statement. Comments start the line with a pound sign (#) and end with the newline character. All comments (except special comments described later) and empty lines are ignored. The format of a statement is:

```
directive  value
```

Each directive starts at the beginning of the line and is separated from value by white space (such as one or more space or tab characters). value consists of one or more quoted strings separated by white space. Use any of the following types of directives for the Solaris message file:

```
domain domainname
msgid message_identifier
msgstr message_string
```

For a GNU-compatible message file, use any of the following types of directives:

```
domain domainname
msgid message_identifier
msgid_plural untranslated_string_plural
msgstr message_string
msgstr[n] message_string
```

The behavior of the domain directive is affected by the options used. See OPTIONS for the behavior when the -o or --output-file options are specified. If the -o or --output-file options are not specified, the behavior of the domain directive is as follows:

- All msgids from the beginning of each .po file to the first domain directive are put into a default message object file. The default message object file is named messages.mo, if the Solaris message catalog file format is used to generate the message object file or if the --strict option is specified. Otherwise, the default message object file is named messages.
- When msgfmt encounters a domain domainname directive in the .po file, all following msgids until the next domain directive are put into the message object file, named domainname.mo, if the Solaris message catalog file format is used to generate the message object file or if the --strict option is specified. Otherwise, the msgids are put into the message object file named domainname.
- Duplicate msgids are defined in the scope of each domain. That is, a msgid is considered a duplicate only if the identical msgid exists in the same domain.
All duplicate msgids are ignored.

The msgid directive specifies the value of a message identifier associated with the directive that follows it. The msgid plural directive specifies the plural form message specified to the plural message handling functions ngettext(), dngettext(), or dcngettext(). The message_identifier string identifies a target string to be used at retrieval time. Each statement containing a msgid directive must be followed by a statement containing a msgstr directive or msgstr[n] directives.

The msgstr directive specifies the target string associated with the message_identifier string declared in the immediately preceding msgid directive.

The directive msgstr[n] (where n = 0, 1, 2,...) specifies the target string to be used with plural form handling functions ngettext(), dngettext(), and dcngettext().

Message strings can contain the escape sequences \n for newline, \t for tab, \v for vertical tab, \b for backspace, \r for carriage return, \f for formfeed, \ for double quote, bsol; a for alarm, \ddd for octal bit pattern, and \xd for hexadecimal bit pattern.

Comments for a GNU-compatible message file should be in one of the following formats (the msgfmt utility will ignore these comments when processing Solaris message files):

```
# translator-comments
#. automatic-comments
#: reference ..
#: flag
```

The ‘#’ comments indicate the location of the msgid string in the source files in filename[linenumber] format. The ‘#’, ‘#.’, and ‘#:’ comments are informative only and are silently ignored by the msgfmt utility. The ‘#’, ‘:’, comments require one or more flags separated by the comma character. The following flags can be specified:

- **fuzzy** This flag can be inserted by the translator. It shows that the msgstr string might not be a correct translation (anymore). Only the translator can judge if the translation requires further modification or is acceptable as is. Once satisfied with the translation, the translator removes this fuzzy flag. If this flag is specified, the msgfmt utility will not generate the entry for the immediately following msgid in the output message catalog.

- **c-format** The c-format flag indicates that the msgid string is used as a format string by printf-like functions. In case the c-format flag is given for a string, the msgfmt utility does some more tests to check the validity of the translation.

In the GNU-compatible message file, the msgid entry with empty string ("") is called the header entry and treated specially. If the message string for the header entry contains nplurals=value, the value indicates the number of plural forms. For example, if nplurals=4,
there are four plural forms. If \texttt{\nplurals} is defined, the same line should contain
\texttt{\plural=\textit{\textit{expression}},} separated by a semicolon character. The \textit{\textit{expression}} is a C language
expression to determine which version of \textit{\texttt{msgstr}[n] is to be used based on the value of \textit{n}, the
last argument of \texttt{ngettext(), dgettext(), or dcgettext(). } For example,

\begin{verbatim}
nplurals=2; plural= n == 1 ? 0 : 1
\end{verbatim}

indicates that there are two plural forms in the language. \textit{\texttt{msgstr[0]}} is used if \textit{n} == 1, otherwise
\textit{\texttt{msgstr[1]}} is used. For another example:

\begin{verbatim}
nplurals=3; plural= n == 1 ? 0 : n == 2 ? 1 : 2
\end{verbatim}

indicates that there are three plural forms in the language. \textit{\texttt{msgstr[0]}} is used if \textit{n} == 1,
\textit{\texttt{msgstr[1]}} is used if \textit{n} == 2, otherwise \textit{\texttt{msgstr[2]}} is used.

If the header entry contains a \texttt{\texttt{\texttt{charset}}} \texttt{\texttt{= codeset}} string, the \textit{\texttt{codeset}} is used to indicate the
codeset to be used to encode the message strings. If the output string's codeset is different from
the message string's codeset, codeset conversion from the message string's codeset to the
output string's codeset will be performed upon the call of \texttt{gettext(), dgettext(),
dgettext(), ngettext(), dgettext(), and dcgettext()} for the GNU-compatible
message catalogs. The output string's codeset is determined by the current locale's codeset (the
return value of \texttt{nl_langinfo(CODESET)}) by default, and can be changed by the call of
\texttt{bind_textdomain_codeset().}

The \texttt{msgfmt} utility can generate the message object both in Solaris message catalog file format
and in GNU-compatible message catalog file format. If the \texttt{-s} option is specified and the input
file is a Solaris \texttt{.po} file, the \texttt{msgfmt} utility generates the message object in Solaris message
catalog file format. If the \texttt{-g} option is specified and the input file is a GNU \texttt{po} file, the \texttt{msgfmt}
utility generates the message object in GNU-compatible message catalog file format. If neither
the \texttt{-s nor -g} option is specified, the \texttt{msgfmt} utility determines the message catalog file format
as follows:

\begin{itemize}
  \item If the \texttt{.po} file contains a valid GNU header entry (having an empty string for \texttt{msgid}), the
  \texttt{msgfmt} utility uses the GNU-compatible message catalog file format.
  \item Otherwise, the \texttt{msgfmt} utility uses the Solaris message catalog file format.
\end{itemize}

If the \texttt{msgfmt} utility determined that the Solaris message catalog file format is used, as above,
but found the \texttt{.po} file contains directives that are specific to the GNU-compatible message
catalog file format, such as \texttt{msgid\_plural} and \texttt{msgstr[n]}, the \texttt{msgfmt} utility handles those
directives as invalid specifications.

\textbf{Examples} \texttt{\texttt{\texttt{\texttt{EXAMPLE 1}}} Creating message objects from message files}

\begin{verbatim}
In this example, \texttt{module1.p0} and \texttt{module2.p0} are portable message objects files.

\texttt{example\% cat module1.p0}
\texttt{# default domain "messages.mo"}
\end{verbatim}
EXAMPLE 1 Creating message objects from message files

(Continued)

msgid "msg 1"
msgid "help 2"
msgid "error 3"
msgid "mesg 4"
msgid "error 5"
msgid "window 6"

msgstr "msg 1 translation"
msgstr "help 2 translation"
msgstr "error 3 translation"
msgstr "mesg 4 translation"
msgstr "error 5 translation"
msgstr "window 6 translation"

The following command will produce the output files messages.mo, help_domain.mo, and error_domain.mo in Solaris message catalog file format:

texample% msgfmt module1.po

The following command will produce the output files messages.mo, help_domain.mo, error_domain.mo, and window_domain.mo in Solaris message catalog file format:

texample% msgfmt module1.po module2.po

The following command will produce the output file hello.mo in Solaris message catalog file format:

texample% msgfmt -o hello.mo module1.po module2.po

Environment Variables

See environ(5) for descriptions of the following environmental variables that affect the execution of msgfmt: LC_CTYPE, LC_MESSAGES, and NLSPATH.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>text/locale</td>
</tr>
</tbody>
</table>
Installing message catalogs under the C locale is pointless, since they are ignored for the sake of efficiency.

**See Also**  `xgettext(1), gettext(3C), setlocale(3C), attributes(5), environ(5)`

**Notes**  Installing message catalogs under the C locale is pointless, since they are ignored for the sake of efficiency.
**Name**
msggen – generate a machine independent formatted message catalog

**Synopsis**
msggen [-fls] *catfile [msgfile]*

**Description**
`msggen` merges the message text source file `msgfile` into a machine independent formatted message catalog `catfile`. The file `catfile` is created if it does not already exist. If `catfile` does exist, its messages are included in the new `catfile`. If set and message numbers collide, the new message text defined in `msgfile` replaces the old message text currently contained in `catfile`.

Non-ASCII characters must be UTF-8 encoded. `iconv(1)` can be used to convert to/from UTF-8.

**Options**
The following options are supported:

- `-f`
- `--format`
  List the `printf(3C)` format signature for each message in `catfile`. A format signature is one line containing one character for each format specification:
  
  - `c` char
  - `d` double
  - `D` long double
  - `f` float
  - `h` short
  - `i` int
  - `j` long long
  - `l` long
  - `p` void*
  - `s` string
  - `t` ptrdiff_t
  - `z` size_t
  - `?` unknown

- `-l`
- `--list`
  List `catfile` in UTF-8 msgfile form.

- `-s`
- `--set`
  Convert the `catfile` to a message set number and print the number on the standard output.
Operands

The following operands are supported:

*catfile*  Machine independent formatted message catalog file.
*msgfile*  Message text source file.

Usage

Message text source files are in `gencat(1)` format, defined as follows. The fields of a message text source line are separated by a single blank character. Any other blank characters are considered to be part of the subsequent field. The `NL_*` constants are defined in one or both of `<limits.h>` and `<nl_types.h>`.

*$ comment*

A line beginning with a $ followed by a blank character is treated as a comment.

*$delset n comment*

This line deletes message set `n` from an existing message catalog. `n` denotes the set number `[1, NL_SETMAX]`. Any text following the set number is treated as a comment.

*$quote c*

This line specifies an optional quote character `c`, which can be used to surround message-text so that trailing spaces or empty messages are visible in a message source line. By default, or if an empty `$quote` directive is supplied, no quoting of message-text is recognized.

*$set n comment*

This line specifies the set identifier of the following messages until the next `$set` or end-of-file (EOF) appears. `n` denotes the set identifier, which is defined as a number in the range `[1, NL_SETMAX]`. Set numbers need not be contiguous. Any text following the set identifier is treated as a comment. If no `$set` directive is specified in a message text source file, all messages are located in message set 1.

*$translation identification YYYY-MM-DD[,...]*

Append translation information to the message catalog header. Only the newest date for a given identification is retained in the catalog. Multiple translation lines are combined into a single, comma-separated list.

*m message-text*

`m` denotes the message identifier, which is defined as a number in the range `[1, NL_MSGMAX]`. The message-text is stored in the message catalogue with the set identifier specified by the last `$set` directive, and with message identifier `m`. If the message-text is empty, and a blank character field separator is present, an empty string is stored in the message catalogue. If a message source line has a message number, but neither a field separator nor message-text, the existing message with that number (if any) is deleted from the catalogue. Message identifiers need not be contiguous. There are no `message-text` length restrictions.
Successful completion.

>0 One or more specified jobs does not exist.

**Examples**  
**EXAMPLE 1  Using msggen**

The following example generates a message catalog xxx from the message file xxx.msg:

```bash
example% msggen xxx xxx.msg
```

**Authors**  
Glenn Fowler, gsf@research.att.com

**Attributes**  
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/astdev</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Volatile</td>
</tr>
</tbody>
</table>

**See Also**  
gencat(1),iconv(1),msgcc(1),printf(3C),attributes(5)
**Name**
msgget – get a message from a message catalog

**Synopsis**
msgget locale [command:]catalog [set.]number [text]

**Description**
msgget gets the message corresponding to the parameters. See OPERANDS.

**Operands**
The following operands are supported:
- *catalog* Specifies the message catalog name.
- *command* Specifies command-specific message.
- *locale* Specifies the locale. If *locale* is - then the current locale is used.
- *[set.] number* Identifies the message by message number and an optional message set. If specified as -, the message set and number are determined by looking up text in the corresponding C locale message catalog.
- *text* Specifies the text of the message to be output upon error.

**Exit Status**
- **0** Successful completion.
- **>0** An error occurred.

**Examples**

**EXAMPLE 1** Getting a Message in the Current Locale

The following example gets msg 1 in the current locale from message catalog hello:

```bash
eexample% msgget - hello 1
hello world
```

**Authors**
Glenn Fowler, gsf@research.att.com

**Attributes**
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/astdev</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Volatile</td>
</tr>
</tbody>
</table>

**See Also**
iconv(1), msgcc(1), msggen(1), attributes(5)
The `mt` utility sends commands to a magnetic tape drive. If `-f tapename` is not specified, the environment variable `TAPE` is used. If `TAPE` does not exist, `mt` uses the device `/dev/rmt/0n`.

The following options are supported:

- `-f tapename` Specifies the raw tape device.

The following operands are supported:

- `count` The number of times that the requested operation is to be performed. By default, `mt` performs `command` once. Multiple operations of `command` can be performed by specifying `count`.

- `command` The following available commands that can be sent to a magnetic tape drive are supported. Only as many characters as are required to uniquely identify a `command` need be specified.

  - `asf` Specifies absolute space to `count` file number. This is equivalent to a `rewind` followed by a `fsf count`.

  - `bsf` Back spaces over `count` EOF marks. The tape is positioned on the beginning-of-tape side of the EOF mark.

  - `bsr` Back spaces `count` records.

  - `bssf` Back spaces over the requested number of sequential file marks. Sequential file marks are where the file marks are one right after the other with no other blocks of any kind between the file marks. The number argument specifies how many sequential file marks to which space. For example, `bssf 4` searches backwards to the first place where there are 4 sequential file marks and positions to the BOP side of the 4th file mark.

    This command is not supported by all drives.

  - `eof` Writes `count` EOF marks at the current position on the tape.

  - `weof` Writes `count` EOF marks at the current position on the tape.

  - `fsf` Forward spaces over `count` EOF marks. The tape is positioned on the first block of the file.

  - `fsr` Forward spaces `count` records.

  - `fssf` Forward spaces the over requested number of sequential file marks. Sequential file marks are where the file marks are one right after the other with no other blocks of any kind between the file marks. The number argument specifies how many sequential file marks to
which to space. For example, \texttt{fsf} 4 searches forwards to the first place where there are 4 sequential file marks and positions after the 4th file mark.

This command is not supported by all drives.

\textbf{load} Requests drive load and thread current media. Not supported by all drives.

\textbf{lock} Prevents media removal.

\textbf{nbsf} Back spaces \textit{count} files. The tape is positioned on the first block of the file. This is equivalent to \textit{count+1 bsf} followed by one \textit{fsf}.

\textbf{seek} Positions to requested logical tape position.

\textbf{tell} Gets and prints current logical tape position.

\textbf{unlock} Allows media removal.

If \textit{count} is specified with any of the following commands, the \textit{count} is ignored and the command is performed only once.

\textbf{config} Reads the drives current configuration from the driver and displays it in \textit{st.conf} format. See \texttt{st(7D)} for definition of fields and there meanings.

\textbf{eom} Spaces to the end of recorded media on the tape. This is useful for appending files onto previously written tapes.

\textbf{erase} Erases the entire tape.

Some tape drives have option settings where only portions of the tape can be erased. Be sure to select the correct setting to erase the whole tape. Erasing a tape can take a long time depending on the device and/or tape. Refer to the device specific manual for time details.

\textbf{forcereserve} Attempts to break a SCSI II reserve issued by another initiator. When this command completes, the drive is not reserved for the current initiator, but is available for use. This command can be only be executed by those with super-user privileges.

\textbf{offline rewoffl} Rewinds the tape and, if appropriate, takes the drive unit off-line by unloading the tape.

\textbf{release} Re-establishes the default behavior of releasing at close.
reserve  Allows the tape drive to remain reserved after closing the device. The drive must then be explicitly released.
retension  Rewinds the cartridge tape completely, then winds it forward to the end of the reel and back to beginning-of-tape to smooth out tape tension.
rewind  Rewinds the tape.
status  Prints status information about the tape unit.

Status information can include the sense key reported by the drive, the residual and retries for the last operation, the current tape position reported in file number, and the number of blocks from the beginning of that file. It might also report that WORM media is loaded in that drive.

Exit Status  
0  All operations were successful.
1  Command was unrecognized or mt was unable to open the specified tape drive.
2  An operation failed.

Files  
/dev/rmt/*  magnetic tape interface
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>SUNWcsu</td>
</tr>
</tbody>
</table>

See Also  
tar(1), tcopy(1), ar.h(3HEAD), attributes(5), mtio(7I), st(7D)

Bugs  Not all devices support all options. Some options are hardware-dependent. Refer to the corresponding device manual page.

mt is architecture sensitive. Heterogeneous operation (that is, SPARC to x86 or the reverse) is not supported.
mv(1)

Name
mv – move files

Synopsis
/usr/bin/mv [-fi] source target_file
/usr/bin/mv [-fi] source... target_dir
/usr/xpg4/bin/mv [-fi] source target_file
/usr/xpg4/bin/mv [-fi] source... target_dir

Description
In the first synopsis form, the mv utility moves the file named by the source operand to the
destination specified by the target_file. source and target_file can not have the same name. If
target_file does not exist, mv creates a file named target_file. If target_file exists, its contents are
overwritten. This first synopsis form is assumed when the final operand does not name an
existing directory.

In the second synopsis form, mv moves each file named by a source operand to a destination file
in the existing directory named by the target_dir operand. The destination path for each
source is the concatenation of the target directory, a single slash character (/), and the last path
name component of the source. This second form is assumed when the final operand names an
existing directory.

If mv determines that the mode of target_file forbids writing, it prints the mode (see chmod(2)),
ask for a response, and read the standard input for one line. If the response is affirmative, the
mv occurs, if permissible; otherwise, the command exits. Notice that the mode displayed can
not fully represent the access permission if target is associated with an ACL. When the parent
directory of source is writable and has the sticky bit set, one or more of the following
conditions must be true:

■ the user must own the file
■ the user must own the directory
■ the file must be writable by the user
■ the user must be a privileged user

If source is a file and target_file is a link to another file with links, the other links remain and
target_file becomes a new file.

If source and target_file/target_dir are on different file systems, mv copies the source and
deletes the original. Any hard links to other files are lost. mv attempts to duplicate the source
file characteristics to the target, that is, the owner and group id, permission modes,
modification and access times, ACLs, and extended attributes, if applicable. For symbolic
links, mv preserves only the owner and group of the link itself.

If unable to preserve owner and group id, mv clears S_ISUID and S_ISGID bits in the target. mv
prints a diagnostic message to stderr if unable to clear these bits, though the exit code is not
affected. mv might be unable to preserve extended attributes if the target file system does not
have extended attribute support. /usr/xpg4/bin/mv prints a diagnostic message to stderr for
all other failed attempts to duplicate file characteristics. The exit code is not affected.
In order to preserve the source file characteristics, users must have the appropriate file access permissions. This includes being super-user or having the same owner id as the destination file.

**Options**

The following options are supported:

- `mv` moves the file(s) without prompting even if it is writing over an existing `target`. Note that this is the default if the standard input is not a terminal.

- `mv` prompts for confirmation whenever the move would overwrite an existing target. This is done regardless of whether the input is coming from a terminal. If the prompt for confirmation fails, this is equivalent to the user answering in the negative. An affirmative answer means that the move should proceed. Any other answer prevents `mv` from overwriting `target`.

### /usr/bin/mv

Specifying both the `-f` and the `-i` options is not considered an error. The `-f` option overrides the `-i` option.

### /usr/xpg4/bin/mv

Specifying both the `-f` and the `-i` options is not considered an error. The last option specified determines the behavior of `mv`.

**Operands**

The following operands are supported:

- `source` A path name of a file or directory to be moved.
- `target_file` A new path name for the file or directory being moved.
- `target_dir` A path name of an existing directory into which to move the input files.

**Usage**

See `largefile(5)` for the description of the behavior of `mv` when encountering files greater than or equal to 2 Gbyte ($2^{31}$ bytes).

**Environment Variables**

See `environ(5)` for descriptions of the following environment variables that affect the execution of `mv`: `LANG`, `LC_ALL`, `LC_COLLATE`, `LC_CTYPE`, `LC_MESSAGES`, and `NLSPATH`.

Affirmative responses are processed using the extended regular expression defined for the `yesexpr` keyword in the `LC_MESSAGES` category of the user’s locale. The locale specified in the `LC_COLLATE` category defines the behavior of ranges, equivalence classes, and multi-character collating elements used in the expression defined for `yesexpr`. The locale specified in `LC_CTYPE` determines the locale for interpretation of sequences of bytes of text data as characters, the behavior of character classes used in the expression defined for the `yesexpr`. See `locale(5)`.

**Exit Status**

The following exit values are returned:

- `0` All input files were moved successfully.
- `>0` An error occurred.
Attributes

See attributes(5) for descriptions of the following attributes:

### /usr/bin/mv

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

### /usr/xpg4/bin/mv

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/xopen/xcu4</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Standard</td>
</tr>
</tbody>
</table>

See Also cp(1), cpio(1), ln(1), rm(1), setfacl(1), chmod(2), attributes(5), environ(5), fsattr(5), largefile(5), standards(5)

Notes

A - - permits the user to mark explicitly the end of any command line options, allowing mv to recognize filename arguments that begin with a - . As an aid to BSD migration, mv accepts - as a synonym for - -. This migration aid might disappear in a future release.
nawk – pattern scanning and processing language

/usr/bin/nawk [-F ERE] [-v assignment] 'program' | -f progfile...
  [argument]...

/usr/xpg4/bin/awk [-F ERE] [-v assignment]... 'program' | -f progfile...
  [argument]...

Description
The /usr/bin/nawk and /usr/xpg4/bin/awk utilities execute programs written in the nawk programming language, which is specialized for textual data manipulation. A nawk program is a sequence of patterns and corresponding actions. The string specifying program must be enclosed in single quotes (') to protect it from interpretation by the shell. The sequence of pattern - action statements can be specified in the command line as program or in one, or more, file(s) specified by the -f progfile option. When input is read that matches a pattern, the action associated with the pattern is performed.

Input is interpreted as a sequence of records. By default, a record is a line, but this can be changed by using the RS built-in variable. Each record of input is matched to each pattern in the program. For each pattern matched, the associated action is executed.

The nawk utility interprets each input record as a sequence of fields where, by default, a field is a string of non-blank characters. This default white-space field delimiter (blanks and/or tabs) can be changed by using the FS built-in variable or the -F ERE option. The nawk utility denotes the first field in a record $1, the second $2, and so forth. The symbol $0 refers to the entire record; setting any other field causes the reevaluation of $0. Assigning to $0 resets the values of all fields and the NF built-in variable.

Options
The following options are supported:

- `-F ERE` Define the input field separator to be the extended regular expression ERE, before any input is read (can be a character).

- `-f progfile` Specifies the pathname of the file progfile containing a nawk program. If multiple instances of this option are specified, the concatenation of the files specified as progfile in the order specified is the nawk program. The nawk program can alternatively be specified in the command line as a single argument.

- `-v assignment` The assignment argument must be in the same form as an assignment operand. The assignment is of the form var=value, where var is the name of one of the variables described below. The specified assignment occurs before executing the nawk program, including the actions associated with BEGIN patterns (if any). Multiple occurrences of this option can be specified.

Operands
The following operands are supported:
If no `-f` option is specified, the first operand to `nawk` is the text of the `nawk` program. The application supplies the `program` operand as a single argument to `nawk`. If the text does not end in a newline character, `nawk` interprets the text as if it did.

Either of the following two types of `argument` can be intermixed:

- **file**: A pathname of a file that contains the input to be read, which is matched against the set of patterns in the program. If no `file` operands are specified, or if a `file` operand is `−`, the standard input is used.

- **assignment**: An operand that begins with an underscore or alphabetic character from the portable character set, followed by a sequence of underscores, digits and alphabets from the portable character set, followed by the `=` character specifies a variable assignment rather than a pathname. The characters before the `=` represent the name of a `nawk` variable. If that name is a `nawk` reserved word, the behavior is undefined. The characters following the equal sign is interpreted as if they appeared in the `nawk` program preceded and followed by a double-quote (" naughty character, as a STRING token, except that if the last character is an unescaped backslash, it is interpreted as a literal backslash rather than as the first character of the sequence \.. The variable is assigned the value of that STRING token. If the value is considered a numeric string, the variable is assigned its numeric value. Each such variable assignment is performed just before the processing of the following `file`, if any. Thus, an assignment before the first `file` argument is executed after the BEGIN actions (if any), while an assignment after the last `file` argument is executed before the END actions (if any). If there are no `file` arguments, assignments are executed before processing the standard input.

### Input Files

Input files to the `nawk` program from any of the following sources:

- any `file` operands or their equivalents, achieved by modifying the `nawk` variables ARGV and ARGC
- standard input in the absence of any `file` operands
- arguments to the `getline` function

must be text files. Whether the variable `RS` is set to a value other than a newline character or not, for these files, implementations support records terminated with the specified separator up to `{LINE_MAX}` bytes and can support longer records.
If `-f progfile` is specified, the files named by each of the `progfile` option-arguments must be text files containing an `awk` program.

The standard input are used only if no `file` operands are specified, or if a `file` operand is `-`.

A `awk` program is composed of pairs of the form:

```
    pattern { action }
```

Either the pattern or the action (including the enclosing brace characters) can be omitted. Pattern-action statements are separated by a semicolon or by a newline.

A missing pattern matches any record of input, and a missing action is equivalent to an action that writes the matched record of input to standard output.

Execution of the `awk` program starts by first executing the actions associated with all `BEGIN` patterns in the order they occur in the program. Then each `file` operand (or standard input if no files were specified) is processed by reading data from the file until a record separator is seen (a newline character by default), splitting the current record into fields using the current value of `FS`, evaluating each pattern in the program in the order of occurrence, and executing the action associated with each pattern that matches the current record. The action for a matching pattern is executed before evaluating subsequent patterns. Last, the actions associated with all `END` patterns is executed in the order they occur in the program.

**Expressions in awk**

Expressions describe computations used in patterns and actions. In the following table, valid expression operations are given in groups from highest precedence first to lowest precedence last, with equal-precedence operators grouped between horizontal lines. In expression evaluation, where the grammar is formally ambiguous, higher precedence operators are evaluated before lower precedence operators. In this table `expr`, `expr1`, `expr2`, and `expr3` represent any expression, while `lvalue` represents any entity that can be assigned to (that is, on the left side of an assignment operator).

<table>
<thead>
<tr>
<th>Syntax</th>
<th>Name</th>
<th>Type of Result</th>
<th>Associativity</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>( expr )</code></td>
<td>Grouping</td>
<td>type of <code>expr</code></td>
<td>n/a</td>
</tr>
<tr>
<td><code>$expr</code></td>
<td>Field reference</td>
<td>string</td>
<td>n/a</td>
</tr>
<tr>
<td><code>++ lvalue</code></td>
<td>Pre-increment</td>
<td>numeric</td>
<td>n/a</td>
</tr>
<tr>
<td><code>lvalue --</code></td>
<td>Pre-decrement</td>
<td>numeric</td>
<td>n/a</td>
</tr>
<tr>
<td><code>lvalue ++</code></td>
<td>Post-increment</td>
<td>numeric</td>
<td>n/a</td>
</tr>
<tr>
<td><code>lvalue --</code></td>
<td>Post-decrement</td>
<td>numeric</td>
<td>n/a</td>
</tr>
<tr>
<td><code>expr ^ expr</code></td>
<td>Exponentiation</td>
<td>numeric</td>
<td>right</td>
</tr>
<tr>
<td><code>! expr</code></td>
<td>Logical not</td>
<td>numeric</td>
<td>n/a</td>
</tr>
<tr>
<td>Syntax</td>
<td>Name</td>
<td>Type of Result</td>
<td>Associativity</td>
</tr>
<tr>
<td>-----------</td>
<td>--------------------</td>
<td>----------------</td>
<td>---------------</td>
</tr>
<tr>
<td>+ expr</td>
<td>Unary plus</td>
<td>numeric</td>
<td>n/a</td>
</tr>
<tr>
<td>~ expr</td>
<td>Unary minus</td>
<td>numeric</td>
<td>n/a</td>
</tr>
<tr>
<td>expr * expr</td>
<td>Multiplication</td>
<td>numeric</td>
<td>left</td>
</tr>
<tr>
<td>expr / expr</td>
<td>Division</td>
<td>numeric</td>
<td>left</td>
</tr>
<tr>
<td>expr % expr</td>
<td>Modulus</td>
<td>numeric</td>
<td>left</td>
</tr>
<tr>
<td>expr + expr</td>
<td>Addition</td>
<td>numeric</td>
<td>left</td>
</tr>
<tr>
<td>expr - expr</td>
<td>Subtraction</td>
<td>numeric</td>
<td>left</td>
</tr>
<tr>
<td>expr expr</td>
<td>String concatenation</td>
<td>string</td>
<td>left</td>
</tr>
<tr>
<td>expr &lt; expr</td>
<td>Less than</td>
<td>numeric</td>
<td>none</td>
</tr>
<tr>
<td>expr &lt;= expr</td>
<td>Less than or equal to</td>
<td>numeric</td>
<td>none</td>
</tr>
<tr>
<td>expr != expr</td>
<td>Not equal to</td>
<td>numeric</td>
<td>none</td>
</tr>
<tr>
<td>expr == expr</td>
<td>Equal to</td>
<td>numeric</td>
<td>none</td>
</tr>
<tr>
<td>expr &gt; expr</td>
<td>Greater than</td>
<td>numeric</td>
<td>none</td>
</tr>
<tr>
<td>expr &gt;= expr</td>
<td>Greater than or equal to</td>
<td>numeric</td>
<td>none</td>
</tr>
<tr>
<td>expr - expr</td>
<td>ERE match</td>
<td>numeric</td>
<td>none</td>
</tr>
<tr>
<td>expr != expr</td>
<td>ERE non-match</td>
<td>numeric</td>
<td>none</td>
</tr>
<tr>
<td>expr in array</td>
<td>Array membership</td>
<td>numeric</td>
<td>left</td>
</tr>
<tr>
<td>( index ) in</td>
<td>Multi-dimension array</td>
<td>numeric</td>
<td>left</td>
</tr>
<tr>
<td>array membership</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>expr &amp;&amp; expr</td>
<td>Logical AND</td>
<td>numeric</td>
<td>left</td>
</tr>
<tr>
<td>expr</td>
<td></td>
<td>expr</td>
<td>Logical OR</td>
</tr>
<tr>
<td>expr1 ? expr2 : expr3</td>
<td>Conditional expression</td>
<td>type of selected</td>
<td>right</td>
</tr>
<tr>
<td>lvalue ^= expr</td>
<td>Exponentiation assignment</td>
<td>numeric</td>
<td>right</td>
</tr>
<tr>
<td>lvalue %= expr</td>
<td>Modulus assignment</td>
<td>numeric</td>
<td>right</td>
</tr>
<tr>
<td>lvalue *= expr</td>
<td>Multiplication assignment</td>
<td>numeric</td>
<td>right</td>
</tr>
</tbody>
</table>
Each expression has either a string value, a numeric value or both. Except as stated for specific contexts, the value of an expression is implicitly converted to the type needed for the context in which it is used. A string value is converted to a numeric value by the equivalent of the following calls:

```
setlocale(LC_NUMERIC, "");
numeric_value = atof(string_value);
```

A numeric value that is exactly equal to the value of an integer is converted to a string by the equivalent of a call to the `printf` function with the string `%d` as the `fmt` argument and the numeric value being converted as the first and only `expr` argument. Any other numeric value is converted to a string by the equivalent of a call to the `sprintf` function with the value of the variable `CONVFMT` as the `fmt` argument and the numeric value being converted as the first and only `expr` argument.

A string value is considered to be a **numeric string** in the following case:

1. Any leading and trailing blank characters is ignored.
2. If the first unignored character is a `+` or `−`, it is ignored.
3. If the remaining unignored characters would be lexically recognized as a `NUMBER` token, the string is considered a **numeric string**.

If a `−` character is ignored in the above steps, the numeric value of the **numeric string** is the negation of the numeric value of the recognized `NUMBER` token. Otherwise the numeric value of the **numeric string** is the numeric value of the recognized `NUMBER` token. Whether or not a string is a **numeric string** is relevant only in contexts where that term is used in this section.

When an expression is used in a Boolean context, if it has a numeric value, a value of zero is treated as false and any other value is treated as true. Otherwise, a string value of the null string is treated as false and any other value is treated as true. A Boolean context is one of the following:

- the first subexpression of a conditional expression.
- an expression operated on by logical NOT, logical AND, or logical OR.
- the second expression of a for statement.
- the expression of an if statement.
- the expression of the while clause in either a while or do . . . while statement.
an expression used as a pattern (as in Overall Program Structure).

The nawk language supplies arrays that are used for storing numbers or strings. Arrays need not be declared. They are initially empty, and their sizes changes dynamically. The subscripts, or element identifiers, are strings, providing a type of associative array capability. An array name followed by a subscript within square brackets can be used as an lvalue and as an expression, as described in the grammar. Unsubscripted array names are used in only the following contexts:

- a parameter in a function definition or function call.
- the NAME token following any use of the keyword in.

A valid array index consists of one or more comma-separated expressions, similar to the way in which multi-dimensional arrays are indexed in some programming languages. Because nawk arrays are really one-dimensional, such a comma-separated list is converted to a single string by concatenating the string values of the separate expressions, each separated from the other by the value of the SUBSEP variable.

Thus, the following two index operations are equivalent:

```
var[expr1, expr2, ... exprn]
var[expr1 SUBSEP expr2 SUBSEP ... SUBSEP exprn]
```

A multi-dimensioned index used with the in operator must be put in parentheses. The in operator, which tests for the existence of a particular array element, does not create the element if it does not exist. Any other reference to a non-existent array element automatically creates it.

Variable can be used in an nawk program by referencing them. With the exception of function parameters, they are not explicitly declared. Uninitialized scalar variables and array elements have both a numeric value of zero and a string value of the empty string.

Field variables are designated by a $ followed by a number or numerical expression. The effect of the field number expression evaluating to anything other than a non-negative integer is unspecified. Uninitialized variables or string values need not be converted to numeric values in this context. New field variables are created by assigning a value to them. References to non-existent fields (that is, fields after $NF) produce the null string. However, assigning to a non-existent field (for example, $(NF+2) = 5) increases the value of NF, create any intervening fields with the null string as their values and cause the value of $0 to be recomputed, with the fields being separated by the value of OFS. Each field variable has a string value when created. If the string, with any occurrence of the decimal-point character from the current locale changed to a period character, is considered a numeric string (see Expressions in nawk above), the field variable also has the numeric value of the numeric string.

nawk sets the following special variables that are supported by both /usr/bin/nawk and /usr/xpg4/bin/awk:

- **ARGC** The number of elements in the ARGV array.
ARGV  An array of command line arguments, excluding options and the program argument, numbered from zero to ARGC−1.

The arguments in ARGV can be modified or added to; ARGC can be altered. As each input file ends, nawk treats the next non-null element of ARGV, up to the current value of ARGC−1, inclusive, as the name of the next input file. Setting an element of ARGV to null means that it is not treated as an input file. The name − indicates the standard input. If an argument matches the format of an assignment operand, this argument is treated as an assignment rather than a file argument.

ENVIROM  The variable ENVIRON is an array representing the value of the environment. The indices of the array are strings consisting of the names of the environment variables, and the value of each array element is a string consisting of the value of that variable. If the value of an environment variable is considered a numeric string, the array element also has its numeric value.

In all cases where nawk behavior is affected by environment variables (including the environment of any commands that nawk executes via the system function or via pipeline redirections with the print statement, the printf statement, or the getline function), the environment used is the environment at the time nawk began executing.

FILENAME  A pathname of the current input file. Inside a BEGIN action the value is undefined. Inside an END action the value is the name of the last input file processed.

FNR  The ordinal number of the current record in the current file. Inside a BEGIN action the value is zero. Inside an END action the value is the number of the last record processed in the last file processed.

FS  Input field separator regular expression; a space character by default.

NF  The number of fields in the current record. Inside a BEGIN action, the use of NF is undefined unless a getline function without a var argument is executed previously. Inside an END action, NF retains the value it had for the last record read, unless a subsequent, redirected, getline function without a var argument is performed prior to entering the END action.

NR  The ordinal number of the current record from the start of input. Inside a BEGIN action the value is zero. Inside an END action the value is the number of the last record processed.

OFMT  The printf format for converting numbers to strings in output statements "%.6g" by default. The result of the conversion is unspecified if the value of OFMT is not a floating-point format specification.

OFS  The printf statement output field separator; a space character by default.
ORS  The print output record separator; a newline character by default.

LENGTH  The length of the string matched by the match function.

RS  The first character of the string value of RS is the input record separator; a newline character by default. If RS contains more than one character, the results are unspecified. If RS is null, then records are separated by sequences of one or more blank lines. Leading or trailing blank lines do not produce empty records at the beginning or end of input, and the field separator is always newline, no matter what the value of FS.

RSTART  The starting position of the string matched by the match function, numbering from 1. This is always equivalent to the return value of the match function.

SUBSEP  The subscript separator string for multi-dimensional arrays. The default value is \034.

/usr/xpg4/bin/awk  The following variable is supported for /usr/xpg4/bin/awk only:

CONVFMT  The printf format for converting numbers to strings (except for output statements, where OFMT is used). The default is %.6g.

Regular Expressions  The /usr/xpg4/bin/nawk utility makes use of the extended regular expression notation (see regex(5)) except that it allows the use of C-language conventions to escape special characters within the EREs, namely \, \a, \b, \f, \n, \r, \t, \v, and those specified in the following table. These escape sequences are recognized both inside and outside bracket expressions. Records need not be separated by newline characters and string constants can contain newline characters, so even the \n sequence is valid in nawk EREs. Using a slash character within the regular expression requires escaping as shown in the table below:

<table>
<thead>
<tr>
<th>Escape Sequence</th>
<th>Description</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;</td>
<td>Backslash quotation-mark</td>
<td>Quotation-mark character</td>
</tr>
<tr>
<td>\/</td>
<td>Backslash slash</td>
<td>Slash character</td>
</tr>
<tr>
<td>\ddd</td>
<td>A backslash character followed by the longest sequence of one, two, or three octal-digit characters (01234567). If all of the digits are 0, (that is, representation of the NULL character), the behavior is undefined.</td>
<td>The character encoded by the one-, two- or three-digit octal integer. Multi-byte characters require multiple, concatenated escape sequences, including the leading \ for each byte.</td>
</tr>
<tr>
<td>\c</td>
<td>A backslash character followed by any character not described in this table or special characters (\, \a, \b, \f, \n, \r, \t, \v).</td>
<td>Undefined</td>
</tr>
</tbody>
</table>
A regular expression can be matched against a specific field or string by using one of the two regular expression matching operators, ~ and !~. These operators interpret their right-hand operand as a regular expression and their left-hand operand as a string. If the regular expression matches the string, the ~ expression evaluates to the value 1, and the !~ expression evaluates to the value 0. If the regular expression does not match the string, the ~ expression evaluates to the value 0, and the !~ expression evaluates to the value 1. If the right-hand operand is any expression other than the lexical token ERE, the string value of the expression is interpreted as an extended regular expression, including the escape conventions described above. Notice that these same escape conventions also are applied in the determining the value of a string literal (the lexical token STRING), and is applied a second time when a string literal is used in this context.

When an ERE token appears as an expression in any context other than as the right-hand of the ~ or !~ operator or as one of the built-in function arguments described below, the value of the resulting expression is the equivalent of:

```
$ 0~/ere/
```

The `ere` argument to the `gsub`, `match`, `sub` functions, and the `fs` argument to the `split` function (see String Functions) is interpreted as extended regular expressions. These can be either ERE tokens or arbitrary expressions, and are interpreted in the same manner as the right-hand side of the ~ or !~ operator.

An extended regular expression can be used to separate fields by using the `-F ERE` option or by assigning a string containing the expression to the built-in variable `FS`. The default value of the `FS` variable is a single space character. The following describes `FS` behavior:

1. If `FS` is a single character:
   - If `FS` is the space character, skip leading and trailing blank characters; fields are delimited by sets of one or more blank characters.
   - Otherwise, if `FS` is any other character `c`, fields are delimited by each single occurrence of `c`.

2. Otherwise, the string value of `FS` is considered to be an extended regular expression. Each occurrence of a sequence matching the extended regular expression delimits fields.

Except in the `gsub`, `match`, `split`, and `sub` built-in functions, regular expression matching is based on input records. That is, record separator characters (the first character of the value of the variable `RS`, a newline character by default) cannot be embedded in the expression, and no expression matches the record separator character. If the record separator is not a newline character, newline characters embedded in the expression can be matched. In those four built-in functions, regular expression matching are based on text strings. So, any character (including the newline character and the record separator) can be embedded in the pattern and an appropriate pattern matches any character. However, in all `nawk` regular expression matching, the use of one or more NULL characters in the pattern, input record or text string produces undefined results.
Patterns  A pattern is any valid expression, a range specified by two expressions separated by comma, or one of the two special patterns BEGIN or END.

Special Patterns  The awk utility recognizes two special patterns, BEGIN and END. Each BEGIN pattern is matched once and its associated action executed before the first record of input is read (except possibly by use of the getline function in a prior BEGIN action) and before command line assignment is done. Each END pattern is matched once and its associated action executed after the last record of input has been read. These two patterns have associated actions.

BEGIN and END do not combine with other patterns. Multiple BEGIN and END patterns are allowed. The actions associated with the BEGIN patterns are executed in the order specified in the program, as are the END actions. An END pattern can precede a BEGIN pattern in a program.

If an awk program consists of only actions with the pattern BEGIN, and the BEGIN action contains no getline function, awk exits without reading its input when the last statement in the last BEGIN action is executed. If an awk program consists of only actions with the pattern END or only actions with the patterns BEGIN and END, the input is read before the statements in the END actions are executed.

Expression Patterns  An expression pattern is evaluated as if it were an expression in a Boolean context. If the result is true, the pattern is considered to match, and the associated action (if any) is executed. If the result is false, the action is not executed.

Pattern Ranges  A pattern range consists of two expressions separated by a comma. In this case, the action is performed for all records between a match of the first expression and the following match of the second expression, inclusive. At this point, the pattern range can be repeated starting at input records subsequent to the end of the matched range.

Actions  An action is a sequence of statements. A statement can be one of the following:

- if ( expression ) statement [ else statement ]
- while ( expression ) statement
- do statement while ( expression )
- for ( expression ; expression ; expression ) statement
- for ( var in array ) statement
- delete array[subscript] #delete an array element
- break
- continue
- { [ statement ] . . . }
- expression # commonly variable = expression
- print [ expression-list ] [ >expression ]
- printf format [ ,expression-list ] [ >expression ]
- next # skip remaining patterns on this input line
- exit [expr] # skip the rest of the input; exit status is expr
- return [expr]

Any single statement can be replaced by a statement list enclosed in braces. The statements are terminated by newline characters or semicolons, and are executed sequentially in the order that they appear.
The `next` statement causes all further processing of the current input record to be abandoned. The behavior is undefined if a `next` statement appears or is invoked in a `BEGIN` or `END` action.

The `exit` statement invokes all `END` actions in the order in which they occur in the program source and then terminate the program without reading further input. An `exit` statement inside an `END` action terminates the program without further execution of `END` actions. If an expression is specified in an `exit` statement, its numeric value is the exit status of `nawk`, unless subsequent errors are encountered or a subsequent `exit` statement with an expression is executed.

The `print` and `printf` statements write to standard output by default. The output is written to the location specified by `output_redirection` if one is supplied, as follows:

```
> expression>> expression| expression
```

In all cases, the `expression` is evaluated to produce a string that is used as a full pathname to write into (for `>` or `>>`) or as a command to be executed (for `|`). Using the first two forms, if the file of that name is not currently open, it is opened, creating it if necessary and using the first form, truncating the file. The output then is appended to the file. As long as the file remains open, subsequent calls in which `expression` evaluates to the same string value simply appends output to the file. The file remains open until the `close` function, which is called with an expression that evaluates to the same string value.

The third form writes output onto a stream piped to the input of a command. The stream is created if no stream is currently open with the value of `expression` as its command name. The stream created is equivalent to one created by a call to the `popen(3C)` function with the value of `expression` as the `command` argument and a value of `w` as the `mode` argument. As long as the stream remains open, subsequent calls in which `expression` evaluates to the same string value writes output to the existing stream. The stream remains open until the `close` function is called with an expression that evaluates to the same string value. At that time, the stream is closed as if by a call to the `pclose` function.

These output statements take a comma-separated list of `expression` referred in the grammar by the non-terminal symbols `expr_list`, `print_expr_list` or `print_expr_list_opt`. This list is referred to here as the `expression list`, and each member is referred to as an `expression argument`.

The `print` statement writes the value of each expression argument onto the indicated output stream separated by the current output field separator (see variable `OFS` above), and terminated by the output record separator (see variable `ORS` above). All expression arguments are taken as strings, being converted if necessary; with the exception that the `printf` format in `OFMT` is used instead of the value in `CONVFMT`. An empty expression list stands for the whole input record ($0$).

The `printf` statement produces output based on a notation similar to the File Format Notation used to describe file formats in this document. Output is produced as specified with the first expression argument as the string `format` and subsequent expression arguments as the strings `arg1` to `argn`, inclusive, with the following exceptions:
1. The *format* is an actual character string rather than a graphical representation. Therefore, it cannot contain empty character positions. The space character in the *format* string, in any context other than a *flag* of a conversion specification, is treated as an ordinary character that is copied to the output.

2. If the character set contains a Delta character and that character appears in the *format* string, it is treated as an ordinary character that is copied to the output.

3. The *escape sequences* beginning with a backslash character is treated as sequences of ordinary characters that are copied to the output. Note that these same sequences is interpreted lexically by *nawk* when they appear in literal strings, but they is not treated specially by the *printf* statement.

4. A *field width or precision* can be specified as the * character instead of a digit string. In this case the next argument from the expression list is fetched and its numeric value taken as the field width or precision.

5. The implementation does not precede or follow output from the *d* or *u* conversion specifications with blank characters not specified by the *format* string.

6. The implementation does not precede output from the *o* conversion specification with leading zeros not specified by the *format* string.

7. For the *c* conversion specification: if the argument has a numeric value, the character whose encoding is that value is output. If the value is zero or is not the encoding of any character in the character set, the behavior is undefined. If the argument does not have a numeric value, the first character of the string value is output; if the string does not contain any characters the behavior is undefined.

8. For each conversion specification that consumes an argument, the next expression argument is evaluated. With the exception of the *c* conversion, the value is converted to the appropriate type for the conversion specification.

9. If there are insufficient expression arguments to satisfy all the conversion specifications in the *format* string, the behavior is undefined.

10. If any character sequence in the *format* string begins with a % character, but does not form a valid conversion specification, the behavior is unspecified.

Both *print* and *printf* can output at least (LINE_MAX) bytes.

**Functions**

The *nawk* language has a variety of built-in functions: arithmetic, string, input/output and general.

**Arithmetic Functions**

The arithmetic functions, except for *int*, are based on the ISO C standard. The behavior is undefined in cases where the ISO C standard specifies that an error be returned or that the behavior is undefined. Although the grammar permits built-in functions to appear with no arguments or parentheses, unless the argument or parentheses are indicated as optional in the following list (by displaying them within the [ ] brackets), such use is undefined.

*atan2*(y,x) Return arctangent of y/x.
\begin{itemize}
\item \texttt{cos(x)} \quad \text{Return cosine of } x, \text{ where } x \text{ is in radians.}
\item \texttt{sin(x)} \quad \text{Return sine of } x, \text{ where } x \text{ is in radians.}
\item \texttt{exp(x)} \quad \text{Return the exponential function of } x.
\item \texttt{log(x)} \quad \text{Return the natural logarithm of } x.
\item \texttt{sqrt(x)} \quad \text{Return the square root of } x.
\item \texttt{int(x)} \quad \text{Truncate its argument to an integer. It is truncated toward 0 when } x > 0.
\item \texttt{rand()} \quad \text{Return a random number } n, \text{ such that } 0 \leq n < 1.
\item \texttt{srand([expr])} \quad \text{Set the seed value for } \texttt{rand} \text{ to } expr \text{ or use the time of day if } expr \text{ is omitted. The previous seed value is returned.}
\end{itemize}

\textbf{String Functions} \quad The string functions in the following list shall be supported. Although the grammar permits built-in functions to appear with no arguments or parentheses, unless the argument or parentheses are indicated as optional in the following list (by displaying them within the [ ] brackets), such use is undefined.

\begin{itemize}
\item \texttt{gsub(ere, repl[, in])} \quad \text{Behave like sub (see below), except that it replaces all occurrences of the regular expression (like the ed utility global substitute) in $0$ or in the in argument, when specified.}
\item \texttt{index(s, t)} \quad \text{Return the position, in characters, numbering from 1, in string } s \text{ where string } t \text{ first occurs, or zero if it does not occur at all.}
\item \texttt{length([s])]}) \quad \text{Return the length, in characters, of its argument taken as a string, or of the whole record, $0$, if there is no argument.}
\item \texttt{match(s, ere)} \quad \text{Return the position, in characters, numbering from 1, in string } s \text{ where the extended regular expression } ere \text{ occurs, or zero if it does not occur at all. \texttt{RSTART} is set to the starting position (which is the same as the returned value), zero if no match is found; \texttt{RLENGTH} is set to the length of the matched string, $-1$ if no match is found.}
\item \texttt{split(s, a[, fs])} \quad \text{Split the string } s \text{ into array elements } a[1], a[2], \ldots, a[n], \text{ and return } n. \text{ The separation is done with the extended regular expression } fs \text{ or with the field separator } FS \text{ if } fs \text{ is not given. Each array element has a string value when created. If the string assigned to any array element, with any occurrence of the decimal-point character from the current locale changed to a period character, would be considered a numeric string; the array element also has the numeric value of the numeric string. The effect of a null string as the value of } fs \text{ is unspecified.}
\end{itemize}
sprintf(fmt,expr,expr,...) Format the expressions according to the printf format given by fmt and return the resulting string.

sub(ere, repl[,...]) Substitute the string repl in place of the first instance of the extended regular expression ERE in string in and return the number of substitutions. An ampersand (&) appearing in the string repl is replaced by the string from in that matches the regular expression. An ampersand preceded with a backslash (\) is interpreted as the literal ampersand character. An occurrence of two consecutive backslashes is interpreted as just a single literal backslash character. Any other occurrence of a backslash (for example, preceding any other character) is treated as a literal backslash character. If repl is a string literal, the handling of the ampersand character occurs after any lexical processing, including any lexical backslash escape sequence processing. If in is specified and it is not an lvalue the behavior is undefined. If in is omitted, awk uses the current record ($0) in its place.

substr(s,m[,n]) Return the at most n-character substring of s that begins at position m, numbering from 1. If n is missing, the length of the substring is limited by the length of the string s.

tolower(s) Return a string based on the string s. Each character in s that is an upper-case letter specified to have a tolower mapping by the LC_CTYPE category of the current locale is replaced in the returned string by the lower-case letter specified by the mapping. Other characters in s are unchanged in the returned string.

toupper(s) Return a string based on the string s. Each character in s that is a lower-case letter specified to have a toupper mapping by the LC_CTYPE category of the current locale is replaced in the returned string by the upper-case letter specified by the mapping. Other characters in s are unchanged in the returned string.

All of the preceding functions that take ERE as a parameter expect a pattern or a string valued expression that is a regular expression as defined below.

Input/Output and General Functions

The input/output and general functions are:

close(expression) Close the file or pipe opened by a print or printf statement or a call to getline with the same string-valued expression. If the close was successful, the function returns 0; otherwise, it returns non-zero.
expressiongetline[var]  Read a record of input from a stream piped from the output of a command. The stream is created if no stream is currently open with the value of expression as its command name. The stream created is equivalent to one created by a call to the popen function with the value of expression as the command argument and a value of r as the mode argument. As long as the stream remains open, subsequent calls in which expression evaluates to the same string value reads subsequent records from the file. The stream remains open until the close function is called with an expression that evaluates to the same string value. At that time, the stream is closed as if by a call to the pclose function. If var is missing, $0 and NF is set. Otherwise, var is set.

The getline operator can form ambiguous constructs when there are operators that are not in parentheses (including concatenate) to the left of the | (to the beginning of the expression containing getline). In the context of the $ operator, | behaves as if it had a lower precedence than $. The result of evaluating other operators is unspecified, and all such uses of portable applications must be put in parentheses properly.

ggetline  Set $0 to the next input record from the current input file. This form of getline sets the NF, NR, and FNR variables.

ggetline var  Set variable var to the next input record from the current input file. This form of getline sets the FNR and NR variables.

ggetline [var] < expression  Read the next record of input from a named file. The expression is evaluated to produce a string that is used as a full pathname. If the file of that name is not currently open, it is opened. As long as the stream remains open, subsequent calls in which expression evaluates to the same string value reads subsequent records from the file. The file remains open until the close function is called with an expression that evaluates to the same string value. If var is missing, $0 and NF is set. Otherwise, var is set.

The getline operator can form ambiguous constructs when there are binary operators that are not in parentheses (including concatenate) to the right of the < (up to the end of the expression containing the getline). The result of evaluating such a construct is unspecified, and all such uses of portable applications must be put in parentheses properly.

system(expression)  Execute the command given by expression in a manner equivalent to the system(3C) function and return the exit
status of the command.

All forms of getline return 1 for successful input, 0 for end of file, and −1 for an error.

Where strings are used as the name of a file or pipeline, the strings must be textually identical. The terminology “same string value” implies that “equivalent strings”, even those that differ only by space characters, represent different files.

User-defined Functions

The nawk language also provides user-defined functions. Such functions can be defined as:

```awk
function name(args, ...) {
    statements
}
```

A function can be referred to anywhere in an nawk program; in particular, its use can precede its definition. The scope of a function is global.

Function arguments can be either scalars or arrays; the behavior is undefined if an array name is passed as an argument that the function uses as a scalar, or if a scalar expression is passed as an argument that the function uses as an array. Function arguments are passed by value if scalar and by reference if array name. Argument names are local to the function; all other variable names are global. The same name is not used as both an argument name and as the name of a function or a special nawk variable. The same name must not be used both as a variable name with global scope and as the name of a function. The same name must not be used within the same scope both as a scalar variable and as an array.

The number of parameters in the function definition need not match the number of parameters in the function call. Excess formal parameters can be used as local variables. If fewer arguments are supplied in a function call than are in the function definition, the extra parameters that are used in the function body as scalars are initialized with a string value of the null string and a numeric value of zero, and the extra parameters that are used in the function body as arrays are initialized as empty arrays. If more arguments are supplied in a function call than are in the function definition, the behavior is undefined.

When invoking a function, no white space can be placed between the function name and the opening parenthesis. Function calls can be nested and recursive calls can be made upon functions. Upon return from any nested or recursive function call, the values of all of the calling function’s parameters are unchanged, except for array parameters passed by reference. The return statement can be used to return a value. If a return statement appears outside of a function definition, the behavior is undefined.

In the function definition, newline characters are optional before the opening brace and after the closing brace. Function definitions can appear anywhere in the program where a pattern-action pair is allowed.

Usage

The index, length, match, and substr functions should not be confused with similar functions in the ISO C standard; the nawk versions deal with characters, while the ISO C standard deals with bytes.
Because the concatenation operation is represented by adjacent expressions rather than an explicit operator, it is often necessary to use parentheses to enforce the proper evaluation precedence.

See `largefile(5)` for the description of the behavior of `nawk` when encountering files greater than or equal to 2 Gbyte ($2^{31}$ bytes).

**Examples**

The `nawk` program specified in the command line is most easily specified within single-quotes (for example, `program`) for applications using `sh`, because `nawk` programs commonly contain characters that are special to the shell, including double-quotes. In the cases where a `nawk` program contains single-quote characters, it is usually easiest to specify most of the program as strings within single-quotes concatenated by the shell with quoted single-quote characters. For example:

```
nawk '/\''\'/ { print "quote:"", $0 }'
```

prints all lines from the standard input containing a single-quote character, prefixed with `quote:`.

The following are examples of simple `nawk` programs:

**EXAMPLE 1**  Write to the standard output all input lines for which field 3 is greater than 5:

```
$3 > 5
```

**EXAMPLE 2**  Write every tenth line:

```
(NR % 10) == 0
```

**EXAMPLE 3**  Write any line with a substring matching the regular expression:

```
/(G|D){2[0-9][[:alpha:]]*/
```

**EXAMPLE 4**  Print any line with a substring containing a G or D, followed by a sequence of digits and characters:

This example uses character classes `digit` and `alpha` to match language-independent digit and alphabetic characters, respectively.

```
/(G|D)([[:digit:][:alpha:]]*)/
```

**EXAMPLE 5**  Write any line in which the second field matches the regular expression and the fourth field does not:

```
$2 ~ /xyz/ && $4 !~ /xyz/
```

**EXAMPLE 6**  Write any line in which the second field contains a backslash:

```
$2 ~ /\\/
```
EXAMPLE 7  Write any line in which the second field contains a backslash (alternate method):
Notice that backslash escapes are interpreted twice, once in lexical processing of the string and once in processing the regular expression.

\$2 = "\\\\"

EXAMPLE 8  Write the second to the last and the last field in each line, separating the fields by a colon:
{OFS="";print $(NF-1), $NF}

EXAMPLE 9  Write the line number and number of fields in each line:
The three strings representing the line number, the colon and the number of fields are concatenated and that string is written to standard output.

{print NR "::" NF}

EXAMPLE 10  Write lines longer than 72 characters:
{length($0) > 72}

EXAMPLE 11  Write first two fields in opposite order separated by the OFS:
{ print $2, $1 }

EXAMPLE 12  Same, with input fields separated by comma or space and tab characters, or both:
BEGIN { FS = ",|\[t]*\[t]+" }
{ print $2, $1 }

EXAMPLE 13  Add up first column, print sum and average:
{ s += $1 }
END {print "sum is ", s, " average is", s/NR}

EXAMPLE 14  Write fields in reverse order, one per line (many lines out for each line in):
{ for (i = NF; i > 0; --i) print $i }

EXAMPLE 15  Write all lines between occurrences of the strings "start" and "stop":
/start/, /stop/

EXAMPLE 16  Write all lines whose first field is different from the previous one:
$1 != prev { print; prev = $1 }

EXAMPLE 17  Simulate the echo command:
BEGIN {
    for (i = 1; i < ARGC; ++i)
        printf "%s", ARGV[i], i==ARGC-1?"\n":""
EXAMPLE 17  Simulate the echo command:  (Continued)

EXAMPLE 18  Write the path prefixes contained in the PATH environment variable, one per line:
BEGIN  
   n = split (ENVIRON["PATH"], path, ":")
   for (i = 1; i <= n; ++i)
      print path[i]

EXAMPLE 19  Print the file “input”, filling in page numbers starting at 5:
If there is a file named input containing page headers of the form
Page#
and a file named program that contains
/Page/ { $2 = n++; }
{ print }
then the command line
nawk -f program n=5 input
prints the file input, filling in page numbers starting at 5.

**Environment Variables**  See environ(5) for descriptions of the following environment variables that affect execution: LC_COLLATE, LC_CTYPE, LC_MESSAGES, and NLSPATH.

**LC_NUMERIC**  Determine the radix character used when interpreting numeric input, performing conversions between numeric and string values and formatting numeric output. Regardless of locale, the period character (the decimal-point character of the POSIX locale) is the decimal-point character recognized in processing awk programs (including assignments in command-line arguments).

**Exit Status**  The following exit values are returned:
0   All input files were processed successfully.
>0  An error occurred.

The exit status can be altered within the program by using an exit expression.

**Attributes**  See attributes(5) for descriptions of the following attributes:
If any file operand is specified and the named file cannot be accessed, nawk writes a diagnostic message to standard error and terminate without any further action.

If the program specified by either the program operand or a progfile operand is not a valid nawk program (as specified in EXTENDED DESCRIPTION), the behavior is undefined.

Notes

Input white space is not preserved on output if fields are involved.

There are no explicit conversions between numbers and strings. To force an expression to be treated as a number add 0 to it; to force it to be treated as a string concatenate the null string ("") to it.

See Also

awk(1), ed(1), egrep(1), grep(1), lex(1), sed(1), popen(3C), printf(3C), system(3C), attributes(5), environ(5), largefile(5), regex(5), XPG4(5)

nc(1)

Name  nc, netcat – arbitrary TCP and UDP connections and listens

Synopsis  nc -h
        nc [-46dnrtuvz] [-P proxy_username] [-p port]
        [-s source_ip_address] [-T dscp] [-w timeout]
        [-X proxy_protocol] [-x proxy_address[:port]] [-L timeout]
        [-e program] [-b bufsize] [-q timeout] [-m bytes]
        [-l bufsize][-o bufsize] hostname port_list
        nc -1 [-46dEFnrtvzZ] [-i interval] [-T dscp] [-e program]
        [-b bufsize] [-q timeout] [-R address/port[/proto]] [-m bytes]
        [-l timeout] [-l bufsize] [-o bufsize] [hostname] port
        nc -l [-46dEFntvzZ] [-i interval] [-T dscp] [-e program]
        [-b bufsize] [-q timeout] [-R address/port[/proto]] [-m bytes]
        [-l timeout] [-l bufsize] [-o bufsize]
        -p port [hostname]
        nc -U [-DdtvZ] [-i interval] [-w timeout] [-e program]
        [-b bufsize] [-q timeout] [-m bytes] path
        nc -U [-46dktvZ] [-i interval] [-e program] [-b bufsize]
        [-q timeout] [-R address/port[/proto]] [-m bytes] path

Description  The nc (or netcat) utility is used for a variety of tasks associated with TCP or UDP. nc can open TCP connections, send UDP packets, listen on arbitrary TCP and UDP ports, perform port scanning, and deal with both IPv4 and IPv6. Unlike telnet(1), nc scripts nicely, and separates error messages onto standard error instead of sending them to standard output.

The nc command is often used for the following tasks:
- simple TCP proxies
- shell-script based HTTP clients and servers
- network daemon testing
- a SOCKS or HTTP ProxyCommand for ssh(1)

The nc command can also be run as netcat, using the identical options.

Options  The following options are supported:
- -4
  Force nc to use IPv4 addresses only.
- -6
  Force nc to use IPv6 addresses only.
- -b bufsize
  Specify buffer size for read operations.

  The default value is 1024 bytes.
-D
Enable debugging on the socket.

-d
Do not attempt to read from stdin.

-E
Use exclusive bind for listening TCP or UDP socket.
It is an error to use this option without the -l option.
This option does not have any effect when used in conjunction with the -u option.

-e program
Execute external program after accepting a connection or making connection. Before the execution stdin, stdout, stderr is redirected to the network descriptor. Only one port can be used with this option.
It is an error to use this option in conjunction with the -R, -k, or -i options.

-F
Do not close network socket for writing after seeing EOF on stdin.

-h
Print nc help.

-I bufsize
Set receive (input) socket buffer size.
This option does not have any effect when used in conjunction with the -u option.

-i interval
Specify a delay time of interval between lines of text sent and received.
The interval is specified in seconds, with possible fractions.
This option also causes a delay time between connections to multiple ports, and therefore also affects port scan mode.

-k
Force nc to listen for another connection after its current connection is closed.
It is an error to use this option without the -l option.
It is an error to use this option in conjunction with the -e option.

-L timeout
Linger on close - wait for messages to be sent after network descriptor is closed up to specified timeout in seconds.
-l
   Listen for an incoming connection rather than initiate a connection to a remote host.
   
   It is an error to use this option in conjunction with the -s or -z options.
   
   If the -l option is used with a wildcard socket (no IP address or hostname specified) and
   without the -4 / -6 options, it accepts both IPv4 and IPv6 connections.

- m byte_count
   Quit after receiving at least byte_count bytes. When used with -l option byte_count is
   compared to number of bytes received from the client.
   
   byte_count must be greater than 0 and less than INT_MAX.

- N file
   Specifies file with pattern for UDP port scanning. The contents of this file are used as
   payload for each emitted UDP packet.
   
   It is an error to use this option without the -u and -z options.

- n
   Do not do any naming or service lookups on any addresses, hostnames, or ports.
   
   Use of this option means that hostname and port arguments are restricted to numeric
   values.
   
   If used with -v option all addresses and ports are printed in numeric form, in addition to
   the restriction imposed on the arguments. This option does not have any effect when used
   in conjunction with the -U option.

- O bufsize
   Set send (output) socket buffer size.
   
   This option does not have any effect when used in conjunction with the -U option.

- P proxy_username
   Specify a username (proxy_username) to present to a proxy server that requires
   authentication. If proxy_username is not specified, authentication is not attempted. Proxy
   authentication is only supported for HTTP CONNECT proxies at present.
   
   It is an error to use this option in conjunction with the -l option.

- p port
   When used without -l option, specify the source port nc should use, subject to privilege
   restrictions and availability. When used with the -l option, set the listen port.
   
   This option can be used with -l option only provided global port argument is not specified.

- q timeout
   After receiving EOF on stdin, wait for specified number of seconds and quit.
-R addr/port[/proto]
  Perform port redirection to given host and port.

  After the connection has been accepted, nc connects to the remote host/port and passes all data between the client and the remote host. The proto (protocol) part of the redirect specification can be either tcp or udp. If the proto is not specified, redirector uses the same protocol as the server.

  It is an error to use this option in conjunction with the -z option.

-r
  Choose destination ports randomly instead of sequentially within all ports specified by the port_list argument.

  It is an error to use this option in conjunction with the -l option.

-s source_ip_address
  Specify the IP of the interface which is used to send the packets.

  It is an error to use this option in conjunction with the -l option.

-T dscp
  Specify Differentiated Services Code Point for the connection.

  For IPv4 this specifies the IP Type of Service (ToS) IP header field and the valid values for the argument are the string tokens: lowdelay, throughput, reliability, or an 8-bit hexadecimal value preceded by 0x.

  For IPv6 (Traffic Class) only hexadecimal value can be used.

-t
  Cause nc to send RFC 854 DON'T and WON'T responses to RFC 854 DO and WILL requests. This makes it possible to use nc to script telnet sessions.

-U
  Specify the use of Unix Domain Sockets. If you specify this option without -l, nc, it becomes AF_UNIX client. If you specify this option with the -l option, a AF_UNIX server is created.

  Use of this option requires that a single argument of a valid Unix domain path has to be provided to nc, not a host name or port.

-u
  Use UDP instead of the default option of TCP.

-v
  Specify verbose output.

-w timeout
  Silently close the connection if a connection and stdin are idle for more than timeout seconds.
The default is no timeout.

This option has no effect on the connection establishment phase in client mode or waiting for a connection in server mode.

-X proxy_protocol
Use the specified protocol when talking to the proxy server. Supported protocols are 4 (SOCKS v.4), 5 (SOCKS v.5) and connect (HTTP proxy). If the protocol is not specified, SOCKS v.5 is used.

It is an error to use this option in conjunction with the -l option.

-x proxy_address[:port]
Request connection to hostname using a proxy at proxy_address and port. If port is not specified, the well-known port for the proxy protocol is used (1080 for SOCKS, 3128 for HTTP).

It is an error to use this option in conjunction with the -l option.

This option does not work with numeric representation of IPv6 addresses.

-Z
In listening mode bind to address/port in all zones using the SO_ALLZONES socket option.

This option requires SYS_NET_CONFIG privilege.

-z
Perform port scan. For TCP ports (default), connect scan (full 3-way handshake) is tried with no data sent. For UDP (-u) empty UDP packets are sent by default. To specify UDP payload the -N option can be used.

The UDP scan mode is estimative, it considers a port to be open if it does not receive negative response (ICMP Destination Port Unreachable message). For this mode the timeout set with the -w option is used to wait for the ICMP messages or data from remote node. With -v any received data is dumped as hexadecimal bytes to stderr.

As most of the operating systems employ rate limiting for sending ICMP messages in reaction to input packets, it is necessary to use -l when performing UDP scan otherwise the results is not reliable.

It is an error to use this option in conjunction with the -l option.

Operands
The following operands are supported:

hostname
Specify host name.

hostname can be a numerical IP address or a symbolic hostname (unless the -n option is specified).
In general, `hostname` must be specified, unless the `-l` option is given or `-U` is used (in which case the argument is a path). If `hostname` argument is specified with `-l` option then `port` argument must be given as well and `nc` tries to bind to that address and port. If `hostname` argument is not specified with `-l` option then `nc` tries to listen on a wildcard socket for given `port`.

`path` Specify pathname.

`port` Specify port.

`port_list` Specify ranges in the form of `nn-mm`. The `port_list` must have at least one member, but can have multiple ports/ranges separated by commas.

In general, a destination port must be specified, unless the `-U` option is given, in which case a Unix Domain Socket path must be specified instead of `hostname`.

It is an error to use list of ports containing more than one port in conjunction with the `-e` option.

**Usage**

**Client/Server Model**

It is quite simple to build a very basic client/server model using `nc`. On one console, start `nc` listening on a specific port for a connection. For example, the command:

```
$ nc -l 1234
```

listens on port 1234 for a connection. On a second console (or a second machine), connect to the machine and port to which `nc` is listening:

```
$ nc 127.0.0.1 1234
```

There should now be a connection between the ports. Anything typed at the second console is concatenated to the first, and vice-versa. After the connection has been set up, `nc` does not really care which side is being used as a `server` and which side is being used as a `client`. The connection can be terminated using an EOF (Ctrl/d).

**Data Transfer**

The example in the previous section can be expanded to build a basic data transfer model. Any information input into one end of the connection is output to the other end, and input and output can be easily captured in order to emulate file transfer.

Start by using `nc` to listen on a specific port, with output captured into a file:

```
$ nc -l 1234 > filename.out
```

Using a second machine, connect to the listening `nc` process, feeding it the file which is to be transferred:
$ nc host.example.com 1234 < filename.in

After the file has been transferred, the connection closes automatically.

Talking to Servers

It is sometimes useful to talk to servers by hand rather than through a user interface. It can aid in troubleshooting, when it might be necessary to verify what data a server is sending in response to commands issued by the client.

For example, to retrieve the homepage of a website:

$ echo -n "GET / HTTP/1.0\r\n\n\n" | nc host.example.com 80

This also displays the headers sent by the web server. They can be filtered, if necessary, by using a tool such as `sed(1)`.

More complicated examples can be built up when the user knows the format of requests required by the server. As another example, an email can be submitted to an SMTP server using:

$ nc localhost 25 << EOF
HELO host.example.com
MAIL FROM: <user@host.example.com
RCPT TO: <user2@host.example.com
DATA
Body of email.
.
QUIT
EOF

Port Scanning

It can be useful to know which ports are open and running services on a target machine. The `-z` flag can be used to tell `nc` to report open ports, rather than to initiate a connection.

In this example:

$ nc -z host.example.com 20-30
Connection to host.example.com 22 port [tcp/ssh] succeeded!
Connection to host.example.com 25 port [tcp/smtp] succeeded!

The port range was specified to limit the search to ports 20 - 30.

Alternatively, it might be useful to know which server software is running, and which versions. This information is often contained within the greeting banners. In order to retrieve these, it is necessary to first make a connection, and then break the connection when the banner has been retrieved. This can be accomplished by specifying a small timeout with the `-w` flag, or perhaps by issuing a QUIT command to the server:

$ echo "QUIT" | nc host.example.com 20-30
SSH-2.0-Sun_SSH_1.1
Protocol mismatch.
One of the possible uses is to create simple services by using `inetd(1M)`.

The following example creates a redirect from TCP port 8080 to port 80 on host `realwww`:

```
# cat << EOF >> /etc/services
wwwredir 8080/tcp # WWW redirect
EOF
# cat << EOF > /tmp/wwwredir.conf
wwwredir stream tcp nowait nobody /usr/bin/nc /usr/bin/nc -w 3 realwww 80
EOF
# inetconv -i /tmp/wwwredir.conf
wwwredir -> /var/svc/manifest/network/wwwredir-tcp.xml
Importing wwwredir-tcp.xml ...Done
# inetadm -l wwwredir/tcp
SCOPE  NAME=VALUE
   name="wwwredir"
   endpoint_type="stream"
   proto="tcp"
   isrpc=FALSE
   wait=FALSE
   exec="/usr/bin/nc -w 3 realwww 80"
   arg0="/usr/bin/nc"
   user="nobody"
   default  bind_addr=""
   default  bind_fail_max=-1
   default  bind_fail_interval=-1
   default  max_con_rate=-1
   default  max_copies=-1
   default  con_rate_offline=-1
   default  failrate_cnt=40
   default  failrate_interval=60
   default  inherit_env=TRUE
   default  tcp_trace=TRUE
   default  tcp_wrappers=FALSE
```

To bind to a privileged port number `nc` needs to be granted the `net_privaddr` privilege. If Solaris Trusted Extensions are configured and the port `nc` should listen on is configured as a multi-level port `nc` also needs the `net_bindmlp` privilege.

Privileges can be assigned to the user or role directly, by specifying them in the account's default privilege set in `user_attr(4)`. However, this means that any application that this user or role starts have these additional privileges. To only grant the `privileges(5)` when `nc` is invoked, the recommended approach is to create and assign an `rbac(5)` rights profile. See `EXAMPLES` for additional information.
Examples

Example 1 Using nc

Open a TCP connection to port 42 of host.example.com, using port 3141 as the source port, with a timeout of 5 seconds:

$ nc -p 3141 -w 5 host.example.com 42

Open a UDP connection to port 53 of host.example.com:

$ nc -u host.example.com 53

Open a TCP connection to port 42 of host.example.com using 10.1.2.3 as the IP for the local end of the connection:

$ nc -s 10.1.2.3 host.example.com 42

Use a list of ports and port ranges for a port scan on various ports:

$ nc -z host.example.com 21-25,53,80,110-120,443

Create and listen on a Unix Domain Socket:

$ nc -lU /var/tmp/dsocket

Create and listen on a UDP socket with associated port 8888:

$ nc -u -l -p 8888

which is the same as:

$ nc -u -l 8888

Create and listen on a TCP socket with associated port 2222 and bind to address 127.0.0.1 only:

$ nc -l 127.0.0.1 2222

Connect to TCP port, send some data and terminate the connection with TCP RST segment (instead of classic TCP closing handshake) by setting the linger option and timeout to 0:

$ echo "foo" | nc -L 0 host.example.com 22

Perform port redirection to port 22 on host host.example.com from local port 4545:

$ nc -R host.example.com/22 -l 4545

After that, it should be possible to run ssh(1) client and connect to host.example.com using host redir.example.com running the above command:

$ ssh -oStrictHostKeyChecking=no -p 4545 redir.example.com

It is also possible to let nc listen on TCP port and convert the TCP data stream to UDP (or vice versa):
EXAMPLE 1 Using nc  
(Continued)

$ nc -R host.example.com/53/udp -l 4666

Connect to port 42 of host.example.com using an HTTP proxy at 10.2.3.4, port 8080. This example could also be used by ssh(1). See the ProxyCommand directive in ssh_config(4) for more information.

$ nc -x10.2.3.4:8080 -Xconnect host.example.com 42

The same example again, this time enabling proxy authentication with username ruser if the proxy requires it:

$ nc -x10.2.3.4:8080 -Xconnect -Pruser host.example.com 42

Basic UDP port scan can be efficiently done like this:

$ nc -z -w 3 -u -i 0.5 host.example.com 11-100

Between each 2 ports it pauses for 0.5 second (thus evading ICMP message rate limiting) and waits up to 3 seconds for reply. If no reply comes then the port might be open.

To run nc with the smallest possible set of privileges as a user or role that has additional privileges (such as the default root account) it can be invoked using ppriv(1) as well. For example, limiting it to only run with the privilege to bind to a privileged port:

$ ppriv -e -sA=basic,!file_link_any,!proc_exec,!proc_fork,!proc_info,!proc_session,net_privaddr nc -l 42

To allow a user or role to use only nc with the net_privaddr privilege, a rights profile needs to be created:

/etc/security/exec_attr
Netcat privileged::solaris:cmd:::/usr/bin/nc:privils=net_privaddr

/etc/security/prof_attr
Netcat privileged:::Allow nc to bind to privileged ports:help=None.html

Assigning this rights profile using user_attr(4) permits the user or role to run nc allowing it to listen on any port. To permit a user or role to use nc only to listen on specific ports a wrapper script should be specified in the rights profiles:

/etc/security/exec_attr
Netcat restricted::solaris:cmd:::/usr/bin/nc-restricted:privils=net_privaddr

/etc/security/prof_attr
Netcat restricted:::Allow nc to bind to privileged ports:help=None.html

and write a shell script that restricts the permissible options, for example, one that permits one to bind only on ports between 42 and 64 (non-inclusive):

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EXAMPLE 1 Using nc  (Continued)

/usr/bin/nc-restricted:

#!/bin/sh
[ $# -eq 1 ] && [ $1 -gt 42 -a $1 -lt 64 ] && /usr/bin/nc -l -p "$1"

This grants the extra privileges when the user or role invokes nc using the wrapper script from a profile shell. See pfsh(1), pfksh(1), pfcsh(1), and pfexec(1).

Invoking nc directly does not run it with the additional privileges, and neither does invoking the script without using pfexec or a profile shell.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>network/netcat</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>See below.</td>
</tr>
</tbody>
</table>

The package name is Committed. The command line syntax is Committed for the -4, -6, -l, -n, -p, -u, and -w options and their arguments (if any). The name and port list arguments are Committed. The port range syntax is Uncommitted. The interface stability level for all other command line options and their arguments is Uncommitted.

See Also  cat(1), pfcsh(1), pfexec(1), pfksh(1), pfsh(1), ppriv(1), sed(1), ssh(1), telnet(1),
inetadm(1M), inetconv(1M), inetd(1M), ssh_config(4), user_attr(4), attributes(5),
privileges(5), rbac(5)

Authors  The original implementation of nc was written by Hobbit, hobbit@avian.org.

nc was rewritten with IPv6 support by Eric Jackson, ericj@monkey.org.

Notes  If an instance of nc is listening on a wildcard socket (regardless of address family specification) it is still possible to bind another nc process to concrete IP address and accept connections to this address. For example, with the following process running:

$ nc -4 -l 5656

it is possible to run another nc process listening on specific IP address and the same port:

$ nc -4 -l 10.20.30.40 5656

TCP connection to address 10.20.30.40 and port 5656 is accepted by the latter process, all TCP connections to port 5656 and different addresses is accepted by the former process.
Also, it is possible to steal IPv4 connections from a process which listens on a wildcard socket (without address family specification) by binding to IPv4 wildcard socket. To suppress this and the behavior described above the `-E` option could be used.
ncab2clf(1)

Name  ncab2clf – convert binary log file to Common Log File format

Synopsis  /usr/bin/ncab2clf [-Dhv] [-i input-file] [-o output-file]
[-b size] [-n number] [-s datetime]

Description  The ncab2clf command is used to convert the log file generated by the Solaris Network Cache and Accelerator (NCA) from binary format, to Common Log File (CLF) format. If no input-file is specified, b2clf uses stdin. If no output-file is specified, the output goes to stdout.

Options  -b  Specifies the binary-log-file blocking in kilobytes; the default is 64 Kbyte.
-D  Specifies that direct I/O be disabled.
-h  Prints usage message.
-i input-file  Specifies the input file.
-n number  Output number CLF records.
-o output-file  Specifies the output file.
-s datetime  Skip any records before the date and time specified in datetime. You can specify the date and time in CLF format or in the format specified by the touch(1) utility. CLF format is the dominant format, so b2clf first analyzes datetime assuming CLF.
-v  Provides verbose output.

Examples  EXAMPLE 1  Converting a Binary File to a Common Log File Format
The following example converts the binary file /var//logs/.blf to a file /var//logs/.clf, which is in Common Log File format.
example% ncab2clf -D -i /var/nca/logs/nca.blf -o /var/nca/logs/nca.clf

EXAMPLE 2  Converting Multiple Log Files
The following script may be used to convert multiple log files. The directory designated by “*” must only contain log files.
!//bin/ksh
for filename in *
do
   ncab2clf -D < $filename > $filename.clf
done

EXAMPLE 3  Using -s and -n on a Raw Device
The following example shows how ncab2clf can be used on a raw device. If not using the -n option, the default is to convert all records from the starting location to the end of the file. The date and time specified with -s, below, is in CLF format.
EXAMPLE 3  Using -s and -n on a Raw Device  (Continued)

example% ncab2clf -s '10/Apr/2001:09:23:13' -n 100 < /dev/dsk/c2t1d0s6

Exit Status  The following exit values are returned:
0      The file converted successfully
>0     An error occurred.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/network/http-cache-accelerator</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  ncakmod(1), nca.if(4), ncakmod.conf(4), ncalogd.conf(4), attributes(5), nca(7d)

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Notes  The binary log files generated by NCA can become very large. When converting these large
binary files, use the -b option to the ncab2clf command to help performance.

Direct I/O is a benefit to the user if the data being written does not come in as large chunks.
However, if the user wishes to convert the log file in large chunks using the -b option, then
direct I/O should be disabled by using the -D option.
ncakmod(1)

Name ncakmod – start or stop the NCA kernel module

Synopsis /etc/init.d/ncakmod start | stop

Description ncakmod is used to start or stop the Solaris Network Cache and Accelerator (NCA) kernel module.

When the start option is specified at the command-line, the NCA kernel module will be activated for all physical interfaces listed in the nca.if file. When the ncakmod command is invoked with the stop option, the NCA kernel module will print the following message:

To stop NCA, please set the status configuration parameter to disable in ncakmod.conf and then reboot your system. See the ncakmod.conf(4) manual page for more information.

To properly stop NCA on your system, you must first edit the ncakmod.conf file and set the status field to “disable,” then reboot your system.

Options

- start    Starts the NCA kernel module.
- stop     Describes the current method for stopping the NCA feature.

Examples

EXAMPLE 1  Starting and Stopping the NCA Feature
The following command is used to start the NCA feature:

example% /etc/init.d/ncakmod start

Files

/etc/init.d/ncakmod  The NCA kernel module startup script.
/etc/nca/ncakmod.conf  Specifies configuration options for the NCA kernel module.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/network/http-cache-accelerator</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also

ncab2clf(1), ncad_addr(4), nca.if(4), ncakmod.conf(4), ncalogd.conf(4), attributes(5), nca(7d)
**Name**

newform – change the format of a text file

**Synopsis**

```
newform [ -s ] [ -i tabspec ] [ -o tabspec ] [ -bn ] [ -en ] [ -pn ]
       [ -an ] [ -f ] [ -cchar ] [ -\ln ] [ filename ]...
```

**Description**

newform reads lines from the named filenames, or the standard input if no input file is named, and reproduces the lines on the standard output. Lines are reformatted in accordance with command line options in effect.

Except for -s, command line options may appear in any order, may be repeated, and may be intermingled with the optional filenames. Command line options are processed in the order specified. This means that option sequences like " -e15 -l60" will yield results different from " -l60 -e15". Options are applied to all filenames on the command line.

**Options**

The following options are supported:

- **-s**
  Shears off leading characters on each line up to the first tab and places up to 8 of the sheared characters at the end of the line. If more than 8 characters (not counting the first tab) are sheared, the eighth character is replaced by a * and any characters to the right of it are discarded. The first tab is always discarded.

  An error message and program exit will occur if this option is used on a file without a tab on each line. The characters sheared off are saved internally until all other options specified are applied to that line. The characters are then added at the end of the processed line.

  For example, to convert a file with leading digits, one or more tabs, and text on each line, to a file beginning with the text, all tabs after the first expanded to spaces, padded with spaces out to column 72 (or truncated to column 72), and the leading digits placed starting at column 73, the command would be:

  ```
  newform -s -i -l -a -e filename
  ```

- **-itabspec**
  Input tab specification: expands tabs to spaces, according to the tab specifications given. Tabspec recognizes all tab specification forms described in tabs(1). In addition, tabspec may be --, in which newform assumes that the tab specification is to be found in the first line read from the standard input (see fspec(4)). If no tabspec is given, tabspec defaults to --8. A tabspec of --0 expects no tabs; if any are found, they are treated as --1.

- **-otabspec**
  Output tab specification: replaces spaces by tabs, according to the tab specifications given. The tab specifications are the same as for -itabspec. If no tabspec is given, tabspec defaults to --8. A tabspec of --0 means that no spaces will be converted to tabs on output.

- **-bn**
  Truncate n characters from the beginning of the line when the line length is greater than the effective line length (see --ln). Default is to truncate the number of characters necessary to obtain the effective line length. The default
value is used when -b with no n is used. This option can be used to delete the sequence numbers from a COBOL program as follows:

```
newform -l1 -b7 filename
```

-`en` Same as -bn except that characters are truncated from the end of the line.

-`pn` Prefix n characters (see -cchar) to the beginning of a line when the line length is less than the effective line length. Default is to prefix the number of characters necessary to obtain the effective line length.

-`an` Same as -pn except characters are appended to the end of a line.

-`f` Write the tab specification format line on the standard output before any other lines are output. The tab specification format line which is printed will correspond to the format specified in the last -o option. If no -o option is specified, the line which is printed will contain the default specification of −8.

-`cchar` Change the prefix/append character to char. Default character for char is a space.

-`ln` Set the effective line length to n characters. If n is not entered, -l defaults to 72. The default line length without the -l option is 80 characters. Note: Tabs and backspaces are considered to be one character (use -i to expand tabs to spaces).

The -l1 must be used to set the effective line length shorter than any existing line in the file so that the -b option is activated.

**Operands** The following operand is supported:

`filename` Input file

**Exit Status** The following exit values are returned:

0 Successful operation.
1 Operation failed.

**Attributes** See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

**See Also** csplit(1), tabs(1), fspec(4), attributes(5)

**Diagnostics** All diagnostics are fatal.

```
usage: . . .
newform was called with a bad option.
"not -s format"
There was no tab on one line.
```
"can’t open file"  Self-explanatory.
"internal line too long"  A line exceeds 512 characters after being expanded in
the internal work buffer.
"tabspec in error"  A tab specification is incorrectly formatted, or
specified tab stops are not ascending.
"tabspec indirection illegal"  A tabspec read from a file (or standard input) may not
contain a tabspec referencing another file (or standard
input).

**Notes**  newform normally only keeps track of physical characters; however, for the -i and -o options,
newform will keep track of backspaces in order to line up tabs in the appropriate logical columns.

newform will not prompt the user if a tabspec is to be read from the standard input (by use of
-i– or -o–).

If the -f option is used, and the last -o option specified was -o–, and was preceded by either a
-o– or a -i–, the tab specification format line will be incorrect.
The `newgrp` command logs a user into a new group by changing a user's real and effective group ID. The user remains logged in and the current directory is unchanged. The execution of `newgrp` always replaces the current shell with a new shell, even if the command terminates with an error (unknown group).

Any variable that is not exported is reset to null or its default value. Exported variables retain their values. System variables (such as `PS1`, `PS2`, `PATH`, `MAIL`, and `HOME`), are reset to default values unless they have been exported by the system or the user. For example, when a user has a primary prompt string (`PS1`) other than `$` (default) and has not exported `PS1`, the user’s `PS1` is set to the default prompt string `$`, even if `newgrp` terminates with an error. Note that the shell command `export` (see `sh(1)` and `set(1)`) is the method to export variables so that they retain their assigned value when invoking new shells.

With no operands and options, `newgrp` changes the user’s group IDs (real and effective) back to the group specified in the user’s password file entry. This is a way to exit the effect of an earlier `newgrp` command.

A password is demanded if the group has a password and the user is not listed in `/etc/group` as being a member of that group. The only way to create a password for a group is to use `passwd(1)`, then cut and paste the password from `/etc/shadow` to `/etc/group`. Group passwords are antiquated and not often used.

Equivalent to `exec newgrp argument` where `argument` represents the options and/or operand of the `newgrp` command.

Equivalent to `exec to/bin/newgrp argument` where `argument` represents the options and/or operand of the `newgrp` command.

On this man page, `ksh88(1)` commands that are preceded by one or two * (asterisks) are treated specially in the following ways:

1. Variable assignment lists preceding the command remain in effect when the command completes.
2. I/O redirections are processed after variable assignments.
3. Errors cause a script that contains them to abort.
4. Words, following a command preceded by ** that are in the format of a variable assignment, are expanded with the same rules as a variable assignment. This means that tilde substitution is performed after the = sign and word splitting and file name generation are not performed.

**ksh Built-in** Equivalent to exec to /bin/newgrp argument where argument represents the options and/or operand of the newgrp command.

On this man page, ksh(1) commands that are preceded by one or two + (plus signs) are treated specially in the following ways:
1. Variable assignment lists preceding the command remain in effect when the command completes.
2. I/O redirections are processed after variable assignments.
3. Errors cause a script that contains them to abort.
4. They are not valid function names.
5. Words, following a command preceded by ++ that are in the format of a variable assignment, are expanded with the same rules as a variable assignment. This means that tilde substitution is performed after the = sign and field splitting and file name generation are not performed.

**Options** The following option is supported:

- l | – Change the environment to what would be expected if the user actually logged in again as a member of the new group.

**Operands** The following operands are supported:

- group A group name from the group database or a non-negative numeric group ID. Specifies the group ID to which the real and effective group IDs is set. If group is a non-negative numeric string and exists in the group database as a group name (see getgrnam(3C)), the numeric group ID associated with that group name is used as the group ID.

- argument sh and ksh88 only. Options and/or operand of the newgrp command.

**Environment Variables** See environ(5) for descriptions of the following environment variables that affect the execution of newgrp: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

**Exit Status** If newgrp succeeds in creating a new shell execution environment, whether or not the group identification was changed successfully, the exit status is the exit status of the shell. Otherwise, the following exit value is returned:

>0 An error occurred.
Files

/etc/group    System group file
/etc/passwd   System password file

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTETYPE</th>
<th>ATTRIBUTEVALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ATTRIBUTETYPE</th>
<th>ATTRIBUTEVALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Uncommitted</td>
</tr>
</tbody>
</table>

See Also
login(1), ksh(1), ksh88(1), set(1), sh(1), Intro(3), getgrnam(3C), group(4), passwd(4), attributes(5), environ(5), standards(5)
newtask(1)

Name
newtask – create new task and optionally change project

Synopsis
newtask [-p project] [-v] [-c pid | [-F] [command...]]

Description
The newtask command executes the user’s default shell or a specified command, placing the executed command in a new task owned by the specified project. The user’s default shell is the one specified in the passwd database, and is determined using getpwnam().

Alternatively, newtask can be used to cause an already running process to enter a newly created task. A project for the new task can also be specified in this form of the command. This might be desirable for processes that are mission critical and cannot be restarted in order to put them into a new project.

In the case that extended accounting is active, the newtask command can additionally cause the creation of a task accounting record marking the completion of the preceding system task.

Options
The following options are supported:

-c pid
Cause a running process to enter a newly created task. A project for the new task can also be specified using the -p option. The invoking user must either own the process or have super-user privileges.

If the project is being changed, the process owner must be a member of the specified project, or the invoking user must have super-user privileges. When the project is changed for a running process, its pool binding as well as resource controls are modified to match the configuration of the new project. Controls not explicitly specified in the project entry is preserved.

This option is incompatible with the -F and -l options.

-F
Creates a finalized task, within which further newtask or settaskid(2) invocations would fail. Finalized tasks can be useful at some sites for simplifying the attribution of resource consumption.

-l
Changes the environment to what would be expected if the user actually logged in again as a member of the new project.

-p
Changes the project ID of the new task to that associated with the given project name. The invoking user must be a valid member of the requested project, or must have super-user privileges, for the command to succeed. If no project name is specified, the new task is started in the invoking user’s current project.

-v
Verbose: displays the system task id as the new system task is begun.

Operands
The following operands are supported:

project
The project to which resource usage by the created task should be charged. The requested project must be defined in the project databases defined in nsswitch.conf(4).
command  The command to be executed as the new task. If no command is given, the user's login shell is invoked. (If the login shell is not available, /bin/sh is invoked.)

Examples  

**EXAMPLE 1**  Creating a New Shell

The following example creates a new shell in the canada project, displaying the task id:

```bash
example$ id -p
uid=565(gh) gid=10(staff) projid=10(default)
example$ newtask -v -p canada
38
example$ id -p
uid=565(gh) gid=10(staff) projid=82(canada)
```

**EXAMPLE 2**  Running the date Command

The following example runs the date command in the russia project:

```bash
example$ newtask -p russia date
Tue Aug 31 11:12:10 PDT 1999
```

**EXAMPLE 3**  Changing the Project of an Existing Process

The following example changes the project of the existing process with a pid of 9999 to russia:

```bash
example$ newtask -c 9999 -p russia
```

Exit Status  The following exit values are returned:

- 0  Successful execution.
- 1  A fatal error occurred during execution.
- 2  Invalid command line options were specified.

Files

- /etc/project  Local database containing valid project definitions for this machine.
- /proc/pid/*  Process information and control files.

Attributes  See attributes(5) for a description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  proc(1), id(1M), poolbind(1M), execvp(2), setrlct(2), settaskid(2), setproject(3PROJECT), nsswitch.conf(4), proc(4), project(4), attributes(5)
nice(1)

### Name
nice – invoke a command with an altered scheduling priority

### Synopsis

```bash
/usr/bin/nice [-increment | -n increment] command [argument]...
```

```bash
/usr/xpg4/bin/nice [-increment | -n increment] command [argument]...
```

csh Builtin

```bash
nice [-increment | +increment] [command]
```

### Description
The `nice` utility invokes `command`, requesting that it be run with a different system scheduling priority. The `priocntl(1)` command is a more general interface to scheduler functions.

The invoking process (generally the user's shell) must be in a scheduling class that supports `nice`.

If the C shell (see `csh(1)`) is used, the full path of the command must be specified. Otherwise, the csh built-in version of `nice` will be invoked. See csh Builtin below.

### Options
The following options are supported:

- `-increment | -n increment`

  * `increment` is a positive or negative decimal integer that has the same effect on the execution of the utility as if the utility had called the `nice()` function with the numeric value of the `increment` option-argument. See `nice(2)`. `nice()` errors, other than EINVAL, are ignored. If not specified, an increment of `10` is assumed.

  The super-user may run commands with priority higher than normal by using a negative increment such as `-10`. A negative `increment` assigned by an unprivileged user is ignored.

### Operands
The following operands are supported:

- `command`
  The name of a command that is to be invoked. If `command` names any of the special built-in utilities (see `shell_builtins(1)`), the results are undefined.

- `argument`
  Any string to be supplied as an argument when invoking `command`.

### Environment Variables
See `environ(5)` for descriptions of the following environment variables that affect the execution of `nice`: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, PATH, and NLSPATH.
Exit Status  If command is invoked, the exit status of nice will be the exit status of command. Otherwise, nice will exit with one of the following values:

- **1-125**  An error occurred.
- **126**  command was found but could not be invoked.
- **127**  command could not be found.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>/usr/bin/nice</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
<td></td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>/usr/xpg4/bin/nice</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/xopen/xcu4</td>
<td></td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
<td></td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
<td></td>
</tr>
</tbody>
</table>

See Also  csh(1), ksh88(1), nohup(1), priocntl(1), sh(1), shell_builtins(1), nice(2), attributes(5), environ(5), standards(5)
**Name**  
**nl** – line numbering filter

**Synopsis**  

```
/usr/bin/nl [-p] [-b [type]] [-d [delim]] [-f [type]]
   [-h [type]] [-i [incr]] [-l [num]] [-n [format]]
   [-s [sep]] [-w [width]] [-v [startnum]] [file]
```

```
/usr/xpg4/bin/nl [-p] [-b type] [-d delim] [-f type]
   [-h type] [-i incr] [-l num] [-n format] [-s sep]
   [-w width] [-v startnum] [file]
```

**Description**  
The **nl** utility reads lines from the named *file*, or the standard input if no *file* is named, and reproduces the lines on the standard output. Lines are numbered on the left in accordance with the command options in effect.

**nl** views the text it reads in terms of logical pages. Line numbering is reset at the start of each logical page. A logical page consists of a header, a body, and a footer section. Empty sections are valid. Different line numbering options are independently available for header, body, and footer. For example, `-bt` (the default) numbers non-blank lines in the body section and does not number any lines in the header and footer sections.

The start of logical page sections are signaled by input lines containing nothing but the following delimiter character(s):

<table>
<thead>
<tr>
<th>Line contents</th>
<th>Start Of</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>\:\\:</code></td>
<td>header</td>
</tr>
<tr>
<td><code>\:\:</code></td>
<td>body</td>
</tr>
<tr>
<td><code>\:</code></td>
<td>footer</td>
</tr>
</tbody>
</table>

Unless optioned otherwise, **nl** assumes the text being read is in a single logical page body.

**Options**  
Command options may appear in any order and may be intermingled with an optional file name. Only one file may be named. The specified default is used when the option is not entered on the command line. **/usr/xpg4/bin/nl** options require option arguments. A SPACE character may separate options from option arguments. **/usr/bin/nl** options may have option arguments. If option-arguments of **/usr/bin/nl** options are not specified, these options result in the default. The supported options are:

- `-btype`  
  Specifies which logical page body lines are to be numbered. Recognized *types* and their meanings are:
  
  *a*    number all lines  
  *t*    number all non-empty lines.  
  *n*    no line numbering
pexp number only lines that contain the regular expression specified in exp. See NOTES below.

Default type for logical page body is t (text lines numbered).

-ftype Same as -btype except for footer. Default type for logical page footer is n (no lines numbered).

-adelim The two delimiter characters specifying the start of a logical page section may be changed from the default characters (\:) to two user-specified characters. If only one character is entered, the second character remains the default character (:). No space should appear between the -d and the delimiter characters. To enter a backslash, use two backslashes.

-htype Same as -btype except for header. Default type for logical page header is n (no lines numbered).

-lincr incr incr is the increment value used to number logical page lines. Default incr is 1.

-lnum num is the number of blank lines to be considered as one. For example, −12 results in only the second adjacent blank being numbered (if the appropriate -ha, -ba, and/or -fa option is set). Default num is 1.

-nformat format is the line numbering format. Recognized values are:
ln left justified, leading zeroes suppressed
rn right justified, leading zeroes suppressed
rz right justified, leading zeroes kept

Default format is rn (right justified).

-p Do not restart numbering at logical page delimiters.

-ss sep sep is the character(s) used in separating the line number and the corresponding text line. Default sep is a TAB.

-vstartnum startnum is the initial value used to number logical page lines. Default startnum is 1.

-wwidth width is the number of characters to be used for the line number. Default width is 6.

Operands The following operand is supported:

file A path name of a text file to be line-numbered.
Examples

An example of the nl command

The command:

```
example% nl -v10 -i10 -d!+ filename1
```

will cause the first line of the page body to be numbered 10, the second line of the page body to be numbered 20, the third 30, and so forth. The logical page delimiters are !+.

Environment Variables

See environ(5) for descriptions of the following environment variables that affect the execution of nl: LANG, LC_ALL, LC_COLLATE, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status

The following exit values are returned:

- 0  Successful completion.
- >0 An error occurred.

Files

```
/usr/lib/locale/locale/LC_COLLATE/ColTable
```
Collation table generated by localedef

```
/usr/lib/locale/locale/LC_COLLATE/coll.so
```
Shared object containing string transformation library routines

Attributes

See attributes(5) for descriptions of the following attributes:

```
<table>
<thead>
<tr>
<th>/usr/bin/nl</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
<td></td>
</tr>
</tbody>
</table>
```

```
<table>
<thead>
<tr>
<th>/usr/xpg4/bin/nl</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/xopen/xcu4</td>
<td></td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5)</td>
<td></td>
</tr>
</tbody>
</table>
```

See Also

pr(1), attributes(5), environ(5), regex(5), regexp(5), standards(5)

Notes

Internationalized Regular Expressions are used in the POSIX and "C" locales. In other locales, Internationalized Regular Expressions are used if the following two conditions are met:

- /usr/lib/locale/locale/LC_COLLATE/ColTable is present.
- /usr/lib/locale/locale/LC_COLLATE/coll.so is not present.

Otherwise, Simple Regular Expressions are used.

Internationalized Regular Expressions are explained on regex(5). Simple Regular Expressions are explained on regexp(5).
nm(1)

Name    nm – print name list of an object file

Synopsis  /usr/bin/nm [-ACDlnPpRsTv] [-e|ofx] [-g | -u] [-t format] file...
          /usr/xpg4/bin/nm [-ACDlnPpRsTv] [-e|ofx] [-g | -u] [-t format] file...

Description  The nm utility displays the symbol table of each ELF object file that is specified by file.

If no symbolic information is available for a valid input file, the nm utility reports that fact, but does not consider it an error condition.

Options  The output of nm can be controlled using the following options:

- A    Writes the full path name or library name of an object on each line.
- C    Demangles C++ symbol names before printing them out.
- D    Displays the SHT_DYNSYM symbol information. This is the symbol table used by ld.so.1 and is present even in stripped dynamic executables. If -D is not specified, the default behavior is to display the SHT_SYMTAB symbol information.
- e    See NOTES below.
- f    See NOTES below.
- g    Writes only external (global) symbol information.
- h    Does not display the output heading data.
- l    Displays the SHT_SUNW_LDNSYM symbol information. This symbol table contains local function symbols. SHT_SUNW_LDNSYM symbol tables are present even in stripped dynamic executables. These symbols augment the global symbols that are found in SHT_DYNSYM symbol table. If -L is not specified, the default behavior is to display the SHT_SYMTAB symbol information.
- n    Sorts external symbols by name before they are printed.
- o    Prints the value and size of a symbol in octal instead of decimal (equivalent to -t o).
- p    Produces easy to parse, terse output. Each symbol name is preceded by its value (blanks if undefined) and one of the letters:
        A    Absolute symbol.
        B    bss (uninitialized data space) symbol.
        C    COMMON symbol.
D  Data object symbol.
F  File symbol.
N  Symbol has no type.
L  Thread-Local storage symbol.
R  Register symbol.
S  Section symbol.
T  Text symbol.
U  Undefined.

If the symbol's binding attribute is:

LOCAL  The key letter is lower case.
WEAK   The key letter is upper case. If the -l modifier is specified, the upper case key letter is followed by a *
GLOBAL  The key letter is upper case.

-P  Writes information in a portable output format, as specified in Standard Output.
-r  Prepends the name of the object file or archive to each output line.
-R  Prints the archive name (if present), followed by the object file and symbol name. If the -r option is also specified, this option is ignored.
-s  Prints section name instead of section index.
-t format  Writes each numeric value in the specified format. The format is dependent on the single character used as the format option-argument:

  d  The offset is written in decimal (default).
  o  The offset is written in octal.
  x  The offset is written in hexadecimal.

-T  See NOTES.

/usr/bin/nm  -u  Prints undefined symbols only.
/usr/xpg4/bin/nm  -u  Prints long listing for each undefined symbol. See OUTPUT below.
-v  Sorts external symbols by value before they are printed.
-V  Prints the version of the nm command executing on the standard error output.
-x  Prints the value and size of a symbol in hexadecimal instead of decimal (equivalent to -t x).
Options can be used in any order, either singly or in combination, and can appear anywhere in the command line. When conflicting options are specified (such as `v` and `-n`, or `-o` and `-x`) the first is taken and the second ignored with a warning message to the user. (See `-R` for exception.)

**Operands**
The following operand is supported:

`file`  
A path name of an object file, executable file or object-file library.

**Output**
This section describes the `nm` utility's output options.

**Standard Output**
For each symbol, the following information is printed:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Index</td>
<td>The index of the symbol. (The index appears in brackets.)</td>
</tr>
<tr>
<td>Value</td>
<td>The value of the symbol is one of the following:</td>
</tr>
<tr>
<td></td>
<td>- A section offset for defined symbols in a relocatable file.</td>
</tr>
<tr>
<td></td>
<td>- Alignment constraints for symbols whose section index is <code>SHN_COMMON</code>.</td>
</tr>
<tr>
<td></td>
<td>- A virtual address in executable and dynamic library files.</td>
</tr>
<tr>
<td>Size</td>
<td>The size in bytes of the associated object.</td>
</tr>
<tr>
<td>Type</td>
<td>A symbol is of one of the following types:</td>
</tr>
<tr>
<td></td>
<td>- <code>NOTYPE</code>  No type was specified.</td>
</tr>
<tr>
<td></td>
<td>- <code>OBJECT</code>  A data object such as an array or variable.</td>
</tr>
<tr>
<td></td>
<td>- <code>FUNC</code>    A function or other executable code.</td>
</tr>
<tr>
<td></td>
<td>- <code>REGI</code>    A register symbol (SPARC only).</td>
</tr>
<tr>
<td></td>
<td>- <code>SECTION</code> A section symbol.</td>
</tr>
<tr>
<td></td>
<td>- <code>FILE</code>    Name of the source file.</td>
</tr>
<tr>
<td></td>
<td>- <code>COMMON</code>  An uninitialized common block.</td>
</tr>
<tr>
<td></td>
<td>- <code>TLS</code>     A variable associated with Thread-Local storage.</td>
</tr>
<tr>
<td>Bind</td>
<td>The symbol's binding attributes.</td>
</tr>
<tr>
<td></td>
<td>- <code>LOCAL</code>   symbols Have a scope limited to the object file containing their definition.</td>
</tr>
<tr>
<td></td>
<td>- <code>GLOBAL</code>  symbols Are visible to all object files being combined.</td>
</tr>
<tr>
<td></td>
<td>- <code>WEAK</code>    symbols Are essentially global symbols with a lower precedence than <code>GLOBAL</code>.</td>
</tr>
</tbody>
</table>
| Other  | An integer corresponding to one of the `STV_` symbol visibility values defined in `<sys/elf.h>`.
Shndx

Except for three special values, this is the section header table index in relation to which the symbol is defined. The following special values exist:

**ABS**
Indicates the symbol's value does not change through relocation.

**COMMON**
Indicates an unallocated block and the value provides alignment constraints.

**UNDEF**
Indicates an undefined symbol.

**Name**
The name of the symbol.

**Object Name**
The name of the object or library if `-A` is specified.

If the `-P` option is specified, the previous information is displayed using the following portable format. The three versions differ depending on whether `-t d`, `-t o`, or `-t x` was specified, respectively:

```
"%s%s %s %d %d\n", library/object name, name, type, value, size
"%s%s %s %o %o\n", library/object name, name, type, value, size
"%s%s %s %x %x\n", library/object name, name, type, value, size
```

where **type** is formatted as described for the `-p` option, and **library/object name** is formatted as follows:

- If `-A` is not specified, **library/object name** is an empty string.
- If `-A` is specified and the corresponding **file** operand does not name a library:

  ```
  "%-s: ", file
  ```

- If `-A` is specified and the corresponding **file** operand names a library. In this case, **object file** names the object file in the library containing the symbol being described:

  ```
  "%-s[%s]: ", file, object file
  ```

If `-A` is not specified, then if more than one **file** operand is specified or if only one **file** operand is specified and it names a library, `nm` writes a line identifying the object containing the following symbols before the lines containing those symbols, in the form:

- If the corresponding **file** operand does not name a library:

  ```
  "%-s:\n", file
  ```

- If the corresponding **file** operand names a library; in this case, **object file** is the name of the file in the library containing the following symbols:

  ```
  "%-s[%s]:\n", file, object file
  ```

If `-P` is specified, but `-t` is not, the format is as if `-t x` had been specified.
Environment Variables

See environ(5) for descriptions of the following environment variables that affect the execution of nm: LANG, LC_ALL, LC_COLLATE, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status

The following exit values are returned:

0  Successful completion.

>0  An error occurred.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/base-developer-utilities</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

See Also

ar(1), as(1), dump(1), ld(1), ld.so.1(1), ar.h(3HEAD), a.out(4), attributes(5), environ(5), standards(5)

Notes

The following options are obsolete because of changes to the object file format and might be deleted in a future release.

- e  Prints only external and static symbols. The symbol table now contains only static and external symbols. Automatic symbols no longer appear in the symbol table. They do appear in the debugging information produced by cc -g, which can be examined using dump(1).

- f  Produces full output. Redundant symbols (such as .text, .data, and so forth), which existed previously, do not exist and producing full output is identical to the default output.

- T  By default, nm prints the entire name of the symbols listed. Since symbol names have been moved to the last column, the problem of overflow is removed and it is no longer necessary to truncate the symbol name.
nohup – run a command immune to hangups

/usr/bin/nohup command [argument]...
/usr/bin/nohup -p [-Fa] pid [pid]...
/usr/bin/nohup -g [-Fa] gpid [gpid]...
/usr/xpg4/bin/nohup command [argument]...

The nohup utility invokes the named command with the arguments supplied. When the command is invoked, nohup arranges for the SIGHUP signal to be ignored by the process.

When invoked with the -p or -g flags, nohup arranges for processes already running as identified by a list of process IDs or a list of process group IDs to become immune to hangups.

The nohup utility can be used when it is known that command takes a long time to run and the user wants to log out of the terminal. When a shell exits, the system sends its children SIGHUP signals, which by default cause them to be killed. All stopped, running, and background jobs ignores SIGHUP and continue running, if their invocation is preceded by the nohup command or if the process programmatically has chosen to ignore SIGHUP.

The nohup utility causes processes to ignore SIGHUP but does not in any way protect those processes from other signals. Since modern shells sometimes send signals other than SIGHUP upon logout, it is possible for jobs running under /usr/bin/nohup to be killed when the controlling shell exits.

Processes run by /usr/bin/nohup are immune to SIGHUP (hangup) and SIGQUIT (quit) signals.

Processes specified by ID are made immune to SIGHUP and SIGQUIT, and all output to the controlling terminal is redirected to nohup.out. If -F is specified, nohup forces control of each process. If -a is specified, nohup changes the signal disposition of SIGHUP and SIGQUIT even if the process has installed a handler for either signal.

Every process in the same process group as the processes specified by ID are made immune to SIGHUP and SIGQUIT, and all output to the controlling terminal is redirected to nohup.out. If -F is specified, nohup forces control of each process. If -a is specified, nohup changes the signal disposition of SIGHUP and SIGQUIT even if the process has installed a handler for either signal.

Processes run by /usr/xpg4/bin/nohup are immune to SIGHUP.
The `nohup` utility does not arrange to make processes immune to a SIGTERM (terminate) signal, so unless they arrange to be immune to SIGTERM or the shell makes them immune to SIGTERM, they receive it.

If `nohup.out` is not writable in the current directory, output is redirected to `$HOME/nohup.out`. If a file is created, the file has read and write permission (600. See `chmod(1)`. If the standard error is a terminal, it is redirected to the standard output, otherwise it is not redirected. The priority of the process run by `nohup` is not altered.

Options

The following options are supported:

- `-a` Always changes the signal disposition of target processes. This option is valid only when specified with `-p` or `-g.`

- `-F` Force. Grabs the target processes even if another process has control. This option is valid only when specified with `-p` or `-g`.

- `-g` Operates on a list of process groups. This option is not valid with `-p`.

- `-p` Operates on a list of processes. This option is not valid with `-g`.

Operands

The following operands are supported:

- `pid` A decimal process ID to be manipulated by `nohup -p`.

- `pgid` A decimal process group ID to be manipulated by `nohup -g`.

- `command` The name of a command that is to be invoked. If the `command` operand names any of the special `shell_builtins(1)` utilities, the results are undefined.

- `argument` Any string to be supplied as an argument when invoking the `command` operand.

Usage

Caution should be exercised when using the `-F` flag. Imposing two controlling processes on one victim process can lead to chaos. Safety is assured only if the primary controlling process, typically a debugger, has stopped the victim process and the primary controlling process is doing nothing at the moment of application of the `proc` tool in question.

Examples

**EXAMPLE 1** Applying `nohup` to Pipelines or Command Lists

It is frequently desirable to apply `nohup` to pipelines or lists of commands. This can be done only by placing pipelines and command lists in a single file, called a shell script. One can then issue:

```
examples$ nohup sh file
```
EXAMPLE 1  Applying nohup to Pipelines or Command Lists  (Continued)

and the nohup applies to everything in *file*. If the shell script *file* is to be executed often, then the
need to type *sh* can be eliminated by giving *file* execute permission.

Add an ampersand and the contents of *file* are run in the background with interrupts also
ignored (see *sh*(1)):

```bash
example$ nohup file &
```

EXAMPLE 2  Applying nohup -p to a Process

```bash
example$ long_running_command &
example$ nohup -p 'pgrep long_running_command'
```

EXAMPLE 3  Applying nohup -g to a Process Group

```bash
example$ make &
example$ ps -o sid -p $$
SID 81079
example$ nohup -g 'pgrep -s 81079 make'
```

**Environment Variables**

See *environ*(5) for descriptions of the following environment variables that affect the
execution of nohup: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, PATH, NLSPATH, and PATH.

**HOME**  Determine the path name of the user’s home directory; if the output file nohup. out
cannot be created in the current directory, the nohup command uses the directory
named by HOME to create the file.

**Exit Status**  The following exit values are returned:

- 126  *command* was found but could not be invoked.
- 127  An error occurred in nohup, or *command* could not be found

Otherwise, the exit values of nohup are those of the *command* operand.

**Files**

- nohup.out  The output file of the nohup execution if standard output is a terminal
  and if the current directory is writable.
- $HOME/nobup.out  The output file of the nohup execution if standard output is a terminal
  and if the current directory is not writable.

**Attributes**  See *attributes*(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>/usr/bin/nohup</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>
### nohup(1)

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

#### /usr/xpg4/bin/nohup

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/xopen/xcu4</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

### See Also
bash(1), batch(1), chmod(1), csh(1), disown(1), ksh88(1), nice(1), pgrep(1), proc(1), ps(1), sh(1), shell_builtins(1), setpgrp(1), signal(3C), proc(4), attributes(5), environ(5), standards(5)

### Warnings
If you are running the Korn shell (ksh88(1)) as your login shell, and have nohup’ed jobs running when you attempt to log out, you are warned with the message:

```
You have jobs running.
```

You need to log out a second time to actually log out. However, your background jobs continues to run.

### Notes
The C-shell (csh(1)) has a built-in command nohup that provides immunity from SIGHUP, but does not redirect output to nohup.out. Commands executed with ‘&’ are automatically immune to HUP signals while in the background.

```
nohup does not recognize command sequences. In the case of the following command,

example$ nohup command1; command2
```

the nohup utility applies only to command1. The command,

```
example$ nohup (command1; command2)
```

is syntactically incorrect.
**Name**
nroff – format documents for display or line-printer

**Synopsis**

**Description**
The `nroff` utility formats text in the named `filename` for typewriter-like devices. See also `troff(1)`.

If no `filename` argument is present, `nroff` reads the standard input. An argument consisting of a `-` is taken to be a file name corresponding to the standard input.

**Options**
The following options are supported. Options can appear in any order so long as they appear before the files.

- `-e` Produces equally-spaced words in adjusted lines, using full terminal resolution.

- `-h` Uses output TAB characters during horizontal spacing to speed output and reduces output character count. TAB settings are assumed to be every 8 nominal character widths.

- `-i` Reads the standard input after the input files are exhausted.

- `-q` Does not print output that was read from an .rd request.

- `-mname` Prepends the macro file `/usr/share/lib/tmac/name` to the input files.

- `-nN` Numbers first generated page `N`.

- `-opagelist` Prints only pages whose page numbers appear in the comma-separated list of numbers and ranges. A range `N-M` means pages `N` through `M`; an initial `-N` means from the beginning to page `N`; and a final `N-` means from `N` to the end.

- `-raN` Sets register `a` (one-character) to `N`.

- `-sN` Stops every `N` pages. `nroff` halts prior to every `N` pages (default `N=1`) to allow paper loading or changing, and resumes upon receipt of a NEWLINE.

- `-Tname` Prepares output for a device of the specified `name`. Known names are:

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>37</td>
<td>37</td>
</tr>
<tr>
<td>lp</td>
<td>tn300</td>
</tr>
<tr>
<td>300</td>
<td>DASI-300.</td>
</tr>
<tr>
<td>300-12</td>
<td>DASI-300 — 12-pitch.</td>
</tr>
<tr>
<td>300S</td>
<td>DASI-300S.</td>
</tr>
<tr>
<td>300S-12</td>
<td>DASI-300S.</td>
</tr>
<tr>
<td>382</td>
<td>DASI-382 (fancy DTC 382).</td>
</tr>
<tr>
<td>450</td>
<td>DASI-450 (Diablo Hyterm).</td>
</tr>
</tbody>
</table>
450-12        DASI-450 (Diablo Hyterm) — 12-pitch.
832          AJ 832.
-uN        Set the emboldening factor for the font mounted in position 3 to \( N \). If \( N \) is missing, then set the emboldening factor to 0.

**Operands**

The following operand is supported:

- `filename` The file containing text to be processed by `nroff`.

**Examples**

**EXAMPLE 1** Formatting with a macro package

The following command formats `users.guide` using the `-me` macro package, and stopping every 4 pages:

```
example% nroff -s4 -me users.guide
```

**Environment Variables**

See `environ(5)` for descriptions of the following environment variables that affect the execution of `nroff`: `LC_CTYPE`, `LC_MESSAGES`, and `NLSPATH`.

**Files**

- `/usr/tmp/trtmp*` temporary file (see NOTES)
- `/usr/share/lib/tmac/tmac.*` standard macro files
- `/usr/share/lib/nterm/*` terminal driving tables for `nroff`
- `/usr/share/lib/nterm/README` index to terminal description files

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTETYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>text/doctools</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

**See Also**

`checknr(1), col(1), eqn(1), man(1), tbl(1), troff(1), attributes(5), environ(5), me(5), ms(5), term(5)`

**Notes**

`/usr/tmp` is currently a symbolic link to `/var/tmp`.

Previous documentation incorrectly described the numeric register `yr` as being the *Last two digits of current year*. `yr` is in actuality the number of years since 1900. To correctly obtain the last two digits of the current year through the year 2099, the definition given below of string register `yy` can be included in a document and subsequently used to display a two-digit year. Notice that any other available one- or two-character register name can be substituted for `yy`.

```
.\" definition of new string register yy--last two digits of year
.\" use yr (# of years since 1900) if it is < 100
.ie \(yr<100 .ds yy \n(yr
.el \{
.\" else, subtract 100 from yr, store in ny
```

---

1218 man pages section 1: User Commands • Last Revised 1 Nov 2007
NAME  od – octal dump

SYNOPSIS  /usr/bin/od [-bcCdf0oOssvXx] [-] [file] [offset_string]
    [-A address_base] [-j skip]
    [-N count] [-t type_string]... [-] [file]...
/usr/xpg4/bin/od [-bcCdf0oOssvXx] [file] [offset_string]
/usr/xpg4/bin/od [-bcCdf0oOssvXx] [-A address_base]
    [-j skip] [-N count] [-t type_string]... [file]...

The od command copies sequentially each input file to standard output and transforms the input data according to the output types specified by the -t or -bcCdf0oOssvXx options. If no output type is specified, the default output is as if -t o2 had been specified. Multiple types can be specified by using multiple -bcCdf0oOssvXx options. Output lines are written for each type specified in the order in which the types are specified. If no file is specified, the standard input is used. The [offset_string] operand is mutually exclusive from the -A, -j, -N, and -t options. For the purposes of this description, the following terms are used:

word  Refers to a 16-bit unit, independent of the word size of the machine.
long word  Refers to a 32-bit unit.
double long word  Refers to a 64-bit unit.

OPTIONS  The following options are supported:

-A address_base  Specifies the input offset base. The address_base option-argument must be a character. The characters d, o and x specify that the offset base will be written in decimal, octal or hexadecimal, respectively. The character n specifies that the offset will not be written. Unless -A n is specified, the output line will be preceded by the input offset, cumulative across input files, of the next byte to be written. In addition, the offset of the byte following the last byte written will be displayed after all the input data has been processed. Without the -A address_base option and the [offset_string] operand, the input offset base is displayed in octal.
-b  Interprets bytes in octal. This is equivalent to -t o1.
-c  Displays single-byte characters. Certain non-graphic characters appear as C-language escapes:

null \0
backspace \b
form-feed \f
new-line \n
return \r

tab \t

Others appear as 3-digit octal numbers. For example:
Interprets bytes as single-byte or multibyte characters according to the current setting of the LC_CTYPE locale category. Printable multibyte characters are written in the area corresponding to the first byte of the character. The two-character sequence ** is written in the area corresponding to each remaining byte in the character, as an indication that the character is continued. Non-graphic characters appear the same as they would using the -C option.

Interprets bytes as single-byte or multibyte characters according to the current setting of the LC_CTYPE locale category. Printable multibyte characters are written in the area corresponding to the first byte of the character. The two-character sequence ** is written in the area corresponding to each remaining byte in the character, as an indication that the character is continued. Certain non-graphic characters appear as escapes:

- null \0
- backspace \b
- form-feed \f
- new-line \n
Other non-printable characters appear as one three-digit octal number for each byte in the character.

Interprets words in unsigned decimal. This is equivalent to -t u2.

Interprets long words in unsigned decimal. This is equivalent to -t u4.

Interprets long words in floating point. This is equivalent to -t f4.

Interprets double long words in extended precision. This is equivalent to -t f8.

Jumps over skip bytes from the beginning of the input. The od command will read or seek past the first skip bytes in the concatenated input files. If the combined input is not at least skip bytes long, the od command will write a diagnostic message to standard error and exit with a non-zero exit status.

By default, the skip option-argument is interpreted as a decimal number. With a leading 0x or 0X, the offset is interpreted as a hexadecimal number; otherwise, with a leading 0, the offset will be interpreted as an octal number. Appending the character b, k, or m to offset will cause it to be interpreted as a
multiple of 512, 1024 or 1 048 576 bytes, respectively. If the skip number is hexadecimal, any appended b is considered to be the final hexadecimal digit. The address is displayed starting at 0000000, and its base is not implied by the base of the skip option-argument.

-\texttt{N count} Formats no more than count bytes of input. By default, count is interpreted as a decimal number. With a leading 0x or 0X, count is interpreted as a hexadecimal number; otherwise, with a leading 0, it is interpreted as an octal number. If count bytes of input (after successfully skipping, if -j skip is specified) are not available, it will not be considered an error. The od command will format the input that is available. The base of the address displayed is not implied by the base of the count option-argument.

-\texttt{o} Interprets words in octal. This is equivalent to -t o2.
-\texttt{O} Interprets long words in unsigned octal. This is equivalent to -t o4.
-\texttt{s} Interprets words in signed decimal. This is equivalent to -t d2.
-\texttt{S} Interprets long words in signed decimal. This is equivalent to -t d4.

-\texttt{t type\_string} Specifies one or more output types. The type\_string option-argument must be a string specifying the types to be used when writing the input data. The string must consist of the type specification characters:

\textbf{a} Named character. Interprets bytes as named characters. Only the least significant seven bits of each byte will be used for this type specification. Bytes with the values listed in the following table will be written using the corresponding names for those characters.

The following are named characters in od:

<table>
<thead>
<tr>
<th>Value</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>\000</td>
<td>nul</td>
</tr>
<tr>
<td>\001</td>
<td>soh</td>
</tr>
<tr>
<td>\002</td>
<td>stx</td>
</tr>
<tr>
<td>\003</td>
<td>etx</td>
</tr>
<tr>
<td>\004</td>
<td>eot</td>
</tr>
<tr>
<td>\005</td>
<td>enq</td>
</tr>
<tr>
<td>\006</td>
<td>ack</td>
</tr>
<tr>
<td>\007</td>
<td>bel</td>
</tr>
<tr>
<td>\010</td>
<td>bs</td>
</tr>
<tr>
<td>\011</td>
<td>ht</td>
</tr>
<tr>
<td>\012</td>
<td>lf</td>
</tr>
<tr>
<td>\013</td>
<td>vt</td>
</tr>
<tr>
<td>\014</td>
<td>ff</td>
</tr>
<tr>
<td>\015</td>
<td>cr</td>
</tr>
<tr>
<td>\016</td>
<td>so</td>
</tr>
</tbody>
</table>
Character. Interprets bytes as single-byte or multibyte characters specified by the current setting of the LC_CTYPE locale category. Printable multibyte characters are written in the area corresponding to the first byte of the character. The two-character sequence ** is written in the area corresponding to each remaining byte in the character, as an indication that the character is continued. Certain non-graphic characters appear as C escapes: \0, \a, \b, \f, \n, \r, \t, \v. Other non-printable characters appear as one three-digit octal number for each byte in the character.

The type specification characters d, f, o, u, and x can be followed by an optional unsigned decimal integer that specifies the number of bytes to be transformed by each instance of the output type.

Floating point. Can be followed by an optional F, D, or L indicating that the conversion should be applied to an item of type float, double, or long double, respectively.

Signed decimal, octal, unsigned decimal, and hexadecimal, respectively. Can be followed by an optional C, S, I, or L indicating that the conversion should be applied to an item of type char, short, int, or long, respectively.

Multiple types can be concatenated within the same type_string and multiple -t options can be specified. Output lines are written for each type specified in the order in which the type specification characters are specified.
-v  Shows all input data (verbose). Without the -v option, all groups of output lines that would be identical to the immediately preceding output line (except for byte offsets), will be replaced with a line containing only an asterisk (*).

-x  Interprets words in hex. This is equivalent to -t x2.

-X  Interprets long words in hex. This is equivalent to -t x4.

Operands

The following operands are supported for /usr/bin/od only:

-  Uses the standard input in addition to any files specified. When this operand is not given, the standard input is used only if no file operands are specified.

file  A path name of a file to be read. If no file operands are specified, the standard input will be used. If there are no more than two operands, none of the -A, - j, -N, or - t options is specified, and any of the following are true:
1. the first character of the last operand is a plus sign (+)
2. the first character of the second operand is numeric
3. the first character of the second operand is x and the second character of the second operand is a lower-case hexadecimal character or digit
4. the second operand is named "x"
5. the second operand is named "."

then the corresponding operand is assumed to be an offset operand rather than a file operand.

Without the -N count option, the display continues until an end-of-file is reached.

[+][0] offset [.][b|B]
[+][0] offset[ .]
[+][0x|x] offset
[+][0x|x] offset[B]

The offset_string operand specifies the byte offset in the file where dumping is to commence. The offset is interpreted in octal bytes by default. If offset begins with "0", it is interpreted in octal. If offset begins with "x" or "0x", it is interpreted in hexadecimal and any appended "b" is considered to be the final hexadecimal digit. If "." is appended, the offset is interpreted in decimal. If "b" or "B" is appended, the offset is interpreted in units of 512 bytes.
argument is omitted, the offset argument must be preceded by a plus sign (+). The address is displayed starting at the given offset. The radix of the address will be the same as the radix of the offset, if specified, otherwise it will be octal. Decimal overrides octal, and it is an error to specify both hexadecimal and decimal conversions in the same offset operand.

The following operands are supported for /usr/xpg4/bin/od only:

```
file
```

Same as /usr/bin/od, except only one of the first two conditions must be true.

```
[+][0](offset [.] [b|B])
+ [offset] [.
+[0x][offset]
+[0x] offset [B]
+x {offset}
+xoffset [B]
```

Description of offset_string is the same as for /usr/bin/od.

See environ(5) for descriptions of the following environment variables that affect the execution of od: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, LC_NUMERIC, and NLSPATH.

Exit Status

The following exit values are returned:

- `0` Successful completion.
- `>0` An error occurred.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>/usr/bin/od</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
<td></td>
</tr>
<tr>
<td>CSI</td>
<td>enabled</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>/usr/xpg4/bin/od</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/xopen/xcu4</td>
<td></td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
<td></td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
<td></td>
</tr>
</tbody>
</table>

See Also sed(1), attributes(5), environ(5), standards(5)
**on**

### Synopsis

`on [-i] [-d] [-n] host command [argument] ...

### Description

The `on` program is used to execute commands on another system, in an environment similar to that invoking the program. All environment variables are passed and the current working directory is preserved. To preserve the working directory, the working file system must be either already mounted on the host or be exported to it. Relative path names will only work if they are within the current file system. Absolute path names may cause problems.

The standard input is connected to the standard input of the remote command. The standard output and the standard error from the remote command are sent to the corresponding files for the `on` command.

Note that the `on` program requires that the `rpc.rexd(1M)` service be running on the remote machine. By default, `rpc.rexd` is present but not running on an Oracle Solaris system. Because of its better security, `ssh(1)` is the preferred method of invoking commands on remote machines.

### Options

The following options are supported:

- `-d` Debug mode. Prints out some messages as work is being done.
- `-i` Interactive mode. Uses remote echoing and special character processing. This option is needed for programs that expect to be talking to a terminal. All terminal modes and window size changes are propagated.
- `-n` No Input. This option causes the remote program to get EOF when it reads from the standard input, instead of passing the standard input from the standard input of the `on` program. For example, `-n` is necessary when running commands in the background with job control.

### Attributes

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/file-system/nfs</td>
</tr>
</tbody>
</table>

### See Also

`chkey(1), rlogin(1), rsh(1), ssh(1), telnet(1), rpc.rexd(1M), attributes(5)`

### Diagnostics

- **unknown host** Host name not found.
- **cannot connect to server** Host down or not running the server.
- **can’t find** Problem finding the working directory.
- **can’t locate mount point** Problem finding current file system.
- **RPC: Authentication error** The server requires DES authentication and you do not have a secret key registered with
keyserv. Perhaps you logged in without a password. Try to keylogin. If that fails, try to set your publickey with chkey.

The 10240 byte limit for arguments to be encoded and passed from the sending to the receiving system has been exceeded.

Other diagnostic messages may be passed back from the server.

**Bugs**  When the working directory is remote mounted over NFS, a Control-Z hangs the window.

Root cannot use on.
optisa(1)

Name  optisa – determine which variant instruction set is optimal to use

Synopsis  optisa  instruction_set...

Description  optisa prints which instruction_set out of the ones specified in the command will perform best on this machine. In this case, “best” is defined by the order in which instruction set names are returned by isalist(1). Possible values for instruction_set are given in isalist(5).

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

Exit Status  The following exit values are returned:

- 0  One of the instruction_set values you specified is printed by this command.
- 1  There is no output; that is, this machine cannot use any instruction_set that you specified with the optisa command.

See Also  isalist(1), uname(1), attributes(5), isalist(5)

Notes  optisa is preferable to uname -p or uname -m (see uname(1)) in determining which of several binary versions of a given program should be used on the given machine.
Name  pack, pcat, unpack – compress and expand files

Synopsis  pack [-f/] [-1] file...
          pcat file...
          unpack [-/] file...

Description

pack  The pack command attempts to store the specified files in a compressed form. Wherever possible (and useful), each input file file is replaced by a packed file file.z with the same access modes, access and modified dates, and owner as those of file. If pack is successful, file is removed.

The amount of compression obtained depends on the size of the input file and the character frequency distribution. Because a decoding tree forms the first part of each .z file, it is usually not worthwhile to pack files smaller than three blocks, unless the character frequency distribution is very skewed, which can occur with printer plots or pictures.

Typically, text files are reduced to 60-75% of their original size. Load modules, which use a larger character set and have a more uniform distribution of characters, show little compression, the packed versions being about 90% of the original size.

The pack utility returns a value that is the number of files that it failed to compress. If that number exceeds 255, 255 is returned.

No packing occurs if:
- the file appears to be already packed
- the file name is too long to add the .z suffix
- the file has links
- the file is a directory
- the file cannot be opened
- the file is empty
- no disk storage blocks are saved by packing
- a file called file.z already exists
- the .z file cannot be created
- an I/O error occurred during processing.

The last segment of the file name must be short enough to allow space for the appended .z extension. Directories cannot be compressed.

pcat  The pcat command does for packed files what cat(1) does for ordinary files, except that pcat cannot be used as a filter. The specified files are unpacked and written to the standard output.

pcat returns the number of files it was unable to unpack. Failure can occur if:
The unpack command expands files created by pack. For each file specified in the command, a search is made for a file called file.z (or just file, if file ends in .z). If this file appears to be a packed file, it is replaced by its expanded version. The new file has the .z suffix stripped from its name, and has the same access modes, access and modification dates, and owner as those of the packed file.

unpack returns a value that is the number of files it was unable to unpack. Failure can occur for the same reasons that it can in pcat, as well as for the following:

- a file with the unpacked name already exists;
- the unpacked file cannot be created.

Options

The following options are supported by pack:

- \( \text{-f} \) Forces packing of file. This is useful for causing an entire directory to be packed even if some of the files do not benefit. Packed files can be restored to their original form using unpack or pcat.

The following options are supported by pack and unpack:

- \( \text{-/} \) When packing or unpacking, copies any ACL and extended system attributes associated with the source file to the target file. If an ACL or extended system attributes cannot be copied, the original file is retained, a diagnostic message is written to stderr, and the final exit status is non-zero.

Operands

The following operands are supported:

- file A path name of a file to be packed, unpacked, or pcatced; file can include or omit the .z suffix.

pack uses Huffman (minimum redundancy) codes on a byte-by-byte basis. If the \( \text{-} \) argument is used, an internal flag is set that causes the number of times each byte is used, its relative frequency, and the code for the byte to be printed on the standard output. Additional occurrences of \( \text{-} \) in place of file causes the internal flag to be set and reset.

Usage

See largefile(5) for the description of the behavior of pack, pcat, and unpack when encountering files greater than or equal to 2 Gbyte \((2^{31} \text{ bytes})\).

Examples

**EXAMPLE 1** Viewing a Packed File

To view a packed file named file.z use:

```
example% pcat file.z
```

or just:
EXAMPLE 1 Viewing a Packed File  (Continued)

eexample% pcat file

EXAMPLE 2 Making and Unpacked Copy:
To make an unpacked copy, say nnn, of a packed file named file.z (without destroying file.z) use the command:

eexample% pcat file > nnn

Environment Variables

See environ(5) for descriptions of the following environment variables that affect the execution of pack, pcat, and unpack: LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status

The following exit values are returned:

0  Successful completion.

>0  An error occurred. The number of files the command failed to pack/unpack is returned. If the number of failures exceeds 255, then 255 is returned.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

See Also  cat(1), compress(1), zcat(1), fgetattr(3C), fsetattr(3C), attributes(5), environ(5), largefile(5)
**Name**
packagemanager – GUI for the Image Packaging System

**Synopsis**
/usr/bin/packagemanager [options]

/usr/bin/packagemanager [-h | --help]
[-i | --info-install file] [-U | --update-all]
[-R | --image-dir dir]

/usr/bin/packagemanager [file]

**Description**
packagemanager is the graphical user interface for pkg(5), the Image Packaging System software.

The Package Manager enables you to perform the following tasks:

- Search, install, and remove packages.
- Add, remove, and modify publishers.
- Create, remove, and manage boot environments.

If the *file* operand is specified and its suffix is `.p5i`, packagemanager launches in Web Install mode, which adds one or more publishers and a number of packages for each publisher.

**Options**
The following options are supported:

- `-h`
  --help
  Display a usage message.

- `-i file`
  --info-install file
  Specify a `.p5i` file to run packagemanager in Web Install mode. The *file* must have the suffix `.p5i`.

- `-R dir`
  --image-dir dir
  Operate on the image rooted at *dir*, rather than the image discovered automatically.

- `-U`
  --update-all
  Update all installed packages that have updates available.

**Note** – If the package/pkg, package/pkg/package-manager, or package/pkg/update-manager packages need to be updated, packagemanager first updates these packages and then restarts to carry out any remaining updates.

**Operands**
*file*  A Web Install file. This file must have the suffix `.p5i`. See the Package Manager online help for more information about Web Install.
Examples

**EXAMPLE 1**  Operate on the Current Image
Invoke `packagemanager` on the current image.

$ packagemanager

**EXAMPLE 2**  Operate on a Specified Image
Invoke `packagemanager` in the image stored at `/aux0/example_root`.

$ packagemanager -R /aux0/example_root

**EXAMPLE 3**  Invoke in Web Install Mode
Invoke `packagemanager` in Web Install mode.

$ packagemanager ~/test.p5i

Exit Status
The following exit values are returned:

0  Everything worked.
1  An error occurred.
2  Invalid command line options were specified.

Files
Since `pkg(5)` images can be located arbitrarily within a larger file system, the token `$IMAGE_ROOT` is used to distinguish relative paths. For a typical system installation, `$IMAGE_ROOT` is equivalent to `/`.

$IMAGE_ROOT/var/pkg
Metadata directory for a full or partial image.

$IMAGE_ROOT/.org.opensolaris,pkg
Metadata directory for a user image.

Within the metadata of a particular image, certain files and directories contain information useful during repair and recovery. The token `$IMAGE_META` is used to refer to the top-level directory that contains the metadata. `$IMAGE_META` is typically one of the two paths given above.

$IMAGE_META/gui-cache
Location for cached metadata maintained by `packagemanager` to speed up program startup and switching between publishers.

Other paths within the `$IMAGE_META` directory hierarchy are Private, and are subject to change.

Attributes
See `attributes(5)` for descriptions of the following attributes:
package manager

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>package/pkg/package-manager</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Uncommitted</td>
</tr>
</tbody>
</table>

See Also  
`pm-updatemanager(1), pkg(1), pkg(5)`

Package Manager online help

http://hub.opensolaris.org/bin/view/Project+pkg/

Notes  
`package manager` needs to be invoked with sufficient privilege to operate on an image’s files and directories.
Name  pagesize – display the size or sizes of a page of memory

Synopsis  /usr/bin/pagessize [-a]

Description  The pagesize utility prints the default size of a page of memory in bytes, as returned by getpagesize(3C). This program is useful in constructing portable shell scripts.

Options  The following option is supported:

- a  Prints out all possible hardware address translation sizes supported by the system.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  pgsz(1), getpagesize(3C), getpagesize(3C), attributes(5)
The `pargs` utility examines a target process or process core file and prints arguments, environment variables and values, or the process auxiliary vector. `pargs` outputs unprintable characters as escaped octal in the format `\xxx`, unless the character is one of the characters specified in the "Escape Sequences" section of `formats(5)`, in which case the character is printed as specified in that section.

`pargs` attempts to be sensitive to the locale of the target process. If the target process and the `pargs` process do not share a common character encoding, `pargs` attempts to employ the `iconv(3C)` facility to generate a printable version of the extracted strings. In the event that such a conversion is impossible, strings are displayed as 7-bit ASCII.

The following options are supported:

- `-a` Prints process arguments as contained in `argv[]` (default).
- `-c` Treats strings in the target process as though they were encoded in 7-bit ASCII, regardless of the locale of the target. The use of `iconv(3C)` is suppressed.
- `-e` Prints process environment variables and values as pointed at by the `_environ` symbol or by `pr_envp` in `/proc/pid/psinfo`.
- `-F` Force. Grabs the target process even if another process has control.
- `-l` Displays the arguments as a single command line. The command line is printed in a manner suitable for interpretation by `/bin/sh`. If the arguments contain unprintable characters, or if the target process is in a different locale, a warning message is displayed. The resulting command line might not be interpreted correctly by `/bin/sh`.
- `-x` Prints process auxiliary vector.

The following operands are supported:

- `pid` Process ID list.
- `core` Process core file.

Caution should be exercised when using the `-F` flag. Imposing two controlling processes on one victim process can lead to chaos. Safety is assured only if the primary controlling process, typically a debugger, has stopped the victim process and the primary controlling process is doing nothing at the moment of application of the `proc` tool in question.

The following exit values are returned:

- `0` Successful operation.
- non-zero An error has occurred (such as no such process, permission denied, or invalid option).
Files  /proc/pid/*  Process information and control files.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  proc(1), iconv(3C), proc(4), ascii(5), attributes(5), environ(5), formats(5)
passwd(1)

Name         passwd – change login password and password attributes
Synopsis      passwd [-r files | -r ldap | -r nis] [name]
               passwd [-r files] [-egh] [name]
               passwd [-r files] -s [-a]
               passwd [-r files] -s [name]
               passwd [-r files] [-d | -l | -u | -N] [-f] [-n min]
               [-w warn] [-x max] name
               passwd -r ldap [-egh] [name]
               passwd [-r ldap ] -s [-a]
               passwd [-r ldap ] -s [name]
               passwd -r ldap [-d | -l | -u | -N] [-f] [-n min]
               [-w warn] [-x max] name
               passwd -r nis [-egh] [name]

Description   The passwd command changes the password or lists password attributes associated with the
               user's login name. Additionally, authorized users can use passwd to install or change
               passwords and attributes associated with any login name.

               When used to change a password, passwd prompts everyone for their old password, if any. It
               then prompts for the new password twice. When the old password is entered, passwd checks
               to see if it has aged sufficiently. If aging is insufficient, passwd terminates; see pwconv(1M) and
               shadow(4) for additional information.

               The pwconv command creates and updates /etc/shadow with information from
               /etc/passwd. pwconv relies on a special value of x in the password field of /etc/passwd. This
               value of x indicates that the password for the user is already in /etc/shadow and should not be
               modified.

               If aging is sufficient, a check is made to ensure that the new password meets construction
               requirements. When the new password is entered a second time, the two copies of the new
               password are compared. If the two copies are not identical, the cycle of prompting for the new
               password is repeated for, at most, two more times.

               Passwords must be constructed to meet the following requirements:

               ■ Each password must have PASSLENGTH characters, where PASSLENGTH is defined in
                 /etc/default/passwd and is set to 6. Setting PASSLENGTH to more than eight characters
                 requires configuring policy.conf(4) with an algorithm that supports greater than eight
                 characters.

               ■ Each password must meet the configured complexity constraints specified in
                 /etc/default/passwd.
Each password must not be a member of the configured dictionary as specified in 
/etc/default/passwd.

For accounts in name services which support password history checking, if prior password 
history is defined, new passwords must not be contained in the prior password history.

If all requirements are met, by default, the passwd command consults /etc/nsswitch.conf to
determine in which repositories to perform password update. It searches the passwd and 
passwd_compat entries. The sources (repositories) associated with these entries are updated. 
However, the password update configurations supported are limited to the following cases. 
Failure to comply with the configurations prevents users from logging onto the system. The 
password update configurations are:

- passwd: files
- passwd: files ldap
- passwd: files nis
- passwd: compat (==> files nis)
- passwd: compat (==> files ldap)
- passwd_compat: ldap

You can append the ad keyword to any of the passwd configurations in the above list. 
However, you cannot use the passwd command to change the password of an Active Directory 
(AD) user. If the ad keyword is found in the passwd entry during a password update operation, 
it is ignored.

Network administrators, who own the password table, can change any password attributes. 
The administrator configured for updating LDAP shadow information can also change any 
password attributes. See ldapclient(1M).

When a user has a password stored in one of the name services as well as a local files entry, 
the passwd command updates both. It is possible to have different passwords in the name 
service and local files entry. Use passwd -r to change a specific password repository.

The passwd command does not prompt authorized users for the old password.

If LDAP is in effect, an authorized user on any Native LDAP client system can change any 
password without being prompted for the old LDAP password.

By default, even users authorized to change the password of other users must comply with the 
configured password policy. See pam_AUThtok_check(5).

Normally, passwd entered with no arguments changes the password of the current user. When 
a user logs in and then invokes su(1M) to become role or another user, passwd changes the 
original user’s password, not the password of the role or the new user.

The -s argument is restricted to an authorized user.
The format of the display is:

```
name status mm/dd/yy min max warn
```

or, if password aging information is not present,

```
name status
```

where

`name`

The login ID of the user.

`status`

The password status of `name`.

The `status` field can take the following values:

- **LK**
  - The account is locked. `passwd -l` was run or the account was automatically locked due to the number of authentication failures reaching the configured maximum allowed. See `policy.conf(4)` and `user_attr(4)` and the “Security” section.

- **NL**
  - The account is a non UNIX authentication account. `passwd -N` has been run. See “Security”. Accounts in this state are not automatically locked when the system or per user policy is `LOCK_AFTER_RETRIES=YES`.

- **NP**
  - This account has no password and is therefore open without authentication.

- **PS**
  - This account has a password.

- **UN**
  - The data in the password field is unknown. It is not a recognizable hashed password or any of the above entries. See `crypt(3C)` for valid password hashes.

- **UP**
  - This account has not yet been activated by the administrator and cannot be used. See Security.

`mm/dd/yy`

The date password was last changed for `name`. All password aging dates are determined using Greenwich Mean Time (Universal Time) and therefore can differ by as much as a day in other time zones.

`min`

The minimum number of days required between password changes for `name`. `MINWEEKS` is found in `/etc/default/passwd` and is set to NULL.
The maximum number of days the password is valid for name. MAXWEEKS is found in /etc/default/passwd and is set to NULL.

The number of days relative to max before the password expires and the name are warned.

passwd uses pam(3PAM) for password change. It calls PAM with a service name passwd and uses service module type auth for authentication and password for password change.

Locking an account (-l option) does not allow its use for any logins or delayed execution (such as at(1), batch(1), or cron(1M)). The -N option can be used to disallow password based login, while continuing to allow delayed execution or login with non UNIX authentication methods.

Locked accounts that have never had a password cannot have their status changed directly to an active password. See -d. Changing a password on a locked account that had a password prior to being locked, changes the password without unlocking the account. See -u to unlock the account. An authorized administrator can activate an account in the not yet activated state by giving it a password or running passwd -N to activate it for non UNIX authentication or delayed execution only.

An account can become locked following inactivity. To unlock such an account use the -u or -f options. With -u, the password is not changed; the use of -f forces a password change.

The following options are supported:

-a
  Shows password attributes for all entries. Use only with the -s option. name must not be provided. For the files and ldap repositories, this is restricted to the authorized user.

-e
  Changes the login shell. A normal user can change his/her own shell information, an authorized user can change it for any user. The choice of shell is limited by the requirements of getusershell(3C). If the user currently has a shell that is not allowed by getusershell, an authorized user can change it.

-g
  Changes the gecos (finger) information. A normal user can change their own gecos information, an authorized user can change it for any user.

-h
  Changes the home directory.

-r
  Specifies the repository to which an operation is applied. The supported repositories are files, ldap, or nis.
-5 name
  Shows password attributes for the login name. For the files and ldap repositories, this
  only works for the authorized user. It does not work at all for the nis repository, which
does not support password aging.

  The output of this option, and only this option, is Committed and parsable. The format is
  username followed by white space followed by one of the following codes.

  New codes might be added in the future so code that parses this must be flexible in the face
  of unknown codes. While all existing codes are two characters in length that might not
  always be the case.

  The following are the current status codes:

  L
  The account is locked. passwd -l was run or the account was automatically locked due
to the number of authentication failures reaching the configured maximum allowed. See
  policy.conf(4) and user_attr(4) and the “Security” section.

  N
  The account is a non UNIX authentication account. passwd -N has been run. See
  “Security”. Accounts in this state are not automatically locked when the system or per
  user policy is LOCK_AFTER_RETRIES=YES.

  P
  Account has no password. passwd -d was run.

  PS
  The account probably has a valid password.

  U
  The data in the password field is unknown. It is not a recognizable hashed password or
  any of the above entries. See crypt(3C) for valid password hashes.

  UP
  This account has not yet been activated by the administrator and cannot be used. See
  Security.

Authorized User
Options
An administrator needs to be granted the User Security profile to be able to lock and unlock an
existing account. That profile also provides the ability to activate a newly created account, set
password aging options and view password attributes. The following lists shows the
authorizations required to perform the various operations.

Only an authorized user can use the following options:

- d
  Deletes password for name and unlocks the account. The login name is not prompted for
  password. It is only applicable to the files and ldap repositories.
If the `login(1)` option `PASSREQ=YES` is configured, the account is not able to login. `PASSREQ=YES` is the delivered default.

- `f`
  Forces the user to change password at the next login by expiring the password for `name`. This option is useful for unlocking accounts that have become locked due to inactivity.

- `l`
  Locks account for `name` unless it is already locked. See the `-u` option for unlocking the account. Accounts that are marked for non UNIX authentication or delayed execution only can be locked and will return to the same state when unlocked.

- `N`
  Makes the password entry for `name` a value that cannot be used for login with UNIX authentication, but does not lock the account. See the `-d` option for removing the value, or `-l` to lock the account.

- `n min`
  Sets minimum field for `name`. The `min` field contains the minimum number of days between password changes for `name`. If `min` is greater than `max`, the user can not change the password. Always use this option with the `-x` option, unless `max` is set to `-1` (aging turned off). In that case, `min` need not be set.

- `u`
  Unlocks a locked password for entry `name`. The `-u` option is useful for unlocking accounts that have become locked due to failed attempts or were administratively locked with the `-l` option. An account that is marked as a non UNIX authentication account (passwd -N) returns to that state when it is unlocked.

- `w warn`
  Sets warn field for `name`. The `warn` field contains the number of days before the password expires and the user is warned. This option is not valid if password aging is disabled.

- `x max`
  Sets maximum field for `name`. The `max` field contains the number of days that the password is valid for `name`. The aging for `name` is turned off immediately if `max` is set to `-1`.

### Operands

The following operand is supported:

- `name`
  User login name.

### Environment Variables

If any of the LC_* variables, that is, LC_CTYPE, LC_MESSAGES, LC_TIME, LC_COLLATE, LC_NUMERIC, and LC_MONETARY (see `environ(5)`), are not set in the environment, the operational behavior of passwd for each corresponding locale category is determined by the value of the LANG environment variable. If LC_ALL is set, its contents are used to override both the LANG and the other LC_* variables. If none of the above variables is set in the environment, the C (U.S. style) locale determines how passwd behaves.
LC_CTYPE
Determines how passwd handles characters. When LC_CTYPE is set to a valid value, passwd can display and handle text and filenames containing valid characters for that locale. passwd can display and handle Extended Unix Code (EUC) characters where any individual character can be 1, 2, or 3 bytes wide. passwd can also handle EUC characters of 1, 2, or more column widths. In the C locale, only characters from ISO 8859-1 are valid.

LC_MESSAGES
Determines how diagnostic and informative messages are presented. This includes the language and style of the messages, and the correct form of affirmative and negative responses. In the C locale, the messages are presented in the default form found in the program itself (in most cases, U.S. English).

Exit Status
The passwd command exits with one of the following values:

0  Success.
1  Permission denied.
2  Invalid combination of options.
3  Unexpected failure. Password file unchanged.
4  Unexpected failure. Password file(s) missing.
5  Password file(s) busy. Try again later.
6  Invalid argument to option.
7  Aging option is disabled.
8  No memory.
9  System error.
10 Account expired.
11 Password information unchanged.
Files  /etc/default/passwd

Default values can be set for the following flags in /etc/default/passwd. For example:

MAXWEEKS=26

DICTIONDBDIR
The directory where the generated dictionary databases reside. Defaults to /var/passwd.

If neither DICTIONLIST nor DICTIONDBDIR is specified, the system does not perform a dictionary check.

DICTIONLIST
DICTIONLIST can contain list of comma separated dictionary files such as
DICTIONLIST=file1,file2,file3. Each dictionary file contains multiple lines and each line consists of a word and a NEWLINE character (similar to /usr/share/lib/dict/words.) You must specify full path names. The words from these files are merged into a database that is used to determine whether a password is based on a dictionary word.

If neither DICTIONLIST nor DICTIONDBDIR is specified, the system does not perform a dictionary check.

To pre-build the dictionary database, see mwpwd dict(1M).

HISTORY
Maximum number of prior password history to keep for a user. Setting the HISTORY value to zero (0), or removing the flag, causes the prior password history of all users to be discarded at the next password change by any user. The default is not to define the HISTORY flag. The maximum value is 26. Currently, this functionality is enforced only for user accounts defined in the files name service (local passwd(4)/shadow(4)).

MAXREPEATS
Maximum number of allowable consecutive repeating characters. If MAXREPEATS is not set or is zero (0), the default is no checks

MAXWEEKS
Maximum time period that password is valid.

MINALPHA
Minimum number of alpha character required. If MINALPHA is not set, the default is 2.

MINDIFF
Minimum differences required between an old and a new password. If MINDIFF is not set, the default is 3.

MINDIGIT
Minimum number of digits required. If MINDIGIT is not set or is set to zero (0), the default is no checks. You cannot be specify MINDIGIT if MINNONALPHA is also specified.
MINLOWER
Minimum number of lower case letters required. If not set or zero (0), the default is no
checks.

MINNONALPHA
Minimum number of non-alpha (including numeric and special) required. If
MINNONALPHA is not set, the default is 1. You cannot specify MINNONALPHA if MINDIGIT or
MINSPECIAL is also specified.

MINWEEKS
Minimum time period before the password can be changed.

MINSPECIAL
Minimum number of special (non-alpha and non-digit) characters required. If
MINSPECIAL is not set or is zero (0), the default is no checks. You cannot specify
MINSPECIAL if you also specify MINNONALPHA.

MINUPPER
Minimum number of upper case letters required. If MINUPPER is not set or is zero (0), the
default is no checks.

NAMECHECK
Enable/disable checking or the login name. The default is to do login name checking. A
case insensitive value of no disables this feature.

PASSLENGTH
Minimum length of password, in characters.

WARNWEEKS
Time period until warning of date of password’s ensuing expiration.

WHITESPACE
Determine if white space characters are allowed in passwords. Valid values are YES and
NO. If WHITESPACE is not set or is set to YES, white space characters are allowed.

/etc/oshadow
Temporary file used by passwd and pwconv to update the real shadow file.

/etc/passwd
Password file.

/etc/shadow
Shadow password file.

/etc/shells
Shell database.

Attributes See attributes(5) for descriptions of the following attributes:
<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>See below.</td>
</tr>
</tbody>
</table>

The human readable output is Uncommitted. The options are Committed.

See Also  
`at(1), batch(1), finger(1), login(1), cron(1M), domainname(1M), eeprom(1M), id(1M), ldapclient(1M), mkpwdict(1M), pconv(1M), su(1M), useradd(1M), userdel(1M), usermod(1M), crypt(3C), getpwnam(3C), getspnam(3C), getusershell(3C), pam(3PAM), loginlog(4), nsswitch.conf(4), pam.conf(4), passwd(4), policy.conf(4), shadow(4), shells(4), user_attr(4), attributes(5), environ(5), pam_authtok_check(5), pam_authtok_get(5), pam_authtok_store(5), pam_dhkeys(5), pam_ldap(5), pam_unix_account(5), pam_unix_auth(5), pam_unix_session(5), crypt_unix(5)`

Notes  
The `yppasswd` command is a wrapper around `passwd`. Use of `yppasswd` is discouraged. Use `passwd -r repository_name` instead.

Changing a password in the files and ldap repositories clears the failed login count.

Changing a password reactivates an account deactivated for inactivity for the length of the inactivity period.

Input terminal processing might interpret some key sequences and not pass them to the `passwd` command.

An account with no password, status code NP, might not be able to login. See the `login(1)` PASSREQ option.

Authorizations required to perform various options:

- delete password  
  -d  
  -N  
  -l  
  -u  
  -n  
  -w  
  -x  
  -f  
  -s  
  -a  
  -e  
  solaris.passwd.assign  
  solaris.passwd.assign  
  solaris.account.setpolicy  
  solaris.account.setpolicy  
  solaris.account.setpolicy  
  solaris.account.setpolicy  
  solaris.account.setpolicy  
  solaris.account.setpolicy  
  solaris.account.setpolicy  
  solaris.account.setpolicy  
  solaris.user.manage
-g  change gecos information  solaris.user.manage
-h  change home directory   solaris.user.manage
     set a newly created account's
     passwd for the first time  solaris.account.activate

All password hash algorithms except crypt_unix(5) have a maximum password length of 255.
The `paste` utility concatenates the corresponding lines of the given input files, and write the resulting lines to standard output.

The default operation of `paste` concatenates the corresponding lines of the input files. The NEWLINE character of every line except the line from the last input file is replaced with a TAB character.

If an EOF (end-of-file) condition is detected on one or more input files, but not all input files, `paste` behaves as though empty lines were read from the files on which EOF was detected, unless the `-s` option is specified.

The following options are supported:

- `-d list` Unless a backslash character (\) appears in list, each character in list is an element specifying a delimiter character. If a backslash character appears in list, the backslash character and one or more characters following it are an element specifying a delimiter character as described below. These elements specify one or more delimiters to use, instead of the default TAB character, to replace the NEWLINE character of the input lines. The elements in list are used circularly. That is, when the list is exhausted, the first element from the list is reused.

When the `-s` option is specified:
- The last NEWLINE character in a file is not modified.
- The delimiter is reset to the first element of list after each file operand is processed.

When the option is not specified:
- The NEWLINE characters in the file specified by the last file is not modified.
- The delimiter is reset to the first element of list each time a line is processed from each file.

If a backslash character appears in list, it and the character following it is used to represent the following delimiter characters:

- `\n` NEWLINE character.
- `\t` TAB character.
- `\\` Backslash character.
- `\0` Empty string (not a null character). If 0 is immediately followed by the character x, the character X, or any character defined by the LC_CTYPE digit keyword, the results are unspecified.
If any other characters follow the backslash, the results are unspecified.

- s  Concatenate all of the lines of each separate input file in command line order. The
      NEWLINE character of every line except the last line in each input file is replaced
      with the TAB character, unless otherwise specified by the - d option.

**Operands**  The following operand is supported:

- file  A path name of an input file. If is specified for one or more of the files, the standard
         input is used. The standard input is read one line at a time, circularly, for each instance
         of dot .. Implementations support pasting of at least 12 file operands.

**Usage**  See *largefile*(5) for the description of the behavior of paste when encountering files greater
            than or equal to 2 Gbyte ($2^{31}$ bytes).

**Examples**  **EXAMPLE 1**  Listing a Directory in One Column

The following example lists a directory in one column:

```
example% ls | paste -d " "
```

**EXAMPLE 2**  Listing a Directory in Four Columns

The following example lists a directory in four columns:

```
example% ls | paste −−−−
```

**EXAMPLE 3**  Combining Pairs of Lines from a File into Single Lines

The following example combines pairs of lines from a file into single lines:

```
example% paste -s -d"\ t \ n" file
```

**Environment Variables**  See *environ*(5) for descriptions of the following environment variables that affect the
                           execution of paste: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

**Exit Status**  The following exit values are returned:

- 0  Successful completion.

- >0  An error occurred.

**Attributes**  See *attributes*(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>ATTRIBUTE TYPE</td>
<td>ATTRIBUTE VALUE</td>
</tr>
<tr>
<td>----------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also  `cut(1), grep(1), attributes(5), environ(5), largefile(5), standards(5)`
Name  patch – apply changes to files

          [-i patchfile] [-o outfile] [-p num] [-r rejectfile]
          [file]

Description  The patch command reads a source (patch) file containing any of the three forms of difference (diff) listings produced by the diff(1) command (normal, context or in the style of ed(1)) and apply those differences to a file. By default, patch reads from the standard input.

patch attempts to determine the type of the diff listing, unless overruled by a -c, -e, or -n option.

If the patch file contains more than one patch, patch attempts to apply each of them as if they came from separate patch files. (In this case the name of the patch file must be determinable for each diff listing.)

Options  The following options are supported:

- b  Saves a copy of the original contents of each modified file, before the differences are applied, in a file of the same name with the suffix .orig appended to it. If the file already exists, it is overwritten. If multiple patches are applied to the same file, the .orig file is written only for the first patch. When the -o outfile option is also specified, file.Orig is not created but, if outfile already exists, outfile.Orig is created.
- c  Interprets the patch file as a context difference (the output of the command diff when the -c or -C options are specified).
- d dir  Changes the current directory to dir before processing as described in EXTENDED DESCRIPTION.
- D define  Marks changes with the C preprocessor construct:

    #ifdef define
    ... 
    #endif

The option-argument define is used as the differentiating symbol.
- e  Interprets the patch file as an ed script, rather than a diff script.
- i patchfile  Reads the patch information from the file named by the path name patchfile, rather than the standard input.
- l  (The letter ell.) Causes any sequence of blank characters in the difference script to match any sequence of blank characters in the input file. Other characters is matched exactly.
- n  Interprets the script as a normal difference.
-N  Ignores patches where the differences have already been applied to the file; by default, already-applied patches are rejected.

-o outfile  Instead of modifying the files (specified by the file operand or the difference listings) directly, writes a copy of the file referenced by each patch, with the appropriate differences applied, to outfile. Multiple patches for a single file is applied to the intermediate versions of the file created by any previous patches, and results in multiple, concatenated versions of the file being written to outfile.

-p num  For all path names in the patch file that indicate the names of files to be patched, deletes num path name components from the beginning of each path name. If the path name in the patch file is absolute, any leading slashes are considered the first component (that is, -p 1 removes the leading slashes). Specifying -p 0 causes the full path name to be used. If -p is not specified, only the basename (the final path name component) is used.

-R  Reverses the sense of the patch script. That is, assumes that the difference script was created from the new version to the old version. The -R option cannot be used with ed scripts. patch attempts to reverse each portion of the script before applying it. Rejected differences is saved in swapped format. If this option is not specified, and until a portion of the patch file is successfully applied, patch attempts to apply each portion in its reversed sense as well as in its normal sense. If the attempt is successful, the user is prompted to determine if the -R option should be set.

-r rejectfile  Overrides the default reject file name. In the default case, the reject file has the same name as the output file, with the suffix .rej appended to it. See Patch Application.

-u  Interprets the patch file as a unified context difference, that is, the output of the command diff when the -u or -U options are specified.

### Operands

The following operand is supported:

`file`  A path name of a file to patch.

### Usage

The -R option does not work with ed scripts because there is too little information to reconstruct the reverse operation.

The -p option makes it possible to customize a patch file to local user directory structures without manually editing the patch file. For example, if the file name in the patch file was /curds/whey/src/blurfl/blurfl.c:

- Setting -p 0 gives the entire path name unmodified.
- Setting -p 1 gives:

```bash
curds/whey/src/blurfl/blurfl.c
```
Without the leading slash, `-p 4` gives:

`blurfl/blurfl.c`

Not specifying `-p` at all gives:

`blurfl.c`

When using `-b` in some file system implementations, the saving of a `.orig` file might produce unwanted results. In the case of 12-, 13-, or 14-character file names, on file systems supporting 14-character maximum file names, the `.orig` file overwrites the new file.

Environment Variables

See `environ(5)` for descriptions of the following environment variables that affect the execution of `patch`: `LANG`, `LC_ALL`, `LC_COLLATE`, `LC_CTYPE`, `LC_MESSAGES`, `LC_TIME`, and `NLSPATH`.

Affirmative responses are processed using the extended regular expression defined for the `yesexpr` keyword in the `LC_MESSAGES` category of the user's locale. The locale specified in the `LC_COLLATE` category defines the behavior of ranges, equivalence classes, and multi-character collating elements used in the expression defined for `yesexpr`. The locale specified in `LC_CTYPE` determines the locale for interpretation of sequences of bytes of text data a characters, the behavior of character classes used in the expression defined for the `yesexpr`. See `locale(5)`.

Output Files

The output of `patch` the save files (`.orig` suffixes) and the reject files (`.rej` suffixes) are text files.

Extended Description

A patch file can contain patching instructions for more than one file. File names are determined as specified in Patch Determination. When the `-b` option is specified, for each patched file, the original is saved in a file of the same name with the suffix `.orig` appended to it.

For each patched file, a reject file can also be created as noted in Patch Application. In the absence of an `-r` option, the name of this file is formed by appending the suffix `.rej` to the original file name.

Patch File Format

The patch file must contain zero or more lines of header information followed by one or more patches. Each patch must contain zero or more lines of file name identification in the format produced by `diff -c`, and one or more sets of `diff` output, which are customarily called hunks.

`patch` recognizes the following expression in the header information:

`Index: pathname`  The file to be patched is named `pathname`.

If all lines (including headers) within a patch begin with the same leading sequence of blank characters, `patch` removes this sequence before proceeding. Within each patch, if the type of difference is context, `patch` recognizes the following expressions:
The patches arose from `filename`.

The patches should be applied to `filename`.

Each hunk within a patch must be the diff output to change a line range within the original file. The line numbers for successive hunks within a patch must occur in ascending order.

If no `file` operand is specified, `patch` performs the following steps to obtain a path name:

1. If the patch contains the strings `***` and `−−−`, `patch` strips components from the beginning of each path name (depending on the presence or value of the `-p` option), then tests for the existence of both files in the current directory (or directory specified with the `-d` option).

2. If both files exist, `patch` assumes that no path name can be obtained from this step. If the header information contains a line with the string `Index:`, `patch` strips components from the beginning of the path name (depending on `-p`), then tests for the existence of this file in the current directory (or directory specified with the `-d` option).

3. If an SCCS directory exists in the current directory, `patch` attempts to perform a `get -e SCCS/s .filename` command to retrieve an editable version of the file.

4. If no path name can be obtained by applying the previous steps, or if the path names obtained do not exist, `patch` writes a prompt to standard output and request a file name interactively from standard input.

If the `-c`, `-e`, `-n`, or `-u` option is present, `patch` interprets information within each hunk as a context difference, an ed difference, a normal difference, or a unified context difference, respectively. In the absence of any of these options, `patch` determines the type of difference based on the format of information within the hunk.

For each hunk, `patch` begins to search for the place to apply the patch at the line number at the beginning of the hunk, plus or minus any offset used in applying the previous hunk. If lines matching the hunk context are not found, `patch` scans both forwards and backwards at least 1000 bytes for a set of lines that match the hunk context.

If no such place is found and it is a context difference, then another scan takes place, ignoring the first and last line of context. If that fails, the first two and last two lines of context is ignored and another scan is made. Implementations can search more extensively for installation locations.

If no location can be found, `patch` appends the hunk to the reject file. The rejected hunk is written in context-difference format regardless of the format of the patch file. If the input was a normal or ed-style difference, the reject file can contain differences with zero lines of context. The line numbers on the hunks in the reject file can be different from the line numbers in the patch file since they reflect the approximate locations for the failed hunks in the new file rather than the old one.
If the type of patch is an `ed` diff, the implementation can accomplish the patching by invoking the `ed` command.

**Exit Status**  The following exit values are returned:

- **0**  Successful completion.
- **1**  One or more lines were written to a reject file.
- **>1**  An error occurred.

**Attributes**  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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</tr>
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<tbody>
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<td>Interface Stability</td>
<td>Committed</td>
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<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

**See Also**  ed(1), diff(1), attributes(5), environ(5), standards(5)
pathchk(1)

Name
pathchk – check path names

Synopsis
pathchk [-p] path...

Description
The pathchk command will check that one or more path names are valid (that is, they could be used to access or create a file without causing syntax errors) and portable (that is, no filename truncation will result). More extensive portability checks are provided by the -p option.

By default, pathchk will check each component of each path operand based on the underlying file system. A diagnostic will be written for each path operand that:

- is longer than PATH_MAX bytes.
- contains any component longer than NAME_MAX bytes in its containing directory
- contains any component in a directory that is not searchable
- contains any character in any component that is not valid in its containing directory.

The format of the diagnostic message is not specified, but will indicate the error detected and the corresponding path operand.

It will not be considered an error if one or more components of a path operand do not exist as long as a file matching the path name specified by the missing components could be created that does not violate any of the checks specified above.

Options
The following option is supported:

- p Instead of performing checks based on the underlying file system, write a diagnostic for each path operand that:
  - is longer than _POSIX_PATH_MAX bytes
  - contains any component longer than _POSIX_NAME_MAX bytes
  - contains any character in any component that is not in the portable filename character set.

Operands
The following operand is supported:

path A path to be checked.

Usage
See largefile(5) for the description of the behavior of pathchk when encountering files greater than or equal to 2 Gbyte (2³¹ bytes).

Examples
EXAMPLE 1 Using the pathchk command
To verify that all paths in an imported data interchange archive are legitimate and unambiguous on the current system:

eample% pax -f archive | sed -e 's/ /"/' | xargs pathchk
if [ $? == 0 ];
then

User Commands 1257
EXAMPLE 1  Using the pathchk command  (Continued)

    pax -r -f archive
else
    echo Investigate problems before importing files.
    exit 1
fi

To verify that all files in the current directory hierarchy could be moved to any system
conforming to the X/Open specification that also supports the pax(1) command:

    example% find . -print | xargs pathchk -p
    if [ $? -eq 0 ]
    then
        pax -w -f archive .
    else
        echo Portable archive cannot be created.
        exit 1
    fi

To verify that a user-supplied path names a readable file and that the application can create a
file extending the given path without truncation and without overwriting any existing file:

    example% case $- in
    "*C") reset="";;
    ") reset="set +C"
    set -C;;
    esac
    test -r "$path" && pathchk "$path.out" &&
    rm "$path.out" > "$path.out"
    if [ $? -ne 0 ]; then
        printf "\%s: \%s not found or \%s.out fails \n\ncreation checks.\n" $0 "$path" "$path"
        $reset  # reset the noclobber option in case a trap
        # on EXIT depends on it
        exit 1
    fi
    $reset
    PROCESSING < "$path" > "$path.out"

The following assumptions are made in this example:

1. PROCESSING represents the code that will be used by the application to use $path once it is
   verified that $path.out will work as intended.

2. The state of the noclobber option is unknown when this code is invoked and should be set
   on exit to the state it was in when this code was invoked. (The reset variable is used in this
   example to restore the initial state.)
EXAMPLE 1  Using the pathchk command  (Continued)

3. Note the usage of:

   \texttt{rm "\$path.out" > "\$path.out"}

   a. The \texttt{pathchk} command has already verified, at this point, that \texttt{\$path.out} will not be truncated.

   b. With the \texttt{noclobber} option set, the shell will verify that \texttt{\$path.out} does not already exist before invoking \texttt{rm}.

   c. If the shell succeeded in creating \texttt{\$path.out}, \texttt{rm} will remove it so that the application can create the file again in the \texttt{PROCESSING} step.

   d. If the \texttt{PROCESSING} step wants the file to exist already when it is invoked, the:

      \texttt{rm "\$path.out" > "\$path.out"}

      should be replaced with:

      \texttt{> "\$path.out"}

      which will verify that the file did not already exist, but leave \texttt{\$path.out} in place for use by \texttt{PROCESSING}.

\textbf{Environment Variables}  See \texttt{environ(5)} for descriptions of the following environment variables that affect the execution of \texttt{pathchk}: \texttt{LANG}, \texttt{LC_ALL}, \texttt{LC_CTYPE}, \texttt{LC_MESSAGES}, and \texttt{NLSPATH}.

\textbf{Exit Status}  The following exit values are returned:

   0  All \texttt{path} operands passed all of the checks.

   >0  An error occurred.

\textbf{Attributes}  See \texttt{attributes(5)} for descriptions of the following attributes:

\begin{center}
\begin{tabular}{|l|l|}
\hline
\textbf{ATTRIBUTE TYPE} & \textbf{ATTRIBUTE VALUE} \\
\hline
Availability & system/core-os \\
Interface Stability & Committed \\
Standard & See \texttt{standards(5)}. \\
\hline
\end{tabular}
\end{center}

\textbf{See Also}  \texttt{pax(1), test(1), attributes(5), environ(5), largefile(5), standards(5)}
**Name**
pax – portable archive interchange

**Synopsis**
pax [-cdnv] [-H | -L] [-f archive] [-o options]...
 [-s replstr]... [pattern]...
pax -r [-cdiknuv@/] [-H | -L] [-f archive] [-o options]...
 [-p string]... [-s replstr]... [pattern]...
pax -w [-dituvX@/] [-H | -L] [-b blocksize] [-a]
 [-f archive] [-o options]... [-s replstr]...
 [-x format] [file]...
pax -r -w [-diklntuvX@/] [-H | -L] [-o options]...
 [-p string]... [-s replstr]... [file]... directory

**Description**
pax reads, writes, and writes lists of the members of archive files and copies directory hierarchies. A variety of archive formats are supported. See the -x format option.

**Modes of Operations**
The action to be taken depends on the presence of the -r and -w options. The four combinations of -r and -w are referred to as the four modes of operation: list, read, write, and copy modes, corresponding respectively to the four forms shown in the SYNOPSIS.

**list**
In list mode, that is, when neither -r nor -w are specified, pax writes the names of the members of the archive file read from the standard input, with path names matching the specified patterns, to standard output. If a named file has extended attributes, the extended attributes are also listed. If a named file is of type directory, the file hierarchy rooted at that file is listed as well.

**read**
In read mode, that is, when -r is specified, but -w is not, pax extracts the members of the archive file read from the standard input, with path names matching the specified patterns. If an extracted file is of type directory, the file hierarchy rooted at that file is extracted as well. The extracted files are created performing path name resolution with the directory in which pax was invoked as the current working directory.

If an attempt is made to extract a directory when the directory already exists, this is not considered an error. If an attempt is made to extract a FIFO when the FIFO already exists, this is not considered an error.

The ownership, access and modification times, and file mode of the restored files are discussed under the -p option.

**write**
In write mode, that is, when -w is specified, but -r is not, pax writes the contents of the file operands to the standard output in an archive format. If no file operands are specified, a list of files to copy, one per line, are read from the standard input. A file of type directory includes all of the files in the file hierarchy rooted at the file.

**copy**
In copy mode, that is, when both -r and -w are specified, pax copies the file operands to the destination directory.
If no file operands are specified, a list of files to copy, one per line, are read from the standard input. A file of type directory includes all of the files in the file hierarchy rooted at the file.

The effect of the copy is as if the copied files were written to an archive file and then subsequently extracted, except that there can be hard links between the original and the copied files. If the destination directory is a subdirectory of one of the files to be copied, the results are unspecified. It is an error if directory does not exist, is not writable by the user, or is not a directory.

In read or copy modes, if intermediate directories are necessary to extract an archive member, pax performs actions equivalent to the mkd1r(2) function, called with the following arguments:

- The intermediate directory used as the path argument.
- The octal value of 777 or rwx (read, write, and execute permissions) as the mode argument (see chmod(1)).

If any specified pattern or file operands are not matched by at least one file or archive member, pax writes a diagnostic message to standard error for each one that did not match and exits with a non-zero exit status.

The supported archive formats are automatically detected on input. The default output archive format is tar(1).

A single archive can span multiple files. pax determines what file to read or write as the next file.

If the selected archive format supports the specification of linked files, it is an error if these files cannot be linked when the archive is extracted, except if the files to be linked are symbolic links and the system is not capable of making hard links to symbolic links. In that case, separate copies of the symbolic link are created instead. Any of the various names in the archive that represent a file can be used to select the file for extraction. For archive formats that do not store file contents with each name that causes a hard link, if the file that contains the data is not extracted during this pax session, either the data is restored from the original file, or a diagnostic message is displayed with the name of a file that can be used to extract the data. In traversing directories, pax detects infinite loops, that is, entering a previously visited directory that is an ancestor of the last file visited. When it detects an infinite loop, pax writes a diagnostic message to standard error and terminates.

**Options**

The following options are supported:

- **-a**
  
  Appends files to the end of the archive. This option does not work for some archive devices, such as 1/4-inch streaming tapes and 8mm tapes.
-b blocksize  Blocks the output at a positive decimal integer number of bytes per write to the archive file. Devices and archive formats can impose restrictions on blocking. Blocking is automatically determined on input. Portable applications must not specify a blocksize value larger than 32256. Default blocking when creating archives depends on the archive format. See the -x option below.

-c  Matches all file or archive members except those specified by the pattern or file operands.

-d  Causes files of type directory being copied or archived or archive members of type directory being extracted or listed to match only the file or archive member itself and not the file hierarchy rooted at the file.

-t archive  Specifies the path name of the input or output archive, overriding the default standard input (in list or read modes) or standard output (write mode).

-H  If a symbolic link referencing a file of type directory is specified on the command line, pax archives the file hierarchy rooted in the file referenced by the link, using the name of the link as the root of the file hierarchy. Otherwise, if a symbolic link referencing a file of any other file type which pax can normally archive is specified on the command line, then pax archives the file referenced by the link, using the name of the link. The default behavior is to archive the symbolic link itself.

-i  Interactively renames files or archive members. For each archive member matching a pattern operand or file matching a file operand, a prompt is written to the file /dev/tty. The prompt contains the name of the file or archive member. A line is then read from /dev/tty. If this line is blank, the file or archive member is skipped. If this line consists of a single period, the file or archive member is processed with no modification to its name. Otherwise, its name is replaced with the contents of the line. pax immediately exits with a non-zero exit status if end-of-file is encountered when reading a response or if /dev/tty cannot be opened for reading and writing.

The results of extracting a hard link to a file that has been renamed during extraction are unspecified.

-k  Prevents the overwriting of existing files.

-l  Links files. In copy mode, hard links are made between the source and destination file hierarchies whenever possible. If specified in conjunction with -H or -L, when a symbolic link is encountered, the hard link created in the destination file hierarchy is to the file referenced by the symbolic link. If specified when neither -H nor -L is specified, when a symbolic link is encountered, the implementation creates a hard link to the symbolic link in the source file hierarchy or copies the symbolic link to the destination.
If a symbolic link referencing a file of type directory is specified on the command line or encountered during the traversal of a file hierarchy, **pax** archives the file hierarchy rooted in the file referenced by the link, using the name of the link as the root of the file hierarchy. Otherwise, if a symbolic link referencing a file of any other file type which **pax** can normally archive is specified on the command line or encountered during the traversal of a file hierarchy, **pax** archives the file referenced by the link, using the name of the link. The default behavior is to archive the symbolic link itself.

**-n**
Selects the first archive member that matches each pattern operand. No more than one archive member is matched for each pattern, although members of type directory still match the file hierarchy rooted at that file.

**-o options**
Provides information to the implementation to modify the algorithm for extracting or writing files. The value of options consists of one or more comma-separated keywords of the form:

```
keyword[:=value],keyword[:=value],...
```

Some keywords apply only to certain file formats, as indicated with each description. Use of keywords that are inapplicable to the file format being processed produces undefined results.

Keywords in the options argument must be a string that would be a valid portable filename.

Keywords are not expected to be filenames, merely to follow the same character composition rules as portable filenames.

Keywords can be preceded with white space. The value field consists of zero or more characters. Within value, the application precedes any literal comma with a backslash, which is ignored, but preserves the comma as part of value. A comma as the final character, or a comma followed solely by white space as the final characters, in options is ignored. Multiple -o options can be specified. If keywords given to these multiple -o options conflict, the keywords and values appearing later in command line sequence take precedence and the earlier ones are silently ignored. The following keyword values of options are supported for the file formats as indicated:

**delete=pattern**
This keyword is applicable only to the -x **pax** format. When used in write or copy mode, **pax** omits from extended header records that it produces any keywords matching the string pattern. When used in read or list mode, **pax** ignores any keywords matching the string pattern in the extended header records. In both cases, matching is performed using the pattern matching notation. For example:

```
-o delete=security.*
```
would suppress security-related information.

When multiple `delete=pattern` options are specified, the patterns are additive. All keywords matching the specified string patterns are omitted from extended header records that pax produces.

`exthdr.name=string`

This keyword is applicable only to the `-x pax` format. This keyword allows user control over the name that is written into the `ustar` header blocks for the extended header. The name is the contents of `string`, after the following character substitutions have been made:

- `%d` The directory name of the file, equivalent to the result of the `dirname` utility on the translated path name.
- `%f` The filename of the file, equivalent to the result of the `basename` utility on the translated path name.
- `%p` The process ID of the pax process.
- `%%` A `%` character.

Any other `%` characters in `string` produce undefined results.

If no `-o exthdr.name=string` is specified, pax uses the following default value:

```
%d/PaxHeaders.%p/%f
```

`globexthdr.name=string`

This keyword is applicable only to the `-x pax` format. When used in write or copy mode with the appropriate options, pax creates global extended header records with `ustar` header blocks that are treated as regular files by previous versions of pax. This keyword allows user control over the name that is written into the `ustar` header blocks for global extended header records. The name is the contents of `string`, after the following character substitutions have been made:

- `%n` An integer that represents the sequence number of the global extended header record in the archive, starting at 1.
- `%p` The process ID of the pax process.
- `%%` A `%` character.

Any other `%` characters in `string` produce undefined results.

If no `-o globexthdr.name=string` is specified, pax uses the following default value:

```
$TMPDIR/GlobalHead.%p.%n
```
where $TMPDIR$ represents the value of the $TMPDIR$ environment variable. If $TMPDIR$ is not set, pax uses /tmp.

invalid=action

This keyword is applicable only to the -x pax format. This keyword allows user control over the action pax takes upon encountering values in an extended header record that, in read or copy mode, are invalid in the destination hierarchy or, in list mode, cannot be written in the codeset and current locale of the implementation. The following are invalid values that are recognized by pax:

- In read or copy mode, a filename or link name that contains character encodings invalid in the destination hierarchy. For example, the name can contain embedded NULs.
- In read or copy mode, a filename or link name that is longer than the maximum allowed in the destination hierarchy, for either a path name component or the entire path name.
- In list mode, any character string value (filename, link name, user name, and so on) that cannot be written in the codeset and current locale of the implementation.

The following mutually-exclusive values of the action argument are supported:

bypass In read or copy mode, pax bypasses the file, causing no change to the destination hierarchy. In list mode, pax writes all requested valid values for the file, but its method for writing invalid values is unspecified.

rename In read or copy mode, pax acts as if the -i option were in effect for each file with invalid filename or link name values, allowing the user to provide a replacement name interactively. In list mode, pax behaves identically to the bypass action.

UTF-8 pax uses the actual UTF-8 encoding for the name when it is used in read, copy, or list mode and a filename, link name, owner name, or any other field in an extended header record cannot be translated from the pax UTF-8 codeset format to the codeset and current locale of the implementation.

write In read or copy mode, pax writes the file, translating the name, regardless of whether this can overwrite an existing file with a valid name. In list mode, pax behaves identically to the bypass action.

If no -o invalid= option is specified, pax acts as if -o invalid=bypass were specified. Any overwriting of existing files that can be allowed by the
-o invalid actions are subject to permission (-p) and modification time (-u) restrictions, and are suppressed if the -k option is also specified.

linkdata
This keyword is applicable only to the -x pax format. In write mode, pax writes the contents of a file to the archive even when that file is merely a hard link to a file whose contents have already been written to the archive.

listopt=format
This keyword specifies the output format of the table of contents produced when the -v option is specified in list mode. (See List Mode Format Specifications below.) To avoid ambiguity, the listopt=format is the only or final keyword=value pair in an -o option-argument. All characters in the remainder of the option-argument are considered to be part of the format string. When multiple -o listopt=format options are specified, the format strings are considered to be a single, concatenated string, evaluated in command line order.

times
This keyword is applicable only to the -x pax and -x xustar formats.
When used in write or copy mode, pax includes a time and mtime extended header records for each file.

In addition to these keywords, if the -x pax format is specified, any of the keywords and values, including implementation extensions, can be used in -o option-arguments, in either of two modes:

keyword=value When used in write or copy mode, these keyword/value pairs are included at the beginning of the archive as typeflag g global extended header records. When used in read or list mode, these keyword/value pairs act as if they had been at the beginning of the archive as typeflag g global extended header records.

keyword:=value When used in write or copy mode, these keyword/value pairs are included as records at the beginning of a typeflag x extended header for each file. This is equivalent to the equal-sign form except that it creates no typeflag g global extended header records. When used in read or list mode, these keyword/value pairs act as if they were included as records at the end of each extended header. Thus, they override any global or file-specific extended header record keywords of the same names. For example, in the command:

```bash
pax -r -o "
gname:=mygroup,
  " <archive
```
the group name is forced to a new value for all files read from the archive.

- **p string** Specifies one or more file characteristic options (privileges). The *string* option-argument must be a string specifying file characteristics to be retained or discarded on extraction. The string consists of the specification characters a, e, m, o, and p. Multiple characteristics can be concatenated within the same string and multiple -p options can be specified. The meaning of the specification characters is as follows:

  a  Does not preserve file access times.
  e  Preserves the user ID, group ID, file mode bits, access time, and modification time.
  m  Does not preserve file modification times.
  o  Preserves the user ID and group ID.
  p  Preserves the file mode bits.

In the preceding list, preserve indicates that an attribute stored in the archive is given to the extracted file, subject to the permissions of the invoking process. Otherwise, the attribute is determined as part of the normal file creation action. The access and modification times of the file is preserved unless otherwise specified with the -p option or not stored in the archive. All attributes that are not preserved are determined as part of the normal file creation action.

If neither the e nor the o specification character is specified, or the user ID and group ID are not preserved for any reason, pax does not set the setuid and setgid bits of the file mode.

If the preservation of any of these items fails for any reason, pax writes a diagnostic message to standard error. Failure to preserve these items affects the final exit status, but does not cause the extracted file to be deleted.

If file characteristic letters in any of the *string* option-arguments are duplicated or conflict with each other, the ones given last take precedence. For example, if -p eem is specified, file modification times are preserved.

- **r** Reads an archive file from standard input.

- **s replstr** Modifies file or archive member names named by *pattern* or *file* operands according to the substitution expression *replstr*, which is based on the ed(1) s (substitution) utility, using the regular expression syntax of regex(5). The concepts of "address" and "line" are meaningless in the context of the pax command, and must not be supplied. The format is:
-s /old/new/ [gp]

where, as in ed, old is a basic regular expression and new can contain an
ampersand (&), a \n backreference, where n is a digit, or subexpression
matching. The old string is also permitted to contain newlines.

Any non-null character can be used as a delimiter (/ shown here). Multiple -s
expressions can be specified. The expressions are applied in the order
specified, terminating with the first successful substitution. The optional
trailing g is as defined in the ed command. The optional trailing p causes
successful substitutions to be written to standard error. File or archive
member names that substitute to the empty string are ignored when reading
and writing archives.

-t When reading files from the file system, and if the user has the permissions
required by utime() to do so, sets the access time of each file read to the access
time that it had before being read by pax.

-u Ignores files that are older (having a less recent file modification time) than a
pre-existing file or archive member with the same name.

read mode An archive member with the same name as a file in the file
system is extracted if the archive member is newer than the
file.

write mode An archive file member with the same name as a file in the
file system is superseded if the file is newer than the archive
member. If option -a is also specified, this is accomplished
by appending to the archive. Otherwise, it is unspecified
whether this is accomplished by actual replacement in the
archive or by appending to the archive.

copy mode The file in the destination hierarchy is replaced by the file in
the source hierarchy or by a link to the file in the source
hierarchy if the file in the source hierarchy is newer.

-v In list mode, produces a verbose table of contents (see Standard Output).
Otherwise, writes archive member path names and extended attributes to
standard error (see Standard Error).

-w Writes files to the standard output in the specified archive format.

-x format Specifies the output archive format. The pax utility recognizes the following
formats:

cpio The extended cpio(1) interchange format. See IEEE Std
1003.1-2001. The default blocksize for this format for character
special archive files is 5120. Implementations support all blocksize
values less than or equal to 32256 that are multiples of 512.
This archive format allows files with UIDs and GIDs up to 262143 to be stored in the archive. Files with UIDs and GIDs greater than this value are archived with the UID and GID of 60001.

**pax**
The pax interchange format. See IEEE Std 1003.1–2001. The default blocksize for this format for character special archive files is 5120. Implementations support all blocksize values less than or equal to 32256 that are multiples of 512.

Similar to **ustar**. Also allows archiving and extracting files whose size is greater than 8GB; whose UID, GID, devmajor, or devminor values are greater than 2097151; whose path (including filename) is greater than 255 characters; or whose linkname is greater than 100 characters.

**ustar**
The extended **tar**(1) interchange format. See the IEEE 1003.1(1990) specifications. The default blocksize for this format for character special archive files is 10240. Implementations support all blocksize values less than or equal to 32256 that are multiples of 512.

This archive format allows files with UIDs and GIDs up to 2097151 to be stored in the archive. Files with UIDs and GIDs greater than this value are archived with the UID and GID of 60001.

**xustar**
Similar to **ustar**. Also allows archiving and extracting files whose size is greater than 8GB; whose UID, GID, devmajor, or devminor values are greater than 2097151; whose path (including filename) is greater than 255 characters; or whose linkname is greater than 100 characters. This option should not be used if the archive is to be extracted by an archiver that cannot handle the larger values.

Any attempt to append to an archive file in a format different from the existing archive format causes pax to exit immediately with a non-zero exit status.

In copy mode, if no -x format is specified, pax behaves as if -x pax were specified.

**-X**
When traversing the file hierarchy specified by a path name, pax does not descend into directories that have a different device ID (st_dev, see **stat**(2)).

**-@**
Includes extended attributes in the archive. pax does not place extended attributes in the archive by default.
When traversing the file hierarchy specified by a path name, pax descends into the attribute directory for any file with extended attributes. Extended attributes go into the archive as special files.

When this flag is used during file extraction, any extended attributes associated with a file being extracted are also extracted. Extended attribute files can only be extracted from an archive as part of a normal file extract. Attempts to explicitly extract attribute records are ignored.

`-H`

Includes extended system attributes in the archive. pax does not place extended system attributes in the archive by default.

When traversing the file hierarchy specified by a path name, pax descends into the attribute directory for any file with extended attributes. Extended attributes go into the archive as special files. When this flag is used during file extraction, any extended attributes associated with a file being extracted are also extracted. Extended attribute files can only be extracted from an archive as part of a normal file extract. Attempts to explicitly extract attribute records are ignored.

Specifying more than one of the mutually-exclusive options `-H` and `-L` is not considered an error. The last option specified determines the behavior of the utility.

The options that operate on the names of files or archive members (`-c`, `-i`, `-n`, `-s`, `-u` and `-v`) interact as follows.

In read mode, the archive members are selected based on the user-specified pattern operands as modified by the `-c`, `-n` and `-u` options. Then, any `-s` and `-i` options modify, in that order, the names of the selected files. The `-v` option writes names resulting from these modifications.

In write mode, the files are selected based on the user-specified path names as modified by the `-n` and `-u` options. Then, any `-s` and `-i` options modify, in that order, the names of these selected files. The `-v` option writes names resulting from these modifications.

If both the `-u` and `-n` options are specified, pax does not consider a file selected unless it is newer than the file to which it is compared.

### List Mode Format Specifications

In `list` mode with the `-o listopt=format` option, the format argument is applied for each selected file. pax appends a NEWLINE to the listopt output for each selected file. The `format` argument is used as the format string with the following exceptions. (See `printf(1)` for the first five exceptions.)

1. A SPACE character in the format string, in any context other than a flag of a conversion specification, is treated as an ordinary character that is copied to the output.
2. A ‘’ character in the format string is treated as a ‘’ character, not as a SPACE.
3. In addition to the escape sequences described in the `formats(5)` manual page, (`\", `\a`, `\b`, `\f`, `\n`, `\r`, `\t`, `\v`), `\ddd`, where `ddd` is a one-, two-, or three-digit octal number, is written as a byte with the numeric value specified by the octal number.

4. Output from the `d` or `u` conversion specifiers is not preceded or followed with BLANKs not specified by the format operand.

5. Output from the `o` conversion specifier is not preceded with zeros that are not specified by the format operand.

6. The sequence `(keyword)` can occur before a format conversion specifier. The conversion argument is defined by the value of `keyword`. The following keywords are supported (see IEEE Std 1003.1–2001):
   - Any of the Field Name entries in `ustar Header Block` and `Octet-Oriented cpio Archive Entry`. The implementation supports the `cpio` keywords without the leading `c_` in addition to the form required by `Values for cpio c_ mode Field`.
   - Any keyword defined for the extended header in `pax Extended Header`.
   - Any keyword provided as an implementation-defined extension within the extended header defined in `pax Extended Header`.

   For example, the sequence "%(charset)s" is the string value of the name of the character set in the extended header.

   The result of the keyword conversion argument is the value from the applicable header field or extended header, without any trailing `NULs`.

   All keyword values used as conversion arguments are translated from the UTF-8 encoding to the character set appropriate for the local file system, user database, and so on, as applicable.

7. An additional conversion specifier character, `T`, is used to specify time formats. The `T` conversion specifier character can be preceded by the sequence `(keyword=subformat)`, where `subformat` is a date format as defined by `date` operands. The default `keyword` is `mtime` and the default `subformat` is:

   `%b %e %H:%M %Y`

8. An additional conversion specifier character, `M`, is used to specify the file mode string as defined in `ls Standard Output`. If `(keyword)` is omitted, the `mode` keyword is used. For example, `% .1M` writes the single character corresponding to the `entry type` field of the `ls -l` command.

9. An additional conversion specifier character, `D`, is used to specify the device for block or special files, if applicable, in an implementation-defined format. If not applicable, and `(keyword)` is specified, then this conversion is equivalent to `%(keyword)u`. If not applicable, and `(keyword)` is omitted, then this conversion is equivalent to `SPACE`. 
10. An additional conversion specifier character, F, is used to specify a path name. The F conversion character can be preceded by a sequence of comma-separated keywords:

\( \text{keyword1, keyword2} \ldots \) 

The values for all the keywords that are non-null are concatenated, each separated by a `/`. The default is (path) if the keyword path is defined. Otherwise, the default is (prefix,name).

11. An additional conversion specifier character, L, is used to specify a symbolic link expansion. If the current file is a symbolic link, then %L expands to:

\( \%s \to \%s \), value of keyword, contents of link

Otherwise, the %L conversion specification is the equivalent of %F.

**Operands**

The following operands are supported:

- **directory** The destination directory path name for copy mode.
- **file** A path name of a file to be copied or archived.
- **pattern** A pattern matching one or more path names of archive members. A pattern must conform to the pattern matching notation found on the `fnmatch(5)` manual page. The default, if no pattern is specified, is to select all members in the archive.

**Output**

Output formats are discussed below:

**Standard Output**

In write mode, if -f is not specified, the standard output is the archive formatted according to one of the formats described below. See -x format for a list of supported formats.

In list mode, when the -o listopt=format option has been specified, the selected archive members are written to standard output using the format described above under List Mode Format Specifications. In list mode without the -o listopt=format option, the table of contents of the selected archive members are written to standard output using the following format:

\( \%s\n\), pathname

If the -v option is specified in list mode, the table of contents of the selected archive members are written to standard output using the following formats:

- For path names representing hard links to previous members of the archive:
  \( \%s = \%s\n\), <ls -l listing, linkname

- For all other path names:
  \( \%s\n\), <ls -l listing>

where <ls -l listing> is the format specified by the ls command with the -l option. When writing path names in this format, it is unspecified what is written for fields for which the
underlying archive format does not have the correct information, although the correct number of blank-character-separated fields is written.

In list mode, standard output is not buffered more than a line at a time.

Standard Error

If -v is specified in read, write or copy modes, pax writes the path names it processes to the standard error output using the following format:

"%s\n", path name

These path names are written as soon as processing is begun on the file or archive member, and are flushed to standard error. The trailing NEWLINE character, which is not buffered, is written when the file has been read or written.

If the -s option is specified, and the replacement string has a trailing p, substitutions are written to standard error in the following format:

"%s >> %s\n", <original path name>, <new path name>

In all operating modes of pax, optional messages of unspecified format concerning the input archive format and volume number, the number of files, blocks, volumes, and media parts as well as other diagnostic messages can be written to standard error.

In all formats, for both standard output and standard error, it is unspecified how non-printable characters in path names or link names are written.

When pax is in read mode or list mode, using the -x pax archive format, and a file name, link name, owner name, or any other field in an extended header record cannot be translated from the pax UTF-8 codeset format to the codeset and current locale of the implementation, pax writes a diagnostic message to standard error, processes the file as described for the -o invalid=option, and then processes the next file in the archive.

Output Files

In read mode, the extracted output files are of the archived file type. In copy mode, the copied output files are the type of the file being copied. In either mode, existing files in the destination hierarchy are overwritten only when all permission (-p), modification time (-u), and invalid-value (-o invalid=) tests allow it. In write mode, the output file named by the -f option-argument is a file formatted according to one of the specifications in IEEE Std 1003.1–2001.

Errors

If pax cannot create a file or a link when reading an archive, or cannot find a file when writing an archive, or cannot preserve the user ID, group ID, or file mode when the -p option is specified, a diagnostic message is written to standard error and a non-zero exit status is returned, but processing continues. In the case where pax cannot create a link to a file, pax does not, by default, create a second copy of the file.

If the extraction of a file from an archive is prematurely terminated by a signal or error, pax can have only partially extracted the file or, if the -n option was not specified, can have
extracted a file of the same name as that specified by the user, but which is not the file the user
wanted. Additionally, the file modes of extracted directories can have additional bits from the
read, write, execute mask set as well as incorrect modification and access times.

**Usage**

The `-p` (privileges) option was invented to reconcile differences between historical `tar(1)` and
`cpio(1)` implementations. In particular, the two utilities use `-m` in diametrically opposed ways.
The `-p` option also provides a consistent means of extending the ways in which future file
attributes can be addressed, such as for enhanced security systems or high-performance files.
Although it can seem complex, there are really two modes that are most commonly used:

- `-p e` Preserve everything. This would be used by the historical superuser, someone with all
the appropriate privileges, to preserve all aspects of the files as they are recorded in
the archive. The `e` flag is the sum of `o` and `p`, and other implementation-dependent
attributes.

- `-p p` Preserve the file mode bits. This would be used by the user with regular privileges who
wished to preserve aspects of the file other than the ownership. The file times are
preserved by default, but two other flags are offered to disable these and use the time
of extraction.

The one path name per line format of standard input precludes path names containing
newlines. Although such path names violate the portable filename guidelines, they can exist
and their presence can inhibit usage of `pax` within shell scripts. This problem is inherited from
historical archive programs. The problem can be avoided by listing file name arguments on
the command line instead of on standard input.

It is almost certain that appropriate privileges are required for `pax` to accomplish parts of this.
Specifically, creating files of type block special or character special, restoring file access times
unless the files are owned by the user (the `-t` option), or preserving file owner, group, and
mode (the `-p` option) all probably require appropriate privileges.

In read mode, implementations are permitted to overwrite files when the archive has multiple
members with the same name. This can fail if permissions on the first version of the file do not
permit it to be overwritten.

When using the `-x xustar` and `-x -pax` archive formats, if the underlying file system reports
that the file being archived contains holes, the Solaris `pax` utility records the presence of holes
in an extended header record when the file is archived. If this extended header record is
associated with a file in the archive, those holes are recreated whenever that file is extracted
from the archive. See the `SEEK_DATA` and `SEEK_HOLE` whence values in `lseek(2)`. In all other
cases, any NUL (`\0`) characters found in the archive is written to the file when it is extracted.

See `largefile(5)` for the description of the behavior of `pax` when encountering files greater
than or equal to 2 Gbyte (\(2^{31}\) bytes).
In write mode, the standard input is used only if no file operands are specified. It is a text file containing a list of path names, one per line, without leading or trailing blanks. In list and read modes, if -f is not specified, the standard input is an archive file. Otherwise, the standard input is not used.

The input file named by the archive option-argument, or standard input when the archive is read from there, is a file formatted according to one of the formats described below. See Extended Description. The file /dev/tty is used to write prompts and read responses.

**Examples**

**EXAMPLE 1**  Copying the Contents of the Current Directory

The following command:

```bash
example% pax -w -f /dev/rmt/1m .
```

copies the contents of the current directory to tape drive 1, medium density. This assumes historical System V device naming procedures. The historical BSD device name would be /dev/rmt9.

**EXAMPLE 2**  Copying the Directory Hierarchy

The following commands:

```bash
example% mkdir newdir
example% pax -rw olddir newdir
```

copy the olddir directory hierarchy to newdir.

**EXAMPLE 3**  Reading an Archive Extracted Relative to the Current Directory

The following command:

```bash
example% pax -r -s ',^/usr//*,,' -f a.pax
```

reads the archive a.pax, with all files rooted in /usr in the archive extracted relative to the current directory.

**EXAMPLE 4**  Overriding the Default Output Description

Using the option:

```bash
-o listopt="\%M \%(atime)T \%(size)D \%(name)s"
```

overrides the default output description in Standard Output and instead writes:

```bash
-rw-rw- - - Jan 12 15:53 2003 1492 /usr/foo/bar
```

Using the options:

```bash
-o listopt='\%L\%(size)D\n\%
-o listopt='\%(name)s\%(atime)T\n\%
```
EXAMPLE 4  Overriding the Default Output Description  (Continued)

overrides the default output description in standard output and instead writes:

    usr/foo/bar  ->  /tmp 1492
    /usr/foo
    Jan 12 15:53 1991
    Jan 31 15:53 2003

See environ(5) for descriptions of the following environment variables that affect the
execution of pax: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, LC_TIME, and NLSPATH.

LC_COLLATE   Determine the locale for the behaviour of ranges, equivalence classes, and
multi-character collating elements used in the pattern matching expressions
for the pattern operand, the basic regular expression for the -s option, and
the extended regular expression defined for the yesexpr locale keyword in
the LC_MESSAGES category.

TMPDIR       Determine the path name that provides part of the default global extended
header record file, as described for the -o globexthdr= keyword as described
in the OPTIONS section.

TZ           Determine the timezone used to calculate date and time strings when the -v
option is specified. If TZ is unset or null, an unspecified default timezone is
used.

Exit Status  The following exit values are returned:

     0        All files were processed successfully.
    >0        An error occurred.

Extended Description

A pax archive tape or file produced in the -xpax format contains a series of blocks. The
physical layout of the archive is identical to the ustar format described in ustar Interchange
Format. Each file archived is represented by the following sequence:

- An optional header block with extended header records. This header block is of the form
  27403 with a typeflag value of x or g. The extended header records is included as the data
  for this header block.
- A header block that describes the file. Any fields in the preceding optional extended header
  overrides the associated fields in this header block for this file.
- Zero or more blocks that contain the contents of the file.

At the end of the archive file there are two 512-byte blocks filled with binary zeroes,
interpreted as an end-of-archive indicator.
The following is a schematic of an example archive with global extended header records and two actual files in pax format archive. In the example, the second file in the archive has no extended header preceding it, presumably because it has no need for extended attributes.

<table>
<thead>
<tr>
<th>Description</th>
<th>Block</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global Extended Header</td>
<td>ustar Header [typeflag=g]</td>
</tr>
<tr>
<td></td>
<td>Global Extended Header Data</td>
</tr>
<tr>
<td>File 1: Extended Header is included</td>
<td>ustar Header [typeflag=x]</td>
</tr>
<tr>
<td></td>
<td>Extended Header Data</td>
</tr>
<tr>
<td></td>
<td>[typeflag=0]</td>
</tr>
<tr>
<td></td>
<td>ustar Header Data for File 1</td>
</tr>
<tr>
<td>File 2: No Extended Header is included</td>
<td>ustar Header [typeflag=0]</td>
</tr>
<tr>
<td></td>
<td>Data for File 2</td>
</tr>
<tr>
<td>End of Archive Indicator</td>
<td>Block of binary zeros</td>
</tr>
<tr>
<td></td>
<td>Block of binary zeros</td>
</tr>
</tbody>
</table>

The pax header block is identical to the ustar header block described in ustar Interchange Format except that two additional typeflag values are defined:

- **g**: Represents global extended header records for the following files in the archive. The format of these extended header records are as described in pax Extended Header. Each value affects all subsequent files that do not override that value in their own extended header record and until another global extended header record is reached that provides another value for the same field. The typeflag g global headers should not be used with interchange media that could suffer partial data loss in transporting the archive.

- **x**: Represents extended header records for the following file in the archive (which has its own ustar header block). The format of these extended header records is as described in pax Extended Header.

For both of these types, the size field is the size of the extended header records in octets. The other fields in the header block are not meaningful to this version of pax. However, if this archive is read by pax conforming to a previous version of ISO POSIX-2:1993 Standard, the header block fields are used to create a regular file that contains the extended header records as data. Therefore, header block field values should be selected to provide reasonable file access to this regular file.

A further difference from the ustar header block is that data blocks for files of typeflag 1 (the digit one) (hard link) might be included, which means that the size field can be greater than zero. Archives created by pax -o linkdata includes these data blocks with the hard links.
A pax extended header contains values that are inappropriate for the ustar header block because of limitations in that format: fields requiring a character encoding other than that described in the ISO/IEC 646: 1991 standard, fields representing file attributes not described in the ustar header, and fields whose format or length do not fit the requirements of the ustar header. The values in an extended header add attributes to the specified file or files or override values in the specified header blocks, as indicated in the following list of keywords. See the description of the typeflag g header block.

An extended header consists of one or more records, each constructed as follows:

"%d %s=%s\n",

length, keyword, value

The extended header records are encoded according to the ISO/IEC 10646-1: 2000 standard (UTF-8). length, BLANK, equals sign (=), and NEWLINE are limited to the portable character set, as encoded in UTF-8. keyword and value can be any UTF-8 characters. length is the decimal length of the extended header record in octets, including the trailing NEWLINE.

keyword is one of the entries from the following list or a keyword provided as an implementation extension. Keywords consisting entirely of lowercase letters, digits, and periods are reserved for future standardization. A keyword does not include an equals sign.

In the following list, the notation of file(s) or block(s) are used to acknowledge that a keyword affects the specified single file after a typeflag x extended header, but possibly multiple files after typeflag g. Any requirements in the list for pax to include a record when in write or copy mode applies only when such a record has not already been provided through the use of the -o option. When used in copy mode, pax behaves as if an archive had been created with applicable extended header records and then extracted.

atime

The file access time for the specified files, equivalent to the value of the st_atime member of the stat structure for a file, as described by the stat(2) function. The access time (atime) is restored if the process has the appropriate privilege required to do so. The format of the value is as described in pax Extended Header File Times.

charset

The name of the character set used to encode the data in the specified files. The entries in the following table are defined to refer to known standards; additional names can be agreed on between the originator and recipient.

<table>
<thead>
<tr>
<th>value</th>
<th>Formal Standard</th>
</tr>
</thead>
</table>
The encoding is included in an extended header for information only; when pax is used as described in IEEE Std 1003.1-200x, it does not translate the file data into any other encoding. The BINARY entry indicates unencoded binary data. When used in write or copy mode, it is implementation-defined whether pax includes a charset extended header record for a file.

**comment**
A series of characters used as a comment. All characters in the value field are ignored by pax.

**gid**
The group ID of the group that owns the file, expressed as a decimal number using digits from the ISO/IEC 646: 1991 standard. This record overrides the gid field in the specified header blocks. When used in write or copy mode, pax includes a gid extended header record for each file whose group ID is greater than 2097151 (octal 7777777).

**gname**
The group of the files, formatted as a group name in the group database. This record overrides the gid and gname fields in the specified header blocks, and any gid extended header record. When used in read, copy, or list mode, pax translates the name from the UTF-8 encoding in the header record to the character set appropriate for the group database on the receiving system. If any of the UTF-8 characters cannot be translated, and if the -o invalid=UTF-8 option is not specified, the results are implementation-defined. When used in write or copy mode, pax includes a
gnome extended header record for each file whose group name cannot be represented entirely with the letters and digits of the portable character set.

linkpath

The pathname of a link being created to another file, of any type, previously archived. This record overrides the linkname field in the specified ustar header blocks. The specified ustar header block determines the type of link created. If typeflag of the specified header block is 1, it is a hard link. If typeflag is 2, it is a symbolic link and the linkpath value is the contents of the symbolic link. pax translates the name of the link (contents of the symbolic link) from the UTF-8 encoding to the character set appropriate for the local file system. When used in write or copy mode, pax includes a linkpath extended header record for each link whose pathname cannot be represented entirely with the members of the portable character set other than NULL.

mtime

The pathname of a link being created to another file, of any type, previously archived. This record overrides the linkname field in the specified ustar header blocks. The specified ustar header block determines the type of link created. If typeflag of the specified header block is 1, it is a hard link. If typeflag is 2, it is a symbolic link and the linkpath value is the contents of the symbolic link. pax translates the name of the link (contents of the symbolic link) from the UTF-8 encoding to the character set appropriate for the local file system. When used in write or copy mode, pax includes a linkpath extended header record for each link whose pathname cannot be represented entirely with the members of the portable character set other than NULL.

path

The pathname of the specified files. This record overrides the name and prefix fields in the specified header blocks. pax translates the pathname of the file from the UTF-8 encoding to the character set appropriate for the local file system. When used in write or copy mode, pax includes a path extended header record for each file whose pathname cannot be represented entirely with the members of the portable character set other than NULL.

realtime.any

The keywords prefixed by realtime are reserved for future standardization.

security.any

The keywords prefixed by security are reserved for future standardization.

size

The size of the file in octets, expressed as a decimal number using digits from the ISO/IEC 646: 1991 standard. This record overrides the size field in the specified header blocks. When used in write or copy mode, pax includes a size extended header record for each file with a size value greater than 8589934591 (octal 77777777777).
uid

The user ID of the file owner, expressed as a decimal number using digits
from the ISO/IEC 646:1991 standard. This record overrides the uid field in
the following header block(s). When used in write or copy mode, pax
includes a uid extended header record for each file whose owner ID is
greater than 2097151 (octal 7777777).

uname

The owner of the specified files, formatted as a username in the user
database. This record overrides the uid and uname fields in the specified
header blocks, and any uid extended header record. When used in read,
copy, or list mode, pax translates the name from the UTF-8 encoding in the
header record to the character set appropriate for the user database on the
receiving system. If any of the UTF-8 characters cannot be translated, and
if the -o invalid= UTF-8 option is not specified, the results are
implementation-defined. When used in write or copy mode, pax includes a
uname extended header record for each file whose username cannot be
represented entirely with the letters and digits of the portable character set.

If the value field is zero length, it deletes any header block field, previously entered extended
header value, or global extended header value of the same name.

If a keyword in an extended header record (or in an -o option-argument) overrides or deletes
a corresponding field in the ustar header block, pax ignores the contents of that header block
field.

Unlike the ustar header block fields, NULLs does not delimit values; all characters within the
value field are considered data for the field.

This section describes the precedence in which the various header records and fields and
command line options are selected to apply to a file in the archive. When pax is used in read or
list modes, it determines a file attribute in the following sequence:

1. If -o delete=keyword-prefix is used, the affected attributes is determined from step 7, if
   applicable, or ignored otherwise.
2. If -o keyword:= is used, the affected attributes is ignored.
3. If -o keyword:=value is used, the affected attribute is assigned the value.
4. If there is a typeflag x extended header record, the affected attribute is assigned the value.
   When extended header records conflict, the last one given in the header takes precedence.
5. If -o keyword=value is used, the affected attribute is assigned the value.
6. If there is a typeflag g global extended header record, the affected attribute is assigned the
   value. When global extended header records conflict, the last one given in the global
   header takes precedence.
7. Otherwise, the attribute is determined from the ustar header block.
pax Extended Header
File Times

pax writes an *mtime* record for each file in write or copy modes if the file’s modification time cannot be represented exactly in the *ustar* header logical record described in *ustar* Interchange Format. This can occur if the time is out of *ustar* range, or if the file system of the underlying implementation supports non-integer time granularities and the time is not an integer. All of these time records are formatted as a decimal representation of the time in seconds since the Epoch. If a period (.) decimal point character is present, the digits to the right of the point represents the units of a sub-second timing granularity, where the first digit is tenths of a second and each subsequent digit is a tenth of the previous digit. In read or copy mode, pax truncates the time of a file to the greatest value that is not greater than the input header file time. In write or copy mode, pax outputs a time exactly if it can be represented exactly as a decimal number, and otherwise generates only enough digits so that the same time is recovered if the file is extracted on a system whose underlying implementation supports the same time granularity.

A *ustar* archive tape or file contains a series of logical records. Each logical record is a fixed-size logical record of 512 octets. Although this format can be thought of as being stored on 9-track industry-standard 12.7mm (0.5 in) magnetic tape, other types of transportable media are not excluded. Each file archived is represented by a header logical record that describes the file, followed by zero or more logical records that give the contents of the file. At the end of the archive file there are two 512-octet logical records filled with binary zeros, interpreted as an end-of-archive indicator.

The logical records can be grouped for physical I/O operations, as described under the "-bblocksize" and "-x ustar" options. Each group of logical records can be written with a single operation equivalent to the *write*(2) function. On magnetic tape, the result of this write is a single tape physical block. The last physical block always is the full size, so logical records after the two zero logical records can contain undefined data.

The header logical record is structured as shown in the following table. All lengths and offsets are in decimal.

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Octet Offset</th>
<th>Length (in Octets)</th>
</tr>
</thead>
<tbody>
<tr>
<td>name</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>mode</td>
<td>100</td>
<td>8</td>
</tr>
<tr>
<td>uid</td>
<td>108</td>
<td>8</td>
</tr>
<tr>
<td>gid</td>
<td>116</td>
<td>8</td>
</tr>
<tr>
<td>size</td>
<td>124</td>
<td>12</td>
</tr>
<tr>
<td>mtime</td>
<td>136</td>
<td>12</td>
</tr>
<tr>
<td>chksum</td>
<td>148</td>
<td>8</td>
</tr>
</tbody>
</table>
All characters in the header logical record is represented in the coded character set of the ISO/IEC 646:1991 standard. For maximum portability between implementations, names should be selected from characters represented by the portable filename character set as octets with the most significant bit zero. If an implementation supports the use of characters outside of slash and the portable filename character set in names for files, users, and groups, one or more implementation-defined encodings of these characters are provided for interchange purposes.

pax never creates filenames on the local system that cannot be accessed using the procedures described in IEEE Std 1003.1-200x. If a filename is found on the medium that would create an invalid filename, it is implementation-defined whether the data from the file is stored on the file hierarchy and under what name it is stored. pax can choose to ignore these files as long as it produces an error indicating that the file is being ignored. Each field within the header logical record is contiguos; that is, there is no padding used.

Each field within the header logical record is contiguous. There is no padding used. Each character on the archive medium is stored contiguously.

The fields magic, uname and gname are character strings, each of which is terminated by a NULL character. The fields name, linkname, and prefix are NULL-terminated character strings except when all characters in the array contain non-NULL characters including the last character. The version field is two octets containing the characters 00 (zero-zero). The typeflag contains a single character. All other fields are leading zero-filled octal numbers using digits from the ISO/IEC 646:1991 standard IRV. Each numeric field is terminated by one or more SPACE of NULL characters.

Each character on the archive medium is stored contiguously. The fields magic, uname, and gname are character strings each terminated by a NULL character.

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Octet Offset</th>
<th>Length (in Octets)</th>
</tr>
</thead>
<tbody>
<tr>
<td>typeflag</td>
<td>156</td>
<td>1</td>
</tr>
<tr>
<td>linkname</td>
<td>157</td>
<td>100</td>
</tr>
<tr>
<td>magic</td>
<td>257</td>
<td>6</td>
</tr>
<tr>
<td>version</td>
<td>263</td>
<td>2</td>
</tr>
<tr>
<td>uname</td>
<td>265</td>
<td>32</td>
</tr>
<tr>
<td>gname</td>
<td>297</td>
<td>32</td>
</tr>
<tr>
<td>devmajor</td>
<td>329</td>
<td>8</td>
</tr>
<tr>
<td>devminor</td>
<td>337</td>
<td>8</td>
</tr>
<tr>
<td>prefix</td>
<td>345</td>
<td>155</td>
</tr>
</tbody>
</table>
name, linkname, and prefix are NULL-terminated character strings except when all characters in the array contain non-NUL characters including the last character. The version field is two octets containing the characters \(00\) (zero-zero). The typeflag contains a single character. All other fields are leading zero-filled octal numbers using digits from the ISO/IEC 646: 1991 standard IRV. Each numeric field is terminated by one or more spaces or NULL characters.

The name and the prefix fields produce the pathname of the file. A new pathname is formed, if prefix is not an empty string (its first character is not NULL), by concatenating prefix (up to the first NULL character), a slash character, and name; otherwise, name is used alone. In either case, name is terminated at the first NULL character. If prefix begins with a NULL character, it is ignored. In this manner, pathnames of at most 256 characters can be supported. If a pathname does not fit in the space provided, pax notifies the user of the error, and does not store any part of the file-header or data-on the medium.

The linkname field does not use the prefix to produce a pathname. As such, a linkname is limited to 100 characters. If the name does not fit in the space provided, pax notifies the user of the error, and does not attempt to store the link on the medium. The mode field provides 12 bits encoded in the ISO/IEC 646: 1991 standard octal digit representation. The encoded bits represent the following values in the ustar mode field:

<table>
<thead>
<tr>
<th>Bit Value</th>
<th>IEE Std 1003.1–2001 Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>04000</td>
<td>S_ISUID</td>
<td>Set UID on execution</td>
</tr>
<tr>
<td>02000</td>
<td>S_ISGID</td>
<td>Set GID on execution</td>
</tr>
<tr>
<td>01000</td>
<td>reserved</td>
<td>Reserved for future standardization</td>
</tr>
<tr>
<td>00400</td>
<td>S_IRUSR</td>
<td>Read permission for file owner class</td>
</tr>
<tr>
<td>00200</td>
<td>S_IWUSR</td>
<td>Write permission for file owner class</td>
</tr>
<tr>
<td>00100</td>
<td>S_IXUSR</td>
<td>Execute/search permission for file owner class</td>
</tr>
<tr>
<td>00040</td>
<td>S_IRGRP</td>
<td>Read permission for file group class</td>
</tr>
<tr>
<td>00020</td>
<td>S_IWGRP</td>
<td>Write permission for file group class</td>
</tr>
<tr>
<td>00010</td>
<td>S_IXGRP</td>
<td>Execute/search permission for file group class</td>
</tr>
<tr>
<td>00004</td>
<td>S_IROTH</td>
<td>Read permission for file other class</td>
</tr>
<tr>
<td>00002</td>
<td>S_IWOTH</td>
<td>Write permission for file other class</td>
</tr>
<tr>
<td>00001</td>
<td>S_IXOTH</td>
<td>Execute/search permission for file other class</td>
</tr>
</tbody>
</table>

When appropriate privilege is required to set one of these mode bits, and the user restoring the files from the archive does not have the appropriate privilege, the mode bits for which the user...
does not have appropriate privilege are ignored. Some of the mode bits in the archive format are not mentioned elsewhere in volume IEEE Std 1003.1-200x. If the implementation does not support those bits, they can be ignored.

The \texttt{uid} and \texttt{gid} fields are the user and group ID of the owner and group of the file, respectively.

The \texttt{size} field is the size of the file in octets. If the \texttt{typeflag} field is set to specify a file to be of type 1 (a link) or 2 (a symbolic link), the \texttt{size} field is specified as zero. If the \texttt{typeflag} field is set to specify a file of type 5 (directory), the \texttt{size} field is interpreted as described under the definition of that record type. No data logical records are stored for types 1, 2, or 5. If the \texttt{typeflag} field is set to 3 (character special file), 4 (block special file), or 6 (FIFO), the meaning of the \texttt{size} field is unspecified by volume IEEE Std 1003.1-200x, and no data logical records is stored on the medium. Additionally, for type 6, the \texttt{size} field is ignored when reading. If the \texttt{typeflag} field is set to any other value, the number of logical records written following the header is \((\texttt{size} + 511)/512\), ignoring any fraction in the result of the division.

The \texttt{mtime} field is the modification time of the file at the time it was archived. It is the ISO/IEC 646:1991 standard representation of the octal value of the modification time obtained from the \texttt{stat()} function.

The \texttt{chksum} field is the ISO/IEC 646:1991 standard IRV representation of the octal value of the simple sum of all octets in the header logical record. Each octet in the header is treated as an unsigned value. These values are added to an unsigned integer, initialized to zero, the precision of which is not less than 17 bits. When calculating the checksum, the \texttt{chksum} field is treated as if it were all spaces.

The \texttt{typeflag} field specifies the type of file archived. If a particular implementation does not recognize the type, or the user does not have appropriate privilege to create that type, the file is extracted as if it were a regular file if the file type is defined to have a meaning for the \texttt{size} field that could cause data logical records to be written on the medium. If conversion to a regular file occurs, pax produces an error indicating that the conversion took place. All of the \texttt{typeflag} fields are coded in the ISO/IEC 646:1991 standard IRV:

0 Represents a regular file. For backward compatibility, a \texttt{typeflag} value of binary zero (‘0’) should be recognized as meaning a regular file when extracting files from the archive. Archives written with this version of the archive file format create regular files with a \texttt{typeflag} value of the ISO/IEC 646:1991 standard IRV ‘0’.

1 Represents a file linked to another file, of any type, previously archived. Such files are identified by each file having the same device and file serial number. The linked-to name is specified in the \texttt{linkname} field with a NULL-character terminator if it is less than 100 octets in length.

2 Represents a symbolic link. The contents of the symbolic link are stored in the \texttt{linkname} field.
3, 4 Represents character special files and block special files respectively. In this case the `devmajor` and `devminor` fields contain information defining the device, the format of which is unspecified by volume IEEE Std 1003.1-200x. Implementations can map the device specifications to their own local specification or can ignore the entry.

5 Specifies a directory or subdirectory. On systems where disk allocation is performed on a directory basis, the `size` field contain the maximum number of octets (which can be rounded to the nearest disk block allocation unit) that the directory can hold. A `size` field of zero indicates no such limiting. Systems that do not support limiting in this manner should ignore the `size` field.

6 Specifies a FIFO special file. The archiving of a FIFO file archives the existence of this file and not its contents.

7 Reserved to represent a file to which an implementation has associated some high-performance attribute. Implementations without such extensions should treat this file as a regular file (type 0).

A-Z The letters A through Z inclusive are reserved for custom implementations. All other values are reserved for future versions of IEEE Std 1003.1-200x.

**SUN.devmajor** A Solaris extension to pax extended header keywords. Specifies the major device number of the file.

When used in write or copy mode and the `xustar` or `pax` format (see `-x format`) was specified, pax includes a `SUN.devmajor` extended header record for each file whose major device number is too large to fit in 8 octets.

**SUN.devminor** A Solaris extension to pax extended header keywords. Specifies the minor device number of the file.

When used in write or copy mode and the `xustar` or `pax` format (see `-x format`) is specified, pax includes a `SUN.devminor` extended header record for each file whose minor device number is too large to fit in 8 octets.

**SUN.holesdata** A Solaris extension to pax extended header keywords. Specifies the data and hole pairs for a sparse file.

In write or copy modes and when the `xustar` or `pax` format (see `-x format`) is specified, pax includes a `SUN.holesdata` extended header record if the underlying file system supports the detection of files with holes (see `fpathconf(2)`) and reports that there is at least one hole in the file being archived. `value` consists of two or more consecutive entries of the following form:
**SUN.holesdata**

where the data and hole offsets are the long values returned by passing SEEK_DATA and SEEK_HOLE to **lseek(2)**, respectively. For example, the following entry is an example of the SUN.holesdata entry in the extended header for a file with data offsets at bytes 0, 24576, and 49152, and hole offsets at bytes 8192, 32768, and 49159: 49

```
SUN.holesdata = 0 8192 24576 32768 49152 49159:
```

When extracting a file from an archive in read or copy modes, if a SUN.holesdata = pair is found in the extended header for the file, then the file is restored with the holes identified using this data. For example, for the SUN.holesdata provided in the example above, bytes from 0 to 8192 are restored as data, a hole is created up to the next data position (24576), bytes 24576 to 32768 is restored as data, and so forth.

**X**

A Solaris custom typeflag implementation which specifies an xustar format (see -x format) extended header. The typeflag ‘x’ extended header is treated as a ustar typeflag ‘x’ extended header.

**E**

A Solaris custom typeflag implementation which specifies an extended attributes header. See **fsattr(5)**.

Attempts to archive a socket using ustar interchange format produce a diagnostic message. Handling of other file types is implementation-defined.

The **magic** field is the specification that this archive was output in this archive format. If this field contains ustar (the five characters from the ISO/IEC 646: 1991 standard IRV shown followed by NULL), the **uname** and **gname** fields contain the ISO/IEC 646: 1991 standard IRV representation of the owner and group of the file, respectively (truncated to fit, if necessary). When the file is restored by a privileged, protection-preserving version of the utility, the user and group databases are scanned for these names. If found, the user and group IDs contained within these files are used rather than the values contained within the **uid** and **gid** fields.

The octet-oriented cpio archive format are a series of entries, each comprising a header that describes the file, name of the file, and contents of the file.

An archive can be recorded as a series of fixed-size blocks of octets. This blocking is be used only to make physical I/O more efficient. The last group of blocks are always at the full size.

For the octet-oriented cpio archive format, the individual entry information are in the order indicated and described by the following table: Octet-Oriented cpio Archive Entry. See the cpio.h header for additional details.
For each file in the archive, a header as defined previously written. The information in the
header fields is written as streams of the ISO/IEC 646: 1991 standard characters interpreted as
octal numbers. The octal numbers are extended to the necessary length by appending the
ISO/IEC 646: 1991 standard IRV zeros at the most-significant-digit end of the number. The
result is written to the most-significant digit of the stream of octets first. The fields are
interpreted as follows:

<table>
<thead>
<tr>
<th>Header Field Name</th>
<th>Length (in Octets)</th>
<th>Interpreted as</th>
</tr>
</thead>
<tbody>
<tr>
<td>c_magic</td>
<td>6</td>
<td>Octal number</td>
</tr>
<tr>
<td>c_dev</td>
<td>6</td>
<td>Octal number</td>
</tr>
<tr>
<td>c_ino</td>
<td>6</td>
<td>Octal number</td>
</tr>
<tr>
<td>c_mode</td>
<td>6</td>
<td>Octal number</td>
</tr>
<tr>
<td>c_uid</td>
<td>6</td>
<td>Octal number</td>
</tr>
<tr>
<td>c_gid</td>
<td>6</td>
<td>Octal number</td>
</tr>
<tr>
<td>c_nlink</td>
<td>6</td>
<td>Octal number</td>
</tr>
<tr>
<td>c_rdev</td>
<td>6</td>
<td>Octal number</td>
</tr>
<tr>
<td>c_mtime</td>
<td>11</td>
<td>Octal number</td>
</tr>
<tr>
<td>c_namesize</td>
<td>6</td>
<td>Octal number</td>
</tr>
<tr>
<td>c_filesize</td>
<td>11</td>
<td>Octal number</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Filename Field Name</th>
<th>Length</th>
<th>Interpreted as</th>
</tr>
</thead>
<tbody>
<tr>
<td>c_name</td>
<td>c_namesize</td>
<td>Pathname string</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Filename Field Name</th>
<th>Length</th>
<th>Interpreted as</th>
</tr>
</thead>
<tbody>
<tr>
<td>c_filename</td>
<td>c_filesize</td>
<td>Data</td>
</tr>
</tbody>
</table>
previously are reserved for compatibility with existing systems. Additional file
types can be supported. Such files should not be written to archives intended
to be transported to other systems.

<table>
<thead>
<tr>
<th>File Permissions Name</th>
<th>Value</th>
<th>Indicates</th>
</tr>
</thead>
<tbody>
<tr>
<td>C_IRUSR</td>
<td>000400</td>
<td>by owner</td>
</tr>
<tr>
<td>C_IWUSR</td>
<td>000200</td>
<td>by owner</td>
</tr>
<tr>
<td>C_IXUSR</td>
<td>000100</td>
<td>by owner</td>
</tr>
<tr>
<td>C_IRGRP</td>
<td>000040</td>
<td>by group</td>
</tr>
<tr>
<td>C_IWGRP</td>
<td>000020</td>
<td>by group</td>
</tr>
<tr>
<td>C_IXGRP</td>
<td>000010</td>
<td>by group</td>
</tr>
<tr>
<td>C_IROTH</td>
<td>000004</td>
<td>by others</td>
</tr>
<tr>
<td>C_IWOTH</td>
<td>000002</td>
<td>by others</td>
</tr>
<tr>
<td>C_IXOTH</td>
<td>000001</td>
<td>by others</td>
</tr>
<tr>
<td>C_ISUID</td>
<td>004000</td>
<td>Set uid</td>
</tr>
<tr>
<td>W_ISGID</td>
<td>002000</td>
<td>Set gid</td>
</tr>
<tr>
<td>W_ISVTX</td>
<td>001000</td>
<td>Reserved</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>File Type Name</th>
<th>Value</th>
<th>Indicates</th>
</tr>
</thead>
<tbody>
<tr>
<td>C_ISDIR</td>
<td>040000</td>
<td>Directory</td>
</tr>
<tr>
<td>C_ISFIFO</td>
<td>010000</td>
<td>FIFO</td>
</tr>
<tr>
<td>C_ISREG</td>
<td>010000</td>
<td>Regular file</td>
</tr>
<tr>
<td>C_ISLNK</td>
<td>012000</td>
<td>Symbolic link</td>
</tr>
<tr>
<td>C_ISBLK</td>
<td>006000</td>
<td>Block special file</td>
</tr>
<tr>
<td>C_ISCHR</td>
<td>020000</td>
<td>Character special file</td>
</tr>
<tr>
<td>C_ISSOCK</td>
<td>014000</td>
<td>Socket</td>
</tr>
<tr>
<td>C_ISCTG</td>
<td>011000</td>
<td>Reserved</td>
</tr>
</tbody>
</table>

\[c\_uid\] Contains the user ID of the owner.

\[c\_gid\] Contains the group ID of the group
**c_nlink**  Contains a number greater than or equal to the number of links in the archive referencing the file. If the `-a` option is used to append to a cpio archive, `pax` does need not to account for the files in the existing part of the archive when calculating the `c_nlink` values for the appended part of the archive. It does also need not alter the `c_nlink` values in the existing part of the archive if additional files with the same `c_dev` and `c_ino` values are appended to the archive.

**c_rdev**  Contains implementation-defined information for character or block special files.

**c_mtime**  Contains the latest time of modification of the file at the time the archive was created.

**c_namesize**  Contains the length of the pathname, including the terminating NULL character.

**c_filesize**  Contains the length of the file in octets. This is the length of the data section following the header structure.

The `c_name` field contains the pathname of the file. The length of this field in octets is the value of `c_namesize`. If a filename is found on the medium that would create an invalid pathname, it is implementation-defined whether the data from the file is stored on the file hierarchy and under what name it is stored. All characters are represented in the ISO/IEC 646:1991 standard IRV. For maximum portability between implementations, names should be selected from characters represented by the portable filename character set as octets with the most significant bit zero. If an implementation supports the use of characters outside the portable filename character set in names for files, users, and groups, one or more implementation-defined encodings of these characters are provided for interchange purposes. `pax` does not create filenames on the local system that cannot be accessed by way of the procedures described in Volume IEEE Std 1003.1-200x. If a filename is found on the medium that would create an invalid filename, it is implementation-defined whether the data from the file is stored on the local file system and under what name it is stored. `pax` can choose to ignore these files as long as it produces an error indicating that the file is being ignored.

Following `c_name`, there is `c_filesize` octets of data. Interpretation of such data occurs in a manner dependent on the file. If `c_filesize` is zero, no data is contained in `c_filedata`. When restoring from an archive:

- If the user does not have the appropriate privilege to create a file of the specified type, `pax` ignores the entry and writes an error message to standard error.
- Only regular files have data to be restored. Presuming a regular file meets any selection criteria that might be imposed on the format-reading utility by the user, such data is restored.
- If a user does not have appropriate privilege to set a particular `mode` flag, the flag is ignored. Some of the `mode` flags in the archive format are not mentioned in Volume IEEE Std 1003.1-200x. If the implementation does not support those flags, they can be ignored.
**cpio Special Entries**

FIFO special files, directories, and the trailer are recorded with `c_filesize` equal to zero. For other special files, `c_filesize` is unspecified in volume *IEEE Std 1003.1-200x*. The header for the next file entry in the archive are written directly after the last octet of the file entry preceding it. A header denoting the filename trailer indicates the end of the archive; the contents of octets in the last block of the archive following such a header are undefined.

**Attributes**

See *attributes(5)* for descriptions of the following attributes:

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<td>Interface Stability</td>
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<tr>
<td>Standard</td>
<td>See <em>standards(5)</em></td>
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</table>

**See Also**


 perl – Practical Extraction and Report Language

 Synopsis perl [-sTuU] [-hv] [-V [: configvar]] [-cw]
 [-d [: debugger]] [-D [number/list]] [-pna]
 [-F pattern] [-l [octal]] [-@ [octal]] [-i dir]
 [-m [-] module] [-M [-] module... ] [-P] [-S]
 [-x [dir]] [-i [extension]] [-e 'command'] [...] 
 [programfile] [argument] ...

 Description For ease of access, the Perl manual has been split up into the following sections.

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 perltoct Perl documentation table of contents

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 perlrequick Perl regular expressions quick start
 perlreutz Perl regular expressions tutorial
 perlboot Perl OO tutorial for beginners
 perltoot Perl OO tutorial, part 1
 perltooc Perl OO tutorial, part 2
 perlobot Perl OO tricks and examples
 perlstyle Perl style guide
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 perltrap Perl traps for the unwary
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| perlxstut        | Perl XS tutorial                             |
| perlxs           | Perl XS application programming interface    |
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<td>perl572delta</td>
<td>Perl changes in version 5.7.2</td>
</tr>
<tr>
<td>perl571delta</td>
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</tr>
<tr>
<td>perl570delta</td>
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</tr>
<tr>
<td>perl561delta</td>
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<td>perl56delta</td>
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<td>perl5005delta</td>
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</tr>
</tbody>
</table>

**If you’re new to Perl, you should start with perlintro, which is a general intro for beginners and provides some background to help you navigate the rest of Perl’s extensive documentation. For ease of access, the Perl manual has been split up into several sections.**

The manpages listed above are installed in the `/usr/perl5/man/` directory.
Extensive additional documentation for Perl modules is available. This additional documentation is in the /usr/perl5/man directory. Some of this additional documentation is distributed standard with Perl, but you'll also find documentation for any customer-installed third-party modules there.

You can view Perl's documentation with man(1) by including /usr/perl5/man in the MANPATH environment variable. Notice that running catman(1M) on the Perl manual pages is not supported. For other Solaris-specific details, see the NOTES section below.

You can also use the supplied /usr/perl5/bin/perldoc script to view Perl information.

If something strange has gone wrong with your program and you're not sure where you should look for help, try the -w switch first. It will often point out exactly where the trouble is.

Perl is a language optimized for scanning arbitrary text files, extracting information from those text files, and printing reports based on that information. It's also a good language for many system management tasks. The language is intended to be practical (easy to use, efficient, complete) rather than beautiful (tiny, elegant, minimal).

Perl combines (in the author's opinion, anyway) some of the best features of C, sed, awk, and sh, so people familiar with those languages should have little difficulty with it. (Language historians will also note some vestiges of csh, Pascal, and even BASIC–PLUS.) Expression syntax corresponds closely to C expression syntax. Unlike most Unix utilities, Perl does not arbitrarily limit the size of your data - if you've got the memory, Perl can slurp in your whole file as a single string. Recursion is of unlimited depth. And the tables used by hashes (sometimes called "associative arrays") grow as necessary to prevent degraded performance. Perl can use sophisticated pattern matching techniques to scan large amounts of data quickly. Although optimized for scanning text, Perl can also deal with binary data, and can make dbm files look like hashes. Setuid Perl scripts are safer than C programs through a dataflow tracing mechanism that prevents many stupid security holes.

If you have a problem that would ordinarily use sed or awk or sh, but it exceeds their capabilities or must run a little faster, and you don't want to write the silly thing in C, then Perl may be for you. There are also translators to turn your sed and awk scripts into Perl scripts.

But wait, there's more...

Begun in 1993 (see perlhists), Perl version 5 is nearly a complete rewrite that provides the following additional benefits:

- Modularity and reusability using innumerable modules Described in perlmod, perlmodlib, and perlmodinstall.
- Embeddable and extensible Described in perlembed, perlxstut, perlxsl, perlcalls, perlgeuts, and xsubpp.
- Roll-your-own magic variables (including multiple simultaneous DBM implementations). Described in perltie and AnyDBM_File.
Subroutines can now be overridden, autoloaded, and prototyped. Described in perlsub.

Arbitrarily nested data structures and anonymous functions. Described in perlrefutut, perlref, perldsc, and perllol.

Object-oriented programming. Described in perlobj, perlboo, perltoot, perltooc, and perlbot.

Support for light-weight processes (threads). Described in perlthrtut and threads.

Support for Unicode, internationalization, and localization. Described in perluniintro, perllocale and Locale::MakeText.

Lexical scoping. Described in perlsub.

Regular expression enhancements. Described in perlre, with additional examples in perlop.

Enhanced debugger and interactive Perl environment, with integrated editor support. Described in perldebtut, perldebug and perldebguts.

POSIX 1003.1 compliant library. Described in POSIX.

Okay, that's definitely enough hype.

Environment Variables
The Perl shipped with Solaris is installed under /usr/perl5 rather than the default /usr/local location. This is so that it can coexist with a customer-installed Perl in the default /usr/local location.

Any additional modules that you choose to install will be placed in the /usr/perl5/site_perl/5.8.4 directory. The /usr/perl5/vendor_perl directory is reserved for SMI-provided modules.

Notice that the Perl utility scripts such as perlrun and perlbug are in the /usr/perl5/bin directory, so if you wish to use them you need to include /usr/perl5/bin in your PATH environment variable.

See also the perlrun manpage.

Author
Larry Wall, with the help of oodles of other folks.

If your Perl success stories and testimonials may be of help to others who wish to advocate the use of Perl in their applications, or if you wish to simply express your gratitude to Larry and the Perl developers, please write to perl-thanks@perl.org.

Files  "@INC"  Locations of Perl libraries

Attributes
See attributes(5) for descriptions of the following attributes:
Perl is available for most operating systems, including virtually all Unix-like platforms. See "Supported Platforms" in perlport for a listing.

The Script interface, the XSUB interface, and the Directory layout are Committed. The Binary interface is Uncommitted.

See Also

a2p          awk to perl\l translator
s2p          sed to perl\l translator
http://www.perl.com  Perl home page
http://www.perl.com/CPAN  The Comprehensive Perl Archive
http://www.perl.org  Perl Mongers (Perl user groups)

Diagnostics  The ‘use warnings’ pragma (and the -w switch) produce some lovely diagnostics.

See perl\l diag for explanations of all Perl's diagnostics. The 'use diagnostics' pragma automatically turns Perl's normally terse warnings and errors into these longer forms.

Compilation errors will tell you the line number of the error, with an indication of the next token or token type that was to be examined. (In a script passed to Perl via -e switches, each -e is counted as one line.)

Setuid scripts have additional constraints that can produce error messages such as "Insecure dependency". See perlsed.

Did we mention that you should definitely consider using the -w switch?

Notes  Perl 5.8.4 has been built to be largefile-aware and to use 64-bit integers, although the interpreter itself is a 32-bit application (LP32). To view detailed configuration information, use perl –V and perlbug –dv.

If you wish to build and install add-on modules from CPAN using gcc, you can do so using the /usr/perl5/5.8.4/bin/perlgcc script – see perlgcc (1) for details.

If you wish to build and install your own version of Perl, you should NOT remove the 5.8.4 version of perl under /usr/perl5, as it is required by several system utilities. The Perl package names are as follows:
Solaris 10 also ships with the 5.6.1 version of Perl that was included in Solaris 9. If you are upgrading your system and wish to continue to use Perl 5.6.1 as the default Perl version you should refer to the perlsolaris manpage for details of how to do this. Note that you should upgrade your installation to use Perl 5.8.4 as soon as is practicable, as Perl 5.6.1 may be removed in a future release.

The Perl motto is "There's more than one way to do it." Divining how many more is left as an exercise to the reader.

The three principal virtues of a programmer are Laziness, Impatience, and Hubris. See the Camel Book for why.

Bugs

The -w switch is not mandatory.

Perl is at the mercy of your machine's definitions of various operations such as type casting, atof(), and floating-point output with sprintf().

If your stdio requires a seek or eof between reads and writes on a particular stream, so does Perl. (This doesn't apply to sysread() and syswrite().)

While none of the built-in data types have any arbitrary size limits (apart from memory size), there are still a few arbitrary limits: a given variable name may not be longer than 251 characters. Line numbers displayed by diagnostics are internally stored as short integers, so they are limited to a maximum of 65535 (higher numbers usually being affected by wraparound).

You may mail your bug reports (be sure to include full configuration information as output by the myconfig program in the perl source tree, or by 'perl -V') to perlbug@perl.org. If you've succeeded in compiling perl, the perlbug script in the utils/ subdirectory can be used to help mail in a bug report.

Perl actually stands for Pathologically Eclectic Rubbish Lister, but don't tell anyone I said that.
**Name** pfexec, pfbash, pfcsb, pfksh, pfsh, pfctsh, pfzsh – execute a command in a profile

**Synopsis**

```
/usr/bin/pfexec command
/usr/bin/pfexec -P privspec command [ arg ]...
/usr/bin/pfsh [ options ] [ argument ]...
/usr/bin/pfcsb [ options ] [ argument ]...
/usr/bin/pfksh [ options ] [ argument ]...
```

**Description**

The `pfexec` program sets the PRIV_PFEXEC process flag and marks the current process as a profile shell. It then executes the specified command. The kernel queries the `exec_attr(4)` database and executes with the appropriate attributes.

Profiles are searched in the order specified in the user’s entry in the `user_attr(4)` database. If the same command appears in more than one profile, the profile shell uses the first matching entry.

The second form, `pfexec -P privspec`, allows a user to obtain the additional privileges awarded to the user’s profiles in `prof_attr(4)`. The privileges specification on the commands line is parsed using `priv_str_to_set(3C)`. The resulting privileges are intersected with the union of the privileges specified using the `prvks` keyword in `prof_attr(4)` for all the user’s profiles and added to the inheritable set before executing the command.

**Usage**

`pfexec` is used to execute commands with predefined process attributes, such as specific user or group IDs.

Refer to the `sh(1)`, `csh(1)`, and `ksh(1)` man pages for complete usage descriptions of the profile shells.

**Examples**

**EXAMPLE 1** Obtaining additional user privileges

```
example% pfexec -P all chown user file
```

This command runs `chown user file` with all privileges assigned to the current user, not necessarily all privileges.

**Exit Status**

The following exit values are returned:

- **0** Successful completion.
- **1** An error occurred.

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>
See Also  
bash(1), csh(1), ksh(1), ksh88(1), profiles(1), sh(1), tcsh(1), zsh(1), exec_attr(4), prof_attr(4), user_attr(4), attributes(5)
The `pg` command is a filter that allows the examination of *filenames* one screenful at a time on a CRT. If the user types a RETURN, another page is displayed; other possibilities are listed below.

This command is different from previous paginators in that it allows you to back up and review something that has already passed. The method for doing this is explained below.

To determine terminal attributes, `pg` scans the `terminfo(4)` data base for the terminal type specified by the environment variable `TERM`. If `TERM` is not defined, the terminal type `dumb` is assumed.

**Options**

- `-n number` An integer specifying the size (in lines) of the window that `pg` is to use instead of the default. (On a terminal containing 24 lines, the default window size is 23).

- `-p string` `pg` uses `string` as the prompt. If the prompt string contains a `%d`, the first occurrence of `%d` in the prompt will be replaced by the current page number when the prompt is issued. The default prompt string is `""`.

- `-c` Home the cursor and clear the screen before displaying each page. This option is ignored if `clear_screen` is not defined for this terminal type in the `terminfo(4)` data base.

- `-e` `pg` does not pause at the end of each file.

- `-f` Normally, `pg` splits lines longer than the screen width, but some sequences of characters in the text being displayed (for instance, escape sequences for underlining) generate undesirable results. The `-f` option inhibits `pg` from splitting lines.

- `-n` Normally, commands must be terminated by a `<newline>` character. This option causes an automatic end of command as soon as a command letter is entered.

- `-r` Restricted mode. The shell escape is disallowed. `pg` prints an error message but does not exit.

- `-s` `pg` prints all messages and prompts in the standard output mode (usually inverse video).

- `+linenumber` Start up at `linenumber`.

- `+/pattern/` Start up at the first line containing the regular expression pattern.
Operands

The following operands are supported:

filename   A path name of a text file to be displayed. If no filename is given, or if it is –, the
standard input is read.

Usage

Commands

The responses that may be typed when pg pauses can be divided into three categories: those
causing further perusal, those that search, and those that modify the perusal environment.

Commands that cause further perusal normally take a preceding address, an optionally signed
number indicating the point from which further text should be displayed. This address is
interpreted in either pages or lines depending on the command. A signed address specifies a
point relative to the current page or line, and an unsigned address specifies an address relative
to the beginning of the file. Each command has a default address that is used if none is
provided.

The perusal commands and their defaults are as follows:

(+1)<newline> or <blank>   This causes one page to be displayed. The address is specified
in pages.
(+1) \   With a relative address this causes pg to simulate scrolling the
screen, forward or backward, the number of lines specified.
With an absolute address this command prints a screenful
beginning at the specified line.
(+1) d or ^D   Simulates scrolling half a screen forward or backward.
i   Skip i screens of text.
iz   Same as <newline> except that i, if present, becomes the new
default number of lines per screenful.

The following perusal commands take no address.
.
or ^L   Typing a single period causes the current page of text to be redisplayed.
$   Displays the last full window in the file. Use with caution when the input is a pipe.

The following commands are available for searching for text patterns in the text. The regular
expressions are described on the regex(5) manual page. They must always be terminated by a
<newline>, even if the -n option is specified.

i/pattern/   Search forward for the ith (default i=1) occurrence of pattern. Searching begins
immediately after the current page and continues to the end of the current file,
without wrap-around.
i\(^\text{pattern}\)\(^\text{\textasciicircum}\)

\textit{i?pattern?} Search backwards for the \textit{i}th (default \textit{i}=1) occurrence of \textit{pattern}. Searching begins immediately before the current page and continues to the beginning of the current file, without wrap-around. The \(^\text{\textasciicirci}\) notation is useful for \\

Adds 100 terminals which will not properly handle the \(?\).

After searching, \texttt{pg} will normally display the line found at the top of the screen. This can be modified by appending \texttt{m} or \texttt{b} to the search command to leave the line found in the middle or at the bottom of the window from now on. The suffix \texttt{t} can be used to restore the original situation.

The user of \texttt{pg} can modify the environment of perusal with the following commands:

\texttt{in} Begin perusing the \textit{i}th next file in the command line. The \textit{i} is an unsigned number, default value is 1.

\texttt{ip} Begin perusing the \textit{i}th previous file in the command line. \textit{i} is an unsigned number, default is 1.

\texttt{iw} Display another window of text. If \textit{i} is present, set the window size to \textit{i}.

\texttt{s filename} Save the input in the named file. Only the current file being perused is saved. The white space between the \texttt{s} and \texttt{filename} is optional. This command must always be terminated by a \texttt{<newline>}, even if the -n option is specified.

\texttt{h} Help by displaying an abbreviated summary of available commands.

\texttt{q or Q} Quit \texttt{pg}.

\texttt{! command} \textit{Command} is passed to the shell, whose name is taken from the SHELL environment variable. If this is not available, the default shell is used. This command must always be terminated by a \texttt{<newline>}, even if the -n option is specified.

At any time when output is being sent to the terminal, the user can hit the quit key (normally \\
CTRL-\textbackslash\) or the interrupt (break) key. This causes \texttt{pg} to stop sending output, and display the \\
prompt. The user may then enter one of the above commands in the normal manner.

Unfortunately, some output is lost when this is done, because any characters waiting in the \\
terminal’s output queue are flushed when the quit signal occurs.

If the standard output is not a terminal, then \texttt{pg} acts just like \texttt{cat(1)}, except that a header is \\
printed before each file (if there is more than one).

\textbf{Large File Behavior} See \texttt{largefile(5)} for the description of the behavior of \texttt{pg} when encountering files greater than or equal to 2 Gbyte ($2^{31}$ bytes).
Examples

**EXAMPLE 1**

An example of the pg command.

The following command line uses pg to read the system news:

```bash
example% news | pg -p "(Page %d):"
```

Environment Variables

See `environ(5)` for descriptions of the following environment variables that affect the execution of **pg**: LC_CTYPE, LC_MESSAGES, and NLSPATH.

The following environment variables affect the execution of pg:

- **COLUMNS**: Determine the horizontal screen size. If unset or **NULL**, use the value of **TERM**, the window size, baud rate, or some combination of these, to indicate the terminal type for the screen size calculation.

- **LINES**: Determine the number of lines to be displayed on the screen. If unset or **NULL**, use the value of **TERM**, the window size, baud rate, or some combination of these, to indicate the terminal type for the screen size calculation.

- **SHELL**: Determine the name of the command interpreter executed for a `!` command.

- **TERM**: Determine terminal attributes. Optionally attempt to search a system-dependent database, keyed on the value of the **TERM** environment variable. If no information is available, a terminal incapable of cursor-addressable movement is assumed.

**Exit Status**

The following exit values are returned:

- **0**: Successful completion.
- **>0**: An error occurred.

**Files**

- `/tmp/pg*` temporary file when input is from a pipe
- `/usr/share/lib/terminfo/??/*` terminal information database

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

**See Also**

`cat(1), grep(1), more(1), terminfo(4), attributes(5), environ(5), largefile(5), regex(5)`

**Notes**

While waiting for terminal input, **pg** responds to **BREAK**, **CTRL-C**, and **CTRL-\** by terminating execution. Between prompts, however, these signals interrupt **pg**'s current task and place the user in prompt mode. These should be used with caution when input is being read from a pipe, since an interrupt is likely to terminate the other commands in the pipeline.

The terminal `/`, `^`, or `?` may be omitted from the searching commands.
If terminal tabs are not set every eight positions, undesirable results may occur.

When using `pg` as a filter with another command that changes the terminal I/O options, terminal settings may not be restored correctly.
**Synopsis**

`pgrep [-flvx] [-n | -o] [-d delim] [-P ppidlist]
   [-g pgplist] [-s sidlist] [-u euidlist] [-U uidlist]
   [-G gidlist] [-J projidlist] [-t termlist]
   [-T taskidlist] [-c ctidlist] [-z zoneidlist]
   [pattern]`

`pkill [-signal] [-vx] [-n | -o] [-P ppidlist]
   [-g pgplist] [-s sidlist] [-u euidlist] [-U uidlist]
   [-G gidlist] [-J projidlist] [-t termlist]
   [-T taskidlist] [-c ctidlist] [-z zoneidlist]
   [pattern]`

**Description**

The `pgrep` utility examines the active processes on the system and reports the process IDs of the processes whose attributes match the criteria specified on the command line. Each process ID is printed as a decimal value and is separated from the next ID by a delimiter string, which defaults to a newline. For each attribute option, the user can specify a set of possible values separated by commas on the command line. For example,

```
pgrep -G other,daemon
```

matches processes whose real group ID is other OR daemon. If multiple criteria options are specified, `pgrep` matches processes whose attributes match the logical AND of the criteria options. For example,

```
pgrep -G other,daemon -U root,daemon
```

matches processes whose attributes are:

(real group ID is other OR daemon) AND
(real user ID is root OR daemon)

`pkill` functions identically to `pgrep`, except that each matching process is signaled as if by `kill(1)` instead of having its process ID printed. A signal name or number may be specified as the first command line option to `pkill`.

**Options**

The following options are supported:

- `-c ctidlist` Matches only processes whose process contract ID is in the given list.

- `-d delim` Specifies the output delimiter string to be printed between each matching process ID. If no `-d` option is specified, the default is a newline character. The `-d` option is only valid when specified as an option to `pgrep`.

- `-f` The regular expression `pattern` should be matched against the full process argument string (obtained from the `pr_psargs` field of the `/proc/nnnnn/psinfo` file). If no `-f` option is specified, the expression is matched only against the name of the executable file (obtained from the `pr_fname` field of the `/proc/nnnnn/psinfo` file).
-g pgrp\list Matches only processes whose process group ID is in the given list. If group 0 is included in the list, this is interpreted as the process group ID of the p\textsf{grep} or p\textsf{kill} process.

-G gidlist Matches only processes whose real group ID is in the given list. Each group ID may be specified as either a group name or a numerical group ID.

-J projidlist Matches only processes whose project ID is in the given list. Each project ID may be specified as either a project name or a numerical project ID.

-l Long output format. Prints the process name along with the process ID of each matching process. The process name is obtained from the \texttt{pr\_psargs} or \texttt{pr\_fname} field, depending on whether the -f option was specified (see above). The -l option is only valid when specified as an option to p\textsf{grep}.

-n Matches only the newest (most recently created) process that meets all other specified matching criteria. Cannot be used with option -o.

-o Matches only the oldest (earliest created) process that meets all other specified matching criteria. Cannot be used with option -n.

-P ppidlist Matches only processes whose parent process ID is in the given list.

-s sidlist Matches only processes whose process session ID is in the given list. If ID 0 is included in the list, this is interpreted as the session ID of the p\textsf{grep} or p\textsf{kill} process.

-t termlist Matches only processes which are associated with a terminal in the given list. Each terminal is specified as the suffix following "/dev/" of the terminal's device path name in /dev. For example, term/a or pts/0.

-T taskidlist Matches only processes whose task ID is in the given list. If ID 0 is included in the list, this is interpreted as the task ID of the p\textsf{grep} or p\textsf{kill} process.

-u euidlist Matches only processes whose effective user ID is in the given list. Each user ID may be specified as either a login name or a numerical user ID.

-U uidlist Matches only processes whose real user ID is in the given list. Each user ID may be specified as either a login name or a numerical user ID.

-v Reverses the sense of the matching. Matches all processes except those which meet the specified matching criteria.

-x Considers only processes whose argument string or executable file name \textit{exactly} matches the specified \textit{pattern} to be matching processes. The pattern match is considered to be exact when all characters in the process argument string or executable file name match the pattern.

-z zoneidlist Matches only processes whose zone ID is in the given list. Each zone ID may be specified as either a zone name or a numerical zone ID. This option is only
useful when executed in the global zone. If the pkill utility is used to send
signals to processes in other zones, the process must have asserted the
{PRIV_PROC_ZONE} privilege (see privileges(5)).

-signal Specifies the signal to send to each matched process. If no signal is specified,
SIGTERM is sent by default. The value of signal can be one of the symbolic
names defined in signal.h(3HEAD) without the SIG prefix, or the
corresponding signal number as a decimal value. The -signal option is only
valid when specified as the first option to pkill.

Operands The following operand is supported:

pattern Specifies an Extended Regular Expression (ERE) pattern to match against either
the executable file name or full process argument string. See regex(5) for a
complete description of the ERE syntax.

Examples

EXAMPLE 1 Obtaining a Process ID
Obtain the process ID of sendmail:

example% pgrp -x -u root sendmail
283

EXAMPLE 2 Terminating a Process
Terminate the most recently created xterm:

example% pkill -n xterm

Exit Status The following exit values are returned:

0 One or more processes were matched.
1 No processes were matched.
2 Invalid command line options were specified.
3 A fatal error occurred.

Files /proc/nnnn/psinfo Process information files

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also kill(1), proc(1), ps(1), truss(1), kill(2), signal.h(3HEAD), proc(4), attributes(5), privileges(5), regex(5), zones(5)
Notes

Both utilities match the ERE pattern argument against either the pr_fname or pr_psargs fields of the /proc/nnnnn/psinfo files. The lengths of these strings are limited according to definitions in <sys/procfs.h>. Patterns which can match strings longer than the current limits may fail to match the intended set of processes.

If the pattern argument contains ERE meta-characters which are also shell meta-characters, it may be necessary to enclose the pattern with appropriate shell quotes.

Defunct processes are never matched by either pgrep or pkill.

The current pgrep or pkill process will never consider itself a potential match.
pkcs11_inspect(1)

Name
pkcs11_inspect – print certificate contents

Synopsis
/usr/lib/pam_pkcs11/pkcs11_inspect [debug] [config_file=filename]

Description
pkcs11_inspect uses the pam_pkcs11 library infrastructure to obtain the content of a certificate and display it.

pkcs11_inspect uses the same configuration file and arguments as the pam_pkcs11(5) PAM module. It loads defined mapper modules, and uses them to look into the certificate for required entries, that is, ms_mapper looks for ms UPN entries, and so forth.

When a mapper module finds a proper entry in the certificate, it converts to UTF-8 and prints it to stdout.

Options
The following options are supported:

config_file=filename Set the configuration file. The default value is /etc/security/pam_pkcs11/pam_pkcs11.conf.

default Enable debugging output.

As it uses the same configuration file as pam_pkcs11(5), all of the pam_pkcs11 options are available. Some of these options make no sense in a non-PAM environment, and are therefore ignored. Some mapper options (mapfile, ignorecase) have no effect on certificate contents, and they are ignored as well.

Exit Status
The following exit values are returned:

0  Successful completion.

pkcs11_inspect prints on stdout all certificate contents that are found for mappers.

1  An error occurred.

Examples
EXAMPLE 1 Using pkcs_inspect
The following example runs the pkcs_inspect command without any options:

% pkcs11_inspect

EXAMPLE 2 Using pkcs_inspect with Options
The following example runs the pkcs_inspect command with options:

% pkcs11_inspect debug config_file=${HOME}/.pam_pkcs11.conf

Files
/etc/security/pam_pkcs11/pam_pkcs11.conf

Authors
Juan Antonio Martinez, jonsito@teleline.es

man pages section 1: User Commands • Last Revised 18 Jan 2012
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>library/security/pam/module/pam-pkcs11</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Uncommitted</td>
</tr>
</tbody>
</table>

See Also  pklogin_finder(1), attributes(5), pam_pkcs11(5)

pkg – Image Packaging System retrieval client

**Synopsis**
/usr/bin/pkg [options] command [cmd_options] [operands]

/usr/bin/pkg refresh [-q] [--full] [publisher ...]
/usr/bin/pkg install [-nvq] [-C n] [-g path_or_uri ...]
   [-accept] [-l licenses] [-no-be-activate] [-no-index]
   [-no-refresh] [-no-backup-be | --require-backup-be]
   [-backup-be-name name]
   [-deny-new-be | --require-new-be] [-be-name name]
   [--reject pkg_fmri_pattern ...] pkg_fmri_pattern ...
/usr/bin/pkg uninstall [-nvq] [-C n] [-no-be-activate]
   [-no-index] [-no-backup-be | --require-backup-be]
   [-backup-be-name name]
   [-deny-new-be | --require-new-be] [-be-name name]
   pkg_fmri_pattern ...
/usr/bin/pkg update [-fnvq] [-C n] [-g path_or_uri ...]
   [-accept] [-l licenses] [-no-be-activate] [-no-index]
   [-no-refresh] [-no-backup-be | --require-backup-be]
   [-backup-be-name name]
   [-deny-new-be | --require-new-be] [-be-name name]
   [--reject pkg_fmri_pattern ...] [pkg_fmri_pattern ...]
/usr/bin/pkg list [-Hafnsuv] [-g path_or_uri ...]
   [-no-refresh] [pkg_fmri_pattern ...]
/usr/bin/pkg info [-lr] [-g path_or_uri ...] [-license]
   [pkg_fmri_pattern ...]
/usr/bin/pkg contents [-Hmr] [-a attribute=pattern ...]
   [-g path_or_uri ...] [-o attribute ...] [-s sort_key]
   [-t action_name ...] [pkg_fmri_pattern ...]
/usr/bin/pkg search [-HIaflpr] [-o attribute ...]
   [-s repo_uri] query
/usr/bin/pkg verify [-Hqv] [pkg_fmri_pattern ...]
/usr/bin/pkg fix [-accept] [-l licenses]
   [pkg_fmri_pattern ...]
/usr/bin/pkg revert [-nv] [-no-be-activate]
   [-no-backup-be | --require-backup-be]
   [-backup-be-name name]
   [-deny-new-be | --require-new-be] [-be-name name]
   (--tagged tag-name ... | path-to-file ...)
/usr/bin/pkg mediator [-aH] [-F format] [mediator ...]
usr/bin/pkg set-mediator [-nv] [-I implementation]
   [-V version] [-no-be-activate]
   [-no-backup-be | --require-backup-be]
Description

pkg is the retrieval client for the Image Packaging System. With a valid configuration, pkg can be invoked to create locations for packages to be installed, called images, and install packages into those images. Packages are published by publishers, who can make their packages available at one or more repositories, or in package archives. pkg retrieves packages from a publisher’s repository or package archives and installs the packages into an image.
A publisher name identifies a person, group of persons, or an organization as the source of one or more packages. To avoid publisher name collisions and help identify the publisher, a best practice is to use a domain name that represents the entity publishing the packages as a publisher name.

A repository is a location where clients can publish and retrieve package content (files contained within the package such as programs and documents) and metadata (information about the package such as its name and description). As an example, a publisher named example.org might have their repository located at the URI http://example.org/repository.

pkg can also uninstall packages, refresh publisher metadata (such as the list of available packages), validate package installation in an image, and query the image for various tokens. These queries can also be made of pkg(5) repositories.

Images can be of three types: full images, capable of providing a complete system; partial images, which are linked to a full image (parent image), but do not provide a complete system on their own; and user images.

Options The following options are supported:

-?
  --help
  Display a usage message.

-R dir
  --image-dir dir
  Operate on the image rooted at dir. If no directory was specified or determined based on environment, the default is /. See the "Environment Variables" section for more information.

Sub-commands The following subcommands are supported:

pkg refresh [-q] [-full] [publisher ...]
  Update the client’s list of available packages and publisher metadata for all publishers.

  publisher
  Update the client’s list of available packages and publisher metadata only for the specified publishers.

  -q
  Hide progress messages during the requested operation.

  --full
  Force a full retrieval of all publisher metadata, instead of attempting an incremental update, and request that any proxies used during the operation ignore cached data. This option exists for troubleshooting purposes and should not be used on a regular basis.
[-backup-be-name name] [-deny-new-be] [-require-new-be] [-be-name name]
[-reject pkg_fmri_pattern ...] pkg_fmri_pattern ...

Install and update the specified packages to the newest version that match
pkg_fmri_pattern allowed by the packages installed in the image. To explicitly request the
latest version of a package, use latest for the version portion of pkg_fmri_pattern. For
example, specify vim@latest.

Packages are selected based on publisher search order and stickiness. See the pkg
publisher and pkg set-publisher commands for information about search order and
stickiness. If the pkg_fmri_pattern does not specify the publisher, the first publisher that
provides a matching package is used as the installation source. If that publisher does not
provide a version of the package that can be installed in this image, then the installation
operation fails. Use the pkg list -a command to see which publishers provide a version of
the package that can be installed in this image.

If more than one pkg_fmri_pattern is specified, and if any of the specified packages cannot
be installed in this image, then none of the specified packages will be installed.

Some configuration files might be renamed or replaced during the installation process. For
more information on how the package system determines which files to preserve, and how
they are preserved during package operations, see “File Actions” in the pkg(5) man page.

If a package is on the avoid list, installing it removes it from that list.

-g path_or_uri
Temporarily add the specified package repository or archive to the list of sources in the
image from which to retrieve package data. Repositories that require a client SSL
certificate cannot be used with this option. This option can be specified multiple times.

When deciding which version of a package to use, publishers configured in the image,
but not found in the specified path_or_uri sources, take precedence. If the version of the
package to be installed is provided by a publisher configured in the image and by a
path_or_uri source, the client retrieves the content for that package from the
path_or_uri sources. After installation or update, any packages provided by publishers
not configured in the image are added to the image configuration without an origin. Use
the pkg publisher command to see which publishers are configured in the image.

-n
Perform a trial run of the operation with no package changes made.

-v
Issue verbose progress messages during the requested operation, and display detailed
planning information (such as changing facets, mediators, and variants). This option
can be specified multiple times to increase the amount of planning information
displayed.
-q
  Hide progress messages during the requested operation.

-C n
  Specify the number of child images to update in parallel. When recursing into child images (usually zones), update at most n child images in parallel. The default number of child images to update in parallel is 1. If n is 0 or a negative number, all child images are updated in parallel. See also PKG_CONCURRENCY in the "Environment Variables" section.

--accept
  Indicate that you agree to and accept the terms of the licenses of the packages that are updated or installed. If you do not provide this option, and any package licenses require acceptance, the installation operation fails.

--licenses
  Display all of the licenses for the packages that are installed or updated as part of this operation.

-no-backup-be
  Do not create a backup boot environment.

-no-be-activate
  If a boot environment is created, do not set it as the active boot environment on the next boot. See the beadm(1M) man page for more information.

-no-index
  Do not update the search indexes after the operation has completed successfully.

-no-refresh
  Do not attempt to contact the repositories for the image’s publishers to retrieve the newest list of available packages and other metadata.

-backup-be-name name
  Name the created backup boot environment using the given argument. Use of -backup-be-name implies -require-backup-be. See also the beadm(1M) man page.

-be-name name
  Rename the newly created boot environment to be the argument given. Use of -be-name implies -require-new-be. See also the beadm(1M) man page.

-require-backup-be
  Always create a backup boot environment if a new boot environment will not be created. Without this option, a backup boot environment is created based on image policy. See be-policy in "Image Properties" below for an explanation of when backup boot environments are created automatically.
--require-new-be
Always create a new boot environment. Without this option, a boot environment is created based on image policy. See be-policy in “Image Properties” below for an explanation of when boot environments are created automatically. This option cannot be combined with --require-backup-be.

--deny-new-be
Do not create a new boot environment. This operation is not performed if a new boot environment is required.

--reject pkg_fmri_pattern
Prevent packages with names matching the given pattern from being installed. If matching packages are already installed, they are removed as part of this operation. Rejected packages that are the target of group dependencies are placed on the avoid list.

Remove installed packages that match pkg_fmri_pattern.

If a package is the subject of a group dependency, uninstalling it places it on the avoid list. See the avoid subcommand below.

For descriptions of options, see the install command above.

In the command output, note any messages that say a new boot environment has been created. If a new boot environment has been created and activated, that is the environment that is booted by default on next reboot. See the beadm(1M) man page for information about managing boot environments.

Update all packages installed in the current image to the newest version allowed by the constraints imposed on the system by installed packages and publisher configuration.

pkg_fmri_pattern
Update only the specified packages installed in the current image. If asterisk (*) is one of the pkg_fmri_pattern patterns provided, update all packages installed in the current image as described above.

To explicitly request the latest version of a package, use latest for the version portion of pkg_fmri_pattern. For example, specify vim@latest.

Versions older or newer than what is already installed can be specified to perform in-place downgrades or upgrades of specific packages. Updating specific packages across package rename or obsolete boundaries is not supported.
Any preserved configuration files that are part of packages to be downgraded and that have been changed since the original version was installed are renamed using the extension .update. For more information about how the package system determines which files to preserve, and how these files are preserved during package upgrades, see “File Actions” in the pkg(5) man page.

If more than one pkg_fmri_pattern is specified, and if any of the specified packages cannot be updated in this image, then none of the specified packages will be updated.

-f
Do not execute the client up-to-date check when updating all installed packages.

For all other options, see the install command above.

In the command output, note any messages that say a new boot environment has been created. If a new boot environment has been created and activated, that is the environment that is booted by default on next reboot if you do not specify the -no-be-activate option. See the beadm(1M) man page for information about managing boot environments.

pkg list [-Hafnsuv] [-q path_or_uri ...] [-no-refresh] [pkg_fmri_pattern ...]
Display a list of all packages installed in the current image, including information such as version and installed state. By default, package variants for a different architecture or zone type are excluded. The usual output is in three columns:

NAME (PUBLISHER) VERSION IFO
system/core-os 0.5.11-0.175.0.0.0.2.1 i--
x11/wm/fvwm (fvwm.org) 2.6.5 i--

The first column contains the name of the package. If the publisher from which the package is installed (or available, if not installed) is not the first in the publisher search order, then the publisher name is listed in parentheses after the package name. The second column contains the release and branch versions of the package. See the pkg(5) man page for information about release and branch versions and about variants.

The last column contains a set of flags that show the status of the package:
- An i in the I column shows that the package is installed.
- An f in the F column shows that the package is frozen.
- An o in the O column shows that the package is obsolete. An r in the O column shows that the package has been renamed (a form of obsoletion).

pkg_fmri_pattern
List only the specified packages.

-H
Omit the headers from the listing.
-a
List installed packages and the newest version of packages that are available for installation. Packages are considered to be available for installation if they are allowed by the installed incorporations and by the image's variants. If one or more patterns are specified, then the newest version matching the specified pattern and allowed by any installed incorporations and the image's variants is listed. Without -a, list only installed packages.

-af
List all versions of all packages for all variants regardless of incorporation constraints or installed state. To explicitly list the latest version of a package when using these options, use latest for the version portion of pkg_fmri_pattern. For example, specify vim@latest.

-g path_or_uri
Use the specified package repository or archive as the source of package data for the operation. Repositories that require a client SSL certificate cannot be used with this option. This option can be specified multiple times. Use of -g implies -a if -n is not specified.

-n
Display the newest versions of all known packages, regardless of installed state.

-s
Display a one-line short-form giving the package name and summary. This option can be used with -a, -n, -u or -v.

-u
List only packages with newer versions available. This option cannot be used with -g.

-v
Show full package FMRI, including publisher and complete version, all in the first column (the VERSION column disappears). This option can be used with -a, -n, or -u.

--no-refresh
Do not attempt to contact the repositories for the image's publishers to retrieve the newest list of available packages.

e pkg info [-lr] [-g path_or_uri ...] [-l license] [pkg_fmri_pattern ...]
Display information about all packages installed in the current image in a human-readable form.

pkg_fmri_pattern
Display information for only the specified packages.

-g path_or_uri
Use the specified package repository or archive as the source of package data for the operation. Repositories that require a client SSL certificate cannot be used with this option. This option can be specified multiple times. Use of -g implies -r.
-l
Only display information for installed packages. This is the default.

-r
Match packages based on the newest available versions, retrieving information for packages not currently installed (if necessary) from the repositories of the image’s configured publishers. At least one package must be specified when using this option. Without -r, only installed packages are displayed by default.

--license
Display the license texts for the packages. This option can be combined with -l or -r.

pkg contents [-Hmr] [-a attribute=pattern ...] [-g path_or_uri ...] [-o attribute,...] [-s sort_key] [-t action_name ...] [pkg_fmri_pattern ...]
Display the contents (action attributes) of all packages installed in the image. With no options, display the value of the path attribute for actions installed in the current image, sorted alphabetically by attribute value. For information about actions and their attributes, see “Actions” in the pkg(5) man page. See also the list of pseudo attribute names below.

 pkg_fmri_pattern
Display contents of only the specified packages.

-H
Omit the headers from the output.

-a attribute=pattern
Limit the output to those actions that have an attribute named in the option argument with a value that matches the (glob) pattern in the option argument (following the attribute name with an equals sign). If multiple -a options are given, then actions matching any of them are displayed.

-g path_or_uri
Display information for packages that could be installed in this image from the specified package repository or archive. Repositories that require a client SSL certificate cannot be used with this option. Packages that could be installed include packages that are currently installed and other packages that satisfy criteria for installation in this image, such as variant and facet restrictions. This option can be specified multiple times. Use of -g implies -r.

-m
Display all attributes of all actions in the specified packages, including actions that could not be installed in this image.

-o attribute
Display the specified attributes, sorted according to the values of the first attribute listed. The -o option can be specified multiple times, or multiple attributes can be specified as the argument to one -o option by separating the attribute names with commas. Only actions that have the requested attributes are displayed.
Display information for the newest available versions of packages that could be installed in this image from the repositories of the publishers configured in this image. Packages that could be installed include packages that are currently installed and other packages that satisfy criteria for installation in this image, such as variant and facet restrictions. At least one package must be specified when using this option.

_sort_key
Sort actions by the specified action attribute. If not provided, the default is to sort by path or by the first attribute specified by the -o option. The -s option can be specified multiple times.

_t_action_name
Only list the specified actions. Multiple actions can be specified in a comma-separated list. The value of action_name is one of the actions listed in “Actions” in the pkg(5) man page, such as file, directory, driver, depend, set. This option can be specified multiple times.

Several special pseudo attribute names are available for convenience:

.action.hash
The value of the action’s hash, if the action carries a payload.

.action.key
The value of the action’s key attribute. For example, for a file action, the key attribute is the path to the file. Some actions do not have a key attribute.

.action.name
The name of the action. For example, for a file action, this is file.

.action.raw
All attributes of matching actions.

.pkg.fmri
The full FMRI of the package containing the action, such as pkg://solaris/group/feature/amp@0.5.11,5.11-0.175.0.0.0.2.1:20120705T153434Z.

.pkg.name
The name of the package containing the action, such as web/amp.

.pkg.publisher
The publisher of the package containing the action, such as solaris.

.pkg.shortfmri
The short form FMRI of the package containing the action, such as pkg://solaris/group/feature/amp@0.5.11,5.11-0.175
or installable packages, filtering the output based on the specified options. The search subcommand approaches the query from the other direction, displaying the names of all packages that contain a user-supplied token.

Each subcommand is capable of formulating some queries of which the other is capable. Care should be taken in choosing the subcommand, as a given query can be more naturally formulated in one than in the other.

pkg search [-Hialfpr] [-o attribute,...] [-s repo_uri] query
Search for matches to the query, and display the results. See the description of query below.

-H
Omit the headers from the output.

-I
Use a case-sensitive search.

-a
Perform the search and display information about the matching actions. This is the default.

-f
Show all results, regardless of package version. By default, search prunes results from packages older than the currently installed version and from package versions excluded by current incorporations.

-l
Search the image’s installed packages.
Both -l and -r (or -s) can be specified together, in which case both local and remote searches are performed.

-p
Display packages that have some actions that match each query term. Using this option is equivalent to putting angle brackets (<>), around each term in the query. See query below for more description of the <> operator.

-r
Search the repositories corresponding to the image’s publishers. This is the default.
Both -l and -r (or -s) can be specified together, in which case both local and remote searches are performed.

-o attribute
Control the columns of the results. The -o option can be specified multiple times, or multiple attributes can be specified as the argument to one -o option by separating the attribute names with commas. In addition to the pseudo attributes outlined above, the following attributes are defined for search results:
The string that matched the search query.

The attribute that contained the string that matched the search query.

Search the pkg(5) repository located at the given URI. This can be specified multiple times. Package archives are not supported.

By default, query is interpreted as a series of terms to be matched exactly. The ? and * characters can be used as `glob(3C)`-style wildcards, allowing more flexible query matches.

In addition to simple token matching and wildcard search, a more complicated query language is supported. Phrases can be searched for by using single or double quotation marks (" or "). Be sure to take your shell into account so that `pkg` actually sees the " or ".

Boolean search using AND and OR is supported.

Which tokens are indexed is action-dependent, but can include content hashes and path names. For information about actions and their attributes, see "Actions" in the pkg(5) man page. See also the list of pseudo attribute names in `pkg contents` and `-o` above.

Structured queries are supported with the following syntax:

`pkg_name:action_name:index:token`

The value of `action_name` is one of the actions listed in "Actions" in the pkg(5) man page. The `index` is an attribute of the action. The value of `index` must match `token`.

Not all action attributes are searchable. For example, `mode` is an attribute of the `file` action, but `mode` is not a valid value for `index`.

Some values for `index` are not action attributes but are values derived from other attributes. For example, `index` can be `basename`, which is not an attribute of any action but is derived from the `path` attribute of the `file` or `dir` action by taking the last component of the path.

Different action types have different valid values for `index`. This documentation does not list all possible values. Some of the more useful `index` values are `basename` and `path` for file system actions, the dependency type (for example, `require`, `optional`, `group`) for depend actions, and `driver_name` and `alias` for `driver` actions.

One special value for `index` is the value of a `name` attribute for a `set` action. In this case, `token` is matched against the value of the `value` attribute that corresponds to the specified `name` attribute. For example, the following search finds packages that are classified as either Development/Databases or System/Databases. In the "Examples" section, see the example of finding SMF services.
pkg search info.classification:databases

Missing fields in a structured query are implicitly wildcarded. A search for
basename:pkg matches all actions in all packages that have an index of basename and
that match the token pkg, as shown in the following partial output:

$ pkg search basename:pkg

INDEX ACTION VALUE PACKAGE
basename dir  /usr/share/pkg pkg:/package/pkg@0.5.11-0.175.0.0.0.2.1
basename dir  /var/sadm/pkg pkg:/package/svr4@0.5.11-0.175.0.0.0.2.1
basename dir  /var/spool/pkg pkg:/package/svr4@0.5.11-0.175.0.0.0.2.1
basename file  /usr/bin/pkg pkg:/package/pkg@0.5.11-0.175.0.0.0.2.1

Adding another field narrows the search, as shown in the following complete output:

$ pkg search file:basename:pkg

INDEX ACTION VALUE PACKAGE
basename file  /usr/bin/pkg pkg:/package/pkg@0.5.11-0.175.0.0.0.2.1

Explicit wildcards are supported in the pkg_name and token fields. The action_name
and index must match exactly.

See the "Examples" section for examples of searching for files and dependencies.

To convert actions to the packages that contain those actions, use =>, as shown in the
following partial output:

$ pkg search \<pkg\>

PACKAGE PUBLISHER
pkg:/package/pkg@0.5.11-0.175.0.0.0.2.1 solaris
pkg:/package/svr4@0.5.11-0.175.0.0.0.2.1 solaris

With the -a option (and by default), searching for token results in information about
the actions that match token, while searching for <token> results in a list of packages
that contain actions that match token.

pkg verify [-Hqv] [pkg_fmri_pattern ...]

Validate the installation of all packages installed in the current image. If current signature
policy for related publishers is not ignore, the signatures of each package are validated
based on policy. See signature-policy in "Image Properties" below for an explanation of
how signature policies are applied.

pkg_fmri_pattern

Validate the installation of only the specified packages installed in the current image.

-H

Omit the headers from the verification output.

-q

Print nothing, but return failure if there are any fatal errors.

-v

Include informational messages regarding packages.
pkg fix [--accept] [--licenses] [pkg_fmri_pattern ...]
Fix any errors reported by pkg verify. Verification of installed package content is based on a custom content analysis that might return different results than those of other programs.

pkg_fmri_pattern
Fix errors reported by pkg verify for only the specified packages installed in the current image.

--accept
Indicate that you agree to and accept the terms of the licenses of the packages that are updated or installed. If you do not provide this option, and any package licenses require acceptance, the operation fails.

--licenses
Display all of the licenses for the packages to be installed or updated as part of this operation.

pkg revert [-nv] [--no-be-activate] [--no-backup-be] [--require-backup-be]
[--backup-be-name name] [--deny-new-be] [--require-new-be] [--be-name name]
(- -tagged tag-name ... | path-to-file ...)
Revert files delivered by pkg(5) packages to their as-delivered condition. File ownership and protections are also restored.

Caution – Reverting some editable files to their default values can make the system unbootable, or cause other malfunctions.

--tagged tag-name
Revert all files tagged with tag-name.

path-to-file
Revert the specified files.

For all other options, see the install command above.

pkg mediator [-ah] [-F format] [mediator ...]
Display the current selected version and/or implementation of all mediators.

mediator
Display the current selected version and/or implementation of only the specified mediators.

-a
List the mediations that can be set for currently installed packages.

-F
Specify an alternative output format. Currently, only tsv (Tab Separated Values) is valid.

-H
Omit the headers from the listing.
[-no-backup-be] [-require-backup-be] [-backup-be-name name] [-deny-new-be]
[-require-new-be] [-be-name name] mediator...
Set the version and/or implementation for the specified mediators in the current image.

-I implementation
Set the implementation of the mediated interface to use. By default, if no version is
specified, all implementation versions are allowed. To specify an implementation with
no version, append an at sign (@).

-V version
Set the version of the mediated interface to use.

If the specified mediator version and/or implementation is not currently available, any
links using the specified mediators are removed.

For all other options, see the install command above.

pkg unset-mediator [-nvIV] [-no-be-activate] [-no-backup-be]
[-require-backup-be] [-backup-be-name name] [-deny-new-be] [-require-new-be]
[-be-name name] mediator...
Revert the version and/or implementation of the specified mediators to the system default.

-I
Revert only the implementation of the mediated interface.

-V
Revert only the version of the mediated interface.

For all other options, see the install command above.

pkg variant [-H] [variant.variant_name ...]
Display the current values of all variants set in this image. See "Facets and Variants" in the
pkg(5) man page for more information about variants.

variant.variant_name
Display the current values of only the specified variants set in this image.

-H
Omit the headers from the listing.

pkg change-variant [-nvq] [-C n] [-g path_or_uri ...] [-accept] [-licenses]
[-no-be-activate] [-no-backup-be] [-require-backup-be] [-backup-be-name name]
[-deny-new-be] [-require-new-be] [-be-name name] variant_name=value ...
Change the values of the specified variants set in the current image.

Changing the value of a variant can cause package content to be removed, updated, or
installed. Changing a variant value can also cause entire packages to be installed, updated,
or removed to satisfy the new image configuration. See "Facets and Variants" in the pkg(5)
man page for more information about variants.
For descriptions of options, see the install command above.

pkg facet [-H] [facet_name ...]
Display the current values of all facets that have been explicitly set in this image by using
the pkg change-facet command. See “Facets and Variants” in the pkg(5) man page for
more information about facets.

facet_name
Display the current values of only the specified facets set in this image.

-H
Omit the headers from the listing.

pkg change-facet [-nvq] [-C n] [-g path_or_uri ...] [-accept] [-licenses]
[-no-be-activate] [-no-backup-be] [-require-backup-be] [-backup-be-name name]
[-deny-new-be] [-require-new-be] [-be-name name] facet_name=[True|False|None] ...
Change the values of the specified facets set in the current image.

Facets can be set to True or False. Setting a facet to None applies the default value of True to
that facet; thus, any actions subject to the facet will be installed. See “Actions” in the pkg(5)
man page for information about actions.

Changing the value of a facet can cause package content to be removed, updated, or
installed. Changing a facet value can also cause entire packages to be installed, updated, or
removed to satisfy the new image configuration. See “Facets and Variants” in the pkg(5)
man page for more information about facets.

For descriptions of options, see the install command above.

pkg avoid [pkg_fmri_pattern ...]
Display each avoided package along with any packages that have a group dependency on
that package.

Packages that are on the avoid list are installed if needed to satisfy a required dependency. If
that dependency is removed, the package is uninstalled.

pkg_fmri_pattern
Avoid the specified packages if they are the target of a group dependency by placing the
package names that currently match the specified patterns on the avoid list. Only
packages that are not currently installed can be avoided. If a package is currently the
target of a group dependency, uninstalling the package places it on the avoid list.

pkg unavoidable [pkg_fmri_pattern ...]
Display the list of avoided packages.

pkg_fmri_pattern
Remove the specified packages from the avoid list. Packages on the avoid list that match
an installed package’s group dependency cannot be removed using this subcommand.
To remove a package from the avoid list that matches a group dependency, install the
Display information about currently frozen packages: package names, versions, when the package was frozen, and any associated reasons for freezing the packages.

Freezing a package does not prevent removal of the package. No warning is displayed if the package is removed.

**pkg_fmri_pattern**

Freeze the specified packages to the specified versions. If no version is given, the package must be installed and is frozen at that installed version. Freezing a package that is already frozen replaces the freeze version with the newly specified version.

When a package that is frozen is installed or updated, it must end up at a version that matches the version at which it was frozen. For example, if a package was frozen at 1.2, then it could be updated to 1.2.1, 1.2.9, 1.2.0.0.1, and so on. That package could not end up at 1.3, or 1.1. A publisher presented in the **pkg_fmri_pattern** is used to find matching packages. However, publisher information is not recorded as part of the freeze. A package is frozen with respect to its version only, not its publisher.

**-c reason**

Record the reason with the packages that are frozen. The reason is shown if a freeze prevents an installation or update from succeeding.

**-n**

Perform a trial run of the freeze operation, displaying the list of packages that would be frozen without freezing any packages.

**pkg unfreeze [-n] [pkg_name_pattern] ...**

Display information about currently frozen packages: package names, versions, when the package was frozen, and any associated reasons for freezing the packages.

**pkg_fmri_pattern**

Remove the constraints that freezing imposes from the specified packages. Any versions provided are ignored.

**-n**

Perform a trial run of the unfreeze operation, displaying the list of packages that would be unfrozen without unfreezing any packages.

**pkg property [-H] [propname ...]**

Display the names and values of all image properties. See "Image Properties" below for descriptions of image properties.

**propname**

Display the names and values for only the specified properties.

**-H**

Omit the headers from the listing.
pkg set-property propname propvalue
  Update an existing image property or add a new image property.

pkg add-property-value propname propvalue
  Add a value to an existing image property or add a new image property.

pkg remove-property-value propname propvalue
  Remove a value from an existing image property.

pkg unset-property propname...
  Remove an existing image property or properties.

pkg publisher [-HPn] [-F format] [publisher ...]
  Display the list of all publishers, their origin URIs, and mirrors in order of search preference.

publisher
  Display detailed configuration for only the specified publishers.

-H
  Omit the headers from the listing.

-P
  Display only the first publisher in the publisher search order.

-n
  Display only enabled publishers.

-F
  Specify an alternative output format. Currently, only tsv (Tab Separated Values) is valid.

  Update an existing publisher or add a publisher. If no options affecting search order are specified, new publishers are appended to the search order and are thus searched last.

-P
  --search-first
  Set the specified publisher first in the search order. When installing new packages, this publisher is searched first. Updates to already installed packages come from the same publisher that originally provided the package as long as that publisher remains sticky.
--non-sticky
 Higher ranked publishers than this one can provide updates to packages originally installed from this publisher.

--sticky
 Updates to packages that were installed from this publisher must also come from this publisher. This is the default behavior.

--search-before publisher
 Alter the publisher search order so that the publisher being added or modified is searched before the publisher specified in this option.

--search-after publisher
 Alter the publisher search order so that the publisher being added or modified is searched after the publisher specified in this option.

--approve-ca-cert path_to_CA
 Add the specified certificate as a CA certificate that is trusted. The hashes of the PEM representation of the user-approved CA certificates are listed in the detailed output of the pkg publisher command.

--revoke-ca-cert hash_of_CA_to_remove
 Treat the certificate with the given hash of its PEM representation as revoked. The hashes of the user-revoked CA certificates are listed in the detailed output of the pkg publisher command.

--unset-ca-cert hash_of_CA_to_remove
 Remove the certificate with the given hash from the list of approved certificates and the list of revoked certificates.

--set-property name_of_property=value
 Update an existing publisher property or add a new publisher property.

--add-property-value name_of_property=value_to_add
 Add a value to an existing publisher property or add a new publisher property.

--remove-property-value name_of_property=value_to_remove
 Remove a value from an existing publisher property.

--unset-property name_of_property_to_delete
 Remove an existing publisher property.

-k ssl_key
 Specify the client SSL key.

-c ssl_cert
 Specify the client SSL certificate.

-g origin_to_add
 --add-origin origin_to_add

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Add the specified URI or path as an origin for the given publisher. This should be the location of a package repository or archive.

-6 origin_to_remove
--remove-origin origin_to_remove
Remove the URI or path from the list of origins for the given publisher. The special value * can be used to remove all origins.

--no-refresh
Do not attempt to contact the repositories for the image's publishers to retrieve the newest list of available packages and other metadata.

--reset-uuid
Choose a new unique identifier that identifies this image to its publisher.

-m mirror_to_add
--add-mirror mirror_to_add
Add the URI as a mirror for the given publisher.

-M mirror_to_remove
--remove-mirror mirror_to_remove
Remove the URI from the list of mirrors for the given publisher. The special value * can be used to remove all mirrors.

-e
--enable
Enable the publisher.

-d
--disable
Disable the publisher. A disabled publisher is not used when populating the package list or in certain package operations (install, uninstall, and update). However, the properties for a disabled publisher can still be set and viewed. If only one publisher exists, it cannot be disabled.

--proxy proxy_to_use
Use the specified web proxy URI to retrieve content for the specified origin (-g) or mirror (-m). The proxy value is stored as part of the publisher configuration. At run time, $http_proxy or related environment variables override this proxy setting. See the curl(1) man page for the list of accepted environment variable names.

[-search-after publisher] [-search-before publisher] [-search-first]
[-approve-ca-cert path_to_CA] [-revoke-ca-cert hash_of_CA_to_remove]
[-unset-ca-cert hash_of_CA_to_remove] [-set-property name_of_property=value]
[-add-property-value name_of_property=value_to_add] [-remove-property-value name_of_property=value_to_remove] [-unset-property name_of_property_to_delete]
[-proxy proxy_to_use] [publisher]
Retrieve publisher configuration information from the repo_uri repository URI.
If a publisher operand is specified to this set-publisher subcommand, then only that publisher is added or updated. If no publisher is specified, all publishers in repo_uri are added or updated as appropriate.

For descriptions of options, see the set-publisher command above. When used with -p, the -P, --search-first, --search-before, and --search-after options only apply to added publishers, not to updated publishers.

The -p option cannot be combined with the -g, --add-origin, -G, --remove-origin, -m, --add-mirror, -M, --remove-mirror, --disable, --enable, --no-refresh, or --reset-uuid options.

pkg unset-publisher publisher ...
Remove the configuration associated with the specified publisher or publishers.

pkg history [ -HNl ] [ -t [ time | time-time],... ] [ -o column,... ] [ -n number ]
Display the command history of the applicable image.

-H
Omit the headers from the listing.

-t time
-t time-time
Display log records for a comma-separated list of timestamps, formatted with %Y-%m-%dT%H:%M:%S (see strftime(3C)). To specify a range of times, use a hyphen (-) between a start and finish timestamp. The keyword now can be used as an alias for the current time. If the timestamps specified contain duplicate timestamps or overlapping date ranges, only a single instance of each duplicate history event is printed.

-l
Display log records in long format, which, in addition to the standard format, includes the outcome of the command, the time the command completed, the version and name of the client used, the name of the user who performed the operation, and any errors that were encountered while executing the command.

-N
Display the release note text.

-n number
Display only the specified number of most recent entries.

-o column
Display output using the specified comma-separated list of column names. Valid column names are:

be
The name of the boot environment this operation was started on.

be_uuid
The uuid of the boot environment this operation was started on.
client
   The name of the client.

client_ver
   The version of the client.

command
   The command line used for this operation.

finish
   The time that this operation finished.

id
   The user id that started this operation.

new_be
   The new boot environment created by this operation.

new_be_uuid
   The uuid of the new boot environment created by this operation.

operation
   The name of the operation.

outcome
   A summary of the outcome of this operation.

reason
   Additional information on the outcome of this operation.

release_note
   Indicates whether this operation generated release notes.

snapshot
   The snapshot taken during this operation. This is only recorded if the snapshot was not automatically removed after successful operation completion.

start
   The time that this operation started.

time
   The total time taken to perform this operation. For operations that take less than one second, 0:00:00 is shown.

user
   The username that started this operation.

If the command or reason columns are specified, they must be the last item in the -o list, in order to preserve output field separation. These two columns cannot be shown in the same history command.
An asterisk (*) is shown after the values for `be` or `new_be` if the boot environment is no longer present on the system.

The values for `be` and `new_be` are obtained by looking up the current boot environment name, using the `be_uuid` or `new_be_uuid` fields. If a boot environment was subsequently renamed, and later deleted, the values displayed for `be` and `new_be` are the values recorded at the time of the `pkg` operation.

```
pkg purge-history
Delete all existing history information.
```

```
pkg rebuild-index
Rebuild the index used by `pkg search`. This is a recovery operation not intended for general use.
```

```
pkg update-format
Update the format of the image to the current version. Once this operation has completed, the image can no longer be used with older versions of the `pkg`(5) system.
```

```
pkg version
Display a unique string identifying the version of `pkg`. This string is not guaranteed to be comparable in any fashion between versions.
```

```
pkg help
Display a usage message.
```

```
pkg image-create [-FPUz] [-f|--force] [-full|--partial] [-user] [-zone] [-k ssl_key] [-c ssl_cert] [-no-refresh] [-variant variant_name=value ...] [-g path_or_uri] [-origin path_or_uri ...] [-m uri] [-mirror uri ...] [-set-property name_of_property=value] [-f --facet facet_name=(True|False) ...][-p|--publisher] [name=repo_uri] dir
At the location given by `dir`, create an image suitable for package operations. The default image type is user, as given by the `-U|--user` option. The image type can be set to a full image (-F|--full) or to a partial image (-P|--partial) linked to the full image enclosing the given `dir` path. Additional origins can be specified using `-g` or `--origin`. Additional mirrors can be specified using `-m` or `--mirror`.

A package repository URI must be provided using the `-p` or `--publisher` option. If a publisher name is also provided, then only that publisher is added when the image is created. If a publisher name is not provided, then all publishers known by the specified repository are added to the image. An attempt to retrieve the catalog associated with this publisher is made following the initial creation operations.

For publishers using client SSL authentication, a client key and client certificate can be registered via the `-c` and `-k` options. This key and certificate are used for all publishers added during image creation.

If the image is to be run within non-global zone context, then the `-z` (`--zone`) option can be used to set an appropriate variant.
-f
--force
  Force the creation of an image over an existing image. This option should be used with care.

--no-refresh
  Do not attempt to contact the repositories for the image's publishers to retrieve the newest list of available packages and other metadata.

--variant variant_name=value
  Set the specified variant to the indicated value. See “Facets and Variants” in the pkg(5) man page for more information about variants.

--facet facet_name=(True|False)
  Set the specified facet to the indicated value. See “Facets and Variants” in the pkg(5) man page for more information about facets.

--set-property name_of_property=value
  Set the specified image property to the indicated value. See “Image Properties” below for descriptions of image properties.

Image Properties
  The following properties define characteristics of the image. These properties store information about the purpose, content, and behavior of the image. To view the current values of these properties in the image, use the pkg property command. To modify the values of these properties, use the pkg set-property and pkg unset-property commands.

be-policy
  (string) Specify when a boot environment is created during packaging operations. The following values are allowed:

default
  Apply the default boot environment creation policy, create-backup.

always-new
  Requires a reboot for all package operations by performing them in a new boot environment set as active on the next boot. A backup boot environment is not created unless explicitly requested.

  This policy is the safest, but is more strict than most sites need since no packages can be added without a reboot.

create-backup
  For package operations that require a reboot, a new boot environment is created and set as active on the next boot. If packages are modified or content that could affect the kernel is installed and the operation affects the live boot environment, a backup boot environment is created but not set as active. A backup boot environment can also be explicitly requested.

  This policy is potentially risky only if newly installed software causes system instability, which is possible but relatively rare.
when-required
For package operations that require a reboot, a new boot environment is created and set as active on the next boot. A backup boot environment is not created unless explicitly requested.

This policy carries the greatest risk since if a packaging change to the live boot environment makes further changes impossible, there might be no recent boot environment to which one can fallback.

c-a-path
(string) A path name that points to a directory where CA certificates are kept for SSL operations. The format of this directory is specific to the underlying SSL implementation. To use an alternate location for trusted CA certificates, change this value to point to a different directory. See the CPath portions of SSL_CTX_load_verify_locations(3openssl) for requirements for the CA directory.

Default value: /etc/openssl/certs

check-certificate-revocation
(boolean) If this is set to True, the package client attempts to contact any CRL distribution points in the certificates used for signature verification to determine whether the certificate has been revoked since being issued.

Default value: False

flush-content-cache-on-success
(boolean) If this is set to True, the package client removes the files in its content-cache when install or update operations complete. For update operations, the content is removed only from the source boot environment. When a packaging operation next occurs in the destination boot environment, the package client flushes its content cache if this option has not been changed.

This property can be used to keep the content-cache small on systems with limited disk space. This property can cause operations to take longer to complete.

Default value: True

mirror-discovery
(boolean) This property tells the client to discover link-local content mirrors using mDNS and DNS-SD. If this property is set to True, the client attempts to download package content from mirrors it dynamically discovers. To run a mirror that advertises its content via mDNS, see the pkg. depot d(1M) man page.

Default value: False

send-uuid
(boolean) Send the image’s Universally Unique Identifier (UUID) when performing network operations. Although users can disable this option, some network repositories might refuse to talk to clients that do not supply a UUID.
signature-policy
(string) Determine what checks will be performed on manifests when installing, updating, modifying, or verifying packages in the image. The final policy applied to a package depends on the combination of image policy and publisher policy. The combination will be at least as strict as the stricter of the two policies taken individually. By default, the package client does not check whether certificates have been revoked. To enable those checks, which might require the client to contact external web sites, set the check-certificate-revocation image property to True. The following values are allowed:

ignore
Ignore signatures for all manifests.

verify
Verify that all manifests with signatures are validly signed, but do not require all installed packages to be signed. This is the default value.

require-signatures
Require that all newly installed packages have at least one valid signature. The pkg fix and pkg verify commands also warn if an installed package does not have a valid signature.

require-names
Follow the same requirements as require-signatures but also require that the strings listed in the signature-required-names property appear as a common name of the certificates used to verify the chains of trust of the signatures.

signature-required-names
(list of strings) A list of names that must be seen as common names of certificates while validating the signatures of a package.

trust-anchor-directory
(string) The path name of the directory that contains the trust anchors for the image. This path is relative to the image. The default value is ignore.

use-system-repo
(boolean) This property indicates whether the image should use the system repository as a source for image and publisher configuration and as a proxy for communicating with the publishers provided. The default value is False. See the pkg.sysrepo(1M) man page for information about system repositories.

The following properties define signature policy for a particular publisher. The image properties of the same name define signature policy for the image. To view the current values of these properties for a particular publisher, use the pkg publisher publisher_name command. To modify the values of these publisher signature policy properties, use the --set-property and --unset-property options of the pkg set-publisher command.
signature-policy
(string) This property functions identically to the image property of the same name except that it only applies to packages from the particular publisher.

signature-required-names
(list of strings) This property functions identically to the image property of the same name except that it only applies to packages from the particular publisher.

Examples

EXAMPLE 1 Create an Image With Publisher Configured
Create a new, full image, with publisher example.com, stored at /aux0/example_root.

```
$ pkg image-create -F -p example.com=http://pkg.example.com:10000 \ 
/aux0/example_root
```

EXAMPLE 2 Create an Image, Specifying Additional Origins and Mirror
Create a new, full image, with publisher example.com, that also has an additional mirror, two additional origins, and is stored at /aux0/example_root.

```
$ pkg image-create -F -p example.com=http://pkg.example.com:10000 \ 
-g http://alternate1.example.com:10000/ \ 
-g http://alternate2.example.com:10000/ \ 
-m http://mirror.example.com:10000/ \ 
/aux0/example_root
```

EXAMPLE 3 Create an Image With No Publisher Configured
Create a new, full image with no publishers configured at /aux0/example_root.

```
$ pkg image-create -F /aux0/example_root
```

EXAMPLE 4 Install a Package
Install the latest version of the widget package in the current image.

```
$ pkg install application/widget
```

EXAMPLE 5 List Specified Contents of a Package
List the contents of the system/file-system/zfs package. Display the action name, the mode of the file (if defined), the size (if defined), the path, and the target (if a link). Limit the action to types dir, file, link, and hardlink, since specifying the action.name attribute, which is available for all actions, displays a line for all actions, which is not desired here.

```
$ pkg contents -t dir,file,link,hardlink \ 
-o action.name,mode,pkg.size,path,target system/file-system/zfs
```

<table>
<thead>
<tr>
<th>ACTION.NAME</th>
<th>MODE</th>
<th>PKG.SIZE</th>
<th>PATH</th>
<th>TARGET</th>
</tr>
</thead>
<tbody>
<tr>
<td>dir</td>
<td>0755</td>
<td>etc</td>
<td>etc</td>
<td></td>
</tr>
<tr>
<td>dir</td>
<td>0755</td>
<td>etc/fs</td>
<td>etc/fs/zfs</td>
<td></td>
</tr>
<tr>
<td>dir</td>
<td>0755</td>
<td>etc/fs/zfs</td>
<td>etc/fs/zfs/mount</td>
<td>../usr/sbin/zfs</td>
</tr>
</tbody>
</table>
EXAMPLE 5  List Specified Contents of a Package  (Continued)

link  etc/fs/zfs/umount  ../../../usr/sbin/zfs
dir  0755  etc/zfs
dir  0755  kernel
dir  0755  kernel/drv
dir  0755  kernel/drv/amd64
file  0755  1706744  kernel/drv/amd64/zfs
file  0644  980  kernel/drv/zfs.conf
dir  0755  kernel/fs
dir  0755  kernel/fs/amd64
hardlink  kernel/fs/amd64/zfs  ../../../kernel/drv/amd64/zfs
...

EXAMPLE 6  List Specified Contents of Two Packages

List the contents of web/browser/firefox and mail/thunderbird, limiting the display to just
the package name and path attributes of actions whose path attribute ends in .desktop or
.png.

$ pkg contents -o pkg.name,path -a path=*.desktop \
-a path=*.png web/browser/firefox mail/thunderbird

PKG.NAME   PATH
web/browser/firefox  usr/share/applications/firefox.desktop
mail/thunderbird    usr/share/applications/thunderbird.desktop
web/browser/firefox  usr/share/pixmaps/firefox-icon.png
mail/thunderbird    usr/share/pixmaps/thunderbird-icon.png
...

EXAMPLE 7  Search for a Package

Search the package database for the token bge.

$ pkg search bge

INDEX  ACTION  VALUE
driver_name  driver  bge  pkg:/driver/network/ethernet/bge@0.5.11-0.175.0.0.0.2.1
basename  file  kernel/drv/sparcv9/bge  pkg:/driver/network/ethernet/bge@0.5.11-0.175.0.0.0.2.1
basename  file  kernel/drv/amd64/bge  pkg:/driver/network/ethernet/bge@0.5.11-0.175.0.0.0.2.1
basename  file  platform/sun4v/kernel/drv/sparcv9/bge  pkg:/system/kernel/platform@0.5.11-0.175.0.0.0.2.1
pkg.fmri  set  solaris/driver/network/bge  pkg:/driver/network/bge@0.5.11-0.173.0.0.1.0
pkg.fmri  set  solaris/driver/network/ethernet/bge  pkg:/driver/network/ethernet/bge@0.5.11-0.175.0.0.0.2.1

The token is in the package driver/network/bge both as the basename for the file action
representing /kernel/drv/arch/bge and as a driver name.

EXAMPLE 8  Search for a File

Search for the package that delivers a file by specifying the full path name of the file, including
the leading slash character.
EXAMPLE 8  Search for a File  (Continued)

```
$ pkg search -o path,pkg.name -l /usr/bin/vim
PATH                  PKG.NAME
usr/bin/vim  editor/vim/vim-core
```

Search for a file and the package that delivers that file by specifying file for the `action_name`, path or basename for the `index`, and the full or partial file name for the `token`.

```
$ pkg search -o path,pkg.name -l file:basename:vim
PATH                  PKG.NAME
usr/bin/vim  editor/vim/vim-core
```

EXAMPLE 9  Search for Files and Directories

Search for files and directories and the packages that deliver them by specifying path or basename for the `index` and the full or partial file name for the `token`. Depending on your shell, you might need to escape wildcards.

```
$ pkg search -o path,pkg.name -l path:/*/vim
PATH                  PKG.NAME
usr/bin/vim  editor/vim/vim-core
usr/share/vim  editor/vim
usr/share/vim  editor/vim/vim-core
$ pkg search -o path,pkg.name -l basename:vim
PATH                  PKG.NAME
usr/share/vim  editor/vim
usr/share/vim  editor/vim/vim-core
usr/bin/vim  editor/vim/vim-core
```

EXAMPLE 10  Show Which Packages Provide Which SMF Services

Show which packages provide a particular SMF service by specifying the value `org.opensolaris.smf.fmri` for the `index` in a structured search and the name of the service you want to find for the `token`. The value `org.opensolaris.smf.fmri` is the name of an attribute of a set action. Remember to escape the `:` in the name of the service.

For example, show which HTTP servers are available by specifying the value `svc:/network/http` for the `token`.

```
$ pkg search 'org.opensolaris.smf.fmri:svc:/network/http'
INDEX ACTION PACKAGE
org.opensolaris.smf.fmri set svc:/network/http pkg:/web/server/lighttpd-14@1.4.23-0.175.0.0.0.2.1
org.opensolaris.smf.fmri set svc:/network/http pkg:/web/proxy/privoxy@3.0.17-0.175.0.0.0.2.1
org.opensolaris.smf.fmri set svc:/network/http pkg:/web/proxy/squid@3.1.18-0.175.0.0.0.2.1
org.opensolaris.smf.fmri set svc:/network/http pkg:/web/java-servlet/tomcat@6.0.35-0.175.0.0.0.2.1
org.opensolaris.smf.fmri set svc:/network/http pkg:/web/server/apache-22@2.22-0.175.0.0.0.2.1
org.opensolaris.smf.fmri set svc:/network/http:apache22 pkg:/web/server/apache-22@2.22-0.175.0.0.0.2.1
org.opensolaris.smf.fmri set svc:/network/http:lighttpd14 pkg:/web/server/lighttpd-14@1.4.23-0.175.0.0.0.2.1
org.opensolaris.smf.fmri set svc:/network/http:privoxy pkg:/web/proxy/privoxy@3.0.17-0.175.0.0.0.2.1
```
EXAMPLE 10  Show Which Packages Provide Which SMF Services  (Continued)

```
org.opensolaris.smf.fmri set svc:/network/http:squid pkg:/web/proxy/squid@3.1.18-0.175.0.0.0.2.1
org.opensolaris.smf.fmri set svc:/network/http:tomcat6 pkg:/web/java-servlet/tomcat@6.0.35-0.175.0.0.0.2.1
```

EXAMPLE 11  Search for Packages that Depend on the Specified Package
Search for installed packages that depend on package/pkg.

```
$ pkg search -l depend::package/pkg
```

```
<table>
<thead>
<tr>
<th>INDEX</th>
<th>ACTION</th>
<th>VALUE</th>
<th>PACKAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>incorporate depend</td>
<td>package/pkg@0.5.11-0.175.0.0.0.2.1</td>
<td>pkg:/consolidation/ips/ips-incorporation@0.5.11-0.175.0.0.0.2.1</td>
</tr>
<tr>
<td>require</td>
<td>depend</td>
<td>pkg:/package/pkg@0.5.11-0.175.0.0.0.2.1 pkg:/package/pkg/package-manager@0.5.11-0.175.0.0.0.2.1</td>
<td></td>
</tr>
<tr>
<td>require</td>
<td>depend</td>
<td>pkg:/package/pkg@0.5.11-0.175.0.0.0.2.1 pkg:/system/library/install@0.5.11-0.175.0.0.0.2.1</td>
<td></td>
</tr>
<tr>
<td>require</td>
<td>depend</td>
<td>pkg:/package/pkg@0.5.11-0.175.0.0.0.2.1 pkg:/package/pkg/update-manager@0.5.11-0.175.0.0.0.2.1</td>
<td></td>
</tr>
<tr>
<td>require</td>
<td>depend</td>
<td>pkg:/package/pkg@0.5.11-0.175.0.0.0.2.1 pkg:/system/library/boot-management@0.5.11-0.175.0.0.0.2.1</td>
<td></td>
</tr>
<tr>
<td>require</td>
<td>depend</td>
<td>pkg:/package/pkg@0.5.11-0.175.0.0.0.2.1 pkg:/system/zones/brand/brand-solaris@0.5.11-0.175.0.0.0.2.1</td>
<td></td>
</tr>
<tr>
<td>require</td>
<td>depend</td>
<td>pkg:/package/pkg@0.5.11-0.175.0.0.0.2.1 pkg:/install/distribution-constructor@0.5.11-0.175.0.0.0.2.1</td>
<td></td>
</tr>
<tr>
<td>require</td>
<td>depend</td>
<td>pkg:/package/pkg@0.5.11-0.175.0.0.0.2.1 pkg:/system/boot-environment-utilities@0.5.11-0.175.0.0.0.2.1</td>
<td></td>
</tr>
<tr>
<td>require</td>
<td>depend</td>
<td>pkg:/package/pkg@0.5.11-0.175.0.0.0.2.1 pkg:/package/pkg/system-repository@0.5.11-0.175.0.0.0.2.1</td>
<td></td>
</tr>
</tbody>
</table>
```

EXAMPLE 12  Search for Dependencies
Search for all incorporate dependencies in installed packages.

```
$ pkg search -l depend:incorporate:
```

```
<table>
<thead>
<tr>
<th>INDEX</th>
<th>ACTION</th>
<th>VALUE</th>
<th>PACKAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>incorporate</td>
<td>depend</td>
<td>pkg:/BRCMbnx@0.5.11-0.175.0.0.0.2.1</td>
<td>pkg:/consolidation/osnet/osnet-incorporation@0.5.11-0.175.0.0.0.2.1</td>
</tr>
<tr>
<td>incorporate</td>
<td>depend</td>
<td>pkg:/BRCMbnxe@0.5.11-0.175.0.0.0.2.1</td>
<td>pkg:/consolidation/osnet/osnet-incorporation@0.5.11-0.175.0.0.0.2.1</td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

EXAMPLE 13  Add a Publisher
Add a new publisher example.com, with a repository located at http://www.example.com/repo.

```
$ pkg set-publisher -g http://www.example.com/repo example.com
```

EXAMPLE 14  Add a Publisher With Key and Certificate
Add a new publisher example.com, with a secure repository located at https://secure.example.com/repo, and a key and certificate stored in the directory /root/creds.

```
$ pkg set-publisher -k /root/creds/example.key \ -c /root/creds/example.cert -g https://secure.example.com/repo \ example.com
```

EXAMPLE 15  Add and Automatically Configure a Publisher
Add a new publisher with a repository located at /export/repo using automatic configuration.
EXAMPLE 15  Add and Automatically Configure a Publisher  

$ pkg set-publisher -p /export/repo

EXAMPLE 16  Add and Manually Configure a Publisher  
Add a new publisher example.com with a repository located at /export/repo/example.com using manual configuration.  

$ pkg set-publisher -g /export/repo example.com

EXAMPLE 17  Add a Publisher and Configure a Proxy  

$ pkg set-publisher -g http://server/repo \   --proxy http://webcache:8080 mypub

EXAMPLE 18  Verify All Signed Packages  
Configure an image to verify all signed packages.  

$ pkg set-property signature-policy verify

EXAMPLE 19  Require All Packages To Be Signed  
Configure an image to require all packages to be signed, and require the string example.com to be seen as a common name for one of the certificates in the chain of trust.  

$ pkg set-property signature-policy require-names example.com

EXAMPLE 20  Require All Packages From a Specified Publisher To Be Signed  
Configure an image so that all packages installed from publisher example.com must be signed.  

$ pkg set-publisher --set-property signature-policy=require-signatures \   example.com

EXAMPLE 21  Require a Specified String in the Chain of Trust  
Add the string foo to the image's list of common names that must be seen in a signature's chain of trust to be considered valid.  

$ pkg add-property-value signature-require-names foo

EXAMPLE 22  Remove a String From the Chain of Trust for a Specified Publisher  
Remove the string foo from the list of common names that must be seen to validate a signature for the publisher example.com.  

$ pkg set-publisher --remove-property-value signature-require-names=foo \   example.com
EXAMPLE 23  Add a Trusted CA Certificate

Add the certificate stored in /tmp/example_file.pem as a trusted CA certificate for the
publisher example.com.

$ pkg set-publisher --approve-ca-cert /tmp/example_file.pem \ example.com

EXAMPLE 24  Revoke a Certificate

Revoke the certificate with the hash a12345 for publisher example.com, preventing the
certificate from validating any signatures for packages from example.com.

$ pkg set-publisher --revoke-ca-cert a12345 example.com

EXAMPLE 25  Forget About a Certificate

Make pkg forget that the certificate a12345 was ever added or revoked by the user.

$ pkg set-publisher --unset-ca-cert a12345 example.com

EXAMPLE 26  Downgrade a Package

Downgrade the installed package foo@1.1 to an older version.

$ pkg update foo@1.0

EXAMPLE 27  Switch Conflicting Package Installation

In the case of two conflicting packages, change which package is installed. Suppose package A
depends on either package B or package C, and B and C are mutually exclusive. If A and B are
installed, use the following command to switch to using C instead of B without uninstalling A:

$ pkg install --reject B C

EXAMPLE 28  List Packages in a Package Archive

List all versions of all packages in a package archive.

$ pkg list -f -g /my/archive.p5p

EXAMPLE 29  List Packages in a Package Repository

List all versions of all packages in a repository.

$ pkg list -f -g http://example.com:10000

EXAMPLE 30  Display Information About a Package in a Package Archive

Display the package information for the latest version of a package in a package archive. The
package might or might not be currently installed.

$ pkg info -g /my/archive.p5p pkg_name
EXAMPLE 31  Display Contents of a Package in a Package Archive

Display the contents of a package in a package archive. The package is not currently installed.

$ pkg contents -g /my/archive.p5p pkg_name

EXAMPLE 32  Remove All Publisher Origins and Mirrors

Remove all of the origins and mirrors for a publisher and add a new origin.

$ pkg set-publisher -G '*' -M '*' -g http://example.com:10000 \\
example.com

Environment Variables

PKG_IMAGE
  The directory containing the image to use for package operations. Ignored if -R is specified.

PKG_CLIENT_CONNECT_TIMEOUT
  Seconds to wait trying to connect during transport operations (for each attempt) before the client aborts the operation. A value of 0 means wait indefinitely.

  Default value: 60

PKG_CLIENT_LOWSPEED_TIMEOUT
  Seconds below the lows speed limit (1024 bytes/sec) during transport operations before the client aborts the operation. A value of 0 means do not abort the operation.

  Default value: 30

PKG_CLIENT_MAX_CONSECUTIVE_ERROR
  Maximum number of transient transport errors before the client aborts the operation. A value of 0 means do not abort the operation.

  Default value: 4

PKG_CLIENT_MAX_REDIRECT
  Maximum number of HTTP or HTTPS redirects allowed during transport operations before a connection is aborted. A value of 0 means do not abort the operation.

  Default value: 5

PKG_CONCURRENCY
  The number of child images to update in parallel. Ignored if the -C option is specified.

  When recursing into child images (usually zones), update at most $PKG_CONCURRENCY child images in parallel. If $PKG_CONCURRENCY is 0 or a negative number, all child images are updated in parallel.

  Default value: 1

PKG_CLIENT_MAX_TIMEOUT
  Maximum number of transport attempts per host before the client aborts the operation. A value of 0 means do not abort the operation.
Default value: 4

http_proxy, https_proxy
HTTP or HTTPS proxy server.

**Exit Status** The following exit values are returned:

0  Command succeeded.
1  An error occurred.
2  Invalid command line options were specified.
3  Multiple operations were requested, but only some of them succeeded.
4  No changes were made - nothing to do.
5  The requested operation cannot be performed on a live image.
6  The requested operation cannot be completed because the licenses for the packages being installed or updated have not been accepted.
7  The image is currently in use by another process and cannot be modified.
99  An unanticipated exception occurred.

**Files** A pkg(5) image can be located arbitrarily within a larger file system. In the following file descriptions, the token $IMAGE_ROOT is used to distinguish relative paths. For a typical system installation, $IMAGE_ROOT is equivalent to /

$IMAGE_ROOT/var/pkg
Metadata directory for a full or partial image.

$IMAGE_ROOT/.org.opensolaris.pkg
Metadata directory for a user image.

Within a particular image's metadata, certain files and directories can contain information useful during repair and recovery. The token $IMAGE_META refers to the top-level directory containing the metadata. $IMAGE_META is typically one of the two paths given above.

$IMAGE_META/lost+found
Location of conflicting directories and files moved during a package operation. Location of unpackaged contents of a removed directory.

$IMAGE_META/publisher
Contains a directory for each publisher. Each directory stores publisher-specific metadata.

Other paths within the $IMAGE_META directory hierarchy are private and are subject to change.

**Attributes** See attributes(5) for descriptions of the following attributes:
### pkg(1)

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>package/pkg</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Uncommitted</td>
</tr>
</tbody>
</table>

**See Also**  
pkgsend(1), pkg.depotd(1M), glob(3C), pkg(5), beadm(1M)

http://hub.opensolaris.org/bin/view/Project+pkg/
pkgdepend – Image Packaging System dependency analyzer

Synopsis
/usr/bin/pkgdepend [options] command [cmd_options] [operands]
/usr/bin/pkgdepend generate [-IMm] [-d dir] [-d dir]
[-D name=value] [-k path] manifest_file
/usr/bin/pkgdepend resolve [-moSv] [-d output_dir]
[-s suffix] manifest_file ...

Description
The pkgdepend command generates and resolves dependencies for packages. A package might depend on files from other packages. The pkgdepend command is typically used in two passes: file dependency generation and file-to-package resolution.

The generate subcommand examines the content of a package and determines what external files the package needs.

The resolve subcommand takes the list of files from the generate step, and searches a reference set of packages to determine the names of the packages that contain those dependent files. The reference set of packages that are searched for the dependent files are the packages that are currently installed on the publisher’s system.

Several components of delivered files are used as sources of dependency information:

ELF    ELF headers in delivered files are analyzed for dependency information, with the -k and -D options modifying the information obtained. For more details on ELF dependencies, see ldd and the Linker and Libraries Guide.

Scripts  Shell scripts that contain #! lines referencing an interpreter result in a dependency on the package that delivers that interpreter.

Python  Python scripts are first analyzed as scripts. In addition, any imports the script declares might also serve as sources of dependency information.

Hard links  Hard links in manifests result in a dependency on the package that delivers the link target.

SMF    Delivered SMF service manifests that include require_all dependencies result in dependencies on the packages that deliver the SMF manifests that provide those FMRIs.

Options
The following options are supported:

-?
--help
Display a usage message.

-R dir
--image -dir dir
Operate on the image rooted at dir. If no directory was specified or determined based on environment, the default is /. See the "Environment Variables" section for more
information.

Sub-commands

The following subcommands are supported:

pkgdepend generate [-IMm] [-d dir] [-D name=value] [-k path] manifest_file

Produce the dependencies on files of the manifest specified by manifest_file.

-I
Show the dependencies that are satisfied within manifest_file. Do not use the result of -I with pkgdepend resolve.

-M
Display a list of file types that could not be analyzed.

-m
Repeat the original manifest with any discovered dependencies added after.

-d dir
Add dir to a list of directories to search for the manifest's files.

-D name=value
Add the value as a way to expand the token name in run paths for ELF file dependencies.

-k path
Add the path to the list of run paths to search for kernel modules. Using the -k option removes the default paths, which are /kernel and /usr/kernel.

Run paths such as those specified by the -k option can also be specified per action or per manifest by using the action or manifest attribute pkg.depend.runpath. The value of the pkg.depend.runpath attribute is a colon-separated string of the paths to use. Setting any pkg.depend.runpath attributes in the manifest or action overrides paths specified with the -k option.

The special token $PKGDEPEND_RUNPATH can be used as one component of the pkg.depend.runpath attribute value in order to include the standard system run path for the file being analyzed.

In some cases, you might want to prevent automatic generation of dependencies. For example, if a package delivers a sample Python script that imports a set of modules, those modules imported by the sample script are not dependencies for the package that delivers the sample script. Use the action or manifest attribute pkg.depend.bypass-generate to prevent generating dependencies against the specified files.

The pkg.depend.bypass-generate values are Python regular expressions that match file names. The regular expressions are implicitly anchored at the start and end of the file path. The value given in the following example matches this/that but does not match something/this/that/the/other.

pkg.depend.bypass-generate=this/that
For more information about Python regular expression syntax, use the command `pydoc re` or see more complete documentation at http://docs.python.org/dev/howto/regex.html.

When `pkgdepend generate` input manifests contain SMF manifest files, any SMF services or instances declared by those SMF manifest files are included in the `pkgdepend` output. These SMF services or instances are included in the form of a set action with the name `org.opensolaris.smf.fMRI`.

`pkgdepend resolve [-moSv] [-d output_dir] [-s suffix] manifest_file ...`
Transform dependencies on files into dependencies on the packages that deliver those files. Dependencies are first resolved against the manifests given on the command line and then against the packages installed on the system. By default, the dependencies for each manifest are placed in a file named `manifest_file.res`.

- `m`
  Repeat the manifest, with any dependencies produced by the `generate` step removed, before adding the resolved dependencies.

- `o`
  Write the results to standard output. This option is intended for human consumption. Appending this output to a file might result in an invalid manifest. The `-d` or `-s` options are strongly recommended instead of `-o` for use in a pipeline for manifest processing.

- `d output_dir`
  Write the resolved dependencies for each manifest provided in a separate file in `output_dir`. By default, each file has the same base name as the manifest that was the source of the dependencies written to that file.

- `s suffix`
  For each output file, append `suffix` to the base name of the file that was the source of the resolved dependencies. If `suffix` is not `.suffix`, a period (.) is prepended to `suffix`.

- `S`
  Only resolve against the manifests given on the command line and not against the manifests installed on the system.

- `v`
  Include additional package dependency debugging metadata.

**Examples**

**EXAMPLE 1 Generate Dependencies**

Generate the dependencies for the manifest written in `foo`, whose content directory is in `.bar/baz`, and store the results in `foo.fdeps`.

```
$ pkgdepend generate -d .bar/baz foo > foo.fdeps
```
EXAMPLE 2  Resolve Dependencies

Resolve the file dependencies in foo. fdeps and bar. fdeps against each other and against the packages currently installed on the system.

```
$ pkgdepend resolve foo.fdeps bar.fdeps
$ ls *.res
foo.fdeps.res  bar.fdeps.res
```

EXAMPLE 3  Generate and Resolve Dependencies For Two Manifests

Generate the file dependencies for two manifests (foo and bar) and retain all the information in the original manifests. Then resolve the file dependencies and place the resulting manifests in ./res. These resulting manifests can be used with pkgsend publish.

```
$ pkgdepend generate -d /proto/foo -m foo > ./deps/foo
$ pkgdepend generate -d /proto/bar -m bar > ./deps/bar
$ pkgdepend resolve -m -d ./res ./deps/foo ./deps/bar
$ ls ./res
foo  bar
```

EXAMPLE 4  Add Values To Tokens For ELF File Dependencies

Replace all PLATFORM tokens in the run paths in ELF files with sun4v and sun4u while generating the dependencies for the manifest written in foo whose content directory is in ./.

```
$ pkgdepend generate -d / -D 'PLATFORM=sun4v' -D 'PLATFORM=sun4u' foo
```

EXAMPLE 5  Specify a Kernel Module Directory

Specify /kmod as the directory in which to find kernel modules when generating the dependencies for the manifest written in foo whose content directory is in ./.

```
$ pkgdepend generate -d / -k /kmod foo
```

EXAMPLE 6  Bypass Dependency Generation

Append opt/python to the standard Python run path for a given Python script, and bypass dependency generation against all Python modules called test for a file delivered as opt/python/foo/file.py.

Avoid generating dependencies against any file delivered in usr/lib/python2.6/vendor-packages/xdg.

```
$ cat manifest.py
set name=pkg.fmri value=pkg:/mypackage@1.0,1.0
set name=pkg.summary value="My test package"
dir path=opt mode=0755 group=sys owner=root
dir path=opt/python mode=0755 group=sys owner=root
dir path=opt/python/foo mode=0755 group=sys owner=root
file NOHASH path=opt/python/__init__.py mode=0644 group=sys owner=root
file NOHASH path=opt/python/foo/__init__.py mode=0644 group=sys owner=root
```
EXAMPLE 6  Bypass Dependency Generation  (Continued)

# Add runpath and bypass-generate attributes:
#
file NOHASH path=opt/python/foo/file.py mode=0644 group=sys owner=root \
    pkg.depend.bypass-generate=.*/test.py.* \
    pkg.depend.bypass-generate=.*/testmodule.so \n
pkg.depend.runpath=$PKGDEPEND_RUNPATH:/opt/python

$ pkgdepend generate -d proto manifest.py

Environment Variables

PKG_IMAGE  Specifies the directory that contains the image to use for package operations. This value is ignored if -R is specified.

Exit Status  The following exit values are returned:

0  Everything worked.
1  An error occurred.
2  Invalid command line options were specified.
99  An unanticipated exception occurred.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>package/pkg</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Uncommitted</td>
</tr>
</tbody>
</table>

See Also  pkg(5)

http://hub.opensolaris.org/bin/view/Project+pkg/
**Name**

pkgdiff – compare package manifests

**Synopsis**

```
/usr/bin/pkgdiff [-i attribute ...] [-o attribute]
[-v name=value ...] file1 file2
```

**Description**

pkgdiff compares two package manifests and reports differences. pkgdiff sorts each manifest and action into a consistent order before comparison.

Output is in the following form:

```
+ complete_action
  This action is in file2 but not in file1.

- complete_action
  This action is in file1 but not in file2.

actionname  keyvalue  [variant values, if any]
- attribute1=value1
  This attribute, value is in file1 but not in file2.

+ attribute2=value2
  This attribute, value is in file2 but not in file1.
```

Actions with different variants but the same type and key attribute value are treated as separate actions for purposes of comparison. Thus, actions that change attributes are shown in their complete form rather than as attribute changes.

**Options**

The following options are supported:

- `-h` or `--help`
  Display a usage message.

- `-i attribute`
  Ignore attribute if present during comparisons. File hash values can be ignored with `-i hash`. This option cannot be used with the `-o` option. This option can be repeated.

- `-o attribute`
  Only report differences in attribute. This option cannot be used with the `-i` option. This option elides any action changes that do not affect attribute on an action.

- `-v name=value`
  Only compute differences for this variant value. For example, only compute differences for `arch=sparc`. This variant tag is removed for all actions before comparison. Only one value can be specified per variant. This option can be repeated for different variants.

**Exit Status**

The following exit values are returned:

```
0  No differences were found.
1  Differences were found.
>1 An error occurred.
```
An unanticipated exception occurred.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
<tr>
<td>Interface Stability</td>
<td>Uncommitted</td>
</tr>
</tbody>
</table>

See Also  pkg(5)

http://hub.opensolaris.org/bin/view/Project+pkg/
pkgfmt – format a package manifest

/usr/bin/pkgfmt [-c|-d|-u] [package-manifest-file]

pkgfmt without the -c or -d options formats a package manifest in a consistent manner, including wrapping lines at 80 characters, sorting actions by type, and sorting attributes. Lines that do not parse into actions (such as macros, comments, or transforms) do not appear in sorted order.

If no arguments are given, pkgfmt reads stdin until EOF, and then writes the formatted manifest to stdout. Any manifests specified on the command line are formatted in place.

pkgfmt with the -c option checks whether the manifests are formatted in pkgfmt style. The -d option displays the differences if the file is not properly formatted.

The following options are supported:

-?  Display a usage message.
--help  Display a usage message.
-c   Check whether the manifest is formatted in the pkgfmt style.
-d   Display manifest differences from the formatted version in unified form.
-u   Do not wrap lines at 80 characters. This option is useful for applying traditional text processing tools to package manifests.

The following exit values are returned:

0  Command succeeded.
1  The -c or -d options were specified, and one or more manifests are not in pkgfmt normal form, or an error occurred.
2  Invalid command line options were specified.
99  An unanticipated exception occurred.

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>package/pkg</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Uncommitted</td>
</tr>
</tbody>
</table>

pkg(5)

http://hub.opensolaris.org/bin/view/Project+pkg/
pkginfo(1)

Name  pkginfo – display software package information

Synopsis  pkginfo [-q | -x | -l] [-p | -i] [-r] [-a arch]
           [-v version] [-c category] ... [pkginst] ...
           pkginfo -d device [-R root_path] [-q | -x | -l] [-a arch]
           [-v version] [-c category] ... [pkginst] ...

Description  pkginfo displays information about software packages that are installed on the system (with
the first synopsis) or that reside on a particular device or directory (with the second synopsis).
Without options, pkginfo lists the primary category, package instance, and the names of all
completely installed and partially installed packages. It displays one line for each package
selected.

Options  The -p and -i options are meaningless if used in conjunction with the -d option.
The options -q, -x, and -l are mutually exclusive.

-a arch
   Specify the architecture of the package as arch.

-c category
   Display packages that match category. Categories are defined with the CATEGORY parameter
   in the pkginfo(4) file. If more than one category is supplied, the package needs to match
   only one category in the list. The match is not case specific.

-d device
   Defines a device, device, on which the software resides. device can be an absolute directory
   pathname or the identifiers for tape, removable disk, and so forth. The special token spool
   may be used to indicate the default installation spool directory (/var/spool/pkg).

-l
   Display information for fully installed packages only.

-l
   Specify long format, which includes all available information about the designated
   package(s).

-p
   Display information for partially installed packages only.

-q
   Do not list any information. Used from a program to check whether or not a package has
   been installed.

-r
   List the installation base for relocatable packages.

-R root_path
   Defines the full path name of a directory to use as the root_path. All files, including package
   system information files, are relocated to a directory tree starting in the specified root_path.
-v version
Specify the version of the package as version. The version is defined with the VERSION parameter in the pkginfo(4) file. All compatible versions can be requested by preceding the version name with a tilde (=). Multiple white spaces are replaced with a single white space during version comparison.

-x
Designate an extracted listing of package information. The listing contains the package abbreviation, package name, package architecture (if available) and package version (if available).

Operands pkginst
A package designation by its instance. An instance can be the package abbreviation or a specific instance (for example, inst.1 or inst.2). All instances of a package can be requested by inst.*. The asterisk character (*) is a special character to some shells and may need to be escaped. In the C-Shell, "*" must be surrounded by single quotes (') or preceded by a backslash (\).

Exit Status 0
Successful completion.

>0
An error occurred.

Files /var/spool/pkg
default installation spool directory

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also pkgtrans(1), pkgadd(1M), pkgask(1M), pkgchk(1M), pkgrm(1M), pkginfo(4), attributes(5), largefile(5)

Application Packaging Developer's Guide

Notes Package commands are largefile(5)-aware. They handle files larger than 2 GB in the same way they handle smaller files. In their current implementations, pkgadd(1M), pkgtrans(1) and other package commands can process a data stream of up to 4 GB.
**Name**
pkglint – Image Packaging System package lint

**Synopsis**
/usr/bin/pkglint [-c cache_dir] [-r repo_uri] [-p regexp]
[-f config_file] [-b build_no] [-v]
[-l lint_uri] [-m manifest]

/usr/bin/pkglint -L [-v]

**Description**
pkglint runs a series of checks on one or more package manifests, optionally referencing another repository.

pkglint should be used during the package authoring process, prior to package publication. pkglint performs exhaustive testing on the manifests that might be too expensive to perform during normal operation of pkgsend or pkg.depotd. pkglint checks include tests for duplicate actions, missing attributes, and unusual file permissions.

Manifests for linting can be passed as a space-separated list of local files on the command line, or manifests can be retrieved from a repository.

When retrieving manifests from repositories, on first run pkglint creates and populates pkg(5) user images in the specified cache directory. If the -r option is supplied, a user image named cache_dir/ref_image is created for the reference repository. If the -l option is supplied, a user image named cache_dir/lint_image is created for the lint repository. No content is installed in these images. These images are only used by pkglint to retrieve manifests from the repositories.

Subsequent invocations of pkglint can reuse the cache directory and can omit any -r or -l arguments.

pkglint provides limited support for configuring publishers in the cache directory. Use pkg to perform more complex publisher configuration on these images.

pkglint allows package authors to bypass checks for a given manifest or action. A manifest or action that contains the attribute pkg.linted set to True does not produce any lint output for that manifest or action.

More granular pkg.linted settings can be made using substrings of pkglint check names. For example, pkg.linted.check.id set to True bypasses all checks with the name check.id for the given manifest or action.

The behavior of pkglint can be configured by specifying apkglintrc file. By default, pkglint searches in /usr/share/lib/pkg/pkglintrc and $HOME/.pkglintrc for configuration options. Use the -f option to specify a different configuration file.

During the lint run, any errors or warnings encountered are printed to stderr.
Options

The following options are supported:

- **h**
  - **--help**
    - Display a usage message.

- **b build_no**
  - Specify a build number used to narrow the list of packages used during linting from lint and reference repositories. If no -b option is specified, the latest versions of packages are used. See also the version.pattern configuration property.

- **c cache_dir**
  - Specify a local directory used for caching package metadata from the lint and reference repositories.

- **l lint_uri**
  - Specify a URI representing the location of the lint repository. Both HTTP and file system based publication are supported. If you specify -l, then you must also specify -c.

- **L**
  - List the known and excluded lint checks and then exit. Display the short name and description of each check. When combined with the -v flag, display the method that implements the check instead of the description.

- **f config_file**
  - Configure the pkglint session using the config_file configuration file.

- **p regexp**
  - Specify a regular expression used to narrow the list of packages to be checked from the lint repository. All manifests from the reference repository are loaded (assuming they match the value for -b, if supplied), ignoring this pattern.

- **r repo_uri**
  - Specify a URI representing the location of the reference repository. If you specify -r, then you must also specify -c.

- **v**
  - Run pkglint in a verbose mode, overriding any log_level settings in the configuration file.

Files

The pkglint rc configuration file takes the following key/value arguments:

- **log_level**
  - The minimum level at which to emit lint messages. Lint messages lower than this level are discarded. The default value is INFO.
  - Log levels in order of least to most severe are DEBUG, INFO, WARNING, ERROR, and CRITICAL.

- **do_pub_checks**
  - If True, perform checks that might only make sense for published packages. The default value is True.
pkglint.ext.*
The plugin mechanism of pkglint allows for additional lint modules to be added at runtime. Any key that starts with pkglint.ext. takes a value that must be a fully-specified Python module. See the “Developers” section for more information.

pkglint.exclude
A space-separated list of fully specified Python modules, classes, or function names to omit from the set of checks performed.

use_progress_tracker
If True, use a progress tracker when iterating over manifests during lint runs. The default value is True.

version.pattern
A version pattern, used when specifying a build number to lint against (-b). If not specified in the configuration file, the -b option uses the pattern *,5.11-0., matching all components of the 5.11 build, with a branch prefix of 0.

Developers
To extend the set of checks performed by pkglint, subclass pkg.lint.base.Checker and its subclasses, ManifestChecker, ActionChecker, and ContentChecker. Add the Python module name that contains those classes to a new pkglint.ext. key in the configuration file.

Instances of those new subclasses are created by pkglint on startup. Methods inside each subclass with the special keyword argument pkglint_id are invoked during the course of the lint session. Those methods should have the same signature as the corresponding check() method in the superclass. Methods should also be assigned a pkglint_desc attribute, which is used as the description printed by pkglint -L.

Parameters are available to Checker subclasses, allowing them to tune their behavior. The recommended parameter naming convention is pkglint_id.name. Parameter values can be stored in the configuration file, or accessed in manifests or actions retrieved using the LintEngine.get_param() method. When accessing parameters from the manifest, the prefix pkg.lint is prepended to the key name to ensure that pkglint parameters do not overlap with any existing action or manifest values.

Examples
EXAMPLE 1 First Run on a Particular Repository
Running a pkglint session for the first time on a given repository.

$ pkglint -c /space/cache -r http://localhost:10000 mymanifest.mf

EXAMPLE 2 Subsequent Run on the Same Repository
A subsequent run against the same repository used in Example 1.

$ pkglint -c /space/cache mymanifest-fixed.mf

EXAMPLE 3 Using a Lint Repository With a Narrowed Manifest Set
Running a pkglint session with a lint repository and specifying a subset of manifests to check.
EXAMPLE 3  Using a Lint Repository With a Narrowed Manifest Set  *Continued*

$ pkglint -c /space/othercache -l http://localhost:10000 \ 
-p '.*firefox.*'

EXAMPLE 4  Specifying a Build
Running a pkglint session against a given build in verbose mode.

$ pkglint -c /space/cache -r http://localhost:10000 \ 
-1 http://localhost:12000 -b 147 -v

EXAMPLE 5  Modifying a Configuration File
A configuration file with a new lint module, excluding some checks.

$ cat ~/.pkglintrc

```
[pkglint]
log_level = DEBUG
# log_level = INFO

pkglint.ext.mycheck = org.timf.mychecks
pkglint.ext.opensolaris = pkg.lint.opensolaris
pkglint.exclude: pkg.lint.opensolaris.OpenSolarisActionChecker
pkg.lint.pkglint.PkgActionChecker.unusual_perms pkg.lint.pkglint.PkgManifestChecker
pkg.lint.opensolaris.OpenSolarisManifestChecker
```

**Exit Status**  The following exit values are returned:

0  Command succeeded.
1  One or more lint checks emitted output.
2  Invalid command line options were specified.
99  An unanticipated exception occurred.

**Attributes**  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>package/pkg</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Uncommitted</td>
</tr>
</tbody>
</table>

**See Also**  pkg(1), pkg.depotd(1M), pkgsend(1), pkg(5)

http://hub.opensolaris.org/bin/view/Project+pkg/
pkgmerge

pkgmerge – Image Packaging System package merging utility

Synopsis
/usr/bin/pkgmerge [-n] -d dest_repo
    -s variant=value[, ...],src_repo ...
    {pkg_fmri_pattern ...}

Description
pkgmerge is a package publication tool for creating multi-variant packages. It does this by
merging packages with identical names and versions (excluding time stamp), tagging actions
that are unique in the versions being merged with the specified variant name and value for the
given source, and then publishing the new packages to the target repository. Only the newest
version of every package from each source is used.

If an action has the attribute pkg.merge.blend set to the name of the variant being merged,
that action is copied to the other manifests prior to merging so that the action appears without
any added variant tags in the final output. Note that the attribute pkg.merge.blend itself is
removed from any actions in the output manifest. This attribute can be repeated with different
values for multiple pass merges.

Non-identical actions that deliver to the same path in an input manifest result in pkgmerge
exiting with an error.

Options
The following options are supported:

-?
- -help
    Display a usage message.

- d dest_repo
    Specify the file system path or URI of the target repository to publish the merged packages
to. The target repository must already exist. New repositories can be created using pkgrepo.

- n
    Perform a trial run with no changes made to the target repository.

- s variant=value[, ...],src_repo ...
    Specify the variant name and value to use for packages from this source, followed by the file
    system path or URI of the source repository or package archive to retrieve packages from.
    Multiple variants can be specified separated by commas. The same variants must be named
    for all sources. This option can be specified multiple times.

Environment
Variables
The following environment variable is supported:
TMPDIR
    The absolute path of the directory where temporary data should be stored during
    program execution. If not set, the default is to store temporary data in /var/tmp.

Examples
EXAMPLE 1 Specify Variant Name and Value
Tag each package found in the specified source with the given variant name and value
specified for the source it was retrieved from:
EXAMPLE 1  Specify Variant Name and Value  (Continued)

```
pkgmerge -s arch=sparc,http://src.example.com -d http://dest.example.com
```

Sample package:

```
set name=pkg.fmri value=pkg://example.com/foo@5.11,5.11-0.200:20381001T163427Z
dir group=sys mode=0755 owner=root path=usr
```

Sample package after operation:

```
set name=pkg.fmri value=pkg://example.com/foo@5.11,5.11-0.200:20381001T163427Z
set name=variant.arch value=sparc
dir group=sys mode=0755 owner=root path=usr
```

EXAMPLE 2  Merge and Publish Packages

Merge the newest version of each package from the given sources and publish the new packages to the target repository:

```
pkgmerge -s arch=sparc,http://src1.example.com
-s arch=i386,http://src2.example.com
-d /path/to/target/repository
```

Sample package from source 1 (SPARC):

```
set name=pkg.fmri value=pkg://example.com/foo@5.11,5.11-0.200:20381001T121410Z
file id mode=0555 owner=root group=bin path=usr/bin/foo
dir group=sys mode=0755 owner=root path=usr
```

Sample package from source 2 (i386):

```
set name=pkg.fmri value=pkg://example.com/foo@5.11,5.11-0.200:20381001T163427Z
file id mode=0555 owner=root group=bin path=usr/bin/foo
dir group=sys mode=0755 owner=root path=usr
```

Merged package:

```
set name=pkg.fmri value=pkg://example.com/foo@5.11,5.11-0.200:20381001T163427Z
set name=variant.arch value=sparc value=i386
file id mode=0555 owner=root group=bin path=usr/bin/foo variant.arch=sparc
file id mode=0555 owner=root group=bin path=usr/bin/foo variant.arch=i386
dir group=sys mode=0755 owner=root path=usr
```

EXAMPLE 3  Merge Debug and Non-Debug Packages for i386 and SPARC Systems

Merge the newest version of each package in a set of debug and non-debug repositories for i386 and SPARC systems:
EXAMPLE 3  Merge Debug and Non-Debug Packages for i386 and SPARC Systems  (Continued)

$ pkgmerge -s arch=sparc,debug=false, /repo/sparc-nondebug \
-s arch=sparc,debug=true, /repo/sparc-debug \
-s arch=i386,debug=false, /repo/i386-nondebug \
-s arch=i386,debug=true, /repo/i386-debug \
-d /path/to/target/repository

Sample package from source 1 (SPARC non-debug):

set name=pkg.fmri value=pkg://example.com/foo@5.11,5.11-0.200:20381001T121410Z
file id mode=0555 owner=root group=bin path=usr/bin/foo
dir group=sys mode=0755 owner=root path=usr

Sample package from source 2 (SPARC debug):

set name=pkg.fmri value=pkg://example.com/foo@5.11,5.11-0.200:20381001T121411Z
file id mode=0555 owner=root group=bin path=usr/bin/foo
dir group=sys mode=0755 owner=root path=usr

Sample package from source 3 (i386 non-debug):

set name=pkg.fmri value=pkg://example.com/foo@5.11,5.11-0.200:20381001T163427Z
file id mode=0555 owner=root group=bin path=usr/bin/foo
dir group=sys mode=0755 owner=root path=usr

Sample package from source 4 (i386 debug):

set name=pkg.fmri value=pkg://example.com/foo@5.11,5.11-0.200:20381001T163428Z
file id mode=0555 owner=root group=bin path=usr/bin/foo
dir group=sys mode=0755 owner=root path=usr

Merged package:

set name=pkg.fmri value=pkg://example.com/foo@5.11,5.11-0.200:20381001T163428Z
set name=variant.arch value=sparc value=i386
set name=variant.debug value=false value=true
file id mode=0555 owner=root group=bin path=usr/bin/foo variant.arch=sparc variant.debug=false
file id mode=0555 owner=root group=bin path=usr/bin/foo variant.arch=sparc variant.debug=true
file id mode=0555 owner=root group=bin path=usr/bin/foo variant.arch=i386 variant.debug=false
file id mode=0555 owner=root group=bin path=usr/bin/foo variant.arch=i386 variant.debug=true
dir group=sys mode=0755 owner=root path=usr

EXAMPLE 4  Merge Using pkg.merge.blend

Merge packages for two architectures that do not collide, using the pkg.merge.blend attribute.

$ pkgmerge -s arch=sparc, http://src1/example.com \
-s arch=i386, http://src2.example.com \
-d /path/to/target/repository

1364          man pages section 1: User Commands • Last Revised 27 May 2012
EX A MP LE 4  Merge Using pkg.merge.blend  (Continued)

Sample package from source 1 (SPARC):

```
set name=pkg.fmri value=pkg://example.com/foo@5.11,5.11-0.200:20381001T121410Z
file 1d5eac1aab628317f9c088d21e4afda9c754bb76 mode=0555 owner=root \n    group=bin path=usr/bin/sparc/foo pkg.merge.blend=arch
file d285ada5f3cae14ea00e97a8d99bd3e357caadc0 mode=0555 owner=root \n    group=bin path=usr/bin/foo
dir group=sys mode=0755 owner=root path=usr
```

Sample package from source 2 (i386):

```
set name=pkg.fmri value=pkg://example.com/foo@5.11,5.11-0.200:20381001T163427Z
file a285ada5f3cae14ea00e97a8d99bd3e357cb0dca mode=0555 owner=root \n    group=bin path=usr/bin/i386/foo pkg.merge.blend=arch
file d285ada5f3cae14ea00e97a8d99bd3e357caadc0 mode=0555 owner=root \n    group=bin path=usr/bin/foo
dir group=sys mode=0755 owner=root path=usr
```

Merged package:

```
set name=pkg.fmri value=pkg://example.com/foo@5.11,5.11-0.200:20381001T163427Z
set name=variant.arch value=sparc value=i386
file d285ada5f3cae14ea00e97a8d99bd3e357caadc0 mode=0555 owner=root \n    group=bin path=usr/bin/foo
file a285ada5f3cae14ea00e97a8d99bd3e357cb0dca mode=0555 owner=root \n    group=bin path=usr/bin/i386/foo
file 1d5eac1aab628317f9c088d21e4afda9c754bb76 mode=0555 owner=root \n    group=bin path=usr/bin/sparc/foo
dir group=sys mode=0755 owner=root path=usr
```

**Exit Status**  The following exit values are returned:

- 0  Command succeeded.
- 1  An error occurred.
- 2  Invalid command line options were specified.
- 99  An unanticipated exception occurred.

**Attributes**  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>package/pkg</td>
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<tr>
<td>Interface Stability</td>
<td>Uncommitted</td>
</tr>
</tbody>
</table>
pkgmerge(1)

See Also  pkgrepo(1), pkg(5)

http://hub.opensolaris.org/bin/view/Project+pkg/
pkgmk – produce an installable package

pkgmk [-o] [-a arch] [-b base_src_dir] [-d device]
[-f prototype] [-l limit] [-p pstamp] [-r root_path]
[-v version] [variable=value]... [pkginst]

The pkgmk utility produces an installable package to be used as input to the pkgadd(1M) command. The package contents is in directory structure format.

The command uses the package prototype(4) file as input and creates a pkgmap(4) file. The contents for each entry in the prototype file is copied to the appropriate output location. Information concerning the contents (checksum, file size, modification date) is computed and stored in the pkgmap file, along with attribute information specified in the prototype file.

pkgmk searches for the files listed in the prototype(4) file as described in the following conditions. Note: If a prototype file contains the explicit location of the file to include in the package, then the following search explanations do not apply.

1. If neither -b nor -r options are specified, the file name component of each file path listed in the prototype(4) file is expected to be found in the same directory as the prototype(4) file
2. If -b is specified as a relative path (without a leading "/"), then base_src_dir is prepended to the relative file paths from the prototype(4) file. The resulting path is searched for in the root_path directories. If a root_path is not specified, it defaults to "/".
3. If -b is specified as an absolute path (with a leading "/"), then base_src_dir is prepended to the relative paths from the prototype(4) file and the result is the location of the file. root_path is not searched.
4. If -r is specified, then full file paths are used from the prototype(4) file. Relative paths have base_src_dir prepended. If base_src_dir is not specified, it defaults to "". The resulting path is searched for in each directory of the root_path.

If you created your prototype file using "pkgproto a/relative/path" or "pkgproto a/relative/path=install/path", you should use the -r root_path option to specify the location of a/relative/path so that pkgmk can correctly locate your source files.

Package commands, including pkgmk, are largefile(5)-aware. They handle files larger than 2 GB in the same way they handle smaller files. In their current implementations, pkgadd(1M), pkgtrans(1) and other package commands can process a datastream of up to 4 GB.

Options

The following options are supported:

- a arch Overrides the architecture information provided in the pkginfo(4) file with arch.
- b base_src_dir Prepends the indicated base_src_dir to locate relocatable objects on the source machine. Use this option to search for all objects in the prototype file. pkgmk expects to find the objects in /base_src_dir or to locate the objects by use of the -b and -r options, respectively.
-d device
  Creates the package on device. device can be an absolute directory
  pathname or the identifiers for a removable disk. The default device is the
  installation spool directory (/var/spool/pkg).

-t prototype
  Uses the file prototype as input to the command. The default prototype
  filename is [Pp]rototype.

-l limit
  Specifies the maximum size in 512 byte blocks of the output device as
  limit. By default, if the output file is a directory or a mountable device,
  pkgmk employs the df(1M) command to dynamically calculate the
  amount of available space on the output device. This option is useful in
  conjunction with pkgtrans(1) to create a package with a datastream
  format.

-o
  Overwrites the same instance; package instance is overwritten if it already
  exists.

-p pstamp
  Overrides the production stamp definition in the pkginfo(4) file with
  pstamp.

-r root_path
  Uses the indicated root_path with the source pathname appended to
  locate objects on the source machine, using a comma (,) as the separator
  for the path elements. If this option is specified, look for the full
  destination path in each of the directories specified. If neither -b nor -r is
  specified, look for the leaf filename in the current directory.

-v version
  Overrides the version information provided in the pkginfo(4) file with
  version.

variable=value
  Places the indicated variable in the packaging environment. (See
  prototype(4) for definitions of variable specifications.)

Operands
  The following operand is supported:

  pkginst
  A package designation by its instance. An instance can be the package
  abbreviation or a specific instance (for example, inst.1 or inst.2). All instances
  of a package can be requested by inst.*. The asterisk character (*) is a special
  character to some shells and might need to be escaped. In the C-Shell, * must be
  surrounded by single quotes (‘) or preceded by a backslash (\).

Exit Status
  The following exit values are returned:

  0    Successful completion.

  >0   An error occurred.

Attributes
  See attributes(5) for descriptions of the following attributes:
<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

**See Also**  
pkgparam(1), pkgproto(1), pkgtrans(1), uname(1), df(1M), pkgadd(1M), pkginfo(4), pkgmap(4), prototype(4), attributes(5), largefile(5)

*Application Packaging Developer's Guide*

**Notes**  
Architecture information is provided on the command line with the `-a` option or in the `prototype(4)` file. If no architecture information is supplied, pkgmk uses the output of `uname -m` (see `uname(1)`).

Version information is provided on the command line with the `-v` option or in the `pkginfo(4)` file. If no version information is supplied, a default based on the current date is provided.

Command line definitions for both architecture and version override the `prototype(4)` definitions.

pkgmk fails if one of the following invalid combinations of zone-related parameters is used:

1. Both `SUNW_PKG_ALLZONES` and `SUNW_PKG_THISZONE` are set to `TRUE`.
2. `SUNW_PKG_HOLLOW` is set to `TRUE` and `SUNW_PKG_ALLZONES` is set to `FALSE`.
3. The package contains a request script and `SUNW_PKG_THISZONE` set to `TRUE`.

For additional information regarding these parameters, see `pkginfo(4)`. 
### Name
pkgmogrify - Image Packaging System manifest transmogrifier

### Synopsis
/usr/bin/pkgmogrify [-vi] [-I includedir ...]
[-D macro=value ...] [-O outputfile]
[-P printfile] [inputfile ...]

### Description
pkgmogrify provides for programmatic editing of package manifests to simplify the typical transformations needed when automating software builds and package publication.

pkgmogrify provides the following:

- Macro replacement to facilitate sharing of a single manifest across various architectures and platforms.
- Inclusion of other manifests or manifest fragments such as standard components and transforms.
- Transformation of package actions, including the modification, deletion, or addition of action attributes.

### Options
The following options are supported:

- **-?**
  Display a usage message.

- **-D macro=value**
  Define *macro* as a macro, with the value *value*. Macros appear in the input file as $(macro)$. Substitution is repeated until no more translations are found. Common idioms include:
  
  - Elimination of lines in a manifest on other architectures by using an architecture-specific tag at the beginning of the line:
    $$ $(sparc_ONLY) file ... $$
    
    When processing the SPARC architecture, this macro would be set to the empty string. When processing other architectures, this macro would be set to # on the command line, thus eliminating this action from the manifest on the current architecture.
  
  - Specifying platform-specific portions of path names, such as the name of the 64-bit architecture directory for executables and libraries:
    ```
    file NOHASH path=usr/bin/$(ARCH64)/cputrack ...
    ```
    These macros should be set to the desired value on the command line. There are no predefined macro values.

- **-I includedir**
  Add the specified directory to the search path for both files specified on the command line and embedded include directives.
-O outputfile
Write manifest output to the specified file. The file is not written if an error occurs or if a
transform directive causes an abort operation. By default, manifest output is written to
stdout.

-P printfile
Write output resulting from transform directive print operations to the specified file. The
file is not written if an error occurs or if a transform directive causes an abort operation. By
default, print output is written to stdout.

-i
Ignore include directives in files. Only files specified on the command line (or stdin)
are processed.

-v
Write comments into the output manifest showing the effect of transforms. This
information can aid in debugging.

Embedded Directives
Two types of directives are supported in manifest files: include directives and transform
directives.

Include directives are of the form:
<include file>
This directive causes pkgmogrify to search for a file named file first in the current directory
and then in the directories specified with the -I option. If found, the contents of the file are
inserted into the manifest at the point at which the directive is encountered. If not found,
pkgmogrify exits with an error.

Transform directives are of the form:
<transform matching-criteria -> operation>
These directives are accumulated until all inputs have been read into memory, and then
applied to the actions in the order in which they were encountered.

Matching criteria are of the form:
[action-name ...] [attribute=<value-regexp> ...]
At least one specified action-name must match. Every specified attribute must match. Action
names and attributes are listed in “Actions” in the pkg(5) man page. The regular expression
syntax used is that of Python. For more information about Python regular expression syntax,
use the command pydoc re or see more complete documentation at
http://docs.python.org/dev/howto/regex.html. The regular expression is anchored at
the beginning but not at the end. Therefore, a regular expression matching files by their
extensions must include a leading .* and should include a trailing $.

Multiple criteria can be specified, separated by spaces.
The following operations are available:

- **add**: Add a value to an attribute. This operation takes two arguments. The first argument is the name of the attribute, and the second is the value.

- **default**: Set the value of an attribute if it doesn’t already exist. This operation takes the same two arguments as the add operation.

- **delete**: Remove attribute values. This operation takes two arguments. The first argument is the name of the attribute. The second argument is a regular expression to match the attribute values deleted. Unlike the regular expression used to match an action, this expression is unanchored.

- **drop**: Discards this action.

- **edit**: Modifies an attribute of the action. This operation takes three arguments. The first argument is the name of the attribute, and the second is a regular expression matching the attribute value. The third argument is the replacement string substituted for the portion of the value matched by the regular expression. Unlike the regular expression used to match an action, this expression is unanchored. Normal regular expression backreferences, of the form \1, \2, and so on, are available in the replacement string if groups are defined in the regular expression.

- **emit**: Emit a line to the manifest output stream. This must be a valid action string, empty (resulting in a blank line), or a comment (a # followed by arbitrary text).

- **exit**: Terminate manifest processing. No manifest is output and no print operations are applied. If one argument is given, it must be an integer, and it is used as the exit code. The default is 0. If two arguments are given, the first is the exit code, and the second is a message to be printed to stderr.

- **print**: Print a message to the output file specified with -P.

- **set**: Set the value of an attribute. This operation takes the same two arguments as the add operation.

All operations except for delete and drop take (possibly optional) arguments whose contents go to the output stream. These strings can contain three different kinds of special tokens which allow the output to contain information that is not based on a fixed transformation of each action.

The first kind of substitution allows the operation to refer to the values of attributes of the current action by putting the name of the attribute inside parentheses following a percent sign. For example, %\{alias\} refers to the value of the action’s alias attribute.
Several synthetic attributes exist. Two are unique to pkgmogrify:

- `pkg.manifest.filename` refers to the name of the file in which the action was found.
- `pkg.manifest.lineno` refers to the line on which the action was found.

Three synthetic attributes are similar to ones used in pkg:

- `action.hash` refers to the hash value of the action if the action carries a payload. For actions with payloads, the `set` operation can change the hash of the action by operating on the `action.hash` attribute.
- `action.key` refers to the value of the key attribute.
- `action.name` refers to the name of the action.

If the attribute whose value is requested does not exist, pkgmogrify exits with an error. To prevent exiting with an error, follow the attribute name with `;notfound=` and a value to substitute in place of the attribute value. For example, `%{alias;notfound='no alias'}` prints the value of the attribute `alias` if it exists, and prints `no alias` otherwise.

If the attribute whose value is requested is multi-valued, each value is printed, separated by spaces. Similarly to the `notfound` token, the tokens `prefix`, `suffix`, and `sep` can be used to change this behavior. The string denoted by `prefix` is prepended to each value, the string denoted by `suffix` is appended to each value, and `sep` is placed in between the suffix of one value and the prefix of the next.

Similarly to action attributes, pkgmogrify directives can reference package attributes using braces instead of parentheses: `%{pkg.fmri}`. At the point at which the transform directive is applied, the attribute must have been defined in a `set` action, or it is treated as `notfound`, described above. When the processing reaches the end of the manifest file describing the package, the attributes are cleared for the next package.

It is useful not only to reference package attributes as if they were action attributes, but also to match on them, and even temporarily modify them. Therefore a synthetic action name, `pkg`, is available (only in the context of pkgmogrify) for use in these situations.

When pkgmogrify finishes reading a manifest specified on the command line and that manifest defined a `pkg.fmri` package attribute, pkgmogrify creates this synthetic `pkg` action, whose attributes are the package’s attributes. A `<transform>` directive can then match on this action, just as it can match on any other action.

Operations on a `pkg` action are special in that they take place only in memory and do not directly affect the emitted manifest. For instance, trying to set an attribute on a `pkg` action via the `add`, `default`, or `set` operations does not result in a `set` action being added to the manifest, though it will be available for other `<transform>` directives to match on. Attempting to emit a `pkg` action causes an error. To add a package attribute, emit a `set` action instead.
The third kind of substitution is a backreference. This substitution is not like the ones usable in the \texttt{edit} operation, but is a reference to groups listed in the transformation match on the left-hand side of the ->. These are indicated by \texttt{%<1>}, \texttt{%<2>}, and so on, in the order seen in the matching criteria.

The order of processing is as follows:

1. Lines are read from input files.
2. Macros are applied.
3. \texttt{<include ...>} and \texttt{<transform>} directives are processed, causing additional files to be found and read.
4. Once all input has been accumulated, each line in the input is converted into actions and all transforms applied.
5. Once processing is complete and successful, the output is written.

\textbf{Examples}

\textbf{EXAMPLE 1} Add Tags To SMF Manifests

Add tags to Service Management Facility (SMF) manifests so they get imported when the package is installed on a live system.

\begin{verbatim}
<transform file path=(var|lib)/svc/manifest/.*\.xml -> \ 
  add restart_fmri svc:/system/manifest-import:default>
\end{verbatim}

\textbf{EXAMPLE 2} Move Files

Move files from \texttt{usr/sfw/bin} to \texttt{usr/bin}.

\begin{verbatim}
<transform file -> edit path usr/sfw/bin usr/bin>
\end{verbatim}

\textbf{EXAMPLE 3} Specify Reboot Needed

Add \texttt{reboot-needed} tags to files under \texttt{/kernel} that are not \texttt{.conf} files. Note that this example leverages how transforms are applied to each action in the order seen in the input files.

\begin{verbatim}
<transform file path=kernel/.* -> set reboot-needed true>
<transform file path=kernel/.*\.conf -> delete reboot-needed .*>
\end{verbatim}

This can also be done in a single transform rule with regular expressions.

\textbf{EXAMPLE 4} Convert FMRI Attribute To Depend Action

Convert the package attribute \texttt{pkg.fmri} into a \texttt{depend} action to become part of an incorporation.

\begin{verbatim}
<transform set name=pkg.fmri -> \ 
  emit depend type=incorporate fmri=%(value)>
<transform set name=pkg.fmri -> drop>
\end{verbatim}
EXAMPLE 5  Print a List of Bug Numbers
Print a comma-separated list of quoted and prefixed bug numbers.

```
set name=bugs value=12345 value=54321 value=13579 value=97531
<transform set name=bugs -> \n   print %%(value;sepe",";prefix="bug=';suffix="\n")>
```

EXAMPLE 6  Allow For Missing Attributes
Safely print a message even when an attribute is missing.

```
<transform driver -> print Found aliases: %%(alias;notfound=<none>)>
```

EXAMPLE 7  Set Default Values
Set default owner, group, and permission values.

```
<transform file dir -> default owner root>
<transform file dir -> default group bin>
<transform file -> default mode 0444>
<transform dir -> default mode 0755>
```

EXAMPLE 8  Add Dependencies To Packages That Are Not Marked Obsolete
For any package that is not marked obsolete, add a dependency on the incorporation for the consolidation that delivers the package. This set of transforms must occur after the manifest has been read in, or the dependency will always be emitted. Because modifying a pkg action has no permanent effect, there is no need to clean up attributes matching pkg.obsolete=false.

```
<transform pkg -> default pkg.obsolete false>
<transform pkg pkg.obsolete=false -> emit depend \n   fmri=consolidation/$(CONS)/$(CONS)-incorporation type=require>
```

EXAMPLE 9  Exit and Print a Message When an Error Is Found
Error out with a message when an obsolete attribute is found in a manifest.

```
<transform file dir link hardlink opensolaris.zone=.* -> \n   exit 1 The opensolaris.zone attribute is obsolete.>
```

EXAMPLE 10  Set the Appropriate Locale Facet
Set the locale facet appropriate for the path name under consideration.

```
<transform dir file link hardlink path=.*locale/{{["/]+}}.* -> \n   default facet.locale.%<1> true>
```

**Exit Status**  The following exit values are returned:

<table>
<thead>
<tr>
<th>Exit Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Everything worked.</td>
</tr>
</tbody>
</table>
Something bad but anticipated happened.
Invalid command line options were specified.
Unexpected processing error.

Files
/usr/share/pkg/transforms
This directory contains files with useful transforms to set facets, actuators, and other attributes.

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>package/pkg</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Uncommitted</td>
</tr>
</tbody>
</table>

See Also
pkg(1), pkg(5)

http://hub.opensolaris.org/bin/view/Project+pkg/
pkgparam – display package parameter values

Synopsis

pkgparam [-v] [-d device] [-R root_path] pkginst [param]...

pkgparam -f filename [-v] [param]...

Description

pkgparam displays the value associated with the parameter or parameters requested on the command line. The values are located in either the pkginfo(4) file for pkginst or from the specific file named with the -f option.

One parameter value is shown per line. Only the value of a parameter is given unless the -v option is used. With this option, the output of the command is in this format:

```plaintext
parameter1='value1'
parameter2='value2'
parameter3='value3'
```

If no parameters are specified on the command line, values for all parameters associated with the package are shown.

Options

Options and arguments for this command are:

- **-d device**  Specify the device on which a pkginst is stored. It can be a directory pathname or the identifiers for a tape or removable disk (for example, /var/tmp or /dev/dsk/c1d0s0). The special token spool may be used to represent the default installation spool directory (/var/spool/pkg).

- **-f filename**  Read filename for parameter values.

- **-R root_path**  Defines the full path name of a subdirectory to use as the root_path. All files, including package system information files, are relocated to a directory tree starting in the specified root_path.

- **-v**  Verbose mode. Display name of parameter and its value.

Operands

**pkginst**  Defines a specific package instance for which parameter values should be displayed.

**param**  Defines a specific parameter whose value should be displayed.

Errors

If parameter information is not available for the indicated package, the command exits with a non-zero status.

Exit Status

- **0**  Successful completion.

- **>0**  An error occurred.

Attributes

See attributes(5) for descriptions of the following attributes:
pkgparam(1)

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also pkgmk(1), pkgproto(1), pkgtrans(1), pkgadd(1M), pkginfo(4), attributes(5), largefile(5)

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Notes With the `-f` option, you can specify the file from which parameter values should be extracted. This file should be in the same format as a pkginfo(4) file. For example, such a file might be created during package development and used while testing software during this stage.

Package commands are largefile(5)-aware. They handle files larger than 2 GB in the same way they handle smaller files. In their current implementations, pkgadd(1M), pkgtrans(1) and other package commands can process a datastream of up to 4 GB.
**Name**  pkgproto – generate prototype file entries for input to pkgmk command

**Synopsis**  pkgproto [-i] [-c class] [path1]

pkgproto [-i] [-c class] [path1=path2]...

**Description**  pkgproto scans the indicated paths and generates prototype(4) file entries that may be used as input to the pkgmk(1) command.

If no paths are specified on the command line, standard input is assumed to be a list of paths. If the path name listed on the command line is a directory, the contents of the directory is searched. However, if input is read from stdin, a directory specified as a path name will not be searched.

Package commands, such as pkgproto, are largefile(5)-aware. They handle files larger than 2 GB in the same way they handle smaller files. In their current implementations, pkgadd(1M), pkgtrans(1) and other package commands can process a data stream of up to 4 GB.

**Options**  
- **-i**  Ignores symbolic links and records the paths as ftype=f (a file) versus ftype=s (symbolic link).

- **-c class**  Maps the class of all paths to class.

**Operands**  
**path1**  Pathname where objects are located.

**path2**  Pathname which should be substituted on output for path1.

**Examples**  
**EXAMPLE 1**  Basic Usage

The following example shows a common usage of pkgproto and a partial listing of the output produced.

```
example% pkgproto /bin=bin /usr/bin=usrbin /etc=etc
f none bin/sed=/bin/sed 0775 bin bin
f none bin/sh=/bin/sh 0755 bin daemon
f none bin/sort=/bin/sort 0755 bin bin
f none usrbinsdb=/usr/bin/sdb 0775 bin bin
f none usrbinshl=/usr/bin/shl 4755 bin bin
d none etc/master.d 0755 root daemon
d none etc/master.d/kernel=/etc/master.d/kernel 0644 root daemon
d none etc/rc=/etc/rc 0744 root daemon
```

**EXAMPLE 2**  Using pkgproto in a Pipeline

The following command shows pkgproto accepting the output of the find command.

```
example% find / -type d -print | pkgproto
d none / 755 root root
d none /bin 755 bin bin
d none /usr 755 root root
d none /usr/bin 775 bin bin
d none /etc 755 root root
```
EXAMPLE 2 Using pkgproto in a Pipeline (Continued)

d none /tmp 777 root root

Exit Status  

<table>
<thead>
<tr>
<th>Exit Status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful completion.</td>
</tr>
<tr>
<td>&gt;0</td>
<td>An error occurred.</td>
</tr>
</tbody>
</table>

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also pkgmk(1), pkgparam(1), pkgtrans(1), pkgadd(1M), prototype(4), attributes(5), largefile(5)

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Notes By default, pkgproto creates symbolic link entries for any symbolic link encountered (ftype=s). When you use the -i option, pkgproto creates a file entry for symbolic links (ftype=f). The prototype(4) file would have to be edited to assign such file types as v (volatile), e (editable), or x (exclusive directory). pkgproto detects linked files. If multiple files are linked together, the first path encountered is considered the source of the link.

By default, pkgproto prints prototype entries on the standard output. However, the output should be saved in a file (named Prototype or prototype, for convenience) to be used as input to the pkgmk(1) command.
pkgrecv - Image Packaging System content retrieval utility

Synopsis
/usr/bin/pkgrecv [-s src_uri] [-a] [-d (path|dest_uri)]
[-c cache_dir] [-k] [-m match] [-n] [-r] [-w]
[-y keyfile --cert certfile] (fmri|pattern) ...

Description
pkgrecv allows the user to retrieve packages from a pkg(5) repository or package archive. pkgrecv can also optionally republish the retrieved packages to a different package repository or archive them. By default, packages are retrieved in package repository format suitable for use with pkg, pkg.depotd, and package publication tools.

After a pkgrecv operation, run pkgrepo refresh or pkgrepo rebuild on the repository to build search indexes.

Options
The following options are supported:

\-h
Display a usage message.

\-a
Store the retrieved package data in a pkg(5) archive at the location specified by -d. The file cannot already exist. This option can be used only with file system based destinations. Although not required, using a file extension of .p5p (for example, archive.p5p) is strongly suggested. This option cannot be combined with \-r.

\-c cache_dir
Specify the path to a directory that will be used to cache downloaded content. If this directory is not supplied, the client automatically selects a cache directory. In the case where a download is interrupted, and a cache directory was automatically chosen, use this option to resume the download. See the “Environment Variables” section below for details about how to set the location used for temporary data storage.

\-d (path|dest_uri)
Specify the file system path or URI of the target to republish packages to. If -a is specified, the target is a new package archive that cannot already exist. Otherwise, the target must be a package repository that already exists. New repositories can be created using pkgrepo.

\-k
Keep the retrieved package content compressed. This option is ignored when republishing. Compressed package content should not be used with pkgsend.

\-m match
Control matching behavior using the following values:

all-timestamps
Includes all matching timestamps, not just the latest (implies all-versions).

all-versions
Includes all matching versions, not just the latest.
-n
Perform a trial run with no changes made.

-r
Recursively retrieve all dependencies for the provided list of packages.

-s src_uri
Specify a URI representing the location of a pkg(5) repository or package archive from which to receive package data.

--cert certfile
Specify a client SSL certificate file to use for package retrieval from an HTTPS repository.

--key keyfile
Specify a client SSL key file to use for package retrieval from an HTTPS repository.

--newest
List the most recent versions of the packages available from the specified repository and exit. (All other options except -s are ignored.)

--raw
Retrieve and store the raw package data in a set of directory structures by stem and version at the location specified by -d. This option can be used only with file system based destinations. This package data can be used to conveniently modify and republish packages, perhaps by correcting file contents or providing additional package metadata. This option cannot be combined with -a.

**Examples**

**EXAMPLE 1** List Newest Packages

List the newest packages available from the repository on the system named test.

```
$ pkgrecv -s http://test --newest
pkg://solaris/system/library/c++-runtime@0.5.11,5.11-0.175.0.0.0.2.1:20120921T190358Z
pkg://solaris/system/library/freetype-2@2.4.8,5.11-0.175.1.0.0.7.1234:20120109T215840Z
pkg://solaris/system/library/math@0.5.11,5.11-0.175.0.0.2.1:20120921T190432Z
```

**EXAMPLE 2** Retrieve Raw Package Data

Receive the c++-runtime package from Example 1 in a format suitable for use with pkgsend publish.

```
$ pkgrecv -s http://test \\
-d /local/repo --raw \\
c++-runtime@0.5.11,5.11-0.175.0.0.0.2.1:20120921T190358Z
Processing packages for publisher solaris ...
Retrieving and evaluating 1 package(s)...
PROCESS ITEMS GET (MB) SEND (MB)
Completed 1/1 3.5/3.5 0.0/0.0
$ ls /local/repo
pkg5.repository publisher system%2Flibrary%2Fc%2B%2B-runtime
```
EXAMPLE 3 Retrieve Dependencies From a System

Receive the package editor/vim and all of its dependencies from the system named test.

$ pkgrecv -s http://test -d /local/repo -r editor/vim

EXAMPLE 4 Retrieve All Versions

Receive all versions of the package editor/vim from the system named test.

$ pkgrecv -s http://test -d /local/repo -m all-versions editor/vim

Processing packages for publisher solaris ...
Retrieving and evaluating 2 package(s)...

<table>
<thead>
<tr>
<th>PROCESS</th>
<th>ITEMS</th>
<th>GET (MB)</th>
<th>SEND(MB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completed</td>
<td>2/2</td>
<td>16.7/16.7</td>
<td>44.9/44.9</td>
</tr>
</tbody>
</table>

EXAMPLE 5 Retrieve All Versions and Republish Remotely

Receive all versions of the package library/zlib from the system named test and republish it to a remote repository on the system named remote.

$ pkgrecv -s http://test -d http://remote:10000 -m all-versions library/zlib

EXAMPLE 6 Retrieve Dependencies From a Repository

Receive the package editor/gnu-emacs and all of its dependencies from the repository located at /export/repo.

$ pkgrecv -s /export/repo -d /local/repo -r editor/gnu-emacs

EXAMPLE 7 Retrieve Additional Packages and Changed Content

Receive all packages that do not already exist and all changed content from the repository located at http://pkg.oracle.com/solaris/release/ to the repository located at /export/repoSolaris11.

$ pkgrecv -s http://pkg.oracle.com/solaris/release/ -d /export/repoSolaris11 -m all-timestamps '*'

EXAMPLE 8 Create a Package Archive

Create a package archive containing the package editor/gnu-emacs and all of its dependencies from the repository located at http://example.com:10000.
EXAMPLE 8  Create a Package Archive  (Continued)

$ pkgrecv -s http://example.com:10000 -d /my/emacs.p5p -a \
        -r editor/gnu-emacs

EXAMPLE 9  Copy Packages From an Archive to a Repository

Copy all of the packages in a package archive to an existing repository located at /export/repo.

$ pkgrecv -s /my/archive.p5p -d /export/repo '*'

Environment Variables  The following environment variables are supported:

PKG_DEST  The path of a directory to save the retrieved package to, or the file system path or URI of a repository or package archive where the packages will be copied.

PKG_SRC  A URI or file system path representing the location of a pkg(5) repository or package archive from which to retrieve packages.

TMPDIR  The absolute path of the directory where temporary data should be stored during program execution. If not set, the default is to store temporary data in /var/tmp.

Exit Status  The following exit values are returned:

0  Command succeeded.
1  An error occurred.
2  Invalid command line options were specified.
3  Multiple operations were requested, but only some of them succeeded.
99  An unanticipated exception occurred.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>package/pkg</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Uncommitted</td>
</tr>
</tbody>
</table>

See Also  pkgrepo(1), pkgsend(1), pkg(5)

http://hub.opensolaris.org/bin/view/Project+pkg/
pkgrepo(1)

Name  pkgrepo – Image Packaging System repository management utility

Synopsis  /usr/bin/pkgrepo create [-version ver] uri_or_path

/usr/bin/pkgrepo add-publisher -s repo_uri_or_path publisher ...

/usr/bin/pkgrepo get [-F format] [-H] [-p publisher ...]
  -s repo_uri_or_path [section/property ...]

/usr/bin/pkgrepo info [-F format] [-H] [-p publisher ...]
  -s repo_uri_or_path

/usr/bin/pkgrepo list [-F format] [-H] [-p publisher ...]
  -s repo_uri_or_path [pkg_fmri_pattern ...]

/usr/bin/pkgrepo rebuild [-p publisher ...]
  -s repo_uri_or_path [--no-catalog] [--no-index]

/usr/bin/pkgrepo refresh [-p publisher ...]
  -s repo_uri_or_path [--no-catalog] [--no-index]

/usr/bin/pkgrepo remove [-n] [-p publisher ...]
  -s repo_uri_or_path pkg_fmri_pattern ...

/usr/bin/pkgrepo set [-p publisher] -s repo_uri_or_path
  section/property=([value]

/usr/bin/pkgrepo set [-p publisher] -s repo_uri_or_path
  section/property=([value]) ...

/usr/bin/pkgrepo help

/usr/bin/pkgrepo version

Description  pkgrepo provides the ability to create and manage pkg(5) package repositories. Package repositories are a predefined set of directories and files that permit the storage and retrieval of package data by pkg and publication clients such as pkgsend or pkgrecv. In addition, when network-based access to a package repository is needed, pkg.depotd can provide clients access to the repository to store and/or retrieve package data.

Options  The following options are supported:

-?
  --help
  Display a usage message.

Sub-commands  The following subcommands are supported:

pkgrepo create [-version ver] uri_or_path
  Create a pkg(5) repository at the specified location.

  This subcommand can be used only with file system based repositories.
--version
Create a repository in a format compatible with the specified version. By default, version
4 repositories are created. Supported versions are:

3  Supports storage of packages for a single publisher, catalog version 1, and search
   version 1.

4  Supports storage of packages for multiple publishers, catalog version 1, and search
   version 1.

pkgrepo add-publisher -s repo_uri_or_path publisher ...
Add the specified publishers to the repository. The new publishers have no packages or
content.

This subcommand can be used only with version 4 file system based repositories.

pkgrepo get [-F format] [-H] [-p publisher ...] -s repo_uri_or_path [section/property ...]
Display the property information for the repository or its publishers.

By default, each property and its value are printed on separate lines. Empty ASCII string
values are represented by a pair of double quotation marks ("""). The following Bourne shell
metacharacters, and newline, space, and tab, in ASCII string values must be escaped by
backslash characters (\):
; & ( ) ^ < > \ " '

See the “Examples” section for examples displaying publisher and repository properties.

For a list of properties and the purpose and value of each property, see the set
subcommand below.

-F format
Specify an alternative output format. The value of format can be tsv (Tab Separated
Values), json (JavaScript Object Notation as a single line), or json-formatted
(JavaScript Object Notation, formatted for readability).

-H
Omit the headers from the listing.

-p publisher
Display the property information for the given publisher. The special value all displays
the properties for all publishers. This option can be specified multiple times.

-s repo_uri_or_path
Operate on the repository located at the given URI or file system path.

section/property
Display values for only the specified properties, such as publisher/prefix or
repository/version. See the set subcommand for a complete list of properties.
pkgrepo info [-F format] [-H] [-p publisher ...] -s repo_uri_or_path
Display a listing of the package publishers known by the repository. The listing includes the
number of packages for each publisher, when the publisher's package data was last
updated, and the status of the publisher's package data (such as whether it is currently
being processed).

-F format
Specify an alternative output format. The value of format can be tsv (Tab Separated
Values), json (JavaScript Object Notation as a single line), or json-formatted
(JavaScript Object Notation, formatted for readability).

-H
Omit the headers from the listing.

-p publisher
Only display the data for the given publisher. If not provided, the data for all publishers
is displayed. This option can be specified multiple times.

-s repo_uri_or_path
Operate on the repository located at the given URI or filesystem path.

pkgrepo list [-F format] [-H] [-p publisher ...] -s repo_uri_or_path [pkg_fmri_pattern ...]
List the packages in the repo_uri_or_path repository that match the specified
pkg_fmri_pattern patterns. If no patterns are specified, all packages in the repository are
listed.

In the default output, the first column contains the name of the publisher of the package.
The second column contains the name of the package. The third column is a flag that shows
the status of the package. A value of o in the status column indicates the package is obsolete.
A value of r in the status column indicates the package has been renamed, which is a form
of obsoletion. The fourth column contains the release and branch versions of the package.
See pkg(5) for information about release and branch versions.

-F format
Specify an alternative output format. The value of format can be tsv (Tab Separated
Values), json (JavaScript Object Notation as a single line), or json-formatted
(JavaScript Object Notation, formatted for readability).

-H
Omit the headers from the listing.

-p publisher
Only display the packages for the given publisher. If not provided, the packages for all
publishers are displayed. This option can be specified multiple times.

-s repo_uri_or_path
Operate on the repository located at the given URI or filesystem path.
pkgrepo rebuild [-p publisher ...] -s repo_uri_or_path [-no-catalog] [-no-index]
Discard all catalog, search, and other cached information found in the repository, and then
recreates it based on the current contents of the repository.

-p publisher
Perform the operation only for the given publisher. If not provided, or if the special
value all is specified, the operation is performed for all publishers. This option can be
specified multiple times.

-s repo_uri_or_path
Operate on the repository located at the given URI or file system path.

--no-catalog
Do not rebuild package data.

--no-index
Do not rebuild search indexes.

pkgrepo refresh [-p publisher ...] -s repo_uri_or_path [-no-catalog] [-no-index]
Catalog any new packages found in the repository and updates all search indexes. This is
intended for use with deferred publication (-no-catalog or -no-index options of
pkgsend).

-p publisher
Perform the operation only for the given publisher. If not provided, or if the special
value all is specified, the operation is performed for all publishers. This option can be
specified multiple times.

-s repo_uri_or_path
Operate on the repository located at the given URI or file system path.

--no-catalog
Do not add any new packages.

--no-index
Do not update search indexes.

pkgrepo remove [-n] [-p publisher ...] -s repo_uri_or_path pkg_fmri_pattern ...
Remove the packages matching the specified patterns from the repository, including any
files they reference that are not in use by any other package.

Note – All search index data for related publishers is removed.

This subcommand can be used only with file system based repositories.

Caution – This operation is not reversible and should not be used while other clients are
accessing the repository since it might cause them to fail during retrieval operations.

-n
Perform a trial run of the operation with no package changes made. A list of the
packages to be removed is displayed before exiting.
-p publisher
  Only remove matching packages for the given publisher. If not provided, any matching packages are removed for all publishers. This option can be specified multiple times.

-s repo_uri_or_path
  Operate on the repository located at the given URI or filesystem path.

pkgrepo set [-p publisher] -s repo_uri_or_path section/property=[value] ...
set [-p publisher] -s repo_uri_or_path section/property=(value) ...
Set the value of the specified properties for the repository or publisher.

This subcommand can be used only with file system based repositories.

- p publisher
  Only set property data for the given publisher. If the publisher does not already exist, it is added. The special value all can be used to set the property for all publishers.

-s repo_uri_or_path
  Operate on the repository located at the given URI or filesystem path.

Properties and values can be specified using one of the following forms:

section/property=
  Clear the property value.

section/property=value
  Replace the property value with the given value.

section/property=(value1 value2 valueN)
  Replace the property value with the list of values.

For repository versions 3 and 4, the following properties can be set for the repository:

publisher/prefix
  A string that represents the name of the default publisher. The first character must be a-z, A-Z, or 0-9. The remainder of the string can only contain the characters 0-9, -., a-z, and A-Z. This value indicates the publisher that should be used when more than one publisher’s packages are present, or when packages are published to the repository and a publisher is not specified.

For repository versions 3 and 4, the following properties can be set for individual publishers in the repository:

publisher/alias
  A string that represents the default alias that clients should use when adding a publisher using the repository’s configuration data. The first character must be a-z, A-Z, or 0-9. The remainder of the string can only contain the characters 0-9, -., a-z, and A-Z.
Can have the value `core` or `supplemental`, indicating the type of packages offered in this repository.

The `core` type indicates that the repository contains all of the dependencies declared by packages in the repository. The `core` type is primarily used for operating system repositories.

The `supplemental` type indicates that the repository contains packages that rely on or are intended to be used with packages located in another repository.

A paragraph of plain text that describes the purpose and contents of the repository.

A URI that represents the location of a document (such as a web page) that provides additional information about the repository.

A list of locations (URIs) for documents that provide additional legal information about the repository.

A list of locations (URIs) of repositories that contain a copy of the repository's package content but not the package metadata.

A plain text string that contains the name of the repository.

A list of locations (URIs) of repositories that contain a complete copy of the repository's package metadata and content.

An integer value that represents the number of seconds clients should wait before checking the repository for updated package data after each update check.

A URI that represents the location of a resource that must be used to obtain credentials for access to the repository. A registration web page is one example.

A list of locations (URIs) of repositories that contain packages that users might be interested in.

Properties not documented here, but listed in the output of the `get` subcommand, are reserved for internal use and should not be set.
pkgrepo help
  Display a usage message.

pkgrepo version
  Display a unique string that identifies the version of the pkg(5) system. The values produced by the version operation are not sortable and are not safe for comparison beyond equality.

### Examples

**EXAMPLE 1** Create a Package Repository

$ pkgrepo create /my/repository

**EXAMPLE 2** Display Information

Display a summary of publishers and the number of packages in a repository.

$ pkgrepo info -s /my/repository

<table>
<thead>
<tr>
<th>PUBLISHER</th>
<th>PACKAGES</th>
<th>STATUS</th>
<th>UPDATED</th>
</tr>
</thead>
<tbody>
<tr>
<td>example.com</td>
<td>5</td>
<td>online</td>
<td>2011-07-22T18:09:09.769106Z</td>
</tr>
</tbody>
</table>

$ pkgrepo info -s http://pkg.oracle.com/solaris/release/

<table>
<thead>
<tr>
<th>PUBLISHER</th>
<th>PACKAGES</th>
<th>STATUS</th>
<th>UPDATED</th>
</tr>
</thead>
<tbody>
<tr>
<td>solaris</td>
<td>3941</td>
<td>online</td>
<td>2010-11-12T19:24:25.967246Z</td>
</tr>
</tbody>
</table>

**EXAMPLE 3** Rebuild Catalogs and Search Data

Rebuild the repository’s catalogs and search data.

$ pkgrepo rebuild -s /my/repository

**EXAMPLE 4** Refresh Catalogs and Search Data

Refresh the repository’s catalogs and search data.

$ pkgrepo refresh -s /my/repository
$ pkgrepo refresh -s http://example.com/repository

**EXAMPLE 5** Display All Repository Properties

$ pkgrepo get -s /export/repoSolaris11

<table>
<thead>
<tr>
<th>SECTION</th>
<th>PROPERTY</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>publisher</td>
<td>prefix</td>
<td>solaris</td>
</tr>
<tr>
<td>repository description</td>
<td>Local\ copy\ of\ the\ Oracle\ Solaris\ 11\ repository</td>
<td></td>
</tr>
<tr>
<td>repository name</td>
<td>Oracle\ Solaris\ 11</td>
<td></td>
</tr>
<tr>
<td>repository version</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

$ pkgrepo get -s http://pkg.oracle.com/solaris/release/

<table>
<thead>
<tr>
<th>SECTION</th>
<th>PROPERTY</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>deployment content</td>
<td>s11.11-11</td>
<td></td>
</tr>
<tr>
<td>deployment pubdate</td>
<td>20111102T222051Z</td>
<td></td>
</tr>
<tr>
<td>publisher prefix</td>
<td>solaris</td>
<td></td>
</tr>
<tr>
<td>repository version</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>
EXAMPLE 6  Display All Publisher Properties

```
$ pkgrepo get -s http://pkg.oracle.com/solaris/release/ -p all
```

<table>
<thead>
<tr>
<th>PUBLISHER SECTION</th>
<th>PROPERTY</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>solaris publisher</td>
<td>alias</td>
<td>solaris</td>
</tr>
<tr>
<td>solaris publisher</td>
<td>prefix</td>
<td>solaris</td>
</tr>
<tr>
<td>solaris repository</td>
<td>collection-type</td>
<td>core</td>
</tr>
<tr>
<td>solaris repository</td>
<td>description</td>
<td>This\ repository\ serves\ the\ Oracle\ Solaris\ 11\ Package\ repository</td>
</tr>
<tr>
<td>solaris repository</td>
<td>mirrors</td>
<td>(<a href="http://pkg-cdn1.oracle.com/solaris.release/">http://pkg-cdn1.oracle.com/solaris.release/</a>)</td>
</tr>
<tr>
<td>solaris repository</td>
<td>name</td>
<td>Oracle\ Solaris\ 11\ Package\ Repository</td>
</tr>
<tr>
<td>solaris repository</td>
<td>origins</td>
<td>()</td>
</tr>
<tr>
<td>solaris repository</td>
<td>refresh-seconds</td>
<td></td>
</tr>
<tr>
<td>solaris repository</td>
<td>registration-uri</td>
<td></td>
</tr>
<tr>
<td>solaris repository</td>
<td>related-uris</td>
<td>()</td>
</tr>
</tbody>
</table>

EXAMPLE 7  Set the Default Publisher

```
$ pkgrepo set -s /my/repository publisher/prefix=example.com
```

EXAMPLE 8  Set a Publisher Property

```
$ pkgrepo set -s /my/repository -p example.com \ repository/origins=http://example.com/repository
```

EXAMPLE 9  Add a New Publisher To the Repository

```
$ pkgrepo add-publisher -s /my/repository example.com
```

**Exit Status**  The following exit values are returned:

<table>
<thead>
<tr>
<th>Exit Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Command succeeded.</td>
</tr>
<tr>
<td>1</td>
<td>An error occurred.</td>
</tr>
<tr>
<td>2</td>
<td>Invalid command line options were specified.</td>
</tr>
<tr>
<td>3</td>
<td>Multiple operations were requested, but only some of them succeeded.</td>
</tr>
<tr>
<td>4</td>
<td>No changes were made, nothing to do.</td>
</tr>
<tr>
<td>99</td>
<td>An unanticipated exception occurred.</td>
</tr>
</tbody>
</table>

**Attributes**  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>package/pkg</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Uncommitted</td>
</tr>
</tbody>
</table>
See Also  pkg(1), pkgsend(1), pkg.depotd(1M), pkg(5)

http://hub.opensolaris.org/bin/view/Project+pkg/
Name  

pkgsend – Image Packaging System publication client

Synopsis  

/usr/bin/pkgsend [options] command [cmd_options] [operands]

/usr/bin/pkgsend generate [-T pattern] [--target file] 

source ...

/usr/bin/pkgsend publish [-b bundle ...] [-d source ...]

[-s repo_uri_or_path] [-T pattern] [-no-catalog]

[manifest ...]

Description  

pkgsend enables the publication of new packages and new package versions to an image packaging repository using package manifests. To create or manage repositories, see pkgrepo(1). To create package archives from packages in an existing repository, see pkgrecv(1). For more information about package manifests, see pkg(5).

After a pkgsend operation, run pkgrepo refresh or pkgrepo rebuild on the repository to build search indexes.

Options  

The following options are supported:

-?

--help

Display a usage message.

Sub-commands  

The following subcommands are supported:

pkgsend generate [-T pattern] [-target file] source ...

Read each source (such as an SVR4 package, a directory, or a tar file) and emit the manifest that describes the source to stdout. In the output manifest, file and dir actions have owner set to root and group set to bin.

The output manifest can then be annotated, have dependencies added or analyzed using pkgdepend, and have its correctness verified using pkglint before being passed to the publish subcommand.

The following are supported sources:

- Filesystem format SVR4 packages
- Datastream format SVR4 packages
- tar files
- Directories

If the base name of files in the source match the patterns specified with -T, the timestamp of the file is added to the action for that file. The pattern uses shell matching rules:

* Matches everything.

? Matches any single character.

[seq] Matches any character in seq.
When the specified source is a directory, there is no clear way to distinguish a file action from a hardlink action when there are multiple path names for a single inode. Normally, the first one found in the file system walk is treated as a file and the rest as hardlinks. This can be arbitrary, depending on the implementation of the file system. To specify which path names should be treated as files, pass each path name as an argument to the -t target option. This option has no effect on other types of sources because they are capable of expressing which path names are files and which are hardlinks.

When SVR4 packages are provided as a source, pkgsend checks that no files with class action scripts are present and no preinstall, postinstall, preremove, or postremove scripts are present. An exception is made for any SMF manifests installed with the manifest class. BASEDIR is removed from all relocatable paths.

The SVR4 DESC parameter is converted to a pkg.description value. The SVR4 NAME parameter is converted to a pkg.summary value.

pkgsend publish [-b bundle ...] [-d source ...] [-s repo_uri_or_path] [-T pattern]

Publish a package using the specified package manifests to the target package repository, retrieving files for the package from the provided sources. If multiple manifests are specified, they are joined in the order provided. If a manifest is not specified, the manifest is read from stdin.

If not specified, pkgsend publish adds the build version to the package FMRI. The publish tool also adds the timestamp (the current time in UTC) to the package FMRI. See the pkg(5) man page for information about the version string of a package FMRI.

-b bundle
Add the specified bundle to the list of sources to search when looking for files in the manifest. Bundles are sources such as tar files and SVR4 packages. If this option is specified multiple times, sources are searched in the order they appear on the command line. If both -b and -d are specified, -d sources are searched first. For a description of supported bundles and how they are used, refer to the generate subcommand above.

-d source
Add the specified directory to the list of sources to search when looking for files in the manifest. If this option is specified multiple times, sources are searched in the order they appear on the command line. For a description of supported sources and how they are used, refer to the generate subcommand above.

-s repo_uri_or_path
Publish the package to the repository located at the given URI or file system path. See the "Notes" section below for more information about restrictions and suggestions for publication. See also the "Environment Variables" section.
--no-catalog
Do not add the package to the publisher’s catalog. This option is recommended whenever multiple packages are being published at one time as updates to publisher catalogs must be performed serially. Once publication is complete, the refresh subcommand of pkgrepo can be used to add the new packages to the respective publisher catalogs.

For a description of the -T option, see the generate subcommand above.

Environment Variables

| PKG_REPO | The path or URI of the destination repository. |

Examples

**EXAMPLE 1** Generate and Publish a Package

Create a package using pkgsend generate and publish it.

```
$ pkgsend generate /path/to/proto > /path/to/manifests/foo.p5m
```

Add the package FMRI for the example.com publisher to the beginning of foo.p5m.

```
set name=pkg.fmri value=pkg://example.com/foo@1.0
```

The resulting manifest should look like this:

```
set name=pkg.fmri value=pkg://example.com/foo@1.0
dir group=sys mode=0755 owner=root path=usr
dir group=bin mode=0755 owner=root path=usr/bin
file/usr/bin/foo group=bin mode=0555 owner=root path=usr/bin/foo
```

```
$ pkgsend publish -s http://example.com:10000 -d /path/to/proto /path/to/manifests/foo.p5m
```

**EXAMPLE 2** Create and Publish a Trivial Package

Create a manifest for publisher example.com containing the following lines:

```
set name=pkg.fmri value=pkg://example.com/foo@1.0-1
file /exdir/foo mode=0555 owner=root group=bin path=/usr/bin/foo
```

Publish the package:

```
$ pkgsend publish -s http://example.com:10000 -d /exdir
```

**EXAMPLE 3** Use a Preexisting Manifest

Publish a package using file system based publication and a preexisting manifest.

```
$ pkgsend publish -s /tmp/example_repo -d /tmp/pkg_files /tmp/pkg_manifest
```

Exit Status The following exit values are returned:

| 0 | Command succeeded. |
1 An error occurred.
2 Invalid command line options were specified.
99 An unanticipated exception occurred.

**Attributes** See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>package/pkg</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Uncommitted</td>
</tr>
</tbody>
</table>

**See Also** pkgdepend(1), pkgrepo(1), pkg.depotd(1M), pkg(5)

http://hub.opensolaris.org/bin/view/Project+pkg/

**Notes** Because of publication protocol limitations, file system based publication must be used when publishing individual package files that are greater than 128 MB in size. File system based publication is also recommended when access control for a repository is needed.

When using file system based publication, any pkg.depotd processes that are serving the target repository must be restarted after publication is completed for the changes to be reflected in its web interface or search responses. See pkg.depotd(1M) for more information.
Name
pkgsign – Image Packaging System signing utility

Synopsis
/usr/bin/pkgsign [-a hash_algorithm]
   [-c path_to_signing_certificate]
   [-i path_to_intermediate_cert] ...
   [-k path_to_private_key] [-n] -s path_or_uri
   [-h] [-no-index] [-no-catalog]
   (fmri|pattern) ...

Description
pkgsign updates the manifest for the given FMRI’s in place in the repository by adding a signature action using the provided key and certificates. The modified package retains the original timestamp.

Options
The following options are supported:

   - -help
      Display a usage message.

   -a hash_algorithm
      Use the signature algorithm hash_algorithm instead of the default. The default signature algorithm is rsa-sha256. Supported signature algorithms are rsa-sha256, rsa-sha384, rsa-sha512, sha256, sha384, and sha512. A signature algorithm that only specifies a hash algorithm causes the signature value to be the hash of the manifest of the package. A signature algorithm that specifies rsa and a hash algorithm causes the signature value to be the hash of the manifest signed with the private key provided (see the -c and -k options).

   -c path_to_signing_certificate
      Add the certificate path_to_signing_certificate as the certificate to use when verifying the value of the signature in the action. The -c option can only be used with the -k option.

   -i path_to_intermediate_cert
      Add the certificate path_to_intermediate_cert as a certificate to use when validating the certificate path_to_signing_certificate given as an argument to -c. Multiple certificates can be provided by specifying -i multiple times.

   -k path_to_private_key
      Use the private key stored in path_to_private_key to sign the manifest. The -k option can only be used with the -c option. If -k is not set, then the signature value is the hash of the manifest.

   -n
      Perform a trial run that does not change the repository in any way.

   -s path_or_uri
      Sign packages in the repository at path_or_uri.

   - -no-index
      Do not update the repository search indexes after the signed manifest has been republished.
- - no - catalog
Do not update the repository catalog after the signed manifest has been republished.

**Examples**

**EXAMPLE 1**  Sign Using the Hash Value of the Manifest

Sign a package published to http://localhost:10000 using the hash value of the manifest.
This is often useful for testing.

```
$ pkgsign -s http://localhost:10000 -a sha256 \
    example_pkg@1.0,5.11-0:20100626T030108Z
```

**EXAMPLE 2**  Sign Using a Key and Certificate

Sign a package published into the file repository in /foo/bar using rsa-sha384 to hash and
sign the manifest. The signature key is in /key/usr2.key, its associated certificate is in
/key/usr2.cert, and a certificate needed to validate the certificate is in /icerts/usr1.cert.

```
$ pkgsign -s file:///foo/bar/ -a rsa-sha384 \
    -k /key/usr2.key -c /key/usr2.cert -i /icerts/usr1.cert \
    example_pkg@1.0,5.11-0:20100626T031341Z
```

**Exit Status**
The following exit values are returned:

<table>
<thead>
<tr>
<th>Exit Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Command succeeded.</td>
</tr>
<tr>
<td>1</td>
<td>An error occurred.</td>
</tr>
<tr>
<td>2</td>
<td>Invalid command line options were specified.</td>
</tr>
<tr>
<td>3</td>
<td>Multiple operations were requested, but only some of them succeeded.</td>
</tr>
<tr>
<td>99</td>
<td>An unanticipated exception occurred.</td>
</tr>
</tbody>
</table>

**Attributes**

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>package/pkg</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Uncommitted</td>
</tr>
</tbody>
</table>

**See Also**

pkg(1), pkgreceive(1), pkgsend(1), pkgrepo(1), pkg(5)

http://hub.opensolaris.org/bin/view/Project+pkg/
pkgtrans – translate package format

pkgtrans [-nosg] [-k keystore] [-a alias] [-P passwd] device1 device2

pkgtrans utility translates an installable package from one format to another. It translates:

- a file system format to a datastream
- a file system format to a signed datastream
- a datastream to a file system format
- one file system format to another file system format

Options

The options and arguments for this command are:

-a alias Use public key certificate associated with friendlyName alias, and the corresponding private key. See KEYSTORE LOCATIONS and KEYSTORE AND CERTIFICATE FORMATS in pkgadd(1M) for more information.

-g Sign resulting datastream.

-i Copies only the pkginfo(4) and pkgmap(4) files.

-k keystore Use keystore to retrieve private key used to generate signature. If it not specified, default locations are searched to find the specified private key specified by -a. If no alias is given, and multiple keys exist in the key store, pkgtrans will abort. See KEYSTORE LOCATIONS and KEYSTORE AND CERTIFICATE FORMATS in pkgadd(1M) for more information on search locations and formats.

- n Creates a new instance of the package on the destination device if any instance of this package already exists, up to the number specified by the MAXINST variable in the pkginfo(4) file.

-o Overwrites the same instance on the destination device. Package instance will be overwritten if it already exists.

-P passwd Supply password used to decrypt the keystore. See PASS PHRASE ARGUMENTS in pkgadd(1M) for details on the syntax of the argument to this option.

-s Indicates that the package should be written to device2 as a datastream rather than as a file system. The default behavior is to write a file system format on devices that support both formats.
device1  Indicates the source device. The package or packages on this device will be translated and placed on device2. See DEVICE SPECIFIERS, below.

device2  Indicates the destination device. Translated packages will be placed on this device. See DEVICE SPECIFIERS, below.

pkginst  Specifies which package instance or instances on device1 should be translated. The token all may be used to indicate all packages. pkginst . * can be used to indicate all instances of a package. If no packages are defined, a prompt shows all packages on the device and asks which to translate.

The asterisk character (*) is a special character to some shells and may need to be escaped. In the C-Shell, the * must be surrounded by single quotes (') or preceded by a backslash (\).

Device Specifiers  Packaging tools, including pkgtrans, pkgadd(1M), and pkgchk(1M), have options for specifying a package location by specifying the device on which it resides. Listed below are the device types that a package can be stored to and retrieved from. Note that source and destination devices cannot be the same.

device  Packages can be stored to a character or block device by specifying the device identifier as the device. A common example of this device type is /dev/rmt/0 for a removable magnetic tape. pkgtrans can also produce regular file system files in a stream format, which is suitable for storage on a character device, web server, or as input to pkgadd(1M).

directory  Packages can be stored onto a directory by specifying an absolute path to a file system directory. The package contents reside in a directory within the specified directory. The package directory name must be identical to its PKG specification in the pkginfo(4) file. An example device specification of this type is /export/packages.

Examples  EXAMPLE 1  Translating Packages on /tmp

The following example translates packages pkg1 and pkg2 on /tmp into a datastream format:

```
example% pkgtrans -s /tmp /tmp/datastream.pkg pkg1 pkg2
```

EXAMPLE 2  Creating a Signed Package

The following example creates a signed package from pkg1 and pkg2, and reads the password from the $PASS environment variable:

```
example% pkgtrans -sg -k /tmp/keystore.p12 -a foo \
  -p env:PASS /tmp /tmp/signedpkg pkg1 pkg2
```
EXAMPLE 3   Translating a Package Datastream

The following example translates a package datastream into a file system format package:

example% pkgtrans /tmp/pkg1.pkg ~/tmp pkg1

Environment Variables

The MAXINST variable is set in the pkginfo(4) file and declares the maximum number of package instances.

Exit Status

0       Successful completion.

>0       An error occurred.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>package/svr4</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also

pkginfo(1), pkgmk(1), pkgparam(1), pkgproto(1), installf(1M), pkgadd(1M), pkgask(1M), pkgrm(1M), removef(1M), pkginfo(4), pkgmap(4), attributes(5), largefile(5)

Application Packaging Developer’s Guide

Notes

By default, pkgtrans does not translate any instance of a package if any instance of that package already exists on the destination device. Using the -n option creates a new instance if an instance of this package already exists. Using the -o option overwrites an instance of this package if it already exists. Neither of these options are useful if the destination device is a datastream.

Package commands are largefile(5)-aware. They handle files larger than 2 GB in the same way they handle smaller files. In their current implementations, pkgadd(1M), pkgtrans and other package commands can process a datastream of up to 4 GB.
**Name**  
pklogin_finder – map certificates into a user

**Synopsis**  
/usr/lib/pam_pkcs11/pklogin_finder [debug] [config_file=filename]

**Description**  
pklogin_finder uses the pam_pkcs11 library infrastructure to interactively map a PKCS#11 provided certificate to a user.

pklogin_finder uses the same configuration file and arguments than pam_pkcs11(5) PAM module. It loads defined mapper modules and tries to find a map between found certificates and a user login.

**Options**  
The following options are supported:

- **config_file=filename**  
  Set the configuration file.
  
  The default value is /etc/security/pam_pkcs11/pam_pkcs11.conf.

- **debug**  
  Enable debugging output.
  
  The default is no debug.

As it uses the same configuration file as pam_pkcs11(5), all of the pam_pkcs11 options are available. Some of these options make no sense in a non-PAM environment, and are therefore ignored. Some mapper options (mapfile, ignorecase) have no effect on certificate contents, and they are ignored as well.

**Exit Status**  
The following exit values are returned:

- **0**  
  Successful completion.
  
  pkcs11.inspect prints on stdout the login name and exits.

- **1**  
  An error occurred.
  
  A user mapping error was found.

- **2**  
  An error occurred.
  
  No user match was found.

**Examples**  

**EXAMPLE1**  
Using pklogin_finder

The following example runs the pklogin_finder command without any options:

```bash
% pkcs11.inspect
```

**EXAMPLE2**  
Using pklogin_finder with Options

The following example runs the pkcs_finder command with options:

```bash
% pklogin_finder debug config_file=${HOME}/.pam_pkcs11.conf
```
Files /etc/security/pam_pkcs11/pam_pkcs11.conf

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Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTETYPE</th>
<th>ATTRIBUTE VALUE</th>
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</thead>
<tbody>
<tr>
<td>Availability</td>
<td>library/security/pam/module/pam-pkcs11</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Uncommitted</td>
</tr>
</tbody>
</table>

See Also pkcs11_inspect(1), attributes(5), pam_pkcs11(5)

pktool – manage certificates and keys

description

The pktool command allows users to manage the certificates and keys on multiple keystores including PKCS#11 tokens (that is, Cryptographic Framework), Netscape Security Services (NSS) tokens, and standard file based keystore for OpenSSL.

pktool also provides support to list, delete and import a Certificate Revocation List (CRL). pktool does not provide support for creating CRLs, signing CRLs, or exporting CRLs. The CRL support for the PKCS#11 keystore is file-based.

Options

The following command options are supported:

- `f option_file`  
  Allows the user to set up the options in a file instead of entering the options on the command line.

  This option is provided as a convenience for users because pktool can potentially have a large list of subcommands and associated options to be specified on the command line.

  The format of the option_file is one option or value pair per line.

  An example option_file might looks as follows:

  ```
  list
  keystore=nss
  dir=/export/foo
  objtype=key
  ```

- `i`  
  Allows the user to specify the subject-DN interactively for the gencert and gencsr subcommands. When -i is specified, the user is prompted to input some data to form a subject-DN.

  An example of using the -i option follows:

  ```
  Country Name (2 letter code) [US]:US
  State or Province Name (full name) [Some-State]:CA
  Locality Name (eg, city) []:Menlo Park
  Organization Name (eg, company):Sun Microsystems Inc.
  Organizational Unit Name (eg, section):OPG
  Common Name (eg, YOUR name):John Smith
  Email Address []: john.smith@sun.com
  ```

  The resulting subject-DN is:

  ```
  C=US, ST=CA, L=Menlo Park, O=Sun Microsystems Inc.,
  OU=OPG, emailAddress=john.smith@sun.com, 
  CN=John Smith
  ```

Subcommands

The following subcommands are supported:

The format for the delete subcommand is as follows:

```
pktool delete [token=token[:manuf[:serial]]]
  [objtype=private|public|both]
  [label=object-label]

pktool delete keystore=pkcs11
  objtype=cert[:public | private | both]]
  [token=token[:manuf[:serial]]]
  [label=cert-label]
  [serial=hex-serial-number]
  [issuer=issuer-DN]
  [subject=subject-DN]

pktool delete keystore=nss
  objtype=cert
  [subject=subject-DN]
  [issuer=issuer-DN]
  [serial=hex-serial-number]
  [nickname=cert-nickname]
  [token=token[:manuf[:serial]]]
  [dir=directory-path]
  [prefix=DBprefix]

pktool delete keystore=nss
  objtype=crl
  [nickname=cert-nickname]
  [subject=subject-DN]
  [token=token[:manuf[:serial]]]
  [dir=directory-path]
  [prefix=DBprefix]

pktool delete keystore=pkcs11
  objtype=key[:public | private | both]]
  [token=token[:manuf[:serial]]]
  [label=key-label]

pktool delete keystore=pkcs11
  objtype=crl
  infile=input-fn

pktool delete keystore=file
  objtype=cert
  [infile=input-fn]
  [dir=directory-path]
  [serial=hex-serial-number]
  [issuer=issuer-DN]
```
[subject=subject-DN]

pktool delete keystore=file
  objtype=key
  [infile=input-fn]
  [dir=directory-path]

pktool delete keystore=file
  objtype=crl
  infile=input-fn

Deletes a certificate, key, or certificate revocation list (CRL).

To delete a private certificate or key from PKCS#11 token, the user is prompted to authenticate to the PKCS#11 by entering the correct Personal Identification Number (PIN).

download
The format for the download subcommand is as follows:

pktool download url=url_str
  [objtype=crl|cert]
  [http_proxy=proxy_str]
  [outfile=output-fn]
  [dir=directory-path]

Downloads a CRL file or a certificate file from the specified URL location. Once the file is successfully downloaded, checks the validity of the downloaded CRL or certificate file. If the CRL or the certificate is expired, download issues a warning.

export
The format for the export subcommand is as follows:

pktool export [token=token[:manuf[:serial]]]
  outfile=output-fn

pktool export keystore=pkcs11
  outfile=output-fn
  [objtype=cert|key]
  [label=label]
  [subject=subject-DN]
  [issuer=issuer-DN]
  [serial=hex-serial-number]
  [outformat=pem|der|pkcs12|raw]
  [token=token[:manuf[:serial]]]

pktool export keystore=nss
  outfile=output-fn
  [subject=subject-DN]
  [issuer=issuer-DN]
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pktool export keystore=file
certfile=cert-input-fn
keyfile=key-input-fn
outfile=output-pkcs12-fn

Saves the contents of PKCS#11 token or certificates in the NSS token or file-based keystore to the specified file.

gencert

The format for the gencert subcommand is as follows:

pktool gencert [-i] keystore=nss
label=cert-nickname
subject=subject-DN
serial=hex_serial_number
[altname=[critical:]subjectAltName,subjectAltName...]
[keyusage=[critical:]usage,usage...]
[token=token[:manuf[:serial]]]
[dir=directory-path]
[prefix=DBprefix]
[keytype=rsa | ec [curve=ECC Curve Name] \n  [hash=md5 | sha1 | sha224 | sha256 | sha384 | sha512]
[trust=trust-value]
[eku=[critical:]EKA_name,....]
[listcurves]
[lifetime=number-hour|number-day|number-year]

pktool gencert [-i] [ keystore=pkcs11]
label=key/cert-label
subject=subject-DN
serial=hex_serial_number
[altname=[critical:]subjectAltName,subjectAltName...]
[keyusage=[critical:]usage,usage...]
[token=token[:manuf[:serial]]]
[keytype=rsa | ec [curve=ECC Curve Name] \n  [hash=md5 | sha1 | sha224 | sha256 | sha384 | sha512]]
[trust=trust-value]
[eku=[critical:]EKA_name,....]
[listcurves]
Generates a self-signed certificate and installs it and its associated private key to the specified keystore.

gencert prompts the user to enter a PIN for token-based keystore.

gencsr

The format for the gencsr subcommand is as follows:

```bash
pktool gencert [-i] keystore=file
  outcert=cert-fn
  outkey=key-fn
  subject=subject-DN
  serial=hex_serial_number
  [altname=[critical:]subjectAltName,subjectAltName]
  [keyusage=[critical:]usage,usage...]
  [format=der|pem]
  [keytype=rsa [hash=md5 | sha1 | sha256 | sha384 | sha512]]
  [keytype=dsa [hash=sha1 | sha224 | sha256 ]]
  [keylen=key-size]
  [eku=[critical:]EUKU_name,...]
  [lifetime=number-hour|number-day|number-year]
```

```
Generates as self-signed certificate and installs it and its associated private key to the specified keystore.

gencert prompts the user to enter a PIN for token-based keystore.

gencsr

The format for the gencsr subcommand is as follows:

```bash
pktool gencsr [-i] keystore=nss
  nickname=key-nickname
  outcsr=csr-fn
  subject=subject-DN
  [altname=[critical:]subjectAltName,subjectAltName]
  [keyusage=[critical:]usage,usage...]
  [token=[token::manuf::serial]]
  [dir=directory-path]
  [prefix=DBprefix]
  [keytype=rsa | ec [curve=ECC Curve Name] \n    [hash= md5 | sha1 | sha224 | sha256 | sha384 | sha512]
  [keytype=dsa [hash=sha1 | sha224]
  [keylen=key-size]
  [format=pem|der]
  [eku=[critical:]EUKU_name,...]
  [listcurves]
```

```
```
pktool gencsr [-i] keystore=file
    outcsr=csr-fn
    outkey=key-fn
    subject=subject-DN
    [altname=[critical:]subjectAltName,subjectAltName...]
    [keyusage=[critical:]usage,usage...]
    [dir=directory-path]
    [keytype=rsa [hash=md5 | sha1 | sha224 | sha256 | sha384 | sha512]]
    [keylen=key-size]
    [format=pem|der]
    [eku=[critical:]EPU_name,...]
    [listcurves]

Creates a PKCS#10 certificate signing request (CSR) file. This CSR can be sent to a Certifying Authority (CA) for signing. The gencsr subcommand prompts the user to enter a PIN for token-based keystore.

genkey
The format for the genkey subcommand is as follows:

pktool genkey [keystore=pkcs11]
    label=key-label
    [keytype=aes|arcfour|des|3des|generic]
    [keylen=key-size (for aes, arcfour, or \ generic keytypes only)]
    [token=token[:manuf[:serial]]]
    [sensitive=y|n]
    [extractable=y|n]
    [print=y|n]

pktool genkey keystore=nss
    label=key-label
    [keytype=aes|arcfour|des|3des|generic]
    [keylen=key-size (for aes, arcfour, or \ generic keytypes only)]
    [token=token[:manuf[:serial]]]
    [dir=directory-path]
    [prefix=DBprefix]

pktool genkey keystore=file
    outkey=key-fn
    [keytype=aes|arcfour|des|3des|generic]
    [keylen=key-size (for aes, arcfour, \
or generic keytypes only)
[print=y|n]

Generates a symmetric key in the specified keystore. The genkey subcommand prompts the user to enter a PIN for token-based keystore.

**genkeypair**

The format for the genkeypair subcommand is as follows:

```
pktool genkeypair keystore=nss
  label=key-nickname
  [token=token[:manuf[:serial]]]
  [dir=directory-path]
  [prefix=DBprefix]
  [keytype=rsa|dsa|ec [curve=ECC Curve Name]]
  [keylen=key-size]
  [listcurves]
```

```
pktool genkeypair [keystore=pkcs11]
  label=key-label
  [token=token[:manuf[:serial]]]
  [keytype=rsa|dsa|ec [curve=ECC Curve Name]]
  [keylen=key-size]
  [listcurves]
```

```
pktool genkeypair keystore=file
  outkey=key_filename
  [format=der|pem]
  [keytype=rsa|dsa]
  [keylen=key-size]
```

**import**

The format for the import subcommand is as follows:

```
pktool import [token=token[:manuf[:serial]]]
  infile=input-fn
```

```
pktool import [keystore=pkcs11]
  infile=input-fn
  label=object-label
  [keytype=aes|arcfour|des|3des|generic]
  [sensitive=y|n]
  [extractable=y|n]
  [token=token[:manuf[:serial]]]
  [objtype=cert|key]
```

```
pktool import keystore=pkcs11
  objtype=crl
  infile=input-fn
  outcrl=output-crl-fn
```
pktool inittoken
The format for the inittoken subcommand is as follows:

pktool inittoken [ slotid=slot number ]
    [ currlabel=token[:manuf[:serial]]]
    [ newlabel=new token label ]

This command initializes a PKCS#11 token using C_InitToken API. The preferred method of locating a token is to specify its default label. Optionally, a new label can be assigned to the token by using the newlabel argument. If newlabel is not present, the token label is not modified. The user is prompted to enter the security officer (SO) PIN for this command to proceed.

list
The format for the list subcommand is as follows:

pktool list [token=token[:manuf[:serial]]]
    [objtype=private|public|both]
pktool list [keystore=pkcs11]
  [objtype=cert[:public | private | both]]
  [token=token[:manuf[:serial]]]
  [label=cert-label]
  [serial=hex-serial-number]
  [issuer=issuer-DN]
  [subject=subject-DN]

pktool list [keystore=pkcs11]
  objtype=key[:public | private | both]]
  [token=token[:manuf[:serial]]]
  [label=key-label]
  [keyvalue=y|n]

pktool list keystore=pkcs11
  objtype=crl
  infile=input-fn

pktool list keystore=nss
  objtype=cert
  [subject=subject-DN]
  [issuer=issuer-DN]
  [serial=hex-serial-number]
  [nickname=cert-nickname]
  [token=token[:manuf[:serial]]]
  [dir=directory-path]
  [prefix=DBprefix]

pktool list keystore=nss
  objtype=key
  [token=token[:manuf[:serial]]]
  [dir=directory-path]
  [prefix=DBprefix]

pktool list keystore=file
  objtype=cert
  [infile=input-fn]
  [dir=directory-path]
  [serial=hex-serial-number]
  [issuer=issuer-DN]
  [subject=subject-DN]

pktool list keystore=file
  objtype=key
  [infile=input-fn]
  [dir=directory-path]
  [keyvalue=y|n]
Lists certificates, list keys, or list certificate revocation lists (CRL). When displaying a private certificate or key in PKCS#11 token, the user is prompted to authenticate to the PKCS#11 token by entering the correct PIN.

**setpin**
The format for the `setpin` subcommand is as follows:

```bash
pktool setpin [keystore=nss] [token=token] [dir=directory-path] [prefix=DBprefix]
```

```bash
pktool setpin [ keystore=pkcs11] [token=token[:manuf[:serial]]] [usertype=user | so]
```

Changes the passphrase used to authenticate a user to the PKCS#11 or NSS token.

Passphrases can be any string of characters with lengths between 1 and 256 with no nulls.

`setpin` prompts the user for the old passphrase, if any. If the old passphrase matches, `pktool` prompts for the new passphrase twice. If the two entries of the new passphrases match, it becomes the current passphrase for the token.

For the Sun Software PKCS#11 softtoken keystore (default), the user must use the `setpin` command with the default passphrase `changeme` as the old passphrase to change the passphrase of the object store. This action is needed to initialize and set the passphrase to a newly created token object store.

If the `usertype=so` option is specified for PKCS#11 based tokens, the Security Officer (SO) user PIN is changed as opposed to the normal user PIN. By default the `usertype` is assumed to be `user`.

**signcsr**
The format for the `signcsr` subcommand is as follows:

```bash
signcsr [keystore=pkcs11] [signkey=label] [csr=CSR_filename] [serial=serial_number_hex_string_for_final_certificate] [outcert=filename_for_final_certificate] [issuer=issuer-DN] [store=y|n] [outlabel=certificate_label] [format=pem|der] [subject=subject-DN] [altname=subjectAltName,...] [keyusage=[critical:]usage,...] [eku=[critical:]EKU_Name,...] [lifetime=number-hour|number-day|number-year]
```

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signcsr keystore=file
  signkey=filename
  csr=CSR_filename
  serial=serial_number_hex_string_for_final_certificate
  outcert=filename_for_final_certificate
  issuer=issuer-DN
  [format=pem|der] (certificate output format)
  [subject=subject-DN] (override the CSR subject name)
  [altname=subjectAltName,...] (add a subjectAltName)
  [keyusage=[critical:]usage,...] (add key usage bits)
  [lifetime=number-hour|number-day|number-year]
  [eku=[critical:]EKU_Name,...] (add Extended Key Usage)

signcsr keystore=nss
  signkey=label (label of key to use for signing)
  csr=CSR_filename
  serial=serial_number_hex_string_for_final_certificate
  outcert=filename_for_final_certificate
  issuer=issuer-DN
  [store=y|n] (store the new cert in NSS DB, default=n)
  [outlabel=certificate label]
  [format=pem|der] (certificate output format)
  [subject=subject-DN] (override the CSR subject name)
  [altname=subjectAltName,...] (add a subjectAltName)
  [keyusage=[critical:]usage,...] (add key usage bits)
  [eku=[critical:]EKU_Name,...] (add Extended Key Usage)
  [lifetime=number-hour|number-day|number-year]
  [token=token[:manuf[:serial]]]
  [dir=directory-path]
  [prefix=DBprefix]

tokens
  The format for the tokens subcommand is as follows:

  pktool tokens

  The tokens subcommand lists all visible PKCS#11 tokens.

-?
  The format for the subcommand is as follows:

  pktool -?
  pktool --help

  The -? option displays usage and help information. --help is a synonym for -?.

Usage
  The pktool subcommands support the following options:
Subject Alternative Names the certificate. The argument that follows the altname option should be in the form of tag=value. Valid tags are IP, DNS, EMAIL, URI, DN, KRB, UPN, and RID. The SubjectAltName extension is marked as critical if the altname string is pre-pended with the word critical.

The critical flag is shared by all the altnames, and should be placed at the beginning of the first subject alternative name.

The delimiter between altname tags (for example, IP, EMAIL, DN, and so forth) is a comma (.). The delimiter between components in the DN type is a semicolon (;).

Example 1: Add an IP address to the subjectAltName extension. altname="IP=1.2.3.4"
Example 2: Add an email address to the subjectAltName extension, and mark it as being critical. altname="critical:EMAIL=first.last@company.com"

Example 3: Add multiple subject alternative names IP address, email address and distinguished name to the subjectAltName extension, and mark it as being critical.

altname="critical:IP=1.2.3.4,EMAIL=first.last@company.com,\ DN=C=US;O=Oracle;OU=Security;CN=John Smith"

curl label=token label

This option is only used by the init token command. This is used to locate the default token that is being initialized. See the token option for details about the format of the token name to be used.

curve=Elliptic_Curve_Name

This option is for specifying the Elliptic Curve parameters to be used when generating an X.509 certificate or certificate signing request or when generating an Elliptic Curve keypair.

The following named curves are supported:

- secp112r1, secp112r2, secp128r1, secp128r2, secp160k1
- secp160r1, secp160r2, secp192k1, secp192r1, secp224k1
- secp224r1, secp256k1, secp256r1, secp384r1, secp521r1
- sect113r1, sect113r2, sect113r1, sect113r2, sect163k1
- sect163r1, sect163r2, sect193r1, sect193r2, sect233k1
- sect233r1, sect239k1, sect283k1, sect283r1, sect409k1
- sect409r1, sect571k1, sect571r1, c2pnb163v1, c2pnb163v2
- c2pnb163v3, c2pnb176v1, c2pnb191v1, c2pnb191v2, c2pnb191v3
- c2pnb208w1, c2tnb239v1, c2tnb239v2, c2tnb239v3, c2pnb272w1
- c2pnb304w1, c2tnb359v1, c2pnb368w1, c2tnb431r1, prime192v2
- prime192v3

The list of named curves can also be seen by using the list curves option with the gencert, gencsr, or genkeypair subcommands.
dir=directory_path
    Specifies the NSS database directory, or OpenSSL keystore directory where the requested object is stored.

eku=[critical:]EKA_Name, [critical:]EKA_Name, ...]
    Specifies the extended key usage X.509v3 extension values to add to the certificate or certificate request.
    Specify EKA_Name as one of the following: serverAuth, clientAuth, codeSigning, emailProtection, ipsecEndSystem, ipsecTunnel, ipsecUser, timeStamping, OCSPSigning, KPClientAuth, KPdc, or sclgson.
    An example is:
    eku=KPClientAuth, clientAuth

extractable=y | n
    Specifies the resulting symmetric key in the PKCS#11 token is extractable or not extractable. The valid values are: y and n. The default value is y.

format=pem | der | pkcs12
    For the gencert subcommand, this option only applies to the file based keystore such as OpenSSL. It is used to specify the output format of the key or certificate file to be created. The valid formats are: pem or der. The default format is pem.
    For the gencsr subcommand, this option specifies the output encoded format of the CSR file. The valid formats are: pem or der. The default format is pem.

hash=md5 | sha1 | sha224 | sha256 | sha384 | sha512
    For the gencert and gencsr subcommands, this option allows the caller to specify the hash algorithm to be use for generating the X.509 certificate signature. This can be used when creating EC or RSA based certificates using the NSS or PKCS#11 keystores. Elliptic Curve support is not available when using the OpenSSL file-based keystore.

infile=input-fn
    Specifies the certificate filename for list and delete subcommands when objtype=cert and keystore=file. For the import subcommand, this option specifies the filename to be imported. Specifies the input CRL filename for list, delete and import subcommands when objtype=crl.

issuer=issuer-DN
    Specifies the issuer of a certificate.

keylen=key-size
    Specifies the size (bits) of the private or symmetric key to generate.
    For the gencert and gencsr subcommands, the default key length is 1024 bits.
    For the genkey subcommand, the minimum and maximum bits of the symmetric key to generate using AES algorithm are 128 and 256. Using the ARCFOUR algorithm, the
minimum and maximum bits are 8 and 2048. The minimum bits for a generic secret key is 8 and the maximum bits is arbitrary. The default key length for the AES, ARCFOUR or generic secret keys is 128. For a DES key or a 3DES key, the key length is fixed and this option is ignored if specified.

keystore=nss | pkcs11 | file
   Specifies the type of the underlying keystore: NSS token, PKCS#11 token, or file-based plugin.

keytype=rsa | dsa | ec | aes | arcfour | des | 3des | generic
   Specifies the type of the private or symmetric key to generate.

   For the gencert and gencsr subcommands, the valid private key types are: rsa, ec or dsa.
The default key type is rsa.

   For the genkey subcommand, the valid symmetric key types are: aes, arcfour, des, 3des, or generic. The default key type is aes.

   keyusage=[critical:]usage,usage,usage,...
   Key Usage strings:
   * digitalSignature
   * nonRepudiation
   * keyEncipherment
   * dataEncipherment
   * keyAgreement
   * keyCertSign
   * cRLSign
   * encipherOnly
   * decipherOnly

   Example 1: Set the KeyUsage so that the cert (or csr) can be used for signing and verifying data other than certificates or CRLs (digitalSignature) and also can be used for encrypting and decrypting data other than cryptographic keys (dataEncipherment).
   keyusage=digitalSignature,dataEncipherment

   Example 2: The same as above (Example 1), but with the critical bit set.
   keyusage=critical:digitalSignature,dataEncipherment

   keyvalue=y | n
   This option displays the key value in hex format for the symmetric keys in the file-based and PKCS#11 keystores. The valid values are y and n. The default value is n.

   label=key-label | cert-label
   For the gencert subcommand, this option specifies the label of the private key and self-signed certificate in the PKCS#11 token.

   For the gencsr subcommand, this option specifies the label of the private key in the PKCS#11 token.
For the `list` subcommand, this option specifies the label of the X.509 Certificate (when `objtype=key`) or the private key (when `objtype=cert`) in the PKCS#11 token to refine the list.

For the `delete` subcommand, this option specifies the label of the X.509 Certificate (when `objtype=key`) or the private key (when `objtype=cert`) to delete a designated object from the PKCS#11 token.

`listcurves`
This causes the list of supported Elliptic Curve names to be displayed. This option is only available with the `gencert`, `gencsr`, or `genkeypair` subcommands.

`lifetime=number-hour | number-day | number-year`
Specifies the validity period a certificate is valid. The certificate life time can be specified by `number-hour`, `number-day`, or `number-year`. Only one format can be specified. The default is `1-year`. Examples of this option might be: `lifetime=1-hour, lifetime=2-day, lifetime=3-year`

`newlabel=token label`
This option is only used by the `inittoken` command. This is used to change the label assigned to the token that is being initialized. See the `token` option for details about the format of the token name to be used.

`nickname=cert-nickname`
For the `gencert` subcommand, this option is required to specify the certificate's nickname for NSS keystore.

For the `list` subcommand, this option specifies the nickname of the certificate in the NSS token to display its content. For the `delete` subcommand, to delete a CRL from the NSS token, this option is used to specify the nickname of the issuer's certificate. For the `delete` subcommand, to delete a certificate from the NSS token, this option specifies the nickname of the certificate. For the `import` subcommand, to import a specified input file to the NSS token, this option is required to specify the nickname of the resulting certificate.

`objtype=cert | key | crl`
Specifies the class of the object: `cert`, `key`, or `crl`. For the `download` subcommand, if this option is not specified, default to `crl`.

`objtype=public | private | both`
Specifies the type of object: private object, public object, or both. This option only applies to `list` and `delete` subcommands for the PKCS#11 token when `objtype=key` is specified. The default value is `public`.

For the `list` subcommand, the label option can be combined with this option to further refine the list of keys. For the `delete` subcommand, this option can used to narrow the keys to be deleted to only public, or private ones. Alternately, the label option can be omitted to indicate that all public, private, or both type of keys are to be deleted. The use of `public`,
private and both as choices for the objtype parameter are only applicable with the PKCS#11 keystore in order to maintain compatibility with earlier versions of the pktool command.

outcert=cert-fn
   Specifies the output certificate filename to write to. This option is required for the file based plugin such as OpenSSL. Option outkey=key-fn is required with this option.

outcrl=output-crl-fn
   Specifies the output CRL filename to write to.

outcsr=csr-fn
   Specifies the output CSR filename to write to.

outfile=output-fn
   For the export subcommand, this option specifies the output filename to be created. For the import subcommand, this option specifies the output filename of the certificate or CRL. It only applies to the file based plugin such as OpenSSL. For the download subcommand, if this option is not specified, the downloaded file name is the basename of the URL string.

outformat=pem | der | pkcs12
   For the import subcommand, this option specifies the output format of the certificate or key that is extracted from a specified PKCS#12 file into the file based plugin. The valid values are: pem or der. The default is pem. When importing a CRL to the CRL file based keystore, this option specifies the output format of the CRL. The valid values are: pem or der. The default is der. For the export subcommand, this option specifies the format of the specified output file to be created. The supported formats are: pem, der or pkcs12. The default is pkcs12.

outkey=key-fn
   Specifies the output private key filename to which to write. This option is only required when using the files keystore.

prefix=DBprefix
   Specifies the NSS database prefix. This option only applies to the NSS token.

print=y | n
   This option is used in the genkey subcommand and it applies to the PKCS11 and File-based keystores. If print=y, the genkey subcommand prints out the key value of the generated key in a single line of hex. The default value is n. For the PKCS11 keystore, if a symmetric key is created with sensitive=y or extractable=n, the key value is not displayed, even the print option is set to y. The key is still created, but a warning like cannot reveal the key value is issued.

sensitive=y | n
   Specifies the resulting symmetric key in the PKCS#11 token is sensitive or not sensitive. The valid values are: y and n. The default value is n.
serial=hex-serial-number
   Specifies a unique serial number for a certificate. The serial number must be specified as a
   hex value. Example: 0x0102030405060708090a0b0c0d0e0f

subject=subject-DN
   Specifies a particular certificate owner for a certificate or certificate request. An example
   subject= setting might be:
       subject=O=Sun Microsystems Inc., OU=Solaris Security Technologies Group, L=Ashburn, ST=VA, C=US, CN=John Smith

token=token[:manuf][:serial]
   When a token label contains trailing spaces, this option does not require them to be typed
   as a convenience to the user.

   Colon separate token identification string token:manuf:serial. If any of the parts have a
   literal : char then it needs to be escaped using a backslash (\). If no : is found then the
   entire string (up to 32 chars) is taken as the token label. If only one : is found then the
   string is the token label and the manufacturer. When keystore=nss is specified, default to
   NSS internal token if this option is not specified. When keystore=pkcs11 is specified, default
to pkcs11_softtoken if this option is not specified.

trust=trust-value
   Specifies the certificate trust attributes. This is only for NSS certificates and that the
   standard NSS syntax applies.

usertype=user | so
   Specifies the type of user for which the setPIN command is being performed. The default is
   for a standard user, but so can be specified in order to set the PIN for the security officer of
   the token.

url=url_string
   Specifies the URL to download a CRL or a certificate file.

verifycrl=y | n
   When importing a CRL to NSS keystore, this option specifies whether the CRL verification
   is performed. The valid values are: y and n. The default value is n.

http_proxy=proxy_str
   Specifies the proxy server hostname and port number. The format can be either
   http://hostname[:port] or hostname[:port]. If this option is not specified, the download
   subcommand checks the http_proxy environment variable. The command line option has
   a higher priority than the environment variable.

Examples

   EXAMPLE 1  Generating a Self-Signed Certificate

   The following example creates the certificate and stores it in the keystore indicated in the
   command:
EXAMPLE 1  Generating a Self-Signed Certificate  (Continued)

$ pktool gencert keystore=nss nickname=WebServerCert \  
  subject="O=Sun Microsystems Inc., OU=Solaris Security Technologies Group, \  
  L=Ashburn, ST=VA, C=US, CN=John Smith" dir=/etc/certs \  
  keytype=rsa keylen=2048 hash=sha512

EXAMPLE 2  Generating a Certificate Signing Request

The following example creates the CSR and stores it in the keystore indicated in the  
command:

$ pktool gencsr keystore=nss subject="O=Sun Microsystems Inc., \  
  OU=Solaris Security Technologies Group, L=Ashburn, ST=VA, C=US, \  
  CN=John Smith" keytype=rsa keylen=2048 hash=sha256 outcsr=csr.dat

EXAMPLE 3  Importing a Certificate

The following example imports a certificate object from the specified input file into the  
keystore indicated in the command:

$ pktool import keystore=nss objtype=cert infile=mycert.pem \  
  nickname=mycert

Exit Status  The following exit values are returned:

0
  Successful completion.

>0
  An error occurred.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  attributes(5), pkcs11_softtoken(5)

RSA PKCS#11 v2.11 http://www.rsasecurity.com
RSA PKCS#12 v1.0 http://www.rsasecurity.com
SECG Recommended Elliptic Curve Domain Parameters http://www.secg.org
plabel(1)

Name
plabel – get the label of a process

Synopsis
/usr/bin/plabel [-sS] [pid...]

Description
plabel, a proc tools command, gets the label of a process. If the pid is not specified, the label displayed is that of the plabel command. When options are not specified, the output format of the label is displayed in default format.

Options
- s    Display the label that is associated with pid in short form.
- S    Display the label that is associated with pid in long form.

Exit Status
plabel exits with one of the following values:
0    Successful completion.
1    Unsuccessful completion because of a usage error.
2    Inability to translate label.
3    Inability to allocate memory.

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/trusted</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>See below.</td>
</tr>
</tbody>
</table>

The plabel utility is Committed. The output is Not-an-Interface.

See Also
proc(1), getplabel(3TSOL), attributes(5)

Notes
The functionality described on this manual page is available only if the system is configured with Trusted Extensions.
plgrp – observe and affect home lgroup and lgroup affinities of threads

plgrp displays or sets the home lgroup and lgroup affinities for one or more processes, threads, or LWPs.

An lgroup represents the set of CPU and memory-like hardware devices that are at most some distance (latency) apart from each other. Each lgroup in the system is identified by a unique lgroup ID. The lgroups are organized into a hierarchy to facilitate finding the nearest resources. See lgrpinfo(1) for more about lgroups and the lgroup hierarchy.

By default, each thread is assigned a home lgroup upon creation. When the system needs to allocate a CPU or memory resource for a thread, it searches the lgroup hierarchy from the thread’s home lgroup for the nearest available resources to the thread’s home.

Typically, the home lgroup for a thread is the lgroup for which the thread has the most affinity. Initially, the system chooses a home lgroup for each thread, but leaves the thread’s affinity for that lgroup set to none. If a thread sets a stronger affinity for an lgroup in its processor set other than its home, the thread is rehomed to that lgroup as long as the thread is not bound to a CPU. The thread can be re-homed to the lgroup in its processor set with the next highest affinity when the affinity (if any) for its home lgroup is removed (set to none).

The different levels of lgroup affinities and their semantics are fully described in lgrp_affinity_set(3LGRP).

Usage

Specifying lgroups

lgroup_list is a comma separated list of one or more of the following:

- lgroup_ID
- Range of lgroup_IDS specified as
  <start lgroup_ID>--<end lgroup_ID>
The `all` keyword represents all `lgroup` IDs in the system. The `root` keyword represents the ID of the root `lgroup`. The `leaves` keyword represents the IDs of all leaf `lgroups`, that is, `lgroups` which do not have any children.

### Specifying Processes and Threads

`plgrp` takes one or more space separated processes or threads as arguments. Processes and threads can be specified in a manner similar to the `proc(1)` tools. A process ID can be specified as an integer `pid` or `/proc/pid`. Shell expansions can be used to specify processes when `/proc/pid` is used. For example, `/proc/*` can be used to specify all the processes in the system. If a process ID is given alone, then all the threads of the process are included as arguments to `plgrp`.

A thread can be explicitly specified with its process ID and thread ID given together as `pid/lwpid`. Multiple threads of a process can be selected at once by using the hyphen (-) and comma (,). For example, `pid/1,2,7-9` specifies threads 1, 2, 7, 8, and 9 of the process with `pid` as its process ID.

### Options

The following options are supported:

- `-a lgroup_list`
  
  Display `lgroup` affinities of specified processes or threads for the specified `lgroup_list`.

- `-A lgroup_list/none|weak|strong{, ...}`
  
  Set affinity of specified processes or threads for the specified `lgroup_list`.
  
  A comma separated list of `lgroups/affinity` assignments can be given to set several affinities at once.

- `-F`
  
  Force by grabbing the target process even if another process has control. Caution should be exercised when using the `-F` flag. Imposing two controlling processes on one victim process can lead to chaos. Safety is assured only when the primary controlling process (typically a debugger) has stopped the victim process, but isn't doing anything during the application of this `proc` tool. See WARNINGS for more details.

- `-e`
  
  Create a new process, apply `plgrp` to that process, and execute the specified command and arguments.
plgrp(1)

- h  Get home lgroup of specified processes and/or threads. If no options are specified, this is the default.

- H lgroup_list  Set home lgroup of specified processes and threads.

   This sets a strong affinity for the desired lgroup to re-home the threads. If more than one lgroup is specified, plgrp tries to home the threads to the lgroups in a round robin fashion.

- i  Display lgroup affinity inheritance of the specified processes or threads.

- I default | none | future  Set lgroup affinity inheritance for the specified processes or threads.

Operands  The following operands are supported:

  lwps  Specifies thread. See USAGE.

  pid  Specifies process ID. See USAGE.

Examples  EXAMPLE 1  Getting the Home lgroup for the Shell

The following example gets the home lgroup for the shell:

   % plgrp $$
   PID/LWPID  HOME
   3401/1  1

EXAMPLE 2  Setting the Home lgroup of Multiple Threads to the Root lgroup

The following example sets the home lgroup of multiple threads to the root lgroup:

   % plgrp -H root 'pgrep firefox'
   PID/LWPID  HOME
   918/1  1 => 0
   934/1  2 => 0
   934/2  1 => 0
   934/3  2 => 0
   934/625 1 => 0
   934/626 2 => 0
   934/624 2 => 0
   934/623 2 => 0
   934/630 1 => 0
The following example executes `firefox` with root as the home lgroup of multiple threads:

```
% plgrp -H root -e /usr/bin/firefox
```

```EXAMPLE 4
Getting Two Threads’ Affinities for lgroups 0-2
```

The following example gets two threads’ affinities for lgroups 1–2:

```
% plgrp -a 0-2 101398/1 101337/1
```

<table>
<thead>
<tr>
<th>PID/LWPID</th>
<th>HOME</th>
<th>AFFINITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>101398/1</td>
<td>1</td>
<td>0-2/none</td>
</tr>
<tr>
<td>101337/1</td>
<td>1</td>
<td>0-2/none</td>
</tr>
</tbody>
</table>

```EXAMPLE 5
Setting lgroup Affinities
```

The following example sets lgroup affinities:

```
% plgrp -A 0/weak,1/none,2/strong 101398
```

<table>
<thead>
<tr>
<th>PID/LWPID</th>
<th>HOME</th>
<th>AFFINITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>101398/1</td>
<td>1 =&gt; 2, 0,2/none =&gt; 2/strong,0/weak</td>
<td></td>
</tr>
</tbody>
</table>

**Exit Status**
The following exit values are returned:

0  Successful completion.
1  Syntax error. Nothing was changed.
2  Non-fatal error or interrupt. Something might have changed.

**Attributes**
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>See below.</td>
</tr>
</tbody>
</table>

The command syntax and output formats are Uncommitted.

**See Also**
`lgrpinfo(1), madv.so.1(l), pmadvise(l), pmap(l), proc(1), ps(1), prstat(1M), lgrp_affinity_get(3LGRP), lgrp_affinity_set(3LGRP), lgrp_affinity_inherit_get(3LGRP), lgrp_affinity_inherit_set(3LGRP), lgrp_home(3LGRP), liblgrp(3LIB), proc(4), attributes(5)`

**Warnings**
Like the `proc(1)` tools, the `plgrp` utility stops its target processes while inspecting them and reports the results when invoked with any option.
There are conditions under which processes can deadlock. A process can do nothing while it is stopped. Stopping a heavily used process in a production environment (even for a short amount of time) can cause severe bottlenecks and even hangs of these processes, making them to be unavailable to users. Thus, stopping a UNIX process in a production environment should be avoided. See \texttt{proc(1)}.

A process that is stopped by this tool might be identified by issuing the following command:

\verbatim{/usr/bin/ps -efll}

and looking for a \texttt{T} in the first column of the output. Certain processes, for example, \texttt{sched}, can show the \texttt{T} status by default most of the time.
Name  plimit – get or set the resource limits of running processes

Synopsis  plimit [-km] pid...

plimit { -cdfnstv} soft,hard... pid...

Description  If one or more of the cdfnstv options is specified, plimit sets the soft (current) limit and/or the hard (maximum) limit of the indicated resource(s) in the processes identified by the process-ID list, pid. Otherwise plimit reports the resource limits of the processes identified by the process-ID list, pid.

Only the owner of a process or the super-user is permitted either to get or to set the resource limits of a process. Only the super-user can increase the hard limit.

Options  The following options are supported:

- k   On output, show file sizes in kilobytes (1024 bytes) rather than in 512-byte blocks.
- m   On output, show file and memory sizes in megabytes (1024*1024 bytes).

The remainder of the options are used to change specified resource limits. They each accept an argument of the form:

soft,hard

where soft specifies the soft (current) limit and hard specifies the hard (maximum) limit. If the hard limit is not specified, the comma may be omitted. If the soft limit is an empty string, only the hard limit is set. Each limit is either the literal string unlimited, or a number, with an optional scaling factor, as follows:

nk   n kilobytes
nm   n megabytes (minutes for CPU time)
nh   n hours (for CPU time only)
mm:ss   minutes and seconds (for CPU time only)

The soft limit cannot exceed the hard limit.

- c soft,hard  Set core file size limits (default unit is 512-byte blocks).
- d soft,hard  Set data segment (heap) size limits (default unit is kilobytes).
- f soft,hard  Set file size limits (default unit is 512-byte blocks).
- n soft,hard  Set file descriptor limits (no default unit).
- s soft,hard  Set stack segment size limits (default unit is kilobytes).
- t soft,hard  Set CPU time limits (default unit is seconds).
- v soft,hard  Set virtual memory size limits (default unit is kilobytes).
The following operands are supported.

**pid**  Process ID list.

**Exit Status**  `plimit` returns the exit value zero on success, non-zero on failure (such as no such process, permission denied, or invalid option).

**Files**  `/proc/pid/*`  process information and control files

**Attributes**  See [attributes(5)] for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

**See Also**  `ulimit(1), proc(1), getrlimit(2), setrlimit(2), proc(4), attributes(5),`
pmadvise – applies advice about memory to a process

Synopsis

pmadvise -o option[,option] [-F] [-l] [-v] pid...

Description

pmadvise applies advice about how memory is used in the specified process using madvise(3C).

pmadvise allows users to apply advice to a specific sub-range at a specific instant in time. pmadvise differs from madv.so.1 in that madv.so.1 applies the advice throughout execution of the target program to all segments of a specified type.

Options

The following options are supported:

- F Force by grabbing the target process even if another process has control.
  You should exercise caution when using the -F option. See proc(1).
- l Show unresolved dynamic linker map names.
- o Specify advice to apply in the following form:

  private=advice
  shared=advice
  heap=advice
  stack=advice
  address[:length]=advice

  where the advice can be one of the following:

  normal
  random
  sequential
  willneed
  dontneed
  free
  access_lwp
  access_many
  access_many_pset
  access_default

  An address and length can be given to specify a subrange to apply the advice. The address should be hexadecimal and the length should be in bytes by default.

  If length is not specified and the starting address refers to the start of a segment, the advice is applied to that segment. length can be qualified by K, M, G, T, P, or E to specify kilobytes, megabytes, gigabytes, terabytes, or exabytes respectively as the unit of measure.

- v Print verbose output. Display output as pmap(1) does, showing what advice is being applied where. This can be useful when the advice is being applied to a named region (for example, private, shared, and so forth) to get feedback on exactly where the advice
is being applied.

`pmadvise` tries to process all legal options. If an illegal address range is specified, an error message is printed and the offending option is skipped. `pmadvise` quits without processing any options and prints a usage message when there is a syntax error.

If conflicting advice is given on a region, the order of precedence is from most specific advice to least, that is, most general. In other words, advice specified for a particular address range takes precedence over advice for heap and stack which in turn takes precedence over advice for private and shared memory.

Moreover, the advice in each of the following groups are mutually exclusive from the other advice within the same group:

- `MADV_NORMAL, MADV_RANDOM, MADV_SEQUENTIAL`
- `MADV_WILLNEED, MADV_DONTNEED, MADV_FREE`
- `MADV_ACCESS_DEFAULT, MADV_ACCESS_LWP, MADV_ACCESS_MANY`

**Operands**  The following operands are supported:

- `pid`  Process ID.

**Examples**  **EXAMPLE 1   Applying Advice to a Segment at Specified Address**

The following example applies advice to a segment at a specified address:

```bash
% pmadvise -o 78000=access_lwp $$
```

```
Operands  The following operands are supported:

pid  Process ID.

% pmap $$
100666: tcsh
 00010000 312K r-x-- /usr/bin/tcsh
 0006C000 48K rwx-- /usr/bin/tcsh
 00078000 536K rwx-- [ heap ]
 FF100000 856K r-x-- /lib/libc.so.1
 FF1E6000 32K rwx-- /lib/libc.so.1
 FF1EE000 8K rwx-- /lib/libc.so.1
 FF230000 168K r-x-- /lib/libcurses.so.1
 FF26A000 32K rwx-- /lib/libcurses.so.1
 FF272000 8K rwx-- /lib/libcurses.so.1
 FF280000 576K r-x-- /lib/libnsl.so.1
 FF310000 40K rwx-- /lib/libnsl.so.1
 FF31A000 24K rwx-- /lib/libnsl.so.1
 FF364000 8K rwx-- [ anon ]
 FF370000 40K r-x-- /lib/libsocket.so.1
 FF38C000 8K rwx-- /lib/libsocket.so.1
 FF380000 176K r-x-- /lib/ld.so.1
 FF3EC000 8K rwx-- /lib/ld.so.1
 FF3EE000 8K rwx-- /lib/ld.so.1
 FFBE6000 104K rw--- [ stack ]
%
```
EXAMPLE 1 Applying Advice to a Segment at Specified Address  (Continued)

% pmadvise -o heap=access_lwp,stack=access_default -v $$
1720:  -sh
00010000  88K r-x-- /usr/sbin/sh
00036000  8K rwx-- /usr/sbin/sh
00038000  16K rwx-- [ heap ] <= access_lwp
FF250000  24K r-x-- /lib/libgen.so.1
FF266000  8K rwx-- /lib/libgen.so.1
FF272000  8K rwxS- [ anon ]
FF280000  840K r-x-- /lib/libc.so.1
FF362000  32K rwx-- /lib/libc.so.1
FF36A000  16K rwx-- /lib/libc.so.1
FF390000  64K rwx-- [ anon ]
FF3B0000  168K r-x-- /lib/ld.so.1
FF3EC000  8K rwx-- /lib/ld.so.1
FFBFE000  8K rwxS- [ stack ] <= access_default

EXAMPLE 2 Using the -v Option
The following example displays verbose output from pmadvise:

% pmadvise -o heap=access_lwp,stack=access_default -v $$
1720:  -sh
00010000  88K r-x-- /usr/sbin/sh
00036000  8K rwx-- /usr/sbin/sh
00038000  16K rwx-- [ heap ] <= access_lwp
FF250000  24K r-x-- /lib/libgen.so.1
FF266000  8K rwx-- /lib/libgen.so.1
FF272000  8K rwxS- [ anon ]
FF280000  840K r-x-- /lib/libc.so.1
FF362000  32K rwx-- /lib/libc.so.1
FF36A000  16K rwx-- /lib/libc.so.1
FF390000  64K rwx-- [ anon ]
FF3B0000  168K r-x-- /lib/ld.so.1
FF3EC000  8K rwx-- /lib/ld.so.1
FFBFE000  8K rwxS- [ stack ] <= access_default

Exit Status  The following exit values are returned:

0       Successful completion.
non-zero An error occurred.

Files    /proc/* Process files
         /usr/prob/lib/* proc tools support files

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>See below.</td>
</tr>
</tbody>
</table>

The command syntax is Committed. The output formats are Uncommitted.
pmadvise(1)

See Also  madv.so.1(1), pmap(1), proc(1), madvise(3C), attributes(5)
**Name**

pmap – display information about the address space of a process

**Synopsis**

```
/usr/bin/pmap [-rs\F] [-A address_range] [pid | core]...

/usr/bin/pmap -L [-rs\F] [-A address_range] [pid]...

/usr/bin/pmap -x [-as\F] [-A address_range] [pid | core]...

/usr/bin/pmap -S [-al\F] [-A address_range] [pid | core]...
```

**Description**

The `pmap` utility prints information about the address space of a process.

**Options**

The following options are supported:

- `-a`
  - Prints anonymous and swap reservations for shared mappings.

- `-A address_range`
  - Specifies the subrange of address space to display. *address_range* is specified in one of the following forms:
    - `start_addr`
      - A single address limits the output to the segment (or the page if the `-L` option is present) containing that address. If the specified address corresponds to the starting address of a segment, the output always includes the whole segment even when the `-L` option is specified.
    - `start_addr,`
      - An address followed by comma without the end address limits the output to all segments (or pages if the `-L` option is present) starting from the one containing the specified address.
    - `start_addr,end_addr`
      - An address range specified by the start address and end addresses limits the output to all segments (or pages if the `-L` option is present) starting from the segment or page containing the start address through the segment or page containing the end address.
    - `,end_addr`
      - An address range started with comma without the start address limits the output to all segments (or pages if the `-L` option is present) starting from the first one present until the segment (or page if the `-L` option is present) containing the specified address.

- `-F`
  - Force. Grabs the target process even if another process has control.

  See *USAGE*.

- `-l`
  - Shows unresolved dynamic linker map names.

- `-L`
  - Prints lgroup containing physical memory that backs virtual memory.

- `-r`
  - Prints the process's reserved addresses.

- `-s`
  - Prints HAT page size information.
pmap(1)

-S Displays swap reservation information per mapping. See USAGE for more information.

-x Displays additional information per mapping. See USAGE for more information.

Usage

The pmap utility prints information about the address space of a process.

Process Mappings

/usr/bin/pmap [-rslF] [-A address_range] [ pid | core ] ...

By default, pmap displays all of the mappings in the virtual address order they are mapped into the process. The mapping size, flags, and mapped object name are shown.

The -A option can be used to limit the output to a specified address range. The specified addresses are rounded up or down to a segment boundary and the output includes the segments bounded by those addresses.

Process Lgroup Mappings

/usr/bin/pmap -L [-rslF] [-A address_range] pid ...

The -L option can be used to determine the lgroup containing the physical memory backing the specified virtual memory. When used with the -A option, the specified addresses are rounded up or down to a page boundary and the output is limited to the page or pages bounded by those addresses.

This can be used in conjunction with plgrp(1) to discover whether the home lgroup of a thread of interest is the same as where the memory is located and whether there should be memory locality for the thread. The lgrpinfo(1) command can also be useful with this pmap option. It displays the lgroup hierarchy, contents, and characteristics which gives more information about the lgroups that the memory is distributed across and their relationship to each other and any other lgroups of interest.

In addition, the thread and memory placement can be changed by using plgrp(1), pmadvise(1), or madv.so.1(1).
Process anon/locked mapping details
/usr/bin/pmap -x [ -aslF ] [-A address_range] [ pid | core ] ...

The -x option displays additional information per mapping. The size of each mapping, the amount of resident physical memory (RSS), the amount of anonymous memory, and the amount of memory locked is shown with this option. This does not include anonymous memory taken by kernel address space due to this process.

Swap Reservations
/usr/bin/pmap -S [ -alF ] [-A address_range] [ pid | core ] ...

The -S option displays swap reservation information per mapping.

Caution should be exercised when using the -F flag. Imposing two controlling processes on one victim process can lead to chaos. Safety is assured only if the primary controlling process, typically a debugger, has stopped the victim process and the primary controlling process is doing nothing at the moment of application of the proc tool in question.

Display Formats

One line of output is printed for each mapping within the process, unless the -s or -L option is specified. With -s option, one line is printed for a contiguous mapping of each hardware translation page size. With -L option one line is printed for a contiguous mapping belonging to the same lgroup. With both -L and -s options, one line is printed for a contiguous mapping of each hardware translation page size belonging to the same lgroup. The column headings are shown in parentheses below.

Virtual Address (Address) The first column of output represents the starting virtual address of each mapping. Virtual addresses are displayed in ascending order.

Virtual Mapping Size (Kbytes) The virtual size in kilobytes of each mapping.

Resident Physical Memory (RSS) The amount of physical memory in kilobytes that is resident for each mapping, including that which is shared with other address spaces.

Anonymous Memory (Anon) The number of pages, counted by using the system page size, of anonymous memory associated with the specified mapping. Anonymous memory shared with other address spaces is not included, unless the -a option is specified.
Anonymous memory is reported for the process heap, stack, for ‘copy on write’ pages with mappings mapped with MAP_PRIVATE (see mmap(2)).

Locked (Locked) The number of pages locked within the mapping. Typical examples are memory locked with mlock() and System V shared memory created with SHM/share/mmU.

Permissions/Flags (Mode) The virtual memory permissions are shown for each mapping. Valid permissions are:

- **r**: The mapping can be read by the process.
- **w**: The mapping can be written by the process.
- **x**: Instructions that reside within the mapping can be executed by the process.

Flags showing additional information for each mapping can be displayed:

- **s**: The mapping is shared such that changes made in the observed address space are committed to the mapped file, and are visible from all other processes sharing the mapping.
- **R**: Swap space is not reserved for this mapping. Mappings created with MAP_NORESERVE and System V ISM shared memory mappings do not reserve swap space.
- *****: The data for the mapping is not present in the core file (only applicable when applied to a core file). See coreadm(1M) for information on configuring core file content.

Lgroup (Lgrp) The lgroup containing the physical memory that backs the specified mapping.

Mapping Name (Mapped File) A descriptive name for each mapping. The following major types of names are displayed for mappings:

- **A mapped file**: For mappings between a process and a file, the pmap command attempts to resolve the file name for each mapping. If the file name cannot be resolved, pmap displays the major and minor number of the device containing the file, and the file system inode number of the file.
Anonymous memory: Memory not relating to any named object or file within the file system is reported as [ anon ].

The pmap command displays common names for certain known anonymous memory mappings:

- [ heap ] The mapping is the process heap.
- [ stack ] The mapping is the main stack.
- [ stack tid=n ] The mapping is the stack for thread n.
- [ altstack tid=n ] The mapping is used as the alternate signal stack for thread n.

If the common name for the mapping is unknown, pmap displays [ anon ] as the mapping name.

System V Shared Memory: Mappings created using System V shared memory system calls are reported with the names shown below:

- shmid=n: The mapping is a System V shared memory mapping. The shared memory identifier that the mapping was created with is reported.
- ism shmid=n: The mapping is an "Intimate Shared Memory" variant of System V shared memory. ISM mappings are created with the SHM_SHARE_MMU flag set, in accordance with shmat(2) (see shmop(2)).
- dism shmid=n: The mapping is a pageable variant of ISM. Pageable ISM is created with the SHM_PAGEABLE flag set in accordance with shmat(2) (see shmop(2)).
Other: Mappings of other objects, including devices such as frame buffers. No mapping name is shown for other mapped objects.

<table>
<thead>
<tr>
<th>Page Size (Pgsz)</th>
<th>The page size in kilobytes that is used for hardware address translation for this mapping. See <code>memcntl(2)</code> for further information.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swap Space (Swap)</td>
<td>The amount of swap space in kilobytes that is reserved for this mapping. That is, swap space that is deducted from the total available pool of reservable swap space that is displayed with the command <code>swap -s</code>. See <code>swap(1M)</code>.</td>
</tr>
</tbody>
</table>

**Examples**

**EXAMPLE 1  Displaying Process Mappings**

By default, `pmap` prints one line for each mapping within the address space of the target process. The following example displays the address space of a typical bourne shell:

```bash
eexample$ pmap 102905
102905:  sh
00010000 192K r-x-- /usr/bin/ksh
00040000  8K rwx-- /usr/bin/ksh
00042000  40K rwx--  [ heap ]
FF180000  664K r-x-- /usr/lib/libc.so.1
FF236000  24K rwx-- /usr/lib/libc.so.1
FF23C000  8K rwx-- /usr/lib/libc.so.1
FF250000  8K rwx--  [ anon ]
FF260000  16K r-x-- /usr/lib/en_US.ISO8859-1.so.2
FF272000  16K rwx-- /usr/lib/en_US.ISO8859-1.so.2
FF280000  560K r-x-- /usr/lib/libnsl.so.1
FF31C000  32K rwx-- /usr/lib/libnsl.so.1
FF324000  32K rwx-- /usr/lib/libnsl.so.1
FF350000  16K r-x-- /usr/lib/libmp.so.2
FF364000  8K rwx-- /usr/lib/libmp.so.2
FF380000  40K r-x-- /usr/lib/libsocket.so.1
FF39A000  8K rwx-- /usr/lib/libsocket.so.1
FF3A0000  8K r-x-- /usr/lib/libdl.so.1
FF3B0000  8K rwx--  [ anon ]
FF3C0000  152K r-x-- /usr/lib/ld.so.1
FF3F6000  8K rwx-- /usr/lib/ld.so.1
FFBFC000  16K rw---  [ stack ]
total  1864
```
Displaying Memory Allocation and Mapping Types

The `-x` option can be used to provide information about the memory allocation and mapping types per mapping. The amount of resident, non-shared anonymous, and locked memory is shown for each mapping:

```
example$ pmap -x 102908
102908: sh
Address Kbytes RSS Anon Locked Mode Mapped File
00010000 88 88 - - r-x-- sh
00036000 8 8 8 - rwx-- sh
00038000 16 16 16 - rwx-- [ heap ]
FF260000 16 16 - - r-x-- en_US.ISO8859-1.so.2
FF272000 16 16 - - rwx-- en_US.ISO8859-1.so.2
FF280000 664 624 - - r-x-- libc.so.1
FF336000 32 32 8 - rwx-- libc.so.1
FF380000 24 24 - - r-x-- libgen.so.1
FF396000 8 8 - - rwx-- libgen.so.1
FF3A0000 8 8 - - r-x-- libdl.so.1
FF3B0000 8 8 8 - rwx-- [ anon ]
FF3C0000 152 152 - - r-x-- ld.so.1
FF3F6000 8 8 8 - rwx-- ld.so.1
FFBFE000 888- rw--- [ stack ]
```

In the above example, the bourne shell has a resident memory size of 1032Kbytes. However, a large amount of the physical memory used by the shell is shared with other instances of shell. Another identical instance of the shell shares physical memory with the other shell where possible, and allocate anonymous memory for any non-shared portion. In the above example, each additional bourne shell uses approximately 56Kbytes of additional physical memory.

A more complex example shows the output format for a process containing different mapping types. In this example, the mappings are as follows:

```
00010000: Executable text, mapped from 'maps' program
00020000: Executable data, mapped from 'maps' program
00022000: Program heap
03000000: A mapped file, mapped MAP_SHARED
04000000: A mapped file, mapped MAP_PRIVATE
```

EXAMPLE 2  Displaying Memory Allocation and Mapping Types  (Continued)

0500000: A mapped file, mapped MAP_PRIVATE | MAP_NORESERVE

0600000: Anonymous memory, created by mapping /dev/zero

0700000: Anonymous memory, created by mapping /dev/zero
with MAP_NORESERVE

0800000: A DISM shared memory mapping, created with SHM_PAGEABLE
with 8MB locked via mlock(2)

0900000: A DISM shared memory mapping, created with SHM_PAGEABLE,
with 4MB of its pages touched.

0A00000: A DISM shared memory mapping, created with SHM_PAGEABLE,
with none of its pages touched.

0B00000: An ISM shared memory mapping, created with SHM_SHARE_MMU

example$ pmap -x 15492

15492: ./maps

Address Kbytes RSS Anon Locked Mode Mapped File

00010000  8  8  -  -  r-x--- maps
00020000  8  8  8  -  rwxx--- maps
00022000 20344 16248 16248  -  rwxx--- [ heap ]
03000000 1024 1024  -  -  rw-s- dev:0,2 ino:4628487
04000000 1024 1024 512  -  rw--- dev:0,2 ino:4628487
05000000 1024 1024 512  -  rw--R  dev:0,2 ino:4628487
06000000 1024 1024 1024  -  rw--- [ anon ]
07000000 512 512  512  -  rw--R  [ anon ]
08000000 8192 8192  -  -  rwxs- [ dism shmid=0x5]
09000000 8192 4096  -  -  rwxs- [ dism shmid=0x4]
0A000000 8192 8192  -  -  rwxsR [ ism shmid=0x2 ]
0B000000 8192 8192  -  -  rwxsR [ ism shmid=0x3 ]
FF280000 680 672  -  -  r-x--- libc.so.1
FF33A000 32 32  32  -  rwxx--- libc.so.1
FF3A0000 8  8  -  -  r-x--- libdl.so.1
FF3B0000 8  8  8  -  rwxx--- [ anon ]
FF3C0000 152 152  -  -  r-x--- ld.so.1
FF3F6000 8  8  8  -  rwxx--- ld.so.1
FFBFA000 24 24  24  -  rwxx--- [ stack ]

---------- ---------- ---------- ----------
total Kb 50456 42256 18888 16384
EXAMPLE 3  Displaying Page Size Information

The -s option can be used to display the hardware translation page sizes for each portion of the address space. (See memcntl(2) for further information on Solaris multiple page size support).

In the example below, we can see that the majority of the mappings are using an 8K-Byte page size, while the heap is using a 4M-Byte page size.

Notice that non-contiguous regions of resident pages of the same page size are reported as separate mappings. In the example below, the libc.so library is reported as separate mappings, since only some of the libc.so text is resident:

example$ pmap -xs 15492
15492: ./maps

<table>
<thead>
<tr>
<th>Address</th>
<th>Kbytes</th>
<th>RSS</th>
<th>Anon</th>
<th>Locked</th>
<th>Pgsz</th>
<th>Mode</th>
<th>Mapped File</th>
</tr>
</thead>
<tbody>
<tr>
<td>00010000 8 8 8 8 8K r-x--</td>
<td>maps</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>00020000 8 8 8 8 8K rwx--</td>
<td>maps</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>00022000 3960 3960 3960 8K rwx-- [ heap ]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>00840000 8192 8192 8192 4M rwx-- [ heap ]</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>00C000000 4096 - - - rwx-- [ heap ]</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>01000000 4096 4096 4096 4M rwx-- [ heap ]</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>03000000 1024 1024 - - 8K rws- dev:0,2 ino:4628487</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>04000000 512 512 512 8K rwx-- dev:0,2 ino:4628487</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>04080000 512 512 - - - rwxs- dev:0,2 ino:4628487</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>05000000 512 512 512 8K rwx-R dev:0,2 ino:4628487</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>05080000 512 512 - - - rwxs- dev:0,2 ino:4628487</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>06000000 1024 1024 1024 - 8K rwx-- [ anon ]</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>07000000 512 512 512 8K rwx-R [ anon ]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08000000 8192 8192 - 8192 - rwxs- dism shmid=0x5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>09000000 4096 4096 - - 8K rwxs- dism shmid=0x4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0A000000 4096 - - - rwxs- dism shmid=0x2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0B000000 8192 8192 - 8192 4M rwxsR [ ism shmid=0x3 ]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FF280000 136 136 - - 8K r-x-- libc.so.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FF2A2000 120 120 - - r-x-- libc.so.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FF2C0000 128 128 - - 8K r-x-- libc.so.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FF2E0000 200 200 - - r-x-- libc.so.1</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>FF312000 48 48 - - 8K r-x-- libc.so.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FF31E000 48 40 - - - r-x-- libc.so.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FF33A000 32 32 32 - 8K rwx-- libc.so.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FF3A0000 8 8 8 - 8K r-x-- libdl.so.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FF3B0000 8 8 8 - 8K rwx-- [ anon ]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FF3C0000 152 152 - - 8K r-x-- ld.so.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FF3F6000 8 8 8 - 8K rwx-- ld.so.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FFBFA0000 24 24 24 - 8K rwx-- [ stack ]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

--------- ------- ------- ------- ------- -------
total Kb 50456 42256 18888 16384
EXAMPLE 4    Displaying Swap Reservations

The -S option can be used to describe the swap reservations for a process. The amount of swap space reserved is displayed for each mapping within the process. Swap reservations are reported as zero for shared mappings, since they are accounted for only once system wide.

```
example$ pmap -S 15492
15492:  ./maps
Address  Kbytes  Swap Mode  Mapped File
00010000  8 -  r-x--  maps
00020000  8  8  rwx--  maps
00022000 20344 20344  rwx--  [ heap ]
01000000 1024  -  rw-s-  dev:0,2 ino:4628487
02000000 1024 1024  rwx--  dev:0,2 ino:4628487
05000000 1024 512  rwx--  dev:0,2 ino:4628487
06000000 1024 1024  rwx--  [ anon ]
07000000 512 512  rwx--  [ anon ]
08000000 8192  -  rwx--  [ dism shmid=0x5]
09000000 8192  -  rwx--  [ dism shmid=0x4]
0A000000 8192  -  rwx--  [ dism shmid=0x3]
0B000000 8192  -  rwx--  [ dism shmid=0x2]
FF280000 680  -  r-x--  libc.so.1
FF33A000 32  32  rwx--  libc.so.1
FF3A0000 8  -  r-x--  libdl.so.1
FF3B0000 8  8  rwx--  [ anon ]
FF3C0000 152  -  r-x--  ld.so.1
FF3F6000 8  8  rwx--  ld.so.1
FEBFA000 24 24  rwx--  [ stack ]
--------  --------  --------  --------
total Kb  50456  23496
```

The swap reservation information can be used to estimate the amount of virtual swap used by each additional process. Each process consumes virtual swap from a global virtual swap pool. Global swap reservations are reported by the 'avail' field of the `swap(1M)` command.

EXAMPLE 5    Labeling Stacks in a Multi-threaded Process

```
example$ pmap 121969
121969:  ./stacks
00010000  8K  r-x--  /tmp/stacks
00020000  8K  rwx--  /tmp/stacks
008FA000 8K  rwx--  [ stack tid=11 ]
010F0000 8K  rwx--  [ stack tid=10 ]
012F0000 8K  rwx--  [ stack tid=9 ]
010F0000 8K  rwx--  [ stack tid=8 ]
014F0000 8K  rwx--  [ stack tid=7 ]
016F0000 8K  rwx--  [ stack tid=6 ]
018F0000 8K  rwx--  [ stack tid=5 ]
01AF0000 8K  rwx--  [ stack tid=4 ]
```
### Example 5  
Labeling Stacks in a Multi-threaded Process (Continued)

<table>
<thead>
<tr>
<th>Address</th>
<th>Size</th>
<th>Permissions</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FF0FA000</td>
<td>8K</td>
<td>rwx-R</td>
<td>[ stack tid=3 ]</td>
</tr>
<tr>
<td>FF1FA000</td>
<td>8K</td>
<td>rwx-R</td>
<td>[ stack tid=2 ]</td>
</tr>
<tr>
<td>FF200000</td>
<td>64K</td>
<td>rw---</td>
<td>[ altstack tid=8 ]</td>
</tr>
<tr>
<td>FF220000</td>
<td>64K</td>
<td>rw---</td>
<td>[ altstack tid=4 ]</td>
</tr>
<tr>
<td>FF240000</td>
<td>112K</td>
<td>rw---</td>
<td>[ anon ]</td>
</tr>
<tr>
<td>FF260000</td>
<td>16K</td>
<td>rw---</td>
<td>[ anon ]</td>
</tr>
<tr>
<td>FF280000</td>
<td>672K</td>
<td>r-x--</td>
<td>/usr/lib/libc.so.1</td>
</tr>
<tr>
<td>FF338000</td>
<td>24K</td>
<td>rwx--</td>
<td>/usr/lib/libc.so.1</td>
</tr>
<tr>
<td>FF33E000</td>
<td>8K</td>
<td>rwx--</td>
<td>/usr/lib/libc.so.1</td>
</tr>
<tr>
<td>FF35A000</td>
<td>8K</td>
<td>rwxs-</td>
<td>[ anon ]</td>
</tr>
<tr>
<td>FF360000</td>
<td>104K</td>
<td>r-x--</td>
<td>/usr/lib/libthread.so.1</td>
</tr>
<tr>
<td>FF38A000</td>
<td>8K</td>
<td>rwx--</td>
<td>/usr/lib/libthread.so.1</td>
</tr>
<tr>
<td>FF38C000</td>
<td>8K</td>
<td>rwx--</td>
<td>/usr/lib/libthread.so.1</td>
</tr>
<tr>
<td>FF3A0000</td>
<td>8K</td>
<td>r-x--</td>
<td>/usr/lib/libdl.so.1</td>
</tr>
<tr>
<td>FF3B0000</td>
<td>8K</td>
<td>rwx--</td>
<td>/usr/lib/ld.so.1</td>
</tr>
<tr>
<td>FD80A000</td>
<td>24K</td>
<td>rwx--</td>
<td>[ anon ]</td>
</tr>
<tr>
<td>FD820000</td>
<td>8K</td>
<td>r-x--</td>
<td>/lib/libmd5.so.1</td>
</tr>
<tr>
<td>FD840000</td>
<td>16K</td>
<td>r-x--</td>
<td>/lib/libmp.so.2</td>
</tr>
<tr>
<td>FD860000</td>
<td>8K</td>
<td>r-x--</td>
<td>/lib/straddr.so.2</td>
</tr>
<tr>
<td>FD872000</td>
<td>8K</td>
<td>rwx--</td>
<td>/lib/straddr.so.2</td>
</tr>
<tr>
<td>FD97A000</td>
<td>8K</td>
<td>r-x--</td>
<td>[ stack tid=24 ]</td>
</tr>
<tr>
<td>FD990000</td>
<td>8K</td>
<td>r-x--</td>
<td>/lib/nss_nis.so.1</td>
</tr>
<tr>
<td>FD992000</td>
<td>16K</td>
<td>r-x--</td>
<td>/lib/nss_nis.so.1</td>
</tr>
<tr>
<td>FD9A6000</td>
<td>8K</td>
<td>rwx--</td>
<td>/lib/nss_nis.so.1</td>
</tr>
<tr>
<td>FD9C0000</td>
<td>8K</td>
<td>rw---</td>
<td>[ anon ]</td>
</tr>
<tr>
<td>FD9D0000</td>
<td>8K</td>
<td>r-x--</td>
<td>/lib/nss_files.so.1</td>
</tr>
<tr>
<td>FD9D2000</td>
<td>16K</td>
<td>r-x--</td>
<td>/lib/nss_files.so.1</td>
</tr>
</tbody>
</table>

### Example 6  
Displaying lgroup Memory Allocation

The following example displays lgroup memory allocation by mapping:

```bash
example5 pmap -L 'pgrep nscl'
```

```
100005: /usr/sbin/nscl
  00010000  8K r-x--  2 /usr/sbin/nscl
  00012000  48K r-x--  1 /usr/sbin/nscl
  0002E000  8K rwxs-  2 /usr/sbin/nscl
  00030000  16K rwx--  1 [ heap ]
  00034000  8K rwxs-  1 [ heap ]

  .
  .

  FD80A000  24K rwxs-  2 [ anon ]
  FD820000  8K r-x--  2 /lib/libmd5.so.1
  FD840000  16K r-x--  1 /lib/libmp.so.2
  FD860000  8K r-x--  2 /lib/straddr.so.2
  FD872000  8K rwxs-  1 /lib/straddr.so.2
  FD97A000  8K rw-R   1 [ stack tid=24 ]
  FD990000  8K r-x--  2 /lib/nss_nis.so.1
  FD992000  16K r-x--  1 /lib/nss_nis.so.1
  FD9A6000  8K rwx--  1 /lib/nss_nis.so.1
  FD9C0000  8K rw---  2 [ anon ]
  FD9D0000  8K r-x--  2 /lib/nss_files.so.1
  FD9D2000  16K r-x--  1 /lib/nss_files.so.1
```

User Commands 1445
EXAMPLE 6  Displaying lgroup Memory Allocation  (Continued)

FD9E6000  8K rwx--  2 /lib/nss_files.so.1
FDADA000  8K rw--R  2 [ stack tid=23 ]
FDBFA000  8K rw--R  1 [ stack tid=22 ]
FDCFA000  8K rw--R  1 [ stack tid=21 ]
FDDFA000  8K rw--R  1 [ stack tid=20 ]
   .
   .
FEFFA000  8K rw--R  1 [ stack tid=2 ]
FF000000  8K rwx--  2 [ anon ]
FF004000  16K rwx--  1 [ anon ]
FF00A000  16K rwx--  1 [ anon ]
   .
   .
FF3EE000  8K rwx--  2 /lib/ld.so.1
FFBFE000  8K rw---  2 [ stack ]
total   2968K

Exit Status  The following exit values are returned:
            0    Successful operation.
            non-zero  An error has occurred.

Files  /proc/*  process files
       /usr/proc/lib/*  proc tools supporting files

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTETYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>See below.</td>
</tr>
</tbody>
</table>

The command syntax is Committed. The -L option and the output formats are Uncommitted.

See Also  ldd(1), lgrpinfo(1), madv.so.1(1), mdb(1), plgrp(1), pmadvise(1), proc(1), ps(1),
coreadm(1M), prstat(1M), swap(1M), mmap(2), memcntl(2), meminfo(2), shmop(2),
dlopen(3C), proc(4), attributes(5)
pm-updatemanager checks for and installs available updates for the packages installed on the system.

Note – If the package/pkg, package/pkg/package-manager, or package/pkg/update-manager packages need to be updated, pm-updatemanager first updates these packages and then restarts to carry out any remaining updates.

Options

The following options are supported:

- **h**
  - **--help**
    - Display a usage message.

- **d**
  - **--debug**
    - Run pm-updatemanager in debug mode.

- **R dir**
  - **--image-dir dir**
    - Operate on the image rooted at dir, rather than on the image discovered automatically.

Examples

**EXAMPLE 1** Update the Current Image

Invoke pm-updatemanager on the current image. This checks for and installs all available updates for packages installed in the current image.

$ /usr/lib/pm-launch pm-updatemanager

This is the same command that the desktop menu option System>Administration>Update Manager invokes.

**EXAMPLE 2** Update a Specified Image

Invoke pm-updatemanager on the image stored at /aux0/example_root.

$ /usr/lib/pm-launch pm-updatemanager -R /aux0/example_root

Exit Status

The following exit values are returned:

0  Everything worked.
1  An error occurred.
2  Invalid command line options were specified.
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>package/pkg/update-manager</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Uncommitted</td>
</tr>
</tbody>
</table>

See Also  package.manager(1), pkg(1), pkg(5)

http://hub.opensolaris.org/bin/view/Project+pkg/

Notes  When operating on an image you do not own, pm-updatemanager needs to be invoked with enough privilege. You will normally invoke pm-updatemanager using /usr/lib/pm-launch under these circumstances.
The `ppgsz` utility sets the preferred page size for stack, heap, and/or other anonymous segments for the target process(es), that is, the launched `cmd` or the process(es) in the pid list. `ppgsz` stops the target process(es) while changing the page size. See `memcntl(2)`.

The following options are supported:

- `-F` Force. Sets the preferred page size options(s) for target process(es) even if controlled by other process(es). Caution should be exercised when using the `-F` flag. See `proc(1)`.

- `-o option[,option]` The options are:
  
  `heap=size` This option specifies the preferred page size for the heap of the target process(es). `heap` is defined to be the bss (uninitialized data) and the brk area that immediately follows the bss (see `brk(2)`). The preferred heap page size is set for the existing heap and for any additional heap memory allocated in the future. See NOTES.

  `stack=size` This option specifies the preferred page size for the stack of the target process(es). The preferred stack page size is set for the existing stack and newly allocated parts of the stack as it expands.

  `anon=size` This option specifies the preferred page size for all existing MAP_PRIVATE anonymous segments of the target process(es), other than `heap` and `stack`, which are large enough to fit at least one aligned page of the specified size. For the segments that are large enough, the preferred page size is set starting at the first size-aligned address in the segment. The anon preferred pagesize is not applied to MAP_PRIVATE anonymous segments created in the future. See MAP_ANON in `mmap(2)`.

Anonymous memory refers to MAP_PRIVATE pages that are not directly associated with a file in some filesystem. The `ppgsz` command uses `memcntl(2)` to set the preferred page size for anonymous segments. See `MC_HAT_ADVISE` in `memcntl(2)`.

At least one of the above options must be specified.
size must be a supported page size (see `pagesize(1)` or 0, in which case the system will select an appropriate page size. See `mempctl(2)`.

`size` defaults to bytes and can be specified in octal (0), decimal, or hexadecimal (0x). The numeric value can be qualified with K, M, G, or T to specify Kilobytes, Megabytes, Gigabytes, or Terabytes, respectively. 4194304, 0x400000, 4096K, 0x1000K, and 4M are different ways to specify 4 Megabytes.

`-p pid` Sets the preferred page size option(s) for the target process(es) in the process-id (pid) list following the -p option. The pid list can also consist of names in the `/proc` directory. Only the process owner or the super-user is permitted to set page `size`.

`cmd` is interpreted if -p is not specified. `ppgsz` launches `cmd` and applies page size option(s) to the new process.

The heap and stack preferred page sizes are inherited. Child process(es) created (see `fork(2)`) from the launched process or the target process(es) in the pid list after `ppgsz` completes will inherit the preferred heap and stack page sizes. The preferred page sizes of all segments are set back to the default system page size on `exec(2)` (see `getpagesize(3C)`). The preferred page size for all other anonymous segments is not inherited by children of the launched or target process(es).

**Examples**

**EXAMPLE 1** Setting the preferred heap and stack page size

The following example sets the preferred heap page size to 4M and the preferred stack page size to 512K for all ora—owned processes running commands that begin with ora:

```
example% ppgsz -o heap=4M,stack=512K -p 'pgrep -u ora "^ora"'
```

**EXAMPLE 2** Setting the preferred anonymous page size

The following example sets the preferred page size of existing qualifying anonymous segments to 512K for process ID 953:

```
example% ppgsz -o anon=512k -p 953
```

**Exit Status** If `cmd` is specified and successfully invoked (see `exec(2)`), the exit status of `ppgsz` will be the exit status of `cmd`. Otherwise, `ppgsz` will exit with one of the following values:

<table>
<thead>
<tr>
<th>Exit Status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successfully set preferred page size(s) for processes in the pid list.</td>
</tr>
<tr>
<td>125</td>
<td>An error occurred in <code>ppgsz</code>. Errors include: invalid argument, invalid page size(s) specified, and failure to set preferred page size(s) for one or more processes in the pid list or <code>cmd</code>.</td>
</tr>
</tbody>
</table>
cmd was found but could not be invoked.

`cmd` could not be found.

**Files**

- `/proc/*` - Process files.
- `/usr/lib/ld/map.bssalign` - A template link-editor mapfile for aligning bss (see NOTES).

**Attributes**

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/extended-system-utilities</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

**See Also**

```
ld(1), mpss.so.1(1), pagesize(1), pgrep(1), pmap(1), proc(1), brk(2), exec(2), fork(2), memcntl(2), mmap(2), sbrk(2), getpagesize(3C), proc(4), attributes(5)
```

**Linker and Libraries Guide**

Due to resource constraints, the setting of the preferred page size does not necessarily guarantee that the target process(es) will get the preferred page size. Use `pmap(1)` to view the actual heap and stack page sizes of the target process(es) (see `pmap -s` option).

Large pages are required to be mapped at addresses that are multiples of the size of the large page. Given that the heap is typically not large page aligned, the starting portions of the heap (below the first large page aligned address) are mapped with the system memory page size. See `getpagesize(3C)`.

To provide a heap that will be mapped with a large page size, an application can be built using a link-editor (`ld(1)`) mapfile containing the bss segment declaration directive. Refer to the section Mapfile Option in the Linker and Libraries Guide for more details of this directive and the template mapfile provided in `/usr/lib/ld/map.bssalign`. Users are cautioned that an alignment specification may be machine-specific and may lose its benefit on different hardware platforms. A more flexible means of requesting the most optimal underlying page size may evolve in future releases.

`mpss.so.1(1)`, a pre-loadable shared object, can also be used to set the preferred stack and/or heap page sizes.
The first invocation of the `ppriv` command runs the `command` specified with the privilege sets and flags modified according to the arguments on the command line.

The second invocation examines or changes the privilege state of running process and core files.

The third invocation lists the privileges defined and information about specified privileges or privilege set specifications.

The following options are supported:

- **-D**
  Turns on privilege debugging for the processes or command supplied.

- **-e**
  Interprets the remainder of the arguments as a command line and runs the command line with specified privilege attributes and sets.

- **-l**
  Lists all currently defined privileges on stdout.

- **-M**
  When a system is configured with Trusted Extensions, this option turns on the `NET_MAC_AWARE` and `NET_MAC_AWARE_INHERIT` process attributes. A process with these attributes and the `net_mac_aware` privilege can communicate with lower-level remote peers.

- **-n**
  Show port numbers and users as numbers. Normally, `ppriv` shows port numbers and users as symbols. This option is only applicable when displaying Extended Policies.

- **-N**
  Turns off privilege debugging for the processes or command supplied.

- **-s spec**
  Modifies a process’s privilege sets according to `spec`, a specification with the format `[AEILP][+-=]privsetspec`, containing no spaces, where:

  - **AEILP**
    Indicates one or more letters indicating which privilege sets to change. These are case insensitive, for example, either a or A indicates all privilege sets.

    For definitions of the single letter abbreviations for privilege sets, see `privileges(5)`.

  - **+-=**
    Indicates a modifier to respectively add (+), remove (-), or assign (=) the listed privileges to the specified set(s) in `privsetspec`.

- **-vn**
  Show port numbers and users as numbers. Normally, `ppriv` shows port numbers and users as symbols. This option is only applicable when displaying Extended Policies.
privsetspec Indicates a comma-separated privilege set specification (priv1, priv2, and so on), as described in `priv_str_to_set(3C)`.

Modifying the same set with multiple `-s` options is possible as long as there is either precisely one assignment to an individual set or any number of additions and removals. That is, assignment and addition or removal for one set are mutually exclusive.

`-r` rule Install an Extended Policy. See `privileges(5)`.

Multiple rules can be specified. The new rules are added to the existing policy. To replace an existing policy, first remove it with `-X`, and then add the new policy with `-r`.

`-S` Short. Reports the shortest possible output strings for sets. The default is portable output. See `priv_str_to_set(3C)`.

`-X` Disable the Extended Policy.

`-v` Verbose. Reports privilege sets using privilege names.

Usage The `ppriv` utility examines processes and core files and prints or changes their privilege sets. `ppriv` can run commands with privilege debugging on or off or with fewer privileges than the invoking process.

When executing a sub process, the only sets that can be modified are L and I. Privileges can only be removed from L and I as `ppriv` starts with P=E=I.

`ppriv` can also be used to remove privileges from processes or to convey privileges to other processes. In order to control a process, the effective set of the `ppriv` utility must be a super set of the controlled process’s E, I, and P. The utility’s limit set must be a super set of the target’s limit set. If the target’s process uids do not match, the `{PRIV_PROC_OWNER}` privilege must be asserted in the utility’s effective set. If the controlled processes have any uid with the value 0, more restrictions might exist. See `privileges(5)`.

Examples Example 1 Obtaining the Process Privileges of the Current Shell

The following example obtains the process privileges of the current shell:

```
example$ ppriv $$
387: -sh
flags = <none>
    E: basic
    I: basic
    P: basic
    L: all
```
EXAMPLE 2  Removing a Privilege From Your Shell’s Inheritable and Effective Set

The following example removes a privilege from your shell’s inheritable and effective set.

```
example$ ppriv -s EI-proc_session $$
```

The subprocess can still inspect the parent shell but it can no longer influence the parent because the parent has more privileges in its Permitted set than the `ppriv` child process:

```
example$ truss -p $$
truss: permission denied: 387
example$ ppriv $$
387:  -sh
flags = <none>
E: basic,!proc_session
I: basic,!proc_session
P: basic
L: all
```

EXAMPLE 3  Running a Process with Privilege Debugging

The following example runs a process with privilege debugging:

```
example$ ppriv -e -D cat /etc/shadow
```

```
cat[418]: missing privilege "file_dac_read" (euid = 21782),
       needed at ufs_access+0x3c
cat: cannot open /etc/shadow
```

The privilege debugging error messages are sent to the controlling terminal of the current process. The `needed at address specification` is an artifact of the kernel implementation and it can be changed at any time after a software update.

The system call number can be mapped to a system call using `/etc/name_to_sysnum`.

EXAMPLE 4  Listing the Privileges Available in the Current Zone

The following example lists the privileges available in the current zone (see `zones(5)`). When run in the global zone, all defined privileges are listed.

```
example$ ppriv -l zone
... listing of all privileges elided ...
```

EXAMPLE 5  Examining a Privilege Aware Process

The following example examines a privilege aware process:

```
example$ ppriv -S 'pgrep rpcbind'
```

```
928: /usr/sbin/rpcbind
```
EXAMPLE 5  Examining a Privilege Aware Process  (Continued)

flags = PRIV_AWARE
  E: netPrivaddr, proc_fork, sys_nfs
  I: none
  P: netPrivaddr, proc_fork, sys_nfs
  L: none

See setpflags(2) for explanations of the flags.

EXAMPLE 6  Running a Process Under an Extended Policy

The following example runs a process under an extended policy:

eexample$ ppriv -r '{file_write}:/home/casper/.mozilla/*'
   -r '{file_write}:/tmp/*, {proc_exec}:/usr/*' -e firefox

See privileges(5).

EXAMPLE 7  Examining a Process that Has been Started

The following example examines the process that was started in example 6:

eexample$ ppriv 101272
101272: /usr/lib/firefox/firefox-bin
flags = PRIV_XPOLICY
Extended policies:
  {file_write}:/home/casper/.mozilla/*
  {file_write}:/tmp/*
  {proc_exec}:/usr/*
  E: basic,!file_write,!proc_exec
  I: basic,!file_write,!proc_exec
  P: basic,!file_write,!proc_exec
  L: all

Exit Status  The following exit values are returned:
  0  Successful operation.
  non-zero  An error has occurred.

Files  /proc/*  Process files
       /etc/name_to_sysnum  system call name to number mapping

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>
### ATTRIBUTE TYPE

| Interface Stability | See below. |

The invocation is Committed. The output is Uncommitted.

**See Also**  
gcore(1), truss(1), setpflags(2), priv_str_to_set(3C), proc(4), attributes(5), privileges(5), zones(5)
pr(1)

Name
pr – print files

Synopsis
/usr/bin/pr [+ page] [-column] [-adFmrt] [-e [char] [gap]]
    [-h header] [-i [char] [gap]] [-\ lines]
    [-n [char] [width]] [-o offset] [-s [char]]
    [-w width] [-fp] [file]...

/usr/xpg4/bin/pr [+ page] [-column | -c column] [-adFmrt]
    [-e [char] [gap]] [-h header] [-i [char] [gap]]
    [-\ lines] [-n [char] [width]] [-o offset]
    [-s [char]] [-w width] [-fp] [file]...

Description
The pr utility is a printing and pagination filter. If multiple input files are specified, each is read, formatted, and written to standard output. By default, the input is separated into 66-line pages, each with:

- a 5-line header that includes the page number, date, time and the path name of the file
- a 5-line trailer consisting of blank lines

If standard output is associated with a terminal, diagnostic messages will be deferred until the pr utility has completed processing.

When options specifying multi-column output are specified, output text columns will be of equal width; input lines that do not fit into a text column will be truncated. By default, text columns are separated with at least one blank character.

Options
The following options are supported. In the following option descriptions, column, lines, offset, page, and width are positive decimal integers; gap is a non-negative decimal integer. Some of the option-arguments are optional, and some of the option-arguments cannot be specified as separate arguments from the preceding option letter. In particular, the -s option does not allow the option letter to be separated from its argument, and the options -e, -i, and -n require that both arguments, if present, not be separated from the option letter.

The following options are supported for both /usr/bin/pr and /usr/xpg4/bin/pr:

+page
   Begins output at page number page of the formatted input.

-column
   Produces multi-column output that is arranged in column columns (default is 1) and is written down each column in the order in which the text is received from the input file. This option should not be used with -m. The -e and -i options will be assumed for multiple text-column output. Whether or not text columns are produced with identical vertical lengths is unspecified, but a text column will never exceed the length of the page (see the -l option). When used with -t, use the minimum number of lines to write the output.

-a
   Modifies the effect of the -column option so that the columns are filled across the page in a round-robin order (for example, when
column is 2, the first input line heads column 1, the second heads
column 2, the third is the second line in column 1, and so forth).

- d Produces output that is double-spaced; append an extra NEWLINE
character following every NEWLINE character found in the input.

- e [ char ][ gap ] Expands each input TAB character to the next greater column
position specified by the formula \( n \cdot \text{gap} + 1 \), where \( n \) is an integer
>0. If \( \text{gap} \) is 0 or is omitted, it defaults to 8. All TAB characters in
the input will be expanded into the appropriate number of SPACE
characters. If any non-digit character, \( \text{char} \), is specified, it will be
used as the input tab character.

- f Uses a FORMFEED character for new pages, instead of the default
behavior that uses a sequence of NEWLINE characters. Pauses
before beginning the first page if the standard output is associated
with a terminal.

- h header Uses the string \( \text{header} \) to replace the contents of the file operand
in the page header.

- l lines Overrides the 66-line default and reset the page length to lines. If
\( \text{lines} \) is not greater than the sum of both the header and trailer
depths (in lines), \( \text{pr} \) will suppress both the header and trailer, as if
the - t option were in effect.

- m Merges files. Standard output will be formatted so \( \text{pr} \) writes one
line from each file specified by \( \text{file} \), side by side into text columns
of equal fixed widths, in terms of the number of column positions.
Implementations support merging of at least nine files.

- n [ char ][ width ] Provides width-digit line numbering (default for width is 5). The
number will occupy the first width column positions of each text
column of default output or each line of -m output. If \( \text{char} \) (any
non-digit character) is given, it will be appended to the line
number to separate it from whatever follows (default for \( \text{char} \) is a
TAB character).

- o offset Each line of output will be preceded by offset <space>s. If the -o
option is not specified, the default offset is 0. The space taken will
be in addition to the output line width (see -w option below).

- p Pauses before beginning each page if the standard output is
directed to a terminal (\( \text{pr} \) will write an ALERT character to
standard error and wait for a carriage-return character to be read
on /dev/tty).

- r Writes no diagnostic reports on failure to open files.
Separates text columns by the single character char instead of by the appropriate number of SPACE characters (default for char is the TAB character).

-w width
Sets the width of the line to width column positions for multiple text-column output only. If the -w option is not specified and the -s option is not specified, the default width is 72. If the -w option is not specified and the -s option is specified, the default width is 512.

For single column output, input lines will not be truncated.

The following options are supported for /usr/bin/pr only:

-F
Folds the lines of the input file. When used in multi-column mode (with the -a or -n options), lines will be folded to fit the current column's width. Otherwise, they will be folded to fit the current line width (80 columns).

-i [ char ] [ gap ]
In output, replaces SPACE characters with TAB characters wherever one or more adjacent SPACE characters reach column positions gap+1, 2*gap+1, 3*gap+1, and so forth. If gap is 0 or is omitted, default TAB settings at every eighth column position are assumed. If any non-digit character, char, is specified, it will be used as the output TAB character.

The following options are supported for /usr/xpg4/bin/pr only:

-F
Uses a FORMFEED character for new pages, instead of the default behavior that uses a sequence of NEWLINE characters.

-i [ char ] [ gap ]
In output, replaces multiple SPACE characters with TAB characters wherever two or more adjacent SPACE characters reach column positions gap+1, 2*gap+1, 3*gap+1, and so forth. If gap is 0 or is omitted, default TAB settings at every eighth column position are assumed. If any non-digit character, char, is specified, it will be used as the output TAB character.

Operands
The following operand is supported:

file
A path name of a file to be written. If no file operands are specified, or if a file operand is -, the standard input will be used.
Examples

**EXAMPLE 1**  
Printing a numbered list of all files in the current directory

```bash
example% ls -a | pr -n -h "Files in $(pwd)."
```

**EXAMPLE 2**  
Printing files in columns

This example prints file1 and file2 as a double-spaced, three-column listing headed by file list:

```bash
example% pr -3d -h "file list" file1 file2
```

**EXAMPLE 3**  
Writing files with expanded column tabs

The following example writes file1 on file2, expanding tabs to columns 10, 19, 28, ...

```bash
example% pr -e9 -t <file1 >file2
```

Environmental Variables

See `environ(5)` for descriptions of the following environment variables that affect the execution of `pr`: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, LC_TIME, TZ, and NLSPATH.

Exit Status

The following exit values are returned:

- 0  
   Successful completion.
- >0  
   An error occurred.

Attributes

See `attributes(5)` for descriptions of the following attributes:

```markdown
<table>
<thead>
<tr>
<th>Attribute</th>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
<td></td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
<td></td>
</tr>
</tbody>
</table>
```

```
<table>
<thead>
<tr>
<th>Attribute</th>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/xopen/xcu4</td>
<td></td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
<td></td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5)</td>
<td></td>
</tr>
</tbody>
</table>
```

See Also  
expand(1), attributes(5), environ(5), standards(5)
praliases(1)

Name  praliases – display system mail aliases
Synopsis  praliases [-C configfile] [-f aliasfile] [key]
Description  The praliases utility displays system mail aliases. When no key is given, praliases displays the current system aliases, one per line, in no particular order. The form is key:value. If a key is given, only that key is looked up and the appropriate key:value is displayed if found.
Options  The following options are supported:
-C configfile  Specifies a sendmail configuration file.
-f aliasfile  Reads the specified file aliasfile instead of the default sendmail system aliases file.
Operands  The following operands are supported:
key  A specific alias key to look up.
Exit Status  The following exit values are returned:
0  Successful operation.
>0  An error occurred.
Files  
/etc/mail/aliases  Default sendmail system aliases file
/etc/mail/aliases.db  Database versions of the /etc/mail/aliases file
/etc/mail/aliases.dir
/etc/mail/aliases.pag  Database versions of the /etc/mail/aliases file
/etc/mail/sendmail.cf  Default sendmail configuration file
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/smt/pl/sendmail</td>
</tr>
</tbody>
</table>
See Also  
mailq(1), newaliases(1M), sendmail(1M), attributes(5)
prctl – get or set the resource controls of running processes, tasks, and projects

**Synopsis**

```
prctl [-P] [-t [basic | privileged | system]]
       [-n name [-srx]] [-v value] [-e | -d action] [-p pid]]
       [-i idtype] id...
```

**Description**

The `prctl` utility allows the examination and modification of the resource controls associated with an active process, task, or project on the system. It allows access to the basic and privileged limits and the current usage on the specified entity.

See `resource_controls(5)` for a description of the resource controls supported in the current release of the Solaris operating system.

**Options**

If none of the `-s`, `-r`, `-x`, `-v`, `-d`, or `-e` options are specified, the invocation is considered a get operation. Otherwise, it is considered a modify operation.

The following options are supported:

- `-d` | `-e action` Disables (`-d`) or enables (`-e`) the specified `action` on the resource control value specified by `-v`, `-t`, and `-p`. If any of the `-v`, `-t`, or `-p` options are unspecified, they match any value, privilege, or recipient pid. For example, specifying only `-v` modifies the first resource control with matching value, matching any privilege and recipient pid. If no matching resource control value is found, a new value is added as if `-s` were specified.

**Actions:**

- `all` This action is only available with `-d`. It disables all actions. This fails on resource control values that have the deny global flag.

- `deny` Indicates that the resource control attempts to deny granting the resource to the process, task, project, or zone on a request for resources in excess of the resource control value. deny actions can not be enabled if the resource control has the no-deny global flag. deny actions can not be disabled if the resource control has the deny global flag.
This action is only available with `-d`. It deactivates the `signal` action.

In the `signal=signum` action, `signum` is a signal number (or string representation of a signal). Setting a `signal` action on a resource control with the `no-local-action` global flag fails. A limited set of signals can be sent. See NOTES for additional details.

-specifies the type of the id operands. Valid `idtypes` are `process`, `task`, `project`, or `zone`. Also allowed are `pid`, `taskid`, `projid`, and `zoneid`. The default `id type`, if the `-i` option is omitted, is `process`.

For a modify operation, the entity to which id operands are members is the target entity. For instance, setting a project resource control on an `-i process` sets the resource control on the project to which each given process argument is a member.

For a get operation, the resource controls are listed for all entities to which the id operands are members. For example, `-i task taskid` lists the task, project, and zone resource controls for the task, and for the project and zone to which that task is a member.

-Specifies the name of the resource control to get or set. If the `name` is unspecified, all resource controls are retrieved.

-When manipulating (using `-s`, `-r`, `-x`, `-d`, or `-e`) a basic task project, or zone resource control values, a recipient `pid` can be specified using `-p`. When setting a new basic resource control or controls on a task, project, or zone, the `-p` option is required if the `-i idtype` option argument is not `process`.

-Display resource control values in space delimited format.

-Replaces the first resource control value (matching with the `-t privilege`) with the new value specified through the `-v` option.
-s
Set a new resource control value.

This option requires the -v option.

If you do not specify the -t option, basic privilege is used. If you want to set a basic task, process, or zone rctl, -p is required. If -e or -d are also specified, the action on the new rctl is set as well.

For compatibility with prior releases, this option is implied if -v is specified, without any of -e, -d, -r, or -x.

See resource_controls(5) for a description of unit modifiers and scaling factors you can use to express large values when setting a resource control value.

-t [basic | privileged | system]
Specifies which resource control type to set. Unless the "lowerable" flag is set for a resource control, only invocations by users (or setuid programs) who have privileges equivalent to those of root can modify privileged resource controls. See rctlblk_set_value(3C) for a description of the RCTL_GLOBAL_LOWERABLE flag. If the type is not specified, basic is assumed. For a get operation, the values of all resource control types, including system, are displayed if no type is specified.

-v value
Specifies the value for the resource control for a set operation. If no value is specified, then the modification (deletion, action enabling or disabling) is carried out on the lowest-valued resource control with the given type.

See resource_controls(5) for a description of unit modifiers and scaling factors you can use to express large values when setting a resource control value.

-x
Deletes the specified resource control value. If the delete option is not provided, the default operation of prctl is to modify a resource control value of matching value and privilege, or insert a new value with the given privilege. The matching criteria are discussed more fully in setrctl(2).
If none of the -d, -e, -v, or -x options is specified, the invocation is considered a get operation.

**Operands**
The following operand is supported:

- **id** The ID of the entity (process, task, project, or zone) to interrogate. If the invoking user's credentials are unprivileged and the entity being interrogated possesses different credentials, the operation fails. If no *id* is specified, an error message is returned.

**Examples**

**EXAMPLE 1** Displaying Current Resource Control Settings

The following example displays current resource control settings for a task to which the current shell belongs:

```bash
example$ ps -o taskid -p $$
```

```bash
TASKID
8
```

```bash
example$ prctl -i task 8
```

136150: /bin/ksh

<table>
<thead>
<tr>
<th>NAME</th>
<th>PRIVILEGE</th>
<th>VALUE</th>
<th>FLAG</th>
<th>ACTION</th>
<th>RECIPIENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>task.max-cpu-time usage</td>
<td></td>
<td>8s</td>
<td>inf</td>
<td>none</td>
<td>-</td>
</tr>
<tr>
<td>task.max-lwps usage</td>
<td></td>
<td>39</td>
<td>max</td>
<td>deny</td>
<td>-</td>
</tr>
<tr>
<td>project.max-contracts</td>
<td>privileged</td>
<td>10.0K</td>
<td>-</td>
<td>deny</td>
<td>-</td>
</tr>
<tr>
<td>project.max-locked-memory</td>
<td>privileged</td>
<td>0B</td>
<td>-</td>
<td>deny</td>
<td>-</td>
</tr>
<tr>
<td>project.max-port-ids</td>
<td>privileged</td>
<td>8.19K</td>
<td>-</td>
<td>deny</td>
<td>-</td>
</tr>
<tr>
<td>project.max-shm-memory</td>
<td>privileged</td>
<td>508MB</td>
<td>-</td>
<td>deny</td>
<td>-</td>
</tr>
<tr>
<td>project.max-shm-ids</td>
<td>privileged</td>
<td>128</td>
<td>-</td>
<td>deny</td>
<td>-</td>
</tr>
<tr>
<td>project.max-msg-ids</td>
<td>privileged</td>
<td>128</td>
<td>-</td>
<td>deny</td>
<td>-</td>
</tr>
<tr>
<td>project.max-sem-ids</td>
<td>privileged</td>
<td>128</td>
<td>-</td>
<td>deny</td>
<td>-</td>
</tr>
<tr>
<td>project.max-crypto-memory</td>
<td>privileged</td>
<td>508MB</td>
<td>-</td>
<td>deny</td>
<td>-</td>
</tr>
<tr>
<td>project.max-tasks usage</td>
<td></td>
<td>2</td>
<td>max</td>
<td>deny</td>
<td>-</td>
</tr>
<tr>
<td>project.max-lwps usage</td>
<td></td>
<td>39</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```
EXAMPLE 1  Displaying Current Resource Control Settings  (Continued)

<table>
<thead>
<tr>
<th>NAME</th>
<th>PRIVILEGE</th>
<th>VALUE</th>
<th>FLAG</th>
<th>ACTION</th>
<th>RECIPIENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>system</td>
<td></td>
<td>2.15G</td>
<td>max</td>
<td>deny</td>
<td>-</td>
</tr>
<tr>
<td>project.cpu-shares usage</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>privileged</td>
<td></td>
<td>1</td>
<td>none</td>
<td></td>
<td></td>
</tr>
<tr>
<td>zone.max-shm-memory</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>system</td>
<td></td>
<td>16.0EB</td>
<td>max</td>
<td>deny</td>
<td>-</td>
</tr>
<tr>
<td>zone.max-shm-ids</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>system</td>
<td></td>
<td>16.8M</td>
<td>max</td>
<td>deny</td>
<td>-</td>
</tr>
<tr>
<td>zone.max-sem-ids</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>system</td>
<td></td>
<td>16.8M</td>
<td>max</td>
<td>deny</td>
<td>-</td>
</tr>
<tr>
<td>zone.max-msg-ids</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>system</td>
<td></td>
<td>16.8M</td>
<td>max</td>
<td>deny</td>
<td>-</td>
</tr>
<tr>
<td>zone.max-lwps</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>system</td>
<td></td>
<td>2.15G</td>
<td>max</td>
<td>deny</td>
<td>-</td>
</tr>
<tr>
<td>zone.cpu-shares</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>privileged</td>
<td></td>
<td>1</td>
<td>none</td>
<td></td>
<td></td>
</tr>
<tr>
<td>zone.max-locked-memory</td>
<td></td>
<td>usage</td>
<td>0B</td>
<td>deny</td>
<td></td>
</tr>
<tr>
<td>system</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

EXAMPLE 2  Displaying, Replacing, and Verifying the Value of a Specific Control

The following examples displays, replaces, and verifies the value of a specific control on an existing project:

example# prctl -n project.cpu-shares -i project group.staff
project: 10: group.staff

NAME  PRIVILEGE  VALUE  FLAG  ACTION  RECIPIENT
project.cpu-shares usage 1
  privileged 1 none
system 65.5K max none

example# prctl -n project.cpu-shares -v 10 -r -i project group.staff
example# prctl -n project.cpu-shares -i project group.staff
project: 10: group.staff

NAME  PRIVILEGE  VALUE  FLAG  ACTION  RECIPIENT
project.cpu-shares usage 10
  privileged 10 none
system 65.5K max none
EXAMPLE 3  Adjusting Resources

The following example uses the project.max-locked-memory resource.

First, use id -p to find out which project the current shell is a member of:

```
/home/garfield> id -p
uid=77880(garfield) gid=10(staff) projid=10(group.staff)
```

Using the target project, identify the resource limit value before the change:

```
/home/garfield> prctl -n project.max-locked-memory -i project \
         group.staff
project 10: group.staff
project.max-locked-memory
     privileged  256MB  -  deny  -
     system      16.0EB  max  deny -
```

Current limit is 256 Megabytes.

Next, adjust the project.max-locked-memory limit to 300 Megabytes for the target project:

```
# prctl -n project.max-locked-memory -v 300M -r -i project group.staff
```

The resource limit value after the change shows a new value of 300 Megabytes:

```
# prctl -n project.max-locked-memory -i project group.staff
project 10:group.staff
project.max-locked-memory
     usage     200MG
     privileged 300MB  -  deny  -
     system      16.0EB  max  deny -
```

EXAMPLE 4  Modifying CPU Caps for a Project

The prctl command can use the project.cpu-cap resource control (see resource_controls(5)) to set and modify CPU caps for a project. (The same resource control can be used in the /etc/project file. See project(4)) The following command modifies the CPU cap to limit user.smith to three CPUs:

```
# prctl -r -t privileged -n project.cpu-cap -v 300 -i project user.smith
```

The prctl -r option, used above, is used to dynamically change a CPU cap for a project or zone. For example, the following command will change the cap set in the preceding command to 80 percent:

```
# prctl -r -t privileged -n project.cpu-cap -v 80 -i project user.smith
```

To remove a CPU cap, enter:

```
# prctl -x -n project.cpu-cap $$
```
EXAMPLE 5  Modifying CPU Caps for a Zone

The `prctl` command can use the `zone.cpu-cap` resource control (see `resource_controls(5)`) to set and modify CPU caps for a zone. (The same resource control can be manipulated using the `zonecfg(1M)` command.) The following command modifies the CPU cap to limit the global zone to 80 percent of a CPU:

```
# prctl -t privileged -n zone.cpu-cap -v 80 -i zone global
```

The cap can be lowered to 50% using:

```
# prctl -r -t privileged -n zone.cpu-cap -v 50 -i zone global
```

**Exit Status**  The following exit values are returned:

- **0**  Success.
- **1**  Fatal error encountered.
- **2**  Invalid command line options were specified.

**Files**  `/proc/pid/*`  Process information and control files

**Attributes**  See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>See below.</td>
</tr>
</tbody>
</table>

The command-line syntax is Committed. The human-readable output is Uncommitted. The parseable output is Committed.

**See Also**  `rctladm(1M), zonecfg(1M), setrctl(2), rctlblk_get_local_action(3C), project(4), attributes(5), resource_controls(5)`

**Notes**  The valid signals that can be set on a resource control block allowing local actions are SIGABRT, SIGXRES, SIGHUP, SIGSTOP, SIGTERM, and SIGKILL. Additionally, CPU time related controls can issue the SIGXCPU signal, and file size related controls can send the SIGXFSZ signal.
preap – force a defunct process to be reaped by its parent

**Synopsis**
preap [-F] pid ...

**Description**
A defunct (or zombie) process is one whose exit status has yet to be reaped by its parent. The exit status is reaped by way of the wait(3C), waitid(2), or waitpid(3C) system call. In the normal course of system operation, zombies can occur, but are typically short-lived. This can happen if a parent exits without having reaped the exit status of some or all of its children. In that case, those children are reparented to PID 1. See init(1M), which periodically reaps such processes.

An irresponsible parent process cannot exit for a very long time and thus leave zombies on the system. Since the operating system destroys nearly all components of a process before it becomes defunct, such defunct processes do not normally impact system operation. However, they do consume a small amount of system memory.

preap forces the parent of the process specified by pid to waitid(3C) for pid, if pid represents a defunct process.

preap attempts to prevent the administrator from unwisely reaping a child process which might soon be reaped by the parent, if:
- The process is a child of init(1M).
- The parent process is stopped and might wait on the child when it is again allowed to run.
- The process has been defunct for less than one minute.

**Options**
The following option is supported:
- F Forces the parent to reap the child, overriding safety checks.

**Operands**
The following operand is supported:

- pid Process ID list.

**Usage**
Caution should be exercised when using the -F flag. Imposing two controlling processes on one victim process can lead to chaos. Safety is assured only if the primary controlling process, typically a debugger, has stopped the victim process and the primary controlling process is doing nothing at the moment of application of the proc tool in question.

**Exit Status**
The following exit values are returned by preap, which prints the exit status of each target process reaped:
- 0 Successfully operation.
- non-zero Failure, such as no such process, permission denied, or invalid option.
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTETYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/extended-system-utilities</td>
</tr>
</tbody>
</table>

See Also  proc(1), init(1M), waitid(2), wait(3C), waitpid(3C), proc(4), attributes(5)

Warnings  preap should be applied sparingly and only in situations in which the administrator or developer has confirmed that defunct processes are not reaped by the parent process. Otherwise, applying preap can damage the parent process in unpredictable ways.
Name  print – shell built-in function to output characters to the screen or window

Synopsis
/usr/bin/print  print [-CRenprsv] [-f format] [-u fd] [string...

ksh88  print [-Rnprsu [n]] [arg]...

ksh  print [-CReprsv] [-f format] [-u fd] [string...

Description
ksh88  The shell output mechanism. With no options or if the - option is specified, the arguments that follow are printed on standard output as described by echo(1). If the - option is specified, anything that follows it is processed as an argument, even if it begins with a -.

/usr/bin/print, ksh  By default, print writes each string operand to standard output and appends a NEWLINE character.

Unless, the -r, -R, or -f option is specified, each \ character in each string operand is processed specially as follows:
\a  Alert character.
\b  Backspace character.
\c  Terminate output without appending NEWLINE. The remaining string operands are ignored.
\E  Escape character (ASCII octal 033).
\f  FORM FEED character.
\n  NEWLINE character.
\t  Tab character.
\v  Vertical tab character.
\  Backslash character.
\0x  The 8-bit character whose ASCII code is the 1-, 2-, or 3-digit octal number x.

Options
ksh88  The following options are supported by ksh88:

- n  Suppresses new-line from being added to the output.
- r-R  Raw mode. Ignore the escape conventions of echo. The -R option prints all subsequent arguments and options other than -n.
- p  Cause the arguments to be written onto the pipe of the process spawned with |& instead of standard output.
- s  Cause the arguments to be written onto the history file instead of standard output.
- u [ n ]  Specify a one digit file descriptor unit number n on which the output is placed. The default is 1.

The following options are supported by /usr/man/print and ksh:
- e  Unless -f is specified, process \ sequences in each string operand as described above. This is the default behavior.
   If both -e and -r are specified, the last one specified is the one that is used.
- f format  Write the string arguments using the format string format and do not append a NEWLINE. See printf(1) for details on how to specify format.
   When the -f option is specified and there are more string operands than format specifiers, the format string is reprocessed from the beginning. If there are fewer string operands than format specifiers, then outputting ends at the first unneeded format specifier.
- n  Do not append a NEWLINE character to the output.
- p  Write to the current co-process instead of standard output.
- r  
- R  Do not process \ sequences in each string operand as described above.
   If both -e and -r are specified, the last one specified is the one that is used.
- s  Write the output as an entry in the shell history file instead of standard output.
- u fd  Write to file descriptor number fd instead of standard output. The default value is 1.
- v  Treat each string as a variable name and write the value in %B format. Cannot be used with -f.
- C  Treat each string as a variable name and write the value in %#B format. Cannot be used with -f.

Exit Status  The following exit values are returned:
   0  Successful completion.
   >0  Output file is not open for writing.

Attributes  See attributes(5) for descriptions of the following attributes:
<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  
`echo(1), ksh(1), ksh88(1), printf(1), attributes(5)`
printenv(1B)

Name printenv – display environment variables currently set

Synopsis /usr/ucb/printenv [variable]

Description printenv prints out the values of the variables in the environment. If a variable is specified, only its value is printed.

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>

See Also csh(1), echo(1), sh(1), stty(1), tset(1B), attributes(5), environ(5)

Diagnostics If a variable is specified and it is not defined in the environment, printenv returns an exit status of 1.
The printf utility writes each string operand to standard output using *format* to control the output format.

### Operands

The following operands are supported by `/usr/bin/printf`:

**format**  
A string describing the format to use to write the remaining operands. The *format* operand is used as the *format* string described on the *formats*(5) manual page, with the following exceptions:

- A SPACE character in the format string, in any context other than a flag of a conversion specification, is treated as an ordinary character that is copied to the output.
- A character in the format string is treated as a character, not as a SPACE character.
- In addition to the escape sequences described on the *formats*(5) manual page (`\`, `\a`, `\b`, `\f`, `\n`, `\r`, `\t`, `\v`), `\ddd`, where `ddd` is a one-, two- or three-digit octal number, is written as a byte with the numeric value specified by the octal number.
- The program does not precede or follow output from the `d` or `u` conversion specifications with blank characters not specified by the *format* operand.
- The program does not precede output from the `o` conversion specification with zeros not specified by the *format* operand.
- An additional conversion character, `b`, is supported as follows. The argument is taken to be a string that can contain backslash-escape sequences. The following backslash-escape sequences are supported:
  - the escape sequences listed on the *formats*(5) manual page (`\`, `\a`, `\b`, `\f`, `\n`, `\r`, `\t`, `\v`), which are converted to the characters they represent
  - `\0ddd`, where `ddd` is a zero-, one-, two- or three-digit octal number that is converted to a byte with the numeric value specified by the octal number
  - `\c`, which is written and causes printf to ignore any remaining characters in the string operand containing it, any remaining string operands and any additional characters in the *format* operand.
The interpretation of a backslash followed by any other sequence of characters is unspecified.

Bytes from the converted string are written until the end of the string or the number of bytes indicated by the precision specification is reached. If the precision is omitted, it is taken to be infinite, so all bytes up to the end of the converted string are written. For each specification that consumes an argument, the next argument operand is evaluated and converted to the appropriate type for the conversion as specified below. The format operand is reused as often as necessary to satisfy the argument operands. Any extra c or s conversion specifications are evaluated as if a null string argument were supplied; other extra conversion specifications are evaluated as if a zero argument were supplied. If the format operand contains no conversion specifications and argument operands are present, the results are unspecified. If a character sequence in the format operand begins with a % character, but does not form a valid conversion specification, the behavior is unspecified.

The strings to be written to standard output, under the control of format. The argument operands are treated as strings if the corresponding conversion character is b, c or s. Otherwise, it is evaluated as a C constant, as described by the ISO C standard, with the following extensions:

- A leading plus or minus sign is allowed.
- If the leading character is a single- or double-quote, the value is the numeric value in the underlying codeset of the character following the single- or double-quote.

If an argument operand cannot be completely converted into an internal value appropriate to the corresponding conversion specification, a diagnostic message is written to standard error and the utility does not exit with a zero exit status, but continues processing any remaining operands and writes the value accumulated at the time the error was detected to standard output.

The format operands support the full range of ANSI C/C99/XPG6 formatting specifiers as well as additional specifiers:

- Each character in the string operand is processed specially, as follows:
  - \a Alert character.
  - \b Backspace character.
  - \c Terminate output without appending NEWLINE. The remaining string operands are ignored.
  - \E Escape character (ASCII octal \33).
  - \f FORM FEED character.
\n NEWLINE character.
\t TAB character.
\v Vertical tab character.
\\ Backslash character.
\0x The 8-bit character whose ASCII code is the 1-, 2-, or 3-digit octal number x.
%B Treat the argument as a variable name and output the value without converting it to a string. This is most useful for variables of type \-b.
%H Output string with characters <, &, >, ", and non-printable characters, properly escaped for use in HTML and XML documents.
%P Treat string as an extended regular expression and convert it to a shell pattern.
%q Output string quoted in a manner that it can be read in by the shell to get back the same string. However, empty strings resulting from missing string operands are not quoted.
%R Treat string as an shell pattern expression and convert it to an extended regular expression.
%T Treat string as a date/time string and format it. The T can be preceded by (dformat), where dformat is a date format as defined by the date(1) command.
%Z Output a byte whose value is 0.

When performing conversions of string to satisfy a numeric format specifier, if the first character of string is " or '\', the value is the numeric value in the underlying code set of the character following the " or '\'. Otherwise, string is treated like a shell arithmetic expression and evaluated.

If a string operand cannot be completely converted into a value appropriate for that format specifier, an error occurs, but remaining string operands continue to be processed.

In addition to the format specifier extensions, the following extensions of ANSI C/C99/XPG6 are permitted in format specifiers:

- The escape sequences \E and \e expand to the escape character which is octal 033 in ASCII.
- The escape sequence \cx expands to CTRL-x.
- The escape sequence \C[. name .] expands to the collating element name.
- The escape sequence \x{hex} expands to the character corresponding to the hexadecimal value hex.
- The format modifier flag = can be used to center a field to a specified width. When the output is a terminal, the character width is used rather than the number of bytes.
Each of the integral format specifiers can have a third modifier after width and precision that specifies the base of the conversion from 2 to 64. In this case, the # modifier causes \texttt{base#} to be prepended to the value.

The # modifier can be used with the d specifier when no base is specified to cause the output to be written in units of 1000 with a suffix of one of k M G T P E.

The # modifier can be used with the i specifier to cause the output to be written in units of 1024 with a suffix of one of Ki Mi Gi Ti Pi Ei.

If there are more string operands than format specifiers, the format string is reprocessed from the beginning. If there are fewer string operands than format specifiers, then string specifiers are treated as if empty strings were supplied, numeric conversions are treated as if \texttt{0} was supplied, and time conversions are treated as if \texttt{now} was supplied.

\texttt{/usr/bin/printf} is equivalent to \texttt{ksh}'s \texttt{printf} built-in and \texttt{print -f}, which allows additional options to be specified.

### Usage

The \texttt{printf} utility, like the \texttt{printf(3C)} function on which it is based, makes no special provision for dealing with multi-byte characters when using the \texttt{%c} conversion specification. Applications should be extremely cautious using either of these features when there are multi-byte characters in the character set.

Field widths and precisions cannot be specified as *.

The \texttt{%b} conversion specification is not part of the ISO C standard; it has been added here as a portable way to process backslash escapes expanded in string operands as provided by the \texttt{echo} utility. See also the USAGE section of the \texttt{echo(1)} manual page for ways to use \texttt{printf} as a replacement for all of the traditional versions of the \texttt{echo} utility.

If an argument cannot be parsed correctly for the corresponding conversion specification, the \texttt{printf} utility reports an error. Thus, overflow and extraneous characters at the end of an argument being used for a numeric conversion are to be reported as errors.

It is not considered an error if an argument operand is not completely used for a c or s conversion or if a string operand’s first or second character is used to get the numeric value of a character.

### Examples

\texttt{/usr/bin/printf} Examples

**EXAMPLE 1** Printing a Series of Prompts

The following example alerts the user, then prints and reads a series of prompts:

```bash
example% printf "Please fill in the following: Name: "
read name
```
**EXAMPLE 1**  Printing a Series of Prompts  

```c
printf "Phone number: 
read phone 
```

**EXAMPLE 2**  Printing a Table of Calculations

The following example prints a table of calculations. It reads out a list of right and wrong answers from a file, calculates the percentage correctly, and prints them out. The numbers are right-justified and separated by a single tab character. The percentage is written to one decimal place of accuracy:

```bash
example% while read right wrong ; do
    percent=$(echo "scale=1;($right*100)/($right+$wrong)" | bc)
    printf "%2d right\t%2d wrong\t(%s\%)\n" \n        $right $wrong $percent
done < database_file 
```

**EXAMPLE 3**  Printing number strings

The command:

```bash
example% printf "%5d%4d\n" 1 21 321 4321 54321 
```

produces:

```
   1 21
3214321
54321 0
```

The `format` operand is used three times to print all of the given strings and that a 0 was supplied by `printf` to satisfy the last `%d` conversion specification.

**EXAMPLE 4**  Tabulating Conversion Errors

The following example tabulates conversion errors.

The `printf` utility tells the user when conversion errors are detected while producing numeric output. These results would be expected on an implementation with 32-bit two's-complement integers when `%d` is specified as the `format` operand:

<table>
<thead>
<tr>
<th>Arguments</th>
<th>Standard</th>
<th>Diagnostic</th>
</tr>
</thead>
<tbody>
<tr>
<td>5a</td>
<td>5</td>
<td><code>printf: 5a not completely converted</code></td>
</tr>
<tr>
<td>9999999999</td>
<td>2147483647</td>
<td><code>printf: 9999999999: Results too large</code></td>
</tr>
<tr>
<td>-.9999999999</td>
<td>-2147483648</td>
<td><code>printf: -.9999999999: Results too large</code></td>
</tr>
<tr>
<td>ABC</td>
<td>0</td>
<td><code>printf: ABC expected numeric value</code></td>
</tr>
</tbody>
</table>
The value shown on standard output is what would be expected as the return value from the function `strtol(3C)`. A similar correspondence exists between `%u` and `strtoul(3C)`, and `%e`, `%f` and `%g` and `strtod(3C)`.

**EXAMPLE 5** Printing Output for a Specific Locale

The following example prints output for a specific locale. In a locale using the ISO/IEC 646:1991 standard as the underlying codeset, the command:

```
example% printf "%d
3 +3 -3 \'3 \"+3 \'\'-3"
```

produces:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Numeric value of constant 3</td>
</tr>
<tr>
<td>3</td>
<td>Numeric value of constant 3</td>
</tr>
<tr>
<td>−3</td>
<td>Numeric value of constant −3</td>
</tr>
<tr>
<td>51</td>
<td>Numeric value of the character ‘3’ in the ISO/IEC 646:1991 standard codeset</td>
</tr>
<tr>
<td>43</td>
<td>Numeric value of the character ‘+’ in the ISO/IEC 646:1991 standard codeset</td>
</tr>
<tr>
<td>45</td>
<td>Numeric value of the character ‘−’ in the ISO/IEC 646:1991 standard codeset</td>
</tr>
</tbody>
</table>

In a locale with multi-byte characters, the value of a character is intended to be the value of the equivalent of the `wchar_t` representation of the character.

If an argument operand cannot be completely converted into an internal value appropriate to the corresponding conversion specification, a diagnostic message is written to standard error and the utility does exit with a zero exit status, but continues processing any remaining operands and writes the value accumulated at the time the error was detected to standard output.

**ksh Examples** The following examples illustrate the use of the ksh93 version of `printf`.

**EXAMPLE 6** Alternative floating point representation 1

The `printf` utility supports an alternative floating point representation (see `printf(3C)` entry for the “%a”/“%A”), which allows the output of floating-point values in a format that avoids the usual base16 to base10 rounding errors.

```
example% printf "%a\n" 2 3.1 NaN
```

produces:

```
0x1.00000000000000000000000000000000p+01
0x1.8ccccccccccccCCCCCCCCCCCCCDp+01
nan
```
EXAMPLE 7 Alternative floating point representation
The following example shows two different representations of the same floating-point value.

```c
example% x=2 ; printf "%.f == %.a\n" x x
```

produces:

```
2.000000 == 0x1.0000000000000000000000000000p+1
```

EXAMPLE 8 Output of unicode values
The following command will print the EURO unicode symbol (code-point 0x20ac).

```c
example% LC_ALL=en_US.UTF-8 printf "\u[20ac]\n"
```

produces:

```
<euro>
```

where `<euro>` represents the EURO currency symbol character.

EXAMPLE 9 Convert unicode character to unicode code-point value
The following command will print the hexadecimal value of a given character.

```c
example% export LC_ALL=en_US.UTF-8
exmple% printf "%x\n" '<euro>'
```

where `<euro>` represents the EURO currency symbol character (code-point 0x20ac).

produces:

```
20ac
```

EXAMPLE 10 Print the numeric value of an ASCII character

```c
example% printf "%d\n" 'A'
```

produces:

```
65
```

EXAMPLE 11 Print the language-independent date and time format
To print the language-independent date and time format, the following statement could be used:

```c
example% printf "format" weekday month day hour min
```

For example,

```c
$ printf format "Sunday" "July" 3 10 2
```

For American usage, format could be the string:
EXAMPLE 11  Print the language-independent date and time format  

"%s, %d %d:%.2d\n"

producing the message:
Sunday, July 3, 10:02

Whereas for EU usage, format could be the string:
"%1$s, %3$d. %2$s, %4$d:%5$.2d\n"

Note that the '$' characters must be properly escaped, such as
"%1\$s, %3\$d. %2\$s, %4\$d:%5\$s.2d\n" in this case

producing the message:
Sunday, 3. July, 10:02

Environment Variables  See environ(5) for descriptions of the following environment variables that affect the execution of printf: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, LC_NUMERIC, and NLSPATH.

Exit Status  The following exit values are returned:
0      Successful completion.
>0     An error occurred.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>/usr/bin/printf</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>text/locale</td>
<td></td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
<td></td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ksh</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
<td></td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Uncommitted</td>
<td></td>
</tr>
</tbody>
</table>

See Also  awk(1), bc(1), date(1), echo(1), ksh(1), printf(3C), strtod(3C), strtol(3C), strtoul(3C), attributes(5), environ(5), formats(5), standards(5)
Notes

Using format specifiers (characters following '%') which are not listed in the `printf(3C)` or this manual page will result in undefined behavior.

Using escape sequences (the character following a backslash ('\')) which are not listed in the `printf(3C)` or this manual page will result in undefined behavior.

Floating-point values follow C99, XPG6 and IEEE 754 standard behavior and can handle values the same way as the platform’s `long double` datatype.

Floating-point values handle the sign separately which allows signs for values like NaN (for example, -nan), Infinite (for example, -inf) and zero (for example, -0.0).
**Name**
priocntl – display or set scheduling parameters of specified processes and LWPs

**Synopsis**
priocntl -l

priocntl -d [-i idtype] [idlist]
priocntl -s [-c class] [class-specific options]
   [-i idtype] [idlist]
priocntl -e [-c class] [class-specific options] command [argument(s)]

**Description**
The `priocntl` command displays or sets scheduling parameters of the specified processes or LWPs. It can also be used to display the current configuration information for the system's process scheduler or execute a command with specified scheduling parameters.

Processes and LWPs fall into distinct classes with a separate scheduling policy applied to each class. The classes currently supported are the real-time class, time-sharing class, interactive class, fair-share class, and the fixed priority class. The characteristics of these classes and the class-specific options they accept are described below in the USAGE section under the headings Real-Time Class, Time-Sharing Class, Inter-Active Class, Fair-Share Class, and Fixed-Priority Class. With appropriate permissions, the `priocntl` command can change the class and other scheduling parameters associated with a running process or LWPs.

In the default configuration, a runnable real-time process or LWP runs before any other process. Therefore, inappropriate use of real-time processes or LWPs can have a dramatic negative impact on system performance.

If an `idlist` is present, it must appear last on the command line and the elements of the list must be separated by white space. If no `idlist` is present, an `idtype` argument of `pid`, `ppid`, `pgid`, `sid`, `taskid`, `class`, `uid`, `gid`, `projid`, or `zoneid` specifies the process ID, parent process ID, process group ID, session ID, task ID, class, user ID, group ID, project ID, or zone ID, respectively, of the `priocntl` command itself.

The command

```
priocntl -d [-i idtype] [idlist]
```

displays the class and class-specific scheduling parameters of the processes specified by `idtype` and `idlist`.

The command

```
priocntl -s [-c class] [class-specific options] 
   [-i idtype] [idlist]
```

sets the class and class-specific parameters of the specified processes to the values given on the command line. The `-c class` option specifies the class to be set. (The valid `class` arguments are `RT` for real-time, `TS` for time-sharing, `IA` for inter-active, `FSS` for fair-share, or `FX` for fixed-priority.)
The class-specific parameters to be set are specified by the class-specific options as explained under the appropriate heading below. If the `-c class` option is omitted, `idtype` and `idlist` must specify a set of processes or LWPs which are all in the same class, otherwise an error results. If no class-specific options are specified, the process's class-specific parameters are set to the default values for the class specified by `-c class` (or to the default parameter values for the process's current class if the `-c class` option is also omitted).

To change the scheduling parameters of a process or LWP using `priocntl` the real or effective user ID (respectively, groupID) of the user invoking `priocntl` must match the real or effective user ID (respectively, groupID) of the receiving process or LWP, or the effective user ID of the user must be super-user. These are the minimum permission requirements enforced for all classes. An individual class can impose additional permissions requirements when setting processes to that class or when setting class-specific scheduling parameters.

When `idtype` and `idlist` specify a set of processes (with or without a list of LWPs), `priocntl` acts on the processes in the set in an implementation-specific order. If `priocntl` encounters an error for one or more of the target processes, it can or cannot continue through the set of processes, depending on the nature of the error.

If the error is related to permissions, `priocntl` prints an error message and then continues through the process set, resetting the parameters for all target processes for which the user has appropriate permissions. If `priocntl` encounters an error other than permissions, it does not continue through the process set but prints an error message and exits immediately.

A special `sys` scheduling class exists for the purpose of scheduling the execution of certain special system processes (such as the swapper process). It is not possible to change the class of any process to `sys`. In addition, any processes or LWPs in the `sys` class that are included in the set of processes specified by `idtype` and `idlist` are disregarded by `priocntl`. For example, if `idtype` were `uid`, an `idlist` consisting of a zero would specify all processes with a UID of 0, except processes in the `sys` class and (if changing the parameters using the `-s` option) the `init` process.

The `init` process (process ID 1) is a special case. In order for the `priocntl` command to change the class or other scheduling parameters of the `init` process, `idtype` must be `pid` and `idlist` must be consist of only a 1. The `init` process can be assigned to any class configured on the system, but the time-sharing class is almost always the appropriate choice. Other choices can be highly undesirable; see the Oracle Solaris Administration: Common Tasks for more information.

The command
```
priocntl -e [-c class] [class-specific options] command \ 
  [argument...]
```
executes the specified command with the class and scheduling parameters specified on the command line (`arguments` are the arguments to the command). If the `-c class` option is omitted the command is run in the user's current class.
Options

The following options are supported:

- **c class**
  Specifies the class to be set. (The valid class arguments are RT for real-time, TS for time-sharing, IA for inter-active, FSS for fair-share, or FX for fixed-priority.) If the specified class is not already configured, it is automatically configured.

- **d**
  Displays the scheduling parameters associated with a set of processes.

- **e**
  Executes a specified command with the class and scheduling parameters associated with a set of processes.

- **i idtype**
  This option, together with the idlist arguments (if any), specifies one or more processes or LWP IDs to which the priocntl command is to apply. The interpretation of idlist depends on the value of idtype. If the -i idtype option is omitted when using the -d or -s options the default idtype of pid is assumed.

The valid idtype arguments and corresponding interpretations of idlist are as follows:

- **i all**
  The priocntl command applies to all existing processes. No idlist should be specified (if one is specified, it is ignored). The permission restrictions described below still apply.

- **i ctid**
  idlist is a list of process contract IDs. The priocntl command applies to all processes with a process contract ID equal to an ID from the list.

- **i class**
  idlist consists of a single class name (RT for real-time, TS for time-sharing, IA for inter-active, FSS for fair-share, or FX for fixed-priority). The priocntl command applies to all processes in the specified class.

- **i gid**
  idlist is a list of group IDs. The priocntl command applies to all processes with an effective group ID equal to an ID from the list.

- **i pgid**
  idlist is a list of process group IDs. The priocntl command applies to all processes in the specified process groups.

- **i pid[/lwp]**
  idlist is a list of process IDs with each ID possibly followed by a forward slash (/) and a list of comma-separated LWP IDs. A range of LWP IDs can be indicated by a hyphen (-) separating the first and final items in the range.
-i ppid
   idlist is a list of parent process IDs. The priocntl command applies to all processes
   whose parent process ID is in the list.

- i projid
   idlist is a list of project IDs. The priocntl command applies to all processes with an
   effective project ID equal to an ID from the list.

- i sid
   idlist is a list of session IDs. The priocntl command applies to all processes in the
   specified sessions.

- i taskid
   idlist is a list of task IDs. The priocntl command applies to all processes in the
   specified tasks.

- i uid
   idlist is a list of user IDs. The priocntl command applies to all processes with an
   effective user ID equal to an ID from the list.

- i zoneid
   idlist is a list of zone IDs. The priocntl command applies to all processes with an
   effective zone ID equal to an ID from the list.

- l
   Displays a list of the classes currently configured in the system along with class-specific
   information about each class. The format of the class-specific information displayed is
   described under USAGE.

- s
   Sets the scheduling parameters associated with a set of processes.

The valid class-specific options for setting real-time parameters are:

- p rtpri
   Sets the real-time priority of the specified processes and LWPs to rtpri.

- t tqntm [-r res]
   Sets the time quantum of the specified processes to tqntm. You can optionally specify a
   resolution as explained below.

- q tqsig
   Sets the real-time time quantum signal of the specified processes and LWPs to tqsig.

The valid class-specific options for setting time-sharing parameters are:

- m tsuprilim
   Sets the user priority limit of the specified processes and LWPs to tsuprilim.

- p tsupri
   Sets the user priority of the specified processes and LWPs to tsupri.
The valid class-specific options for setting inter-active parameters are:

- **-m iauprilim**
  Sets the user priority limit of the specified processes and LWPs to iauprilim.

- **-p iaupri**
  Sets the user priority of the specified processes and LWPs to iaupri.

The valid class-specific options for setting fair-share parameters are:

- **-m fssuprilim**
  Sets the user priority limit of the specified processes and LWPs to fssuprilim.

- **-p fssupri**
  Sets the user priority of the specified processes and LWPs to fssupri.

The valid class-specific options for setting fixed-priority parameters are:

- **-m fxuprilim**
  Sets the user priority limit of the specified processes and LWPs to fxuprilim.

- **-p fxupri**
  Sets the user priority of the specified processes and LWPs to fxupri.

- **-t tqntm**
  
  [-r res] Sets the time quantum of the specified processes and LWPs to tqntm. You can optionally specify a resolution as explained below.

**Usage**

**Real-Time Class** The real-time class provides a fixed priority preemptive scheduling policy for those processes requiring fast and deterministic response and absolute user/application control of scheduling priorities. If the real-time class is configured in the system, it should have exclusive control of the highest range of scheduling priorities on the system. This ensures that a runnable real-time process is given CPU service before any process belonging to any other class.

The real-time class has a range of real-time priority (rtpri) values that can be assigned to processes within the class. Real-time priorities range from 0 to x, where the value of x is configurable and can be displayed for a specific installation that has already configured a real-time scheduler, by using the command

```
priocntl -l
```

The real-time scheduling policy is a fixed priority policy. The scheduling priority of a real-time process never changes except as the result of an explicit request by the user/application to change the rtpri value of the process.

For processes in the real-time class, the rtpri value is, for all practical purposes, equivalent to the scheduling priority of the process. The rtpri value completely determines the scheduling priority of a real-time process relative to other processes within its class. Numerically higher
rtpri values represent higher priorities. Since the real-time class controls the highest range of scheduling priorities in the system, it is guaranteed that the runnable real-time process with the highest rtpri value is always selected to run before any other process in the system.

In addition to providing control over priority, priocntl provides for control over the length of the time quantum allotted to processes in the real-time class. The time quantum value specifies the maximum amount of time a process can run, assuming that it does not complete or enter a resource or event wait state (sleep). Notice that if another process becomes runnable at a higher priority, the currently running process can be preempted before receiving its full time quantum.

The command

```
priocntl -d [-i idtype] [idlist]
```

displays the real-time priority, time quantum (in millisecond resolution), and time quantum signal value for each real-time process in the set specified by idtype and idlist.

Any combination of the -p, -t [-r], and -q options can be used with priocntl -s or priocntl -e for the real-time class. If an option is omitted and the process is currently real-time, the associated parameter is unaffected. If an option is omitted when changing the class of a process to real-time from some other class, the associated parameter is set to a default value. The default value for rtpri is 0 and the default for time quantum is dependent on the value of rtpri and on the system configuration; see rt_dptbl(4).

When using the -t tqntm option, you can optionally specify a resolution using the -r res option. (If no resolution is specified, millisecond resolution is assumed.) If res is specified, it must be a positive integer between 1 and 1,000,000,000 inclusively and the resolution used is the reciprocal of res in seconds. For example, specifying -t 10 -r 100 would set the resolution to hundredths of a second and the resulting time quantum length would be 10/100 seconds (one tenth of a second). Although very fine (nanosecond) resolution can be specified, the time quantum length is rounded up by the system to the next integral multiple of the system clock’s resolution. Requests for time quantum of zero or quantums greater than the (typically very large) implementation-specific maximum quantum result in an error.

The real-time time quantum signal can be used to notify runaway real-time processes about the consumption of their time quantum. Those processes, which are monitored by the real-time time quantum signal, receive the configured signal in the event of time quantum expiration. The default value (0) of the time quantum signal tqsig denotes no signal delivery. A positive value denotes the delivery of the signal specified by the value. Like kill(1) and other commands operating on signals, the -q tqsig option is also able to handle symbolically named signals, like XCPU or KILL.

In order to change the class of a process to real-time (from any other class), the user invoking priocntl must have super-user privilege. In order to change the rtpri value or time quantum of a real-time process, the user invoking priocntl must either be super-user, or must currently be in the real-time class (shell running as a real-time process) with a real or effective user ID matching the real or effective user ID of the target process.
The real-time priority, time quantum, and time quantum signal are inherited across the `fork(2)` and `exec(2)` system calls. When using the time quantum signal with a user defined signal handler across the `exec(2)` system call, the new image must install an appropriate user defined signal handler before the time quantum expires. Otherwise, unpredictable behavior would result.

The time-sharing scheduling policy provides for a fair and effective allocation of the CPU resource among processes with varying CPU consumption characteristics. The objectives of the time-sharing policy are to provide good response time to interactive processes and good throughput to CPU-bound jobs, while providing a degree of user/application control over scheduling.

The time-sharing class has a range of time-sharing user priority (`tsupri`) values that can be assigned to processes within the class. User priorities range from $-x$ to $+x$, where the value of $x$ is configurable. The range for a specific installation can be displayed by using the command `priocntl -l`.

The purpose of the user priority is to provide some degree of user/application control over the scheduling of processes in the time-sharing class. Raising or lowering the `tsupri` value of a process in the time-sharing class raises or lowers the scheduling priority of the process. It is not guaranteed, however, that a time-sharing process with a higher `tsupri` value runs before one with a lower `tsupri` value. This is because the `tsupri` value is just one factor used to determine the scheduling priority of a time-sharing process. The system can dynamically adjust the internal scheduling priority of a time-sharing process based on other factors such as recent CPU usage.

In addition to the system-wide limits on user priority (displayed with `priocntl -l`), there is a per process user priority limit (`tsuprilim`), which specifies the maximum `tsupri` value that can be set for a given process.

The command
```
priocntl -d [-i idtype] [idlist]
```
displays the user priority and user priority limit for each time-sharing process in the set specified by `idtype` and `idlist`.

Any time-sharing process can lower its own `tsuprilim` (or that of another process with the same user ID). Only a time-sharing process with super-user privilege can raise a `tsuprilim`. When changing the class of a process to time-sharing from some other class, super-user privilege is required in order to set the initial `tsuprilim` to a value greater than zero.

Any time-sharing process can set its own `tsupri` (or that of another process with the same user ID) to any value less than or equal to the process’s `tsuprilim`. Attempts to set the `tsupri` above the `tsuprilim` (and/or set the `tsuprilim` below the `tsupri`) result in the `tsupri` being set equal to the `tsuprilim`. 

Time-Sharing Class

The time-sharing class has a range of time-sharing user priority (`tsupri`) values that can be assigned to processes within the class. User priorities range from $-x$ to $+x$, where the value of $x$ is configurable. The range for a specific installation can be displayed by using the command `priocntl -l`.

The purpose of the user priority is to provide some degree of user/application control over the scheduling of processes in the time-sharing class. Raising or lowering the `tsupri` value of a process in the time-sharing class raises or lowers the scheduling priority of the process. It is not guaranteed, however, that a time-sharing process with a higher `tsupri` value runs before one with a lower `tsupri` value. This is because the `tsupri` value is just one factor used to determine the scheduling priority of a time-sharing process. The system can dynamically adjust the internal scheduling priority of a time-sharing process based on other factors such as recent CPU usage.

In addition to the system-wide limits on user priority (displayed with `priocntl -l`), there is a per process user priority limit (`tsuprilim`), which specifies the maximum `tsupri` value that can be set for a given process.

The command
```
priocntl -d [-i idtype] [idlist]
```
displays the user priority and user priority limit for each time-sharing process in the set specified by `idtype` and `idlist`.

Any time-sharing process can lower its own `tsuprilim` (or that of another process with the same user ID). Only a time-sharing process with super-user privilege can raise a `tsuprilim`. When changing the class of a process to time-sharing from some other class, super-user privilege is required in order to set the initial `tsuprilim` to a value greater than zero.

Any time-sharing process can set its own `tsupri` (or that of another process with the same user ID) to any value less than or equal to the process’s `tsuprilim`. Attempts to set the `tsupri` above the `tsuprilim` (and/or set the `tsuprilim` below the `tsupri`) result in the `tsupri` being set equal to the `tsuprilim`. 

Time-Sharing Class

The time-sharing scheduling policy provides for a fair and effective allocation of the CPU resource among processes with varying CPU consumption characteristics. The objectives of the time-sharing policy are to provide good response time to interactive processes and good throughput to CPU-bound jobs, while providing a degree of user/application control over scheduling.

The time-sharing class has a range of time-sharing user priority (`tsupri`) values that can be assigned to processes within the class. User priorities range from $-x$ to $+x$, where the value of $x$ is configurable. The range for a specific installation can be displayed by using the command `priocntl -l`.

The purpose of the user priority is to provide some degree of user/application control over the scheduling of processes in the time-sharing class. Raising or lowering the `tsupri` value of a process in the time-sharing class raises or lowers the scheduling priority of the process. It is not guaranteed, however, that a time-sharing process with a higher `tsupri` value runs before one with a lower `tsupri` value. This is because the `tsupri` value is just one factor used to determine the scheduling priority of a time-sharing process. The system can dynamically adjust the internal scheduling priority of a time-sharing process based on other factors such as recent CPU usage.

In addition to the system-wide limits on user priority (displayed with `priocntl -l`), there is a per process user priority limit (`tsuprilim`), which specifies the maximum `tsupri` value that can be set for a given process.

The command
```
priocntl -d [-i idtype] [idlist]
```
displays the user priority and user priority limit for each time-sharing process in the set specified by `idtype` and `idlist`.

Any time-sharing process can lower its own `tsuprilim` (or that of another process with the same user ID). Only a time-sharing process with super-user privilege can raise a `tsuprilim`. When changing the class of a process to time-sharing from some other class, super-user privilege is required in order to set the initial `tsuprilim` to a value greater than zero.

Any time-sharing process can set its own `tsupri` (or that of another process with the same user ID) to any value less than or equal to the process’s `tsuprilim`. Attempts to set the `tsupri` above the `tsuprilim` (and/or set the `tsuprilim` below the `tsupri`) result in the `tsupri` being set equal to the `tsuprilim`.
Any combination of the `-m` and `-p` options can be used with `priocntl -s` or `priocntl -e` for the time-sharing class. If an option is omitted and the process is currently time-sharing, the associated parameter is normally unaffected. The exception is when the `-p` option is omitted and `-m` is used to set a `tsuprilim` below the current `tsupri`. In this case, the `tsupri` is set equal to the `tsuprilim` which is being set. If an option is omitted when changing the class of a process to time-sharing from some other class, the associated parameter is set to a default value. The default value for `tsuprilim` is 0 and the default for `tsupri` is to set it equal to the `tsuprilim` value which is being set.

The time-sharing user priority and user priority limit are inherited across the `fork(2)` and `exec(2)` system calls.

**Inter-Active Class**

The inter-active scheduling policy provides for a fair and effective allocation of the CPU resource among processes with varying CPU consumption characteristics while providing good responsiveness for user interaction. The objectives of the inter-active policy are to provide good response time to interactive processes and good throughput to CPU-bound jobs. The priorities of processes in the inter-active class can be changed in the same manner as those in the time-sharing class, though the modified priorities continue to be adjusted to provide good responsiveness for user interaction.

The inter-active user priority limit, `iaupri`, is equivalent to `tsupri`. The inter-active per process user priority, `iauprilim`, is equivalent to `tsuprilim`.

Inter-active class processes that have the `iamode` ("interactive mode") bit set are given a priority boost value of 10, which is factored into the user mode priority of the process when that calculation is made, that is, every time a process's priority is adjusted. This feature is used by the X windowing system, which sets this bit for those processes that run inside of the current active window to give them a higher priority.

**Fair-Share Class**

The fair-share scheduling policy provides a fair allocation of system CPU resources among projects, independent of the number of processes they own. Projects are given "shares" to control their entitlement to CPU resources. Resource usage is remembered over time, so that entitlement is reduced for heavy usage, and increased for light usage, with respect to other projects. CPU time is scheduled among processes according to their owner's entitlements, independent of the number of processes each project owns.

The FSS scheduling class supports the notion of per-process user priority and user priority limit for compatibility with the time-share scheduler. The fair share scheduler attempts to provide an evenly graded effect across the whole range of user priorities. Processes with negative `fssupri` values receive time slices less frequently than normal, while processes with positive `fssupri` values receive time slices more frequently than normal. Notice that user priorities do not interfere with shares. That is, changing a `fssupri` value of a process is not going to affect its project's overall CPU usage which only relates to the amount of shares it is allocated compared to other projects.

The priorities of processes in the fair-share class can be changed in the same manner as those in the time-share class.
The fixed-priority class provides a fixed priority preemptive scheduling policy for those processes requiring that the scheduling priorities do not get dynamically adjusted by the system and that the user/application have control of the scheduling priorities.

The fixed-priority class shares the same range of scheduling priorities with the time-sharing class, by default. The fixed-priority class has a range of fixed-priority user priority (fxupri) values that can be assigned to processes within the class. User priorities range from 0 to \(x\), where the value of \(x\) is configurable. The range for a specific installation can be displayed by using the command

```
prioctl -l
```

The purpose of the user priority is to provide user/application control over the scheduling of processes in the fixed-priority class. For processes in the fixed-priority class, the fxupri value is, for all practical purposes, equivalent to the scheduling priority of the process. The fxupri value completely determines the scheduling priority of a fixed-priority process relative to other processes within its class. Numerically higher fxupri values represent higher priorities.

In addition to the system-wide limits on user priority (displayed with `prioctl -l`), there is a per-process user priority limit (fxuprilim), which specifies the maximum fxupri value that can be set for a given process.

Any fixed-priority process can lower its own fxuprilim (or that of another process with the same user ID). Only a process with super-user privilege can raise a fxuprilim. When changing the class of a process to fixed-priority from some other class, super-user privilege is required in order to set the initial fxuprilim to a value greater than zero.

Any fixed-priority process can set its own fxupri (or that of another process with the same user ID) to any value less than or equal to the process's fxuprilim. Attempts to set the fxupri above the fxuprilim (or set the fxuprilim below the fxupri) result in the fxupri being set equal to the fxuprilim.

In addition to providing control over priority, `prioctl` provides for control over the length of the time quantum allotted to processes in the fixed-priority class. The time quantum value specifies the maximum amount of time a process can run, before surrendering the CPU, assuming that it does not complete or enter a resource or event wait state (sleep). Notice that if another process becomes runnable at a higher priority, the currently running process can be preempted before receiving its full time quantum.

Any combination of the -m, -p, and -t options can be used with `prioctl -s` or `prioctl -e` for the fixed-priority class. If an option is omitted and the process is currently fixed-priority, the associated parameter is normally unaffected. The exception is when the -p option is omitted and the -m option is used to set a fxuprilim below the current fxupri. In this case, the fxupri is set equal to the fxuprilim which is being set. If an option is omitted when changing the class of a process to fixed-priority from some other class, the associated parameter is set to a default value. The default value for fxuprilim is 0. The default for fxupri is to set it equal to the fxuprilim value which is being set. The default for time quantum is dependent on the fxupri and on the system configuration. See `fx_dptbl.4`.
The time quantum of processes in the fixed-priority class can be changed in the same manner as those in the real-time class.

The fixed-priority user priority, user priority limit, and time quantum are inherited across the fork(2) and exec(2) system calls.

Examples

The following are real-time class examples:

**EXAMPLE 1** Setting the Class

The following example sets the class of any non-real-time processes selected by *idtype* and *idlist* to real-time and sets their real-time priority to the default value of 0. The real-time priorities of any processes currently in the real-time class are unaffected. The time quantums of all of the specified processes are set to 1/10 seconds.

Example% priocntl -s -c RT -t 1 -r 10 -i idtype idlist

**EXAMPLE 2** Executing a Command in Real-time

The following example executes *command* in the real-time class with a real-time priority of 15 and a time quantum of 20 milliseconds:

Example% priocntl -e -c RT -p 15 -t 20 command

**EXAMPLE 3** Executing a Command in Real-time with a Specified Quantum Signal

The following example executes *command* in the real-time class with a real-time priority of 11, a time quantum of 250 milliseconds, and where the specified real-time quantum signal is SIGXCPU:

Example% priocntl -e -c RT -p 11 -t 250 -q XCPU command

The following are time-sharing class examples:

**EXAMPLE 4** Setting the Class of non-time-sharing Processes

The following example sets the class of any non-time-sharing processes selected by *idtype* and *idlist* to time-sharing and sets both their user priority limit and user priority to 0. Processes already in the time-sharing class are unaffected.

Example% priocntl -s -c TS -i idtype idlist

**EXAMPLE 5** Executing a Command in the Time-sharing Class

The following example executes *command* with the arguments *arguments* in the time-sharing class with a user priority limit of 0 and a user priority of −15:

Example% priocntl -e -c TS -m 0 -p -15 command [arguments]
EXAMPLE 6  Executing a Command in Fixed-Priority Class

The following example executes a command in the fixed-priority class with a user priority limit of 20 and user priority of 10 and time quantum of 250 milliseconds:

```
example% priocntl -e -c FX -m 20 -p 10 -t 250 command
```

EXAMPLE 7  Changing the Priority of a Specific LWP

The following example sets the user priority limit of 20 and user priority of 15 for the LWP 5 in process 500:

```
example% priocntl -s -m 20 -p 15 500/5
```

Exit Status  The following exit values are returned:

For options -d, -l, and -s:

- 0  Successful operation.
- 1  Error condition.

For option -e:

Return of the Exit Status of the executed command denotes successful operation. Otherwise,

- 1  Command could not be executed at the specified priority.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

See Also  kill(1), nice(1), ps(1), dispadmin(1M), exec(2), fork(2), priocntl(2), fx_dptbl(4), process(4), rt_dptbl(4), attributes(5), zones(5), FSS(7)

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Diagnostics  priocntl prints the following error messages:

Process(es) not found
None of the specified processes exists.

Specified processes from different classes
The -s option is being used to set parameters, the -c class option is not present, and processes from more than one class are specified.
Invalid option or argument
   An unrecognized or invalid option or option argument is used.
proc(1)

Name  proc, pflags, pcred, pldd, psig, pstack, pfiles, pwdx, pstop, prun, pwait, ptime – proctools

Synopsis  /usr/bin/pflags [-r] pid | core [/lwp] ...
/usr/bin/pcred [pid | core]...
/usr/bin/pldd [-F] [pid | core]...
/usr/bin/psig [-n] pid...
/usr/bin/pstack [-F] pid | core [/lwp] ...
/usr/bin/pfiles [-Fn] pid...
/usr/bin/pwdx pid...
/usr/bin/pstop pid[/lwp] ...
/usr/bin/prun pid[/lwp] ...
/usr/bin/pwait [-v] pid...
/usr/bin/ptime [-Fm] [-p] pid...
/usr/bin/ptime [-m] command [arg]...

Description  The proctools are utilities that exercise features of /proc (see proc(4)). Most of them take a list of process-ids (pid). The tools that do take process-ids also accept /proc/nnn as a process-id, so the shell expansion /proc/* can be used to specify all processes in the system.

Some of the proc tools can also be applied to core files (see core(4)). The tools that apply to core files accept a list of either process IDs or names of core files or both.

Some of the proc tools can operate on individual threads. Users can examine only selected threads by appending /thread-id to the process-id or core. Multiple threads can be selected using the - and , delimiters. For example /1,2,7-9 examines threads 1, 2, 7, 8, and 9.

See WARNINGS.

pflags  Print the /proc tracing flags, the pending and held signals, and other /proc status information for each process or specified lwps in each process.

pcred  Print or set the credentials (effective, real, saved UIDs and GIDs) of each process.

pldd  List the dynamic libraries linked into each process, including shared objects explicitly attached using dlopen(3C). See also ldd(1).

psig  List the signal actions and handlers of each process. See signal.h(3HEAD).

pstack  Print a hex+symbolic stack trace for each process or specified lwps in each process.
**pfiles**  Report `fstat(2)` and `fcntl(2)` information for all open files in each process. For network endpoints, the local (and peer if connected) address information is also provided. For sockets, the socket type, socket options and send and receive buffer sizes are also provided. In addition, a path to the file is reported if the information is available from `/proc/pid/path`. This is not necessarily the same name used to open the file. See `proc(4)` for more information.

**pwdx**  Print the current working directory of each process.

**pstop**  Stop each process or the specified lwps (PR_REQUESTED stop).

**prun**  Set running each process or the specified lwps (the inverse of `pstop`).

**pwait**  Wait for all of the specified processes to terminate.

**ptime**  Time the command, like `time(1)`, but using microstate accounting for reproducible precision. Unlike `time(1)`, children of the command are not timed. If the `-p pid` version is used, display a snapshot of timing statistics for the specified `pid`.

**Options**  The following general options are supported:

- `-F`  Force. Grabs the target process even if another process has control.
- `-n`  (psig and pfiles only) Sets non-verbose mode. psig displays signal handler addresses rather than names. pfiles does not display verbose information for each file descriptor. Instead, pfiles limits its output to the information that would be retrieved if the process applied `fstat(2)` to each of its file descriptors.
- `-r`  (pflags only) If the process is stopped, displays its machine registers.
- `-v`  (pwait only) Verbose. Reports terminations to standard output.

In addition to the general options, pcred supports the following options:

- `-g group/gid`  Sets the real, effective, and saved group ids (GIDs) of the target processes to the specified value.
- `-G grouplist`  Sets the supplementary GIDs of the target process to the specified list of groups. The supplementary groups should be specified as a comma-separated list of group names ids. An empty list clears the supplementary group list of the target processes.
- `-l login`  Sets the real, effective, and saved UIDs of the target processes to the UID of the specified login. Sets the real, effective, and saved GIDs of the target processes to the GID of the specified login. Sets the supplementary group list to the supplementary groups list of the specified login.
- `-u user/uid`  Sets the real, effective, and saved user ids (UIDs) of the target processes to the specified value.
In addition to the general options, p1dd supports the following option:

- l     Shows unresolved dynamic linker map names.

In addition to the general options, p1me supports the following options:

- m     Display the full set of microstate accounting statistics.

The displayed fields are as follows:

real    Wall clock time.
user    User level CPU time.
sys     System call CPU time.
trap    Other system trap CPU time.
tflt    Text page fault sleep time.
dflt    Data page fault sleep time.
kflt    Kernel page fault sleep time.
lock    User lock wait sleep time.
slp     All other sleep time.
lat     CPU latency (wait) time.
stop    Stopped time.

-p pid    Displays a snapshot of timing statistics for the specified pid.

To set the credentials of another process, a process must have sufficient privilege to change its user and group ids to those specified according to the rules laid out in setuid(2) and it must have sufficient privilege to control the target process.

Usage These proc tools stop their target processes while inspecting them and reporting the results: pfiles, p1dd, and pstack. A process can do nothing while it is stopped. Thus, for example, if the X server is inspected by one of these proc tools running in a window under the X server’s control, the whole window system can become deadlocked because the proc tool would be attempting to print its results to a window that cannot be refreshed. Logging in from another system using ssh(1) and killing the offending proc tool would clear up the deadlock in this case.

See WARNINGS.

Caution should be exercised when using the - F flag. Imposing two controlling processes on one victim process can lead to chaos. Safety is assured only if the primary controlling process, typically a debugger, has stopped the victim process and the primary controlling process is doing nothing at the moment of application of the proc tool in question.
Some of the proc tools can also be applied to core files, as shown by the synopsis above. A core file is a snapshot of a process’s state and is produced by the kernel prior to terminating a process with a signal or by the `gcore(1)` utility. Some of the proc tools can need to derive the name of the executable corresponding to the process which dumped core or the names of shared libraries associated with the process. These files are needed, for example, to provide symbol table information for `pstack(1)`. If the proc tool in question is unable to locate the needed executable or shared library, some symbol information is unavailable for display. Similarly, if a core file from one operating system release is examined on a different operating system release, the run-time link-editor debugging interface (librtld_db) cannot be able to initialize. In this case, symbol information for shared libraries is not available.

**Exit Status**
The following exit values are returned:

<table>
<thead>
<tr>
<th>Exit Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful operation.</td>
</tr>
<tr>
<td>non-zero</td>
<td>An error has occurred.</td>
</tr>
</tbody>
</table>

**Files** `/proc/*` process files

**Attributes** See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>See below.</td>
</tr>
</tbody>
</table>

The human readable output is Uncommitted. The options are Committed.

**See Also** `gcore(1), ldd(1), pargs(1), pgrep(1), pkill(1), pmap(1), preap(1), ps(1), ptree(1), ppgsz(1), pwd(1), rlogin(1), ssh(1), time(1), truss(1), wait(1), fcntl(2), fstat(2), setuid(2), dlopen(3C), signal.h(3HEAD), core(4), proc(4), process(4), attributes(5), zones(5)`

**Warnings**
The following proc tools stop their target processes while inspecting them and reporting the results: `pfiles`, `pldd`, and `pstack`. However, even if `pstack` operates on an individual thread, it stops the whole process.

A process or thread can do nothing while it is stopped. Stopping a heavily used process or thread in a production environment, even for a short amount of time, can cause severe bottlenecks and even hangs of these processes or threads, causing them to be unavailable to users. Some databases could also terminate abnormally. Thus, for example, a database server under heavy load could hang when one of the database processes or threads is traced using the above mentioned proc tools. Because of this, stopping a UNIX process or thread in a production environment should be avoided.
A process or thread being stopped by these tools can be identified by issuing `/usr/bin/ps -ef` and looking for “T” in the first column. Notice that certain processes, for example “sched”, can show the “T” status by default most of the time.

The process ID returned for locked files on network file systems might not be meaningful.
The `prof` command interprets a profile file produced by the `monitor` function. The symbol table in the object file `prog` (a.out by default) is read and correlated with a profile file (mon.out by default). For each external text symbol the percentage of time spent executing between the address of that symbol and the address of the next is printed, together with the number of times that function was called and the average number of milliseconds per call.

The mutually exclusive options `-a`, `-c`, `-n`, and `-t` determine the type of sorting of the output lines:

- `-a` Sort by increasing symbol address.
- `-c` Sort by decreasing number of calls.
- `-n` Sort lexically by symbol name.
- `-t` Sort by decreasing percentage of total time (default).

The mutually exclusive options `-o` and `-x` specify the printing of the address of each symbol monitored:

- `-o` Print each symbol address (in octal) along with the symbol name.
- `-x` Print each symbol address (in hexadecimal) along with the symbol name.

The mutually exclusive options `-g` and `-l` control the type of symbols to be reported. The `-l` option must be used with care; it applies the time spent in a static function to the preceding (in memory) global function, instead of giving the static function a separate entry in the report. If all static functions are properly located, this feature can be very useful. If not, the resulting report may be misleading.

Assume that A and B are global functions and only A calls static function S. If S is located immediately after A in the source code (that is, if S is properly located), then, with the `-l` option, the amount of time spent in A can easily be determined, including the time spent in S. If, however, both A and B call S, then, if the `-l` option is used, the report will be misleading; the time spent during B’s call to S will be attributed to A, making it appear as if more time had been spent in A than really had. In this case, function S cannot be properly located.

- `-g` List the time spent in static (non-global) functions separately. The `-g` option function is the opposite of the `-l` function.

- `-l` Suppress printing statically declared functions. If this option is given, time spent executing in a static function is allocated to the closest global function loaded before the static function in the executable. This option is the default. It is the opposite of the `-g` function and should be used with care.
The following options may be used in any combination:

- **C**  
  Demangle C++ symbol names before printing them out.

- **h**  
  Suppress the heading normally printed on the report. This is useful if the report is to be processed further.

- **m mdata**  
  Use file mdata instead of mon.out as the input profile file.

- **s**  
  Print a summary of several of the monitoring parameters and statistics on the standard error output.

- **V**  
  Print prof version information on the standard error output.

- **z**  
  Include all symbols in the profile range, even if associated with zero number of calls and zero time.

A single function may be split into subfunctions for profiling by means of the MARK macro. See prof(5).

### Environment Variables

**PROFDIR**  
The name of the file created by a profiled program is controlled by the environment variable PROFDIR. If PROFDIR is not set, mon.out is produced in the directory current when the program terminates. If PROFDIR=string, string/pid.progname is produced, where progname consists of argv[0] with any path prefix removed, and pid is the process ID of the program. If PROFDIR is set, but null, no profiling output is produced.

### Files

- **mon.out**  
  default profile file

- **a.out**  
  default namelist (object) file

### Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/base-developer-utilities</td>
</tr>
</tbody>
</table>

### See Also

gprof(1), exit(2), pcsample(2), profil(2), malloc(3C), malloc(3MALLOC), monitor(3C), attributes(5), prof(5)

### Notes

If the executable image has been stripped and does not have the .symtab symbol table, gprof reads the global dynamic symbol tables .dynsym and .SUNW ldynsym, if present. The symbols in the dynamic symbol tables are a subset of the symbols that are found in .symtab. The .dynsym symbol table contains the global symbols used by the runtime linker. .SUNW ldynsym augments the information in .dynsym with local function symbols. In the case where .dynsym is found and .SUNW ldynsym is not, only the information for the global symbols is available. Without local symbols, the behavior is as described for the -a option.
The times reported in successive identical runs may show variances because of varying cache-hit ratios that result from sharing the cache with other processes. Even if a program seems to be the only one using the machine, hidden background or asynchronous processes may blur the data. In rare cases, the clock ticks initiating recording of the program counter may beat with loops in a program, grossly distorting measurements. Call counts are always recorded precisely, however.

Only programs that call exit or return from main are guaranteed to produce a profile file, unless a final call to monitor is explicitly coded.

The times for static functions are attributed to the preceding external text symbol if the -g option is not used. However, the call counts for the preceding function are still correct; that is, the static function call counts are not added to the call counts of the external function.

If more than one of the options -t, -c, -a, and -n is specified, the last option specified is used and the user is warned.

LD_LIBRARY_PATH must not contain /usr/lib as a component when compiling a program for profiling. If LD_LIBRARY_PATH contains /usr/lib, the program will not be linked correctly with the profiling versions of the system libraries in /usr/lib/libp. See gprof(1).

Functions such as mcount(), _mcount(), _moncontrol(), _moncontrol(), monitor(), and _monitor() may appear in the prof report. These functions are part of the profiling implementation and thus account for some amount of the runtime overhead. Since these functions are not present in an unprofiled application, time accumulated and call counts for these functions may be ignored when evaluating the performance of an application.

64-bit profiling
64-bit profiling may be used freely with dynamically linked executables, and profiling information is collected for the shared objects if the objects are compiled for profiling. Care must be applied to interpret the profile output, since it is possible for symbols from different shared objects to have the same name. If duplicate names are seen in the profile output, it is better to use the -s (summary) option, which prefixes a module id before each symbol that is duplicated. The symbols can then be mapped to appropriate modules by looking at the modules information in the summary.

If the -a option is used with a dynamically linked executable, the sorting occurs on a per-shared-object basis. Since there is a high likelihood of symbols from different shared objects to have the same value, this results in an output that is more understandable. A blank line separates the symbols from different shared objects, if the -s option is given.

32-bit profiling
32-bit profiling may be used with dynamically linked executables, but care must be applied. In 32-bit profiling, shared objects cannot be profiled with prof. Thus, when a profiled, dynamically linked program is executed, only the main portion of the image is sampled. This means that all time spent outside of the main object, that is, time spent in a shared object, will not be included in the profile summary; the total time reported for the program may be less than the total time used by the program.
Because the time spent in a shared object cannot be accounted for, the use of shared objects should be minimized whenever a program is profiled with prof. If desired, the program should be linked to the profiled version of a library (or to the standard archive version if no profiling version is available), instead of the shared object to get profile information on the functions of a library. Versions of profiled libraries may be supplied with the system in the /usr/lib/libp directory. Refer to compiler driver documentation on profiling.

Consider an extreme case. A profiled program dynamically linked with the shared C library spends 100 units of time in some libc routine, say, malloc(). Suppose malloc() is called only from routine B and B consumes only 1 unit of time. Suppose further that routine A consumes 10 units of time, more than any other routine in the main (profiled) portion of the image. In this case, prof will conclude that most of the time is being spent in A and almost no time is being spent in B. From this it will be almost impossible to tell that the greatest improvement can be made by looking at routine B and not routine A. The value of the profiler in this case is severely degraded; the solution is to use archives as much as possible for profiling.
profiles(1)

Name  profiles – list and manage rights profiles

Synopsis  profiles [-l] [-a | user ...] [-S repository]
           profiles -p profiles [-S repository]
           profiles -p profiles [-S repository] subcommand
           profiles -p profiles [-S repository] -f command_file
           profiles help

Description  The profiles utility creates and modifies the configuration of a rights profile in the prof_attr(4) or exec_attr(4) databases in the local files name service or LDAP name service. A rights profile configuration consists of a profile name and a number of properties.

The following synopsis of the profiles subcommand is for interactive usage:
           profiles -p profile [-S repository] [subcommand]

The profiles command prints on standard output the names of the rights profiles that have been assigned to you or to the optionally-specified user or role name. Profiles are a bundling mechanism used to enumerate the commands and authorizations needed to perform a specific function. Along with each listed executable are the process attributes, such as the effective user and group IDs, with which the process runs when started by a privileged command interpreter. See the pfexec(1) man page. Profiles can contain other profiles defined in prof_attr(4).

Multiple profiles can be combined to construct the appropriate access control. When profiles are assigned, the authorizations are added to the existing set. If the same command appears in multiple profiles, the first occurrence, as determined by the ordering of the profiles is used for process-attribute settings. For convenience, a wildcard can be specified to match all commands.

The special profile “Stop” shortcuts the evaluations of further profiles. Profiles seen after the “Stop” profile are not evaluated nor are they used to find additional commands. This profile can be used to sidestep profiles listed in /etc/security/policy.conf with the PROF_GRANTED key and the authorizations listed with AUTH_GRANTED in that file.

When profiles are interpreted, the profile list is loaded from user_attr(4). If any default profiles are defined in /etc/security/policy.conf (see policy.conf(4)), the list of default profiles are added to the list loaded from user_attr(4). Matching entries in prof_attr(4) provide the authorizations list, and matching entries in exec_attr(4) provide the commands list.

Properties  When invoked with the -p option, the properties of the specified profile, as well as the properties of its associated executable files can be managed. However, to maintain system integrity, those profiles that are maintained by Solaris can not modified by this command. Such profiles can only be modified via the pkg(1) command during a system update.

Optionally, other profiles can also be delivered by the pkg(1) command as not modifiable.
To prevent privilege escalation, the property values are restricted based on the user's authorizations. At a minimum, an administrator needs to be granted the Rights Management profile. Additionally, to modify security-related properties controlled by delegate authorizations, an administrator must be granted Rights Delegation profile. See `exec_attr(4)`, `prof_attr(4)`, and the following summary for details.

Property values can be simple strings, or comma-separated lists of simple strings. Simple strings containing white space must be double quoted.

The `profiles` command operates in both `profile` and `command` contexts. The `profile` context is the initial state, in which the various profile properties can be managed. The following table summarizes the properties in the `profile` context:

<table>
<thead>
<tr>
<th>Property Name</th>
<th>Value Type</th>
<th>Required Authorizations</th>
</tr>
</thead>
<tbody>
<tr>
<td>name</td>
<td>simple</td>
<td>none</td>
</tr>
<tr>
<td>auths</td>
<td>list of simple</td>
<td>solaris.auth.{assign/delegate}</td>
</tr>
<tr>
<td>profiles</td>
<td>list of simple</td>
<td>solaris.profile.{assign/delegate}</td>
</tr>
<tr>
<td>privs</td>
<td>list of simple</td>
<td>solaris.privilege.{assign/delegate}</td>
</tr>
<tr>
<td>limitpriv</td>
<td>list of simple</td>
<td>solaris.privilege.{assign/delegate}</td>
</tr>
<tr>
<td>defaultpriv</td>
<td>list of simple</td>
<td>solaris.privilege.{assign/delegate}</td>
</tr>
<tr>
<td>always_audit</td>
<td>list of simple</td>
<td>solaris.audit.assign</td>
</tr>
<tr>
<td>never_audit</td>
<td>list of simple</td>
<td>solaris.audit.assign</td>
</tr>
<tr>
<td>desc</td>
<td>simple</td>
<td>none</td>
</tr>
<tr>
<td>help</td>
<td>simple</td>
<td>none</td>
</tr>
<tr>
<td>pam_policy</td>
<td>simple</td>
<td>solaris.account.setpolicy</td>
</tr>
<tr>
<td>cmd</td>
<td>simple/new context</td>
<td>none</td>
</tr>
</tbody>
</table>

The command context is entered by specifying the `cmd` property. While in the command context, the properties of the current command can be managed.

The following table summarizes the properties in the `command` context:

<table>
<thead>
<tr>
<th>Property Name</th>
<th>Value Type</th>
<th>Required Authorizations</th>
</tr>
</thead>
<tbody>
<tr>
<td>id</td>
<td>simple</td>
<td>none</td>
</tr>
<tr>
<td>privs</td>
<td>list of simple</td>
<td>solaris.privilege.{assign/delegate}</td>
</tr>
<tr>
<td>limitprivs</td>
<td>list of simple</td>
<td>solaris.privilege.{assign/delegate}</td>
</tr>
<tr>
<td>euid</td>
<td>simple</td>
<td>solaris.profile.cmd.setuid</td>
</tr>
<tr>
<td>uid</td>
<td>simple</td>
<td>solaris.profile.cmd.setuid</td>
</tr>
<tr>
<td>egid</td>
<td>simple</td>
<td>solaris.group.{assign/delegate}</td>
</tr>
<tr>
<td>gid</td>
<td>simple</td>
<td>solaris.group.{assign/deleg}</td>
</tr>
</tbody>
</table>

The values that can be specified in the `profile` context properties are described in the following list. An equal sign (=) is required between the property and its values as specified in the following list.
always_audit
The audit flags specifying event classes to always audit. Only the first occurrence of this property, either in the user's user_attr(4) entry, or in the ordered list of assigned profiles is applied at login and su.

auths
One or more comma-separated authorizations to be added to the new profile. If the wildcard character (*) is use in an authorization name, the name must be enclosed in double quotes (").

cmd
The fully qualified path to an executable file or the asterisk (*) symbol, which is used to specify all commands. An asterisk that replaces the filename component in a pathname indicates all files in a particular directory.

This is a special property that is used to enter the command context to manage the security properties of a command.

Either numeric IDs and names can be used for these IDs.

id
This property is initially set to the value that was specified by the previous cmd property, but can be modified. When used in conjunction with the select subcommand, the properties of an existing command can be cloned for subsequent editing.

pam_policy
The PAM policy to apply to a user. pam_policy must be either an absolute pathname to a pam.conf(4)-formatted file or the name of a pam.conf(4)-formatted file located in /etc/security/pam_policy. See pam_user_policy(5) for more information.

privs
The set of privileges to be applied to the inheritable set of the executable process. The default is basic.

limitprivs
The set of privileges to be applied to the limit set of the executable process. The default is all.

euid
The effective user ID of the process that executes with the command.

uid
The real user ID of the process that executes with the command.

egid
The effective group ID of the process that executes with the command.

gid
The real group ID of the process that executes with the command.
defaultpriv
The default set of privileges assigned to a user’s set of processes. Only the first occurrence of this property, either in the user’s user_attr(4) entry, or in the ordered list of assigned profiles is applied at login and su.

desc
The description of the new profile. The text must be enclosed in quotation marks.

help
The help file name for the new profile. The help file is copied to the
/usr/lib/help/profiles/locale/<locale> directory. Where <locale> is the value of the user’s language locale, or C if none is specified. Specifying this property is only applicable in the files repository.

limitpriv
The maximum set of privileges a user or any process started by the user, whether through su(1M) or any other means, can obtain. Only the first occurrence of this property, either in the user’s user_attr(4) entry, or in the ordered list of assigned profiles is applied at login and su.

name
The name of the profile. The initial value for the name is specified using -p option on the command line. If the name is changed, the current profile properties are applied to the newly named profile. In this way an existing profile can be cloned for subsequent editing. The name must not match an existing profile.

never_auditaudit flagsspecifying event class to never audit. Only the first occurrence of this property, either in the user’s user_attr(4) entry, or in the ordered list of assigned profiles is applied at login and su.

privs
The set of privileges that can be specified using the P option of the pfexec(1) command.

profiles
One or more comma-separated supplementary profiles to be added to the new profile.

**Options**
The following options are supported:

- `-a`
  Lists all the profile names in the specified repository. If no repository is specified, it follows whatever is configured for prof_attr in nsswitch.conf(4).

- `-f command_file`
  Specifies the name of profiles command file. command_file is a text file of profiles subcommands, one per line.

- `-l`
  Provides information about the Rights Profile and lists the commands and their special process attributes such as user and group IDs.
-p profile
   Specifies the profile name.

-S repository
   The valid repositories are files and ldap. repository specifies which name service is
   updated. The default repository is files.

**Sub-commands**

When invoked with the -p option, subcommands can be provided on the command line or
interactively. Multiple subcommands, separated by semicolons can be specified on the
command line by enclosing the entire set in quotation marks. The lack of subcommands
implies an interactive session, during which auto-completion of subcommands can be
invoked by using the TAB key.

The add and select subcommands can be used to select a specific command, at which point
the context changes to that of the command. During an interactive session, the command
context is identified by the command basename in the prompt string. The end and cancel
subcommands are used to complete the command specification, at which time the context is
reverted to the profile context.

Subcommands that can result in destructive actions or loss of work have a -F option to force
the action. If input is from a terminal device, the user is prompted when appropriate. This
could occur if a subcommand is given without the -F option. Otherwise, the action is
disallowed, with a diagnostic message written to standard error.

The property-value can be a simple value, or a list of simple values for those properties which
accept lists. The following subcommands are supported:

**add cmd=pathname**
   In the profile context, begins the specification for a given command. The context is
   changed to the command type.

**add property-name=property-value**
   Adds the specified values to the current property values. This subcommand can only be
   applied to properties that accept lists.

**cancel**
   End the command specification and reset context to profile. Abandons any partially
   specified resources. cancel is only applicable in the command context.

**clear property name**
   Clear the value for the property.

**commit**
   Commit the current configuration from memory to stable storage. The configuration must
   be committed for the changes to take effect. Until the in-memory configuration is
   committed, you can remove changes with the revert subcommand. The commit operation
   is attempted automatically upon completion of a profiles session. Since a configuration
   must be correct to be committed, this operation automatically does a verify.
delete [-F]
Delete the specified profile from memory and stable storage. This operation is not permitted if the profile is included as a subprofile of another profile in the same repository. Instead, a list of profiles which include this profile is supplied from which the user must manually remove this profile prior to deleting it. Specify the -F option to force the action. If the deletion is allowed, its action is instantaneous and the session is terminated.

end
End the command specification. This subcommand is only applicable in the command context. The `profiles` command verifies that the current command is completely specified. If so, it is added to the in-memory configuration (see `commit` for saving this to stable storage) and the context reverts to the `profile` context. If the specification is incomplete, it issues an appropriate error message.

exit [-F]
Exit the profiles session. A `commit` is automatically attempted if needed. You can also use an EOF character to exit profiles. The -F option can be used to force the action.

export [-f output-file]
Print configuration to standard output. Use the -f option to print the configuration to output-file. This option produces output in a form suitable for use in a command file option.

help [usage] [subcommands] [properties] [command] [properties]
Print general help or help about specific topic.

info [property-name]
Display information about the current profile or the specified property.

remove cmd=fullpath
Removes the specified command from the profile. This subcommand is only valid in the `profile` context.

remove [-F] cmd
Removes all the commands from the profile. A confirmation is required, unless you use the -F option. This subcommand is only valid in the `profile` context.

remove property-name=property-value
Remove the specified values from the property. This can only be applied to properties that accept lists.

revert [-F]
Revert the configuration back to the last committed state. The -F option can be used to force the action.

select cmd=fullpath
Select the command which matches the given pathname criteria, for modification. This subcommand is applicable only in the `profile` context.
set property-name=property-value
Set a given property name to the given value. Some properties (for example, name and desc) are only valid in the profile context, while others are only valid in the command context. This subcommand is applicable in both the profile and command contexts.

verify
Verify the current configuration for correctness:
- The required properties are specified.
- The values are valid for each keyword.
- The user is authorized to specify the values.

Examples
EXAMPLE 1 Using the profiles Command
The output of the profiles command has the following form:

example% profiles tester01 tester02
tester01 : Audit Management, All Commands
tester02 : Device Management, All Commands
example%

EXAMPLE 2 Using the list Option
example% profiles -l tester01 tester02
tester01 :
  Audit Management:
    /usr/sbin/audit   euid=root
    /usr/sbin/auditconfig   euid=root   egid=sys
  All Commands:
  *
tester02 :
  Device Management:
    /usr/bin/allocate:   euid=root
    /usr/bin/deallocate:   euid=root
  All Commands
  *
example%

EXAMPLE 3 Creating a New Profile
The following creates a new User Manager profile in LDAP. new profile description is Manage users and groups, and the authorization assigned is solaris.user.manage. The supplementary profile assigned is Mail Management. The help file name is RtUserMgmt.html.

example% profiles -p "User Manager" -S ldap
profiles:User Manager> set desc="Manage users and groups"
profiles:User Manager> set help=RtUserMgmt.html
profiles:User Manager> set auths=solaris.user.manage
profiles:User Manager> set profiles="Mail Management"
profiles:User Manager> exit
EXAMPLE 4  Displaying Information Regarding the Current Configuration

The following command displays information regarding the User Manager profile:

```bash
example% profiles -p "User Manager" -S ldap info
```

```
name=User Manager
desc=Manage users and groups
auths=solaris.user.manage
profiles=Mail Management
help=RtUserMgmt.html
```

EXAMPLE 5  Deleting a Profile

The following command deletes the User Manager profile from LDAP:

```bash
example% profiles -p "User Manager" -S ldap delete -F
```

EXAMPLE 6  Modifying a Profile

The following modifies the User Manager profile in LDAP. The new profile description is Manage world, the new authorization assignment is solaris.user.* authorizations, and the new supplementary profile assignment is All.

```bash
example% profiles -p "User Manager" -S ldap
profiles:User Manager> set desc="Manage world"
profiles:User Manager> set auths="solaris.user.*"
profiles:User Manager> set profiles=All
profiles:User Manager> exit
```

EXAMPLE 7  Creating an exec_attr Database Entry

The following command creates a new exec_attr entry for the User Manager profile in LDAP. The /usr/bin/cp entry is added. The command has an effective user ID of 0 and an effective group ID of 0.

```bash
example% profiles -p "User Manager" -S ldap
profiles:User Manager> add cmd=/usr/bin/cp
profiles:User Manager:cp> set euid=0
profiles:User Manager:cp> set egid=0
profiles:User Manager:cp> end
profiles:User Manager> exit
example%
```

EXAMPLE 8  Deleting an exec_attr Database Entry

The following example deletes an exec_attr database entry for the User Manager profile from LDAP. The entry designated for the command /usr/bin/cp is deleted.

```bash
example% profiles -p "User Manager" -S ldap
profiles:User Manager> remove cmd=/usr/bin/cp
profiles:User Manager> exit
example%
```
EXAMPLE 9  Modifying an exec_attr Database Entry

The following modifies the attributes of the exec_attr database entry for the User Manager profile in LDAP. The /usr/bin/cp entry is modified to execute with the real user ID of 0 and the real group ID of 0.

example% profiles -p "User Manager" -S ldap
profiles:User Manager> select cmd=/usr/bin/cp
profiles:User Manager:cp> clear euid
profiles:User Manager:cp> clear egid
profiles:User Manager:cp> set uid=0
profiles:User Manager:cp> set gid=0
profiles:User Manager:cp> end
profiles:User Manager> exit
example%

Exit Status  The following exit values are returned:

    0  Successful completion.
    1  An error occurred.

Files  /etc/security/exec_attr
       /etc/security/prof_attr
       /etc/user_attr
       /etc/security/policy.conf

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  auths(1), pfexec(1), pkg(1), roles(1), getprofattr(3C), auth_attr(4), exec_attr(4), nsswitch.conf(4), pam.conf(4), policy.conf(4), prof_attr(4), user_attr(4), audit_flags(5), attributes(5), pam_user_policy(5), privileges(5)
Name  projects – print project membership of user

Synopsis  projects [-dv] [ user]
          projects -l [projectname [projectname]...

Description  The projects command prints on standard output the projects to which the invoking user or an optionally specified user belongs. Each user belongs to some set of projects specified in the project(4) file and possibly in the associated NIS maps and LDAP databases for project information.

Options  The following options are supported:
          -d    Prints only default project.
          -l    Prints verbose info on each project projectname. If no projectnames are given, info on all projects is printed.
          -v    Prints project descriptions along with project names.

Operands  The following operand is supported:
          projectname   Display information for the specified project.
          user          Displays project memberships for the specified user.

Examples  EXAMPLE 1  Displaying Membership for a Specified User

          example$ projects paul
          default beatles wings
          example$ projects ringo
          default beatles
          example$ projects -d paul
          beatles

Exit Status  The following exit values are returned:
          0   Successful completion.
          1   A fatal error occurred during execution.
          2   Invalid command line options were specified.

Files    /etc/project   Local database containing valid project definitions for this machine.

Attributes  See attributes(5) for a description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Stability</td>
<td>See below.</td>
</tr>
</tbody>
</table>
The invocation is Committed. The human-readable output is Uncommitted.

See Also  getdefaultproj(3PROJECT), getprojent(3PROJECT), project(4), attributes(5)
ps – report process status

**Synopsis**

```
ps [-aAcdefHlLPyZ] [-g grplist] [-h lgrp]
   [-n namelist] [-o format]... [-p proclist]
   [-s sidlist] [-t term] [-u uidlist] [-U uidlist]
   [-G gidlist] [-z zonelist]
```

**Description**

The `ps` command prints information about active processes. Without options, `ps` prints information about processes that have the same effective user ID and the same controlling terminal as the invoker. The output contains only the process ID, terminal identifier, cumulative execution time, and the command name. Otherwise, the information that is displayed is controlled by the options.

Some options accept lists as arguments. Items in a list can be either separated by commas or else enclosed in quotes and separated by commas or spaces. Values for `proclist` and `grplist` must be numeric.

The `ps` command tries to determine whether it is called natively or using the command syntax expected by `ps(1B)`. In the latter case, the `ps` command behaves exactly as described in `ps(1B)`.

**Options**

The following options are supported:

- `-a`
  Lists information about all processes most frequently requested: all those except session leaders and processes not associated with a terminal.

- `-A`
  Lists information for all processes. Identical to `-e`, below.

- `-c`
  Prints information in a format that reflects scheduler properties as described in `priocntl(1)`. The `-c` option affects the output of the `-f` and `-t` options, as described below.

- `-d`
  Lists information about all processes except session leaders.

- `-e`
  Lists information about every process now running.

  When the `-e` option is specified, options `-z`, `-t`, `-u`, `-U`, `-g`, `-G`, `-p`, `-g`, `-s` and `-a` options have no effect.

- `-f`
  Generates a full listing. (See below for significance of columns in a full listing.)

- `-g grplist`
  Lists only process data whose group leader’s ID number(s) appears in `grplist`. (A group leader is a process whose process ID number is identical to its process group ID number.)
-G gidlist
   Lists information for processes whose real group ID numbers are given in gidlist. The gidlist must be a single argument in the form of a blank- or comma-separated list.

-h lgrpist
   Lists only the processes homed to the specified lgrpist. Nothing is listed for any invalid group specified in lgrpist.

-H
   Prints the home lgroup of the process under an additional column header, LGRP.

-J
   Prints session ID and process group ID.

-1
   Generates a long listing. (See below.)

-L
   Prints information about each lightweight process (lwp) in each selected process. (See below.)

-n namelist
   Specifies the name of an alternative system namelist file in place of the default. This option is accepted for compatibility, but is ignored.

-o format
   Prints information according to the format specification given in format. This is fully described in DISPLAY FORMATS. Multiple -o options can be specified; the format specification is interpreted as the space-character-separated concatenation of all the format option-arguments.

-P proclist
   Lists only process data whose process ID numbers are given in proclist.

-P
   Prints the number of the processor to which the process or lwp is bound, if any, under an additional column header, PSR.

-s sidlist
   Lists information on all session leaders whose IDs appear in sidlist.

-t term
   Lists only process data associated with term. Terminal identifiers are specified as a device file name, and an identifier. For example, term/a, or pts/0.

-u uidlist
   Lists only process data whose effective user ID number or login name is given in uidlist. In the listing, the numerical user ID is printed unless you give the -f option, which prints the login name.
-U uidlist
   Lists information for processes whose real user ID numbers or login names are given in
   uidlist. The uidlist must be a single argument in the form of a blank- or comma-separated
   list.

- y
   Under a long listing (-U), omits the obsolete F and ADDR columns and includes an RSS
   column to report the resident set size of the process. Under the -y option, both RSS and SZ
   (see below) is reported in units of kilobytes instead of pages.

- z zonelist
   Lists only processes in the specified zones. Zones can be specified either by name or ID.
   This option is only useful when executed in the global zone.

- Z
   Prints the name of the zone with which the process is associated under an additional
   column header, ZONE. The ZONE column width is limited to 8 characters. Use ps -eZ for a
   quick way to see information about every process now running along with the associated
   zone name. Use

   ps -eo zone,uid,pid,ppid,time,comm,...

   to see zone names wider than 8 characters.

The following options are used by the /usr/ucb/ps command (see ps(1B)). They are
supported in /usr/bin/ps, allowing the latter to emulate UCB behavior. The UCB options do
not use a hyphen. You cannot mix these options with the options described above.

r
   Restricts output to running and runnable processes.

S
   Displays accumulated CPU time used by this process and all of its reaped children.

v
   Displays a version of the output containing virtual memory. This includes fields SIZE,
   %CPU, %MEM, and RSS, described below.

w
   Uses a wide output format, that is, 132 columns rather than 80. If the option letter is
   repeated, that is, -ww, this option uses arbitrarily wide output. This information is used to
   decide how much of long commands to print. Note: The wide output option can be viewed
   only by a superuser or the user who owns the process.

x
   Includes processes with no controlling terminal.

num
   A process number may be given, in which case the output is restricted to that process. This
   option must be supplied last.
Many of the options shown are used to select processes to list. If any are specified, the default list is ignored and ps selects the processes represented by the inclusive OR of all the selection-criteria options.

**Display Formats**

Under the -f option, ps tries to determine the command name and arguments given when the process was created by examining the user block. Failing this, the command name is printed, as it would have appeared without the -f option, in square brackets.

The column headings and the meaning of the columns in a ps listing are given below; the letters f and l indicate the option (full or long, respectively) that causes the corresponding heading to appear; all means that the heading always appears. *Note:* These two options determine only what information is provided for a process; they do not determine which processes are listed.

**F(l)**

Flags (hexadecimal and additive) associated with the process. These flags are available for historical purposes; no meaning should be currently ascribed to them.

**S (l)**

The state of the process:

- **O**  Process is running on a processor.
- **S**  Sleeping: process is waiting for an event to complete.
- **R**  Runnable: process is on run queue.
- **T**  Process is stopped, either by a job control signal or because it is being traced.
- **W**  Waiting: process is waiting for CPU usage to drop to the CPU-caps enforced limits.
- **Z**  Zombie state: process terminated and parent not waiting.

**UID (f,l)**

The effective user ID number of the process (the login name is printed under the -f option).

**PID(all)**

The process ID of the process (this datum is necessary in order to kill a process).

**PPID(f,l)**

The process ID of the parent process.

**C(f,l)**

Processor utilization for scheduling (obsolete). Not printed when the -c option is used.
CLS(f,l)
   Scheduling class. Printed only when the -c option is used.

PRI(l)
   The priority of the process. Without the -c option, higher numbers mean lower priority.
   With the -c option, higher numbers mean higher priority.

NI(l)
   Nice value, used in priority computation. Not printed when the -c option is used. Only processes in the certain scheduling classes have a nice value.

ADDR(l)
   The memory address of the process, 0 unless running with all privilege.

SZ(l)
   The total size of the process in virtual memory, including all mapped files and devices, in pages. See pagesize(1).

WCHAN(l)
   The address of an event for which the process is sleeping. Only visible when running with all privilege, otherwise it is 0. To determine if a process is sleeping, check the S column.

STIME(f)
   The starting time of the process, given in hours, minutes, and seconds. (A process begun more than twenty-four hours before the ps inquiry is executed is given in months and days.)

TTY(all)
   The controlling terminal for the process (the message, ?, is printed when there is no controlling terminal).

TIME(all)
   The cumulative execution time for the process.

LTIME(all)
   The execution time for the lwp being reported.

CMD(all)
   The command name (the full command name and its arguments, up to a limit of 80 characters, are printed under the -f option).

The following two additional columns are printed when the -j option is specified:

PGID
   The process ID of the process group leader.

SID
   The process ID of the session leader.

The following two additional columns are printed when the -L option is specified:
LWP
   The lwp ID of the lwp being reported.

NLWP
   The number of lwps in the process (if -f is also specified).

Under the -L option, one line is printed for each lwp in the process and the time-reporting fields STIME and LTIME show the values for the lwp, not the process. A traditional single-threaded process contains only one lwp.

A process that has exited and has a parent, but has not yet been waited for by the parent, is marked <defunct>.

-o format
   The -o option allows the output format to be specified under user control.

The format specification must be a list of names presented as a single argument, blank- or comma-separated. Each variable has a default header. The default header can be overridden by appending an equals sign and the new text of the header. The rest of the characters in the argument is used as the header text. The fields specified are written in the order specified on the command line, and should be arranged in columns in the output. The field widths are selected by the system to be at least as wide as the header text (default or overridden value). If the header text is null, such as -o user=, the field width is at least as wide as the default header text. If all header text fields are null, no header line is written.

The following names are recognized in the POSIX locale:

user
   The effective user ID of the process. This is the textual user ID, if it can be obtained and the field width permits, or a decimal representation otherwise.

ruser
   The real user ID of the process. This is the textual user ID, if it can be obtained and the field width permits, or a decimal representation otherwise.

group
   The effective group ID of the process. This is the textual group ID, if it can be obtained and the field width permits, or a decimal representation otherwise.

rgroup
   The real group ID of the process. This is the textual group ID, if it can be obtained and the field width permits, or a decimal representation otherwise.

pid
   The decimal value of the process ID.

ppid
   The decimal value of the parent process ID.

pgid
   The decimal value of the process group ID.
pcpu
The ratio of CPU time used recently to CPU time available in the same period, expressed as a percentage. The meaning of “recently” in this context is unspecified. The CPU time available is determined in an unspecified manner.

vsz
The total size of the process in virtual memory, in kilobytes.

nice
The decimal value of the system scheduling priority of the process. See nice(1).

etime
In the POSIX locale, the elapsed time since the process was started, in the form:

\([ [dd\cdot]hh:]mm:ss\)

where
\(dd\)
  is the number of days
\(hh\)
  is the number of hours
\(mm\)
  is the number of minutes
\(ss\)
  is the number of seconds

The \(dd\) field is a decimal integer. The \(hh, mm, ss\) fields is two-digit decimal integers padded on the left with zeros.

time
In the POSIX locale, the cumulative CPU time of the process in the form:

\([dd\cdot]hh:mm:ss\)

The \(dd, hh, mm, ss\) fields is as described in the etime specifier.

tty
The name of the controlling terminal of the process (if any) in the same format used by the who(1) command.

comm
The name of the command being executed (argv[0] value) as a string.

args
The command with all its arguments as a string. The implementation might truncate this value to the field width; it is implementation-dependent whether any further truncation occurs. It is unspecified whether the string represented is a version of the argument list as it...
was passed to the command when it started, or is a version of the arguments as they might have been modified by the application. Applications cannot depend on being able to modify their argument list and having that modification be reflected in the output of `ps`. The Solaris implementation limits the string to 80 bytes; the string is the version of the argument list as it was passed to the command when it started.

The following names are recognized in the Solaris implementation:

- **f**  
  Flags (hexadecimal and additive) associated with the process.

- **s**  
  The state of the process.

- **c**  
  Processor utilization for scheduling (obsolete).

- **uid**  
  The effective user ID number of the process as a decimal integer.

- **ruid**  
  The real user ID number of the process as a decimal integer.

- **gid**  
  The effective group ID number of the process as a decimal integer.

- **rgid**  
  The real group ID number of the process as a decimal integer.

- **projid**  
  The project ID number of the process as a decimal integer.

- **project**  
  The project ID of the process as a textual value if that value can be obtained; otherwise, as a decimal integer.

- **zoneid**  
  The zone ID number of the process as a decimal integer.

- **zone**  
  The zone ID of the process as a textual value if that value can be obtained; otherwise, as a decimal integer.

- **sid**  
  The process ID of the session leader.

- **taskid**  
  The task ID of the process.

- **class**  
  The scheduling class of the process.
The priority of the process. Higher numbers mean higher priority.

The obsolete priority of the process. Lower numbers mean higher priority.

The decimal value of the lwp ID. Requesting this formatting option causes one line to be printed for each lwp in the process.

The number of lwps in the process.

The number of the processor to which the process or lwp is bound.

The ID of the processor set to which the process or lwp is bound.

The memory address of the process.

The total size of the process in virtual memory, in pages.

The address of an event for which the process is sleeping (if --, the process is running).

The starting time or date of the process, printed with no blanks.

The resident set size of the process, in kilobytes. The rss value reported by ps is an estimate provided by proc(4) that might underestimate the actual resident set size. Users who wish to get more accurate usage information for capacity planning should use pmap(1) -x instead.

The ratio of the process’s resident set size to the physical memory on the machine, expressed as a percentage.

The first 8 bytes of the base name of the process’s executable file.

The contract ID of the process contract the process is a member of as a decimal integer.

The home lgroup of the process.

Only comm and args are allowed to contain blank characters; all others, including the Solaris implementation variables, are not.
The following table specifies the default header to be used in the POSIX locale corresponding to each format specifier.

<table>
<thead>
<tr>
<th>Format Specifier</th>
<th>Default Header</th>
<th>Format Specifier</th>
<th>Default Header</th>
</tr>
</thead>
<tbody>
<tr>
<td>args</td>
<td>COMMAND</td>
<td>ppid</td>
<td>PPID</td>
</tr>
<tr>
<td>comm</td>
<td>COMMAND</td>
<td>rgroup</td>
<td>RGROUP</td>
</tr>
<tr>
<td>etime</td>
<td>ELAPSED</td>
<td>ruser</td>
<td>RUSER</td>
</tr>
<tr>
<td>group</td>
<td>GROUP</td>
<td>time</td>
<td>TIME</td>
</tr>
<tr>
<td>nice</td>
<td>NI</td>
<td>tty</td>
<td>TT</td>
</tr>
<tr>
<td>pcpu</td>
<td>%CPU</td>
<td>user</td>
<td>USER</td>
</tr>
<tr>
<td>pgid</td>
<td>PGID</td>
<td>vsz</td>
<td>VSZ</td>
</tr>
<tr>
<td>pid</td>
<td>PID</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following table lists the Solaris implementation format specifiers and the default header used with each.

<table>
<thead>
<tr>
<th>Format Specifier</th>
<th>Default Header</th>
<th>Format Specifier</th>
<th>Default Header</th>
</tr>
</thead>
<tbody>
<tr>
<td>addr</td>
<td>ADDR</td>
<td>projid</td>
<td>PROJID</td>
</tr>
<tr>
<td>c</td>
<td>C</td>
<td>project</td>
<td>PROJECT</td>
</tr>
<tr>
<td>class</td>
<td>CLS</td>
<td>psr</td>
<td>PSR</td>
</tr>
<tr>
<td>f</td>
<td>F</td>
<td>rgid</td>
<td>RGID</td>
</tr>
<tr>
<td>fname</td>
<td>COMMAND</td>
<td>rss</td>
<td>RSS</td>
</tr>
<tr>
<td>gid</td>
<td>GID</td>
<td>ruid</td>
<td>RUID</td>
</tr>
<tr>
<td>lgrp</td>
<td>LGRP</td>
<td>s</td>
<td>S</td>
</tr>
<tr>
<td>lwp</td>
<td>LWP</td>
<td>sid</td>
<td>SID</td>
</tr>
<tr>
<td>nlwp</td>
<td>NLWP</td>
<td>stime</td>
<td>STIME</td>
</tr>
<tr>
<td>opri</td>
<td>PRI</td>
<td>taskid</td>
<td>TASKID</td>
</tr>
<tr>
<td>osz</td>
<td>SZ</td>
<td>uid</td>
<td>UID</td>
</tr>
<tr>
<td>pmem</td>
<td>%MEM</td>
<td>wchan</td>
<td>WCHAN</td>
</tr>
</tbody>
</table>
EXAMPLE 1 Using ps Command

The command:

eexample% ps -o user,pid,ppid=MOM -o args

writes the following in the POSIX locale:

<table>
<thead>
<tr>
<th>USER</th>
<th>PID</th>
<th>MOM</th>
<th>COMMAND</th>
</tr>
</thead>
<tbody>
<tr>
<td>helene</td>
<td>34</td>
<td>12</td>
<td>ps -o uid,pid,ppid=MOM -o args</td>
</tr>
</tbody>
</table>

The contents of the COMMAND field need not be the same due to possible truncation.

Environment Variables
See environ(5) for descriptions of the following environment variables that affect the execution of ps: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, LC_TIME, and NLSPATH.

COLUMNs
Override the system-selected horizontal screen size, used to determine the number of text columns to display.

Exit Status
The following exit values are returned:

- 0
  Successful completion.
- >0
  An error occurred.

Files

- /dev/pts/*
- /dev/term/*
  terminal ("tty") names searcher files
- /etc/passwd
  UID information supplier
- /proc/*
  process control files

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>ATTRIBUTE TYPE</td>
<td>ATTRIBUTE VALUE</td>
</tr>
<tr>
<td>-------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled (see USAGE)</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

**See Also**  
kill(1), lgrpinfo(1), nice(1), pagesize(1), pmap(1), priocntl(1), who(1), ps(1B), getty(1M), proc(4), ttysrch(4), attributes(5), environ(5), resource_controls(5), standards(5), zones(5)

**Notes**  
Things can change while ps is running. The snapshot it gives is true only for a split-second, and it might not be accurate by the time you see it. Some data printed for defunct processes is irrelevant.

If no options to select processes are specified, ps reports all processes associated with the controlling terminal. If there is no controlling terminal, there is no report other than the header.

`ps -ef` or `ps -o stime` might not report the actual start of a tty login session, but rather an earlier time, when a getty was last respawned on the tty line.

On prior releases the ADDR and WCHAN fields might have contained the kernel memory address of the process and/or event it was waiting on. These fields are now always 0 unless requested by a process running with all privilege. The values can still be obtained using the `::ps` and `::thread dcmds` within `mdb`.

ps is CSI-enabled except for login names (usernames).
The `ps` command displays information about processes. Normally, only those processes that are running with your effective user ID and are attached to a controlling terminal (see `termio(7)`), are shown. Additional categories of processes can be added to the display using various options. In particular, the `-a` option allows you to include processes that are not owned by you (that do not have your user ID), and the `-x` option allows you to include processes without controlling terminals. When you specify both `-a` and `-x`, you get processes owned by anyone, with or without a controlling terminal. The `-r` option restricts the list of processes printed to running and runnable processes.

`ps` displays in tabular form the process ID, under `PID`; the controlling terminal (if any), under `TT`; the CPU time used by the process so far, including both user and system time, under `TIME`; the state of the process, under `S`; and finally, an indication of the `COMMAND` that is running.

The state is given by a single letter from the following:

- **O**: Process is running on a processor.
- **S**: Sleeping. Process is waiting for an event to complete.
- **R**: Runnable. Process is on run queue.
- **Z**: Zombie state. Process terminated and parent not waiting.
- **T**: Traced. Process stopped by a signal because parent is tracing it.

### Options

The following options must all be combined to form the first argument. The `ps` command accepts the arguments without the leading `-` for historical reasons.

- **-a**: Includes information about processes owned by others.
- **-c**: Displays the command name rather than the command arguments.
- **-e**: Displays the environment as well as the arguments to the command.
- **-g**: Displays all processes. Without this option, `ps` only prints interesting processes. Processes are deemed to be uninteresting if they are process group leaders. This normally eliminates top-level command interpreters and processes waiting for users to login on free terminals.
- **-l**: Displays a long listing, with fields `F`, `PPID`, `CP`, `PRI`, `NI`, `SZ`, `RSS`, and `WCHAN` as described below.
- **-n**: Produces numerical output for some fields. In a user listing, the `USER` field is replaced by a `UID` field.
- **-r**: Restricts output to running and runnable processes.
-S Displays accumulated CPU time used by this process and all of its reaped children.

- t term Lists only process data associated with the terminal, term. Terminal identifiers may be specified in one of two forms: the device’s file name (for example, tty04 or term/14) or, if the device’s file name starts with tty, just the digit identifier (for example, 04).

-u Displays user-oriented output. This includes fields USER, %CPU, %MEM, SZ, RSS, and START as described below.

-U Obsolete. This option no longer has any effect. It causes ps to exit without printing the process listing.

-v Displays a version of the output containing virtual memory. This includes fields SIZE, %CPU, %MEM, and RSS, described below.

-w Uses a wide output format, that is, 132 columns rather than 80. If the option letter is repeated, that is, -ww, this option uses arbitrarily wide output. This information is used to decide how much of long commands to print. Note: The wide output option can be viewed only by a superuser or the user who owns the process.

-x Includes processes with no controlling terminal.

num A process number may be given, in which case the output is restricted to that process. This option must be supplied last.

**Display Formats** Fields that are not common to all output formats:

- **USER** Name of the owner of the process.
- **%CPU** CPU use of the process. This is a decaying average over up to a minute of previous (real) time.
- **NI** Process scheduling increment (see getpriority(3C)).
- **SIZE** The total size of the process in virtual memory, including all mapped files and devices, in kilobyte units.
- **SZ** Same as SIZE.
- **RSS** Real memory (resident set) size of the process, in kilobyte units.
- **UID** Numerical user-ID of process owner.
- **PPID** Numerical ID of parent of process.
- **CP** Short-term CPU utilization factor (used in scheduling).
- **PRI** The priority of the process (higher numbers mean lower priority).
START The starting time of the process, given in hours, minutes, and seconds. A process begun more than 24 hours before the ps inquiry is executed is given in months and days.

WCHAN The address of an event for which the process is sleeping (if blank, the process is running).

%MEM The ratio of the process's resident set size to the physical memory on the machine, expressed as a percentage.

F Flags (hexadecimal and additive) associated with the process. These flags are available for historical purposes; no meaning should be currently ascribed to them.

A process that has exited and has a parent, but has not yet been waited for by the parent, is marked <defunct>; otherwise, ps tries to determine the command name and arguments given when the process was created by examining the user block.

Files  /dev/tty*
       /etc/passwd UID information supplier

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>

See Also  kill(1), ps(1), whodo(1M), getpriority(3C), proc(4), attributes(5), termio(7I)

Notes Things can change while ps is running. The picture ps gives is only a close approximation to the current state. Some data printed for defunct processes is irrelevant.
Name  ptree – print process trees

Synopsis  /usr/bin/ptree [-a] [-c] [-z zone] [pid | user]...

Description  The ptree utility prints the process trees containing the specified pids or users, with child processes indented from their respective parent processes. An argument of all digits is taken to be a process-ID, otherwise it is assumed to be a user login name. The default is all processes.

Options  The following options are supported:
  -a  All. Print all processes, including children of process 0.
  -c  Contracts. Print process contract memberships in addition to parent-child relationships. See process(4). This option implies the -a option.
  -z zone  Zones. Print only processes in the specified zone. Each zone ID can be specified as either a zone name or a numerical zone ID.

This option is only useful when executed in the global zone.

Operands  The following operands are supported:
  pid  Process-id or a list of process-ids. ptree also accepts /proc/nnn as a process-id, so the shell expansion /proc/* can be used to specify all processes in the system.
  user  Username or list of usernames. Processes whose effective user IDs match those given are displayed.

Examples  EXAMPLE1  Using ptree

The following example prints the process tree (including children of process 0) for processes which match the command name ssh:

$ ptree -a 'pgrep ssh'
  1 /usr/sbin/init
  100909 /usr/lib/ssh/sshd
  569150 /usr/lib/ssh/sshd
  569157 /usr/lib/ssh/sshd
  569159 /ksh
  569171 bash
  569173 /bin/ksh
  569193 bash

Exit Status  The following exit values are returned:
  0  Successful operation.
  non-zero  An error has occurred.
Files  /proc/*    process files

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>See below.</td>
</tr>
</tbody>
</table>

The human readable output is Uncommitted The options are Committed.

See Also  gcore(1), ldd(1), pargs(1), pgrep(1), pkill(1), plimit(1), pmap(1), prep(1), proc(1), ps(1), ppgsz(1), pwd(1), rlogin(1), time(1), truss(1), wait(1), fcntl(2), fstat(2), setuid(2), dlopen(3C), signal.h(3HEAD), core(4), proc(4), process(4), attributes(5), zones(5)
**Name** pvs – display the internal version information of dynamic objects

**Synopsis** pvs [-Cdlnorsv] [-I index-expr] [-N name] file...

**Description** The pvs utility displays any internal version information contained within an ELF file. Commonly, these files are dynamic executables and shared objects, and possibly relocatable objects. This version information can fall into one of two categories:

- version definitions
- version dependencies

Version definitions describe the interfaces that are made available by an ELF file. Each version definition is associated to a set of global symbols provided by the file. Version definitions can be assigned to a file during its creation by the link-editor using the `-M` option and the associated mapfile directives. See the Linker and Libraries Guide for more details.

Version dependencies describe the binding requirements of dynamic objects on the version definitions of any shared object dependencies. When a dynamic object is built with a shared object, the link-editor records information within the dynamic object indicating that the shared object is a dependency. This dependency must be satisfied at runtime. If the shared object also contains version definitions, then those version definitions that satisfy the global symbol requirements of the dynamic object are also recorded in the dynamic object being created. At process initialization, the runtime linker uses any version dependencies as a means of validating the interface requirements of the dynamic objects used to construct the process.

**Options** The following options are supported. If neither the `-d` or `-r` options are specified, both are enabled.

- `-C` Demangles C++ symbol names.
- `-d` Prints version definition information.
- `-I index-expr` Qualifies the versions to examine with a specific version index or index range. For example, the version with index 3 in an object can be displayed using:

  ```
  example% pvs -I 3 filename
  ```

  An index-expr can be a single non-negative integer value that specifies a specific version, as shown in the previous example. Alternatively, an index-expr can consist of two such values separated by a colon (:), indicating a range of versions. The following example displays the versions 3, 4, and 5 in a file:

  ```
  example% pvs -I 3:5 filename
  ```

  When specifying an index range, the second value can be omitted to indicate the final item in the file. For example, the following statement lists all versions from the tenth to the end:

  ```
  example% pvs -I 10: filename
  ```
See Matching Options for additional information about the matching options (-I, -N).

- l
Prints any symbols that have been reduced from global to local binding due to versioning. By convention, these symbol entries are located in the .syntab section, and fall between the FILE symbol representing the output file, and the FILE symbol representing the first input file used to generate the output file. These reduced symbol entries are assigned the fabricated version definition _LOCAL_. No reduced symbols will be printed if the file has been stripped (see `strip(1)`), or if the symbol entry convention cannot be determined.

Use of the - l option implicitly enables the - s option

- n
Normalizes version definition information. By default, all version definitions within the object are displayed. However, version definitions can inherit other version definitions. Under normalization, only the head of each inheritance list is displayed.

- N name
When used with the - d option, - N prints only the information for the given version definition name and any of its inherited version definitions.

When used with the - r option, - N prints only the information for the given dependency file name. It is possible to qualify a specific version from the dependency file by including the version in parenthesis following the file name:

```
example% pvs -N 'dependency (version)' filename
```

See Matching Options for additional information about the matching options (-I, -N).

- o
Creates one-line version definition output. By default, file, version definitions, and any symbol output is indented to ease human inspection. This option prefixes each output line with the file and version definition name and can be more useful for analysis with automated tools.

- r
Prints version dependency (requirements) information.

- s
Prints the symbols associated with each version definition. Any data symbols from versions defined by the object are accompanied with the size, in bytes, of the data item.

- v
Verbose output. Indicates any weak version definitions, and any version definition inheritance. When used with the - N and - d options, the inheritance of the base version definition is also shown. When used with the - s option, the version symbol definition is also shown.
The following operands are supported.

*file* The ELF file about which internal version information is displayed.

**Usage**

**Matching Options** The -I and -N options are collectively referred to as the matching options. These options are used to narrow the range of versions to examine, by index or by name.

Any number and type of matching option can be mixed in a given invocation of *pvs*. In this case, *pvs* displays the superset of all versions matched by any of the matching options used. This feature allows for the selection of complex groupings of items using the most convenient form for specifying each item.

**Examples**

**EXAMPLE 1** Displaying version definitions

The following example displays the version definitions of *libelf.so.1*:

```
% pvs -d /lib/libelf.so.1
libelf.so.1; SUNW_1.1
```

**EXAMPLE 2** Creating a one-liner display

A normalized, one-liner display, suitable for creating a *mapfile* version control directive, can be created using the -n and -o options:

```
% pvs -don /lib/libelf.so.1
/lib/libelf.so.1 - SUNW_1.1;
```

**EXAMPLE 3** Displaying version requirements

The following example displays the version requirements of *ldd* and *pvs*:

```
% pvs -r /usr/bin/ldd /usr/bin/pvs
/usr/bin/ldd:
   libelf.so.1 (SUNW_1.1);
   libc.so.1 (SUNW_1.1);
/usr/bin/pvs:
   libelf.so.1 (SUNW_1.1);
   libc.so.1 (SUNW_1.1);
```

**EXAMPLE 4** Determining a dependency symbol version

The following example displays the shared object from which the *ldd* command expects to find the printf function at runtime, as well as the version it belongs to:

```
% pvs -ors /usr/bin/ldd | grep ' printf'
/usr/bin/ldd - libc.so.1 (SYSVABI_1.3): printf;
```
EXAMPLE 5  Determine all dependency symbols from a specific version

The -N option can be used to obtain a list of all the symbols from a dependency that belong to a specific version. To determine the symbols that `ldd` will find from version SYSVABI_1.3 of `libc.so.1`:

```
% pvs -s -N 'libc.so.1 (SYSVABI_1.3)' /usr/bin/ldd

libc.so.1 (SYSVABI_1.3):
  _exit;
  strstr;
  printf;
  _fpstart;
  strcmp;
  lseek;
  strchr;
  optarg;
  execl;
  close;
  fflush;
  wait;
  strerror;
  putenv;
  sprintf;
  getenv;
  open;
  perror;
  fork;
  strlen;
  geteuid;
  access;
  setlocale;
  atexit;
  fprintf;
  exit;
  read;
  malloc;
```

Note that the specific list of symbols used by `ldd` may change between Solaris releases.

EXAMPLE 6  Display base defined version by index

By convention, the base global version defined by an object has the name of the object. For example, the base version of `pvs` is named `pvs`. The base version of any object is always version index 1. Therefore, the -I option can be used to display the base version of any object without having to specify its name:

```
% pvs -v -I 1 /usr/bin/pvs
pvs [BASE];
```
Exit Status  If the requested version information is not found, a non-zero value is returned. Otherwise, a 0 value is returned.

Version information is determined not found when any of the following is true:
- the -d option is specified and no version definitions are found.
- the -r option is specified and no version requirements are found.
- neither the -d nor -r option is specified and no version definitions or version requirements are found.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/base-developer-utilities</td>
</tr>
</tbody>
</table>

See Also  elfdump(1), ld(1), ldd(1), strip(1), elf(3ELF), attributes(5)

Linker and Libraries Guide
**Name**
pwd – return working directory name

**Synopsis**
/usr/bin/pwd

**Description**
The `pwd` utility writes an absolute path name of the current working directory to standard output.

Both the Bourne shell, `sh(1)`, and the Korn shells, `ksh(1)` and `ksh88(1)`, also have a built-in `pwd` command.

**Environment Variables**
See `environ(5)` for descriptions of the following environment variables that affect the execution of `pwd`: LANG, LC_ALL, LC_MESSAGES, and NLSPATH.

**Exit Status**
The following exit values are returned:

- 0: Successful completion.
- >0: An error occurred.

If an error is detected, output will not be written to standard output, a diagnostic message will be written to standard error, and the exit status will not be 0.

**Attributes**
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTETYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

**See Also**
`cd(1), ksh(1), ksh88(1), sh(1), shell_builtins(1), attributes(5), environ(5), standards(5)`

**Diagnostics**
pwd: cannot determine current directory!

Consult your network administrator.

**Notes**
If you move the current directory or one above it, `pwd` may not give the correct response. Use the `cd(1)` command with a full path name to correct this situation.
radadrgen(1)

Name  radadrgen – code generator

Synopsis  

/usr/bin/radadrgen [-N] spec.xml
/usr/bin/radadrgen [-N] -c dir [-r [ -m ] [ -s ]] spec.xml
/usr/bin/radadrgen [-N] -j dir [-i] spec.xml
/usr/bin/radadrgen [-N] {-o docbook | docbook-man | man | rmdoc} spec.xml
/usr/bin/radadrgen -d baseline.xml spec.xml

Description  The radadrgen command is the ADR IDL processing tool. Its primary purpose is to generate language bindings for the rad server and the various rad client environments. It can also generate documentation, and audit changes to interfaces for consistency with their versions.

All invocations validate the given spec.xml against the ADR schema.

Options  The following options are supported:

Common Options  
- N
  Do not limit what types can be nullable. This restriction is in place to facilitate mapping to languages where certain types are not naturally nullable. This option relaxes this restriction for uses where it is both permissible and advantageous for all types to be nullable.

C Definition Options  
- c dir
  Generate C definitions for the types and interfaces defined in the input file. Files will be created under dir.

  - r
  Generate C server-side definitions that reference entry points using the prescribed entry-point naming scheme.

  - m
  Do not generate separate definitions for inherited interfaces. By default, new definitions are generated for inherited interfaces, replicating the definitions in the inherited interface.

  - s
  Generate C stubs for entry points referenced by the definitions created by the - r option.

Java Definition Options  
- j dir
  Generate Java interfaces for the types and interfaces defined in the input file. The Java source tree will be created under dir.

  - i
  Generate concrete implementation classes for the interfaces created for structured types.

Documentation Generation Options  
- o format
  Generate documentation, in the given format, for the interface definition in spec.xml.
  Documentation can be improved by decorating the various parts of the interface definition with summary and doc elements.

Valid formats:
docbook
  standard docbook format

docbook-man
  man page content in docbook format, a precursor to man format, below

man
  a man page, in [nt]roff format

rmdoc
  spec.xml, with the summary and doc elements removed

Interface Comparison Options
  -d baseline.xml
  Compare the interfaces defined by baseline.xml and spec.xml and verify that the version of the modified interface is consistent with the differences found. An error message is displayed if the versions are inconsistent.

Operands
  The following operand must be specified on the command line:

  spec.xml
  The path to the API specification for which type and interface definitions must be generated.

Files
  /usr/share/lib/xml/rng/radadr.rng.1
  The core ADR RelaxNG schema definition.

  /usr/share/lib/xml/rng/radadr-doc.rng.1
  The ADR RelaxNG schema definition for documentation elements.

Attributes
  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTETYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/management/rad</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Private</td>
</tr>
</tbody>
</table>

See Also
  rad(1M), attributes(5)
The `ranlib` utility was used in SunOS 4.x to add a table of contents to archive libraries, which converted each archive to a form that could be linked more rapidly. This is no longer needed, as the `ar(1)` command automatically provides all the functionality `ranlib` used to provide.

This script is provided as a convenience for software developers who need to maintain Makefiles that are portable across a variety of operating systems.

**Exit Status**

`ranlib` has exit status 0.

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/base-developer-utilities</td>
</tr>
</tbody>
</table>

**See Also**

`ar(1), ar.h(3HEAD), attributes(5)`
rcapstat(1)

Name
rcapstat – report resource cap enforcement daemon statistics

Synopsis
rcapstat [-g] [-p | -z] [-T u | d] [interval [count]]

Description
The rcapstat command reports on the projects or zones capped by rcapd(1M). Each report contains statistics that pertain to the project or zone and paging statistics. Paging refers to the act of relocating portions of memory, called pages, to or from physical memory. rcapd pages out the most infrequently used pages.

The paging statistics in the first report issued show the activity since the daemon was started. Subsequent reports reflect the activity since the last report was issued.

Reports are issued every interval seconds up to the quantity specified by count, or forever if count is not specified.

Options
The following options are supported:

- g Global statistics. Reports the minimum memory utilization for memory cap enforcement (see rcapadm(1M)) and reports current memory utilization as a percentage of installed physical memory.

- p Report statistics for capped projects. This is the default if no option is specified.

- T u | d Display a time stamp.

Specify u for a printed representation of the internal representation of time. See time(2). Specify d for standard date format. See date(1).

- z Report statistics for capped zones.

Output
The following list defines the column headings in the rcapstat report and provides information about how to interpret the report.

id The project ID or zone ID of the capped project or zone.
project The project name.
zone The zone name.
nproc The number of processes in the project or zone since the last report.
vm The total of all anonymous mappings that reserve disk or memory swap.
rss The total resident set size (RSS) of the project or zone’s processes, in kilobytes (K), megabytes (M), or gigabytes (G). The count does not account for shared pages.
cap The RSS cap for the project or zone. See rcapd(1M) for information about how to specify memory caps.
at The total amount of memory that rcapd attempted to page out.

Paging refers to the act of relocating portions of memory, called pages, to or from physical memory. rcapd pages out the most infrequently used pages.
The average amount of memory that `rcapd` attempted to page out during each sample cycle. The rate at which `rcapd` samples RSS can be set with `rcapadm(1M)`.

An estimate of the total amount of memory that `rcapd` successfully paged out.

An estimate of the average amount of memory that `rcapd` successfully paged out during each sample cycle. The rate at which `rcapd` samples process RSS sizes can be set with `rcapadm`.

The following operands are supported:

- **interval**: Specifies the reporting interval in seconds. The default interval is 5 seconds.
- **count**: Specifies the number of reports to produce. By default, `rcapstat` reports statistics until a termination signal is received or until the `rcapd` process exits.

**Examples**

**Example 1** Using `rcapstat` to Report Cap and Project Information

Caps are defined for two projects associated with two users. `user1` has a cap of 50 megabytes and `user2` has a cap of 10 megabytes.

The following command produces five reports at 5-second sampling intervals.

```
example# rcapstat 5 5

id project nproc vm rss cap at avgat pg avgpg
112270 user1 24 123M 35M 50M 50M 0K 3312K 0K
78194 user2 1 2368K 1856K 10M 0K 0K 0K 0K
id project nproc vm rss cap at avgat pg avgpg
112270 user1 24 123M 35M 50M 0K 0K 0K 0K
78194 user2 1 2368K 1856K 10M 0K 0K 0K 0K
id project nproc vm rss cap at avgat pg avgpg
112270 user1 24 123M 35M 50M 0K 0K 0K 0K
78194 user2 1 2368K 1928K 10M 0K 0K 0K 0K
id project nproc vm rss cap at avgat pg avgpg
112270 user1 24 123M 35M 50M 0K 0K 0K 0K
78194 user2 1 2368K 1928K 10M 0K 0K 0K 0K
```

The first three lines of output constitute the first report, which contains the cap and project information for the two projects and paging statistics since `rcapd` was started. The `at` and `pg` columns are a number greater than zero for `user1` and zero for `user2`, which indicates that at some time in the daemon’s history, `user1` exceeded its cap but `user2` did not.

The subsequent reports show no significant activity.
EXAMPLE 2 Using rcapstat to Monitor the RSS of a Project

```
example% rcapstat 5 5
```

<table>
<thead>
<tr>
<th>id</th>
<th>project</th>
<th>nproc</th>
<th>vm</th>
<th>rss</th>
<th>cap</th>
<th>at</th>
<th>avgat</th>
<th>pg</th>
<th>avgpg</th>
</tr>
</thead>
<tbody>
<tr>
<td>376565</td>
<td>user1</td>
<td>57</td>
<td>209M</td>
<td>46M</td>
<td>10M</td>
<td>440M</td>
<td>220M</td>
<td>5528K</td>
<td>2764K</td>
</tr>
<tr>
<td>376565</td>
<td>user1</td>
<td>57</td>
<td>209M</td>
<td>44M</td>
<td>10M</td>
<td>394M</td>
<td>131M</td>
<td>4912K</td>
<td>1637K</td>
</tr>
<tr>
<td>376565</td>
<td>user1</td>
<td>56</td>
<td>207M</td>
<td>43M</td>
<td>10M</td>
<td>440M</td>
<td>147M</td>
<td>6048K</td>
<td>2016K</td>
</tr>
<tr>
<td>376565</td>
<td>user1</td>
<td>56</td>
<td>207M</td>
<td>42M</td>
<td>10M</td>
<td>522M</td>
<td>174M</td>
<td>4368K</td>
<td>1456K</td>
</tr>
<tr>
<td>376565</td>
<td>user1</td>
<td>56</td>
<td>207M</td>
<td>44M</td>
<td>10M</td>
<td>482M</td>
<td>161M</td>
<td>3376K</td>
<td>1125K</td>
</tr>
</tbody>
</table>

The project user1 has an RSS in excess of its physical memory cap. The nonzero values in the pg column indicate that rcapd is consistently paging out memory as it attempts to meet the cap by lowering the physical memory utilization of the project's processes. However, rcapd is unsuccessful, as indicated by the varying rss values that do not show a corresponding decrease. This means that the application's resident memory is being actively used, forcing rcapd to affect the working set. Under this condition, the system continues to experience high page fault rates, and associated I/O, until the working set size (WSS) is reduced, the cap is raised, or the application changes its memory access pattern. Notice that a page fault occurs when either a new page must be created, or the system must copy in a page from the swap device.

EXAMPLE 3 Determining the Working Set Size of a Project

This example is a continuation of Example 1, and it uses the same project.

```
example% rcapstat 5 5
```

<table>
<thead>
<tr>
<th>id</th>
<th>project</th>
<th>nproc</th>
<th>vm</th>
<th>rss</th>
<th>cap</th>
<th>at</th>
<th>avgat</th>
<th>pg</th>
<th>avgpg</th>
</tr>
</thead>
<tbody>
<tr>
<td>376565</td>
<td>user1</td>
<td>56</td>
<td>207M</td>
<td>44M</td>
<td>10M</td>
<td>381M</td>
<td>191M</td>
<td>7924K</td>
<td>7924K</td>
</tr>
<tr>
<td>376565</td>
<td>user1</td>
<td>56</td>
<td>207M</td>
<td>46M</td>
<td>10M</td>
<td>479M</td>
<td>160M</td>
<td>2696K</td>
<td>898K</td>
</tr>
<tr>
<td>376565</td>
<td>user1</td>
<td>56</td>
<td>207M</td>
<td>46M</td>
<td>10M</td>
<td>424M</td>
<td>141M</td>
<td>7280K</td>
<td>2426K</td>
</tr>
<tr>
<td>376565</td>
<td>user1</td>
<td>56</td>
<td>207M</td>
<td>43M</td>
<td>10M</td>
<td>461M</td>
<td>201M</td>
<td>4880K</td>
<td>2404K</td>
</tr>
<tr>
<td>376565</td>
<td>user1</td>
<td>56</td>
<td>207M</td>
<td>43M</td>
<td>10M</td>
<td>456M</td>
<td>152M</td>
<td>4800K</td>
<td>1600K</td>
</tr>
<tr>
<td>376565</td>
<td>user1</td>
<td>56</td>
<td>207M</td>
<td>44M</td>
<td>10M</td>
<td>480M</td>
<td>162M</td>
<td>4064K</td>
<td>1354K</td>
</tr>
<tr>
<td>376565</td>
<td>user1</td>
<td>56</td>
<td>207M</td>
<td>52M</td>
<td>100M</td>
<td>191M</td>
<td>95M</td>
<td>1944K</td>
<td>972K</td>
</tr>
<tr>
<td>376565</td>
<td>user1</td>
<td>56</td>
<td>207M</td>
<td>55M</td>
<td>100M</td>
<td>0K</td>
<td>0K</td>
<td>0K</td>
<td>0K</td>
</tr>
<tr>
<td>376565</td>
<td>user1</td>
<td>56</td>
<td>207M</td>
<td>56M</td>
<td>100M</td>
<td>0K</td>
<td>0K</td>
<td>0K</td>
<td>0K</td>
</tr>
<tr>
<td>376565</td>
<td>user1</td>
<td>56</td>
<td>207M</td>
<td>56M</td>
<td>100M</td>
<td>0K</td>
<td>0K</td>
<td>0K</td>
<td>0K</td>
</tr>
<tr>
<td>376565</td>
<td>user1</td>
<td>56</td>
<td>207M</td>
<td>56M</td>
<td>100M</td>
<td>0K</td>
<td>0K</td>
<td>0K</td>
<td>0K</td>
</tr>
</tbody>
</table>

By inhibiting cap enforcement, either by raising the cap of a project or by changing the minimum physical memory utilization for cap enforcement (see rcapadm(1M)), the resident set can become the working set. The rss column might stabilize to show the project WSS, as shown in the previous example. The WSS is the minimum cap value that allows the project's processes to operate without perpetually incurring page faults.
Exit Status  The following exit values are returned:
0  Successful completion.
1  An error occurred.
2  Invalid command-line options were specified.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/resource-mgmt/resource-caps</td>
</tr>
</tbody>
</table>

See Also  rcapadm(1M), rcapd(1M), attributes(5)


Notes  If the interval specified to rcapstat is shorter than the reporting interval specified to rcapd (with rcapadm(1M)), the output for some intervals can be zero. This is because rcapd does not update statistics more frequently than the interval specified with rcapadm, and this interval is independent of (and less precise than) the sampling interval used by rcapstat.
Name  rcp - remote file copy

          rcp [-pr] [-a] [-K] [-x] [-PN | -PO] [-k realm] filename... directory

Description  The rcp command copies files between machines. Each filename or directory argument is either a remote file name of the form:

  hostname:path

or a local file name (containing no : (colon) characters, or / (backslash) before any : (colon) characters).

The hostname can be an IPv4 or IPv6 address string. See inet(7P) and inet6(7P). Since IPv6 addresses already contain colons, the hostname should be enclosed in a pair of square brackets when an IPv6 address is used. Otherwise, the first occurrence of a colon can be interpreted as the separator between hostname and path. For example,

  [1080::8:800:200C:417A]:tmp/file

If a filename is not a full path name, it is interpreted relative to your home directory on hostname. A path on a remote host can be quoted using \", ", or ", so that the metacharacters are interpreted remotely. Please notice that the kerberized versions of rcp are not IPv6-enabled.

rcp does not prompt for passwords. It either uses Kerberos authentication which is enabled through command-line options or your current local user name must exist on hostname and allow remote command execution by rsh(1).

The rcp session can be kerberized using any of the following Kerberos specific options: -a, -PN or -PO, -x, and -k realm. Some of these options (-a, -x and -PN or -PO) can also be specified in the [appdefaults] section of krb5.conf(4). The usage of these options and the expected behavior is discussed in the OPTIONS section below. If Kerberos authentication is used, authorization to the account is controlled by rules in krb5_auth_rules(5). If this authorization fails, fallback to normal rcp using rhosts occurs only if the -PO option is used explicitly on the command line or is specified in krb5.conf(4). If authorization succeeds, remote copy succeeds without any prompting of password. Also notice that the -PN or -PO, -x, and -k realm options are just supersets of the -a option.

rcp handles third party copies, where neither source nor target files are on the current machine. Hostnames can also take the form

  username@hostname:filename

to use username rather than your current local user name as the user name on the remote host. rcp also supports Internet domain addressing of the remote host, so that:

  username@host.domain:filename
specifies the username to be used, the hostname, and the domain in which that host resides. File names that are not full path names are interpreted relative to the home directory of the user named \textit{username}, on the remote host.

\textbf{Options} The following options are supported:

\begin{itemize}
  \item \texttt{-a} This option explicitly enables Kerberos authentication and trusts the \texttt{.k5login} file for access-control. If the authorization check by \texttt{in.rshd(1M)} on the server-side succeeds and if the \texttt{.k5login} file permits access, the user is allowed to carry out the \texttt{rcp} transfer.
  \item \texttt{-k realm} Causes \texttt{rcp} to obtain tickets for the remote host in \textit{realm} instead of the remote host's realm as determined by \texttt{krb5.conf(4)}.
  \item \texttt{-K realm} This option explicitly disables Kerberos authentication. It can be used to override the \texttt{auto.login} variable in \texttt{krb5.conf(4)}.
  \item \texttt{-p} Attempts to give each copy the same modification times, access times, modes, and ACLs if applicable as the original file.
  \item \texttt{-PO\ -PN} Explicitly requests new (\texttt{-PN}) or old (\texttt{-PO}) version of the Kerberos "\texttt{rcmd}" protocol. The new protocol avoids many security problems prevalent in the old one and is regarded much more secure, but is not interoperable with older (MIT/SEAM) servers. The new protocol is used by default, unless explicitly specified using these options or through \texttt{krb5.conf(4)}. If Kerberos authorization fails when using the old "\texttt{rcmd}" protocol, there is fallback to regular, non-kerberized \texttt{rcp}. This is not the case when the new, more secure "\texttt{rcmd}" protocol is used.
  \item \texttt{-r} Copies each subtree rooted at \textit{filename}; in this case the destination must be a directory.
  \item \texttt{-x} Causes the information transferred between hosts to be encrypted. Notice that the command is sent unencrypted to the remote system. All subsequent transfers are encrypted.
\end{itemize}

\textbf{Usage} See \texttt{largefile(5)} for the description of the behavior of \texttt{rcp} when encountering files greater than or equal to 2 Gbyte (\(2^{31}\) bytes).

The \texttt{rcp} command is IPv6–enabled. See \texttt{ip6(7P)}. IPv6 is not currently supported with Kerberos V5 authentication.

For the kerberized \texttt{rcp} session, each user can have a private authorization list in a file \texttt{.k5login} in their home directory. Each line in this file should contain a Kerberos principal name of the form \texttt{principal/instance@realm}. If there is a \texttt{~/.k5login} file, then access is granted to the account if and only if the originater user is authenticated to one of the principals named in the \texttt{~/.k5login} file. Otherwise, the originating user is granted access to the account if and
only if the authenticated principal name of the user can be mapped to the local account name using the `authenticated-principal-name → local-user-name` mapping rules. The `.k5login` file (for access control) comes into play only when Kerberos authentication is being done.

**Exit Status**

The following exit values are returned:

- 0: All files were copied successfully.
- >0: An error occurred.

See the NOTES section for caveats on the exit code.

**Files**

`$HOME/.profile`

`$HOME/.k5login` File containing Kerberos principals that are allowed access

`/etc/krb5/krb5.conf` Kerberos configuration file

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/network-clients</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

**See Also**

`cpio(1), ftp(1), rlogin(1), rsh(1), setfacl(1), tar(1), tar(1), in.rshd(1M),
hosts.equiv(4), krb5.conf(4), attributes(5), largefile(5), krb5_auth_rules(5),
inet(7P), inet6(7P), ip6(7P)`

**Notes**

`rcp` is meant to copy between different hosts. Attempting to `rcp` a file onto itself, as with:

```
example% rcp tmp/file myhost:/tmp/file
```

results in a severely corrupted file.

`rcp` might not correctly fail when the target of a copy is a file instead of a directory.

`rcp` can become confused by output generated by commands in a `$HOME/.profile` on the remote host.

`rcp` requires that the source host have permission to execute commands on the remote host when doing third-party copies.

`rcp` does not properly handle symbolic links. Use `tar` or `cpio` piped to `rsh` to obtain remote copies of directories containing symbolic links or named pipes. See `tar(1)` and `cpio(1)`.

If you forget to quote metacharacters intended for the remote host, you get an incomprehensible error message.

`rcp` fails if you copy ACLs to a file system that does not support ACLs.
rcp is CSI-enabled except for the handling of username, hostname, and domain.

When rcp is used to perform third-party copies where either of the remote machines is not running Solaris, the exit code cannot be relied upon. That is, errors could occur when success is reflected in the exit code, or the copy could be completely successful even though an error is reflected in the exit code.
Name  read – read a line from standard input

Synopsis

/usr/bin/read /usr/bin/read [-r] var...

sh  read name...

csh  set variable= $<

ksh88  read [-prsnu [n]] [name ? prompt] [name]...

ksh  read [-ACprs] [-d delim] [-n nsize] [-N nsize] [-t timeout]

[-u unit] [vname?prompt] [vname... ]

Description

The read utility reads a single line from standard input.

By default, unless the -r option is specified, backslash (\) acts as an escape character. If standard input is a terminal device and the invoking shell is interactive, read prompts for a continuation line when:

- The shell reads an input line ending with a backslash, unless the -r option is specified.
- A here-document is not terminated after a NEWLINE character is entered.

The line is split into fields as in the shell. The first field is assigned to the first variable var, the second field to the second variable var, and so forth. If there are fewer var operands specified than there are fields, the leftover fields and their intervening separators is assigned to the last var. If there are fewer fields than vars, the remaining vars is set to empty strings.

The setting of variables specified by the var operands affects the current shell execution environment. If it is called in a sub-shell or separate utility execution environment, such as one of the following:

- (read foo)
- nohup read ...
- find . -exec read ... ;

It does not affect the shell variables in the caller’s environment.

The standard input must be a text file.

sh  One line is read from the standard input and, using the internal field separator, IFS (normally space or tab), to delimit word boundaries, the first word is assigned to the first name, the second word to the second name, and so on, with leftover words assigned to the last name. Lines can be continued using \newLine. Characters other than NEWLINE can be quoted by preceding them with a backslash. These backslashes are removed before words are assigned to names, and no interpretation is done on the character that follows the backslash. The return code is 0, unless an end-of-file is encountered.

csh  The notation:
set variable =$<

loads one line of standard input as the value for variable. (See csh(1)).

ksh88 The shell input mechanism. One line is read and is broken up into fields using the characters in IFS as separators. The escape character, (\), is used to remove any special meaning for the next character and for line continuation. In raw mode, the -r, the , and the \ character are not treated specially. The first field is assigned to the first name, the second field to the second name, and so on, with leftover fields assigned to the last name. The -p option causes the input line to be taken from the input pipe of a process spawned by the shell using |&. If the -s flag is present, the input is saved as a command in the history file. The flag -u can be used to specify a one digit file descriptor unit n to read from. The file descriptor can be opened with the exec special command. The default value of n is 0. If name is omitted, REPL is used as the default name. The exit status is 0 unless the input file is not open for reading or an end-of-file is encountered. An end-of-file with the -p option causes cleanup for this process so that another can be spawned. If the first argument contains a ?, the remainder of this word is used as a prompt on standard error when the shell is interactive. The exit status is 0 unless an end-of-file is encountered.

ksh read reads a line from standard input and breaks it into fields using the characters in the value of the IFS variable as separators. The escape character, \, is used to remove any special meaning for the next character and for line continuation unless the -r option is specified.

If there are more variables than fields, the remaining variables are set to empty strings. If there are fewer variables than fields, the leftover fields and their intervening separators are assigned to the last variable. If no var is specified, the variable REPL is used.

When var has the binary attribute and -n or -N is specified, the bytes that are read are stored directly into var.

If you specify ?prompt after the first var, read displays a prompt on standard error when standard input is a terminal or pipe.

Options

/usr/bin/read,ksh88 The following option is supported by /usr/bin/read and ksh88:

  -r Do not treat a backslash character in any special way. Considers each backslash to be part of the input line.

ksh The following options are supported by ksh:

  -A Unset var, and create an indexed array containing each field in the line starting at index 0.

  -C Unset var and read var as a compound variable.

  -d delim Read until delimiter delim instead of to the end of line.

  -n nsize Read at most nsize bytes. Binary field size is in bytes.
-N nsize  Read exactly nsize bytes. Binary field size is in bytes.
-p        Read from the current co-process instead of standard input. An end of file
         causes read to disconnect the co-process so that another can be created.
-r        Do not treat \ specially when processing the input line.
-s        Save a copy of the input as an entry in the shell history file.
-t timeout Specify a timeout in seconds when reading from a terminal or pipe.
-u fd     Read from file descriptor number fd instead of standard input. The default
         value is 0.
-v        When reading from a terminal, display the value of the first variable and use it
         as a default value.

Operands  The following operand is supported:

   var     The name of an existing or non-existing shell variable.

Examples  EXAMPLE 1  Using the read Command

The following example for /usr/bin/read prints a file with the first field of each line moved to
the end of the line:

example% while read -r xx yy
do
    printf "%s %s\n" "$yy" "$xx"
done < input_file

Environment Variables  See environ(5) for descriptions of the following environment variables that affect
the execution of read: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

   IFS       Determines the internal field separators used to delimit fields.
   PS2       Provides the prompt string that an interactive shell writes to standard error when a
line ending with a backslash is read and the -r option was not specified, or if a
here-document is not terminated after a NEWLINE character is entered.

Exit Status  The following exit values are returned:

   0         Successful completion.
   >0        End-of-file was detected or an error occurred.

Attributes  See attributes(5) for descriptions of the following attributes:

```bash
ATRIBUTE      ATTRIBUTE VALUE
Availability   system/core-os
```
<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

### ksh

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Uncommitted</td>
</tr>
</tbody>
</table>

**See Also** `csh(1), ksh(1), ksh88(1), line(1), set(1), sh(1), attributes(5), environ(5), standards(5)`
readonly(1)

Name  readonly – shell built-in function to protect the value of the given variable from reassignment

Synopsis

sh  readonly [name]...

ksh88  **readonly [name [= value]]...
  **readonly -p

ksh  ++readonly [-p] [name [= value]]...

Description

sh  The given names are marked readonly and the values of these names may not be changed by subsequent assignment. If no arguments are given, a list of all readonly names is printed.

ksh88  The given names are marked readonly and these names cannot be changed by subsequent assignment.

When -p is specified, readonly writes to the standard output the names and values of all read-only variables, in the following format:

"readonly %s=%s\n", name, value

if name is set, and:

"readonly $s\n", name

if name is unset.

The shell formats the output, including the proper use of quoting, so that it is suitable for re-input to the shell as commands that achieve the same value and readonly attribute-setting results in a shell execution environment in which:

1. Variables with values set at the time they were output do not have the readonly attribute set.
2. Variables that were unset at the time they were output do not have a value at the time at which the saved output is re-input to the shell.

On this manual page, ksh88(1) commands that are preceded by one or two ** (asterisks) are treated specially in the following ways:

1. Variable assignment lists preceding the command remain in effect when the command completes.
2. I/O redirections are processed after variable assignments.
3. Errors cause a script that contains them to abort.
4. Words, following a command preceded by ** that are in the format of a variable assignment, are expanded with the same rules as a variable assignment. This means that tilde substitution is performed after the = sign and word splitting and file name generation are not performed.
readonly(1)

readonly sets the readonly attribute on each of the variables specified by name which prevents their values from being changed. If \textit{=value} is specified, the variable name is set to \textit{value} before the variable is made readonly.

If no names are specified then the names and values of all readonly variables are written to standard output.

readonly is built-in to the shell as a declaration command so that field splitting and pathname expansion are not performed on the arguments. Tilde expansion occurs on value.

\texttt{-p} Causes the output to be in a form of readonly commands that can be used as input to the shell to recreate the current set of readonly variables.

On this manual page, \texttt{ksh(1)} commands that are preceded by one or two + symbols are treated specially in the following ways:

1. Variable assignment lists preceding the command remain in effect when the command completes.
2. I/O redirections are processed after variable assignments.
3. Errors cause a script that contains them to abort.
4. They are not valid function names.
5. Words, following a command preceded by ++ that are in the format of a variable assignment, are expanded with the same rules as a variable assignment. This means that tilde substitution is performed after the = sign and field splitting and file name generation are not performed.

Exit Status

\texttt{ksh} The following exit values are returned:

\texttt{0} Successful completion.
\texttt{>0} An error occurred.

Attributes See \texttt{attributes(5)} for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also \texttt{ksh(1), ksh88(1), sh(1), typeset(1), attributes(5)
Refer – expand and insert references from a bibliographic database

**Synopsis**
[-skeys] filename...

**Description**
Refer is a preprocessor for nroff(1), or troff(1), that finds and formats references. The input files (standard input by default) are copied to the standard output, except for lines between ‘. ’ and ‘. ’ command lines. Such lines are assumed to contain keywords as for lookbib(1), and are replaced by information from a bibliographic database. The user can avoid the search, override fields from it, or add new fields. The reference data, from whatever source, is assigned to a set of troff strings. Macro packages such as ms(5) print the finished reference text from these strings. A flag is placed in the text at the point of reference. By default, the references are indicated by numbers.

When refer is used with eqn(1), neqn, or tbl(1), refer should be used first in the sequence, to minimize the volume of data passed through pipes.

**Options**
- b Bare mode — do not put any flags in text (neither numbers or labels).
- e Accumulate references instead of leaving the references where encountered, until a sequence of the form:
  . [ 
  \$LIST$ 
  . ]
  is encountered, and then write out all references collected so far. Collapse references to the same source.
- n Do not search the default file.
- ar Reverse the first r author names (Jones, J. A. instead of J. A. Jones). If r is omitted, all author names are reversed.
- cstring Capitalize (with SMALL CAPS) the fields whose key-letters are in string.
- kx Instead of numbering references, use labels as specified in a reference data line beginning with the characters \%x; By default, x is L.
- \(lm,n\) Instead of numbering references, use labels from the senior author’s last name and the year of publication. Only the first m letters of the last name and the last n digits of the date are used. If either of m or n is omitted, the entire name or date, respectively, is used.
- p filename Take the next argument as a file of references to be searched. The default file is searched last.
- skeys Sort references by fields whose key-letters are in the keys string, and permute reference numbers in the text accordingly. Using this option implies the -e option. The key-letters in keys may be followed by a number indicating how many such fields are used, with a + sign taken as a very large number. The
default is AD, which sorts on the senior author and date. To sort on all authors
and then the date, for instance, use the options `-sA+T`.

**Files**  
/usr/lib/refer directory of programs  
/usr/lib/refer/papers directory of default publication lists and indexes

**Attributes**  
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>text/doctools</td>
</tr>
</tbody>
</table>

**See Also**  
addbib(1), eqn(1), indxbib(1), lookbib(1), nroff(1), roffbib(1), sortbib(1), tbl(1), troff(1), attributes(5)
Name  
regcmp – regular expression compile

Synopsis  
regcmp  [-]  filename...

Description  
The regcmp command performs a function similar to regcmp and, in most cases, precludes the need for calling regcmp from C programs. Bypassing regcmp saves on both execution time and program size. The command regcmp compiles the regular expressions in filename and places the output in filename.i.

Options  
- If the – option is used, the output is placed in filename.c. The format of entries in filename is a name (C variable) followed by one or more blanks followed by one or more regular expressions enclosed in double quotes. The output of regcmp is C source code. Compiled regular expressions are represented as extern char vectors. filename.i files may thus be #included in C programs, or filename.c files may be compiled and later loaded. In the C program that uses the regcmp output, regex(abc, line) applies the regular expression named abc to line. Diagnostics are self-explanatory.

Examples  
EXAMPLE 1  Using the regcmp command.

name "([A-Za-z][A-Za-z0-9_]*)$0"
telno "((\{0\}([2-9]|[01])\{1-9\})$0\{(0,1)\} "
       "((2-9)\{0-9\}\{2\})\{1-9\}\{0,1\} "
       "((0-9)\{4\})\{2\}"

The three arguments to telno shown above must all be entered on one line.

In the C program that uses the regcmp output,

regex(telno, line, area, exch, rest)

Applies the regular expression named telno to line.

Environment Variables  
A general description of the usage of the LC_* environmental variables can be found in environ(5).

LC_CTYPE  
Determines how regcmp handles characters. When LC_CTYPE is set to a valid value, regcmp can display and handle text and filenames containing valid characters for that locale.

LCMESSAGES  
Determines how diagnostic and informative messages are presented. This includes the language and style of the messages, and the correct form of affirmative and negative responses. In the "C" locale, the messages are presented in the default form found in the program itself (in most cases, U.S. English).
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/base-developer-utilities</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

See Also  regcmp(3C), attributes(5), environ(5)
The `renice` command alters the scheduling priority of one or more running processes. By default, the processes to be affected are specified by their process IDs.

If the first operand is a number within the valid range of priorities (−20 to 20), `renice` will treat it as a priority (as in all but the first synopsis form). Otherwise, `renice` will treat it as an ID (as in the first synopsis form).

Users other than the privileged user may only alter the priority of processes they own, and can only monotonically increase their "nice value" within the range 0 to 19. This prevents overriding administrative fiats. The privileged user may alter the priority of any process and set the priority to any value in the range −20 to 19. Useful priorities are: 19 (the affected processes will run only when nothing else in the system wants to); 0 (the "base" scheduling priority); and any negative value (to make things go very fast). 20 is an acceptable nice value, but will be rounded down to 19.

`renice` supports the following option features:

- The first operand, `priority`, must precede the options and can have the appearance of a multi-digit option.
- The `-g`, `-p`, and `-u` options can each take multiple option-arguments.
- The `pid` option-argument can be used without its `-p` option.
- The `-i` option can be used to specify the ID type for the ID list. This is preferred in specifying ID type over the use of the `-g | -p | -u` syntax, which is now obsolete. See NOTES.

The following options are supported:

- `-g` Interprets all operands or just the `gid` arguments as unsigned decimal integer process group IDs.
- `-i` This option, together with the ID list arguments, specifies a class of processes to which the `renice` command is to apply. The interpretation of the ID list depends on the value of `idtype`. The valid `idtype` arguments are: `pid`, `pgid`, `uid`, `gid`, `sid`, `taskid`, `projid`, and `zoneid`. 

-n increment Specifies how the system scheduling priority of the specified process or processes is to be adjusted. The *increment* option-argument is a positive or negative decimal integer that will be used to modify the system scheduling priority of the specified process or processes. Positive *increment* values cause a lower system scheduling priority. Negative *increment* values may require appropriate privileges and will cause a higher system scheduling priority.

-p Interprets all operands or just the *pid* arguments as unsigned decimal integer process IDs. The -p option is the default if no options are specified.

-u Interprets all operands or just the *user* argument as users. If a user exists with a user name equal to the operand, then the user ID of that user will be used in further processing. Otherwise, if the operand represents an unsigned decimal integer, it will be used as the numeric user ID of the user.

**Operands** The following operands are supported:

- **ID** A process ID, process group ID, or user name/user ID, depending on the option selected.
- **priority** The value specified is taken as the actual system scheduling priority, rather than as an increment to the existing system scheduling priority. Specifying a scheduling priority higher than that of the existing process may require appropriate privileges.

**Examples**

**EXAMPLE 1** Adjusting the scheduling priority of process IDs

Adjust the system scheduling priority so that process IDs 987 and 32 would have a lower scheduling priority:

```bash
example% renice -n 5 -p 987 32
```

**EXAMPLE 2** Adjusting the scheduling priority of group IDs

Adjust the system scheduling priority so that group IDs 324 and 76 would have a higher scheduling priority, if the user has the appropriate privileges to do so:

```bash
example% renice -n -4 -g 324 76
```

**EXAMPLE 3** Adjusting the scheduling priority of a user ID and user name

Adjust the system scheduling priority so that numeric user ID 8 and user sas would have a lower scheduling priority:

```bash
example% renice -n 4 -u 8 sas
```

**Environment Variables** See *environ(5)* for descriptions of the following environment variables that affect the execution of *renice*: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.
The following exit values are returned:

0 Successful completion.

>0 An error occurred.

Files /etc/passwd map user names to user IDs

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also nice(1), passwd(1), priocntl(1), attributes(5), environ(5), standards(5)

Notes The renice syntax

renice [-n increment] [-i idtype] ID ...

is preferred over the old syntax

renice [-n increment] [-g | -p | -u] ID ...

which is now obsolete.

If you make the priority very negative, then the process cannot be interrupted.

To regain control you must make the priority greater than 0.

Users other than the privileged user cannot increase scheduling priorities of their own processes, even if they were the ones that decreased the priorities in the first place.

The priocntl command subsumes the function of renice.
**Name**
rlogin – remote login

**Synopsis**
   [-l username] [-k realm] hostname

**Description**
The `rlogin` utility establishes a remote login session from your terminal to the remote machine named `hostname`. The user can choose to kerberize the `rlogin` session using Kerberos V5 and also protect the data being transferred.

Hostnames are listed in the `hosts` database, which can be contained in the `/etc/hosts` file, the Network Information Service (NIS) `hosts` map, the Internet domain name server, or a combination of these. Each host has one official name (the first name in the database entry), and optionally one or more nicknames. Either official hostnames or nicknames can be specified in `hostname`.

The user can opt for a secure `rlogin` session which uses Kerberos V5 for authentication. Encryption of the session data is also possible. The `rlogin` session can be kerberized using any of the following Kerberos specific options: `-A`, `-PN` or `-PO`, `-x`, `-f` or `-F`, and `-k realm`. Some of these options (`-A`, `-x`, `-PN` or `-PO`, and `-f` or `-F`) can also be specified in the `[appdefaults]` section of `krb5.conf(4)`. The usage of these options and the expected behavior is discussed in the OPTIONS section below. If Kerberos authentication is used, authorization to the account is controlled through rules in `krb5_auth_rules(5)`. If this authorization fails, fallback to normal `rlogin` using `rhosts` occurs only if the `-PO` option is used explicitly on the command line or is specified in `krb5.conf(4)`. Also notice that the `-PN` or `-PO`, `-x`, `-f` or `-F`, and `-k realm` options are just superset of the `-A` option.

The remote terminal type is the same as your local terminal type, as given in your environment `TERM` variable. The terminal or window size is also copied to the remote system if the server supports the option. Changes in size are reflected as well. All echoing takes place at the remote site, so that (except for delays) the remote login is transparent. Flow control using Control-S and Control-Q and flushing of input and output on interrupts are handled properly.

**Options**
The following options are supported:

- **-8**
  Passes eight-bit data across the net instead of seven-bit data.

- **-a**
  Forces the remote machine to ask for a password by sending a null local username.

- **-A**
  Explicitly enables Kerberos authentication and trusts the `.k5login` file for access-control. If the authorization check by `in_rlogin(1M)` on the server-side succeeds and if the `.k5login` file permits access, the user is allowed to login without supplying a password.

- **-ec**
  Specifies a different escape character, `c`, for the line used to disconnect from the remote host.

- **-E**
  Stops any character from being recognized as an escape character.
-f  Forwards a copy of the local credentials (Kerberos Ticket Granting Ticket) to
the remote system. This is a non-forwardable ticket granting ticket. You
must forward a ticket granting ticket if you need to authenticate yourself to
other Kerberized network services on the remote host. An example is if your
home directory on the remote host is NFS mounted via Kerberos V5. If your
local credentials are not forwarded in this case, you cannot access your home
directory. This option is mutually exclusive with the -F option.

-F  Forwards a forwardable copy of the local credentials (Kerberos Ticket
Granting Ticket) to the remote system. The -F option provides a superset
of the functionality offered by the -f option. For example, with the -f option,
after you connected to the remote host, any attempt to invoke
/usr/bin/ftp, /usr/bin/telnet, /usr/bin/rlogin, or /usr/bin/rsh with
the -f or -F options would fail. Thus, you would be unable to push your
single network sign on trust beyond one system. This option is mutually
exclusive with the -f option.

-k realm  Causes rlogin to obtain tickets for the remote host in realm instead of the
remote host’s realm as determined by krb5.conf.

-K  This option explicitly disables Kerberos authentication. It can be used to
override the autoLogin variable in krb5.conf.

-l username  Specifies a different username for the remote login. If you do not use this
option, the remote username used is the same as your local username.

-L  Allows the rlogin session to be run in “litout” mode.

-PN  -PO  Explicitly requests the new (-PN) or old (-PO) version of the Kerberos `rcmd`
protocol. The new protocol avoids many security problems prevalent in the
old one and is considered much more secure, but is not interoperable with
older (MIT/SEAM) servers. The new protocol is used by default, unless
explicitly specified using these options or by using krb5.conf. If Kerberos
authorization fails when using the old `rcmd` protocol, there is fallback to
regular, non-kerberized rlogin. This is not the case when the new, more
secure `rcmd` protocol is used.

-x  Turns on DES encryption for all data passed through the rlogin session. This
reduces response time and increases CPU utilization.

Escape Sequences  Lines that you type which start with the tildes character (~) are “escape sequences.” The escape
character can be changed using the -e option.

~.  Disconnects from the remote host. This is not the same as a logout, because the
local host breaks the connection with no warning to the remote end.
~susp  Suspends the login session, but only if you are using a shell with Job Control. susp is your "suspend" character, usually Control-Z. See tty(1).

~dsusp  Suspends the input half of the login, but output is still able to be seen (only if you are using a shell with Job Control). dsusp is your "deferred suspend" character, usually Control-Y. See tty(1).

Operands  

hostname  The remote machine on which rlogin establishes the remote login session.

Usage  

For the kerberized rlogin session, each user can have a private authorization list in a file, .k5login, in his home directory. Each line in this file should contain a Kerberos principal name of the form principal/instance@realm. If there is a ~/.k5login file, access is granted to the account if and only if the originating user is authenticated to one of the principals named in the ~/.k5login file. Otherwise, the originating user is granted access to the account if and only if the authenticated principal name of the user can be mapped to the local account name using the authenticated-principal-name → local-user-name mapping rules. The .k5login file (for access control) comes into play only when Kerberos authentication is being done.

For the non-secure rlogin session, each remote machine can have a file named /etc/hosts.equiv containing a list of trusted host names with which it shares user names. Users with the same user name on both the local and remote machine can rlogin from the machines listed in the remote machine’s /etc/hosts.equiv file without supplying a password. Individual users can set up a similar private equivalence list with the file .rhosts in their home directories. Each line in this file contains two names, that is, a host name and a user name, separated by a space. An entry in a remote user’s .rhosts file permits the user named username who is logged into hostname to log in to the remote machine as the remote user without supplying a password. If the name of the local host is not found in the /etc/hosts.equiv file on the remote machine, and the local user name and host name are not found in the remote user’s .rhosts file, then the remote machine prompts for a password. Host names listed in the /etc/hosts.equiv and .rhosts files must be the official host names listed in the hosts database. Nicknames cannot be used in either of these files.

For security reasons, the .rhosts file must be owned by either the remote user or by root.

Files  

/etc/passwd  Contains information about users’ accounts.

/usr/hosts/*  For hostname version of the command.

/etc/hosts.equiv  List of trusted hostnames with shared user names.

/etc/nologin  Message displayed to users attempting to login during machine shutdown.

$HOME/.rhosts  Private list of trusted hostname/username combinations.

$HOME/.k5login  File containing Kerberos principals that are allowed access.

/etc/krb5/krb5.conf  Kerberos configuration file.
/etc/hosts  Hosts database.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/network-clients</td>
</tr>
</tbody>
</table>

See Also  rsh(1), stty(1), tty(1), in.rlogind(1M), hosts(4), hosts.equiv(4), krb5.conf(4),
           nologin(4), attributes(5), krb5_auth_rules(5)

Diagnostics  The following message indicates that the machine is in the process of being shutdown and
             logins have been disabled:

             NO LOGINS: System going down in N minutes

Notes  When a system is listed in hosts.equiv, its security must be as good as local security. One
        insecure system listed in hosts.equiv can compromise the security of the entire system.

        The Network Information Service (NIS) was formerly known as Sun Yellow Pages (YP). The
        functionality of the two remains the same. Only the name has changed.

        This implementation can only use the TCP network service.
The `rm` utility removes the directory entry specified by each `file` argument. If a file has no write permission and the standard input is a terminal, the full set of permissions (in octal) for the file are printed followed by a question mark. This is a prompt for confirmation. If the answer is affirmative, the file is deleted, otherwise the file remains.

If `file` is a symbolic link, the link is removed, but the file or directory to which it refers is not deleted. Users do not need write permission to remove a symbolic link, provided they have write permissions in the directory.

If multiple `files` are specified and removal of a `file` fails for any reason, `rm` writes a diagnostic message to standard error, do nothing more to the current `file`, and go on to any remaining `files`.

If the standard input is not a terminal, the utility operates as if the `-f` option is in effect.

The `rmdir` utility removes the directory entry specified by each `dirname` operand, which must refer to an empty directory.

Directories are processed in the order specified. If a directory and a subdirectory of that directory are specified in a single invocation of `rmdir`, the subdirectory must be specified before the parent directory so that the parent directory is empty when `rmdir` tries to remove it.

The following options are supported for `/usr/bin/rm` and `/usr/xpg4/bin/rm`:

- `-r` Recursively removes directories and subdirectories in the argument list. The directory is emptied of files and removed. The user is normally prompted for removal of any write-protected files which the directory contains. The write-protected files are removed without prompting, however, if the `-f` option is used, or if the standard input is not a terminal and the `-i` option is not used.

  Symbolic links that are encountered with this option is not traversed.

  If the removal of a non-empty, write-protected directory is attempted, the utility always fails (even if the `-f` option is used), resulting in an error message.

- `-R` Same as `-r` option.
The following options are supported for `/usr/bin/rm` only:

- `-f` Removes files (even if write-protected) in a directory without prompting the user. In a write-protected directory, however, files are never removed (whatever their permissions are) and no messages are displayed.

- `-i` Interactive. With this option, `rm` prompts for confirmation before removing any files. It overrides the `-f` option and remains in effect even if the standard input is not a terminal.

The following options are supported for `/usr/xpg4/bin/rm` only:

- `-f` Does not prompt for confirmation. Does not write diagnostic messages or modify the exit status in the case of non-existent operands. Any previous occurrences of the `-i` option is ignored.

- `-i` Prompts for confirmation. Any occurrences of the `-f` option is ignored.

The following options are supported for `/usr/bin/rmdir` only:

- `-p` Allows users to remove the directory `dirname` and its parent directories which become empty. A message is printed to standard error if all or part of the path could not be removed.

- `-s` Suppresses the message printed on the standard error when `-p` is in effect.

**Operands**

The following operands are supported:

`file` Specifies the pathname of a directory entry to be removed.

`dirname` Specifies the pathname of an empty directory to be removed.

**Usage**

See `largefile(5)` for the description of the behavior of `rm` and `rmdir` when encountering files greater than or equal to 2 Gbyte ($2^{31}$ bytes).

**Examples**

The following examples are valid for the commands shown.

```
EXAMPLE 1  Removing Directories

The following command removes the directory entries a.out and core:

  example% rm a.out core

EXAMPLE 2  Removing a Directory without Prompting

The following command removes the directory junk and all its contents, without prompting:

  example% rm -rf junk
```
EXAMPLE 3  Removing Empty Directories

If a directory a in the current directory is empty, except that it contains a directory b, and a/b is empty except that it contains a directory c, the following command removes all three directories:

```bash
example% rmdir -p a/b/c
```

Environment Variables

See `environ(5)` for descriptions of the following environment variables that affect the execution of `rm` and `rmdir`: LANG, LC_ALL, LC_COLLATE, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Affirmative responses are processed using the extended regular expression defined for the `yesexpr` keyword in the LC_MESSAGES category of the user's locale. The locale specified in the LC_COLLATE category defines the behavior of ranges, equivalence classes, and multi-character collating elements used in the expression defined for `yesexpr`. The locale specified in LC_CTYPE determines the locale for interpretation of sequences of bytes of text data a characters, the behavior of character classes used in the expression defined for the `yesexpr`. See `locale(5)`.

Exit Status

The following exit values are returned:

- **0**  
  If the `-f` option was not specified, all the named directory entries were removed; otherwise, all the existing named directory entries were removed.

- **>0**  
  An error occurred.

Attributes

See `attributes(5)` for descriptions of the following attributes:

```
<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
</tbody>
</table>
```

```
<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/xopen/xcu4</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See <code>standards(5)</code></td>
</tr>
</tbody>
</table>
```

See Also

`rmdir(2), unlink(2), attributes(5), environ(5), largefile(5), standards(5)`

Diagnostics

It is forbidden to remove the files "." and ".." in order to avoid the consequences of inadvertently doing something like the following:

```bash
example% rm -r . *
```
It is forbidden to remove the file "/" in order to avoid the consequences of inadvertently doing something like:

```bash
example% rm -rf $x/$y
```

or

```bash
example% rm -rf /$y
```

when $x and $y expand to empty strings.

**Notes**  
A − permits the user to mark explicitly the end of any command line options, allowing `rm` to recognize file arguments that begin with a −. As an aid to BSD migration, `rm` accepts −− as a synonym for −. This migration aid may disappear in a future release. If a −− and a − both appear on the same command line, the second is interpreted as a file.
The `rmformat` utility is used to format, label, partition, and perform other miscellaneous functions on removable, rewritable media that include PCMCIA memory and ata cards. The `rmformat` utility should also be used with all USB mass storage devices, including USB hard drives. This utility can also be used for the verification and surface analysis and for repair of the bad sectors found during verification if the drive or the driver supports bad block management.

After formatting, `rmformat` writes the label, which covers the full capacity of the media as one slice on PCMCIA memory cards. The partition information can be changed with the help of other options provided by `rmformat`.

**Options**

The following options are supported:

- `-b label`
  
  Labels the media with a SUNOS label. A SUNOS volume label name is restricted to 8 characters. For media size greater than 1 TB, an EFI label is created. For writing a DOS Volume label, the user should use `mkfs_pcfs(1M)`.

- `-c blockno`
  
  Corrects and repairs the given block. This correct and repair option may not be applicable to all devices supported by `rmformat`, as some devices may have a drive with bad block management capability and others may have this option implemented in the driver. If the drive or driver supports bad block management, a best effort is made to rectify the bad block. If the bad block still cannot be rectified, a message is displayed to indicate the failure to repair. The block number can be provided in decimal, octal, or hexadecimal format.

  The normal PCMCIA memory and ata cards do not support bad block management.

- `-e`
  
  Ejects the media upon completion. This feature may not be available if the drive does not support motorized eject.

- `-F quick | long | force`
  
  Formats the media.

  The `quick` option starts a format without certification or format with limited certification of certain tracks on the media.

  The `long` option starts a complete format. For some devices this might include the certification of the whole media by the drive itself.
The `force` option to format is provided to start a long format without user confirmation before the format is started.

On PCMCIA memory cards, all options start a long format.

- `l`
  Lists all removable devices. By default, without any options, `rmformat` also lists all removable devices. If the `dev_name` is given, `rmformat` lists the device associated with the `dev_name`. The output shows the device pathname, vendor information, and the device type.

- `s filename`
  Enables the user to lay out the partition information in the SUNOS label.

  The user should provide a file as input with information about each slice in a format providing byte offset, size required, tags, and flags, as follows:

  \[
  \text{slices: } n = \text{offset}, \text{size} [\text{, flags, tags}]
  \]

  where `n` is the slice number, `offset` is the byte offset at which the slice `n` starts, and `size` is the required size for slice `n`. Both `offset` and `size` must be a multiple of 512 bytes. These numbers can be represented as decimal, hexadecimal, or octal numbers. No floating point numbers are accepted. Details about maximum number of slices can be obtained from the Oracle Solaris Administration: Common Tasks.

  To specify the `size` or `offset` in kilobytes, megabytes, or gigabytes, add `KB`, `MB`, `GB`, respectively. A number without a suffix is assumed to be a byte offset. The flags are represented as follows:

  \[
  \text{wm} = \text{read-write, mountable} \\
  \text{wu} = \text{read-write, unmountable} \\
  \text{ru} = \text{read-only, unmountable}
  \]

  The tags are represented as follows: `unassigned`, `boot`, `root`, `swap`, `usr`, `backup`, `stand`, `var`, `home`, `alternates`.

  The tags and flags can be omitted from the four tuple when finer control on those values is not required. It is required to omit both or include both. If the tags and flags are omitted from the four tuple for a particular slice, a default value for each is assumed. The default value for flags is `wm` and for tags is `unassigned`.

  Either full tag names can be provided or an abbreviation for the tags can be used. The abbreviations can be the first two or more letters from the standard tag names. `rmformat` is case insensitive in handling the defined tags & flags.

  Slice specifications are separated by `:`

  For example:
slices: 0 = 0, 30MB, "wm", "home":
  1 = 30MB, 51MB :
  2 = 0, 100MB, "wm", "backup":
  6 = 81MB, 19MB

rmformat does the necessary checking to detect any overlapping partitions or illegal requests to addresses beyond the capacity of the media under consideration. There can be only one slice information entry for each slice n. If multiple slice information entries for the same slice n are provided, an appropriate error message is displayed. The slice 2 is the backup slice covering the whole disk capacity. The pound sign character, #, can be used to describe a line of comments in the input file. If the line starts with #, then rmformat ignores all the characters following # until the end of the line.

Partitioning some of the media with very small capacity is permitted, but be cautious in using this option on such devices.

-U  Performs umount on any file systems and then formats. See mount(1M). This option unmounts all the mounted slices and issues a long format on the device requested.

-V read | write  Verifies each block of media after format. The write verification is a destructive mechanism. The user is queried for confirmation before the verification is started. The output of this option is a list of block numbers, which are identified as bad.

The read verification only verifies the blocks and report the blocks which are prone to errors.

The list of block numbers displayed can be used with the -c option for repairing.

Operands  The following operand is supported:

devname  
  devname can be provided as absolute device pathname or relative pathname for the device from the current working directory or the nickname, such as cdrom or rmdisk.

  For systems without volume management running, the user can also provide the absolute device pathname as /dev/rdsk/c?t?d?s? or the appropriate relative device pathname from the current working directory.

Examples  EXAMPLE 1  Formatting Removable Media for a PCFS File System

  The following example shows how to create an alternate fdisk partition:

  example$ rmformat -F quick /dev/rdsk/c0t4d0s2:c
  Formatting will erase all the data on disk.
  Do you want to continue? (y/n)y
  example$ su
  # fdisk /dev/rdsk/c0t4d0s2:c
  # mkfs -F pcfs /dev/rdsk/c0t4d0s2:c
EXAMPLE 1 Formatting Removable Media for a PCFS File System (Continued)

Construct a new FAT file system on /dev/rdsck/c0t4d0s2:c: (y/n)? y
#

Files
/dev/aliases
Directory providing symbolic links to the character devices for the different media under the control of volume management using appropriate alias.

/dev/dsk
Directory providing block device access for the PCMCIA memory and ata cards and removable media devices.

/dev/rdsck
Directory providing character device access for the PCMCIA memory and ata cards and removable media devices.

/dev/aliases/pcmemS
Symbolic link to the character device for the PCMCIA memory card in socket S, where S represents a PCMCIA socket number.

/dev/aliases/rmdisk0
Symbolic link to the generic removable media device that is not a CD-ROM, DVD-ROM, PCMCIA memory card, and so forth.

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/storage/media-volume-manageR</td>
</tr>
</tbody>
</table>

See Also cpio(1), eject(1), tar(1), volcheck(1), volrmmount(1), format(1M), mkfs_pcfs(1M), mount(1M), newfs(1M), prtvtoc(1M), rmmount(1M), rpc. smserverd(1M), attributes(5), scsa2usb(7D), sd(7D), pcfs(7FS), udfs(7FS)

Oracle Solaris Administration: Common Tasks

Notes A rewritable media or PCMCIA memory card or PCMCIA ata card containing a ufs file system created on a SPARC-based system (using newfs(1M)) is not identical to a rewritable media or PCMCIA memory card containing a ufs file system created on an x86 based system.
Do not interchange any removable media containing ufs between these platforms; use cpio\(1\) or tar\(1\) to transfer files on memory cards between them. For interchangeable filesystems refer to pcfs\(7FS\) and udfs\(7FS\).

`rmformat` might not list all removable devices in virtualization environments.

**Bugs** Currently, bad sector mapping is not supported on PCMCIA memory cards. Therefore, memory card is unusable if `rmformat` finds an error (bad sector).
rmmount, rmumount – mounts and unmounts removable media

Synopsis

rmmount [-u] [-o options] [nickname | device] [mount_point]

rmount [-d] [-l]

rmumount [nickname | mount_point | device]

rmumount [-d] [-l]

Description

The rmmount and rmumount utilities mount and unmount removable or hot-pluggable volumes. The optional argument can identify the volume by its volume label, mount point or block device path.

rmmount can also take additional mount options if the user has sufficient privileges to override the default mount options.

Unmounting removable media does not result in its ejection. Use eject(1) to optionally unmount and eject the media.

Options

The following options are supported for rmmount and rmumount:

- d  Display the device path of the default device. This device is used if no arguments are supplied.

- l  Display the paths and nicknames of mountable devices.

The following options are supported for rmmount only:

- o options  Display mount options. This option can only be used by users that have privileges to override the system default options.

- u  Unmounts the volume as opposed to mounting it.

Operands

The following operands are supported:

device  Specifies which device to mount or unmount, by the name it appears in the directory /dev.

mount_point  Specifies which device to mount or unmount, by the name it appears in the directory /dev.

nickname  Specifies which device to mount or unmount, by its nickname as known to this command.

Examples

EXAMPLE 1  Mounting a USB disk

The following example mounts a USB disk with a volume label of PHOTOS:

example% rmmount PHOTOS
EXAMPLE 2 Unmounting a pcfs Volume
The following example unmounts a pcfs volume by device path:

cexample% rmount /dev/dsk/c4t0d0p0:1

Exit Status The following exit values are returned:

0 Successful completion.

>0 An error occurred.

Files /media Default mount root.

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/storage/media-volume-manager</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Uncommitted</td>
</tr>
</tbody>
</table>

See Also eject(1), attributes(5)
Name  roffbib – format and print a bibliographic database

         [-sN] [-Term] [-V] [-x] [filename] ...

Description  roffbib prints out all records in a bibliographic database, in bibliography format rather than as footnotes or endnotes. Generally it is used in conjunction with sortbib(1):

example% sortbib database | roffbib

Options  roffbib accepts all options understood by nroff(1) except -i and -q.

-e  Produce equally-spaced words in adjusted lines using full terminal resolution.

-h  Use output tabs during horizontal spacing to speed output and reduce output character count. TAB settings are assumed to be every 8 nominal character widths.

-m filename  Prepend the macro file /usr/share/lib/tmac/tmac.name to the input files. There should be a space between the -m and the macro filename. This set of macros will replace the ones defined in /usr/share/lib/tmac/tmac.bib.

-np  Number first generated page p.

-olist  Print only page numbers that appear in the comma-separated list of numbers and ranges. A range N–M means pages N through M; an initial -N means from the beginning to page N; a final N– means from page N to end.

-Q  Queue output for the phototypesetter. Page offset is set to 1 inch.

-raN  Set register a (one-character) to N. The command-line argument -rN1 will number the references starting at 1.

Four command-line registers control formatting style of the bibliography, much like the number registers of ms(5). The flag -rV2 will double space the bibliography, while -rV1 will double space references but single space annotation paragraphs. The line length can be changed from the default 6.5 inches to 6 inches with the -rL6i argument, and the page offset can be set from the default of 0 to one inch by specifying -rO1i (capital O, not zero).

-sN  Halt prior to every N pages for paper loading or changing (default N =1). To resume, enter NEWLINE or RETURN.

-Tterm  Specify term as the terminal type.

-V  Send output to the Versatec. Page offset is set to 1 inch.

-x  If abstracts or comments are entered following the %X field key, roffbib will format them into paragraphs for an annotated bibliography. Several %X fields may be given if several annotation paragraphs are desired.
Files  /usr/share/lib/tmac/tmac.bib file of macros used by nroff/troff

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>text/doctools</td>
</tr>
</tbody>
</table>

See Also  addbib(1), indxbib(1), lookbib(1), nroff(1) refer(1), sortbib(1), troff(1), attributes(5)

Bugs  Users have to rewrite macros to create customized formats.
roles(1)

Nameoles – print roles granted to a user

Synopsisoles [ user ]...

Description
The command roles prints on standard output the roles that you or the optionally-specified user have been granted. Roles are special accounts that correspond to a functional responsibility rather than to an actual person (referred to as a normal user).

Each user may have zero or more roles. Roles have most of the attributes of normal users and are identified like normal users in passwd(4) and shadow(4). Each role must have an entry in the user_attr(4) file that identifies it as a role. Roles can have their own authorizations and profiles. See auths(1) and profiles(1).

Roles are not allowed to log into a system as a primary user. Instead, a user must log in as him— or herself and assume the role. The actions of a role are attributable to the normal user. When auditing is enabled, the audited events of the role contain the audit ID of the original user who assumed the role.

A role may not assume itself or any other role. Roles are not hierarchical. However, rights profiles (see prof_attr(4)) are hierarchical and can be used to achieve the same effect as hierarchical roles.

Role assumption can be performed using su(1M), ssh(1), or some other service that supports the PAM_AUSER variable. Successful assumption requires both role authentication and membership. Role authentication can require either the user’s password or the role’s password, depending on the setting of the roleauth property in the role’s user_attr(4) entry. By default, the role’s password is required. Roles are typically assigned a profile shell. By convention, a profile shell is specified by preceding the standard shell’s name with pf, for example, pf bash. Role assignments are specified in user_attr(4).

Examples

**Example 1** Sample Output

The output of the roles command has the following form:

```
example% roles tester01 tester02 tester01 : admin
tester02 : secadmin, root
example%
```

Exit Status
The following exit values are returned:

<table>
<thead>
<tr>
<th>Exit Status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful completion.</td>
</tr>
<tr>
<td>1</td>
<td>An error occurred.</td>
</tr>
</tbody>
</table>

Files

```
/etc/user_attr

/etc/security/auth_attr

/etc/security/prof_attr
```
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  auths(1), pfexec(1), profiles(1), rlogin(1), ssh(1), su(1M), auth_attr(4), passwd(4), prof_attr(4), shadow(4), user_attr(4), attributes(5)
rpcgen(1)

Name
rpcgen – an RPC protocol compiler

Synopsis
rpcgen infile

rpcgen [-a] [-A] [-b] [-C] [-D name [= value]] [-i size]
    [-Y pathname] infile

rpcgen [-c | -h | -l | -m | -t | -Sc | -Ss | -Sm]
    [-o outfile] [infile]

rpcgen [-s nettype] [-o outfile] [infile]

rpcgen [-n netid] [-o outfile] [infile]

Description
The rpcgen utility is a tool that generates C code to implement an RPC protocol. The input to rpcgen is a language similar to C known as RPC Language (Remote Procedure Call Language).

The rpcgen utility is normally used as in the first synopsis where it takes an input file and generates three output files. If the infile is named proto.x, then rpcgen generates a header in proto.h, XDR routines in proto_xdr.c, server-side stubs in proto_svc.c, and client-side stubs in proto_clnt.c. With the -T option, it also generates the RPC dispatch table in proto_tbl.i.

rpcgen can also generate sample client and server files that can be customized to suit a particular application. The -Sc, -Ss, and -Sm options generate sample client, server, and makefile, respectively. The -a option generates all files, including sample files. If the infile is proto.x, then the client side sample file is written to proto_client.c, the server side sample file to proto_server.c and the sample makefile to makefile.proto.

The server created can be started both by the port monitors (for example, inetd) or by itself. When it is started by a port monitor, it creates servers only for the transport for which the file descriptor 0 was passed. The name of the transport must be specified by setting up the environment variable PM_TRANSPORT. When the server generated by rpcgen is executed, it creates server handles for all the transports specified in the NETPATH environment variable, or if it is unset, it creates server handles for all the visible transports from the /etc/netconfig file. Note: the transports are chosen at run time and not at compile time. When the server is self-started, it backgrounds itself by default. A special define symbol RPC_SVC_FG can be used to run the server process in foreground.

The second synopsis provides special features which allow for the creation of more sophisticated RPC servers. These features include support for user-provided #defines and RPC dispatch tables. The entries in the RPC dispatch table contain:

- pointers to the service routine corresponding to that procedure
- a pointer to the input and output arguments
- the size of these routines
A server can use the dispatch table to check authorization and then to execute the service routine. A client library can use the dispatch table to deal with the details of storage management and XDR data conversion.

The other three synopses shown above are used when one does not want to generate all the output files, but only a particular one. See the EXAMPLES section below for examples of rpcgen usage. When rpcgen is executed with the -s option, it creates servers for that particular class of transports. When executed with the -n option, it creates a server for the transport specified by netid. If infile is not specified, rpcgen accepts the standard input.

All the options mentioned in the second synopsis can be used with the other three synopses, but the changes are made only to the specified output file.

The C preprocessor `cc -E` is run on the input file before it is actually interpreted by rpcgen. For each type of output file, rpcgen defines a special preprocessor symbol for use by the rpcgen programmer:

- `RPC_HDR` defined when compiling into headers
- `RPC_XDR` defined when compiling into XDR routines
- `RPC_SVC` defined when compiling into server-side stubs
- `RPC_CLNT` defined when compiling into client-side stubs
- `RPC_TBL` defined when compiling into RPC dispatch tables

Any line beginning with "%" is passed directly into the output file, uninterpreted by rpcgen, except that the leading "%" is stripped off. To specify the path name of the C preprocessor, use the `-Y` flag.

For every data type referred to in infile, rpcgen assumes that there exists a routine with the string `xdr_` prepended to the name of the data type. If this routine does not exist in the RPC/XDR library, it must be provided. Providing an undefined data type allows customization of XDR routines.

Server Error Reporting

By default, errors detected by `proto_svc.c` is reported to standard error and/or the system log.

This behavior can be overridden by compiling the file with a definition of `RPC_MSGOUT`, for example, `-DRPC_MSGOUT=mymsgfunc`. The function specified is called to report errors. It must conform to the following `printf`-like signature:

```c
extern void RPC_MSGOUT(const char *fmt, ...);
```

Options

The following options are supported:

- `-a` Generates all files, including sample files.
-A Enables the Automatic MT mode in the server main program. In this mode, the RPC library automatically creates threads to service client requests. This option generates multithread-safe stubs by implicitly turning on the -M option. Server multithreading modes and parameters can be set using the `rpc_control(3NSL)` call. Rpcgen generated code does not change the default values for the Automatic MT mode.

-b Backward compatibility mode. Generates transport-specific RPC code for older versions of the operating system.

-c Compiles into XDR routines.

-C Generates header and stub files which can be used with ANSI C compilers. Headers generated with this flag can also be used with C++ programs.

-D `name[=value]` Defines a symbol `name`. Equivalent to the `#define` directive in the source. If no `value` is given, `value` is defined as 1. This option can be specified more than once.

-h Compiles into C data-definitions (a header). The -T option can be used in conjunction to produce a header which supports RPC dispatch tables.

-i `size` Size at which to start generating inline code. This option is useful for optimization. The default `size` is 5.

-I Compiles support for `inetd(1M)` in the server side stubs. Such servers can be self-started or can be started by `inetd`. When the server is self-started, it backgrounds itself by default. A special define symbol `RPC_SVC_FG` can be used to run the server process in foreground, or the user can simply compile without the -I option.

If there are no pending client requests, the `inetd` servers exit after 120 seconds (default). The default can be changed with the -K option. All of the error messages for `inetd` servers are always logged with `syslog(3C).

Note: This option is supported for backward compatibility only. It should always be used in conjunction with the -b option which generates backward compatibility code. By default (that is, when -b is not specified), rpcgen generates servers that can be invoked through portmonitors.

-K `seconds` By default, services created using rpcgen and invoked through portmonitors wait 120 seconds after servicing a request before exiting. That interval can be changed using the -K flag. To create a server that exits immediately upon servicing a request, use -K 0. To create a server that never exits, the appropriate argument is -K -1.
When monitoring for a server, some port monitors, always spawn a new process in response to a service request. If it is known that a server are used with such a monitor, the server should exit immediately on completion. For such servers, rpcgen should be used with -K 0.

-`l` Compiles into client-side stubs.

-`L` When the servers are started in foreground, uses `syslog(3C)` to log the server errors instead of printing them on the standard error.

-`m` Compiles into server-side stubs, but do not generate a "main" routine. This option is useful for doing callback-routines and for users who need to write their own "main" routine to do initialization.

-`M` Generates multithread-safe stubs for passing arguments and results between rpcgen-generated code and user written code. This option is useful for users who want to use threads in their code.

-`N` This option allows procedures to have multiple arguments. It also uses the style of parameter passing that closely resembles C. So, when passing an argument to a remote procedure, you do not have to pass a pointer to the argument, but can pass the argument itself. This behavior is different from the old style of rpcgen-generated code. To maintain backward compatibility, this option is not the default.

-`n netid` Compiles into server-side stubs for the transport specified by `netid`. There should be an entry for `netid` in the `netconfig` database. This option can be specified more than once, so as to compile a server that serves multiple transports.

-`o outfile` Specifies the name of the output file. If none is specified, standard output is used (`-c`, `-h`, `-l`, `-m`, `-n`, `-s`, `-Sc`, `-Sm`, `-Ss`, and `-t` modes only).

-`s nettype` Compiles into server-side stubs for all the transports belonging to the class `nettype`. The supported classes are `netpath`, `visible`, `circuit_n`, `circuit_v`, `datagram_n`, `datagram_v`, `tcp`, and `udp` (see `rpc(3NSL)` for the meanings associated with these classes). This option can be specified more than once. Note: The transports are chosen at run time and not at compile time.

-`Sc` Generates sample client code that uses remote procedure calls.

-`Sm` Generates a sample Makefile which can be used for compiling the application.

-`Ss` Generates sample server code that uses remote procedure calls.

-`t` Compiles into RPC dispatch table.

-`T` Generates the code to support RPC dispatch tables.
The options -c, -h, -l, -m, -s, -Sc, -Sm, -Ss, and -t are used exclusively to generate a particular type of file, while the options -D and -T are global and can be used with the other options.

- v Displays the version number.
- Y pathname Gives the name of the directory where rpcgen starts looking for the C preprocessor.

**Operands**  The following operand is supported:

infile input file

**Examples**

**EXAMPLE 1**  Generating the output files and dispatch table

The following entry

example% rpcgen -T prot.x

generates all the five files: prot.h, prot_clnt.c, prot_svc.c, prot_xdr.c, and prot_tbl.i.

**EXAMPLE 2**  Sending headers to standard output

The following example sends the C data-definitions (header) to the standard output:

example% rpcgen -h prot.x

**EXAMPLE 3**  Sending a test version

To send the test version of the -DTEST, server side stubs for all the transport belonging to the class datagram_n to standard output, use:

example% rpcgen -s datagram_n -DTEST prot.x

**EXAMPLE 4**  Creating server side stubs

To create the server side stubs for the transport indicated by netid tcp, use:

example% rpcgen -n tcp -o prot_svc.c prot.x

**Exit Status**

0  Successful operation.

>0  An error occurred.

**Attributes**  See [attributes(5)] for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/base-developer-utilities</td>
</tr>
</tbody>
</table>
The `rpcgen` chapter in the *ONC+ Developer's Guide* manual.

See Also  `inetd(1M), rpc(3NSL), rpc_control(3NSL), rpc_svc_calls(3NSL), syslog(3C), netconfig(4), attributes(5)`
rpm2cpio – convert Red Hat Package (RPM) to cpio archive

Synopsis  
`rpm2cpio [file.rpm]`

Description  
The `rpm2cpio` utility converts the `.rpm` file specified as its sole argument to a cpio archive on standard output. (See NOTES.) If no argument is given, an rpm stream is read from standard input. In both cases, `rpm2cpio` will fail and print a usage message if the standard output is a terminal. Therefore, the output is usually redirected to a file or piped through the `cpio(1)` utility.

Examples  
**EXAMPLE 1**  Converting an rpm file
```
example% rpm2cpio Device3Dfx-1.1-2.src.rpm | cpio -itv
CPIO archive found!
-rw-r--r-- 1 root root 2635 Sep 13 16:39 1998, 3dfx.gif
-rw-r--r-- 1 root root 11339 Sep 27 16:03 1998, Dev3Dfx.tar.gz
-rw-r--r-- 1 root root 1387 Sep 27 16:04 1998, Device3Dfx-1.1-2.spec
31 blocks
```

**EXAMPLE 2**  Converting from standard input
```
example% rpm2cpio < Device3Dfx-1.1-2.src.rpm | cpio -itv
CPIO archive found!
-rw-r--r-- 1 root root 2635 Sep 13 16:39 1998, 3dfx.gif
-rw-r--r-- 1 root root 11339 Sep 27 16:03 1998, Dev3Dfx.tar.gz
-rw-r--r-- 1 root root 1387 Sep 27 16:04 1998, Device3Dfx-1.1-2.spec
31 blocks
```

Attributes  
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>package/rpm</td>
</tr>
</tbody>
</table>

See Also  
cpio(1), attributes(5)

Notes  
rpm2cpio handles versions 3 and 4 RPMs.
Name  rsh, remsh, remote_shell – remote shell

            [-k realm] hostname command

            [-l username] [-k realm] command

            [-l username] [-k realm] command

            [-l username] [-k realm] command

            [-l username] [-k realm] command

Description  The rsh utility connects to the specified hostname and executes the specified command. rsh copies its standard input to the remote command, the standard output of the remote command to its standard output, and the standard error of the remote command to its standard error. Interrupt, quit, and terminate signals are propagated to the remote command. rsh normally terminates when the remote command does.

The user can opt for a secure session of rsh which uses Kerberos V5 for authentication. Encryption of the network session traffic is also possible. The rsh session can be kerberized using any of the following Kerberos specific options: -a, -PN or -PO, -x, -f or -F, and -k realm. Some of these options (-a, -x, -PN or -PO, and -f or -F) can also be specified in the [appdefaults] section of krb5.conf(4). The usage of these options and the expected behavior is discussed in the OPTIONS section below. If Kerberos authentication is used, authorization to the account is controlled by rules in krb5_auth_rules(5). If this authorization fails, fallback to normal rsh using rhosts occurs only if the -PO option is used explicitly on the command line or is specified in krb5.conf(4). Also, the -PN or -PO, -x, -f or -F, and -k realm options are just supersets of the -a option.

If you omit command, instead of executing a single command, rsh logs you in on the remote host using rlogin(1).

rsh does not return the exit status code of command.

Shell metacharacters which are not quoted are interpreted on the local machine, while quoted metacharacters are interpreted on the remote machine. See EXAMPLES.

If there is no locale setting in the initialization file of the login shell (.cshrc, ...) for a particular user, rsh always executes the command in the “C” locale instead of using the default locale of the remote machine.

The command is sent unencrypted to the remote system. All subsequent network session traffic is encrypted. See -x.
Options

The following options are supported:

- **a**  
  Explicitly enable Kerberos authentication and trusts the .k5login file for access-control. If the authorization check by `in.rshd(1M)` on the server-side succeeds and if the .k5login file permits access, the user is allowed to carry out the command.

- **f**  
  Forward a copy of the local credentials (Kerberos Ticket Granting Ticket) to the remote system. This is a non-forwardable ticket granting ticket. Forward a ticket granting ticket if you need to authenticate yourself to other Kerberized network services on the remote host. An example would be if your home directory on the remote host is NFS mounted by way of Kerberos V5. If your local credentials are not forwarded in this case, you cannot access your home directory. This option is mutually exclusive with the -F option.

- **F**  
  Forward a forwardable copy of the local credentials (Kerberos Ticket Granting Ticket) to the remote system. The -F option provides a superset of the functionality offered by the -f option. For example, with the -f option, if, after you connected to the remote host, your remote command attempted to invoke `/usr/bin/ftp`, `/usr/bin/telnet`, `/usr/bin/rlogin`, or `/usr/bin/rsh`, with the -f or -F options, the attempt would fail. Thus, you would be unable to push your single network sign on trust beyond one system. This option is mutually exclusive with the -f option.

- **k realm**  
  Causes `rsh` to obtain tickets for the remote host in `realm` instead of the remote host's realm as determined by `krb5.conf(4)`.

- **K**  
  This option explicitly disables Kerberos authentication. It can be used to override the autologin variable in `krb5.conf(4)`.

- **l username**  
  Uses `username` as the remote username instead of your local username. In the absence of this option, the remote username is the same as your local username.

- **n**  
  Redirect the input of `rsh` to `/dev/null`. You sometimes need this option to avoid unfortunate interactions between `rsh` and the shell which invokes it. For example, if you are running `rsh` and invoke a `rsh` in the background without redirecting its input away from the terminal, it blocks even if no reads are posted by the remote command. The -n option prevents this.

- **PO**  
  Explicitly request new (-PN) or old (-PO) version of the Kerberos “rcmd” protocol. The new protocol avoids many security problems prevalent in the old one and is regarded much more secure, but is not interoperable with older (MIT/SEAM) servers. The new protocol is used by default, unless explicitly specified using these options or through `krb5.conf(4)`. If Kerberos
authorization fails when using the old "rcmd" protocol, there is fallback to regular, non-kerberized rsh. This is not the case when the new, more secure "rcmd" protocol is used.

- x   Cause the network session traffic to be encrypted. See DESCRIPTION.

The type of remote shell (sh, rsh, or other) is determined by the user's entry in the file /etc/passwd on the remote system.

Operands

The following operand is supported:

command   The command to be executed on the specified hostname.

Usage

See largefile(5) for the description of the behavior of rsh and remsh when encountering files greater than or equal to 2 Gbyte (2^31 bytes).

The rsh and remsh commands are IPv6-enabled. See ip6(7P). IPv6 is not currently supported with Kerberos V5 authentication.

Hostnames are given in the hosts database, which can be contained in the /etc/hosts file, the Internet domain name database, or both. Each host has one official name (the first name in the database entry) and optionally one or more nicknames. Official hostnames or nicknames can be given as hostname.

If the name of the file from which rsh is executed is anything other than rsh, rsh takes this name as its hostname argument. This allows you to create a symbolic link to rsh in the name of a host which, when executed, invokes a remote shell on that host. By creating a directory and populating it with symbolic links in the names of commonly used hosts, then including the directory in your shell's search path, you can run rsh by typing hostname to your shell.

If rsh is invoked with the basename remsh, rsh checks for the existence of the file /usr/bin/remsh. If this file exists, rsh behaves as if remsh is an alias for rsh. If /usr/bin/remsh does not exist, rsh behaves as if remsh is a host name.

For the kerberized rsh session, each user can have a private authorization list in a file .k5login in their home directory. Each line in this file should contain a Kerberos principal name of the form principal/instance@realm. If there is a ~/.k5login file, then access is granted to the account if and only if the originater user is authenticated to one of the principals named in the ~/.k5login file. Otherwise, the originating user is granted access to the account if and only if the authenticated principal name of the user can be mapped to the local account name using the authenticated-principal-name → local-user-name mapping rules. The .k5login file (for access control) comes into play only when Kerberos authentication is being done.

For the non-secure rsh session, each remote machine can have a file named /etc/hosts.equiv containing a list of trusted hostnames with which it shares usernames. Users with the same username on both the local and remote machine can run rsh from the machines listed in the remote machine's /etc/hosts.equiv file. Individual users can set up a
similar private equivalence list with the file .rhosts in their home directories. Each line in this file contains two names: a hostname and a username separated by a space. The entry permits the user named username who is logged into hostname to use rsh to access the remote machine as the remote user. If the name of the local host is not found in the /etc/hosts.equiv file on the remote machine, and the local username and hostname are not found in the remote user's .rhosts file, then the access is denied. The hostnames listed in the /etc/hosts.equiv and .rhosts files must be the official hostnames listed in the hosts database; nicknames cannot be used in either of these files.

You cannot log in using rsh as a trusted user from a trusted hostname if the trusted user account is locked.

rsh does not prompt for a password if access is denied on the remote machine unless the command argument is omitted.

**Examples**

**EXAMPLE 1** Using rsh to Append Files

The following command appends the remote file lizard.file from the machine called lizard to the file called example.file on the machine called example:

```
example% rsh lizard cat lizard.file >> example.file
```

The following command appends the file lizard.file on the machine called lizard to the file lizard.file2 which also resides on the machine called lizard:

```
example% rsh lizard cat lizard.file ">>" lizard.file2
```

**Exit Status**

The following exit values are returned:

- **0** Successful completion.
- **1** An error occurred.

**Files**

<table>
<thead>
<tr>
<th>File</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>/etc/hosts</td>
<td>Internet host table</td>
</tr>
<tr>
<td>/etc/hosts.equiv</td>
<td>Trusted remote hosts and users</td>
</tr>
<tr>
<td>/etc/passwd</td>
<td>System password file</td>
</tr>
<tr>
<td>$HOME/.k5login</td>
<td>File containing Kerberos principals that are allowed access</td>
</tr>
<tr>
<td>/etc/krb5/krb5.conf</td>
<td>Kerberos configuration file</td>
</tr>
</tbody>
</table>

**Attributes**

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/network-clients</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
</tbody>
</table>
When a system is listed in hosts.equiv, its security must be as good as local security. One insecure system listed in hosts.equiv can compromise the security of the entire system.

You cannot run an interactive command (such as vi(1)). Use rlogin if you wish to do this.

Stop signals stop the local rsh process only. This is arguably wrong, but currently hard to fix for reasons too complicated to explain here.

The current local environment is not passed to the remote shell.

Sometimes the -n option is needed for reasons that are less than obvious. For example, the command:

```
example% rsh somehost dd if=/dev/nrmt0 bs=20b | tar xvpBf -
```

puts your shell into a strange state. Evidently, the tar process terminates before the rsh process. The rsh command then tries to write into the “broken pipe” and, instead of terminating neatly, proceeds to compete with your shell for its standard input. Invoking rsh with the -n option avoids such incidents.

This bug occurs only when rsh is at the beginning of a pipeline and is not reading standard input. Do not use the -n option if rsh actually needs to read standard input. For example:

```
example% tar cf - . | rsh sundial dd of=/dev/rmt0 obs=20b
```

does not produce the bug. If you were to use the -n option in a case like this, rsh would incorrectly read from /dev/null instead of from the pipe.

For most purposes, ssh(1) is preferred over rsh.
The runat utility is used to execute shell commands in a file's hidden attribute directory. Effectively, this utility changes the current working directory to be the hidden attribute directory associated with the file argument and then executes the specified command in the bourne shell (/bin/sh). If no command argument is provided, an interactive shell is spawned. The environment variable $SHELL defines the shell to be spawned. If this variable is undefined, the default shell, /bin/sh, is used.

The file argument can be any file, including a directory, that can support extended attributes. It is not necessary that this file have any attributes, or be prepared in any way, before invoking the runat command.

Operands
The following operands are supported:

file Any file, including a directory, that can support extended attributes.

command The command to be executed in an attribute directory.

Errors A non-zero exit status will be returned if runat cannot access the file argument, or the file argument does not support extended attributes.

Usage See fsattr(5) for a detailed description of extended file attributes.

The process context created by the runat command has its current working directory set to the hidden directory containing the file's extended attributes. The parent of this directory (the ".." entry) always refers to the file provided on the command line. As such, it may not be a directory. Therefore, commands (such as pwd) that depend upon the parent entry being well-formed (that is, referring to a directory) may fail.

In the absence of the command argument, runat will spawn a new interactive shell with its current working directory set to be the provided file's hidden attribute directory. Notice that some shells (such as zsh and tcsh) are not well behaved when the directory parent is not a directory, as described above. These shells should not be used with runat.

Examples

EXAMPLE 1 Using runat to list extended attributes on a file

dir% runat file.1 ls -l

EXAMPLE 2 Creating extended attributes

dir% runat file.2 cp /tmp/attrdata attr.1

dir% runat file.2 cat /tmp/attrdata > attr.1

EXAMPLE 3 Copying an attribute from one file to another

dir% runat file.2 cat attr.1 | runat file.1 "cat > attr.1"
EXAMPLE 4  Using runat to spawn an interactive shell

example% runat file.3 /bin/sh

This spawns a new shell in the attribute directory for file.3. Notice that the shell will not be able to determine what your current directory is. To leave the attribute directory, either exit the spawned shell or change directory (cd) using an absolute path.

Recommended methods for performing basic attribute operations:

- **display**
  - runat file ls [options]

- **read**
  - runat file cat attribute

- **create/modify**
  - runat file cp absolute-file-path attribute

- **delete**
  - runat file rm attribute

- **permission changes**
  - runat file chmod mode attribute
  - runat file chgrp group attribute
  - runat file chown owner attribute

- **interactive shell**
  - runat file /bin/sh
  - or set your $SHELL to /bin/sh and
  - runat file

The above list includes commands that are known to work with runat. While many other commands may work, there is no guarantee that any beyond this list will work. Any command that relies on being able to determine its current working directory is likely to fail. Examples of such commands follow:

EXAMPLE 5  Using man in an attribute directory

example% runat file.1 man runat
>getcwd: Not a directory

EXAMPLE 6  Spawning a tcsh shell in an attribute directory

example% runat file.3 /usr/bin/tcsh
tcsh: Not a directory
tcsh: Trying to start from "/home/user"

A new tcsh shell has been spawned with the current working directory set to the user's home directory.
EXAMPLE 7  Spawning a zsh shell in an attribute directory
example% runat file.3 /usr/bin/zsh
example% 
While the command appears to have worked, zsh has actually just changed the current
working directory to '/'. This can be seen by using /bin/pwd:
example% /bin/pwd
/

Environment Variables
SHELL  Specifies the command shell to be invoked by runat.

Exit Status
The following exit values are returned:

125  The attribute directory of the file referenced by the file argument cannot be accessed.
126  The exec of the provided command argument failed.

Otherwise, the exit status returned is the exit status of the shell invoked to execute the
provided command.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  open(2), attributes(5), fsattr(5)

Notes  It is not always obvious why a command fails in runat when it is unable to determine the
current working directory. The errors resulting can be confusing and ambiguous (see the tcsh
and zsh examples above).
rup(1)

Name  rup – show host status of remote machines (RPC version)

Synopsis  rup [-hlt]
          rup [host]...

Description  rup gives a status similar to uptime for remote machines. It broadcasts on the local network, and displays the responses it receives.

Normally, the listing is in the order that responses are received, but this order can be changed by specifying one of the options listed below.

When host arguments are given, rather than broadcasting rup will only query the list of specified hosts.

A remote host will only respond if it is running the rstatd daemon, which is normally started up from inetd(1M).

In the absence of a name service, such as LDAP or NIS, rup displays host names as numeric IP addresses.

Options  -h  Sort the display alphabetically by host name.
          -l  Sort the display by load average.
          -t  Sort the display by up time.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/network-clients</td>
</tr>
</tbody>
</table>

See Also  runtime(1), inetd(1M), attributes(5)

Installing Oracle Solaris 11.1 Systems

Bugs  Broadcasting does not work through gateways.
Name  rup – show host status of remote machines (RPC version)

Synopsis  rup [-hlt]
          rup [host]...

Description  rup gives a status similar to uptime for remote machines. It broadcasts on the local network, and displays the responses it receives.

Normally, the listing is in the order that responses are received, but this order can be changed by specifying one of the options listed below.

When host arguments are given, rather than broadcasting rup only queries the list of specified hosts.

A remote host will only respond if it is running the rstatd daemon, which is normally started up from inetd(1M).

Options  -h  Sort the display alphabetically by host name.
         -l  Sort the display by load average.
         -t  Sort the display by up time.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/extended-system-utilities</td>
</tr>
</tbody>
</table>

See Also  runtime(1), inetd(1M), attributes(5)

Bugs  Broadcasting does not work through gateways.
Name: runtime – show host status of local machines

Synopsis: runtime [-ar] [-l | -t | -u]

Description: The `runtime` utility gives a status line like `uptime` (see `uptime(1)`) for each machine on the local network; these are formed from packets broadcast by each host on the network approximately every three minutes.

Machines for which no status report has been received for 11 minutes are shown as being down.

Normally, the listing is sorted by hostname, but this order can be changed by specifying one of the options listed below.

Options: The following options are supported:

- `-a` Counts even those users who have been idle for an hour or more.
- `-r` Reverses the sorting order.
- `-l | -t | -u` These options are mutually exclusive. The use of one overrides the previous one(s).
  - `-l` Sorts the display by load average.
  - `-t` Sorts the display by up time.
  - `-u` Sorts the display by number of users.

Files: `/var/spool/rwho/*` data files

Attributes: See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/network-clients</td>
</tr>
</tbody>
</table>

See Also: `uptime(1), rwho(1), in.rwhod(1M), attributes(5)`
Name
rusage – print resource usage for a command

Synopsis
/usr/ucb/rusage command

Description
The rusage command is similar to time(1). It runs the given command, which must be specified; that is, command is not optional as it is in the C shell’s timing facility. When the command is complete, rusage displays the real (wall clock), the system CPU, and the user CPU times which elapsed during execution of the command, plus other fields in the rusage structure, all on one long line. Times are reported in seconds and hundredths of a second.

Examples

EXAMPLE 1
The format of rusage output

The example below shows the format of rusage output.

eexample% rusage wc /usr/share/man/man1/csh (1)
3045 13423 78071 /usr/share/man/man1/csh (1)
2.26 real 0.80 user 0.36 sys 11 pf 30 pr 0 sw 11 rb 0 wb 16 vcx 37
ixc 24 mx 0 ix 1230 id 9 is
eexample%

Each of the fields identified corresponds to an element of the rusage structure, as described in getrusage(3C), as follows:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>real</td>
<td>elapsed real time</td>
</tr>
<tr>
<td>user</td>
<td>ru_utime user time used</td>
</tr>
<tr>
<td>sys</td>
<td>ru_stime system time used</td>
</tr>
<tr>
<td>pf</td>
<td>ru_majflt page faults requiring physical I/O</td>
</tr>
<tr>
<td>pr</td>
<td>ru_minflt page faults not requiring physical I/O</td>
</tr>
<tr>
<td>sw</td>
<td>ru_majflt page faults not requiring physical I/O</td>
</tr>
<tr>
<td>rb</td>
<td>ru_inblock block input operations</td>
</tr>
<tr>
<td>wb</td>
<td>ru_outblock block output operations</td>
</tr>
<tr>
<td>vcx</td>
<td>ru_nvcs S voluntary context switches</td>
</tr>
<tr>
<td>icx</td>
<td>ru_nivcsw involuntary context switches</td>
</tr>
<tr>
<td>mx</td>
<td>ru_maxrss maximum resident set size</td>
</tr>
<tr>
<td>ix</td>
<td>ru_ixrss currently 0</td>
</tr>
<tr>
<td>id</td>
<td>ru_idrss integral resident set size</td>
</tr>
<tr>
<td>is</td>
<td>ru_isrss currently 0</td>
</tr>
</tbody>
</table>
Attributes  See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>

See Also  `csh(1), time(1), getusage(3C), attributes(5)`

Bugs  When the command being timed is interrupted, the timing values displayed may be inaccurate.
Name  rusers – who is logged in on remote machines

Synopsis  rusers [-ahlu] host...

Description  The rusers command produces output similar to who(1), but for remote machines. The listing is in the order that responses are received, but this order can be changed by specifying one of the options listed below.

The default is to print out the names of the users logged in. When the -l flag is given, additional information is printed for each user:

user_id hostname:terminal login_date login_time idle_time login_host

If hostname and login_host are the same value, the login_host field is not displayed. Likewise, if hostname is not idle, the idle_time is not displayed.

A remote host will only respond if it is running the rusersd daemon, which may be started up from inetd(1M).

In the absence of a name service, such as LDAP or NIS, rusers displays host names as numeric IP addresses.

Options  
- a  Give a report for a machine even if no users are logged on.
- h  Sort alphabetically by host name.
- i  Sort by idle time.
- l  Give a longer listing in the style of who(1).
- u  Sort by number of users.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/network-clients</td>
</tr>
</tbody>
</table>

See Also  who(1), inetd(1M), attributes(5)
**rwho(1)**

### Name
rwho – who is logged in on local machines

### Synopsis
rwho [-a]

### Description
The `rwho` command produces output similar to `who(1)`, but for all machines on your network. If no report has been received from a machine for 5 minutes, `rwho` assumes the machine is down, and does not report users last known to be logged into that machine.

If a user has not typed to the system for a minute or more, `rwho` reports this idle time. If a user has not typed to the system for an hour or more, the user is omitted from the output of `rwho` unless the `-a` flag is given.

### Options
- `-a` Report all users whether or not they have typed to the system in the past hour.

### Files
`/var/spool/rwho/whod.*` information about other machines

### Attributes
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability network</td>
<td>service/network/network-servers</td>
</tr>
</tbody>
</table>

### See Also
`finger(1), ruptime(1), who(1), in.rwhod(1M), attributes(5)`

### Notes
`rwho` does not work through gateways.

The directory `/var/spool/rwho` must exist on the host from which `rwho` is run.

This service takes up progressively more network bandwith as the number of hosts on the local net increases. For large networks, the cost becomes prohibitive.

The `rwho` service daemon, `in.rwhod(1M)`, must be enabled for this command to return useful results.
**Name**
sar – system activity reporter

**Synopsis**
sar [-aAbcdgkmpqruvwy] [-o filename] t [n]
sar [-aAbcdgkmpqruvwy] [-e time] [-f filename] [-i sec]
     [-s time]

**Description**
In the first instance, the `sar` utility samples cumulative activity counters in the operating system at `n` intervals of `t` seconds, where `t` should be 5 or greater. If `t` is specified with more than one option, all headers are printed together and the output can be difficult to read. (If the sampling interval is less than 5, the activity of `sar` itself can affect the sample.) If the -o option is specified, it saves the samples in `filename` in binary format. The default value of `n` is 1.

In the second instance, no sampling interval is specified. `sar` extracts data from a previously recorded `filename`, either the one specified by the -f option or, by default, the standard system activity daily data file `/var/adm/sa/sadd` for the current day `dd`. The starting and ending times of the report can be bounded using the -e and -s arguments with `time` specified in the form `hh:mm:ss`. The -i option selects records at `sec` second intervals. Otherwise, all intervals found in the data file are reported.

**Options**
The following options modify the subsets of information reported by `sar`.

- `-a` Reports use of file access system routines: `iget/s`, `namei/s`, `dirblk/s`
- `-A` Reports all data. Equivalent to `-abcdgkmpqruvwy`.
- `-b` Reports buffer activity:
  - `bread/s`, `bwr/s` transfers per second of data between system buffers and disk or other block devices.
  - `lread/s`, `lwrit/s` accesses of system buffers.
  - `%rcache`, `%wcach` cache hit ratios, that is, (1 – `bread/lread`) as a percentage.
- `-c` Reports system calls:
  - `scall/s` system calls of all types.
  - `sread/s`, `swrit/s`, `fork/s`, `exec/s` specific system calls.
  - `rchar/s`, `wchar/s` characters transferred by read and write system calls. No incoming or outgoing `exec(2)` and `fork(2)` calls are reported.

If run in a non-global zone and the pools facility is active, these values reflect activity on the processors of the processor set of the pool to which the zone is bound.
If run in a non-global zone and the pools facility is active, these values reflect activity on the processors of the processor set of the pool to which the zone is bound.

-d
Reports activity for each block device (for example, disk or tape drive) with the exception of XDC disks and tape drives. When data is displayed, the device specification _dsk- is generally used to represent a disk drive. The device specification used to represent a tape drive is machine dependent. The activity data reported is:

%busy, avque portion of time device was busy servicing a transfer request, average number of requests outstanding during that time.
read/s, write/s, blks/s number of read/write transfers from or to device, number of bytes transferred in 512-byte units.
avwait average wait time in milliseconds.
avserv average service time in milliseconds.

For more general system statistics, use _iostat(1M), sar(1M), or vmstat(1M).


-e time Selects data up to _time. Default is 18:00.

-f filename Uses _filename as the data source for sar. Default is the current daily data file _/var/adm/sa/sadd_.

-g
Reports paging activities:
pgout/s page-out requests per second.
ppgout/s pages paged-out per second.
pgfree/s pages per second placed on the free list by the page stealing daemon.
pgscan/s pages per second scanned by the page stealing daemon.
%ufs_ipf the percentage of UFS inodes taken off the freelist by iget which had reusable pages associated with them. These pages are flushed and cannot be reclaimed by processes. Thus, this is the percentage of igets with page flushes.

If run in a non-global zone and the pools facility is active, these values reflect activity on the processors of the processor set of the pool to which the zone is bound.
-i sec  Selects data at intervals as close as possible to sec seconds.
-k    Reports kernel memory allocation (KMA) activities:
      sml_mem, alloc, fail  information about the memory pool reserving and
                           allocating space for small requests: the amount of
                           memory in bytes KMA has for the small pool, the
                           number of bytes allocated to satisfy requests for small
                           amounts of memory, and the number of requests for
                           small amounts of memory that were not satisfied
                           (failed).
      lg_mem, alloc, fail   information for the large memory pool (analogous to
                           the information for the small memory pool).
      ovsz Alloc, fail     the amount of memory allocated for oversize
                           requests and the number of oversize requests which
                           could not be satisfied (because oversized memory is
                           allocated dynamically, there is not a pool).
-m    Reports message and semaphore activities:
      msg/s, sema/s      primitives per second.

      If run in a non-global zone and the pools facility is active, these values reflect
      activity on the processors of the processor set of the pool to which the zone is
      bound.
-o filename Saves samples in file, filename, in binary format.
-p    Reports paging activities:
      atch/s      page faults per second that are satisfied by reclaiming a page
                   currently in memory (attaches per second).
      pgin/s      page-in requests per second.
      ppgin/s     pages paged-in per second.
      pflt/s      page faults from protection errors per second (illegal access to
                   page) or "copy-on-writes".
      vflt/s      address translation page faults per second (valid page not in
                   memory).
      slock/s     faults per second caused by software lock requests requiring
                   physical I/O.

      If run in a non-global zone and the pools facility is active, these values reflect
      activity on the processors of the processor set of the pool to which the zone is
      bound.
- q  Reports average queue length while occupied, and percent of time occupied:
  runq-sz, %runocc  Run queue of kernel threads in memory and runnable
  swpq-sz, %swpocc  Swap queue of processes

- r  Reports unused memory pages and disk blocks:
  freemem  average pages available to user processes.
  freeswap  disk blocks available for page swapping.

- s time  Selects data later than time in the form hh[:mm]. Default is 08:00.

- u  Reports CPU utilization (the default):
  %usr, %sys, %wio, %idle  portion of time running in user mode, running
  in system mode, idle with some process waiting
  for block I/O, and otherwise idle.

  If run in a non-global zone and the pools facility is active, these values reflect
  activity on the processors of the processor set of the pool to which the zone is
  bound.

- v  Reports status of process, i-node, file tables:
  proc-sz, inod-sz, file-sz, lock-sz  entries/size for each table, evaluated once
  at sampling point.
  ov  overflows that occur between sampling
  points for each table.

- w  Reports system swapping and switching activity:
  swpin/s, swpot/s, bswin/s, bswot/s  number of transfers and number of
  512-byte units transferred for swapins
  and swapouts (including initial loading
  of some programs).
  pswch/s  process switches.

  If run in a non-global zone and the pools facility is active, these values reflect
  activity on the processors of the processor set of the pool to which the zone is
  bound.

- y  Reports TTY device activity:
  rawch/s, canch/s, outch/s  input character rate, input character rate
  processed by canon, output character rate.
  rcvin/s, xmtin/s, madmin/s  receive, transmit and modem interrupt rates.
If run in a non-global zone and the pools facility is active, these values reflect activity on the processors of the processor set of the pool to which the zone is bound.

**Examples**

**EXAMPLE 1** Viewing System Activity

The following example displays today’s CPU activity so far:

```
example% sar
```

**EXAMPLE 2** Watching System Activity Evolve

To watch CPU activity evolve for 10 minutes and save data:

```
example% sar -o temp 60 10
```

**EXAMPLE 3** Reviewing Disk and Tape Activity

To later review disk and tape activity from that period:

```
example% sar -d -f temp
```

**Files**  `/var/adm/sa/sadd` daily data file, where `dd` are digits representing the day of the month

**Attributes** See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/accounting/legacy-accounting</td>
</tr>
</tbody>
</table>

**See Also** `iostat(1M), sar(1M), vmstat(1M), exec(2), fork(2), attributes(5)`

*Oracle Solaris Administration: Common Tasks*

**Notes** The sum of CPU utilization might vary slightly from 100 because of rounding errors in the production of a percentage figure.
sccs – front end for the Source Code Control System (SCCS)

/home/sccs [-r] [-d rootprefix] [-p subdir] subcommand [option]... [file]...

/home/xpg4/bin/sccs [-r] [-d rootprefix] [-p subdir] subcommand [option]... [file]...

The sccs command is a comprehensive, straightforward front end to the various utility programs of the Source Code Control System (SCCS).

sccs applies the indicated *subcommand* to the history file associated with each of the indicated files.

The name of an SCCS history file is derived by prepending the ‘s.’ prefix to the filename of a working copy. The sccs command normally expects these ‘s. files’ to reside in an SCCS subdirectory. Thus, when you supply sccs with a *file* argument, it normally applies the subcommand to a file named *s.*file in the SCCS subdirectory. If *file* is a path name, sccs looks for the history file in the SCCS subdirectory of that file’s parent directory. If *file* is a directory, however, sccs applies the subcommand to every *s.*file file it contains. Thus, the command:

```
example% sccs get program.c
```

would apply the get subcommand to a history file named SCCS/s.program.c, while the command:

```
example% sccs get SCCS
```

would apply it to every *s.*file in the SCCS subdirectory.

Options for the sccs command itself must appear before the *subcommand* argument. Options for a given subcommand must appear after the *subcommand* argument. These options are specific to each subcommand, and are described along with the subcommands themselves (see Subcommands below).

Running Setuid

The sccs command also includes the capability to run "setuid" to provide additional protection. However, this does not apply to subcommands such as sccs-admin(1), since this would allow anyone to change the authorizations of the history file. Commands that would do so always run as the real user.

Options

The following options are supported:

```
/usr/bin/sccs      -d rootprefix
/usr/xpg4/bin/sccs -d rootprefix
```

Defines the root portion of the path name for SCCS history files. The default root portion is the current directory. *rootprefix* is prepended to the entire *file* argument, even if *file* is an absolute path name. -d overrides any directory specified by the PROJECTDIR environment variable (see ENVIRONMENT VARIABLES below).

```
/usr/bin/sccs      -p subdir
```

Options for the sccs command itself must appear before the *subcommand* argument. Options for a given subcommand must appear after the *subcommand* argument. These options are specific to each subcommand, and are described along with the subcommands themselves (see Subcommands below).
Definesthe(sub)directorywithinwhichahistoryfileisexpectedtoreside. SCCSisthe
default.(SeeEXAMPLESbelow).

- r  Runs sccswiththerealuserID,ratherthansetototheeffectiveuserID.

**Operands**  Thefollowingoperandsaresupported:

*file*  
afilepassedtосомmand

*option*  
anoptionornoption-argumentpassedtосомmand

*сомmand*  
oneofthesомmandslistedin**Usage**

**Usage**  Theusageforsccsisdescribedbelow.

**Subcommands**  Manyofthefollowingsccssомmandsinvokesprogramsthatresidein/usr/bin. Manyof
theseомmandsacceptadditionalargumentsthataredocumentedintherferencepageforthеutilityprogramtheомmandinvokes.

*сомmand*  
ModifytheflagsorchecksumofanSCCShistoryfile.Referto*sccs-admin(1)*formore
informationabouttheсомmandutility. Whileсомmandcanbeusedtoinitializeahistoryfile,you
mightfindthatthecreateомmandissimplertouseforthispurpose.

```
/usr/bin/sccs  cdc -rsid [ -y[comment] ]
```

```
/usr/xpg4/bin/sccs  cdc -rsid [ -y[comment] ]
```

Annotate(change)thedeltacommentary.Refertosccscdc(1). Thefixомmandcan
beusedtoreplacethedelta,ratherthanmerelyannotatingtheexistingcommentary.

```
- y"[comment]"
```

SpecifytheSCCSSCDSdeltaID(SID)towhichthechangenotationistobeadded. TheSID
foragivendeltaisanumber,indeweydecimalformat,composedoftwoorfouroffields:
therelesealandlevelfields,andalforbranchdeltas,branchandsequencefields.Force
instance,thesIDfortheinitialdeltaisnormally1.1.

```
- y"[comment]"
```

Specifythecommentwithwhichtoannotatethedeltacommentary. If- yisomitted,
sccsreleasesformacomment.Anullcommentresultsinanemptyannotation.
check [-b] [-u [username]] [-U]
Check for files currently being edited. Like info and tell, but returns an exit code, rather
 than producing a listing of files. check returns a non-zero exit status if anything is being
 edited.
   -b
   Ignore branches.
   -u [username] | -u [username] | -U
   Check only files being edited by you. When username is specified, check only files being
   edited by that user. For /usr/xpg4/bin/sccs, the -U option is equivalent to -u <current_user>.

clean [-b]
Remove everything in the current directory that can be retrieved from an SCCS history.
Does not remove files that are being edited.
   -b
   Do not check branches to see if they are being edited. 'clean -b' is dangerous when
   branch versions are kept in the same directory.

comb
Generate scripts to combine deltas. Refer to sccs-comb(1).

create
Create (initialize) history files. create performs the following steps:
   ■ Renames the original source file to , program.c in the current directory.
   ■ Create the history file called s.program.c in the SCCS subdirectory.
   ■ Performs an 'sccs get' on program.c to retrieve a read-only copy of the initial version.

deledit [-s] [-y [comment]]
Equivalent to an 'sccs delta' and then an 'sccs edit'. deledit checks in a delta, and
checks the file back out again, but leaves the current working copy of the file intact.
   -s
   Silent. Do not report delta numbers or statistics.
   -y [comment]
   Supply a comment for the delta commentary. If -y is omitted, delta prompts for a comment. A null comment results in an empty comment field for the delta.

delget [-s] [-y [comment]]
Perform an 'sccs delta' and then an 'sccs get' to check in a delta and retrieve read-only
copies of the resulting new version. See the deledit subcommand for a description of -s
and -y. sccs performs a delta on all the files specified in the argument list, and then a get
on all the files. If an error occurs during the delta, the get is not performed.

delta [-s] [-y [comment]]
Check in pending changes. Records the line-by-line changes introduced while the file was
checked out. The effective user ID must be the same as the ID of the person who has the file
checked out. Refer to sccs-delta(1). See the deledit subcommand for a description of -s
and -y.

```
/usr/bin/sccs  diffs [-C] [-I] [-c date-time] [-r sid] diff-options
```

Compare (in `diff(1)` format) the working copy of a file that is checked out for editing, with a version from the SCCS history. Use the most recent checked-in version by default. The `diffs` subcommand accepts the same options as `diff`.

Any -r, -c, -i, -x, and -t options are passed to subcommand `get`. A -C option is passed to `diff` as -c. An -I option is passed to `diff` as -i.

```
-c date-time | -c date-time
```

Use the most recent version checked in before the indicated date and time for comparison. `date-time` takes the form: `yy[mm][dd][ hh][mm][ss] ] ] ]. Omitted units default to their maximum possible values; that is -c7502 is equivalent to -c750228235959.

```
-r sid | -rsid
```

Use the version corresponding to the indicated delta for comparison.

### edit

Retrieve a version of the file for editing. `sccs edit` extracts a version of the file that is writable by you, and creates a `.file in the SCCS subdirectory as lock on the history, so that no one else can check that version in or out. ID keywords are retrieved in unexpanded form. edit accepts the same options as get, below. Refer to `sccs-get(1)` for a list of ID keywords and their definitions.

### enter

Similar to create, but omits the final 'sccs get'. This can be used if an 'sccs edit' is to be performed immediately after the history file is initialized.

```
/usr/bin/sccs  fix -rsid
/usr/xpg4/bin/sccs  fix -r sid | -rsid
```

Revise a (leaf) delta. Remove the indicated delta from the SCCS history, but leave a working copy of the current version in the directory. This is useful for incorporating trivial updates for which no audit record is needed, or for revising the delta commentary. fix must be followed by a -r option, to specify the SID of the delta to remove. The indicated delta must be the most recent (leaf) delta in its branch. Use fix with caution since it does not leave an audit trail of differences (although the previous commentary is retained within the history file).

```
/usr/bin/sccs  get [-ekmps] [-Gnewname] [-c date-time] [-r[sid] ]
```
get [-ekmps] [-G newname | -G newname]
    [-c date-time | -c date-time] [-r sid | -rsid]
Retrieve a version from the SCCS history. By default, this is a read-only working copy of the most recent version. ID keywords are in expanded form. Refer to sccs-get(1), which includes a list of ID keywords and their definitions.

- c date-time | -c date-time
Retrieve the latest version checked in prior to the date and time indicated by the date-time argument. date-time takes the form: yy[mm][dd][hh][mm][ss] | ] ] ].

-e
Retrieve a version for editing. Same as sccs edit.

-G newname | -G newname
Use newname as the name of the retrieved version.

-k
Retrieve a writable copy but do not check out the file. ID keywords are unexpanded.

-m
Precede each line with the SID of the delta in which it was added.

-p
Produce the retrieved version on the standard output. Reports that would normally go to the standard output (delta IDs and statistics) are directed to the standard error.

-r sid | -rsid
Retrieve the version corresponding to the indicated SID. For /usr/bin/sccs, if no sid is specified, the latest sid for the specified file is retrieved.

-s
Silent. Do not report version numbers or statistics.

/sccs-help message-code/sccs-command
/sccs-help stuck
Supply more information about SCCS diagnostics. sccs-help displays a brief explanation of the error when you supply the code displayed by an SCCS diagnostic message. If you supply the name of an SCCS command, it prints a usage line. sccs-help also recognizes the keyword stuck. Refer to sccs-help(1).

info [-b] [-u [username]]
Display a list of files being edited, including the version number checked out, the version to be checked in, the name of the user who holds the lock, and the date and time the file was checked out.

-b
Ignore branches.
-u[username] | -u [username] | -U
List only files checked out by you. When username is specified, list only files checked out by that user. For /usr/xpg4/bin/sccs, the -U option is equivalent to -u <current_user>.

print
Print the entire history of each named file. Equivalent to an ‘sccs prs -e’ followed by an ‘sccs get -p -m’.

/usr/bin/sccs prs [-el] [-c date-time] [-rsid]
/usr/xpg4/bin/sccs prs [-el] [-c date-time] [-c date-time] [-r sid] [-rsid]
Peruse (display) the delta table, or other portion of an s. file. Refer to sccs-prs(1).

-c date-time | -c date-time
Specify the latest delta checked in before the indicated date and time. The date-time argument takes the form: yy[mm][dd[ hh[mm[ss]] ]] ]).

-e
Display delta table information for all deltas earlier than the one specified with -r (or all deltas if none is specified).

-l
Display information for all deltas later than, and including, that specified by -c or -r.

-r sid | -rsid
Specify a given delta by SID.

prt [-y]
Display the delta table, but omit the MR field (see sccsfile(4) for more information on this field). Refer to sccs-prt(1).

-y
Display the most recent delta table entry. The format is a single output line for each file argument, which is convenient for use in a pipeline with awk(1) or sed(1).

/usr/bin/sccs rmdel -rsid
/usr/xpg4/bin/sccs rmdel -rsid
Remove the indicated delta from the history file. That delta must be the most recent (leaf) delta in its branch. Refer to sccs-rmdel(1).

sact
Show editing activity status of an SCCS file. Refer to sccs-sact(1).

sccsdiff -r old-sid -r new-sid diff-options
Compare two versions corresponding to the indicated SIDs (deltas) using diff. Refer to sccs-sccsdiff(1).

/usr/bin/sccs tell [-b] [-u[username]]
tell [-b] [-u username] [-U]
Display the list of files that are currently checked out, one file per line.

- b
  Ignore branches.
- u[username] | - u [username] | - U
  List only files checked out to you. When username is specified, list only files checked out to that user. For /usr/xpg4/bin/sccs, the -U option is equivalent to -u <current_user>.

unedit
“Undo” the last edit or ‘get -e’, and return the working copy to its previous condition. unedit backs out all pending changes made since the file was checked out.

unget
Same as unedit. Refer to sccs-unget(1).

val
Validate the history file. Refer to sccs-val(1).

what
Display any expanded ID keyword strings contained in a binary (object) or text file. Refer to what(1) for more information.

Examples
EXAMPLE 1 Checking out, editing, and checking in a file
To check out a copy of program.c for editing, edit it, and then check it back in:

example% sccs edit program.c
1.1
new delta 1.2
14 lines

example% vi program.c
your editing session

example% sccs delget program.c
comments? clarified cryptic diagnostic
1.2
3 inserted
2 deleted
12 unchanged
1.2
15 lines

EXAMPLE 2 Defining the root portion of the command pathname
sccs converts the command:

example% sccs -d/usr/src/include get stdio.h

to:
EXAMPLE 2  Defining the root portion of the command pathname  

/usr/bin/get /usr/src/include/SCCS/sstdio.h  

EXAMPLE 3  Defining the resident subdirectory  
The command:  

example% sccs -pprivate get include/stdio.h  

becomes:  

/usr/bin/get include/private/sstdio.h  

EXAMPLE 4  Initializing a history file  
To initialize the history file for a source file named program.c, make the SCCS subdirectory,  
and then use ‘sccs create’:  

example% mkdir SCCS  
exmple% sccs create program.c  
program.c:  
1.1  
14 lines  

After verifying the working copy, you can remove the backup file that starts with a comma:  

example% diff program.c ,program.c  
exmple% rm ,program.c  

EXAMPLE 5  Retrieving a file from another directory  
To retrieve a file from another directory into the current directory:  

example% sccs get /usr/src/sccs/cc.c  
or:  

example% sccs -p/usr/src/sccs/ get cc.c  

EXAMPLE 6  Checking out all files  
To check out all files under SCCS in the current directory:  

example% sccs edit SCCS  

EXAMPLE 7  Checking in all files  
To check in all files currently checked out to you:  

example% sccs delta 'sccs tell -u'
EXAMPLE 8  Entering multiple lines of comments

If using -y to enter a comment, for most shells, enclose the comment in single or double quotes. In the following example, Myfile is checked in with a two-line comment:

example% sccs deledit Myfile -y "Entering a multi-line comment"
No id keywords (cm7)
1.2
2 inserted
0 deleted
14 unchanged
1.2
new delta 1.3

Displaying the SCCS history of Myfile:

example% sccs prt Myfile

SCCS/s.Myfile:

D 1.2 01/04/20 16:37:07 me 2 1 00002/00000/00014
Entering a multi-line comment

D 1.1 01/04/15 13:23:32 me 1 0 00014/00000/00000
date and time created 01/04/15 13:23:32 by me

If -y is not used and sccs prompts for a comment, the newlines must be escaped using the backslash character (\):

example% sccs deledit Myfile
comments? Entering a "
multi-line comment"
No id keywords (cm7)
1.2
0 inserted
0 deleted
14 unchanged
1.2
new delta 1.3

Environment Variables

See environ(5) for descriptions of the following environment variables that affect the execution of sccs: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

PROJECTDIR  If contains an absolute path name (beginning with a slash), sccs searches for SCCS history files in the directory given by that variable.

If PROJECTDIR does not begin with a slash, it is taken as the name of a user, and sccs searches the src or source subdirectory of that user’s home directory for history files. If such a directory is found, it is used. Otherwise,
the value is used as a relative path name.

**Exit Status** The following exit values are returned:

- **0** Successful completion.
- **>0** An error occurred.

**Files**

- **SCCS** SCCS subdirectory
- **SCCS/d .file** temporary file of differences
- **SCCS/p .file** lock (permissions) file for checked-out versions
- **SCCS/q .file** temporary file
- **SCCS/s .file** SCCS history file
- **SCCS/x .file** temporary copy of the s .file
- **SCCS/z .file** temporary lock file
- **/usr/bin/*** SCCS utility programs

**Attributes** See attributes(5) for descriptions of the following attributes:

```
<table>
<thead>
<tr>
<th>/usr/bin/sccs</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/build/make</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>/usr/xpg4/bin/sccs</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/xopen/xcu4</td>
<td></td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5)</td>
<td></td>
</tr>
</tbody>
</table>
```

**See Also** awk(1), diff(1), sccs-admin(1), sccs-cdc(1), sccs-comb(1), sccs-delta(1), sccs-get(1), sccs-help(1), sccs-prs(1), sccs-rmdel(1), sccs-sact(1), sccs-sccsdiff(1), sccs-unget(1), sccs-val(1), sed(1), what(1), sccsfile(4), attributes(5), environ(5), standards(5)
**Name**
scs-admin, admin – create and administer SCCS history files

**Synopsis**
```
/usr/bin/admin [-bhnz] [-a username | groupid]...
    [-d flag] ... [-e username | groupid]...
    [-f flag [value]] ... [-i [filename]] [-m mr-list]
    [-r release] [-t [description-file]] [-y [comment]] s.filename...
```

**Description**
The `admin` command creates or modifies the flags and other parameters of SCCS history files. Filenames of SCCS history files begin with the `s.` prefix, and are referred to as `s.` files, or history files.

The named `s.` file is created if it does not exist already. Its parameters are initialized or modified according to the options you specify. Parameters not specified are given default values when the file is initialized, otherwise they remain unchanged.

If a directory name is used in place of the `s.filename` argument, the `admin` command applies to all `s.` files in that directory. Unreadable `s.` files produce an error. The use of `−` as the `s.filename` argument indicates that the names of files are to be read from the standard input, one `s.` file per line.

**Options**
The following options are supported:

- `-a username | groupid`
  Adds a user name, or a numerical group ID, to the list of users who may check deltas in or out. If the list is empty, any user is allowed to do so.

- `-b`
  Forces encoding of binary data. Files that contain ASCII NUL or other control characters, or that do not end with a `NEWLINE`, are recognized as binary data files. The contents of such files are stored in the history file in encoded form. See `uuencode(1C)` for details about the encoding. This option is normally used in conjunction with `-i` to force `admin` to encode initial versions not recognized as containing binary data.

- `-d flag`
  Deletes the indicated `flag` from the SCCS file. The `-d` option may be specified only for existing `s.` files. See `-f` for the list of recognized flags.

- `-e username | groupid`
  Erases a user name or group ID from the list of users allowed to make deltas.

- `-f flag [value]`
  Sets the indicated `flag` to the (optional) `value` specified. The following flags are recognized:

  - `b`
    Enables branch deltas. When `b` is set, branches can be created using the `-b` option of the SCCS `get` command (see `sccs-get(1)`).
ceiling
Sets a ceiling on the releases that can be checked out. ceiling is a number less than or equal to 9999. If c is not set, the ceiling is 9999.

delta
Specifies the default delta number, or SID, to be used by an SCCS get command.

floor
Sets a floor on the releases that can be checked out. The floor is a number greater than 0 but less than 9999. If f is not set, the floor is 1.

i
Treats the 'No id keywords (getdelta)' message issued by an SCCS get or delta command as an error rather than a warning.

j
Allows concurrent updates.

\release
\release[ , release...]
Locks the indicated list of releases against deltas. If a is used, this flag locks out deltas to all releases. An SCCS 'get -e' command fails when applied against a locked release.

module
Supplies a value for the module name to which the sccs-admin.1 keyword is to expand. If the m flag is not specified, the value assigned is the name of the SCCS file with the leading s. removed.

n
Creates empty releases when releases are skipped. These null (empty) deltas serve as anchor points for branch deltas.

qvalue
Supplies a value to which the keyword is to expand when a read-only version is retrieved with the SCCS get command.

snumber
Specifies how many lines of code are scanned for the SCCS keyword.

type
Supplies a value for the module type to which the keyword is to expand.
v[program]
  Specifies a validation program for the MR numbers associated with a new delta. The optional program specifies the name of an MR number validity checking program. If this flag is set when creating an SCCS file, the -m option must also be used, in which case the list of MRs may be empty.

y[value, [value]]
  Specifies the SCCS keywords to be expanded. If no value is specified, no keywords will be expanded.

-h
  Checks the structure of an existing s.file (see SCCSfile(4)), and compares a newly computed check-sum with one stored in the first line of that file. -h inhibits writing on the file and so nullifies the effect of any other options.

-i[filename]
  Initializes the history file with text from the indicated file. This text constitutes the initial delta, or set of checked-in changes. If filename is omitted, the initial text is obtained from the standard input. Omitting the -i option altogether creates an empty s.file. You can only initialize one s.file with text using -i. This option implies the -n option.

-m mr-list
  Inserts the indicated Modification Request (MR) numbers into the commentary for the initial version. When specifying more than one MR number on the command line, mr-list takes the form of a quoted, space-separated list. A warning results if the v flag is not set or the MR validation fails.

-n
  Creates a new SCCS history file.

-r release
  Specifies the release for the initial delta. -r may be used only in conjunction with -i. The initial delta is inserted into release 1 if this option is omitted. The level of the initial delta is always 1. Initial deltas are named 1.1 by default.

-t[description-file]
  Inserts descriptive text from the file description-file. When -t is used in conjunction with -n, or -i to initialize a new s.file, the description-file must be supplied. When modifying the description for an existing file: a -t option without a description-file removes the descriptive text, if any; a -t option with a description-file replaces the existing text.

-y[comment]
  Inserts the indicated comment in the "Comments:" field for the initial delta. Valid only in conjunction with -i or -n. If -y option is omitted, a default comment line is inserted that notes the date and time the history file was created.
-z  Recomputes the file check-sum and stores it in the first line of the
    s. file.  *Caution:* It is important to verify the contents of the history
    file (see `sccs-val(1)`), and the print subcommand in `sccs(1)`),
    since using -z on a truly corrupted file may prevent detection of the
    error.

**Examples**

**EXAMPLE 1**  Preventing SCCS keyword expansion

In the following example, 10 lines of file will be scanned and only the W, Y, X keywords will be
interpreted:

```
example% sccs admin -fs10 file
example% sccs admin -fyW,Y,X file
example% get file
```

**Environment Variables**

See `environ(5)` for descriptions of the following environment variables that affect the
execution of alias and unalias: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

**Exit Status**

The following exit values are returned:

0  Successful completion.
1  An error occurred.

**Files**

s.*  history file
SCCS/s.*  history file in SCCS subdirectory
z.*  temporary lock file

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/build/make</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See <code>standards(5)</code>.</td>
</tr>
</tbody>
</table>

**See Also**

`sccs(1), sccs-cdc(1), sccs-delta(1), sccs-get(1), sccs-help(1), sccs-rmdel(1),
 sccs-val(1), sccsfile(4), attributes(5), environ(5), standards(5)`

**Diagnostics**

Use the `sccs-help` command for explanations of SCCS commands. See `sccs-help(1)`.  

**Warnings**

The last component of all SCCS filenames must have the 's.' prefix. New SCCS files are given
mode 444 (see `chmod(1)`).  All writing done by `admin` is to a temporary file with an x. prefix,
created with mode 444 for a new SCCS file, or with the same mode as an existing SCCS file.
After successful execution of `admin`, the existing s. file is removed and replaced with the x. file.
This ensures that changes are made to the SCCS file only when no errors have occurred.
It is recommended that directories containing SCCS files have permission mode 755, and that the s . files themselves have mode 444. The mode for directories allows only the owner to modify the SCCS files contained in the directories, while the mode of the s . files prevents all modifications except those performed using SCCS commands.

If it should be necessary to patch an SCCS file for any reason, the mode may be changed to 644 by the owner to allow use of a text editor. However, extreme care must be taken when doing this. The edited file should always be processed by an 'admin -h' command to check for corruption, followed by an 'admin -z' command to generate a proper check-sum. Another 'admin -h' command is recommended to ensure that the resulting s . file is valid.

admin also uses a temporary lock s . file, starting with the 'z .' prefix, to prevent simultaneous updates to the s . file. See sccs-get(1) for further information about the 'z . file'.

admin also uses a temporary lock s . file, starting with the 'z .' prefix, to prevent simultaneous updates to the s . file. See sccs-get(1) for further information about the 'z . file'.
Name  sccs-cdc, cdc – change the delta commentary of an SCCS delta

Synopsis  cdc  -rsid  [-m mr-list]  [-y [comment]]  s.filename... 

Description  cdc annotates the delta commentary for the SCCS delta ID (SID) specified by the -r option in each named s. file.

If the v flag is set in the s. file, you can also use cdc to update the Modification Request (MR) list.

If you checked in the delta, or, if you own the file and directory and have write permission, you can use cdc to annotate the commentary.

Rather than replacing the existing commentary, cdc inserts the new comment you supply, followed by a line of the form:

*** CHANGED *** yy/mm/dd hh/mm/ss username

above the existing commentary.

If a directory is named as the s.filename argument, the cdc command applies to all s. files in that directory. Unreadable s. files produce an error; processing continues with the next file (if any). If ‘-’ is given as the s.filename argument, each line of the standard input is taken as the name of an SCCS history file to be processed, and the -m and -y options must be used.

Options  -rsid  Specify the SID of the delta to change.

- m mr-list  Specify one or more MR numbers to add or delete. When specifying more than one MR on the command line, mr-list takes the form of a quoted, space-separated list. To delete an MR number, precede it with a ! character (an empty MR list has no effect). A list of deleted MRs is placed in the comment section of the delta commentary. If -m is not used and the standard input is a terminal, cdc prompts with MRs? for the list (before issuing the comments? prompt). -m is only useful when the v flag is set in the s. file. If that flag has a value, it is taken to be the name of a program to validate the MR numbers. If that validation program returns a non-zero exit status, cdc terminates and the delta commentary remains unchanged.

- y[comment]  Use comment as the annotation in the delta commentary. The previous comments are retained; the comment is added along with a notation that the commentary was changed. A null comment leaves the commentary unaffected. If -y is not specified and the standard input is a terminal, cdc prompts with comments? for the text of the notation to be added. An unescaped NEWLINE character terminates the annotation text.
EXAMPLE 1  Changing the annotated commentary

The following command:

```
example% cdc -r1.6 -y"corrected commentary" s.program.c
```

produces the following annotated commentary for delta 1.6 in `s.program.c`:

```
D 1.6 88/07/05 23:21:07 username 9 0 00001/00000/00000
MRs:
COMMENTS:
corrected commentary
*** CHANGED *** 88/07/07 14:09:41 username
performance enhancements in main()
```

**Files**  
z.file    temporary lock file

**Attributes**  
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/build/make</td>
</tr>
</tbody>
</table>

**See Also**  
`sccs(1), sccs-admin(1), sccs-comb(1), sccs-delta(1), sccs-help(1), sccs-prs(1),
  sccs-prt(1), sccs-rmdel(1), what(1), sccsfile(4), attributes(5)`

**Diagnostics**  
Use the `sccs-help` command for explanations of SCCS commands. See `sccs-help(1)`. 
sccs-comb(1)

Name  sccs-comb, comb – combine SCCS deltas


Description  comb generates a shell script (see sh(1)) that you can use to reconstruct the indicated s. files. This script is written to the standard output.

If a directory name is used in place of the s.filename argument, the comb command applies to all s. files in that directory. Unreadable s. files produce an error; processing continues with the next file (if any). The use of – as the s.filename argument indicates that the names of files are to be read from the standard input, one s. file per line.

If no options are specified, comb preserves only the most recent (leaf) delta in a branch, and the minimal number of ancestors needed to preserve the history.

Options  The following options are supported:

-o  For each get -e generated, access the reconstructed file at the release of the delta to be created. Otherwise, the reconstructed file is accessed at the most recent ancestor. The use of -o can decrease the size of the reconstructed s. file. It can also alter the shape of the delta tree of the original file.

-s  Generate scripts to gather statistics, rather than combining deltas. When run, the shell scripts report: the file name, size (in blocks) after combining, original size (also in blocks), and the percentage size change, computed by the formula:

\[
100 \times \frac{\text{original} - \text{combined}}{\text{original}}
\]

This option can be used to calculate the space that is saved, before actually doing the combining.

-csid-list  Include the indicated list of deltas. All other deltas are omitted. sid-list is a comma-separated list of SCCS delta IDs (SIDs). To specify a range of deltas, use a – separator instead of a comma, between two SIDs in the list.

-psID  The SID of the oldest delta to be preserved.

Files  s. COMB  reconstructed SCCS file

comb?????  temporary file

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/build/make</td>
</tr>
</tbody>
</table>

See Also  sccs(1), sccs-admin(1), sccs-cdc(1), sccs-delta(1), sccs-help(1), sccs-prs(1), sccs-prt(1), sccs-rmdel(1), sccs-sccsdiff(1), what(1), sccsfile(4), attributes(5)
Use the `sccs-help` command for explanations of SCCS commands. See `sccs-help(1)`.

**Bugs**  
`comb` might rearrange the shape of the tree of deltas. It might not save any space; in fact, it is possible for the reconstructed file to actually be larger than the original.
Name  sccs-delta, delta – make a delta to an SCCS file

Synopsis  
```
/usr/bin/delta [-dnps] [-g sid-list | -gsid-list]
 [-m mr-list | -mmr-list] [-r sid | -rsid]
 [-y [comment]] s.filename...
```
```
/usr/xpg4/bin/delta [-dnps] [-g sid-list | -gsid-list]
 [-m mr-list | -mmr-list] [-r sid | -rsid]
 [-y [comment]] s.filename...
```

Description  The delta utility checks in a record of the line-by-line differences made to a checked-out version of a file under SCCS control. These changes are taken from the writable working copy that was retrieved using the SCCS get command (see sccs-get(1)). This working copy does not have the ‘s.’ prefix, and is also referred to as a g-file.

If a directory name is used in place of the s.filename argument, the delta command applies to all s.files in that directory. Unreadable s.files produce an error; processing continues with the next file (if any). The use of ‘−’ as the s.filename argument indicates that the names of files are to be read from the standard input, one s.file per line (requires -y, and in some cases, -m).

delta can issue prompts on the standard output depending upon the options specified and the flags that are set in the s.file (see sccs-admin(1), and the -m and -y options below, for details).

/usr/xpg4/bin/delta  The SID of the delta is not echoed to stdout.

Options  The following options are supported:

- d  Use command diff(1) instead of bdiff(1). Returns exit status 2 if s.filename argument is not specified.

- n  Retain the edited g-file, which is normally removed at the completion of processing.

- p  Display line-by-line differences (in diff(1) format) on the standard output.

- s  Silent. Do not display warning or confirmation messages. Do not suppress error messages (which are written to standard error).

- g sid-list | -gsid-list  Specify a list of deltas to omit when the file is accessed at the SCCS version ID (SID) created by this delta. sid-list is a comma-separated list of SIDs. To specify a range of deltas, use a ‘−’ separator instead of a comma, between two SIDs in the list.

- m mr-list | -mmr-list  If the SCCS file has the v flag set (see sccs-admin(1)), you must supply one or more Modification Request (MR) numbers for the new delta. When specifying more than one MR number on the command line, mr-list takes the form of a quoted, space-separated list. If -m is not used and the standard input is a terminal, delta prompts with
MRs? for the list (before issuing the comments? prompt). If the v flag in the s.file has a value, it is taken to be the name of a program to validate the MR numbers. If that validation program returns a non-zero exit status, delta terminates without checking in the changes.

```
-r sid | -rsid
```

When two or more versions are checked out, specify the version to check in. This SID value can be either the SID specified on the get command line, or the SID of the new version to be checked in as reported by get. A diagnostic results if the specified SID is ambiguous, or if one is required but not supplied.

```
-y[comment]
```

Supply a comment for the delta table (version log). A null comment is accepted, and produces an empty commentary in the log. If -y is not specified and the standard input is a terminal, delta prompts with ‘comments?’; An unescaped NEWLINE terminates the comment.

**Environment Variables** See environ(5) for descriptions of the following environment variables that affect the execution of delta: LANG, LC_ALL, LC_COLLATE, LC_CTYPE, LC_MESSAGES, and NLSPATH.

**Exit Status** The following exit values are returned:

<table>
<thead>
<tr>
<th>Exit Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful completion.</td>
</tr>
<tr>
<td>1</td>
<td>An error occurred and the -d option had not been specified.</td>
</tr>
<tr>
<td>2</td>
<td>An error occurred, the -d option had been specified, and the s.filename argument was not specified.</td>
</tr>
</tbody>
</table>

**Files**

- **d.file** temporary file of differences
- **p.file** lock file for a checked-out version
- **q.file** temporary file
- **s.file** SCCS history file
- **x.file** temporary copy of the s.file
- **z.file** temporary file

**Attributes** See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/build/make</td>
</tr>
</tbody>
</table>
sccs-delta(1)

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/xopen/xcu4</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5)</td>
</tr>
</tbody>
</table>

See Also  

Diagnostics Use the SCCS help command for explanations (see sccs-help(1)).

Warnings Lines beginning with an ASCII SOH character (binary 001) cannot be placed in the SCCS file unless the SOH is escaped. This character has special meaning to SCCS (see sccsfile(4)) and produces an error.
Name  sccs-get, get – retrieve a version of an SCCS file

Synopsis  /usr/bin/get [-bkmnpst] [-l [p]] [-asequence]
                 [-c date-time | -cdate-time] [-G g-file]
                 [-i sid-list | -isid-list] [-r [sid]]
                 [-x sid-list | -xsid-list] s.filename...

/usr/xpg4/bin/get [-bkmnpst] [-l [p]] [-asequence]
                 [-c date-time | -cdate-time] [-G g-file]
                 [-i sid-list | -isid-list] [-r sid | -rsid]
                 [-x sid-list | -xsid-list] s.filename...

Description  The get utility retrieves a working copy from the SCCS history file, according to the specified options.

For each s.filename argument, get displays the SCCS delta ID (SID) and number of lines retrieved.

If a directory name is used in place of the s.filename argument, the get command applies to all s.files in that directory. Unreadable s.files produce an error; processing continues with the next file (if any). The use of ‘−’ as the s.filename argument indicates that the names of files are to be read from the standard input, one s.file per line.

The retrieved file normally has the same filename base as the s.file, less the prefix, and is referred to as the g-file.

For each file processed, get responds (on the standard output) with the SID being accessed, and with the number of lines retrieved from the s.file.

Options  The following options are supported:

-asequence  Retrieves the version corresponding to the indicated delta sequence number. This option is used primarily by the SCCS comb command (see sccs-comb(1)). For users, -r is an easier way to specify a version. The -a option supersedes the -r option when both are used.

-b  Creates a new branch. Used with the -e option to indicate that the new delta should have a SID in a new branch. Instead of incrementing the level for version to be checked in, get indicates in the p.file that the delta to be checked in should either initialize a new branch and sequence (if there is no existing branch at the current level), or increment the branch component of the SID. If the b flag is not set in the s.file, this option is ignored.

-c date-time | -cdate-time  Retrieves the latest version checked in prior to the date and time indicated by the date-time argument. date-time takes the form:
Units omitted from the indicated date and time default to their maximum possible values; that is, -c7502 is equivalent to -c750228235959. Values of yy in the range 69–99 refer to the twentieth century. Values in the range 00–68 refer to the twenty-first century. Any number of non-numeric characters can separate the various 2 digit components. If white-space characters occur, the date-time specification must be quoted.

-e  Retrieves a version for editing. With this option, get places a lock on the .s file, so that no one else can check in changes to the version you have checked out. If the j flag is set in the .s file, the lock is advisory; get issues a warning message. Concurrent use of ‘get -e’ for different SIDs is allowed. However, get does not check out a version of the file if a writable version is present in the directory. All SCCS file protections stored in the .s file, including the release ceiling, floor, and authorized user list, are honored by ‘get -e’.

-g  Gets the SCCS version ID, without retrieving the version itself. Used to verify the existence of a particular SID.

-G newname  Uses newname as the name of the retrieved version.

-i sid-list | -isid-list  Specifies a list of deltas to include in the retrieved version. The included deltas are noted in the standard output message. sid-list is a comma-separated list of SIDs. To specify a range of deltas, use a ‘−’ separator instead of a comma, between two SIDs in the list.

-k  Suppresses expansion of ID keywords. -k is implied by the -e.

-l [ p ]  Retrieves a summary of the delta table (version log) and write it to a listing file, with the ‘.l.’ prefix (called ‘.l.file’). When -lp is used, write the summary onto the standard output.

-m  Precedes each retrieved line with the SID of the delta in which it was added to the file. The SID is separated from the line with a TAB.

-n  Precedes each line with the %% ID keyword and a TAB. When both the -m and -n options are used, the ID keyword precedes the SID, and the line of text.

-p  Writes the text of the retrieved version to the standard output. All messages that normally go to the standard output are written to the standard error instead.
-s Suppresses all output normally written on the standard output. However, fatal error messages (which always go to the standard error) remain unaffected.

-t Retrieves the most recently created (top) delta in a given release (for example: -r1).

/usr/bin/get -r[sid] Retrieves the version corresponding to the indicated SID (delta).

The SID for a given delta is a number, in Dewey decimal format, composed of two or four fields: the release and level fields, and for branch deltas, the branch and sequence fields. For instance, if 1.2 is the SID, 1 is the release, and 2 is the level number. If 1.2.3.4 is the SID, 3 is the branch and 4 is the sequence number.

You need not specify the entire SID to retrieve a version with get. When you omit -r altogether, or when you omit both release and level, get normally retrieves the highest release and level. If the d flag is set to an SID in the s. file and you omit the SID, get retrieves the default version indicated by that flag.

When you specify a release but omit the level, get retrieves the highest level in that release. If that release does not exist, get retrieves highest level from the next-highest existing release.

Similarly with branches, if you specify a release, level and branch, get retrieves the highest sequence in that branch.

/usr/xpg4/bin/get -r sid | -rsid Same as for /usr/bin/get except that SID is mandatory.

-x sid-list | -xsid-list Excludes the indicated deltas from the retrieved version. The excluded deltas are noted in the standard output message. sid-list is a comma-separated list of SIDs. To specify a range of deltas, use a '−' separator instead of a comma, between two SIDs in the list.

Output

/usr/bin/get The output format for /usr/bin/get is as follows:

"%s
%d lines
", <SID>, <number of lines>

/usr/xpg4/bin/get The output format for /usr/xpg4/bin/get is as follows:

"%s
%d
", <SID>, <number of lines>

Usage Usage guidelines are as follows:

ID Keywords In the absence of -e or -k, get expands the following ID keywords by replacing them with the indicated values in the text of the retrieved source.
### Keyword Value

- **%%A%%**: Shorthand notation for an ID line with data for **what(1)**: %%2%%Y %M %I%%2%
- **%B%**: SID branch component
- **%C%**: Current line number. Intended for identifying messages output by the program such as **“this shouldn’t have happened”** type errors. It is **not** intended to be used on every line to provide sequence numbers.
- **%D%**: Current date: \(yy/mm/dd\)
- **%E%**: Date newest applied delta was created: \(yy/mm/dd\)
- **%F%**: SCCS s. file name
- **%G%**: Date newest applied delta was created: \(mm/dd/yy\)
- **%H%**: Current date: \(mm/dd/yy\)
- **%I%**: SID of the retrieved version: %R. %L. %B. %S%
- **%J%**: SID level component
- **%K%**: Module name: either the value of the \(n\) flag in the s. file (see **sccs-admin(1)**), or the name of the s. file less the prefix
- **%L%**: Fully qualified s. file name
- **%M%**: Value of the \(q\) flag in the s. file
- **%N%**: SID Release component
- **%O%**: SID Sequence component
- **%P%**: Current time: \(hh:mm:ss\)
- **%Q%**: Time the newest applied delta was created: \(hh:mm:ss\)
- **%R%**: Shorthand notation for an ID line with data for **what**: %Z%& %I%
- **%S%**: 4-character string: ‘@(#),’ recognized by **what**

### Determination of SCCS Identification String

<table>
<thead>
<tr>
<th>SID (1) Specified</th>
<th>-b Option Used (2)</th>
<th>Other Conditions</th>
<th>SID Retrieved</th>
<th>SID of Delta to be Created</th>
</tr>
</thead>
<tbody>
<tr>
<td>none (3)</td>
<td>no</td>
<td>R defaults to mR</td>
<td>mR.mL</td>
<td>mR.(mL+1)</td>
</tr>
<tr>
<td>none (3)</td>
<td>yes</td>
<td>R defaults to mR</td>
<td>mR.mL</td>
<td>mR.mL.(mB+1).1</td>
</tr>
</tbody>
</table>

**ID String**  
The table below explains how the SCCS identification string is determined for retrieving and creating deltas.
### Determination of SCCS Identification String

<table>
<thead>
<tr>
<th>SID (1) Specified</th>
<th>-b Option Used (2)</th>
<th>Other Conditions</th>
<th>SID Retrieved</th>
<th>SID of Delta to be Created</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>no</td>
<td>R &gt; mR</td>
<td>mR.mL</td>
<td>R.1 (4)</td>
</tr>
<tr>
<td>R</td>
<td>no</td>
<td>R = mR</td>
<td>mR.mL</td>
<td>R.R.(mL+1)</td>
</tr>
<tr>
<td>R</td>
<td>yes</td>
<td>R &gt; mR</td>
<td>mR.mL</td>
<td>R.R.mL.(mB+1).1</td>
</tr>
<tr>
<td>R</td>
<td>yes</td>
<td>R = mR</td>
<td>mR.mL</td>
<td>R.R.mL.(mB+1).1</td>
</tr>
<tr>
<td>R</td>
<td>–</td>
<td>R &lt; mR and R does not exist</td>
<td>hR.mL (5)</td>
<td>hR.mL.(mB+1).1</td>
</tr>
<tr>
<td>R</td>
<td>–</td>
<td>Trunk succ. (6) in release &gt; R and R exists</td>
<td>R.mL</td>
<td>R.mL.(mB+1).1</td>
</tr>
<tr>
<td>R.L</td>
<td>no</td>
<td>No trunk succ.</td>
<td>R.L</td>
<td>R.(L+1)</td>
</tr>
<tr>
<td>R.L</td>
<td>yes</td>
<td>No trunk succ.</td>
<td>R.L</td>
<td>R.L.(mB+1).1</td>
</tr>
<tr>
<td>R.L</td>
<td>–</td>
<td>Trunk succ. in release ≥ R</td>
<td>R.L</td>
<td>R.L.(mB+1).1</td>
</tr>
<tr>
<td>R.L.B</td>
<td>no</td>
<td>No branch succ.</td>
<td>R.L.B.mS</td>
<td>R.L.B.(mS+1)</td>
</tr>
<tr>
<td>R.L.B</td>
<td>yes</td>
<td>No branch succ.</td>
<td>R.L.B.mS</td>
<td>R.L.B.(mB+1).1</td>
</tr>
<tr>
<td>R.L.B.S</td>
<td>no</td>
<td>No branch succ.</td>
<td>R.L.B.S</td>
<td>R.L.B.(S+1)</td>
</tr>
<tr>
<td>R.L.B.S</td>
<td>yes</td>
<td>No branch succ.</td>
<td>R.L.B.S</td>
<td>R.L.(mB+1).1</td>
</tr>
<tr>
<td>R.L.B.S</td>
<td>–</td>
<td>Branch succ.</td>
<td>R.L.B.S</td>
<td>R.L.(mB+1).1</td>
</tr>
</tbody>
</table>

1. ‘R’, ‘L’, ‘B’, and ‘S’ are the ‘release’, ‘level’, ‘branch’, and ‘sequence’ components of the SID, respectively; ‘m’ means ‘maximum’. Thus, for example, ‘R.mL’ means ‘the maximum level number within release R’; ‘R.L.(mB+1).1’ means ‘the first sequence number on the new branch (that is, maximum branch number plus one) of level L within release R’. Note: If the SID specified is of the form ‘R.L’, ‘R.L.B’, or ‘R.L.B.S’, each of the specified components must exist.

2. The -b option is effective only if the b flag is present in the file. An entry of ‘-’ means ‘irrelevant’.

3. This case applies if the d (default SID) flag is not present in the file. If the d flag is present in the file, the SID obtained from the d flag is interpreted as if it had been specified on the command line. Thus, one of the other cases in this table applies.

4. Forces creation of the first delta in a new release.

5. ‘hR’ is the highest existing release that is lower than the specified, nonexistent, release R.

**Environment Variables**

See `environ(5)` for descriptions of the following environment variables that affect the execution of `get`: `LANG`, `LC_ALL`, `LC_COLLATE`, `LC_CTYPE`, `LC_MESSAGES`, and `NLSPATH`.

**Files**

- `g-file` version retrieved by `get`
- `\file` file containing extracted delta table info
- `p.file` permissions (lock) file
- `z.file` temporary copy of `s.file`

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>/usr/bin/get</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Availability</td>
<td>developer/build/make</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>/usr/xpg4/bin/get</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Availability</td>
<td>developer/xopen/xcu4</td>
</tr>
<tr>
<td></td>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td></td>
<td>Standard</td>
<td>See <code>standards(5)</code></td>
</tr>
</tbody>
</table>

**See Also**

- `sccs(1)`, `sccs-admin(1)`, `sccs-delta(1)`, `sccs-help(1)`, `sccs-prs(1)`, `sccs-prt(1)`, `sccs-sact(1)`, `sccs-unget(1)`, `what(1)`, `sccsfile(4)`, `attributes(5)`, `environ(5)`, `standards(5)`

**Diagnostics**

Use the `sccs-help` command for explanations of SCCS commands. See `sccs-help(1)`.

**Bugs**

If the effective user has write permission (either explicitly or implicitly) in the directory containing the SCCS files, but the real user does not, only one file can be named when using `-e`. 
The `sccs-help` utility retrieves information to further explain errors messages and warnings from SCCS commands. It also provides some information about SCCS command usage. If no arguments are given, `sccs-help` prompts for one.

An argument may be a message number (which normally appears in parentheses following each SCCS error or warning message), or an SCCS command name. `sccs-help` responds with an explanation of the message or a usage line for the command.

When all else fails, try `/usr/bin/sccs-help stuck`.

### Files

`/usr/lib/help` directory containing files of message text

### Attributes

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTribute Type</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/build/make</td>
</tr>
</tbody>
</table>

### See Also

sccs-prs(1)

Name  sccs-prs, prs – display selected portions of an SCCS history

Synopsis  prs [-ael] [-cdate-time] [-ddataspec] [-rsid] s.filename...

Description  The prs utility displays part or all of the SCCS file (see sccsfile(4)) in a user supplied format.

If a directory name is used in place of the s.filename argument, the prs command applies to all s.files in that directory. Unreadable s.files produce an error; processing continues with the next file (if any). The use of ‘−’ as the s.filename argument indicates that the names of files are to be read from the standard input, one s.file per line.

Options  In the absence of options, prs displays the delta table (version log). In the absence of -d, or -l, prs displays the entry for each delta indicated by the other options.

-a  Includes all deltas, including those marked as removed (see sccs-rmdel(1)).

-e  Requests information for all deltas created earlier than, and including, the delta indicated with -r or -c.

-l  Requests information for all deltas created later than, and including, the delta indicated with -r or -c.

-cdate-time  Either options -e or -l must be used with this option. -cdate-time displays information on the deltas checked in either prior to and including the date and time indicated by the date-time argument (option -e); or later than and including the date and time indicated (option -l). date-time takes the form:

```
yy[mm][dd][hh][mm][ss] ] ] ] ]
```

Units omitted from the indicated date and time default to their maximum possible values; that is -c7502 is equivalent to -c750228235959. Any number of non-numeric characters may separate the various 2 digit components. If white-space characters occur, the date-time specification must be quoted. Values of yy in the range 69−99 refer to the twentieth century. Values in the range of 00−68 refer to the twenty-first century.

-ddataspec  Produce a report according to the indicated data specification. dataspec consists of a (quoted) text string that includes embedded data keywords of the form: ‘:key:’ (see Data Keywords, below). prs expands these keywords in the output it produces. To specify a TAB character in the output, use \t; to specify a NEWLINE in the output, use \n.

-rsid  Specifies the SCCS delta ID (SID) of the delta for which information is desired. If no SID is specified, the most recently created delta is used.

Usage  Usage of prs is described below.
Data Keywords

Data keywords specify which parts of an SCCS file are to be retrieved. All parts of an SCCS file (see `sccsfile(4)`) have an associated data keyword. A data keyword may appear any number of times in a data specification argument to `-d`. These data keywords are listed in the table below:

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Data Item</th>
<th>File Section*</th>
<th>Value</th>
<th>Format**</th>
</tr>
</thead>
<tbody>
<tr>
<td>:A:</td>
<td>a format for the what string:</td>
<td>N/A</td>
<td>:Z::Y: :M::I::Z:</td>
<td>S</td>
</tr>
<tr>
<td>:B:</td>
<td>branch number</td>
<td>D</td>
<td>mmmn</td>
<td>S</td>
</tr>
<tr>
<td>:BD:</td>
<td>body</td>
<td>B</td>
<td>text</td>
<td>M</td>
</tr>
<tr>
<td>:BF:</td>
<td>branch flag</td>
<td>F</td>
<td>yes or no</td>
<td>S</td>
</tr>
<tr>
<td>:CB:</td>
<td>ceiling boundary</td>
<td>F</td>
<td>:R:</td>
<td>S</td>
</tr>
<tr>
<td>:C:</td>
<td>comments for delta</td>
<td>D</td>
<td>text</td>
<td>M</td>
</tr>
<tr>
<td>:D:</td>
<td>date delta created</td>
<td>D</td>
<td>:Dy:/:Dm:/:Dd:</td>
<td>S</td>
</tr>
<tr>
<td>:Dd:</td>
<td>day delta created</td>
<td>D</td>
<td>nn</td>
<td>S</td>
</tr>
<tr>
<td>:Dg:</td>
<td>deltas ignored (seq #)</td>
<td>D</td>
<td>:Dg::Dg:...</td>
<td>S</td>
</tr>
<tr>
<td>:DI:</td>
<td>seq-no. of deltas included, excluded, ignored</td>
<td>D</td>
<td>:Dn:/:Dx:/:Dg:</td>
<td>S</td>
</tr>
<tr>
<td>:DL:</td>
<td>delta line statistics</td>
<td>D</td>
<td>:Li:/:Ld:/:Lu:</td>
<td>S</td>
</tr>
<tr>
<td>:Dn:</td>
<td>month delta created</td>
<td>D</td>
<td>nn</td>
<td>S</td>
</tr>
<tr>
<td>:Dn:</td>
<td>deltas included (seq #)</td>
<td>D</td>
<td>:Dn::Dn:...</td>
<td>S</td>
</tr>
<tr>
<td>:DP:</td>
<td>predecessor delta seq-no.</td>
<td>D</td>
<td>mmmn</td>
<td>S</td>
</tr>
<tr>
<td>:DS:</td>
<td>default SID</td>
<td>F</td>
<td>:I:</td>
<td>S</td>
</tr>
<tr>
<td>:DS:</td>
<td>delta sequence number</td>
<td>D</td>
<td>mmmn</td>
<td>S</td>
</tr>
<tr>
<td>:DT:</td>
<td>delta type</td>
<td>D</td>
<td>D or R</td>
<td>S</td>
</tr>
<tr>
<td>:Dx:</td>
<td>deltas excluded (seq #)</td>
<td>D</td>
<td>:Dx::Dx:...</td>
<td>S</td>
</tr>
<tr>
<td>:Dy:</td>
<td>year delta created</td>
<td>D</td>
<td>nn</td>
<td>S</td>
</tr>
<tr>
<td>:F:</td>
<td>s. file name</td>
<td>N/A</td>
<td>text</td>
<td>S</td>
</tr>
<tr>
<td>:FB:</td>
<td>floor boundary</td>
<td>F</td>
<td>:R:</td>
<td>S</td>
</tr>
<tr>
<td>:FD:</td>
<td>file descriptive text</td>
<td>C</td>
<td>text</td>
<td>M</td>
</tr>
</tbody>
</table>
### sccs-prs(1)

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Data Item</th>
<th>File Section*</th>
<th>Value</th>
<th>Format**</th>
</tr>
</thead>
<tbody>
<tr>
<td>:FL:</td>
<td>flag list</td>
<td>F</td>
<td>text</td>
<td>M</td>
</tr>
<tr>
<td>:GB:</td>
<td>gotten body</td>
<td>B</td>
<td>text</td>
<td>M</td>
</tr>
<tr>
<td>:I:</td>
<td>SCCS delta ID (SID)</td>
<td>D</td>
<td>:R:..L:..B:..S:</td>
<td>S</td>
</tr>
<tr>
<td>:J:</td>
<td>joint edit flag</td>
<td>F</td>
<td>yes or no</td>
<td>S</td>
</tr>
<tr>
<td>:KF:</td>
<td>keyword error/warning flag</td>
<td>F</td>
<td>yes or no</td>
<td>S</td>
</tr>
<tr>
<td>:L:</td>
<td>level number</td>
<td>D</td>
<td>nnnnn</td>
<td>S</td>
</tr>
<tr>
<td>:Ld:</td>
<td>lines deleted by delta</td>
<td>D</td>
<td>nnnnn</td>
<td>S</td>
</tr>
<tr>
<td>:Li:</td>
<td>lines inserted by delta</td>
<td>D</td>
<td>nnnnn</td>
<td>S</td>
</tr>
<tr>
<td>:LK:</td>
<td>locked releases</td>
<td>F</td>
<td>:R:...</td>
<td>S</td>
</tr>
<tr>
<td>:Lu:</td>
<td>lines unchanged by delta</td>
<td>D</td>
<td>nnnnn</td>
<td>S</td>
</tr>
<tr>
<td>:M:</td>
<td>module name</td>
<td>F</td>
<td>text</td>
<td>S</td>
</tr>
<tr>
<td>:MF:</td>
<td>MR validation flag</td>
<td>F</td>
<td>yes or no</td>
<td>S</td>
</tr>
<tr>
<td>:MP:</td>
<td>MR validation program</td>
<td>F</td>
<td>text</td>
<td>S</td>
</tr>
<tr>
<td>:MR:</td>
<td>MR numbers for delta</td>
<td>D</td>
<td>text</td>
<td>M</td>
</tr>
<tr>
<td>:ND:</td>
<td>null delta flag</td>
<td>F</td>
<td>yes or no</td>
<td>S</td>
</tr>
<tr>
<td>:Q:</td>
<td>user defined keyword</td>
<td>F</td>
<td>text</td>
<td>S</td>
</tr>
<tr>
<td>:P:</td>
<td>user who created delta</td>
<td>D</td>
<td>username</td>
<td>S</td>
</tr>
<tr>
<td>:PN:</td>
<td>s. file's pathname</td>
<td>N/A</td>
<td>text</td>
<td>S</td>
</tr>
<tr>
<td>:R:</td>
<td>release number</td>
<td>D</td>
<td>nnnnn</td>
<td>S</td>
</tr>
<tr>
<td>:S:</td>
<td>sequence number</td>
<td>D</td>
<td>nnnnn</td>
<td>S</td>
</tr>
<tr>
<td>:T:</td>
<td>time delta created</td>
<td>D</td>
<td>:Th:::Tm:::Ts:</td>
<td>S</td>
</tr>
<tr>
<td>:Th:</td>
<td>hour delta created</td>
<td>D</td>
<td>nn</td>
<td>S</td>
</tr>
<tr>
<td>:Tm:</td>
<td>minutes delta created</td>
<td>D</td>
<td>nn</td>
<td>S</td>
</tr>
<tr>
<td>:Ts:</td>
<td>seconds delta created</td>
<td>D</td>
<td>nn</td>
<td>S</td>
</tr>
<tr>
<td>:UN:</td>
<td>user names</td>
<td>U</td>
<td>text</td>
<td>M</td>
</tr>
<tr>
<td>:W:</td>
<td>a form of what string</td>
<td>N/A</td>
<td>:Z:..M::t:I:</td>
<td>S</td>
</tr>
<tr>
<td>:Y:</td>
<td>module type flag</td>
<td>F</td>
<td>text</td>
<td>S</td>
</tr>
<tr>
<td>:Z:</td>
<td>what string delimiter</td>
<td>N/A</td>
<td>@(#)</td>
<td>S</td>
</tr>
</tbody>
</table>
EXAMPLE1
Displaying delta entries

The following command displays delta entries:

code example% prs -e -d":I:\t:P:" program.c

produces:

1.6  username
1.5  username...

**Environment Variables**
See *environ(5)* for descriptions of the following environment variables that affect the execution of *prs*: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

**Files**
/tmp/pr????? temporary file

**Attributes**
See *attributes(5)* for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/build/make</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See <em>standards(5)</em>.</td>
</tr>
</tbody>
</table>

**See Also**
*sccs(1), sccs-cdc(1), sccs-delta(1), sccs-get(1), sccs-help(1), sccs-prt(1),
sccs-sact(1), sccs-sccsdiff(1), what(1), sccsfile(4), attributes(5), environ(5),
standards(5)*

**Diagnostics**
Use the *sccs-help* command for explanations of SCCS commands. See *sccs-help(1).*
Name  sccs-prt, prt – display delta table information from an SCCS file

Synopsis  

prt [-abdefistu] [-cdate-time] [-rdate-time] [-ysid] s.filename ...

Description  prt prints selected portions of an SCCS file. By default, it prints the delta table (version log).

If a directory name is used in place of the s.filename argument, the prt command applies to all s.files in that directory. Unreadable s.files produce an error; processing continues with the next file (if any). The use of ‘−’ as the s.filename argument indicates that the names of files are to be read from the standard input, one s.file per line.

Options  If any option other than -y, -c, or -r is supplied, the name of each file being processed (preceded by one NEWLINE and followed by two NEWLINE characters) appears above its contents.

If none of the -u, -f, -t, or -b options are used, -d is assumed. -s, -i are mutually exclusive, as are -c and -r.

- a  Display log entries for all deltas, including those marked as removed.
- b  Print the body of the s.file.
- d  Print delta table entries. This is the default.
- e  Everything. This option implies -d, -i, -u, -f, and -t.
- f  Print the flags of each named s.file.
- i  Print the serial numbers of included, excluded, and ignored deltas.
- s  Print only the first line of the delta table entries; that is, only up to the statistics.
- t  Print the descriptive text contained in the s.file.
- u  Print the user-names and/or numerical group IDs of users allowed to make deltas.

- cdate-time  Exclude delta table entries that are specified cutoff date and time. Each entry is printed as a single line, preceded by the name of the SCCS file. This format (also produced by -r, and -y) makes it easy to sort multiple delta tables in chronological order. When both -y and -c, or -y and -r are supplied, prt stops printing when the first of the two conditions is met.

- rdate-time  Exclude delta table entries that are newer than the specified cutoff date and time.

- ysid  Exclude delta table entries made prior to the SID specified. If no delta in the table has the specified SID, the entire table is printed. If no SID is specified, the most recent delta is printed.
Usage

Output Format
The following format is used to print those portions of the s. file that are specified by the various options.

- NEWLINE
- Type of delta (D or R)
- SPACE
- SCCS delta ID (SID)
- TAB
- Date and time of creation in the form: yy/mm/dd hh/mm/ss
- SPACE
- Username the delta's creator
- TAB
- Serial number of the delta
- SPACE
- Predecessor delta's serial number
- TAB
- Line-by-line change statistics in the form: inserted/deleted/unchanged
- NEWLINE
- List of included deltas, followed by a NEWLINE (only if there were any such deltas and the -i options was used)
- List of excluded deltas, followed by a NEWLINE (only if there were any such deltas and the -i options was used)
- List of ignored deltas, followed by a NEWLINE (only if there were any such deltas and the -i options was used)
- List of modification requests (MRs), followed by a NEWLINE (only if any MR numbers were supplied).
- Lines of the delta commentary (if any), followed by a NEWLINE.

Examples

**EXAMPLE 1** Producing a Display of the Delta Table

The following command produces a one-line display of the delta table entry for the most recent version:

```
example% prt -y program.c
s.program.c: D 1.6  88/07/06 21:39:39 username  5 4 00159/00080/00636
```
Attributes See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTETYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/build/make</td>
</tr>
</tbody>
</table>

See Also `sccs(1), sccs-cdc(1), sccs-delta(1), sccs-get(1), sccs-help(1), sccs-prs(1), sccs-sact(1), sccs-sccsdiff(1), what(1), sccsfile(4), attributes(5)`

Diagnostics Use the `sccs-help` command for explanations of SCCS commands. See `sccs-help(1)`. 
**Name**
sccs-rmdel, rmdel – remove a delta from an SCCS file

**Synopsis**
rmdel -rsid s.filename ...

**Description**
The `rmdel` utility removes the delta specified by the SCCS delta ID (SID) supplied with `-r`. The delta to be removed must be the most recent (leaf) delta in its branch. In addition, the SID must not be that of a version checked out for editing; it must not appear in any entry of the version lock file (`p.file`).

If you created the delta, or, if you own the file and directory and have write permission, you can remove it with `rmdel`.

If a directory name is used in place of the `s.filename` argument, the `rmdel` command applies to all `s.files` in that directory. Unreadable `s.files` produce an error; processing continues with the next file (if any). The use of `−` as the `s.filename` argument indicates that the names of files are to be read from the standard input, one `s.file` per line.

**Options**
The following option is supported:

`-rsid` Remove the version corresponding to the indicated SID (delta).

**Environment Variables**
See `environ(5)` for descriptions of the following environment variables that affect the execution of `rmdel`: `LANG`, `LC_ALL`, `LC_CTYPE`, `LC_MESSAGES`, and `NLSPATH`.

**Files**
- `p.file` permissions file
- `s.file` history file
- `z.file` temporary copy of the `s.file`

**Attributes**
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/build/make</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See <code>standards(5)</code></td>
</tr>
</tbody>
</table>

**See Also**

**Diagnostics**
Use the SCCS help command for explanations (see `sccs-help(1)`).
Name          sccs-sact, sact – show editing activity status of an SCCS file

Synopsis       sact  s.filename...

Description    The `sact` utility informs the user of any SCCS files that are checked out for editing.

The output for each named file consists of five fields separated by SPACE characters.

- SID of a delta that currently exists in the SCCS file, to which changes are made to make the new delta
- SID for the new delta to be created
- Username of the person who has the file checked out for editing.
- Date that the version was checked out.
- Time that the version was checked out.

If a directory name is used in place of the `s.filename` argument, the `sact` command applies to all .s.files in that directory. Unreadable .s.files produce an error; processing continues with the next file (if any). The use of `−` as the `s.filename` argument indicates that the names of files are to be read from the standard input, one .s.file per line.

Environment Variables  See `environ(5)` for descriptions of the following environment variables that affect the execution of `sact`: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Attributes   See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/build/make</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See <code>standards(5)</code></td>
</tr>
</tbody>
</table>

See Also          `sccs(1), sccs-delta(1), sccs-get(1), sccs-help(1), sccs-prs(1), sccs-prt(1), what(1), sccsfile(4), attributes(5), environ(5), standards(5)`

Diagnostics      Use the `sccs-help` command for explanations of SCCS commands. See `sccs-help(1)`. 
**Name**
scs-sccsdiff, sccsdiff – compare two versions of an SCCS file

**Synopsis**
```
sccsdiff [-p] -rsid -rsid [diff-options] s.filename
```

**Description**
sccsdiff compares two versions of an SCCS file and displays the differences between the two versions. Any number of SCCS files can be specified. The options specified apply to all named files.

**Options**
The following options are supported:
- `-p` Pipe output for each file through `pr(1)`.
- `-rsid` Specify a version corresponding to the indicated SCCS delta ID (SID) for comparison. Versions are passed to `diff(1)` in the order given.
- `diff-options` Pass options to `diff(1)`, including: `-b`, `-c`, `-e`, `-f`, `-h`, `-u`, `-C number`, `-U number`, and `-D string`.

**Files**
```
/tmp/get????? temporary files
```

**Attributes**
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/build/make</td>
</tr>
</tbody>
</table>

**See Also**
diff(1), scs(1), scss-delta(1), scs-get(1), scss-help(1), scss-prs(1), scss-prt(1), what(1), scssfile(4), attributes(5)

**Diagnostics**
- `filename: No differences` If the two versions are the same.
- Use the `scs-help` command for explanations of SCCS commands. See `scs-help(1)`.

User Commands 1647
sccs-unget, unget – undo a previous get of an SCCS file

Synopsis

unget [-ns] [-rsid] s.filename ...

Description

The unget utility undoes the effect of a get-e command executed before the creation of the pending delta.

If a directory name is used in place of the s.filename argument, the unget command applies to all s. files in that directory. Unreadable s. files produce an error; processing continues with the next file (if any). The use of ‘−’ as the s.filename argument indicates that the names of files are to be read from the standard input, one s. file per line.

Options

The following options are supported:

- n Retains the retrieved version, which is otherwise removed.
- s Suppress display of the SCCS delta ID (SID).
- rsid When multiple versions are checked out, this option specifies which pending delta to abort. A diagnostic results if the specified SID is ambiguous, or if it is necessary but omitted from the command line.

Environment Variables

See environ(5) for descriptions of the following environment variables that affect the execution of unget: LANG, LC_ALL, LC_COLLATE, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/build/make</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also


Diagnostics

Use the sccs-help command for explanations of SCCS commands. See sccs-help(1).
val [-s] [-m name] [-r sid] [-y type] s.filename...

The val utility determines if the specified s. files meet the characteristics specified by the indicated arguments. val can process up to 50 files on a single command line.

val has a special argument, ‘−’, which reads the standard input until the end-of-file condition is detected. Each line read is independently processed as if it were a command line argument list.

val generates diagnostic messages on the standard output for each command line and file processed and also returns a single 8−bit code upon exit as described below.

The 8-bit code returned by val is a disjunction of the possible errors, that is, it can be interpreted as a bit string where (moving from left to right) the bits set are interpreted as follows:

bit 0 = missing file argument
bit 1 = unknown or duplicate option
bit 2 = corrupted s.file
bit 3 = can not open file or file not in s.file format
bit 4 = the SCCS delta ID (SID) is invalid or ambiguous
bit 5 = the SID does not exist
bit 6 = mismatch between Y% and -y argument
bit 7 = mismatch between sccs-val.1 and -m argument

val can process two or more files on a given command line, and in turn can process multiple command lines (when reading the standard input). In these cases, an aggregate code is returned which is the logical OR of the codes generated for each command line and file processed.

Options
The following options are supported:

- s Silent. Suppresses the normal error or warning messages.
- m name Compares name with the %M% ID keyword in the s . file.
- rsid Checks to see if the indicated SID is ambiguous, invalid, or absent from the s . file.
- y type Compares type with the %Y% ID keyword.

Environment Variables
See environ(5) for descriptions of the following environment variables that affect the execution of val: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLS_PATH.

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/build/make</td>
</tr>
</tbody>
</table>
Interface Stability: Committed

Standard: See standards(5).

See Also: sccs(1), sccs-admin(1), sccs-delta(1), sccs-get(1), sccs-help(1), what(1), sccsfile(4), attributes(5), environ(5), standards(5)

Diagnostics: Use the sccs-help command for explanations of SCCS commands. See sccs-help(1).
scp – secure copy (remote file copy program)

Synopsis

```
scp [-pqrvC46] [-F ssh_config] [-S program] [-P port]
    [-c cipher] [-i identity_file] [-o ssh_option]
    [ user@]host1:file1 ... [ ] user@host2:file2
```

Description

The `scp` utility copies files between hosts on a network. It uses `ssh(1)` for data transfer, and uses the same authentication and provides the same security as `ssh(1)`. Unlike `rcp(1)`, `scp` will ask for passwords or passphrases if they are needed for authentication.

Any file name may contain a host and user specification to indicate that the file is to be copied to/from that host. Copies between two remote hosts are permitted.

Options

The following options are supported:

- `-4` Forces `scp` to use IPv4 addresses only.
- `-6` Forces `scp` to use IPv6 addresses only.
- `-B` Selects batch mode. (Prevents asking for passwords or passphrases.)
- `-c cipher` Selects the cipher to use for encrypting the data transfer. This option is directly passed to `ssh(1)`.
- `-C` Compression enable. Passes the `-C` flag to `ssh(1)` to enable compression.
- `-F ssh_config` Specifies an alternative per-user configuration file for `ssh(1)`.
- `-i identity_file` Selects the file from which the identity (private key) for RSA authentication is read. This option is directly passed to `ssh(1)`.
- `-o ssh_option` The given option is directly passed to `ssh(1)`.
- `-p` Preserves modification times, access times, and modes from the original file.
- `-P port` Specifies the port to connect to on the remote host. Notice that this option is written with a capital ‘P’, because `-p` is already reserved for preserving the times and modes of the file in `rcp(1)`.
- `-q` Disables the progress meter.
- `-r` Recursively copies entire directories.
- `-S program` Specifies the name of the program to use for the encrypted connection. The program must understand `ssh(1)` options.
- `-v` Verbose mode. Causes `scp` and `ssh(1)` to print debugging messages about their progress. This is helpful in debugging connection, authentication, and configuration problems.
Operands  The following operands are supported:

    host1, host2,...  The name(s) of the host from or to which the file is to be copied.

    file1, file2,...  The file(s) to be copied.

Exit Status  The following exit values are returned:

    0  Successful completion.

    1  An error occurred.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>network/ssh</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  rcp(1), ssh(1), ssh-add(1), ssh-agent(1), ssh-keygen(1), sshd(1M), ssh_config(4), attributes(5)

Notes  Generally, use of scp with password or keyboard-interactive authentication method and two remote hosts does not work. It does work with either the pubkey, hostbased or gssapi-keyex authentication method. For the pubkey authentication method, either private keys not protected by a passphrase, or an explicit ssh agent forwarding have to be used. The gssapi-keyex authentication method works with the kerberos_v5 GSS-API mechanism, but only if the GSSAPIDelegateCredentials option is enabled.
Name          script – make record of a terminal session

Synopsis       script [-a] [filename]

Description    The script utility makes a record of everything printed on your screen. The record is written to filename. If no file name is given, the record is saved in the file typescript. See WARNINGS.

The script command forks and creates a sub-shell, according to the value of $SHELL, and records the text from this session. The script ends when the forked shell exits or when Control-d is typed.

Options        The following option is supported:

-a            Appends the session record to filename, rather than overwriting it.

Notes          script places everything that appears on the screen in filename, including prompts.

Attributes     See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

See Also        attributes(5)

Warnings        script can pose a security risk when used in directories that are writable by other users (for example, /tmp), especially when run by a privileged user, that is, root. Be sure that typescript is not a link before running script.
sdiff(1)

Name
sdiff – print differences between two files side-by-side

Synopsis
sdiff [-l] [-s] [-o output] [-w n] filename1 filename2

Description
sdiff uses the output of the diff command to produce a side-by-side listing of two files indicating lines that are different. Lines of the two files are printed with a blank gutter between them if the lines are identical, a < in the gutter if the line appears only in filename1, a > in the gutter if the line appears only in filename2, and a | for lines that are different. (See the EXAMPLES section below.)

Options
- l
  Print only the left side of any lines that are identical to
- s
  Do not print identical lines.
- o output
  Use the argument output as the name of a third file that is created as a user-controlled merge of filename1 and filename2. Identical lines of filename1 and filename2 are copied to output. Sets of differences, as produced by diff, are printed; where a set of differences share a common gutter character. After printing each set of differences, sdiff prompts the user with a % and waits for one of the following user-typed commands:
  \l Append the left column to the output file.
  r Append the right column to the output file.
  s Turn on silent mode; do not print identical lines.
  v Turn off silent mode.
  e l Call the editor with the left column.
  e r Call the editor with the right column.
  e b Call the editor with the concatenation of left and right.
  e Call the editor with a zero length file.
  q Exit from the program.

On exit from the editor, the resulting file is concatenated to the end of the output file.

- w n
  Use the argument n as the width of the output line. The default line length is 130 characters.

Usage
See largefile(5) for the description of the behavior of sdiff when encountering files greater than or equal to 2 Gbyte (2^{31} bytes).

Examples
EXAMPLE 1  An example of the sdiff command.
A sample output of sdiff follows.
EXAMPLE 1  An example of the sdiff command.  (Continued)

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>a</td>
</tr>
<tr>
<td>b</td>
<td>&lt;</td>
</tr>
<tr>
<td>c</td>
<td>&lt;</td>
</tr>
<tr>
<td>d</td>
<td>d</td>
</tr>
<tr>
<td></td>
<td>&gt; c</td>
</tr>
</tbody>
</table>

Environment Variables

If any of the LC_* variables (LC_CTYPE, LC_MESSAGES, LC_TIME, LC_COLLATE, LC_NUMERIC, and LC_MONETARY) (see environ(5)) are not set in the environment, the operational behavior of sdiff for each corresponding locale category is determined by the value of the LANG environment variable. If LC_ALL is set, its contents are used to override both the LANG and the other LC_* variables. If none of the above variables is set in the environment, the "C" locale determines how sdiff behaves.

<table>
<thead>
<tr>
<th>Environment Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC_CTYPE</td>
<td>Determines how sdiff handles characters. When LC_CTYPE is set to a valid value, sdiff can display and handle text and filenames containing valid characters for that locale.</td>
</tr>
</tbody>
</table>

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

See Also  diff(1), ed(1), attributes(5), environ(5), largefile(5)
sed – stream editor

Description

The sed utility is a stream editor that reads one or more text files, makes editing changes according to a script of editing commands, and writes the results to standard output. The script is obtained from either the `script` operand string, or a combination of the option-arguments from the `-e script` and `-f script_file` options.

The sed utility is a text editor. It cannot edit binary files or files containing ASCII NUL (\0) characters or very long lines.

Options

The following options are supported:

- `-e script` 
  `script` is an edit command for sed. See USAGE below for more information on the format of `script`. If there is just one `-e option and no `-f` options, the flag `-e` may be omitted.

- `-f script_file` 
  Takes the script from `script_file`. `script_file` consists of editing commands, one per line.

- `-n` 
  Suppresses the default output.

Multiple `-e` and `-f` options may be specified. All commands are added to the script in the order specified, regardless of their origin.

Operands

The following operands are supported:

- `file` 
  A path name of a file whose contents will be read and edited. If multiple `file` operands are specified, the named files will be read in the order specified and the concatenation will be edited. If no `file` operands are specified, the standard input will be used.

- `script` 
  A string to be used as the script of editing commands. The application must not present a `script` that violates the restrictions of a text file except that the final character need not be a NEWLINE character.

Usage

A script consists of editing commands, one per line, of the following form:

```
[ address [, address ] ] command [ arguments ]
```

Zero or more blank characters are accepted before the first address and before `command`. Any number of semicolons are accepted before the first address.
In normal operation, sed cyclically copies a line of input (less its terminating \texttt{NEWLINE} character) into a \texttt{pattern space} (unless there is something left after a \texttt{d} command), applies in sequence all commands whose \texttt{addresses} select that pattern space, and copies the resulting pattern space to the standard output (except under \texttt{-n}) and deletes the pattern space. Whenever the pattern space is written to standard output or a named file, sed will immediately follow it with a \texttt{NEWLINE} character.

Some of the commands use a \texttt{hold space} to save all or part of the \texttt{pattern space} for subsequent retrieval. The \texttt{pattern} and \texttt{hold spaces} will each be able to hold at least 8192 bytes.

\textbf{sed Addresses}  
An \texttt{address} is either empty, a decimal number that counts input lines cumulatively across files, a \$ that addresses the last line of input, or a context address, which consists of a \texttt{/regular expression/} as described on the \texttt{regexp(5)} manual page.

A command line with no addresses selects every pattern space.

A command line with one address selects each pattern space that matches the address.

A command line with two addresses selects the inclusive range from the first pattern space that matches the first address through the next pattern space that matches the second address. Thereafter the process is repeated, looking again for the first address. (If the second address is a number less than or equal to the line number selected by the first address, only the line corresponding to the first address is selected.)

Typically, address are separated from each other by a comma (,). They may also be separated by a semicolon (;).

\textbf{sed Regular Expressions}  
sed supports the basic regular expressions described on the \texttt{regexp(5)} manual page, with the following additions:

\begin{itemize}
  \item \texttt{\backslash cREc} \quad In a context address, the construction \texttt{\backslash cREc}, where \texttt{c} is any character other than a backslash or \texttt{NEWLINE} character, is identical to \texttt{/RE/}. If the character designated by \texttt{c} appears following a backslash, then it is considered to be that literal character, which does not terminate the \texttt{RE}. For example, in the context address \texttt{\backslash abc\backslash xdefx}, the second \texttt{x} stands for itself, so that the regular expression is \texttt{abc\backslash xdef}.
  \item \texttt{\backslash n} \quad The escape sequence \texttt{\backslash n} matches a \texttt{NEWLINE} character embedded in the pattern space. A literal \texttt{NEWLINE} character must not be used in the regular expression of a context address or in the substitute command.
\end{itemize}

Editing commands can be applied only to non-selected pattern spaces by use of the negation command \texttt{!} (described below).

\textbf{sed Editing Commands}  
In the following list of functions the maximum number of permissible addresses for each function is indicated.
The r and w commands take an optional rfile (or wfile) parameter, separated from the command letter by one or more blank characters.

Multiple commands can be specified by separating them with a semicolon (;) on the same command line.

The text argument consists of one or more lines, all but the last of which end with \ to hide the NEWLINE. Each embedded NEWLINE character in the text must be preceded by a backslash. Other backslashes in text are removed and the following character is treated literally. Backslashes in text are treated like backslashes in the replacement string of an s command, and may be used to protect initial blanks and tabs against the stripping that is done on every script line. The rfile or wfile argument must terminate the command line and must be preceded by exactly one blank. The use of the wfile parameter causes that file to be initially created, if it does not exist, or will replace the contents of an existing file. There can be at most 10 distinct wfile arguments.

Regular expressions match entire strings, not just individual lines, but a NEWLINE character is matched by \n in a sed RE. A NEWLINE character is not allowed in an RE. Also notice that \n cannot be used to match a NEWLINE character at the end of an input line; NEWLINE characters appear in the pattern space as a result of the N editing command.

Two of the commands take a command-list, which is a list of sed commands separated by NEWLINE characters, as follows:

{ command command }

The { can be preceded with blank characters and can be followed with white space. The commands can be preceded by white space. The terminating } must be preceded by a NEWLINE character and can be preceded or followed by <blank>s. The braces may be preceded or followed by <blank>s. The command may be preceded by <blank>s, but may not be followed by <blank>s.

The following table lists the functions, with the maximum number of permissible addresses.

<table>
<thead>
<tr>
<th>Max Address</th>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>a\ text</td>
<td>Append by executing N command or beginning a new cycle. Place text on the output before reading the next input line.</td>
</tr>
<tr>
<td>2</td>
<td>b label</td>
<td>Branch to the : command bearing the label. If label is empty, branch to the end of the script. Labels are recognized unique up to eight characters.</td>
</tr>
<tr>
<td>2</td>
<td>c\ text</td>
<td>Change. Delete the pattern space. Place text on the output. Start the next cycle.</td>
</tr>
</tbody>
</table>
Max Address| Command| Description
---|---|---
2| d| Delete the pattern space. Start the next cycle.
2| D| Delete the initial segment of the pattern space through the first new-line. Start the next cycle. (See the N command below.)
2| g| Replace the contents of the pattern space by the contents of the hold space.
2| G| Append the contents of the hold space to the pattern space.
2| h| Replace the contents of the hold space by the contents of the pattern space.
2| H| Append the contents of the pattern space to the hold space.
1| i\ text\| Insert. Place text on the standard output.
2| l| /usr/bin/sed: List the pattern space on the standard output in an unambiguous form. Non-printable characters are displayed in octal notation and long lines are folded.
2| l| /usr/xpg4/bin/sed: List the pattern space on the standard output in an unambiguous form. Non-printable characters are displayed in octal notation and long lines are folded. The characters (\, \a, \b, \f, \r, \t, and \v) are written as the corresponding escape sequences. Non-printable characters not in that table will be written as one three-digit octal number (with a preceding backslash character) for each byte in the character (most significant byte first). If the size of a byte on the system is greater than nine bits, the format used for non-printable characters is implementation dependent. Long lines are folded, with the point of folding indicated by writing a backslash followed by a NEWLINE; the length at which folding occurs is unspecified, but should be appropriate for the output device. The end of each line is marked with a $.
2| n| Copy the pattern space to the standard output if default output is not suppressed. Replace the pattern space with the next line of input.
2| N| Append the next line of input to the pattern space with an embedded new-line. (The current line number changes.) If no next line of input is available, the N command verb shall branch to the end of the script and quit without starting a new cycle and without writing the pattern space.
2| p| Print. Copy the pattern space to the standard output.
<table>
<thead>
<tr>
<th>Max Address</th>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>\p</td>
<td>Copy the initial segment of the pattern space through the first new-line to the standard output.</td>
</tr>
<tr>
<td>1</td>
<td>\q</td>
<td>Quit. Branch to the end of the script. Do not start a new cycle.</td>
</tr>
<tr>
<td>2</td>
<td>\r \rfile</td>
<td>Read the contents of \rfile. Place them on the output before reading the next input line. If \rfile does not exist or cannot be read, it is treated as if it were an empty file, causing no error condition.</td>
</tr>
<tr>
<td>2</td>
<td>\t \label</td>
<td>Test. Branch to the : command bearing the \label if any substitutions have been made since the most recent reading of an input line or execution of a t. If \label is empty, branch to the end of the script.</td>
</tr>
<tr>
<td>2</td>
<td>\w \wfile</td>
<td>Write. Append the pattern space to \wfile. The first occurrence of \w will cause \wfile to be cleared. Subsequent invocations of \w will append. Each time the sed command is used, \wfile is overwritten.</td>
</tr>
<tr>
<td>2</td>
<td>\x</td>
<td>Exchange the contents of the pattern and hold spaces.</td>
</tr>
<tr>
<td>2</td>
<td>! \command</td>
<td>Don’t. Apply the \command (or group, if \command is { }) only to lines not selected by the address(es).</td>
</tr>
<tr>
<td>0</td>
<td>: \label</td>
<td>This command does nothing; it bears a \label for b and t commands to branch to.</td>
</tr>
<tr>
<td>1</td>
<td>=</td>
<td>Place the current line number on the standard output as a line.</td>
</tr>
<tr>
<td>2</td>
<td>{ \command-list }</td>
<td>Execute \command-list only when the pattern space is selected.</td>
</tr>
<tr>
<td>0</td>
<td>#</td>
<td>An empty command is ignored.</td>
</tr>
<tr>
<td>0</td>
<td>#</td>
<td>If a # appears as the first character on a line of a script file, then that entire line is treated as a comment, with one exception: if a # appears on the first line and the character after the # is an n, then the default output will be suppressed. The rest of the line after #n is also ignored. A script file must contain at least one non-comment line.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Max Addr</th>
<th>Command (Using strings) and Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>s/regular expression/replacement/flags</td>
</tr>
</tbody>
</table>
Max Addr | Command (Using strings) and Description
--- | ---
 | Substitute the replacement string for instances of the regular expression in the pattern space. Any character other than backslash or newline can be used instead of a slash to delimit the RE and the replacement. Within the RE and the replacement, the RE delimiter itself can be used as a literal character if it is preceded by a backslash.

An ampersand (&) appearing in the replacement will be replaced by the string matching the RE. The special meaning of & in this context can be suppressed by preceding it by backslash. The characters \n, where n is a digit, will be replaced by the text matched by the corresponding backreference expression. For each backslash (\) encountered in scanning replacement from beginning to end, the following character loses its special meaning (if any). It is unspecified what special meaning is given to any character other than &, \ or digits.

A line can be split by substituting a NEWLINE character into it. The application must escape the NEWLINE character in the replacement by preceding it with backslash. A substitution is considered to have been performed even if the replacement string is identical to the string that it replaces.

flags is zero or more of:

n n=1 - 512. Substitute for just the nth occurrence of the regular expression.

g Global. Substitute for all nonoverlapping instances of the regular expression rather than just the first one. If both g and n are specified, the results are unspecified.

p Print the pattern space if a replacement was made.

P Copy the initial segment of the pattern space through the first new-line to the standard output.

w wfile Write. Append the pattern space to wfile if a replacement was made. The first occurrence of w will cause wfile to be cleared. Subsequent invocations of w will append. Each time the sed command is used, wfile is overwritten.

2 y/ string1 / string2 /

Transform. Replace all occurrences of characters in string1 with the corresponding characters in string2. string1 and string2 must have the same number of characters, or if any of the characters in string1 appear more than once, the results are undefined. Any character other than backslash or NEWLINE can be used instead of slash to delimit the strings. Within string1 and string2, the delimiter itself can be used as a literal character if it is preceded by a backslash. For example, y/abc/ABC/ replaces a with A, b with B, and c with C.

See largefile(5) for the description of the behavior of sed when encountering files greater than or equal to 2 Gbyte (2^31 bytes).
Examples

**EXAMPLE 1**  An example sed script

This sed script simulates the BSD `cat -s` command, squeezing excess blank lines from standard input.

```bash
sed -n ' 
  # Write non-empty lines.
  /./    { 
    p 
    d 
  } 
  # Write a single empty line, then look for more empty lines.
  /^$/  p 
  # Get next line, discard the held <newline> (empty line),
  # and look for more empty lines.
  :Empty
  /^$/    { 
    N 
    s/\n// 
    b Empty 
  } 
  # Write the non-empty line before going back to search 
  # for the first in a set of empty lines.
  ,
  p
',
```

Environment Variables

See `environ(5)` for descriptions of the following environment variables that affect the execution of `sed`: LANG, LC_ALL, LC_COLLATE, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status

The following exit values are returned:

- **0**  Successful completion.
- **>0**  An error occurred.

Attributes

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>/usr/bin/sed</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
<td></td>
</tr>
<tr>
<td>CSI</td>
<td>Not enabled</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>/usr/xpg4/bin/sed</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/xopen/xcu4</td>
<td></td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
<td></td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
<td></td>
</tr>
</tbody>
</table>
### Attribute Type and Value

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
</table>
| Standard       | See `standards(5)`.

**See Also**  
`awk(1), ed(1), grep(1), attributes(5), environ(5), largefile(5), regexp(5), standards(5)`
The sed utility copies the filenames (standard input default) to the standard output, edited according to a script of commands.

The following options are supported:

- `-n` Suppresses the default output.
- `-e script` `script` is an edit command for sed. If there is just one `-e` option and no `-f` options, the `-e` flag may be omitted.
- `-f sfilename` Takes the script from `sfilename`.

sed scripts consist of editing commands, one per line, of the following form:

```
{ address [, address ] } function { arguments }
```

In normal operation, sed cyclically copies a line of input into a pattern space (unless there is something left after a `D` command), sequentially applies all commands with addresses matching that pattern space until reaching the end of the script, copies the pattern space to the standard output (except under `-n`), and finally, deletes the pattern space.

Some commands use a `hold space` to save all or part of the pattern space for subsequent retrieval.

An `address` is either:

- a decimal number linecount, which is cumulative across input files;
- a `$`, which addresses the last input line;
- or a context address, which is a `/regular expression/` as described on the `regexp(5)` manual page, with the following exceptions:

  - `\?RE?` In a context address, the construction `\?regular expression?`, where `?` is any character, is identical to `/regular expression/`. Note: in the context address `\xabc\xdef\x`, the second `x` stands for itself, so that the regular expression is `abcxdef`.

  - `\n` Matches a NEWLINE embedded in the pattern space.

  - `.` Matches any character except the NEWLINE ending the pattern space.

  - `null` A command line with no address selects every pattern space.

  - `address` Selects each pattern space that matches.
Selects the inclusive range from the first pattern space matching `address1` to the first pattern space matching `address2`. Selects only one line if `address1` is greater than or equal to `address2`.

If the first nonwhite character in a line is a '#' (pound sign), `sed` treats that line as a comment, and ignores it. If, however, the first such line is of the form:

```
#n
```

`sed` runs as if the `-n` flag were specified.

The maximum number of permissible addresses for each function is indicated in parentheses in the list below.

An argument denoted `text` consists of one or more lines, all but the last of which end with `\` to hide the NEWLINE. Backslashes in text are treated like backslashes in the replacement string of an `s` command, and may be used to protect initial SPACE and TAB characters against the stripping that is done on every script line.

An argument denoted `rfilename` or `wfilename` must terminate the command line and must be preceded by exactly one SPACE. Each `wfilename` is created before processing begins. There can be at most 10 distinct `wfilename` arguments.

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>a\text</code></td>
<td>Append: place <code>text</code> on the output before reading the next input line.</td>
</tr>
<tr>
<td><code>b label</code></td>
<td>Branch to the <code>'.'</code> command bearing the <code>label</code>. Branch to the end of the script if <code>label</code> is empty.</td>
</tr>
<tr>
<td><code>c\text</code></td>
<td>Change: delete the pattern space. With 0 or 1 address or at the end of a 2 address range, place <code>text</code> on the output. Start the next cycle.</td>
</tr>
<tr>
<td><code>d</code></td>
<td>Delete the pattern space. Start the next cycle.</td>
</tr>
<tr>
<td><code>D</code></td>
<td>Delete the initial segment of the pattern space through the first NEWLINE. Start the next cycle.</td>
</tr>
<tr>
<td><code>g</code></td>
<td>Replace the contents of the pattern space by the contents of the hold space.</td>
</tr>
<tr>
<td><code>G</code></td>
<td>Append the contents of the hold space to the pattern space.</td>
</tr>
<tr>
<td><code>h</code></td>
<td>Replace the contents of the hold space by the contents of the pattern space.</td>
</tr>
<tr>
<td><code>H</code></td>
<td>Append the contents of the pattern space to the hold space.</td>
</tr>
<tr>
<td><code>i\text</code></td>
<td>Insert: place <code>text</code> on the standard output.</td>
</tr>
</tbody>
</table>
List the pattern space on the standard output in an unambiguous form. Non-printing characters are spelled in two digit ASCII and long lines are folded.

Copy the pattern space to the standard output. Replace the pattern space with the next line of input.

Append the next line of input to the pattern space with an embedded newline. (The current line number changes.)

Print: copy the pattern space to the standard output.

Copy the initial segment of the pattern space through the first NEWLINE to the standard output.

Quit: branch to the end of the script. Do not start a new cycle.

Read the contents of rfilename. Place them on the output before reading the next input line.

Substitute the replacement string for instances of the regular expression in the pattern space. Any character may be used instead of '/' . For a fuller description see regexp(5). flags is zero or more of:

- n = 1 − 512. Substitute for just the nth occurrence of the regular expression.
- g Global: substitute for all nonoverlapping instances of the regular expression rather than just the first one.
- p Print the pattern space if a replacement was made.
- w wfilename Write: append the pattern space to wfilename if a replacement was made.

Test: branch to the ':' command bearing the label if any substitutions have been made since the most recent reading of an input line or execution of a t. If label is empty, branch to the end of the script.

Write: append the pattern space to wfilename.

Exchange the contents of the pattern and hold spaces.
(2)y/string1/string2/  Transform: replace all occurrences of characters in string1 with the corresponding character in string2. The lengths of string1 and string2 must be equal.

(2) function  Do not: apply the function (or group, if function is ‘{’ only to lines not selected by the address(es).

(0): label  This command does nothing. It bears a label for b and t commands to branch to. Note: The maximum length of label is seven characters.

(1)=  Place the current line number on the standard output as a line.

(2)  Execute the following commands through a matching ‘}’ only when the pattern space is selected. Commands are separated by ‘;’.

(0)  An empty command is ignored.

Large Files  See largefile(5) for the description of the behavior of sed when encountering files greater than or equal to 2 Gbyte (2^31 bytes).

Diagnostics  Too many commands  The command list contained more than 200 commands.

Too much command text  The command list was too big for sed to handle. Text in the a, c, and i commands, text read in by r commands, addresses, regular expressions and replacement strings in s commands, and translation tables in y commands all require sed to store data internally.

Command line too long  A command line was longer than 4000 characters.

Too many line numbers  More than 256 decimal number linecounts were specified as addresses in the command list.

Too many files in w commands  More than 10 different files were specified in w commands or w options for s commands in the command list.

Too many labels  More than 50 labels were specified in the command list.

Unrecognized command  A command was not one of the ones recognized by sed.

Extra text at end of command  A command had extra text after the end.
Illegal line number

An address was neither a decimal number linecount, a $, nor a context address.

Space missing before filename

There was no space between an r or w command, or the w option for a s command, and the filename specified for that command.

Too many {’s

There were more { than } in the list of commands to be executed.

Too many }’s

There were more } than { in the list of commands to be executed.

No addresses allowed

A command that takes no addresses had an address specified.

Only one address allowed

A command that takes one address had two addresses specified.

"\digit" out of range

The number in a \n item in a regular expression or a replacement string in an s command was greater than 9.

Bad number

One of the endpoints in a range item in a regular expression (that is, an item of the form \{n\} or \{n,m\}) was not a number.

Range endpoint too large

One of the endpoints in a range item in a regular expression was greater than 255.

More than 2 numbers given in \{ \}

More than two endpoints were given in a range expression.

} expected after \

A \ appeared in a range expression and was not followed by a }.

First number exceeds second in \{ \}

The first endpoint in a range expression was greater than the second.

Illegal or missing delimiter

The delimiter at the end of a regular expression was absent.

\{ \} imbalance

There were more \( than \), or more \) than \(, in a regular expression.

[ ] imbalance

There were more [ than ], or more ] than [, in a regular expression.
First RE may not be null

The first regular expression in an address or in a s command was null (empty).

Ending delimiter missing on substitution

The ending delimiter in a s command was absent.

Ending delimiter missing on string

The ending delimiter in a y command was absent.

Transform strings not the same size

The two strings in a y command were not the same size.

Suffix too large - 512 max

The suffix in a s command, specifying which occurrence of the regular expression should be replaced, was greater than 512.

Label too long

A label in a command was longer than 8 characters.

Duplicate labels

The same label was specified by more than one : command.

File name too long

The filename specified in a r or w command, or in the w option for a s command, was longer than 1024 characters.

Output line too long

An output line was longer than 4000 characters long.

Too many appends or reads after line n

More than 20 a or r commands were to be executed for line n.

Hold space overflowed.

More than 4000 characters were to be stored in the hold space.

Files

usr/ucb/sed    BSD sed

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>

See Also

awk(1), grep(1), lex(1), attributes(5), largefile(5), regexp(5)

Bugs

There is a combined limit of 200 - e and - f arguments. In addition, there are various internal size limits which, in rare cases, may overflow. To overcome these limitations, either combine or break out scripts, or use a pipeline of sed commands.
**set(1)**

**Name** set, unset, setenv, unsetenv, export – shell built-in functions to determine the characteristics for environmental variables of the current shell and its descendents

**Synopsis**

```sh
csh
ksh88
ksh
```

```sh
does not change any of the flags. This option is useful in setting $1 to -.
```

```sh
Marks variables which are modified or created for export.
```

```sh
Exits immediately if a command exits with a non-zero exit status.
```

```sh
Disables file name generation.
```

```sh
Locates and remembers function commands as functions are defined. Function commands are normally located when the function is executed.
```

```sh
All keyword arguments are placed in the environment for a command, not just those that precede the command name.
```

```sh
Reads commands but does not execute them.
```

```sh
Exits after reading and executing one command.
```

**Description**

The set built-in command has the following options:

- - Does not change any of the flags. This option is useful in setting $1 to -.
- a Marks variables which are modified or created for export.
- e Exits immediately if a command exits with a non-zero exit status.
- f Disables file name generation.
- h Locates and remembers function commands as functions are defined. Function commands are normally located when the function is executed.
- k All keyword arguments are placed in the environment for a command, not just those that precede the command name.
- n Reads commands but does not execute them.
- t Exits after reading and executing one command.

**Synopsis**

```sh
csh
ksh88
ksh
```

```sh
```
- u  Treats unset variables as an error when substituting.
- v  Prints shell input lines as they are read.
- x  Prints commands and their arguments as they are executed.

Using + rather than – causes these flags to be turned off. These flags can also be used upon invocation of the shell. The current set of flags can be found in $−. The remaining arguments are positional parameters and are assigned, in order, to $1, $2, . . . . If no arguments are specified the values of all names are printed.

For each name, unset removes the corresponding variable or function value. The variables PATH, PS1, PS2, MAILCHECK, and IF cannot be unset.

With the export built-in, the specified names are marked for automatic export to the environment of subsequently executed commands. If no arguments are specified, variable names that have been marked for export during the current shell’s execution are listed. Function names are not exported.

With no arguments, set displays the values of all shell variables. Multiword values are displayed as a parenthesized list. With the var argument alone, set assigns an empty (null) value to the variable var. With arguments of the form var = value set assigns value to var, where value is one of:

word         A single word (or quoted string).
(wordlist)   A space-separated list of words enclosed in parentheses.

Values are command and filename expanded before being assigned. The form set var(n)=word replaces the n'th word in a multiword value with word.

unset removes variables whose names match (filename substitution) pattern. All variables are removed by ‘unset *’.

With no arguments, setenv displays all environment variables. With the VAR argument, setenv sets the environment variable VAR to an empty (null) value. (By convention, environment variables are normally specified upper-case names.) With both VAR and word arguments specified, setenv sets VAR to word, which must be either a single word or a quoted string. The PATH variable can take multiple word arguments, separated by colons (see EXAMPLES). The most commonly used environment variables, USER, TERM, and PATH, are automatically imported to and exported from the csh variables user, term, and path. Use setenv if you need to change these variables. In addition, the shell sets the PWD environment variable from the csh variable cwd whenever the latter changes.

The environment variables LC_CTYPE, LC_MESSAGES, LC_TIME, LC_COLLATE, LC_NUMERIC, and LC_MONETARY take immediate effect when changed within the C shell. See environ(5) for descriptions of these environment variables.
unsetenv removes variable from the environment. As with unset, pattern matching is not performed.

ksh88 The flags for the set built-in have meaning as follows:

- **-A** Array assignment. Unsets the variable name and assigns values sequentially from the list arg. If +A is used, the variable name is not unset first.
- **-a** All subsequent variables that are defined are automatically exported.
- **-b** Causes the shell to notify the user asynchronously of background job completions.
- **-C** Prevents existing files from being overwritten by the shell’s > redirection operator. The > | redirection operator overrides this noclobber option for an individual file.
- **-e** If a command has a non-zero exit status, executes the ERR trap, if set, and exits. This mode is disabled while reading profiles.
- **-f** Disables file name generation.
- **-h** Each command becomes a tracked alias when first encountered.
- **-k** All variable assignment arguments are placed in the environment for a command, not just those that precede the command name.
- **-m** Background jobs run in a separate process group and a line prints upon completion. The exit status of background jobs is reported in a completion message. On systems with job control, this flag is turned on automatically for interactive shells.
- **-n** Reads commands and checks them for syntax errors, but does not execute them. Ignored for interactive shells.
- **+o** Writes the current option settings to standard output in a format that is suitable for reinput to the shell as commands that achieve the same option settings.

**-o option** The option argument can be one of the following option names:

- **allexport** Same as -a.
- **errexit** Same as -e.
- **bgnice** All background jobs are run at a lower priority. This is the default mode. emacs Puts you in an emacs style in-line editor for command entry.
- **gmacs** Puts you in a gmacs style in-line editor for command entry.
- **ignoreeof** The shell does not exit on end-of-file. The command exit must be used.
keyword Same as -k.
markdirs All directory names resulting from file name generation have a trailing / appended.
monitor Same as -m.
oclobber Prevents redirection operator > from truncating existing files. Requires the > | operator to truncate a file when turned on. Same as -C.
noexec Same as -n.
noglob Same as -f.
nolog Does not save function definitions in history file.
notify Same as -b.
nounset Same as -u.
privileged Same as -p.
verbose Same as -v.
trackall Same as -h.
vi Puts you in insert mode of a vi style in-line editor until you hit escape character 033. This puts you in control mode. A return sends the line.
viraw Each character is processed as it is typed in vi mode.
xtrace Same as -x.

If no option name is supplied then the current option settings are printed.

-p Disables processing of the $HOME/.profile file and uses the file /etc/suid_profile instead of the ENV file. This mode is on whenever the effective uid is not equal to the real uid, or when the effective gid is not equal to the real gid. Turning this off causes the effective uid and gid to be set to the real uid and gid.
-s Sorts the positional parameters lexicographically.
-t Exits after reading and executing one command.
-u Treats unset parameters as an error when substituting.
-v Prints shell input lines as they are read.
-x Prints commands and their arguments as they are executed.
- T urns off -x and -v flags and stops examining arguments for flags.
Does not change any of the flags. This option is useful in setting $1 to a value beginning with --. If no arguments follow this flag then the positional parameters are unset.

Using + rather than – causes these flags to be turned off. These flags can also be used upon invocation of the shell. The current set of flags can be found in $-. Unless -A is specified, the remaining arguments are positional parameters and are assigned, in order, to $1 $2 . . . . If no arguments are specified then the names and values of all variables are printed on the standard output.

The variables specified by the list of names are unassigned, that is, their values and attributes are erased. readonly variables cannot be unset. If the -f flag is set, then the names refer to function names. Unsetting ERRNO, LINENO, MAILCHECK, OPTARG, OPTIND, RANDOM, SECONDS, TMOUT, and _ removes their special meaning even if they are subsequently assigned.

When using unset, the variables specified by the list of names are unassigned, i.e., their values and attributes are erased. readonly variables cannot be unset. If the -f, flag is set, then the names refer to function names. Unsetting ERRNO, LINENO, MAILCHECK, OPTARG, OPTIND, RANDOM, SECONDS, TMOUT, and _ removes their special meaning even if they are subsequently assigned.

With the export built-in, the specified names are marked for automatic export to the environment of subsequently-executed commands.

When -p is specified, export writes to the standard output the names and values of all exported variables in the following format:

"export %s=%s\n", name, value

if name is set, and:

"export %s\n", name

if name is unset.

The shell formats the output, including the proper use of quoting, so that it is suitable for reinput to the shell as commands that achieve the same exporting results, except for the following:

1. Read-only variables with values cannot be reset.
2. Variables that were unset at the time they were output are not reset to the unset state if a value is assigned to the variable between the time the state was saved and the time at which the saved output is reinput to the shell.

On this manual page, ksh88(1) commands that are preceded by one or two * (asterisks) are treated specially in the following ways:

1. Variable assignment lists preceding the command remain in effect when the command completes.
2. I/O redirecions are processed after variable assignments.
3. Errors cause a script that contains them to abort.
4. Words, following a command preceded by ** that are in the format of a variable assignment, are expanded with the same rules as a variable assignment. This means that tilde substitution is performed after the = sign and word splitting and file name generation are not performed.

ksh set sets or unsets options and positional parameters. Options that are specified with a - cause the options to be set. Options that are specified with a + cause the option to be unset.

set without any options or arguments displays the names and values of all shell variables in the order of the collation sequence in the current locale. The values are quoted so that they are suitable for input again to the shell.

If no arguments are specified, not even the end of options argument --, the positional parameters are unchanged. Otherwise, unless the -A option has been specified, the positional parameters are replaced by the list of arguments. A first argument of -- is ignored when setting positional parameters.

For backwards compatibility, a set command without any options specified, whose first argument is - turns off the -v and -x options. If any additional arguments are specified, they replace the positional parameters.

The options for set in ksh are:

- **a**
  Set the export attribute for each variable whose name does not contain a . that you assign a value in the current shell environment.

- **A name**
  Assign the arguments sequentially to the array named by name starting at subscript 0 rather than to the positional parameters.

- **b**
  The shell writes a message to standard error as soon it detects that a background job completes rather than waiting until the next prompt.

- **B**
  Enable {...} group expansion. On by default.

- **C**
  Prevents existing regular files from being overwritten using the > redirection operator. The > | redirection overrides this noclobber option.

- **e**
  A simple command that has a non-zero exit status causes the shell to exit unless the simple command is:
  - contained in an && or || list
  - the command immediately following if, while, or until
  - contained in the pipeline following !

- **f**
  Pathname expansion is disabled.
-G Causes ** by itself to also match all sub-directories during pathname expansion.

-h Obsolete. Causes each command whose name has the syntax of an alias to become a tracked alias when it is first encountered.

-H Enable !-style history expansion similar to csh.

-k This is obsolete. All arguments of the form name=value are removed and placed in the variable assignment list for the command. Ordinarily, variable assignments must precede command arguments.

-m When enabled, the shell runs background jobs in a separate process group and displays a line upon completion. This mode is enabled by default for interactive shells on systems that support job control.

-n The shell reads commands and checks for syntax errors, but does not execute the command. Usually specified on command invocation.

-o [option] If option is not specified, the list of options and their current settings is written to standard output. When invoked with a + the options are written in a format that can be input again to the shell to restore the settings. This option can be repeated to enable or disable multiple options.

The value of option must be one of the following:

- allexport Same as -a.
- bgnice All background jobs are run at lower priorities.
- braceexpand Same as -B.
- emacs Enables or disables emacs editing mode.
- errexit Same as -e.
- globstar Equivalent to -G.
- gmacs Enables or disables gmacs. gmacs editing mode is the same as emacs editing mode, except for the handling of CTRL-T.
- histexpand Same as -H.
- ignoreeof The interactive shell does not exit on end-of-file.
- keyword Same as -k.
- markdirs All directory names resulting from file name generation have a trailing / appended.
- monitor Same as -m.
<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>multiline</td>
<td>Use multiple lines when editing lines that are longer than the window width.</td>
</tr>
<tr>
<td>noclobber</td>
<td>Same as -C.</td>
</tr>
<tr>
<td>noexec</td>
<td>Same as -n.</td>
</tr>
<tr>
<td>noglob</td>
<td>Same as -f.</td>
</tr>
<tr>
<td>nolog</td>
<td>This has no effect. It is provided for backward compatibility.</td>
</tr>
<tr>
<td>notify</td>
<td>Same as -b.</td>
</tr>
<tr>
<td>nounset</td>
<td>Same as -u.</td>
</tr>
<tr>
<td>pipefail</td>
<td>A pipeline does not complete until all components of the pipeline have completed, and the exit status of the pipeline is the value of the last command to exit with non-zero exit status, or is zero if all commands return zero exit status.</td>
</tr>
<tr>
<td>privileged</td>
<td>Same as -p.</td>
</tr>
<tr>
<td>showme</td>
<td>Simple commands preceded by a ; are traced as if -x were enabled but not executed.</td>
</tr>
<tr>
<td>trackall</td>
<td>Same as -h.</td>
</tr>
<tr>
<td>verbose</td>
<td>Same as -v.</td>
</tr>
<tr>
<td>vi</td>
<td>Enables or disables vi editing mode.</td>
</tr>
<tr>
<td>viraw</td>
<td>Does not use canonical input mode when using vi edit mode</td>
</tr>
<tr>
<td>xtrace</td>
<td>Same as -x.</td>
</tr>
</tbody>
</table>

- p Privileged mode. Disabling -p sets the effective user id to the real user id, and the effective group id to the real group id. Enabling -p restores the effective user and group ids to their values when the shell was invoked. The -p option is on whenever the real and effective user id is not equal or the real and effective group id is not equal. User profiles are not processed when -p is enabled.

- r Restricted. Enables restricted shell. This option cannot be unset once enabled.

- s Sort the positional parameters

- t Obsolete. The shell reads one command and then exits.

- u If enabled, the shell displays an error message when it tries to expand a variable that is unset.

- v Verbose. The shell displays its input onto standard error as it reads it.

- x Execution trace. The shell displays each command after all expansion and before execution preceded by the expanded value of the PS4 parameter.
The following exit values are returned by set in ksh:

0   Successful completion.
>0   An error occurred.

For each name specified, unset unsets the variable, or function if -f is specified, from the current shell execution environment. Read-only variables cannot be unset.

The options for unset in ksh are:

- f   Where name refers to a function name, the shell unsets the function definition.
- n   If name refers to variable that is a reference, the variable name is unset rather than the variable it references. Otherwise, this option is equivalent to the -v option.
- v   Where name refers to a variable name, the shell unsets it and removes it from the environment. This is the default behavior.

The following exit values are returned by unset in ksh:

0   Successful completion. All names were successfully unset.
>0   An error occurred, or one or more name operands could not be unset

export sets the export attribute on each of the variables specified by name which causes them to be in the environment of subsequently executed commands. If =value is specified, the variable name is set to value.

If no name is specified, the names and values of all exported variables are written to standard output.

export is built-in to the shell as a declaration command so that field splitting and pathname expansion are not performed on the arguments. Tilde expansion occurs on value.

The options for export in ksh are:

- p   Causes the output to be in the form of export commands that can be used as input to the shell to recreate the current exports.

The following exit values are returned by export in ksh:

0   Successful completion.
>0   An error occurred.

On this manual page, ksh(1) commands that are preceded by one or two + are treated specially in the following ways:

1. Variable assignment lists preceding the command remain in effect when the command completes.
2. I/O redirections are processed after variable assignments.
3. Errors cause a script that contains them to abort.
4. They are not valid function names.
5. Words, following a command preceded by `++` that are in the format of a variable assignment, are expanded with the same rules as a variable assignment. This means that tilde substitution is performed after the `=` sign and field splitting and file name generation are not performed.

**Examples**

csh  The following example sets the PATH variable to search for files in the `/bin`, `/usr/bin`, `/usr/sbin`, and `/usr/ucb/bin` directories, in that order:

```bash
setenv PATH "/bin:/usr/bin:/usr/sbin:/usr/ucb/bin"
```

**Attributes**  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

**See Also**  csh(1), ksh(1), ksh88(1), read(1), sh(1), typeset(1), attributes(5), environ(5)
setfacl(1)

Name
setfacl – modify the Access Control List (ACL) for a file or files

Synopsis
setfacl [-r] -s acl_entries file
setfacl [-r] -md acl_entries file
setfacl [-r] -f acl_file file

Description
For each file specified, setfacl either replaces its entire ACL, including the default ACL on a
directory, or it adds, modifies, or deletes one or more ACL entries, including default entries on
directories.

When the setfacl command is used, it can result in changes to the file permission bits. When
the user ACL entry for the file owner is changed, the file owner class permission bits are
modified. When the group ACL entry for the file group class is changed, the file group class
permission bits are modified. When the other ACL entry is changed, the file other class
permission bits are modified.

If you use the chmod(1) command to change the file group owner permissions on a file with
ACL entries, both the file group owner permissions and the ACL mask are changed to the new
permissions. Be aware that the new ACL mask permissions can change the effective
permissions for additional users and groups who have ACL entries on the file.

A directory can contain default ACL entries. If a file or directory is created in a directory that
contains default ACL entries, the newly created file has permissions generated according to
the intersection of the default ACL entries and the permissions requested at creation time. The
umask(1) are not applied if the directory contains default ACL entries. If a default ACL is
specified for a specific user (or users), the file has a regular ACL created. Otherwise, only the
mode bits are initialized according to the intersection described above. The default ACL
should be thought of as the maximum discretionary access permissions that can be granted.

Use the setfacl command to set ACLs on files in a UFS file system, which supports
POSIX-draft ACLS (or aclent_t style ACLs). Use the chmod command to set ACLs on files in
a ZFS file system, which supports NFSv4-style ACLS (or ace_t style ACLs).

acl_entries Syntax
For the -m and -s options, acl_entries are one or more comma-separated ACL entries.

An ACL entry consists of the following fields separated by colons:

entry_type Type of ACL entry on which to set file permissions. For example, entry_type
can be user (the owner of a file) or mask (the ACL mask).

uid or gid User name or user identification number. Or, group name or group
identification number.

perms Represents the permissions that are set on entry_type. perms can be indicated
by the symbolic characters rwx or a number (the same permissions numbers
used with the chmod command).
The following table shows the valid ACL entries (default entries can only be specified for directories):

<table>
<thead>
<tr>
<th>ACL Entry</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>u[ser]:perms</td>
<td>File owner permissions.</td>
</tr>
<tr>
<td>g[roup]:perms</td>
<td>File group owner permissions.</td>
</tr>
<tr>
<td>o[ther]:perms</td>
<td>Permissions for users other than the file owner or members of file group owner.</td>
</tr>
<tr>
<td>m[ask]:perms</td>
<td>The ACL mask. The mask entry indicates the maximum permissions allowed for users (other than the owner) and for groups. The mask is a quick way to change permissions on all the users and groups.</td>
</tr>
<tr>
<td>u[ser]:uid:perms</td>
<td>Permissions for a specific user. For uid, you can specify either a user name or a numeric UID.</td>
</tr>
<tr>
<td>g[roup]:gid:perms</td>
<td>Permissions for a specific group. For gid, you can specify either a group name or a numeric GID.</td>
</tr>
<tr>
<td>d[efault]:u[ser]:perms</td>
<td>Default file owner permissions.</td>
</tr>
<tr>
<td>d[efault]:g[roup]:perms</td>
<td>Default file group owner permissions.</td>
</tr>
<tr>
<td>d[efault]:o[ther]:perms</td>
<td>Default permissions for users other than the file owner or members of the file group owner.</td>
</tr>
<tr>
<td>d[efault]:m[ask]:perms</td>
<td>Default ACL mask.</td>
</tr>
<tr>
<td>d[efault]:u[ser]:uid:perms</td>
<td>Default permissions for a specific user. For uid, you can specify either a user name or a numeric UID.</td>
</tr>
<tr>
<td>d[efault]:g[roup]:gid:perms</td>
<td>Default permissions for a specific group. For gid, you can specify either a group name or a numeric GID.</td>
</tr>
</tbody>
</table>

For the -d option, acl_entries are one or more comma-separated ACL entries without permissions. Notice that the entries for file owner, file group owner, ACL mask, and others cannot be deleted.

**Options**

The options have the following meaning:

- **-d acl_entries** Deletes one or more entries from the file. The entries for the file owner, the file group owner, and others can not be deleted from the ACL. Notice that deleting an entry does not necessarily have the same effect as removing all permissions from the entry.

- **-f acl_file** Sets a file's ACL with the ACL entries contained in the file named acl_file. The same constraints on specified entries hold as with the -s option.
entries are not required to be in any specific order in the file. Also, if you specify a dash (-) for acl_file, standard input is used to set the file’s ACL.

The character # in acl_file can be used to indicate a comment. All characters, starting with the # until the end of the line, are ignored. Notice that if the acl_file has been created as the output of the getfacl(1) command, any effective permissions, which follow a #, are ignored.

-m acl_entries Adds one or more new ACL entries to the file, and/or modifies one or more existing ACL entries on the file. If an entry already exists for a specified uid or gid, the specified permissions replace the current permissions. If an entry does not exist for the specified uid or gid, an entry is created. When using the -m option to modify a default ACL, you must specify a complete default ACL (user, group, other, mask, and any additional entries) the first time.

-r Recalculates the permissions for the ACL mask entry. The permissions specified in the ACL mask entry are ignored and replaced by the maximum permissions necessary to grant the access to all additional user, file group owner, and additional group entries in the ACL. The permissions in the additional user, file group owner, and additional group entries are left unchanged.

-s acl_entries Sets a file’s ACL. All old ACL entries are removed and replaced with the newly specified ACL. The entries need not be in any specific order. They are sorted by the command before being applied to the file.

Required entries:

- Exactly one user entry specified for the file owner.
- Exactly one group entry for the file group owner.
- Exactly one other entry specified.

If there are additional user and group entries:

- Exactly one mask entry specified for the ACL mask that indicates the maximum permissions allowed for users (other than the owner) and groups.
- Must not be duplicate user entries with the same uid.
- Must not be duplicate group entries with the same gid.

If file is a directory, the following default ACL entries can be specified:

- Exactly one default user entry for the file owner.
- Exactly one default group entry for the file group owner.
- Exactly one default mask entry for the ACL mask.
- Exactly one default other entry.
There can be additional default user entries and additional default group entries specified, but there cannot be duplicate additional default user entries with the same uid, or duplicate default group entries with the same gid.

**Examples**

**EXAMPLE 1** Adding read permission only

The following example adds one ACL entry to file abc, which gives user shea read permission only.

```bash
setfacl -m user:shea:r abc
```

**EXAMPLE 2** Replacing a file's entire ACL

The following example replaces the entire ACL for the file abc, which gives shea read access, the file owner all access, the file group owner read access only, the ACL mask read access only, and others no access.

```bash
setfacl -s user:shea:rwx,group::rwx,mask::r-,other::--- abc
```

Notice that after this command, the file permission bits are rwxr----- . Even though the file group owner was set with read/write permissions, the ACL mask entry limits it to have only read permission. The mask entry also specifies the maximum permissions available to all additional user and group ACL entries. Once again, even though the user shea was set with all access, the mask limits it to have only read permission. The ACL mask entry is a quick way to limit or open access to all the user and group entries in an ACL. For example, by changing the mask entry to read/write, both the file group owner and user shea would be given read/write access.

**EXAMPLE 3** Setting the same ACL on two files

The following example sets the same ACL on file abc as the file xyz.

```bash
getfacl xyz | setfacl -f abc
```

**Files**

/etc/passwd password file

/etc/group group file

**Attributes**

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

**See Also**

chmod(1), getfacl(1), umask(1), aclcheck(3SEC), aclsort(3SEC), group(4), passwd(4), attributes(5)
setlabel(1)

Name setlabel – change effective sensitivity label of files

Synopsis /usr/bin/setlabel newlabel filename...

Description In most cases, setlabel moves files into the zone whose label corresponds to newlabel. The old file pathname is adjusted so that it is relative to the root pathname of the new zone. If the old pathname for a file’s parent directory does not exist as a directory in the new zone, the file is not moved. Once moved, the file might no longer be accessible in the current zone.

However, setlabel behaves differently for files and directories which are on multilevel ZFS file systems. Refer to zfs(1M). In that case, files are not moved, but are re-labeled in place, since multilevel file systems support per-file labels.

Unless newlabel and filename have been specified, no labels are set.

Labels are defined by the security administrator at your site. The system always displays labels in uppercase. Users can enter labels in any combination of uppercase and lowercase. Incremental changes to labels are supported.

Refer to setlabel(3TSOL) for a complete description of the conditions that are required to satisfy this command, and the privileges that are needed to execute this command.

Exit Status setlabel exits with one of the following values:

0 Successful completion.
1 Usage error.
2 Error in getting, setting or translating the label.

Usage On the command line, enclose the label in double quotes unless the label is only one word. Without quotes, a second word or letter separated by a space is interpreted as a second argument.

% setlabel SECRET somefile
% setlabel "TOP SECRET" somefile

Use any combination of upper and lowercase letters. You can separate items in a label with blanks, tabs, commas or slashes (/). Do not use any other punctuation.

% setlabel "ts a b" somefile
% setlabel "ts,a,b" somefile
% setlabel "ts/a b" somefile
% setlabel " TOP SECRET A B " somefile

Examples EXAMPLE 1 Set a Label.

To set somefile’s label to SECRET A:

example% setlabel "Secret a" somefile
EXAMPLE 2  
Turn On a Compartment.
Plus and minus signs can be used to modify an existing label. A plus sign turns on the specified compartment for *somefile*’s label.
```bash
example% setlabel +b somefile
```

EXAMPLE 3  
Turn Off a Compartment.
A minus sign turns off the compartments that are associated with a classification. To turn off compartment A in *somefile*’s label:
```bash
example% setlabel -A somefile
```

If an incremental change is being made to an existing label and the first character of the label is a hyphen (−), a preceding double-hyphen (−−) is required.

To turn off compartment -A in *somefile*’s label:
```bash
example% setlabel -- -A somefile
```

Attributes  
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/trusted</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  
zfs(1M), setlabel(3TSOL), label_encodings(4), attributes(5)

Notes  
The functionality described on this manual page is available only if the system is configured with Trusted Extensions.

This implementation of setting a label is meaningful for the Defense Intelligence Agency (DIA) Mandatory Access Control (MAC) policy. For more information, see label_encodings(4).
setpgrp(1)

Name  setpgrp – set process group ID

Synopsis  setpgrp command [arg]...

Description  If the current process is not already a session leader, the setpgrp utility sets the process group ID and session ID to the current process ID and does an exec() of command and its argument(s), if any.

Operands  The following operands are supported:

  command  The name of a command to be invoked.
  arg  An option or argument to command.

Exit Status  The following exit values are returned:

  1  Error executing the setpgrp utility or during exec() of command.

Otherwise, the exit status will be that of command.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  exec(2), setpgrp(2), attributes(5)
sftp – secure file transfer program

**Synopsis**

```
sftp [-LCv] [-B buffer_size] [-b batchfile] [-F ssh_config]
    [-o ssh_option] [-P sftp_server_path] [-R num_requests]
    [-S program] [-s subsystem | sftp_server] host
```

```
sftp [[user@]host[:file [file]]]
```

```
sftp [[user@]host[:dir/]]
```

```
sftp -b batchfile [user@]host
```

**Description**

The `sftp` utility is an interactive file transfer program with a user interface similar to `ftp(1)` that uses the `ssh(1)` command to create a secure connection to the server.

`sftp` implements the SSH File Transfer Protocol as defined in IETF draft-ietf-secsh-filexfer. There is no relationship between the protocol used by `sftp` and the FTP protocol (RFC 959) provided by `ftp(1)`.

The first usage format causes `sftp` to connect to the specified host and enter an interactive mode. If a username was provided then `sftp` tries to log in as the specified user. If a directory is provided then `sftp` tries to change the current directory on the server to the specified directory before entering the interactive mode.

The second usage format retrieves the specified file from the server and copies it to the specified target file or directory on the client. If a username is specified `sftp` tries to log in as the specified user.

**Options**

The following options are supported:

```
-b batchfile
```

Batch mode reads a series of commands from an input `batchfile` instead of `stdin`. Since it lacks user interaction, it should be used in conjunction with non-interactive authentication. A batchfile of `-` can be used to indicate standard input. `sftp` aborts if any of the following commands fail: `get`, `put`, `rm`, `rename`, `ln`, `rm`, `mkdir`, `rmdir`, `ls`, `lchdir`, `chmod`, `chown`, `chgrp`, `pwd`, and `mkdir`. Termination on error can be suppressed on a command by command basis by prefixing the command with a `-` character (for example, `-rm /tmp/blah*`).

```
-B buffer_size
```

Specify the size of the buffer that `sftp` uses when transferring files. Larger buffers require fewer round trips at the cost of higher memory consumption. The default is 32768 bytes.

```
-C
```

Enables compression, using the `-C` flag in `ssh(1)`.

```
-F ssh_config
```

Specifies an alternative per-user configuration file for `ssh`. This option is directly passed to `ssh(1)`. 
-o ssh_option
   Specifies an option to be directly passed to ssh(1).

-P sftp_server path
   Executes the specified path as an sftp-server and uses a pipe, rather than an ssh connection, to communicate with it. This option can be useful in debugging the sftp client and server. When the -P is specified, the -S option is ignored.

-R num_requests
   Specifies how many requests can be outstanding at any one time. Increasing this can slightly improve file transfer speed but increases memory usage. The default is 64 outstanding requests.

-s subsystem | sftp_server
   Specifies the SSH2 subsystem or the path for an sftp server on the remote host. A path is useful for using sftp over protocol version 1, or when the remote sshd does not have an sftp subsystem configured.

-S ssh_program path
   Uses the specified program instead of ssh(1) to connect to the sftp server. When the -P option is specified, the -S option is ignored. The program must understand ssh(1) options.

-v
   Raises logging level. This option is also passed to ssh(1).

-1
   Specifies the use of protocol version 1.

Operands
   The following operands are supported:

hostname | user@hostname
   The name of the host to which sftp connects and logs into.

Interactive Commands
   Once in interactive mode, sftp understands a set of commands similar to those of ftp(1). Commands are case insensitive and path names can be enclosed in quotes if they contain spaces.
   bye
      Quits sftp.
   cd path
      Changes remote directory to path.
   chgrpgrp path
      Changes group of file path to grp. grp must be a numeric GID.
   chmod mode path
      Changes permissions of file path to mode.
   chown own path
      Changes owner of file path to own. own must be a numeric UID.
exit
Quits sftp.

get [flags] remote-path [local-path]
Retrieves the remote-path and stores it on the local machine. If the local path name is not
specified, it is specified the same name it has on the remote machine. If the -P flag is
specified, then the file's full permission and access time are copied too.

help
Displays help text.

Identical to the ? command.

lcd path
Changes local directory to path.

ls [ls-options [path]]
Displays local directory listing of either path or current directory if path is not specified.

mkdir path
Creates local directory specified by path.

ln oldpath newpath
Creates a link from oldpath to newpath.

pwd
Prints local working directory.

ls [-aflnrSt] [path]
Displays remote directory listing of either path or current directory if path is not specified.
path can contain wildcards.

The ls supports the following options:

-a
Lists files beginning with a dot (.)..

-f
Does not sort the listing. The default sort order is lexicographical.

-l
Displays additional details including permissions and ownership information.

-n
Produces a long listing with user and group information presented numerically.

-r
Reverses the sort order of the listing.

-S
Sorts the listing by file size.
- t
  Sorts the listing by last modification time.

- l
  Produces single column output.

umask umask
  Sets local umask to umask.

mkdir path
  Creates remote directory specified by path.

put [flags] local-path [local-path]
  Uploads local-path and stores it on the remote machine. If the remote path name is not specified, it is specified the same name it has on the local machine. If the -P flag is specified, then the file's full permission and access time are copied too.

pwd
  Displays remote working directory.

quit
  Quits sftp.

rename oldpath newpath
  Renames remote file from oldpath to newpath.

rmdir path
  Removes remote directory specified by path.

rm path
  Deletes remote file specified by path.

symlink oldpath newpath
  Creates a symbolic link from oldpath to newpath.

version
  Displays the sftp protocol version.

# [comment]
  Include a comment. This is useful in batch files.

! [command]
  If command is not specified, escapes to the local shell.
  If command is specified, executes command in the local shell.

?
  Displays help text.
  Identical to the help command.
The following exit values are returned:

0
Successful completion.

>0
An error occurred.

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>network/ssh</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also ftp(1), scp(1), ssh(1), ssh-add(1), ssh-keygen(1), sshd(1M), attributes(5)
sh(1)

Name  sh, jsh – standard and job control shell and command interpreter

Synopsis  
/usr/sunos/bin/sh  [-acefhiknprstuvx] [argument]...
/usr/xpg4/bin/sh  [± abCefhikmnoprstuvx]
[± o  option]... [-c string] [arg]...
/usr/sunos/bin/jsh  [-acefhiknprstuvx] [argument]...

Description  The /usr/sunos/bin/sh utility is a command programming language that executes commands read from a terminal or a file.

The /usr/xpg4/bin/sh utility is a standards compliant shell. This utility provides all the functionality of ksh88(1), except in cases discussed in ksh88(1) where differences in behavior exist.

The jsh utility is an interface to the shell that provides all of the functionality of sh and enables job control (see Job Control section below).

Note – /usr/bin/sh and /usr/bin/jsh are links to ksh93. See ksh93(1).

Arguments to the shell are listed in the Invocation section below.

Definitions  A blank is a tab or a space. A name is a sequence of ASCII letters, digits, or underscores, beginning with a letter or an underscore. A parameter is a name, a digit, or any of the characters *, @, #, ?, −, $, and !.

Usage  

Commands  A simple-command is a sequence of non-blank words separated by blanks. The first word specifies the name of the command to be executed. Except as specified below, the remaining words are passed as arguments to the invoked command. The command name is passed as argument 0 (see exec(2)). The value of a simple-command is its exit status if it terminates normally, or (octal) 200+status if it terminates abnormally. See signal.h(3HEAD) for a list of status values.

A pipeline is a sequence of one or more commands separated by |. The standard output of each command but the last is connected by a pipe(2) to the standard input of the next command. Each command is run as a separate process. The shell waits for the last command to terminate. The exit status of a pipeline is the exit status of the last command in the pipeline.

A list is a sequence of one or more pipelines separated by ;, &, ||, or |, and optionally terminated by ; or &. Of these four symbols, ; and & have equal precedence, which is lower than that of && and |. The symbols && and | also have equal precedence. A semicolon (;) causes sequential execution of the preceding pipeline, that is, the shell waits for the pipeline to finish before executing any commands following the semicolon. An ampersand (&) causes asynchronous execution of the preceding pipeline, that is, the shell does not wait for that pipeline to finish. The symbol && ( | | ) causes the list following it to be executed only if the preceding pipeline returns a zero (non-zero) exit status. An arbitrary number of newlines can appear in a list, instead of semicolons, to delimit commands.
A command is either a simple-command or one of the following. Unless otherwise stated, the value returned by a command is that of the last simple-command executed in the command.

```bash
for name [ in word ... ] do list done
```

Each time a for command is executed, name is set to the next word taken from the in word list. If in word ... is omitted, then the for command executes the do list once for each positional parameter that is set (see Parameter Substitution section below). Execution ends when there are no more words in the list.

```bash
case word in [ pattern | pattern ] list ; ; ]... esac
```

A case command executes the list associated with the first pattern that matches word. The form of the patterns is the same as that used for file-name generation (see File Name Generation section), except that a slash, a leading dot, or a dot immediately following a slash need not be matched explicitly.

```bash
if list ; then list elif list ; then list ; ]...[ else list ; ] fi
```

The list following if is executed and, if it returns a zero exit status, the list following the first then is executed. Otherwise, the list following elif is executed and, if its value is zero, the list following the next then is executed. Failing that, the else list is executed. If no else list or then list is executed, then the if command returns a zero exit status.

```bash
while list do list done
```

A while command repeatedly executes the while list and, if the exit status of the last command in the list is zero, executes the do list; otherwise the loop terminates. If no commands in the do list are executed, then the while command returns a zero exit status; until can be used in place of while to negate the loop termination test.

```bash
(list)
```

Execute list in a sub-shell.

```bash
{ list;}
```

list is executed in the current (that is, parent) shell. The { must be followed by a space.

```bash
name ( ) { list;)
```

Define a function which is referenced by name. The body of the function is the list of commands between { and ). The { must be followed by a space. Execution of functions is described below (see Execution section). The ( and ) are unnecessary if the body of the function is a command as defined above, under Commands.

The following words are only recognized as the first word of a command and when not quoted:

```bash
if then else elif fi case esac for while until do done { }
```

Comments Lines
A word beginning with # causes that word and all the following characters up to a newline to be ignored.
Command Substitution

The shell reads commands from the string between two grave accents (`'`) and the standard output from these commands can be used as all or part of a word. Trailing newlines from the standard output are removed.

No interpretation is done on the string before the string is read, except to remove backslashes (`\`) used to escape other characters. Backslashes can be used to escape a grave accent (`'`) or another backslash (`\`) and are removed before the command string is read. Escaping grave accents allows nested command substitution. If the command substitution lies within a pair of double quotes ("..."), a backslash used to escape a double quote (`\"`) is removed. Otherwise, it is left intact.

If a backslash is used to escape a newline character (`\newline`), both the backslash and the newline are removed (see the later section on Quoting). In addition, backslashes used to escape dollar signs (`\$`) are removed. Since no parameter substitution is done on the command string before it is read, inserting a backslash to escape a dollar sign has no effect. Backslashes that precede characters other than `\`, `'`, `\newline`, and `$` are left intact when the command string is read.

Parameter Substitution

The character `$` is used to introduce substitutable parameters. There are two types of parameters, positional and keyword. If `parameter` is a digit, it is a positional parameter.

Positional parameters can be assigned values by `set`. Keyword parameters (also known as variables) can be assigned values by writing:

```
name=value [ name=value ] . . .
```

Pattern-matching is not performed on `value`. There cannot be a function and a variable with the same `name`.

`$(parameter)`

The value, if any, of the parameter is substituted. The braces are required only when `parameter` is followed by a letter, digit, or underscore that is not to be interpreted as part of its name. If `parameter` is `*` or `@`, all the positional parameters, starting with `$1`, are substituted (separated by spaces). Parameter `$0` is set from argument zero when the shell is invoked.

`$(parameter:−word)`

Use Default Values. If `parameter` is unset or null, the expansion of `word` is substituted; otherwise, the value of `parameter` is substituted.

`$(parameter:=word)`

Assign Default Values. If `parameter` is unset or null, the expansion of `word` is assigned to `parameter`. In all cases, the final value of `parameter` is substituted. Only variables, not positional parameters or special parameters, can be assigned in this way.

`$(parameter:?word)`

If `parameter` is set and is non-null, substitute its value; otherwise, print `word` and exit from the shell. If `word` is omitted, the message “parameter null or not set” is printed.
If parameter is set and is non-null, substitute word; otherwise substitute nothing.

In the above, word is not evaluated unless it is to be used as the substituted string, so that, in the following example, pwd is executed only if d is not set or is null:

```
echo ${d:-'pwd'}
```

If the colon (:) is omitted from the above expressions, the shell only checks whether parameter is set or not.

The following parameters are automatically set by the shell.

#  The number of positional parameters in decimal.
– Flags supplied to the shell on invocation or by the set command.
?  The decimal value returned by the last synchronously executed command.
$  The process number of this shell.
!  The process number of the last background command invoked.

The following parameters are used by the shell. The parameters in this section are also referred to as environment variables.

HOME  The default argument (home directory) for the cd command, set to the user’s login directory by login(1) from the password file (see passwd(4)).
PATH  The search path for commands (see Execution section below).
CDPATH  The search path for the cd command.
MAIL  If this parameter is set to the name of a mail file and the MAILPATH parameter is not set, the shell informs the user of the arrival of mail in the specified file.
MAILCHECK  This parameter specifies how often (in seconds) the shell checks for the arrival of mail in the files specified by the MAILPATH or MAIL parameters. The default value is 600 seconds (10 minutes). If set to 0, the shell checks before each prompt.
MAILPATH  A colon-separated list of file names. If this parameter is set, the shell informs the user of the arrival of mail in any of the specified files. Each file name can be followed by % and a message that is e printed when the modification time changes. The default message is, you have mail.
PS1  Primary prompt string, by default “ $ ”.
PS2  Secondary prompt string, by default “ > ”.
IFS  Internal field separators, normally space, tab, and newline (see Blank Interpretation section).
SHACCT  If this parameter is set to the name of a file writable by the user, the shell writes an accounting record in the file for each shell procedure executed.

SHELL    When the shell is invoked, it scans the environment (see Environment section below) for this name.

See `environ(5)` for descriptions of the following environment variables that affect the execution of `sh`: `LC_CTYPE` and `LC_MESSAGES`.

The shell gives default values to `PATH`, `PS1`, `PS2`, `MAILCHECK`, and `IFS`. Default values for `HOME` and `MAIL` are set by `login(1)`.

After parameter and command substitution, the results of substitution are scanned for internal field separator characters (those found in `IFS`) and split into distinct arguments where such characters are found. Explicit null arguments ("" or ") are retained. Implicit null arguments (those resulting from parameters that have no values) are removed.

A command’s input and output can be redirected using a special notation interpreted by the shell. The following can appear anywhere in a `simple-command` or can precede or follow a `command` and are not passed on as arguments to the invoked command. Note: Parameter and command substitution occurs before `word` or `digit` is used.

A command’s input and output can be redirected using a special notation interpreted by the shell. The following can appear anywhere in a `simple-command` or can precede or follow a `command` and are not passed on as arguments to the invoked command. Note: Parameter and command substitution occurs before `word` or `digit` is used.

- `<word>` Use file `word` as standard input (file descriptor 0).
- `>word` Use file `word` as standard output (file descriptor 1). If the file does not exist, it is created; otherwise, it is truncated to zero length.
- `>>word` Use file `word` as standard output. If the file exists, output is appended to it by first seeking to the EOF. Otherwise, the file is created.
- `< >word` Open file `word` for reading and writing as standard input.
- `<<[−]word` After parameter and command substitution is done on `word`, the shell input is read up to the first line that literally matches the resulting `word`, or to an EOF. If, however, the hyphen (−) is appended to `<<`:
  1. leading tabs are stripped from `word` before the shell input is read (but after parameter and command substitution is done on `word`);
  2. leading tabs are stripped from the shell input as it is read and before each line is compared with `word`; and
  3. shell input is read up to the first line that literally matches the resulting `word`, or to an EOF.

If any character of `word` is quoted (see Quoting section later), no additional processing is done to the shell input. If no characters of `word` are quoted:

- 1. parameter and command substitution occurs;
- 2. (escaped) \newlines are removed; and
3. \ must be used to quote the characters \, $, and ‘.

The resulting document becomes the standard input.

&lt;\&digit Use the file associated with file descriptor digit as standard input. Similarly for the standard output using &gt;\&digit.

&lt;\&– The standard input is closed. Similarly for the standard output using &gt;\&–.

If any of the above is preceded by a digit, the file descriptor which is associated with the file is that specified by the digit (instead of the default 0 or 1). For example:

... 2&gt;\&1

associates file descriptor 2 with the file currently associated with file descriptor 1.

The order in which redirections are specified is significant. The shell evaluates redirections left-to-right. For example:

... 1&gt;xxx 2&gt;\&1

first associates file descriptor 1 with file xxx. It associates file descriptor 2 with the file associated with file descriptor 1 (that is, xxx). If the order of redirections were reversed, file descriptor 2 would be associated with the terminal (assuming file descriptor 1 had been) and file descriptor 1 would be associated with file xxx.

Using the terminology introduced on the first page, under Commands, if a command is composed of several simple commands, redirection is evaluated for the entire command before it is evaluated for each simple command. That is, the shell evaluates redirection for the entire list, then each pipeline within the list, then each command within each pipeline, then each list within each command.

If a command is followed by &&, the default standard input for the command is the empty file, /dev/null. Otherwise, the environment for the execution of a command contains the file descriptors of the invoking shell as modified by input/output specifications.

File Name Generation

Before a command is executed, each command word is scanned for the characters *, ?, and [. If one of these characters appears the word is regarded as a pattern. The word is replaced with alphabetically sorted file names that match the pattern. If no file name is found that matches the pattern, the word is left unchanged. The character . at the start of a file name or immediately following a /, as well as the character / itself, must be matched explicitly.

* Matches any string, including the null string.

? Matches any single character.

[... ] Matches any one of the enclosed characters. A pair of characters separated by — matches any character lexically between the pair, inclusive. If the first character following the opening [ is a \, any character not enclosed is matched.
Notice that all quoted characters (see below) must be matched explicitly in a filename.

**Quoting**

The following characters have a special meaning to the shell and cause termination of a word unless quoted:

\, & ( ) | ^ < > newline space tab

A character can be *quoted* (that is, made to stand for itself) by preceding it with a backslash (\) or inserting it between a pair of quote marks (’ ’ or “”). During processing, the shell can quote certain characters to prevent them from taking on a special meaning. Backslashes used to quote a single character are removed from the word before the command is executed. The pair \newline is removed from a word before command and parameter substitution.

All characters enclosed between a pair of single quote marks (’ ’), except a single quote, are quoted by the shell. Backslash has no special meaning inside a pair of single quotes. A single quote can be quoted inside a pair of double quote marks (for example, “’”), but a single quote cannot be quoted inside a pair of single quotes.

Inside a pair of double quote marks (""), parameter and command substitution occurs and the shell quotes the results to avoid blank interpretation and file name generation. If $* is within a pair of double quotes, the positional parameters are substituted and quoted, separated by quoted spaces ("$1 $2 ... "). However, if $@ is within a pair of double quotes, the positional parameters are substituted and quoted, separated by unquoted spaces ("$1" "$2" ... ). \ quotes the characters \, , (comma), and $. The pair \newline is removed before parameter and command substitution. If a backslash precedes characters other than \, , (comma), $, and newline, then the backslash itself is quoted by the shell.

**Prompting**

When used interactively, the shell prompts with the value of PS1 before reading a command. If at any time a newline is typed and further input is needed to complete a command, the secondary prompt (that is, the value of PS2) is issued.

**Environment**

The *environment* (see environ(5)) is a list of name-value pairs that is passed to an executed program in the same way as a normal argument list. The shell interacts with the environment in several ways. On invocation, the shell scans the environment and creates a parameter for each name found, giving it the corresponding value. If the user modifies the value of any of these parameters or creates new parameters, none of these affects the environment unless the export command is used to bind the shell's parameter to the environment (see also set -a). A parameter can be removed from the environment with the unset command. The environment seen by any executed command is thus composed of any unmodified name-value pairs originally inherited by the shell, minus any pairs removed by unset, plus any modifications or additions, all of which must be noted in export commands.

The environment for any *simple-command* can be augmented by prefixing it with one or more assignments to parameters. Thus:

```
TERM=450 command
```
and

(export TERM; TERM=450; command)

are equivalent as far as the execution of command is concerned if command is not a Special Command. If command is a Special Command, then

TERM=450 command

modifies the TERM variable in the current shell.

If the -k flag is set, all keyword arguments are placed in the environment, even if they occur after the command name. The following example first prints a=b c and c:

```
set -k
```

echo a=b c

a=b c

```
set −k
echo a=b c
c
```

Signals The INTERRUPT and QUIT signals for an invoked command are ignored if the command is followed by &. Otherwise, signals have the values inherited by the shell from its parent, with the exception of signal 11 (but see also the trap command below).

Execution Each time a command is executed, the command substitution, parameter substitution, blank interpretation, input/output redirection, and filename generation listed above are carried out. If the command name matches the name of a defined function, the function is executed in the shell process (note how this differs from the execution of shell script files, which require a sub-shell for invocation). If the command name does not match the name of a defined function, but matches one of the Special Commands listed below, it is executed in the shell process.

The positional parameters $1, $2, ... are set to the arguments of the function. If the command name matches neither a Special Command nor the name of a defined function, a new process is created and an attempt is made to execute the command via exec(2).

The shell parameter PATH defines the search path for the directory containing the command. Alternative directory names are separated by a colon (:). The path to sh is /usr/sunos/bin. The current directory is specified by a null path name, which can appear immediately after the equal sign, between two colon delimiters anywhere in the path list, or at the end of the path list. If the command name contains a / the search path is not used. Otherwise, each directory in the path is searched for an executable file. If the file has execute permission but is not an a.out file, it is assumed to be a file containing shell commands. A sub-shell is spawned to read it. A parenthesized command is also executed in a sub-shell.
The location in the search path where a command was found is remembered by the shell (to help avoid unnecessary execs later). If the command was found in a relative directory, its location must be re-determined whenever the current directory changes. The shell forgets all remembered locations whenever the PATH variable is changed or the hash - r command is executed (see below).

**Special Commands**

Input/output redirection is now permitted for these commands. File descriptor 1 is the default output location. When Job Control is enabled, additional Special Commands are added to the shell’s environment (see Job Control section below).

- **:**
  - No effect; the command does nothing. A zero exit code is returned.

- **. filename**
  - Read and execute commands from filename and return. The search path specified by PATH is used to find the directory containing filename.

- **bg [\%jobid . . .]**
  - When Job Control is enabled, the bg command is added to the user’s environment to manipulate jobs. Resumes the execution of a stopped job in the background. If \%jobid is omitted the current job is assumed. (See Job Control section below for more detail.)

- **break [ n ]**
  - Exit from the enclosing for or while loop, if any. If n is specified, break n levels.

- **cd [ argument ]**
  - Change the current directory to argument. The shell parameter HOME is the default argument. The shell parameter CDPATH defines the search path for the directory containing argument. Alternative directory names are separated by a colon (:). The default path is <null> (specifying the current directory). Note: The current directory is specified by a null path name, which can appear immediately after the equal sign or between the colon delimiters anywhere else in the path list. If argument begins with a / the search
path is not used. Otherwise, each directory in the path is searched for argument.

chdir [ dir ]
chdir changes the shell’s working directory to directory dir. If no argument is given, change to the home directory of the user. If dir is a relative pathname not found in the current directory, check for it in those directories listed in the CDPATH variable. If dir is the name of a shell variable whose value starts with a /, change to the directory named by that value.

continue [ n ]
Resume the next iteration of the enclosing for or while loop. If n is specified, resume at the n-th enclosing loop.

echo [ arguments ]
The words in arguments are written to the shell’s standard output, separated by space characters. See echo(1) for fuller usage and description.

eval [ argument... ]
The arguments are read as input to the shell and the resulting command(s) executed.

exec [ argument... ]
The command specified by the arguments is executed in place of this shell without creating a new process. Input/output arguments can appear and, if no other arguments are given, cause the shell input/output to be modified.

exit [ n ]
Causes the calling shell or shell script to exit with the exit status specified by n. If n is omitted the exit status is that of the last command executed (an EOF also causes the shell to exit.)

export [ name... ]
The given names are marked for automatic export to the environment of subsequently executed commands.
If no arguments are given, variable names that have been marked for export during the current shell’s execution are listed. (Variable names exported from a parent shell are listed only if they have been exported again during the current shell’s execution.) Function names are not exported.

`fg [jobid...]` When Job Control is enabled, the `fg` command is added to the user’s environment to manipulate jobs. This command resumes the execution of a stopped job in the foreground and also moves an executing background job into the foreground. If `jobid` is omitted, the current job is assumed. (See Job Control section below for more detail.)

`getopts` Use in shell scripts to support command syntax standards (see Intro(1)). This command parses positional parameters and checks for legal options. See `getoptcvt(1)` for usage and description.

`hash [ -r ] [ name... ]` For each `name`, the location in the search path of the command specified by `name` is determined and remembered by the shell. The `-r` option causes the shell to forget all remembered locations. If no arguments are given, information about remembered commands is presented. `Hits` is the number of times a command has been invoked by the shell process. `Cost` is a measure of the work required to locate a command in the search path. If a command is found in a “relative” directory in the search path, after changing to that directory, the stored location of that command is recalculated. Commands for which this are done are indicated
by an asterisk (*) adjacent to the hits information. Cost is incremented when the recalculation is done.

`jobs [-p|l] [jobid ...]`
Reports all jobs that are stopped or executing in the background. If `jobid` is omitted, all jobs that are stopped or running in the background are reported. (See Job Control section below for more detail.)

`kill [-sig] %job ...`
`kill -l`
Sends either the TERM (terminate) signal or the specified signal to the specified jobs or processes. Signals are either given by number or by names (as given in `signal.h` stripped of the prefix “SIG” with the exception that `SIGCHLD` is named `CHLD`). If the signal being sent is TERM (terminate) or HUP (hangup), then the job or process is sent a CONT (continue) signal if it is stopped. The argument `job` can be the process id of a process that is not a member of one of the active jobs. See Job Control section below for a description of the format of `job`. In the second form, `kill -l`, the signal numbers and names are listed. (See `kill(1)`).

`login [ argument ... ]`
Equivalent to `exec login argument ...`. See `login(1)` for usage and description.

`newgrp [ argument ]`
Equivalent to `exec newgrp argument`. See `newgrp(1)` for usage and description.

`pwd`
Print the current working directory. See `pwd(1)` for usage and description.

`read name ...`
One line is read from the standard input and, using the internal field separator, `IFS` (normally space or tab),
to delimit word boundaries, the first word is assigned to the first name, the second word to the second name, and so forth, with leftover words assigned to the last name. Lines can be continued using `\newline`. Characters other than `\newline` can be quoted by preceding them with a backslash. These backslashes are removed before words are assigned to names, and no interpretation is done on the character that follows the backslash. The return code is 0, unless an EOF is encountered.

### readonly [name...]

The given names are marked readonly and the values of the these names can not be changed by subsequent assignment. If no arguments are given, a list of all readonly names is printed.

### return [n]

Causes a function to exit with the return value specified by n. If n is omitted, the return status is that of the last command executed.

### set [-aefhkntux [argument...]]

- **-a** Mark variables which are modified or created for export.
- **-e** Exit immediately if a command exits with a non-zero exit status.
- **-f** Disable file name generation.
- **-h** Locate and remember function commands as functions are defined (function commands are normally located when the function is executed).
- **-k** All keyword arguments are placed in the environment for a
command, not just those that precede the command name.

- n Read commands but do not execute them.
- t Exit after reading and executing one command.
- u Treat unset variables as an error when substituting.
- v Print shell input lines as they are read.
- x Print commands and their arguments as they are executed.

– Do not change any of the flags; useful in setting $1 to –.

Using + rather than – causes these flags to be turned off. These flags can also be used upon invocation of the shell. The current set of flags can be found in $–. The remaining arguments are positional parameters and are assigned, in order, to $1, $2, . . . If no arguments are given, the values of all names are printed.

shift [n] The positional parameters from $n+1 . . . are renamed $1 . . . If n is not given, it is assumed to be 1.

stop pid... Halt execution of the process number pid. (see ps(1)).

suspend Stops the execution of the current shell (but not if it is the login shell).

test Evaluate conditional expressions. See test(1) for usage and description.

times Print the accumulated user and system times for processes run from the shell.
The command argument is to be read and executed when the shell receives numeric or symbolic signal(s) \( n \). (Note: argument is scanned once when the trap is set and once when the trap is taken.) Trap commands are executed in order of signal number or corresponding symbolic names. Any attempt to set a trap on a signal that was ignored on entry to the current shell is ineffective. An attempt to trap on signal 11 (memory fault) produces an error. If argument is absent, all trap(s) \( n \) are reset to their original values. If argument is the null string, this signal is ignored by the shell and by the commands it invokes. If \( n \) is 0, the command argument is executed on exit from the shell. The trap command with no arguments prints a list of commands associated with each signal number.

For each name, indicate how it would be interpreted if used as a command name.

ulimit [[\(-\)HS]|-a|\(-\)cdfnstv]]
ulimit [[\(-\)HS]|-c|-d|-f|-n|-s|-t|-v]] limit

ulimit prints or sets hard or soft resource limits. These limits are described in getrlimit(2).

If limit is not present, ulimit prints the specified limits. Any number of limits can be printed at one time. The -a option prints all limits.

If limit is present, ulimit sets the specified limit to limit. The string unlimited requests that the current limit, if any, be removed. Any user can set a soft limit to any value less than or equal to the hard limit. Any user can lower a hard limit. Only a user with
appropriate privileges can raise or remove a hard limit. See \texttt{getrlimit(2)}.

The \texttt{-H} option specifies a hard limit. The \texttt{-S} option specifies a soft limit. If neither option is specified, \texttt{ulimit} sets both limits and print the soft limit.

The following options specify the resource whose limits are to be printed or set. If no option is specified, the file size limit is printed or set.

- \texttt{-c} maximum core file size (in 512-byte blocks)
- \texttt{-d} maximum size of data segment or heap (in kbytes)
- \texttt{-f} maximum file size (in 512-byte blocks)
- \texttt{-n} maximum file descriptor plus 1
- \texttt{-s} maximum size of stack segment (in kbytes)
- \texttt{-t} maximum CPU time (in seconds)
- \texttt{-v} maximum size of virtual memory (in kbytes)

Run the \texttt{sysdef(1M)} command to obtain the maximum possible limits for your system. The values reported are in hexadecimal, but can be translated into decimal numbers using the \texttt{bc(1)} utility. See \texttt{swap(1M)}.

As an example of \texttt{ulimit}, to limit the size of a core file dump to 0 Megabytes, type the following:

\texttt{ulimit -c 0}
umask [ nnn ]
The user file-creation mask is set to nnn (see umask(1)). If nnn is omitted, the current value of the mask is printed.

unset [ name ... ]
For each name, remove the corresponding variable or function value. The variables PATH, PS1, PS2, MAILCHECK, and IFS cannot be unset.

wait [ n ]
Wait for your background process whose process id is n and report its termination status. If n is omitted, all your shell’s currently active background processes are waited for and the return code is zero.

Invocation
If the shell is invoked through exec(2) and the first character of argument zero is −, commands are initially read from /etc/profile and from $HOME/.profile, if such files exist. Thereafter, commands are read as described below, which is also the case when the shell is invoked as /usr/sunos/bin/sh. The flags below are interpreted by the shell on invocation only. Note: Unless the -c or -s flag is specified, the first argument is assumed to be the name of a file containing commands, and the remaining arguments are passed as positional parameters to that command file:

- c string If the - c flag is present commands are read from string.
- i If the - i flag is present or if the shell input and output are attached to a terminal, this shell is interactive. In this case, TERMINATE is ignored (so that kill 0 does not kill an interactive shell) and INTERRUPT is caught and ignored (so that wait is interruptible). In all cases, QUIT is ignored by the shell.
- p If the - p flag is present, the shell does not set the effective user and group IDs to the real user and group IDs.
- r If the - r flag is present the shell is a restricted shell (see rsh(1M)).
- s If the - s flag is present or if no arguments remain, commands are read from the standard input. Any remaining arguments specify the positional parameters. Shell output (except for Special Commands) is written to file descriptor 2.

The remaining flags and arguments are described under the set command above.

Job Control (jsh) When the shell is invoked as jsh, Job Control is enabled in addition to all of the functionality described previously for sh. Typically, Job Control is enabled for the interactive shell only. Non-interactive shells typically do not benefit from the added functionality of Job Control.
With Job Control enabled, every command or pipeline the user enters at the terminal is called a job. All jobs exist in one of the following states: foreground, background, or stopped. These terms are defined as follows:

1. A job in the foreground has read and write access to the controlling terminal.
2. A job in the background is denied read access and has conditional write access to the controlling terminal (see stty(1)).
3. A stopped job is a job that has been placed in a suspended state, usually as a result of a SIGTSTP signal (see signal.h(3HEAD)).

Every job that the shell starts is assigned a positive integer, called a job number which is tracked by the shell and is used as an identifier to indicate a specific job. Additionally, the shell keeps track of the current and previous jobs. The current job is the most recent job to be started or restarted. The previous job is the first non-current job.

The acceptable syntax for a Job Identifier is of the form:

%jobid

where jobid can be specified in any of the following formats:

% or + For the current job.
- For the previous job.
?<string> Specify the job for which the command line uniquely contains string.
n For job number n.
pref Where pref is a unique prefix of the command name. For example, if the command ls -l name were running in the background, it could be referred to as %ls. pref cannot contain blanks unless it is quoted.

When Job Control is enabled, the following commands are added to the user’s environment to manipulate jobs:

bg [%jobid ...] Resumes the execution of a stopped job in the background. If %jobid is omitted the current job is assumed.

fg [%jobid ...] Resumes the execution of a stopped job in the foreground, also moves an executing background job into the foreground. If %jobid is omitted the current job is assumed.

jobs [-p| -l] [%jobid ...] jobs -x command [arguments] Reports all jobs that are stopped or executing in the background. If %jobid is omitted, all jobs that are stopped or running in the background is reported. The following options modify/enhance the output of jobs:
-l Report the process group ID and working directory of the jobs.

-p Report only the process group ID of the jobs.

-x Replace any jobid found in command or arguments with the corresponding process group ID, and then execute command passing it arguments.

kill [ -signal ] %jobid Builtin version of kill to provide the functionality of the kill command for processes identified with a jobid.

stop %jobid... Stops the execution of a background job(s).

suspend Stops the execution of the current shell (but not if it is the login shell).

wait [ %jobid ... ] wait builtin accepts a job identifier. If %jobid is omitted wait behaves as described above under Special Commands.

Large File Behavior See largefile(5) for the description of the behavior of sh and jsh when encountering files greater than or equal to 2 Gbyte (2^31 bytes).

Exit Status Errors detected by the shell, such as syntax errors, cause the shell to return a non-zero exit status. If the shell is being used non-interactively execution of the shell file is abandoned. Otherwise, the shell returns the exit status of the last command executed (see also the exit command above).

jsh Only If the shell is invoked as jsh and an attempt is made to exit the shell while there are stopped jobs, the shell issues one warning:

There are stopped jobs.

This is the only message. If another exit attempt is made, and there are still stopped jobs they are sent a SIGHUP signal from the kernel and the shell is exited.

Files $HOME/.profile
/dev/null
/etc/profile
/tmp/sh*

Attributes See attributes(5) for descriptions of the following attributes:
The use of `setuid` shell scripts is strongly discouraged.

Words used for filenames in input/output redirection are not interpreted for filename generation (see File Name Generation section above). For example, `cat file1 > a*` creates a file named `a*`.

Because commands in pipelines are run as separate processes, variables set in a pipeline have no effect on the parent shell.

If the input or the output of a `while` or `until` loop is redirected, the commands in the loop are run in a sub-shell, and variables set or changed there have no effect on the parent process:

```bash
lastline=
while read line
do
    lastline=$line
    done < /etc/passwd
echo "lastline=$lastline"  # lastline is empty!
```

In these cases, the input or output can be redirected by using `exec`, as in the following example:

```bash
# Save standard input (file descriptor 0) as file
# descriptor 3, and redirect standard input from the file /etc/passwd:
exec 3<&0  # save standard input as fd 3
exec < /etc/passwd  # redirect input from file
lastline=
```
while read line
do
    lastline=$line
done

exec 0<&3  # restore standard input
exec 3<&-  # close file descriptor 3
echo "$lastline"  # lastline

If you get the error message, "cannot fork, too many processes", try using the `wait(1)` command to clean up your background processes. If this doesn't help, the system process table is probably full or you have too many active foreground processes. There is a limit to the number of process ids associated with your login, and to the number the system can keep track of.

Only the last process in a pipeline can be waited for.

If a command is executed, and a command with the same name is installed in a directory in the search path before the directory where the original command was found, the shell continues to exec the original command. Use the hash command to correct this situation.

The Bourne shell has a limitation on the effective UID for a process. If this UID is less than 100 (and not equal to the real UID of the process), then the UID is reset to the real UID of the process.

Because the shell implements both foreground and background jobs in the same process group, they all receive the same signals, which can lead to unexpected behavior. It is, therefore, recommended that other job control shells be used, especially in an interactive environment.

When the shell executes a shell script that attempts to execute a non-existent command interpreter, the shell returns an erroneous diagnostic message that the shell script file does not exist.
Name       shcomp – compile a ksh shell script

Synopsis   shcomp [-nv] [infile [outfile]]

Description If the -D option is not specified, shcomp takes a shell
script, infile, and creates a binary format
file, outfile, that ksh reads and executes with the same effect as the original script.

Aliases are processed as the script is read. Alias definitions whose value requires variable
expansion will not work correctly.

Options     The following options are supported:

-D            Generate a list of strings that need to be placed in a message catalog for
              internationalization.

              With this option, all double quoted strings that are preceded by $ are
              printed, one literal per line. A literal $"foo" prints "foo" in the output.
              These are the messages that need to be translated to locale specific versions
              for internationalization.

-n            Display warning messages for obsolete or non-conforming constructs.

-v            Display input from infile onto standard error as it reads it.

Operands     The following operands are supported:

infile      Specifies the name of the file that contains the shell script to be used as input.

            If infile is omitted, the shell script is read from standard input.

outfile     Specifies the name of the output file.

            If outfile is omitted, both modes write their results to standard output.

Exit Status  The following exit values are returned:

            0        Successful completion.

            >0       An error occurred.

Attributes   See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
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</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
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</tbody>
</table>
CSI Enabled
Interface Stability See below.

The command-line interface and the system variables are Committed. The compiled shell code format is Private. The output of the \texttt{-D} option is Volatile.

\textbf{See Also} \texttt{ksh(1), attributes(5)}
Name  shell_builtins, case, for, foreach, function, if, repeat, select, switch, until, while – shell command interpreter built-in commands

Description  The shell command interpreters csh(1), ksh(1), ksh88(1), and sh(1) have special built-in commands. The commands case, for, foreach, function, if, repeat, select, switch, until, and while are commands in the syntax recognized by the shells. They are described in the Commands section of the manual pages of the respective shells. In ksh(1), fc, hash, stop, suspend, times, and type are aliases by default.

The remaining commands listed in the following table are built into the shells for reasons such as efficiency or data sharing between command invocations. They are described on their respective manual pages.

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<td>csh, ksh88, ksh, sh</td>
</tr>
<tr>
<td>source</td>
<td>csh</td>
</tr>
<tr>
<td>stop</td>
<td>csh, ksh88, ksh, sh</td>
</tr>
<tr>
<td>suspend</td>
<td>csh, ksh88, sh</td>
</tr>
<tr>
<td>switch</td>
<td>csh</td>
</tr>
<tr>
<td>test</td>
<td>ksh88, ksh, sh</td>
</tr>
<tr>
<td>time</td>
<td>csh</td>
</tr>
<tr>
<td><strong>times</strong></td>
<td>ksh88, ksh, sh</td>
</tr>
<tr>
<td><strong>+trap</strong></td>
<td>ksh88, ksh, sh</td>
</tr>
<tr>
<td>true</td>
<td>ksh88, ksh</td>
</tr>
<tr>
<td>type</td>
<td>ksh88, ksh, sh</td>
</tr>
<tr>
<td><strong>+typeset</strong></td>
<td>ksh88, ksh</td>
</tr>
<tr>
<td>ulimit</td>
<td>ksh88, ksh, sh</td>
</tr>
<tr>
<td>umask</td>
<td>csh, ksh88, ksh, sh</td>
</tr>
<tr>
<td><strong>unalias</strong></td>
<td>csh, ksh88, ksh</td>
</tr>
<tr>
<td>unhash</td>
<td>csh</td>
</tr>
<tr>
<td>unlimit</td>
<td>csh</td>
</tr>
<tr>
<td><strong>unset</strong></td>
<td>csh, ksh88, ksh, sh</td>
</tr>
<tr>
<td>unsetenv</td>
<td>csh</td>
</tr>
<tr>
<td>until</td>
<td>ksh88, ksh, sh</td>
</tr>
</tbody>
</table>
Input/output redirection is now permitted for these commands. File descriptor 1 is the default output location. When Job Control is enabled, additional *Special Commands* are added to the shell's environment.

In addition to these built-in reserved command words, *sh* also uses:

- ****: No effect; the command does nothing. A zero exit code is returned.
- `.filename` Read and execute commands from `filename` and return. The search path specified by `PATH` is used to find the directory containing `filename`.

*Built-in commands are executed within the C shell. If a built-in command occurs as any component of a pipeline except the last, it is executed in a subshell. In addition to these built-in reserved command words, *csh* also uses:*

- ****: Null command. This command is interpreted, but performs no action.

Input/Output redirection is permitted. Unless otherwise indicated, the output is written on file descriptor 1 and the exit status, when there is no syntax error, is zero.

Commands that are preceded by one or two `*` (asterisks) are treated specially in the following ways:

1. Variable assignment lists preceding the command remain in effect when the command completes.
2. I/O redirections are processed after variable assignments.
3. Errors cause a script that contains them to abort.
4. Words, following a command preceded by `**` that are in the format of a variable assignment, are expanded with the same rules as a variable assignment. This means that tilde substitution is performed after the `=` sign and word splitting and file name generation are not performed.

In addition to these built-in reserved command words, *ksh88* also uses:

- `*` : `[ arg . . . ]` The command only expands parameters.
* .file [ arg . . ]  Read the complete file then execute the commands. The commands are executed in the current shell environment. The search path specified by PATH is used to find the directory containing file. If any arguments arg are specified, they become the positional parameters. Otherwise, the positional parameters are unchanged. The exit status is the exit status of the last command executed. The loop termination test.

Input/Output redirection is permitted. Unless otherwise indicated, the output is written on file descriptor 1 and the exit status, when there is no syntax error, is zero.

Except for . , true, false, echo, newgrp, and login, all built-in commands accept -- to indicate end of options. They also interpret the option --man as a request to display the manual page onto standard error and -? as a help request which prints a usage message on standard error.

Commands that are preceded by one or two + are treated specially in the following ways:

1. Variable assignment lists preceding the command remain in effect when the command completes.
2. I/O redirections are processed after variable assignments.
3. Errors cause a script that contains them to abort.
4. They are not valid function names.
5. Words, following a command preceded by ++ that are in the format of a variable assignment, are expanded with the same rules as a variable assignment. This means that tilde substitution is performed after the = sign and field splitting and file name generation are not performed.

In addition to these built-in reserved command words, ksh also uses:

: [ arg . . ]  The command only expands parameters.

.name [ arg . . ]  If name is a function defined with the function name reserved word syntax, the function is executed in the current environment (as if it had been defined with the name ( ) syntax.) Otherwise if name refers to a file, the file is read in its entirety and the commands are executed in the current shell environment. The search path specified by PATH is used to find the directory containing the file. If any arguments arg are specified, they become the positional parameters while processing the . command and the original positional parameters are restored upon completion. Otherwise the positional parameters are unchanged. The exit status is the exit status of the last command executed.

See Also  Intro(1), alias(1), break(1), builtin(1), cd(1), csh(1), chmod(1), chown(1), echo(1), exec(1), exit(1), find(1), getopt(1), getopts(1), glob(1), hash(1), history(1), jobs(1), kill(1), ksh(1), ksh88(1), let(1), limit(1), login(1), logout(1), newgrp(1), nice(1),

User Commands  1719
nohup(1), printf(1), pwd(1), read(1), readonly(1), set(1), sh(1), shift(1),
sleep(1), suspend(1), test(1)test(1), test(1B), time(1), times(1), trap(1), typeset(1),
umask(1), wait(1), chdir(2), chmod(2), creat(2), umask(2), getopt(3C), profile(4),
environ(5)
Name  shift – shell built-in function to traverse either a shell's argument list or a list of field-separated words

Synopsis

sh  shift [n]
csh shift [variable]
ksh88  *shift [n]
ksh88  +shift [n]

Description

sh  The positional parameters from $n+1 \ldots$ are renamed $1 \ldots$. If $n$ is not specified, it is assumed to be 1.
csh  The components of argv, or variable, if supplied, are shifted to the left, discarding the first component. It is an error for the variable not to be set or to have a null value.
ksh88  The positional parameters from $n+1$ $n+1 \ldots$ are renamed $1 \ldots$, default $n$ is 1. The parameter $n$ can be any arithmetic expression that evaluates to a non-negative number less than or equal to $#.

On this manual page, ksh88(1) commands that are preceded by one or two * (asterisks) are treated specially in the following ways:

1. Variable assignment lists preceding the command remain in effect when the command completes.
2. I/O redirections are processed after variable assignments.
3. Errors cause a script that contains them to abort.
4. Words, following a command preceded by ** that are in the format of a variable assignment, are expanded with the same rules as a variable assignment. This means that tilde substitution is performed after the = sign and word splitting and file name generation are not performed.

ksh  shift is a shell special built-in that shifts the positional parameters to the left by the number of places defined by $n$, or 1 if $n$ is omitted. The number of positional parameters remaining is reduced by the number of places that are shifted.

If $n$ is specified, it is evaluated as an arithmetic expression to determine the number of places to shift. It is an error to shift more than the number of positional parameters or a negative number of places.

The following exit values are returned by shift in ksh:

0  Successful completion. The positional parameters were successfully shifted.
An error occurred.

On this manual page, `ksh(1)` commands that are preceded by one or two `+` are treated specially in the following ways:

1. Variable assignment lists preceding the command remain in effect when the command completes.
2. I/O redirections are processed after variable assignments.
3. Errors cause a script that contains them to abort.
4. They are not valid function names.
5. Words, following a command preceded by `++` that are in the format of a variable assignment, are expanded with the same rules as a variable assignment. This means that tilde substitution is performed after the `=` sign and field splitting and file name generation are not performed.

**Attributes**  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

**See Also**  `csh(1), ksh(1), ksh88(1), sh(1), attributes(5)`
shutdown – close down the system at a given time

/shutdown [-fhknr] time [warning-message]

Description

shutdown provides an automated procedure to notify users when the system is to be shut down. `time` specifies when shutdown will bring the system down; it may be the word `now` (indicating an immediate shutdown), or it may specify a future time in one of two formats: `+number` and `hour:min`. The first form brings the system down in `number` minutes, and the second brings the system down at the time of day indicated in 24-hour notation.

At intervals that get closer as the apocalypse approaches, warning messages are displayed at terminals of all logged-in users, and of users who have remote mounts on that machine.

At shutdown time a message is written to the system log daemon, `syslogd(1M)`, containing the time of shutdown, the instigator of the shutdown, and the reason. Then a terminate signal is sent to `init`, which brings the system down to single-user mode.

Options

As an alternative to the above procedure, these options can be specified:

- `f` Arrange, in the manner of `fastboot(1B)`, that when the system is rebooted, the file systems will not be checked.
- `h` Execute `halt(1M)`.
- `k` Simulate shutdown of the system. Do not actually shutdown the system.
- `n` Prevent the normal `sync(2)` before stopping.
- `r` Execute `reboot(1M)`.

Files

/etc/rmtab remote mounted file system table

Attributes

See `attributes(5)` for descriptions of the following attributes:

```
<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>
```

See Also

`fastboot(1B), login(1), halt(1M), reboot(1M), syslogd(1M), sync(2), rmtab(4), attributes(5)`

Notes

Only allows you to bring the system down between `now` and 23:59 if you use the absolute time for shutdown.
The `size` command produces segment or section size information in bytes for each loaded section in ELF object files. `size` prints out the size of the text, data, and bss (uninitialized data) segments (or sections) and their total.

`size` processes ELF object files entered on the command line. If an archive file is input to the `size` command, the information for each object file in the archive is displayed.

When calculating segment information, the `size` command prints out the total file size of the non-writable segments, the total file size of the writable segments, and the total memory size of the writable segments minus the total file size of the writable segments.

If it cannot calculate segment information, `size` calculates section information. When calculating section information, it prints out the total size of sections that are allocatable, non-writable, and not NOBITS, the total size of the sections that are allocatable, writable, and not NOBITS, and the total size of the writable sections of type NOBITS. NOBITS sections do not actually take up space in the `filename`.

If `size` cannot calculate either segment or section information, it prints an error message and stops processing the file.

The following options are supported:

- `-f` Prints out the size of each allocatable section, the name of the section, and the total of the section sizes. If there is no section data, `size` prints out an error message and stops processing the file.

- `-F` Prints out the size of each loadable segment, the permission flags of the segment, then the total of the loadable segment sizes. If there is no segment data, `size` prints an error message and stops processing the file.

- `-n` Prints out non-loadable segment or non-allocatable section sizes. If segment data exists, `size` prints out the memory size of each loadable segment or file size of each non-loadable segment, the permission flags, and the total size of the segments. If there is no segment data, `size` prints out, for each allocatable and non-allocatable section, the memory size, the section name, and the total size of the sections. If there is no segment or section data, `size` prints an error message and stops processing.

- `-o` Prints numbers in octal, not decimal.

- `-V` Prints the version information for the `size` command on the standard error output.

- `-x` Prints numbers in hexadecimal, not decimal.
Examples The examples below are typical size output.

EXAMPLE 1 Producing size information
example% size filename
2724 + 88 + 0 = 2812

EXAMPLE 2 Producing allocatable section size information
example% size -f filename
26(.text) + 5(.init) + 5(.fini) = 36

EXAMPLE 3 Producing loadable segments size information
example% size -F filename
2724(r-x) + 88(rwx) + 0(rwx) = 2812 ... (If statically linked)

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/base-developer-utilities</td>
</tr>
</tbody>
</table>

See Also as(1), ld(1), ar.h(3HEAD), a.out(4), attributes(5)

Notes Since the size of bss sections is not known until link-edit time, the size command will not give the true total size of pre-linked objects.
sleep(1)

Name  
sleep – suspend execution for an interval

Synopsis  
/usr/bin/sleep interval[d|h|m|s]...

Description  
sleep suspends execution for at least the time in seconds specified by seconds or until a SIGALRM signal is received. The seconds operand can be specified as a floating point number but the actual granularity normally depends on the underlying system.

Operands  
interval  
A floating-point number specifying the time for which to suspend execution. The floating-point number may be specified in all formats required by C99/XPG6, including constants such as Inf or infinite. One of four suffixes may optionally be specified, indicating the number specified is days (d), hours (h), minutes (m), or seconds (s). With no suffix, the interval is assumed to be seconds. If multiple intervals are specified they are summed together. Individual intervals may be negative but the sum must be greater than or equal to zero.

Examples  
EXAMPLE 1  
Suspending Command Execution  
The following example executes a command after a certain amount of time:

```
example% (sleep 105; command)&
```

EXAMPLE 2  
Executing a Command Every So Often  
The following example executes a command every so often:

```
example% while true
do
   command
   sleep 37
done
```

EXAMPLE 3  
Suspending Command Execution Forever  
The following example suspends command execution forever or until a SIGALRM signal is received:

```
example% sleep Inf
```

EXAMPLE 4  
Suspending Command Execution for 0.5 Seconds  
Suspending command execution for 0.5 seconds using an alternative floating-point representation for the value 0.5:

```
example% printf "%a\n" 0.5
0x1.00000000000000000000000000000000p-01
example% sleep 0x1.00000000000000000000000000000000p-01
```
EXAMPLE 5  Suspending Execution for 23 Hours

The following example suspends execution for twenty three hours using a letter suffixes:

example% sleep 1d -1h

See environ(5) for descriptions of the following environment variables that affect the execution of sleep: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status  The following exit values are returned:

0   The execution was successfully suspended for at least time seconds, or a SIGALRM signal was received (see NOTES).
>0   An error has occurred.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also  wait(1), alarm(2), sleep(3C), attributes(5), environ(5), standards(5)

Notes  If the sleep utility receives a SIGALRM signal, one of the following actions is taken:

- Terminate normally with a zero exit status.
- Effectively ignore the signal.

The sleep utility takes the standard action for all other signals.
soelim(1)

Name soelim – resolve and eliminate .so requests from nroff or troff input

Synopsis soelim [filename]...

Description soelim reads the specified files or the standard input and performs the textual inclusion implied by the nroff(1) directives of the form:

    .so somefile

when they appear at the beginning of input lines.

This is useful as programs such as tbl(1) do not normally do this. It allows the placement of individual tables in separate files to be run as a part of a large document.

An argument consisting of – is taken to be a file name corresponding to the standard input.

Inclusion can be suppressed by using a single quote (’) instead of a dot (.) that is,

    ' so /usr/share/lib/tmac/tmac.s

Examples EXAMPLE 1 Using the soelim Command

The following is an example of the soelim command:

    example% soelim exum?.n | tbl | nroff -ms | col | lpr

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>text/doctools</td>
</tr>
</tbody>
</table>

See Also more(1), nroff(1), tbl(1), attributes(5)
Name
sort – sort, merge, or sequence check text files

Synopsis
/usr/bin/sort [-bcdfinru] [-k keydef] [-o output]
[-S kmem] [-t char] [-T directory]
[+pos1 [-pos2]] [file]...

/usr/xpg4/bin/sort [-bcdfinru] [-k keydef] [-o output]
[-S kmem] [-t char] [-T directory] [-y [kmem]]
[-z recsz] [+pos1 [-pos2]] [file]...

Description
The sort command sorts lines of all the named files together and writes the result on the standard output.

Comparisons are based on one or more sort keys extracted from each line of input. By default, there is one sort key, the entire input line. Lines are ordered according to the collating sequence of the current locale.

Options
The following options alter the default behavior:

Options for /usr/bin/sort
- c
  Checks that the single input file is ordered as specified by the arguments and the collating sequence of the current locale. The exit code is set and no output is produced unless the file is out of sort.

Options for /usr/xpg4/bin/sort
- c
  Same as /usr/bin/sort except no output is produced under any circumstances.
- y kmem
  (obsolete). This option was used to specify the amount of main memory initially used by sort. Its functionality is not appropriate for a virtual memory system; memory usage for sort is now specified using the -S option.
- z recsz
  (obsolete). This option was used to prevent abnormal termination when lines longer than the system-dependent default buffer size are encountered. Because sort automatically allocates buffers large enough to hold the longest line, this option has no effect.

Options for /usr/bin/sort and /usr/xpg4/bin/sort
- m
  Merges only. The input files are assumed to be already sorted.
- o output
  Specifies the name of an output file to be used instead of the standard output. This file can be the same as one of the input files.
- S kmem
  Specifies the maximum amount of swap-based memory used for sorting, in kilobytes (the default unit). kmem can also be specified directly as a number of bytes (b), kilobytes (k), megabytes (m), gigabytes (g), or terabytes (t); or as a percentage (%) of the installed physical memory.
- T directory
  Specifies the directory in which to place temporary files.
- u
  Unique: suppresses all but one in each set of lines having equal keys. If used with the -c option, checks that there are no lines with duplicate keys in addition to checking that the input file is sorted.
The default sort order depends on the value of LC_COLLATE. If LC_COLLATE is set to C, sorting is in ASCII order. If LC_COLLATE is set to en_US, sorting is case insensitive except when the two strings are otherwise equal and one has an uppercase letter earlier than the other. Other locales have other sort orders.

The following options override the default ordering rules. When ordering options appear independent of any key field specifications, the requested field ordering rules are applied globally to all sort keys. When attached to a specific key (see Sort Key Options), the specified ordering options override all global ordering options for that key. In the obsolescent forms, if one or more of these options follows a +pos1 option, it affects only the key field specified by that preceding option.

- **d**  Dictionary order: only letters, digits, and blanks (spaces and tabs) are significant in comparisons.
- **f**  Folds lower-case letters into upper case.
- **i**  Ignores non-printable characters.
- **M**  Compares as months. The first three non-blank characters of the field are folded to upper case and compared. For example, in English the sorting order is "JAN" < "FEB" < . . . < "DEC". Invalid fields compare low to "JAN". The -M option implies the -b option (see below).
- **n**  Restricts the sort key to an initial numeric string, consisting of optional blank characters, optional minus sign, and zero or more digits with an optional radix character and thousands separators (as defined in the current locale), which is sorted by arithmetic value. An empty digit string is treated as zero. Leading zeros and signs on zeros do not affect ordering.
- **r**  Reverses the sense of comparisons.

The treatment of field separators can be altered using the following options:

- **b**  Ignores leading blank characters when determining the starting and ending positions of a restricted sort key. If the -b option is specified before the first sort key option, it is applied to all sort key options. Otherwise, the -b option can be attached independently to each -k field_start, field_end, or +pos1 or −pos2 option-argument (see below).
- **t char**  Use char as the field separator character. char is not considered to be part of a field (although it can be included in a sort key). Each occurrence of char is significant (for example, <char><char> delimits an empty field). If -t is not specified, blank characters are used as default field separators; each maximal non-empty sequence of blank characters that follows a non-blank character is a field separator.
The keydef argument is a restricted sort key field definition. The format of this definition is:

```
-k field_start [type] [field_end [type]]
```

where:

- **field_start** and **field_end** define a key field restricted to a portion of the line.

- **type** is a modifier from the list of characters `bdfiMnr`. The `b` modifier behaves like the `-b` option, but applies only to the `field_start` or `field_end` to which it is attached and characters within a field are counted from the first non-blank character in the field. (This applies separately to `first_character` and `last_character`.) The other modifiers behave like the corresponding options, but apply only to the key field to which they are attached. They have this effect if specified with `field_start`, `field_end` or both. If any modifier is attached to a `field_start` or a `field_end`, no option applies to either.

When there are multiple key fields, later keys are compared only after all earlier keys compare equal. Except when the `-u` option is specified, lines that otherwise compare equal are ordered as if none of the options `-d`, `-f`, `-i`, `-n` or `-k` were present (but with `-r` still in effect, if it was specified) and with all bytes in the lines significant to the comparison.

The notation:

```
-k field_start[type] [field_end[type]]
```

defines a key field that begins at `field_start` and ends at `field_end` inclusive, unless `field_start` falls beyond the end of the line or after `field_end`, in which case the key field is empty. A missing `field_end` means the last character of the line.

A field comprises a maximal sequence of non-separating characters and, in the absence of option `-t`, any preceding field separator.

The **field_start** portion of the **keydef** option-argument has the form:

```
field_number[first_character]
```

Fields and characters within fields are numbered starting with 1. `field_number` and `first_character`, interpreted as positive decimal integers, specify the first character to be used as part of a sort key. If `first_character` is omitted, it refers to the first character of the field.

The **field_end** portion of the **keydef** option-argument has the form:

```
field_number[last_character]
```
The field_number is as described above for field_start. last_character, interpreted as a non-negative decimal integer, specifies the last character to be used as part of the sort key. If last_character evaluates to zero or .last_character is omitted, it refers to the last character of the field specified by field_number.

If the -b option or b type modifier is in effect, characters within a field are counted from the first non-blank character in the field. (This applies separately to first_character and last_character.)

[pos1 [-pos2]] (obsolete). Provide functionality equivalent to the -kkeydef option.

pos1 and pos2 each have the form m.n optionally followed by one or more of the flags bfdimnr. A starting position specified by +m.n is interpreted to mean the n+1st character in the m+1st field. A missing .n means .0, indicating the first character of the m+1st field. If the b flag is in effect n is counted from the first non-blank in the m+1st field; +m.0b refers to the first non-blank character in the m+1st field.

A last position specified by −m.n is interpreted to mean the nth character (including separators) after the last character of the mth field. A missing .n means .0, indicating the last character of the mth field. If the b flag is in effect n is counted from the last leading blank in the m+1st field; −m.1b refers to the first non-blank in the m+1st field.

The fully specified +pos1 −pos2 form with type modifiers T and U:

+w.xT -y.zU

is equivalent to:

undefined (z==0 & U contains b & -t is present)
-k w+1.x+1T,y.0U (z==0 otherwise)
-k w+1.x+1T,y+1.zU (z > 0)

Implementations support at least nine occurrences of the sort keys (the -k option and obsolescent +pos1 and −pos2) which are significant in command line order. If no sort key is specified, a default sort key of the entire line is used.

Operands

The following operand is supported:

file A path name of a file to be sorted, merged or checked. If no file operands are specified, or if a file operand is −, the standard input is used.

Usage

See largefile(5) for the description of the behavior of sort when encountering files greater than or equal to 2 Gbyte (2^31 bytes).
Examples

In the following examples, first the preferred and then the obsolete way of specifying sort keys are given as an aid to understanding the relationship between the two forms.

EXAMPLE 1  Sorting with the Second Field as a sort Key

Either of the following commands sorts the contents of infile with the second field as the sort key:

example% sort -k 2,2 infile
example% sort +1 -2 infile

EXAMPLE 2  Sorting in Reverse Order

Either of the following commands sorts, in reverse order, the contents of infile1 and infile2, placing the output in outfile and using the second character of the second field as the sort key (assuming that the first character of the second field is the field separator):

example% sort -r -o outfile -k 2.2,2.2 infile1 infile2
example% sort -r -o outfile +1.1 -1.2 infile1 infile2

EXAMPLE 3  Sorting Using a Specified Character in One of the Files

Either of the following commands sorts the contents of infile1 and infile2 using the second non-blank character of the second field as the sort key:

example% sort -k 2.2b,2.2b infile1 infile2
example% sort +1.1b -1.2b infile1 infile2

EXAMPLE 4  Sorting by Numeric UserID

Either of the following commands prints the passwd(4) file (user database) sorted by the numeric user ID (the third colon-separated field):

example% sort -t : -k 3,3n /etc/passwd
example% sort -t : +2 -3n /etc/passwd

EXAMPLE 5  Printing Sorted Lines Excluding Lines that Duplicate a Field

Either of the following commands prints the lines of the already sorted file infile, suppressing all but one occurrence of lines having the same third field:

example% sort -um -k 3.1,3.0 infile
example% sort -um +2.0 -3.0 infile

EXAMPLE 6  Sorting by Host IP Address

Either of the following commands prints the hosts(4) file (IPv4 hosts database), sorted by the numeric IP address (the first four numeric fields):

example$ sort -t . -k 1,1n -k 2,2n -k 3,3n -k 4,4n /etc/hosts
example$ sort -t . +0 -1n +1 -2n +2 -3n +3 -4n /etc/hosts
EXAMPLE 6  Sorting by Host IP Address  (Continued)

Since ‘,’ is both the field delimiter and, in many locales, the decimal separator, failure to
specify both ends of the field leads to results where the second field is interpreted as a
fractional portion of the first, and so forth.

Environment Variables  See environ(5) for descriptions of the following environment variables that affect the
execution of sort: LANG, LC_ALL, LC_COLLATE, LC_MESSAGES, and NLSPATH.

LC_CTYPE  Determine the locale for the interpretation of sequences of bytes of text data
as characters (for example, single- versus multi-byte characters in arguments
and input files) and the behavior of character classification for the -b, -d, -f,
-1 and -n options.

LC_NUMERIC  Determine the locale for the definition of the radix character and thousands
separator for the -n option.

Exit Status  The following exit values are returned:

0  All input files were output successfully, or -c was specified and the input file was
correctly sorted.

1  Under the -c option, the file was not ordered as specified, or if the -c and -u options
were both specified, two input lines were found with equal keys.

>1  An error occurred.

Files  /var/tmp/stm???

Temporary files

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>/usr/bin/sort</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
<td></td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>/usr/xpg4/bin/sort</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/xopen/xcu4</td>
<td></td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
<td></td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
<td></td>
</tr>
</tbody>
</table>
comments, join, uniq, nl_langinfo(3C), strftime(3C), hosts(4), passwd(4), attributes(5), environ(5), largefile(5), standards(5)

Diagnostics
Comments and exits with non-zero status for various trouble conditions (for example, when input lines are too long), and for disorders discovered under the -c option.

Notes
When the last line of an input file is missing a new-line character, sort appends one, prints a warning message, and continues.

sort does not guarantee preservation of relative line ordering on equal keys.

One can tune sort performance for a specific scenario using the -S option. However, one should note in particular that sort has greater knowledge of how to use a finite amount of memory for sorting than the virtual memory system. Thus, a sort invoked to request an extremely large amount of memory via the -S option could perform extremely poorly.

As noted, certain of the field modifiers (such as -M and -d) cause the interpretation of input data to be done with reference to locale-specific settings. The results of this interpretation can be unexpected if one’s expectations are not aligned with the conventions established by the locale. In the case of the month keys, sort does not attempt to compensate for approximate month abbreviations. The precise month abbreviations from nl_langinfo(3C) or strftime(3C) are the only ones recognized. For printable or dictionary order, if these concepts are not well-defined by the locale, an empty sort key might be the result, leading to the next key being the significant one for determining the appropriate ordering.
Name  sortbib – sort a bibliographic database

Synopsis  sortbib [ -s KEYS ] database...

Description  sortbib sorts files of records containing refer key-letters by user-specified keys. Records may be separated by blank lines, or by ‘[ ‘ and ‘]’ delimiters, but the two styles may not be mixed together. This program reads through each database and pulls out key fields, which are sorted separately. The sorted key fields contain the file pointer, byte offset, and length of corresponding records. These records are delivered using disk seeks and reads, so sortbib may not be used in a pipeline to read standard input.

The most common key-letters and their meanings are given below.

%A   Author’s name
%B   Book containing article referenced
%C   City (place of publication)
%D   Date of publication
%E   Editor of book containing article referenced
%F   Footnote number or label (supplied by refer)
%G   Government order number
%H   Header commentary, printed before reference
%I   Issuer (publisher)
%J   Journal containing article
%K   Keywords to use in locating reference
%L   Label field used by -k option of refer
%M   Bell Labs Memorandum (undefined)
%N   Number within volume
%O   Other commentary, printed at end of reference
%P   Page number(s)
%Q   Corporate or Foreign Author (unreversed)
%R   Report, paper, or thesis (unpublished)
%S   Series title
%T   Title of article or book
%V   Volume number
%X   Abstract — used by roffbib, not by refer
%Y,Z Ignored by refer

By default, `sortbib` alphabetizes by the first `%A` and the `%D` fields, which contain the senior author and date.

`sortbib` sorts on the last word on the `%A` line, which is assumed to be the author's last name. A word in the final position, such as 'jr.' or 'ed.', will be ignored if the name beforehand ends with a comma. Authors with two-word last names or unusual constructions can be sorted correctly by using the `nroff` convention `\0` in place of a blank. A `%Q` field is considered to be the same as `%A`, except sorting begins with the first, not the last, word. `sortbib` sorts on the last word of the `%D` line, usually the year. It also ignores leading articles (like 'A' or 'The') when sorting by titles in the `%T` or `%J` fields; it will ignore articles of any modern European language. If a sort-significant field is absent from a record, `sortbib` places that record before other records containing that field.

No more than 16 databases may be sorted together at one time. Records longer than 4096 characters will be truncated.

**Options**  
- `-sKEYS` Specify new `KEYS`. For instance, `-sATD` will sort by author, title, and date, while `-sA+D` will sort by all authors, and date. Sort keys past the fourth are not meaningful.

**Attributes**  
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>text/doctools</td>
</tr>
</tbody>
</table>

**See Also**  
`addbib(1), indexbib(1), lookbib(1), refer(1), roffbib(1), attributes(5)`

**Bugs**  
Records with missing author fields should probably be sorted by title.
sotruss(1)

Name sotruss – trace shared library procedure calls

Synopsis /usr/bin/sotruss [-f] [-F bindfromlist] [-T bindtolist]
   [-o outputfile] executable [executable arguments...]

Description sotruss executes the specified command and produces a trace of the library calls that it performs. Each line of the trace output reports what bindings are occurring between dynamic objects as each procedure call is executed. sotruss traces all of the procedure calls that occur between dynamic objects via the Procedure Linkage Table, so only those procedure calls which are bound via the Procedure Linkage Table will be traced. See Linker and Libraries Guide

Options -F bindfromlist A colon-separated list of libraries that are to be traced. Only calls from these libraries will be traced. The default is to trace calls from the main executable only.

-T bindtolist A colon-separated list of libraries that are to be traced. Only calls to these libraries will be traced. The default is to trace all calls.

-o outputfile sotruss output will be directed to the outputfile. If this option is combined with the -f option then the pid of the executing program will be placed at the end of the filename. By default sotruss output is placed on stderr.

-f Follow all children created by fork() and print truss output on each child process. This option will also cause a pid to be output on each truss output line.

Examples EXAMPLE 1 An example of sotruss.

A simple example shows the tracing of a simple ls command:

```bash
% sotruss ls | more
ls -> lib.so.1:*atexit(0xef7d7d1c, 0x23c00, 0x0)
ls -> lib.so.1:*atexit(0x1392c, 0xef7d7d1c, 0xef621bb0)
ls -> lib.so.1:*setlocale(0x6, 0x1396c, 0xef621ba8)
ls -> lib.so.1:*textdomain(0x13970, 0x1396c, 0xef621ba8)
ls -> lib.so.1:*time(0x0, 0xef61f6fc, 0xef621ba8)
ls -> lib.so.1:*isatty(0x1, 0xef61f6fc, 0x0)
ls -> lib.so.1:*getopt(0x1, 0xef67f8fc, 0x13980)
ls -> lib.so.1:*malloc(0x100, 0x0, 0x0)
ls -> lib.so.1:*malloc(0x9000, 0x0, 0x0)
ls -> lib.so.1:*lstat64(0x23ee8, 0xef67f7a0, 0x0)
...
ls -> lib.so.1:*printf(0x13a64, 0x26208, 0x23ef0)
ls -> lib.so.1:*printf(0x13a64, 0x26448, 0x23ef0)
ls -> lib.so.1:*exit(0x0, 0x24220, 0x2421c)
```
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/base-developer-utilities</td>
</tr>
</tbody>
</table>

See Also  ld.so.1(1), truss(1), whocalls(1), fork(2), attributes(5)

Linker and Libraries Guide
### spell(1)

**Name**  
spell, hashmake, spellin, hashcheck – report spelling errors

**Synopsis**  
spell [-bilvx] [+ local_file] [file] ...

```
/usr/lib/spell/hashmake
/usr/lib/spell/spellin n
/usr/lib/spell/hashcheck spelling_list
```

**Description**  
The `spell` command collects words from the named files and looks them up in a spelling list. Words that neither occur among nor are derivable (by applying certain inflections, prefixes, or suffixes) from words in the spelling list are written to the standard output.

If there are no file arguments, words to check are collected from the standard input. `spell` ignores most `troff(1)`, `tbl(1)`, and `eqn(1)` constructs. Copies of all output words are accumulated in the history file (`spellhist`), and a stop list filters out misspellings (for example, `their=thy=+ier`) that would otherwise pass.

By default, `spell` (like `deroff(1)`) follows chains of included files (`.so` and `.nx `troff(1)` requests), unless the names of such included files begin with `/usr/lib`.

The standard spelling list is based on many sources, and while more haphazard than an ordinary dictionary, is also more effective in respect to proper names and popular technical words. Coverage of the specialized vocabularies of biology, medicine and chemistry is light.

Three programs help maintain and check the hash lists used by `spell`:

<table>
<thead>
<tr>
<th>Program</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>hashmake</td>
<td>Reads a list of words from the standard input and writes the corresponding nine-digit hash code on the standard output.</td>
</tr>
<tr>
<td>spellin</td>
<td>Reads $n$ hash codes from the standard input and writes a compressed spelling list on the standard output.</td>
</tr>
<tr>
<td>hashcheck</td>
<td>Reads a compressed <code>spelling_list</code> and recreates the nine-digit hash codes for all the words in it. It writes these codes on the standard output.</td>
</tr>
</tbody>
</table>

**Options**  
The following options are supported:

- `-b`  
Check British spelling. Besides preferring `centre, colour, programme, speciality, travelled`, and so forth, this option insists upon `−ise` in words like `standardise`.

- `-i`  
Cause `deroff(1)` to ignore `.so` and `.nx `troff(1)` commands. If `deroff(1)` is not present on the system, then this option is ignored.

- `-l`  
Follow the chains of all included files.

- `-v`  
Print all words not literally in the spelling list, as well as plausible derivations from the words in the spelling list.

- `-x`  
Print every plausible stem, one per line, with `−` preceding each word.
+local_file Specify a set of words that are correct spellings (in addition to spell's own spelling list) for each job. local_file is the name of a user-provided file that contains a sorted list of words, one per line. Words found in local_file are removed from spell's output. Use sort(1) to order local_file in ASCII collating sequence. If this ordering is not followed, some entries in local_file might be ignored.

Operands The following operands are supported:

file A path name of a text file to check for spelling errors. If no files are named, words are collected from the standard input.

Environment Variables See environ(5) for descriptions of the following environment variables that affect the execution of spell: LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status The following exit values are returned:

0 Successful completion.

>0 An error occurred.

Files

D_SPELL=/usr/lib/spell/hlist[ab] hashed spelling lists, American & British
S_SPELL=/usr/lib/spell/hstop hashed stop list
H_SPELL=$HOME/.spellhist history file
/usr/share/lib/dict/words master dictionary

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>text/spelling-utilities</td>
</tr>
</tbody>
</table>

See Also deroff(1), eqn(1), sort(1), tbl(1), troff(1), attributes(5), environ(5)

Notes spell works only on English words defined in the U.S. ASCII codeset.

Bugs The spelling list's coverage is uneven. New installations might wish to monitor the output for several months to gather local additions.

British spelling was done by an American.

Misspelled words can be monitored by default. To do so, set the H_SPELL environment variable to the name of a file which is writable to the spell process. If H_SPELL is not set, $HOME/.spellhist is used as the history file. If no monitoring is desired, one can create the appropriate spell history file with write permission disabled.
## Name
split – split a file into pieces

## Synopsis
```
split [-l linecount] [-a suffixlength] [file [name]]
```

```
split [-b n | nk | nm] [-a suffixlength] [file [name]]
```

## Description
The `split` utility reads `file` and writes it in `linecount`-line pieces into a set of output-files. The name of the first output-file is `name` with `aa` appended, and so on lexicographically, up to `zz` (a maximum of 676 files). The maximum length of `name` is 2 characters less than the maximum filename length allowed by the filesystem. See `statvfs(2)`. If no output name is given, `x` is used as the default (output-files will be called `xaa`, `xab`, and so forth).

## Options
The following options are supported:

- `-l linecount` or `-l linecount` Number of lines in each piece. Defaults to 1000 lines.
- `-a suffixlength` Uses `suffixlength` letters to form the suffix portion of the filenames of the split file. If `-a` is not specified, the default suffix length is 2. If the sum of the `name` operand and the `suffixlength` option-argument would create a filename exceeding `NAME_MAX` bytes, an error will result; `split` will exit with a diagnostic message and no files will be created.
- `-b n` Splits a file into pieces `n` bytes in size.
- `-b nk` Splits a file into pieces `n*1024` bytes in size.
- `-b nm` Splits a file into pieces `n*1048576` bytes in size.

## Operands
The following operands are supported:

- `file` The path name of the ordinary file to be split. If no input file is given or `file` is `−`, the standard input will be used.
- `name` The prefix to be used for each of the files resulting from the `split` operation. If no `name` argument is given, `x` will be used as the prefix of the output files. The combined length of the basename of `prefix` and `suffixlength` cannot exceed `NAME_MAX` bytes. See OPTIONS.

## Usage
See `largefile(5)` for the description of the behavior of `split` when encountering files greater than or equal to 2 Gbyte (2³¹ bytes).

## Environment Variables
See `environ(5)` for descriptions of the following environment variables that affect the execution of `split`: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

## Exit Status
The following exit values are returned:

- `0` Successful completion.
- `>0` An error occurred.
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also  csplit(1), statvfs(2), attributes(5), environ(5), largefile(5), standards(5)
The `srchtxt` utility is used to display all the text strings in message data bases, or to search for a text string in message data bases (see `mkmsgs(1)`). These data bases are files in the directory `/usr/lib/locale/locale/LC_MESSAGES` (see `setlocale(3C)`), unless a file name given with the `-m` option contains a `/`. The directory `locale` can be viewed as the name of the language in which the text strings are written. If the `-l` option is not specified, the files accessed will be determined by the value of the environment variable `LC_MESSAGES`. If `LC_MESSAGES` is not set, the files accessed will be determined by the value of the environment variable `LANG`. If `LANG` is not set, the files accessed will be in the directory `/usr/lib/locale//C/LC_MESSAGES`, which contains default strings.

If no `text` argument is present, then all the text strings in the files accessed will be displayed.

If the `-s` option is not specified, the displayed text is prefixed by message sequence numbers. The message sequence numbers are enclosed in angle brackets: `<msgfile:msgnum>`.

This display is in the format used by `gettext(1)` and `gettext(3C)`.

### Options

- `-s` Suppress printing of the message sequence numbers of the messages being displayed.
- `-l locale` Access files in the directory `/usr/lib/locale/locale/LC_MESSAGES`. If `-m msgfile` is also supplied, `LOCALE` is ignored for `msgfile` containing a `/`.
- `-m msgfile` Access files specified by one or more `msgfile`s. If `msgfile` contains a `/` character, then `msgfile` is interpreted as a pathname; otherwise, it will be assumed to be in the directory determined as described above. To specify more than one `msgfile`, separate the file names using commas.

### Examples

**EXAMPLE 1** Using `srchtxt`

If message files have been installed in a locale named `french` by using `mkmsgs(1)`, then you could display the entire set of text strings in the `french` locale (/usr/lib/locale/french/LC_MESSAGES/*) by typing:

```
example% srchtxt -l french
```
EXAMPLE 2  Using srchtxt

If a set of error messages associated with the operating system have been installed in the file UX in the french locale (/usr/lib/locale/french/LC_MESSAGE/UX), then, using the value of the LANG environment variable to determine the locale to be searched, you could search that file in that locale for all error messages dealing with files by typing:

```
example% setenv LANG=french; export LANG
example% srchtxt -m UX "[Ff]ichier"
```

If /usr/lib/locale/french/LC_MESSAGES/UX contained the following strings:

```
Erreur E/S
Liste d'arguments trop longue
Fichier inexistant
Argument invalide
Trop de fichiers ouverts
Fichier trop long
Trop de liens
Argument hors du domaine
Identificateur supprim
Etreinte fatale
```

then the following strings would be displayed:

```
<UX:3>Fichier inexistant
<UX:5>Trop de fichiers ouverts
<UX:6>Fichier trop long
```

EXAMPLE 3  Using srchtxt

If a set of error messages associated with the operating system have been installed in the file UX and a set of error messages associated with the INGRESS database product have been installed in the file ingress, both in the german locale, then you could search for the pattern [Dd]atei in both the files UX and ingress in the german locale by typing:

```
example% srchtxt -l german -m UX,ingress "[Dd]atei"
```

Environment Variables

See environ(5) for a description of the LC_CTYPE environment variable that affects the execution of srchtxt.

Files

/usr/lib/locale/C/LC_MESSAGES/*  default files created by mkmsgs(1)
/usr/lib/locale/locale/LC_MESSAGES/*  message files created by mkmsgs(1)
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>text/locale</td>
</tr>
</tbody>
</table>

See Also  extr(1), gettxt(1), locale(1), mkmsgs(1), gettxt(3C), setlocale(3C), attributes(5), environ(5), locale(5), regexp(5)

Diagnostics  The error messages produced by srchtxt are intended to be self-explanatory. They indicate an error in the command line or errors encountered while searching for a particular locale and/or message file.
Name  ssh – secure shell client (remote login program)

Synopsis  ssh [ -l login_name ] hostname | user@hostname [ command ]

          ssh [ -a -f -g -n -q -s -t -v -x -A -N -T -X -1 -2 -4 -6 ]
          [ -b bind_address ] [ -m mac_spec ]
          [ -c cipher_spec ] [ -e escape_char ] [ -i identity_file ]
          [ -i PKCS#11-URI ]
          [ -l login_name ] [ -F configfile ] [ -o option ] [ -p port ]
          [ -L [ bind_address : ] port : host : hostport ]
          [ -R [ bind_address : ] port : host : hostport ]
          [ -D [ bind_address : ] port ] hostname | user@hostname [ command ]

Description  ssh (Secure Shell) is a program for logging into a remote machine and for executing
commands on a remote machine. It is intended to replace rlogin and rsh, and to provide
secure encrypted communications between two untrusted hosts over an insecure network.
X11 connections and arbitrary TCP/IP ports can also be forwarded over the secure channel.

This implementation of ssh supports both SSH protocol versions 1 and 2 simultaneously.
Because of security weaknesses in the v1 protocol, only v2 should be run, if possible.

Support for v1 is provided to help sites with existing ssh v1 servers to transition to v2. v1
might not be supported in a future release.

ssh connects and logs into the specified hostname. The user must prove his or her identity to
the remote machine using one of several methods depending on the protocol version used:

SSH Protocol Version 1  First, if the machine the user logs in from is listed in /etc/hosts.equiv or
/etc/shosts.equiv on the remote machine, and the user names are the same on both sides,
the user is immediately permitted to log in. Second, if .rhosts or .shosts exists in the user's
home directory on the remote machine and contains a line containing the name of the client
machine and the name of the user on that machine, the user is permitted to log in. This form
of authentication alone is normally not allowed by the server because it is not secure.

The second (and primary) authentication method is the rhosts or hosts.equiv method
combined with RSA-based host authentication. It means that if the login would be permitted
by $HOME/.rhosts, $HOME/.shosts, /etc/hosts.equiv, or /etc/shosts.equiv, and if
additionally the server can verify the client's host key (see /etc/ssh_known_hosts in the
FILES section), only then is login permitted. This authentication method closes security holes
due to IP spoofing, DNS spoofing, and routing spoofing.

Note to the administrator: /etc/hosts.equiv, $HOME/.rhosts, and the rlogin/rsh protocol in
general, are inherently insecure and should be disabled if security is desired.

As a third authentication method, ssh supports RSA-based authentication. The scheme is
based on public–key cryptography. There are cryptosystems where encryption and decryption
are done using separate keys, and it is not possible to derive the decryption key from the
encryption key. RSA is one such system. The idea is that each user creates a public/private key
pair for authentication purposes. The server knows the public key, and only the user knows
the private key. The file $HOME/.ssh/authorized_keys lists the public keys that are permitted for logging in. When the user logs in, the ssh program tells the server which key pair it would like to use for authentication. The server checks if this key is permitted, and if so, sends the user (actually the ssh program running on behalf of the user) a challenge in the form of a random number, encrypted by the user’s public key. The challenge can only be decrypted using the proper private key. The user’s client then decrypts the challenge using the private key, proving that he or she knows the private key but without disclosing it to the server.

ssh implements the RSA authentication protocol automatically. The user creates his or her RSA key pair by running ssh-keygen(1). This stores the private key in $HOME/.ssh/identity and the public key in $HOME/.ssh/identity.pub in the user’s home directory. The user should then copy the identity.pub to $HOME/.ssh/authorized_keys in his or her home directory on the remote machine (the authorized_keys file corresponds to the conventional $HOME/.rhosts file, and has one key per line, though the lines can be very long). After this, the user can log in without giving the password. RSA authentication is much more secure than rhosts authentication.

The most convenient way to use RSA authentication can be with an authentication agent. See ssh-agent(1) for more information.

If other authentication methods fail, ssh prompts the user for a password. The password is sent to the remote host for checking. However, since all communications are encrypted, the password cannot be seen by someone listening on the network.

SSH Protocol Version 2
The SSH version 2 protocol supports multiple user authentication methods, some of which are similar to those available with the SSH protocol version 1. These authentication mechanisms are negotiated by the client and server, with the client trying methods in the order specified in the PreferredAuthentications client configuration option. The server decides when enough authentication methods have passed successfully so as to complete the authentication phase of the protocol.

When a user connects by using protocol version 2, similar authentication methods are available. Using the default values for PreferredAuthentications, the client tries to authenticate first by using the host-based method. If this method fails, public key authentication is attempted. Finally, if this method fails, keyboard-interactive and password authentication are tried.

The public key method is similar to RSA authentication described in the previous section and allows the RSA or DSA algorithm to be used. The client uses his or her private key, $HOME/.ssh/id_dsa or $HOME/.ssh/id_rsa, to sign the session identifier and sends the result to the server. The server checks whether the matching public key is listed in $HOME/.ssh/authorized_keys and grants access if both the key is found and the signature is correct. The session identifier is derived from a shared Diffie-Hellman value and is only known to the client and the server.
If public key authentication fails or is not available, a password can be sent encrypted to the remote host for proving the user’s identity, or an extended prompt/reply protocol can be engaged.

Additionally, ssh supports host-based or challenge response authentication.

Protocol 2 provides additional mechanisms for confidentiality (the traffic is encrypted using 3DES, Blowfish, CAST128 or Arcfour) and integrity (hmac-sha2-256, hmac-sha2-256-96, hmac-sha2-512, hmac-sha2-512-96, hmac-sha1, and hmac-md5). Protocol 1 lacks a strong mechanism for ensuring the integrity of the connection.

When the user’s identity has been accepted by the server, the server either executes the specified command, or logs into the machine and gives the user a normal shell on the remote machine. All communication with the remote command or shell is automatically encrypted.

If a pseudo-terminal has been allocated (normal login session), the user can use the escape characters noted below. If a pseudo-terminal has been allocated (normal login session), the user can disconnect with ~, and suspend ssh with ~^Z. All forwarded connections can be listed with ~#. If the session blocks waiting for forwarded X11 or TCP/IP connections to terminate, ssh can be backgrounded with ~^S, although this should not be used while the user shell is active, as it can cause the shell to hang. All available escapes can be listed with ~?.

A single tilde character can be sent as ~, or by following the tilde with a character other than those described above. The escape character must always follow a newline to be interpreted as special. The escape character can be changed in configuration files or on the command line.

If no pseudo tty has been allocated, the session is transparent and can be used to reliably transfer binary data. On most systems, setting the escape character to "none" also makes the session transparent even if a tty is used.

The session terminates when the command or shell on the remote machine exits and all X11 and TCP/IP connections have been closed. The exit status of the remote program is returned as the exit status of ssh.

When a pseudo-terminal has been requested, ssh supports a number of functions through the use of an escape character.

A single tilde character can be sent as ~ or by following the tilde with a character other than those described below. The escape character must always follow a newline to be interpreted as special. The escape character can be changed in configuration files using the EscapeChar configuration directive or on the command line by the -e option.

The supported escapes, assuming the default ~, are:

~ . Disconnect.
~^Z Background ssh.
~# List forwarded connections.
~& Background ssh at logout when waiting for forwarded connection / X11 sessions to terminate.

~? Display a list of escape characters.

~B Send a break to the remote system. Only useful for SSH protocol version 2 and if the peer supports it.

~C Open command line. Only useful for adding port forwardings using the -L and -R options).

~R Request rekeying of the connection. Only useful for SSH protocol version 2 and if the peer supports it.

X11 and TCP Forwarding

If the ForwardX11 variable is set to "yes" (or, see the description of the -X and -x options described later) and the user is using X11 (the DISPLAY environment variable is set), the connection to the X11 display is automatically forwarded to the remote side in such a way that any X11 programs started from the shell (or command) goes through the encrypted channel, and the connection to the real X server is made from the local machine. The user should not manually set DISPLAY. Forwarding of X11 connections can be configured on the command line or in configuration files.

The DISPLAY value set by ssh points to the server machine, but with a display number greater than zero. This is normal behavior, because ssh creates a "proxy" X11 server on the server machine for forwarding the connections over the encrypted channel.

ssh also automatically sets up Xauthority data on the server machine. For this purpose, it generates a random authorization cookie, store it in Xauthority on the server, and verify that any forwarded connections carry this cookie and replace it by the real cookie when the connection is opened. The real authentication cookie is never sent to the server machine (and no cookies are sent in the plain).

If the ForwardAgent variable is set to "yes" (or, see the description of the -A and -a options described later) and the user is using an authentication agent, the connection to the agent is automatically forwarded to the remote side.

Forwarding of arbitrary TCP/IP connections over the secure channel can be specified either on the command line or in a configuration file. One possible application of TCP/IP forwarding is a secure connection to an electronic purse. Another possible application is firewall traversal.

Server Authentication

ssh automatically maintains and checks a database containing identifications for all hosts it has ever been used with. Host keys are stored in $HOME/.ssh/known_hosts in the user's home directory. Additionally, the file /etc/ssh_known_hosts is automatically checked for known hosts. The behavior of ssh with respect to unknown host keys is controlled by the StrictHostKeyChecking parameter. If a host's identification ever changes, ssh warns about this and disables password authentication to prevent a trojan horse from getting the user's...
password. Another purpose of this mechanism is to prevent attacks by intermediaries which could otherwise be used to circumvent the encryption. The `StrictHostKeyChecking` option can be used to prevent logins to machines whose host key is not known or has changed.

However, when using key exchange protected by GSS-API, the server can advertise a host key. The client automatically adds this host key to its known hosts file, `$HOME/.ssh/known_hosts`, regardless of the setting of the `StrictHostKeyChecking` option, unless the advertised host key collides with an existing known hosts entry.

When the user's GSS-API credentials expire, the client continues to be able to rekey the session using the server's public host key to protect the key exchanges.

GSS-API user authentication is covered in `gss_auth_rules(5)`.

Rekeying can be used to redelegate credentials when GssKeyEx is "yes". (See -R under Escape Characters above.)

Configure `ssh` with:

```bash
UseFIPS140 yes
```

...to run OpenSSL in FIPS-140 mode. Only SSH Protocol Version 2 is supported. SunSSH may still delegate cryptographic operations for user/host authentication to other parts of Solaris which may or may not be FIPS 140–certified. The default value of `UseOpenSSLEngine` option is no, and the setting of `UseOpenSSLEngine` to yes does not have an effect in FIPS mode. As a further requirement to run ssh in FIPS-140 mode, the client needs to generate the user's private key in PKCS#8 format with the `ssh-keygen -8` command.

For the case of `ssh` with FIPS-140 enabled, when logging into a non-FIPS-140 `sshd`, the supported and approved FIPS ciphers must be explicitly specified in the `sshd_config(4)`, using "Ciphers" for this scenario.
The following options are supported:

- `-1` Forces `ssh` to try protocol version 1 only.
- `-2` Forces `ssh` to try protocol version 2 only.
- `-4` Forces `ssh` to use IPv4 addresses only.
- `-6` Forces `ssh` to use IPv6 addresses only.
- `-a` Disables forwarding of the authentication agent connection.
- `-A` Enables forwarding of the authentication agent connection. This can also be specified on a per-host basis in a configuration file.

Agent forwarding should be enabled with caution. Users with the ability to bypass file permissions on the remote host (for the agent's UNIX-domain socket) can access the local agent through the forwarded connection. An attacker cannot obtain key material from the agent. However, the attacker can perform operations on the keys that enable the attacker to authenticate using the identities loaded into the agent.

- `-b bind_address` Specifies the interface to transmit from on machines with multiple interfaces or aliased addresses.

- `-c cipher_spec` Selects the cipher specification for encrypting the session.

For protocol version 1, `cipher_spec` is a single cipher. See the `Cipher` option in `ssh_config(4)` for more information.

For protocol version 2, `cipher_spec` is a comma-separated list of ciphers listed in order of preference. See the `Ciphers` option in `ssh_config(4)` for more information.

- `-C` Requests compression of all data (including stdin, stdout, stderr, and data for forwarded X11 and TCP/IP connections). The compression algorithm is the same used by `gzip(1)`. The `gzip` man page is available in the `SUNWsfman` package. The “level” can be controlled by the `CompressionLevel` option (see `ssh_config(4)`). Compression is desirable on
modem lines and other slow connections, but only slows down things on fast networks. The default value can be set on a host-by-host basis in the configuration files. See the `Compression` option in `ssh_config(4)`.

`-D [bind_address:]port` Specifies a local dynamic application-level port forwarding. This works by allocating a socket to listen to port on the local side, optionally bound to the specified `bind_address`. Whenever a connection is made to this port, the connection is forwarded over the secure channel. The application protocol is then used to determine where to connect to from the remote machine. Currently, the SOCKS4 and SOCKS5 protocols are supported and `ssh` acts as a SOCKS server. Only a user with enough privileges can forward privileged ports. Dynamic port forwardings can also be specified in the configuration file.

IPv6 addresses can be specified with an alternative syntax: `[bind_address/]port` or by enclosing the address in square brackets. By default, the local port is bound in accordance with the `GatewayPorts` setting. However, an explicit `bind_address` can be used to bind the connection to a specific address. The `bind_address` of `localhost` indicates that the listening port be bound for local use only, while an empty address or `*` indicates that the port should be available from all interfaces.

`-e ch | ^ch | none` Sets the escape character for sessions with a pty (default: `~`). The escape character is only recognized at the beginning of a line. The escape character followed by a dot (.) closes the connection. If followed by CTRL-z, the escape character suspends the connection. If followed by itself, the escape character sends itself once. Setting the character to `none` disables any escapes and makes the session fully transparent.

`-f` Requests `ssh` to go to background just before command execution. This is useful if `ssh` is going to ask for passwords or passphrases, but the user wants it in the background. This implies the `-n` option.
The recommended way to start X11 programs at a remote site is with something like `ssh -f host xterm`.

- **F configfile**
  Specifies an alternative per-user configuration file. If a configuration file is specified on the command line, the system-wide configuration file, `/etc/ssh_config`, is ignored. The default for the per-user configuration file is `$HOME/.ssh/config`.

- **g**
  Allows remote hosts to connect to local forwarded ports.

- **i identity_file**
  Selects a file from which the identity (private key) for RSA or DSA authentication is read. The default is `$HOME/.ssh/identity` for protocol version 1, and `$HOME/.ssh/id_rsa` and `$HOME/.ssh/id_dsa` for protocol version 2. Identity files can also be specified on a per-host basis in the configuration file. It is possible to have multiple `-i` options (and multiple identities specified in configuration files).

- **I PKCS#11-URI**
  Works with a certificate and a private key stored in the PKCS#11 token, instead of an identity file. See the Using X.509 Certificates section in the `sshd(1M)` man page for details.

- **l login_name**
  Specifies the user to log in as on the remote machine. This also can be specified on a per-host basis in the configuration file.

- **L [bind_address:]port:host:hostport**
  Specifies that the specified port on the local (client) host is to be forwarded to the specified host and port on the remote side. This works by allocating a socket to listen to the port on the local side, optionally bound to the specified `bind_address`. Then, whenever a connection is made to this port, the connection is forwarded over the secure channel and a connection is made to host `port host:port` from the remote machine. Port forwardings can also be specified in the configuration file. Only a user with enough privileges can forward privileged ports. IPv6 addresses can be specified with an alternative syntax: `[/bind_address/]port/host/hostport` or by enclosing the address in square brackets.

  By default, the local port is bound in accordance with the `GatewayPorts` setting. However, an explicit
**bind_address** can be used to bind the connection to a specific address. The **bind_address** of **localhost** indicates that the listening port be bound for local use only, while an empty address or * indicates that the port should be available from all interfaces.

- **m mac_spec**
  Additionally, for protocol version 2 a comma-separated list of MAC (message authentication code) algorithms can be specified in order of preference. See the **MACs** keyword for more information.

- **n**
  Redirects stdin from /dev/null (actually, prevents reading from stdin). This must be used when ssh is run in the background. A common trick is to use this to run X11 programs on a remote machine. For example,

  ```
  ssh -n shadows.cs.hut.fi emacs &
  ```

  starts an emacs on shadows.cs.hut.fi, and the X11 connection is automatically forwarded over an encrypted channel. The ssh program is put in the background. This does not work if ssh needs to ask for a password or passphrase. See also the **-f** option.

- **N**
  Does not execute a remote command. This is useful if you just want to forward ports (protocol version 2 only).

- **o option**
  Can be used to give options in the format used in the configuration file. This is useful for specifying options for which there is no separate command-line flag. The option has the same format as a line in the configuration file.

- **p port**
  Specifies the port to connect to on the remote host. This can be specified on a per-host basis in the configuration file.

- **P**
  Obsoleted option. SSHv1 connections from privileged ports are not supported.

- **q**
  Quiet mode. Causes all warning and diagnostic messages to be suppressed. Only fatal errors are displayed.

- **R [bind_address:]port:host:hostport**
  Specifies that the specified port on the remote (server) host is to be forwarded to the specified host
and port on the local side. This works by allocating a socket to listen to the port on the remote side. Then, whenever a connection is made to this port, the connection is forwarded over the secure channel and a connection is made to host port hostport from the local machine. Port forwardings can also be specified in the configuration file. Privileged ports can be forwarded only when logging in on the remote machine as a user with enough privileges.

IPv6 addresses can be specified by enclosing the address in square braces or using an alternative syntax: ([bind_address/])host/port/hostport.

By default, the listening socket on the server is bound to the loopback interface only. This can be overridden by specifying a bind_address. An empty bind_address, or the address *, indicates that the remote socket should listen on all interfaces. Specifying a remote bind_address only succeeds if the server’s GatewayPorts option is enabled. See sshd_config(4).

- s Can be used to request invocation of a subsystem on the remote system. Subsystems are a feature of the SSH2 protocol which facilitate the use of SSH as a secure transport for other applications, for example, sftp. The subsystem is specified as the remote command.

- t Forces pseudo-tty allocation. This can be used to execute arbitrary screen-based programs on a remote machine, which can be very useful, for example, when implementing menu services. Multiple -t options force allocation, even if ssh has no local tty.

- T Disables pseudo-tty allocation (protocol version 2 only).

- v Verbose mode. Causes ssh to print debugging messages about its progress. This is helpful in debugging connection, authentication, and configuration problems. Multiple -v options increase the verbosity. Maximum is 3.

- x Disables X11 forwarding.
Enables X11 forwarding. This can also be specified on a per-host basis in a configuration file.

X11 forwarding should be enabled with caution. Users with the ability to bypass file permissions on the remote host (for the user’s X authorization database) can access the local X11 display through the forwarded connection. An attacker can then be able to perform activities such as keystroke monitoring.

For this reason, X11 forwarding might be subjected to X11 SECURITY extension restrictions. Refer to the ForwardX11Trusted directive in `ssh_config(4)` for more information.

If X11 forwarding is enabled, remote X11 clients is trusted by default. This means that they have full access to the original X11 display.

### Environment Variables

- **DISPLAY**
  - The DISPLAY variable must be set for X11 display forwarding to work.

- **SSH_ASKPASS**
  - If ssh needs a passphrase, it reads the passphrase from the current terminal if it was run from a terminal. If ssh does not have a terminal associated with it but DISPLAY and SSH_ASKPASS are set, it executes the program specified by SSH_ASKPASS and opens an X11 window to read the passphrase. This is particularly useful when calling ssh from a .Xsession or related script. On some machines it might be necessary to redirect the input from /dev/null to make this work. The system is shipped with /usr/lib/ssh/ssh-askpass which is the default value for SSH_ASKPASS.

- **SSH_AUTH_SOCK**
  - Indicates the path of a unix-domain socket used to communicate with the agent.
**SSH_LANGS**
A comma-separated list of IETF language tags (see RFC3066) indicating the languages that the user can read and write. Used for negotiation of the locale on the server.

**LANG, LC_ALL, LC_COLLATE, LC_CTYPE, LC_MESSAGES, LC_MONETARY, LC_NUMERIC, LC_TIME**
The values of these environment variables can be set in remote sessions according to the locale settings on the client side and availability of support for those locales on the server side. Environment Variable Passing (see RFC 4254) is used for passing them over to the server side.

See the ENVIRONMENT VARIABLES section in the sshd(1M) man page for more information on how locale setting can be further changed depending on server side configuration.

**Exit Status**
The status of the remote program is returned as the exit status of ssh. 255 is returned if an error occurred at anytime during the ssh connection, including the initial key exchange.

**Files**
- `$HOME/.ssh/known_hosts` Records host keys for all hosts the user has logged into that are not in `/etc/ssh/ssh_known_hosts`. See sshd(1M).
- `$HOME/.ssh/identity`
- `$HOME/.ssh/id_rsa`
- `$HOME/.ssh/id_ssa`
Contains the authentication identity of the user. These files are for protocol 1 RSA, protocol 2 DSA, and protocol 2 RSA, respectively. These files contain sensitive data and should be readable by the user but not accessible by others (read/write/execute). ssh ignores a private key file if it is accessible by others. It is possible to specify a passphrase when generating the key. The passphrase is used to encrypt the sensitive part of this file using 3DES.

- `/etc/ssh/sshrc`
Commands in this file are executed by ssh when the user logs in just before the user's shell or command is started. See sshd(1M) for more information.

- `$HOME/.ssh/rc`
Commands in this file are executed by ssh when the user logs in just before the user's shell or command is started. See sshd(1M) for more information.

- `$HOME/.ssh/environment`
Contains additional definitions for environment variables. See ENVIRONMENT VARIABLES.
Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>network/ssh</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>See below.</td>
</tr>
</tbody>
</table>

The command line syntax is Committed. The remote locale selection through passing LC_* environment variables is Uncommitted.

See Also  rlogin(1), rsh(1), scp(1), ssh-add(1), ssh-agent(1), ssh-keygen(1), ssh-http-proxy-connect(1), ssh-socks5-proxy-connect(1), telnet(1), ssdh(1M), ssh_config(4), sshd_config(4), attributes(5), gss_auth_rules(5), kerberos(5), privileges(5)

See the discussion of the .k5login file in krb5_auth_rules(5).

RFC 1928

RFC 4254
ssh-add – add RSA or DSA identities to the authentication agent

Synopsis  ssh-add [-dDlxX] [-t life] [ file ]...

Description  The ssh-add utility adds RSA or DSA identities to the authentication agent, ssh-agent(1). When run without arguments, it attempts to add all of the files $HOME/.ssh/identity (RSA v1), $HOME/.ssh/id_rsa (RSA v2), and $HOME/.ssh/id_dsa (DSA v2) that exist. If more than one of the private keys exists, an attempt to decrypt each with the same passphrase is made before reprompting for a different passphrase. The passphrase is read from the user's tty or by running the program defined in SSH_ASKPASS (see below).

The authentication agent must be running.

Options  The following options are supported:

- d Instead of adding the identity, this option removes the identity from the agent.
- D Deletes all identities from the agent.
- l Lists fingerprints of all identities currently represented by the agent.
- L Lists public key parameters of all identities currently represented by the agent.
- t life Sets a maximum lifetime when adding identities to an agent. The lifetime can be specified in seconds or in a time format specified in sshd(1M).
- x Locks the agent with a password.
- X Unlocks the agent.

Environment Variables  DISPLAY  SSH_ASKPASS  If ssh-add needs a passphrase, it reads the passphrase from the current terminal if it was run from a terminal. If ssh-add does not have a terminal associated with it but DISPLAY and SSH_ASKPASS are set, it executes the program specified by SSH_ASKPASS and open an X11 window to read the passphrase. This is particularly useful when calling ssh-add from a .Xsession or related script. The system is shipped with /usr/lib/ssh/ssh-askpass which is the default value for SSH_ASKPASS.

SSH_AUTH_SOCK  Identifies the path of a unix-domain socket used to communicate with the agent.

Exit Status  The following exit values are returned:

0  Successful completion.
1  An error occurred.

Files  These files should not be readable by anyone but the user. Notice that ssh-add ignores a file if it is accessible by others. It is possible to specify a passphrase when generating the key; that passphrase is used to encrypt the private part of this file.
If these files are stored on a network file system it is assumed that either the protection provided in the file themselves or the transport layer of the network file system provides sufficient protection for the site policy. If this is not the case, then it is recommended the key files are stored on removable media or locally on the relevant hosts.

Recommended names for the DSA and RSA key files:

\$HOME/.ssh/identity
Contains the RSA authentication identity of the user for protocol version 1.

\$HOME/.ssh/identity.pub
Contains the public part of the RSA authentication identity of the user for protocol version 1.

\$HOME/.ssh/id_dsa
Contains the private DSA authentication identity of the user.

\$HOME/.ssh/id_dsa.pub
Contains the public part of the DSA authentication identity of the user.

\$HOME/.ssh/id_rsa
Contains the private RSA authentication identity of the user.

\$HOME/.ssh/id_rsa.pub
Contains the public part of the RSA authentication identity of the user.

/usr/lib/ssh/ssh-askpass
Contains the default value for SSH_ASKPASS.

**Attributes** See attributes(5) for descriptions of the following attributes:

<table>
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<tr>
<th>ATTRIBUTE TYPE</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
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</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

**See Also** ssh(1), ssh-agent(1), ssh-keygen(1), sshd(1M), attributes(5)
ssh-agent(1)

**Name**  
ssh-agent – authentication agent

**Synopsis**  
```
ssh-agent [-a bind_address] [-c | -s | -d]
             [-t life] [command [args] . . .]
```

```
ssh-agent [-c | -s] -k
```

**Description**  
ssh-agent is a program to hold private keys used for public key authentication (RSA, DSA). ssh-agent is often started at the beginning of a login session. All other windows or programs are started as clients to the ssh-agent program. Through use of environment variables, the agent can be located and automatically used for authentication when logging in to other machines using ssh(1). See the Oracle Solaris 11.1 Administration: Security Services.

If a command line is given, this is executed as a subprocess of the agent. When the command dies, so does the agent.

The agent initially does not have any private keys. Keys are added using ssh-add(1), which sends the identity to the agent. Several identities can be stored in the agent; the agent can automatically use any of these identities. Use the -l option in ssh-add(1) to display the identities currently held by the agent.

The agent is run in the user’s localhost. Authentication data need not be stored on any other machine, and authentication passphrases never go over the network. However, if the connection to the agent is forwarded over SSH remote logins, the user can use the privileges given by the identities anywhere in the network in a secure way.

There are two main ways to get an agent setup. Either you let the agent start a new subcommand into which some environment variables are exported, or you let the agent print the needed shell commands (either sh(1) or csh(1) syntax can be generated) which can be evalled in the calling shell. Later, use ssh(1) to look at these variables and use them to establish a connection to the agent.

A unix-domain socket is created (/tmp/ssh-XXXXXXXX/agent.pid) and the name of this socket is stored in the SSH_AUTH_SOCK environment variable. The socket is made accessible only to the current user. This method is easily abused by root or another instance of the same user.

The SSH_AGENT_PID environment variable holds the agent’s PID.

The agent exits automatically when the command given on the command line terminates.

**Options**  
The following options are supported:

- `-a bind_address`  
  Binds the agent to the unix-domain socket bind_address. The default is /tmp/ssh-XXXXXXXX/agent.pid.

- `-c`  
  Generates C-shell commands on stdout. This is the default if SHELL indicates that it is a csh style of shell.

- `-d`  
  Debug mode. When this option is specified, ssh-agent does not fork.
-k  Kills the current agent (given by the SSH_AGENT_PID environment variable).
-s  Generates Bourne shell commands on stdout. This is the default if SHELL
does not indicate that it is a csh style of shell.
-t life  Set a default value for the maximum lifetime (life) of identities added to
the agent. life can be specified in seconds or in a time format specified in
sshd_config(4). life specified for an identity with ssh-add(1) overrides
this value. Without this option the default maximum life is forever.

Exit Status  The following exit values are returned:
  0  Successful completion.
  1  An error occurred.

Files  /tmp/ssh-XXXXXXXX/agent.pid  Unix-domain sockets used to contain the connection to
the authentication agent. These sockets should only be
readable by the owner. The sockets are removed when
the agent exits.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
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<tr>
<td>Availability</td>
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<tr>
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<td>Committed</td>
</tr>
</tbody>
</table>

See Also  ssh(1), ssh-add(1), ssh-keygen(1), sshd(1M), sshd config(4), attributes(5)

Oracle Solaris 11.1 Administration: Security Services
Name  ssh-http-proxy-connect – Secure Shell proxy for HTTP


Description  A proxy command for ssh(1) that uses HTTP CONNECT. Typical use is where connections external to a network are only allowed via a proxy web server.

Options  The following options are supported:

- h http_proxy_host Specify the proxy web server through which to connect. Overrides the HTTPPROXY and http_proxy environment variables if they are set.

- p http_proxy_port Specify the port on which the proxy web server runs. If not specified, port 80 is assumed. Overrides the HTTPPROXYPORT and http_proxy environment variables if they are set.

Operands  The following operands are supported:

http_proxy_host The host name or IP address (IPv4 or IPv6) of the proxy.

http_proxy_port The numeric port number to connect to on http_proxy_host.

connect_host The name of the remote host to which the proxy web server is to connect you.

connect_port The numeric port number of the proxy web server to connect you to on http_proxy_host.

Examples  The recommended way to use a proxy connection command is to configure the ProxyCommand in ssh_config(4) (see Example 1 and Example 2). Example 3 shows how the proxy command can be specified on the command line when running ssh(1).

EXAMPLE 1  Setting the proxy from the environment

The following example uses ssh-http-proxy-connect in ssh_config(4) when the proxy is set from the environment:

```
Host playtime.foo.com
  ProxyCommand /usr/lib/ssh/ssh-http-proxy-connect \
    playtime.foo.com 22
```

EXAMPLE 2  Overriding proxy environment variables

The following example uses ssh-http-proxy-connect in ssh_config(4) to override (or if not set) proxy environment variables:

```
Host playtime.foo.com
  ProxyCommand /usr/lib/ssh/ssh-http-proxy-connect -h webcache \
    -p 8080 playtime.foo.com 22
```
EXAMPLE 3 Using the command line

The following example uses ssh-http-proxy-connect from the ssh(1) command line:

```
example$ ssh -o ProxyCommand="/usr/lib/ssh/ssh-http-proxy-connect \
    -h webcache -p 8080 playtime.foo.com 22" playtime.foo.com
```

Environment Variables

- **HTTPPROXY**: Takes the `http_proxy_host` operand to specify the default proxy host. Overrides `http_proxy` if both are set.
- **HTTPPROXYPORT**: Takes the `http_proxy_port` operand to specify the default proxy port. Ignored if HTTPPROXY is not set.
- **http_proxy**: URL format for specifying proxy host and port.

Exit Status

The following exit values are returned:

- 0  Successful completion.
- 1  An error occurred.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>network/ssh</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also ssh(1), ssh-socks5-proxy-connect(1), ssh_config(4), attributes(5)
The `ssh-keygen` utility generates, manages, and converts authentication keys for `ssh(1)`. `ssh-keygen` can create RSA keys for use by SSH protocol version 1 and RSA or DSA keys for use by SSH protocol version 2. The type of key to be generated is specified with the `-t` option. `ssh-keygen` can also generate fingerprints or convert the public keys from the X.509v3 certificates specified as PKCS#11 URIs.

Normally, each user wishing to use SSH with RSA or DSA authentication runs this once to create the authentication key in `$HOME/.ssh/identity`, `$HOME/.ssh/id_dsa`, or `$HOME/.ssh/id_rsa`. The system administrator can also use this to generate host keys.

Ordinarily, this program generates the key and asks for a file in which to store the private key. The public key is stored in a file with the same name but with the " .pub" extension appended. The program also asks for a passphrase. The passphrase can be empty to indicate no passphrase (host keys must have empty passphrases), or it can be a string of arbitrary length. Good passphrases are 10-30 characters long, are not simple sentences or otherwise easy to guess, and contain a mix of uppercase and lowercase letters, numbers, and non-alphanumeric characters. (English prose has only 1-2 bits of entropy per word and provides very poor passphrases.) If a passphrase is set, it must be at least 4 characters long.

The passphrase can be changed later by using the `-p` option.

There is no way to recover a lost passphrase. If the passphrase is lost or forgotten, you have to generate a new key and copy the corresponding public key to other machines.
For RSA, there is also a comment field in the key file that is only for convenience to the user to help identify the key. The comment can tell what the key is for, or whatever is useful. The comment is initialized to "user@host" when the key is created, but can be changed using the -c option.

After a key is generated, instructions below detail where to place the keys to activate them.

**Options**
The following options are supported:

- **b bits**
  Specifies the number of bits in the key to create. The minimum number is 512 bits. Generally, 2048 bits is considered sufficient. Key sizes above that no longer improve security but make things slower. The default is 2048 bits.

- **B**
  Shows the bubblebabble digest of the specified private or public key file.

- **c**
  Requests changing the comment in the specified private or public key file. The program prompts for the file containing the private keys, for the passphrase if the key has one, and for the new comment.

  This option only applies to rsa1 (SSHv1) keys.

- **C comment**
  Provides the new comment.

- **e**
  This option reads a private or public OpenSSH key file and prints the key in a "SECSH" Public Key File Format to stdout. This option allows exporting keys for use by several other SSH implementations.

- **f**
  Specifies the filename of the key file.

- **F**
  Search for the specified hostname in a known_hosts file, listing any occurrences found. This option is useful to find hashed host names or addresses and can also be used in conjunction with the -H option to print found keys in a hashed format.

- **H**
  Hash a known_hosts file. This replaces all host names and addresses with hashed representations within the specified file. The original content is moved to a file with a .old suffix. These hashes may be used normally by ssh and sshd, but they do not reveal identifying information should the file's contents be disclosed. This option does not modify existing hashed host names and is therefore safe to use on files that mix hashed and nonhashed names.
-i
  This option reads an unencrypted private (or public) key file in SSH2-compatible format and prints an OpenSSH compatible private (or public) key to stdout. ssh-keygen also reads the “SECSH” Public Key File Format. This option allows importing keys from several other SSH implementations.

-1
  Shows the fingerprint of the specified private or public key file.

-N new_passphrase
  Provides the new passphrase.

-p
  Requests changing the passphrase of a private key file instead of creating a new private key. The program prompts for the file containing the private key, for the old passphrase, and prompts twice for the new passphrase.

-P passphrase
  Provides the (old) passphrase.

-q
  Silences ssh-keygen.

-t type
  Specifies the algorithm used for the key, where type is one of rsa, dsa, and rsa1. Type rsa1 is used only for the SSHv1 protocol.

-R hostname
  Removes all keys belonging to hostname from a known_hosts file. This option is useful to delete hashed hosts. See -H.

-x
  Obsolete. Replaced by the -e option.

-X
  Obsolete. Replaced by the -i option.

-y
  This option reads a private OpenSSH format file and prints an OpenSSH public key to stdout.

-8
  Specifies that ssh-keygen will generate the keys in PKCS#8 format. The supported type of key to be generated is rsa or dsa.

**Exit Status** The following exit values are returned:

0
  Successful completion.
An error occurred.

**Files**

$HOME/.ssh/identity

This file contains the RSA private key for the SSHv1 protocol. This file should not be readable by anyone but the user. It is possible to specify a passphrase when generating the key; that passphrase is used to encrypt the private part of this file using 128–bit AES. This file is not automatically accessed by ssh-keygen, but it is offered as the default file for the private key. sshd(1M) reads this file when a login attempt is made.

$HOME/.ssh/identity.pub

This file contains the RSA public key for the SSHv1 protocol. The contents of this file should be added to $HOME/.ssh/authorized_keys on all machines where you wish to log in using RSA authentication. There is no need to keep the contents of this file secret.

$HOME/.ssh/id_dsa

$HOME/.ssh/id_rsa

These files contain, respectively, the DSA or RSA private key for the SSHv2 protocol. These files should not be readable by anyone but the user. It is possible to specify a passphrase when generating the key; that passphrase is used to encrypt the private part of the file using 3DES. Neither of these files is automatically accessed by ssh-keygen but is offered as the default file for the private key. sshd(1M) reads this file when a login attempt is made.

$HOME/.ssh/id_dsa.pub

$HOME/.ssh/id_rsa.pub

These files contain, respectively, the DSA or RSA public key for the SSHv2 protocol. The contents of these files should be added, respectively, to $HOME/.ssh/authorized_keys on all machines where you wish to log in using DSA or RSA authentication. There is no need to keep the contents of these files secret.

**Attributes**

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>network/ssh/ssh-key</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

**See Also**

ssh(1), ssh-add(1), ssh-agent(1), sshd(1M), attributes(5)
ssh-keyscan(1)

Name
ssh-keyscan – gather public ssh host keys of a number of hosts

Synopsis
ssh-keyscan [-v46] [-p port] [-T timeout] [-t type] 
[-f file] [-] [host... | addrlist namelist] [...]

Description
ssh-keyscan is a utility for gathering the public ssh host keys of a number of hosts. It was designed to aid in building and verifying ssh_known_hosts files. ssh-keyscan provides a minimal interface suitable for use by shell and perl scripts. The output of ssh-keyscan is directed to standard output.

ssh-keyscan uses non-blocking socket I/O to contact as many hosts as possible in parallel, so it is very efficient. The keys from a domain of 1,000 hosts can be collected in tens of seconds, even when some of those hosts are down or do not run ssh. For scanning, one does not need login access to the machines that are being scanned, nor does the scanning process involve any encryption.

File Format
Input format:

1.2.3.4,1.2.4.4
name.my.domain,name,n.my.domain,n,1.2.3.4,1.2.4.4

Output format for rsa1 keys:

host-or-namelist bits exponent modulus

Output format for rsa and dsa keys, where keytype is either ssh-rsa or 'ssh-dsa:

host-or-namelist keytype base64-encoded-key

Options
The following options are supported:

-t filename
Read hosts or addrlist namelist pairs from this file, one per line. If you specify - instead of a filename, ssh-keyscan reads hosts or addrlist namelist pairs from the standard input.

-p port
Port to connect to on the remote host.

-T timeout
Set the timeout for connection attempts. If timeout seconds have elapsed since a connection was initiated to a host or since the last time anything was read from that host, the connection is closed and the host in question is considered unavailable. The default is for timeout is 5 seconds.

-t type
Specify the type of the key to fetch from the scanned hosts. The possible values for type are rsa1 for protocol version 1 and rsa or dsa for protocol version 2. Specify multiple values by separating them with commas. The default is rsa1.

-v
Specify verbose mode. Print debugging messages about progress.
ForcetouseIPv4addressesonly.
-6
ForcetouseIPv6addressesonly.

**Security** If a `ssh_known_hosts`file is constructed using `ssh-keyscan`without verifying the keys, users are vulnerable to man-in-the-middle attacks. If the security model allows such a risk, `ssh-keyscan`can help in the detection of tampered key files or man-in-the-middle attacks which have begun after the `ssh_known_hosts`file was created.

**Examples**

**EXAMPLE 1** Printing the rsa1 Host Key
The following example prints the rsa1 host key for machine hostname:

```
$ ssh-keyscan hostname
```

**EXAMPLE 2** Finding All Hosts
The following commands finds all hosts from the file `ssh_hosts` which have new or different keys from those in the sorted file `ssh_known_hosts`:

```
$ ssh-keyscan -t rsa,dsa -f ssh_hosts | \
    sort -u - ssh_known_hosts | diff ssh_known_hosts -
```

**Files**
`/etc/ssh_known_hosts`
Contains list of public ssh host keys.

**Exit Status** The following exit values are returned:

0
No usage errors. `ssh-keyscan` might or might not have succeeded or failed to scan one, more or all of the given hosts.

1
Usage error.

**Attributes** See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>network/ssh</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

**See Also**
`ssh(1), sshd(1M), attributes(5)`

**Authors**
David Mazieres wrote the initial version, and Wayne Davison added support for protocol version 2.
ssh-keyscan(1)

**Bugs**  
ssh-keyscan generates the following messages on the consoles of all machines it scans if the server is older than version 2.9:

Connection closed by remote host

This is because ssh-keyscan opens a connection to the ssh port, reads the public key, and drops the connection as soon as it gets the key.
Name  ssh-socks5-proxy-connect – Secure Shell proxy for SOCKS5

Synopsis  
```
/usr/lib/ssh/ssh-socks5-proxy-connect
[-h socks5_proxy_host]
[-p socks5_proxy_port] connect_host connect_port
```

Description  A proxy command for ssh(1) that uses SOCKS5 (RFC 1928). Typical use is where connections external to a network are only allowed via a socks gateway server.

This proxy command does not provide any of the SOCKS5 authentication mechanisms defined in RFC 1928. Only anonymous connections are possible.

Options  The following options are supported:

- **-h socks5_proxy_host**  Specifies the proxy web server through which to connect. Overrides the SOCKS5_SERVER environment variable.
- **-p socks5_proxy_port**  Specifies the port on which the proxy web server runs. If not specified, port 80 is assumed. Overrides the SOCKS5_PORT environment variable.

Operands  The following operands are supported:

- **socks5_proxy_host**  The host name or IP address (IPv4 or IPv6) of the proxy.
- **socks5_proxy_port**  The numeric port number to connect to on `socks5_proxy_host`.
- **connect_host**  The name of the remote host to which the socks gateway is to connect you.
- **connect_port**  The numeric port number of the socks gateway to connect you to on `connect_host`.

Examples  The recommended way to use a proxy connection command is to configure the ProxyCommand in ssh_config(4) (see Example 1 and Example 2). Example 3 shows how the proxy command can be specified on the command line when running ssh(1).

**EXAMPLE 1**  Setting the proxy from the environment

The following example uses `ssh-socks5-proxy-connect` in ssh_config(4) when the proxy is set from the environment:

```
Host playtime.foo.com
  ProxyCommand /usr/lib/ssh/ssh-socks5-proxy-connect \
  playtime.foo.com 22
```

**EXAMPLE 2**  Overriding proxy environment variables

The following example uses `ssh-socks5-proxy-connect` in ssh_config(4) to override (or if not set) proxy environment variables:
EXAMPLE 2  Overriding proxy environment variables  (Continued)

Host playtime.foo.com
  ProxyCommand /usr/lib/ssh/ssh-socks5-proxy-connect -h socks-gw \
              -p 1080 playtime.foo.com 22

EXAMPLE 3  Using the command line

The following example uses ssh-socks5-proxy-connect from the ssh(1) command line:

exemple$ ssh -o'ProxyCommand=/usr/lib/ssh/ssh-socks5-proxy-connect \
              -h socks-gw -p 1080 playtime.foo.com 22' playtime.foo.com

Environment Variables

Socks5_Server    Takes socks5_proxy_host operand to specify the default proxy host.
Socks5_Port      Takes socks5_proxy_port operand to specify the default proxy port.

Exit Status   The following exit values are returned:

0   Successful completion.
1   An error occurred.

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>network/ssh</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also   ssh(1), ssh-http-proxy-connect(1), ssh_config(4), attributes(5)
strchg, strconf – change or query stream configuration

Synopsis

strchg -h module1 [, module2 . . . ]
strchg -p [-a | -u module]
strchg -f filename
strconf [-m | -t module]

Description

These commands are used to alter or query the configuration of the stream associated with the user’s standard input. The strchg command pushes modules on and/or pops modules off the stream. The strconf command queries the configuration of the stream. Only the super-user or owner of a STREAMS device can alter the configuration of that stream.

Invoked without any arguments, strconf prints a list of all the modules in the stream as well as the topmost driver. The list is printed with one name per line where the first name printed is the topmost module on the stream (if one exists) and the last item printed is the name of the driver.

Options

The following options apply to strchg and, -h, -f, and -p are mutually exclusive.

- a
  Pop all the modules above the topmost driver off the stream. This option requires the -p option.

- f filename
  Specify a filename that contains a list of modules representing the desired configuration of the stream. Each module name must appear on a separate line where the first name represents the topmost module and the last name represents the module that should be closest to the driver. strchg determines the current configuration of the stream and pop and push the necessary modules in order to end up with the desired configuration.

- h module1 [, module2 . . . ]
  Mnemonic for push, pushes modules onto a stream. It takes as arguments the names of one or more pushable streams modules. These modules are pushed in order; that is, module1 is pushed first, module2 is pushed second, etc.

- p
  Mnemonic for pop, pops modules off the stream. With the -p option alone, strchg pops the topmost module from the stream.

- u module
  All modules above, but not including module are popped off the stream. This option requires the -p option.

The following options apply to strconf and, -m and -t are mutually exclusive.
-m module
Determine if the named module is present on a stream. If it is, strconf prints the message yes and returns zero. If not, strconf prints the message no and returns a non-zero value. The -t and -m options are mutually exclusive.

-t module
Print only the topmost module (if one exists). The -t and -m options are mutually exclusive.

Examples

EXAMPLE 1  Using the strchg Command

The following command pushes the module ldterm on the stream associated with the user’s standard input:

example% strchg -h ldterm

The following command pops the topmost module from the stream associated with /dev/term/24. The user must be the owner of this device or the super user.

example% strchg -p < /dev/term/24

If the file fileconf contains the following:

ttcompat
ldterm
ptem

then the command

example% strchg -f fileconf

configures the user’s standard input stream so that the module ptem is pushed over the driver, followed by ldterm and ttcompat closest to the stream head.

The strconf command with no arguments lists the modules and topmost driver on the stream; for a stream that has only the module ldterm pushed above the zs driver, it would produce the following output:

ldterm
zs

The following command asks if ldterm is on the stream:

example% strconf -m ldterm

and produces the following output while returning an exit status of 0:

yes

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
</table>

See manpages section 1: User Commands • Last Revised: 24 Mar 2005
strchg(1)

See Also  attributes(5), streamio(7I)

Diagnostics  strchg returns zero on success. It prints an error message and returns non-zero status for various error conditions, including usage error, bad module name, too many modules to push, failure of an ioctl on the stream, or failure to open filename from the -f option.

strconf returns zero on success (for the -m or -t option, "success" means the named or topmost module is present). It returns a non-zero status if invoked with the -m or -t option and the module is not present. It prints an error message and returns non-zero status for various error conditions, including usage error or failure of an ioctl on the stream.

Notes  If the user is neither the owner of the stream nor the super-user, the strchg command fails. If the user does not have read permissions on the stream and is not the super user, the strconf command fails.

If modules are pushed in the wrong order, one could end up with a stream that does not function as expected. For ttys, if the line discipline module is not pushed in the correct place, one could have a terminal that does not respond to any commands.
The `strings` utility looks for ASCII strings in a binary file. A string is any sequence of 4 or more printing characters ending with a NEWLINE or a NULL character.

`strings` is useful for identifying random object files and many other things.

By default, `strings` looks at program sections that are loaded in memory. Program sections are identified by the section type `SHT_PROGBITS`. Sections that are loaded in memory are identified by the section flag `SHF_ALLOC`. Use `elfdump(1)` to display complete section information for a file.

All sections can be inspected with the `-a` option. Individual sections can be inspected with the `-N` option.

The following options are supported:

- `-a` | `-L` Look everywhere in the file for strings.
- `-n number` | `-number` Use a `number` as the minimum string length rather than the default, which is 4. An invalid number results in the default string length being used.
- `-N name` Look only in ELF section name. See `elfdump(1)`. Multiple `-N` options can be specified to inspect multiple sections.

If the `-a` or `-L` option is specified, all `-N` options are ignored.

- `-o` Equivalent to `-t d` option.
- `-t format` Write each string preceded by its byte offset from the start of the file. The format is dependent on the single character used as the `format` option-argument:
  - `d` The offset is written in decimal.
  - `o` The offset is written in octal.
  - `x` The offset is written in hexadecimal.

The following operand is supported:

- `file` A path name of a regular file to be used as input. If no `file` operand is specified, the `strings` utility reads from the standard input.

See `environ(5)` for descriptions of the following environment variables that affect the execution of `strings`: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.
Exit Status  The following exit values are returned:
   0    Successful completion.
   >0   An error occurred.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>See below.</td>
</tr>
</tbody>
</table>

The strings utility, including all options except -N, are specified by standards. See standards(5). The -N option is not currently specified by any standard.

See Also  elfdump(1), od(1), attributes(5), environ(5), standards(5)

Notes  The algorithm for identifying strings is extremely primitive.

For backwards compatibility, the options -a and – are interchangeable.
strip(1)

Name strip – strip symbol table, debugging and line number information from an object file

Synopsis strip [-lvx] file...

Description The strip command removes the symbol table SHT_SYMTAB and its associated string table, debugging information, and line number information from ELF object files. That is, besides the symbol table and associated string table, the following sections are removed:

.line
.debug*
.stab*

Once this stripping process has been done, limited symbolic debugging access is available for that file. Therefore, this command is normally run only on production modules that have been debugged and tested.

If strip is executed on a common archive file (see ar.h(3HEAD)) in addition to processing the members, strip removes the archive symbol table. The archive symbol table must be restored by executing the ar(1) command with the -s option before the archive can be linked by the ld(1) command. strip produces appropriate warning messages when this situation arises.

strip is used to reduce the file storage overhead taken by the object file.

Options The amount of information stripped from the ELF object file can be controlled by using any of the following options. The following options are supported:

- l Strip line number information only. Does not strip the symbol table or debugging information.
- V Prints, on standard error, the version number of strip.
- x Does not strip the symbol table. Debugging and line number information might be stripped.

Operands The following operand is supported:

file A path name referring to an executable file.

Environment Variables See environ(5) for descriptions of the following environment variables that affect the execution of strip: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status The following exit values are returned:

0 Successful completion.
>0 An error occurred.
Files  /tmp/strp*  Temporary files

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/base-developer-utilities</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also  ar(1), as(1), ld(1), mcs(1), elf(3ELF), tmpnam(3C), a.out(4), ar.h(3HEAD), attributes(5), environ(5), standards(5)

Notes  The symbol table section is not removed if it is contained within a segment or if the file is a relocatable object.

The line number and debugging sections are not removed if they are contained within a segment or if their associated relocation section is contained within a segment.

The strip command is used to remove a standard predefined set of sections from an ELF object file. To remove a user specified section by name, see mcs(1).
Name  stty – set the options for a terminal

Synopsis  /usr/bin/stty [-a] [-g]
          /usr/bin/stty [modes]
          /usr/xpg4/bin/stty [-a | -g]
          /usr/xpg4/bin/stty [modes]
          /usr/xpg6/bin/stty [-a | -g]
          /usr/xpg6/bin/stty [modes]

Description  The stty utility sets certain terminal I/O options for the device that is the current standard input. Without arguments, stty reports the settings of certain options.

In this report, if a character is preceded by a caret (^), then the value of that option is the corresponding control character (for example, ^h is CTRL-h. In this case, recall that CTRL-h is the same as the BACKSPACE key). The sequence ^@ means that an option has a null value.

See termio(7I) for detailed information about the modes listed from Control Modes through Local Modes. For detailed information about the modes listed under Hardware Flow Control Modes and Clock Modes, see termiox(7I).

Operands described in the Combination Modes section are implemented using options in the earlier sections. Notice that many combinations of options make no sense, but no sanity checking is performed. Hardware flow control and clock modes options might not be supported by all hardware interfaces.

Options  The following options are supported:
-  a      Writes to standard output all of the option settings for the terminal.
-  g      Reports current settings in a form that can be used as an argument to another stty command. Emits termios-type output if the underlying driver supports it. Otherwise, it emits termio-type output.

Operands  The following mode operands are supported:

Control Modes
parenb (-parenb)  Enable (disable) parity generation and detection.
parext (-parext)  Enable (disable) extended parity generation and detection for mark and space parity.
parodd (-parodd)  Select odd (even) parity, or mark (space) parity if parext is enabled.

cs5 cs6 cs7 cs8  Select character size (see termio(7I)).

0                  Hang up line immediately.

hupcl (-hupcl)    Hang up (do not hang up) connection on last close.
hup (-hup)   Same as hupcl (-hupcl).
cstopb (-cstopb)   Use two (one) stop bits per character.
cread (-cread)   Enable (disable) the receiver.
crtscts (-crlscts)   Enable output hardware flow control. Raise the RTS (Request to Send) modem control line. Suspends output until the CTS (Clear to Send) line is raised.
crtsxoff (-crtsxoff)   Enable input hardware flow control. Raise the RTS (Request to Send) modem control line to receive data. Suspends input when RTS is low.
clocal (-clocal)   Assume a line without (with) modem control.
defeucw   Set the widths of multibyte characters to the values defined in the current locale specified by LC_CTYPE. Internally, width is expressed in terms of bytes per character, and screen or display columns per character.

| Set terminal baud rate to the number given, if possible. (All speeds are not supported by all hardware interfaces.) |
| 110 300 600 1200 1800 |
| 2400 4800 9600 19200  |
| 38400 357600 76800 115200  |
| 153600 230400 307200 460800  |

| Set terminal input baud rate to the number given, if possible. (Not all hardware supports split baud rates.) If the input baud rate is set to 0, the input baud rate is specified by the value of the output baud rate. |
| 0 110 300 600 1200 |
| 1800 2400 4800 9600 19200  |
| 38400 57600 76800 115200  |
| 153600 230400 307200 460800  |

| Set terminal output baud rate to the number given, if possible. (Not all hardware supports split baud rates.) If the output baud rate is set to 0, the line is hung up immediately. |
| 0 110 300 600 1200 |
| 1800 2400 4800 9600 19200  |
| 38400 57600 76800 115200  |
| 153600 230400 307200 460800  |

Input Modes

ignbrk (-ignbrk)   Ignore (do not ignore) break on input.
brkint (-brkint)   Signal (do not signal) INTR on break.
ignpar (-ignpar)   Ignore (do not ignore) parity errors.
parmrk (-parmrk)   Mark (do not mark) parity errors (see termio(7I)).
inpck (-inpck) Enable (disable) input parity checking.

istrip (-istrip) Strip (do not strip) input characters to seven bits.
inlcr (-inlcr) Map (do not map) NL to CR on input.
igncr (-igncr) Ignore (do not ignore) CR on input.
icrnl (-icrnl) Map (do not map) CR to NL on input.
iuclc (-iuclc) Map (do not map) upper-case alphabets to lower case on input.
ixon (-ixon) Enable (disable) START/STOP output control. Output is stopped by sending START control character and started by sending the START control character.
ixany (-ixany) Allow any character (only DC1) to restart output.
ixoff (-ixoff) Request that the system send (not send) START/STOP characters when the input queue is nearly empty/full.
imaxbel (-imaxbel) Echo (do not echo) BEL when the input line is too long. If -imaxbel is set, the ASCII BEL character (07 hex) is echoed if the input stream overflows. Further input is not stored, but any input already present is not disturbed. If -imaxbel is set, no BEL character is echoed, and all unread input present in the input queue is discarded if the input stream overflows.

Output Modes

Output Modes

opost (-opost) Post-process output (do not post-process output; ignore all other output modes).

olcuc (-olcuc) Map (do not map) lower-case alphabets to upper case on output.
onlcr (-onlcr) Map (do not map) NL to CR-NL on output.
ocrn (-ocrn) Map (do not map) CR to NL on output.
onocr (-onocr) Do not (do) output CRs at column zero.
onlret (-onlret) On the terminal NL performs (does not perform) the CR function.
ofill (-ofill) Use fill characters (use timing) for delays.
ofdel (-ofdel) Fill characters are DELs (NULs).
cr0 cr1 cr2 cr3 Select style of delay for carriage returns (see termio(7I)).
nl0 nl1 Select style of delay for line-feeds (see termio(7I)).
tab0 tab1 tab2 tab3 Select style of delay for horizontal tabs (see termio(7I)).
bs0 bs1 Select style of delay for backspaces (see termio(7I)).
ff0 ff1 Select style of delay for form-feeds (see termio(7I)).
Select style of delay for vertical tabs (see termio(7)).

Enable (disable) the checking of characters against the special control characters INTR, QUIT, SWTCH, and SUSP. For information on SWTCH, see NOTES.

Enable (disable) canonical input (ERASE and KILL processing). Does not set MIN or TIME.

Canonical (unprocessed) upper/lower-case presentation.

Echo back (do not echo back) every character typed.

Echo (do not echo) ERASE character as a backspace-space-backspace string. This mode erases the ERASEed character on many CRT terminals; however, it does not keep track of column position and, as a result, it might be confusing for escaped characters, tabs, and backspaces.

Echo (do not echo) NL after KILL character.

The same as echo(-echok); obsolete.

Echo (do not echo) NL.

Disable (enable) flush after INTR, QUIT, or SUSP.

Disable (enable) truncation of lines longer than 79 characters on a synchronous line.

Send (do not send) SIGTTOU when background processes write to the terminal.

Echo (do not echo) control characters as ^char, delete as ^?.

Echo (do not echo) erase character as character is “erased”.

BS-SP-BS erase (do not BS-SP-BS erase) entire line on line kill.

Output is (is not) being flushed.

Retype (do not retype) pending input at next read or input character.

Enable (disable) special control characters not currently controlled by icanon, isig, ixon, or ixoff: VEOL, VSWTCH, VREPRINT, VDISCARD, VDSUSP, VWERASE, and VLNEXT.

Enable (disable) flush on a synchronous line after every write(2).

Use application mode (use line mode) on a synchronous line.
### Hardware Flow Control Modes

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>rtsxoff (-rtsxoff)</td>
<td>Enable (disable) RTS hardware flow control on input.</td>
</tr>
<tr>
<td>ctsxon (-ctxon)</td>
<td>Enable (disable) CTS hardware flow control on output.</td>
</tr>
<tr>
<td>dtrxoff (-dtrxoff)</td>
<td>Enable (disable) DTR hardware flow control on input.</td>
</tr>
<tr>
<td>cdxon (-cdxon)</td>
<td>Enable (disable) CD hardware flow control on output.</td>
</tr>
<tr>
<td>isxoff (-isxoff)</td>
<td>Enable (disable) isochronous hardware flow control on input.</td>
</tr>
</tbody>
</table>

### Clock Modes

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>xciibr</td>
<td>Get transmit clock from internal baud rate generator.</td>
</tr>
<tr>
<td>xctset</td>
<td>Get the transmit clock from transmitter signal element timing (DCE source) lead, CCITT V.24 circuit 114, EIA-232-D pin 15.</td>
</tr>
<tr>
<td>xcrset</td>
<td>Get transmit clock from receiver signal element timing (DCE source) lead, CCITT V.24 circuit 115, EIA-232-D pin 17.</td>
</tr>
<tr>
<td>rcibr</td>
<td>Get receive clock from internal baud rate generator.</td>
</tr>
<tr>
<td>rctset</td>
<td>Get receive clock from transmitter signal element timing (DCE source) lead, CCITT V.24 circuit 114, EIA-232-D pin 15.</td>
</tr>
<tr>
<td>rcrset</td>
<td>Get receive clock from receiver signal element timing (DCE source) lead, CCITT V.24 circuit 115, EIA-232-D pin 17.</td>
</tr>
<tr>
<td>tsetcoff</td>
<td>Transmitter signal element timing clock not provided.</td>
</tr>
<tr>
<td>tsetcrbrg</td>
<td>Output receiver baud rate generator on transmitter signal element timing (DTE source) lead, CCITT V.24 circuit 113, EIA-232-D pin 24.</td>
</tr>
<tr>
<td>tsetctbrg</td>
<td>Output transmit baud rate generator on transmitter signal element timing (DTE source) lead, CCITT V.24 circuit 113, EIA-232-D pin 24.</td>
</tr>
<tr>
<td>tsetctset</td>
<td>Output transmitter signal element timing (DCE source) on transmitter signal element timing (DTE source) lead, CCITT V.24 circuit 113, EIA-232-D pin 24.</td>
</tr>
<tr>
<td>tsetcrset</td>
<td>Output receiver signal element timing (DCE source) on transmitter signal element timing (DTE source) lead, CCITT V.24 circuit 113, EIA-232-D pin 24.</td>
</tr>
<tr>
<td>rsetcoff</td>
<td>Receiver signal element timing clock not provided.</td>
</tr>
<tr>
<td>rsetcrbrg</td>
<td>Output receiver baud rate generator on receiver signal element timing (DTE source) lead, CCITT V.24 circuit 128, no EIA-232-D pin.</td>
</tr>
<tr>
<td>rsetctbrg</td>
<td>Output transmit baud rate generator on receiver signal element timing (DTE source) lead, CCITT V.24 circuit 128, no EIA-232-D pin.</td>
</tr>
<tr>
<td>rsetctset</td>
<td>Output transmitter signal element timing (DCE source) on receiver signal element timing (DTE source) lead, CCITT V.24 circuit 128, no EIA-232-D pin.</td>
</tr>
<tr>
<td>rsetcrset</td>
<td>Output receiver signal element timing (DCE source) on receiver signal element timing (DTE source) lead, CCITT V.24 circuit 128, no EIA-232-D pin.</td>
</tr>
</tbody>
</table>
Control Assignments

control-character c

Set control-character to c, where:

control-character is ctab, discard, dsusp, eof, eol, eol2, erase, intr, kill, lnext, quit, reprint, start, stop, susp, swtch, or werase (ctab is used with -stappl, see termio(7)). For information on swtch, see NOTES.

c

If c is a single character, the control character is set to that character.

In the POSIX locale, if c is preceded by a caret (^) indicating an escape from the shell and is one of those listed in the ^c column of the following table, then its value used (in the Value column) is the corresponding control character (for example, "^d" is a CTRL-d). "^?" is interpreted as DEL and "^-" is interpreted as undefined.

<table>
<thead>
<tr>
<th>^c</th>
<th>Value</th>
<th>^c</th>
<th>Value</th>
<th>^c</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>a, A</td>
<td>&lt;SOH&gt;</td>
<td>l, L</td>
<td>&lt;FF&gt;</td>
<td>w, W</td>
<td>&lt;ETB&gt;</td>
</tr>
<tr>
<td>b, B</td>
<td>&lt;STX&gt;</td>
<td>m, M</td>
<td>&lt;CR&gt;</td>
<td>x, X</td>
<td>&lt;CAN&gt;</td>
</tr>
<tr>
<td>c, C</td>
<td>&lt;ETX&gt;</td>
<td>n, N</td>
<td>&lt;SO&gt;</td>
<td>y, Y</td>
<td>&lt;EM&gt;</td>
</tr>
<tr>
<td>d, D</td>
<td>&lt;EOT&gt;</td>
<td>o, O</td>
<td>&lt;SI&gt;</td>
<td>z, Z</td>
<td>&lt;SUB&gt;</td>
</tr>
<tr>
<td>e, E</td>
<td>&lt;ENQ&gt;</td>
<td>p, P</td>
<td>&lt;DLE&gt;</td>
<td></td>
<td>&lt;ESC&gt;</td>
</tr>
<tr>
<td>f, F</td>
<td>&lt;ACK&gt;</td>
<td>q, Q</td>
<td>&lt;DC1&gt;</td>
<td>\</td>
<td>&lt;FS&gt;</td>
</tr>
<tr>
<td>g, G</td>
<td>&lt;BEL&gt;</td>
<td>r, R</td>
<td>&lt;DC2&gt;</td>
<td></td>
<td>&lt;GS&gt;</td>
</tr>
<tr>
<td>h, H</td>
<td>&lt;BS&gt;</td>
<td>s, S</td>
<td>&lt;DC3&gt;</td>
<td>^</td>
<td>&lt;RS&gt;</td>
</tr>
<tr>
<td>i, I</td>
<td>&lt;HT&gt;</td>
<td>t, T</td>
<td>&lt;DC4&gt;</td>
<td>_</td>
<td>&lt;US&gt;</td>
</tr>
<tr>
<td>j, J</td>
<td>&lt;LF&gt;</td>
<td>u, U</td>
<td>&lt;NAK&gt;</td>
<td>?</td>
<td>&lt;DEL&gt;</td>
</tr>
<tr>
<td>k, K</td>
<td>&lt;VT&gt;</td>
<td>v, V</td>
<td>&lt;SYN&gt;</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

min number

time number

Set the value of min or time to number. MIN and TIME are used in Non-Canonical mode input processing (-icanon).

line i

Set line discipline to i (0 < i < 127).

Combination Modes

saved settings

Set the current terminal characteristics to the saved settings produced by the -g option.

evenp or parity

Enable parenb and cs7, or disable parodd.
oddp     Enable parenb, cs7, and parodd.
spacep   Enable parenb, cs7, and parext.
markp    Enable parenb, cs7, parodd, and parext.
-parity, or -evenp  Disable parenb, and set cs8.
-oddp    Disable parenb and parodd, and set cs8.
-spacep  Disable parenb and parext, and set cs8.
-markp   Disable parenb, parodd, and parext, and set cs8.
raw (-raw or cooked) Enable (disable) raw input and output. Raw mode is equivalent to setting:
               stty cs8 -icanon min 1 time 0 -isig -xcase \   
               -inpck -opost

/nl (-nl)  Unset (set) icrnl, onlcr. In addition -nl unsets inlcr, igncr, ocrl, and
            onlret.
            /usr/bin/stty,   nl (-nl)  Set (unset) icrnl. In addition, -nl unsets inlcr, igncr, ocrl, and
            /usr/xpg6/bin/stty onlret; -nl sets onlcr, and nl unsets onlcr.
/usr/xpg4/bin/stty nl (-nl)  Set (unset) icrnl. In addition, -nl unsets inlcr, igncr, ocrl, and
            onlret; -nl sets onlcr, and nl unsets onlcr.
            lcase (-lcase)  Set (unset) xcase, iuc1c, and olcuc.
             LCASE (-LCASE) Same as lcase (-lcase).
tabs (-tabs or tab3)  Preserve (expand to spaces) tabs when printing.
ek       Reset ERASE and KILL characters back to normal DEL and
         CTRL-u, respectively.
sane     Reset all modes to some reasonable values.
term     Set all modes suitable for the terminal type term, where term is one of
tty33, tty37, vt05, tn300, t1700, or tek.
async    Set normal asynchronous communications where clock settings are
         xcibrg, rcibrg, tsetcoff and rsetcoff.

Window Size

rows n   Set window size to n rows.
columns n Set window size to n columns.
cols n    Set window size to n columns. cols is a shorthand alias for columns.
ypixels n Set vertical window size to n pixels.
xpixels n Set horizontal window size to n pixels.
The -g flag is designed to facilitate the saving and restoring of terminal state from the shell level. For example, a program can:

```
saveterm="$(stty -g)"  # save terminal state
stty (new settings)     # set new state
...                     # ...
stty $saveterm          # restore terminal state
```

Since the -a format is so loosely specified, scripts that save and restore terminal settings should use the -g option.

**Environment Variables**

See `environ(5)` for descriptions of the following environment variables that affect the execution of stty: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

**Exit Status**

The following exit values are returned:

- **0** Successful completion.
- **>0** An error occurred.

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

```
<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See <code>standards(5)</code>.</td>
</tr>
</tbody>
</table>
```

**See Also** `tabs(1), ioctl(2), write(2), getwidth(3C), attributes(5), environ(5), standards(5), ldtterm(7M), termio(7I), termiox(7I)`

**Notes** Solaris does not support any of the actions implied by swtch, which was used by the sxt driver on System V release 4. Solaris allows the swtch value to be set, and prints it out if set, but it does not perform the swtch action.
The job switch functionality on Solaris is actually handled by job control. susp is the correct setting for this.
Name: stty – set the options for a terminal

Synopsis: /usr/ucb/stty [-a] [-g] [-h] [modes]

Description: stty sets certain terminal I/O options for the device that is the current standard output. Without arguments, stty reports the settings of certain options.

Options: In this report, if a character is preceded by a caret (^), then the value of that option is the corresponding CTRL character (for example, ^h is CTRL-h. In this case, recall that CTRL-h is the same as the BACKSPACE key.) The sequence ^@ means that an option has a null value.

- a Reports all of the option settings.
- g Reports current settings in a form that can be used as an argument to another stty command.
- h Reports all the option settings with the control characters in an easy to read column format.

Options in the last group are implemented using options in the previous groups. Many combinations of options make no sense, but no sanity checking is performed. Hardware flow control and clock modes options might not be supported by all hardware interfaces. The options are selected from the following:

Special Requests:
- all Reports the same option settings as stty without arguments, but with the control characters in column format.
- everything Everything stty knows about is printed. Same as -h option.
- speed The terminal speed alone is reported on the standard output.
- size The terminal (window) sizes are printed on the standard output, first rows and then columns. This option is only appropriate if currently running a window system.

size and speed always report on the settings of /dev/tty, and always report the settings to the standard output.

Control Modes:
- parenb (-parenb) Enable (disable) parity generation and detection.
- parext (-parext) Enable (disable) extended parity generation and detection for mark and space parity.
- parodd (-parodd) Select odd (even) parity, or mark (space) parity if parext is enabled.
- cs5 cs6 cs7 cs8 Select character size (see termio(71)).
- 0 Hang up line immediately.
Set terminal baud rate to the number given, if possible. (All speeds are not supported by all hardware interfaces.)

Set terminal input baud rate to the number given, if possible. (Not all hardware supports split baud rates.) If the input baud rate is set to zero, the input baud rate is specified by the value of the output baud rate.

Set terminal output baud rate to the number given, if possible. (Not all hardware supports split baud rates.) If the baud rate is set to zero, the line is hung up immediately.

Hang up (do not hang up) connection on last close.

Same as hupcl (-hupcl).

Use two (one) stop bits per character.

Enable (disable) the receiver.

Assume a line without (with) modem control.

Enable hardware flow control. Raise the RTS (Request to Send) modem control line. Suspends output until the CTS (Clear to Send) line is raised.

Block (do not block) output from a non-current layer.

Ignore (do not ignore) break on input.

Signal (do not signal) INTR on break.

Ignore (do not ignore) parity errors.

Mark (do not mark) parity errors (see termio(7)).

Enable (disable) input parity checking.

Strip (do not strip) input characters to seven bits.

Map (do not map) NL to CR on input.

Ignore (do not ignore) CR on input.

Map (do not map) CR to NL on input.

Map (do not map) upper-case alphabets to lower case on input.
ixon (-ixon) Enable (disable) START/STOP output control. Output is stopped by sending an STOP and started by sending an START.

ixany (-ixany) Allow any character (only START) to restart output.

dectlq (-dectlq) Same as -ixany.

ixoff (-ixoff) Request that the system send (not send) START/STOP characters when the input queue is nearly empty/full.

tandem (-tandem) Same as ixoff.

imaxbel (-imaxbel) Echo (do not echo) BEL when the input line is too long.

iexten (-iexten) Enable (disable) extended (implementation-defined) functions for input data.

Output Modes

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>opost</td>
<td>Post-process output (do not post-process output; ignore all other output modes).</td>
</tr>
<tr>
<td>olcuc</td>
<td>Map (do not map) lower-case alphabets to uppercase on output.</td>
</tr>
<tr>
<td>onlcr</td>
<td>Map (do not map) NL to CR-NL on output.</td>
</tr>
<tr>
<td>ocrnl</td>
<td>Map (do not map) CR to NL on output.</td>
</tr>
<tr>
<td>onocr</td>
<td>Do not (do) output CRs at column zero.</td>
</tr>
<tr>
<td>onlret</td>
<td>On the terminal NL performs (does not perform) the CR function.</td>
</tr>
<tr>
<td>ofill</td>
<td>Use fill characters (use timing) for delays.</td>
</tr>
<tr>
<td>ofdel</td>
<td>Fill characters are DELs (NULs).</td>
</tr>
<tr>
<td>cr0 cr1 cr2 cr3</td>
<td>Select style of delay for carriage returns (see termio(7I)).</td>
</tr>
<tr>
<td>nl0 nl1</td>
<td>Select style of delay for line-feeds (see termio(7I)).</td>
</tr>
<tr>
<td>tab0 tab1 tab2 tab3</td>
<td>Select style of delay for horizontal tabs (see termio(7I)).</td>
</tr>
<tr>
<td>bs0 bs1</td>
<td>Select style of delay for backspaces (see termio(7I)).</td>
</tr>
<tr>
<td>ff0 ff1</td>
<td>Select style of delay for form-feeds (see termio(7I)).</td>
</tr>
<tr>
<td>vt0 vt1</td>
<td>Select style of delay for vertical tabs (see termio(7I)).</td>
</tr>
</tbody>
</table>

Local Modes

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>isig</td>
<td>Enable (disable) the checking of characters against the special control characters INTR, QUIT, and SWTCH. For information on SWTCH, see NOTES.</td>
</tr>
<tr>
<td>icanon</td>
<td>Enable (disable) canonical input (ERASE and KILL processing). Does not set MIN or TIME.</td>
</tr>
<tr>
<td>cbreak</td>
<td>Equivalent to -icanon min 1 time 0.</td>
</tr>
</tbody>
</table>
xcase (-xcase) Canonical (unprocessed) upper/lower-case presentation.
echo (-echo) Echo back (do not echo back) every character typed.
echoe (-echoe) Echo (do not echo) ERASE character as a backspace-space-backspace string. Note: This mode erases the ERASEed character on many CRT terminals; however, it does not keep track of column position and, as a result, can be confusing on escaped characters, tabs, and backspaces.
crterase (-crterase) Same as echoe.
echok (-echok) Echo (do not echo) NL after KILL character.
lfkc (-lfkc) The same as echok (-echok); obsolete.
echonl (-echonl) Echo (do not echo) NL.
noflsh (-noflsh) Disable (enable) flush after INTR, QUIT, or SWTCH. For information on SWTCH, see NOTES.
stwrap (-stwrap) Disable (enable) truncation of lines longer than 79 characters on a synchronous line. (Does not apply to the 3B2.)
tostop (-tostop) Send (do not send) SIGTTOU for background processes.
echoctl (-echoctl) Echo (do not echo) control characters as ^char, delete as ^?
ctlecho (-ctlecho) Same as echoctl.
echoprtrt (-echoprtrt) Echo (do not echo) erase character as character is "erased".
prterase (-prterase) Same as echoprtrt.
echoke (-echoke) BS-SP-BS erase (do not BS-SP-BS erase) entire line on line kill.
crtkill (-crtkill) Same as echoke.
flusho (-flusho) Output is (is not) being flushed.
pentin (-pendin) Retype (do not retype) pending input at next read or input character.
stflush (-stflush) Enable (disable) flush on a synchronous line after every write(2). (Does not apply to the 3B2.)
stappl (-stappl) Use application mode (use line mode) on a synchronous line. (Does not apply to the 3B2.)

**Hardware Flow Control Modes**

rtsloff (-rtsloff) Enable (disable) RTS hardware flow control on input.
ctsson (-ctsson) Enable (disable) CTS hardware flow control on output.
dterxoff (-dterxoff) Enable (disable) DTER hardware flow control on input.
Clock Modes

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>rlsdxon</td>
<td>Enable (disable) RLSD hardware flow control on output.</td>
</tr>
<tr>
<td>isxoff</td>
<td>Enable (disable) isochronous hardware flow control on input.</td>
</tr>
<tr>
<td>xcibrg</td>
<td>Get transmit clock from internal baud rate generator.</td>
</tr>
<tr>
<td>xcset</td>
<td>Get the transmit clock from transmitter signal element timing (DCE source) lead, CCITT V.24 circuit 114, EIA-232-D pin 15.</td>
</tr>
<tr>
<td>xcrset</td>
<td>Get transmit clock from receiver signal element timing (DCE source) lead, CCITT V.24 circuit 115, EIA-232-D pin 17.</td>
</tr>
<tr>
<td>rcibrg</td>
<td>Get receive clock from internal baud rate generator.</td>
</tr>
<tr>
<td>rctset</td>
<td>Get receive clock from transmitter signal element timing (DCE source) lead, CCITT V.24 circuit 114, EIA-232-D pin 15.</td>
</tr>
<tr>
<td>rcrset</td>
<td>Get receive clock from receiver signal element timing (DCE source) lead, CCITT V.24 circuit 115, EIA-232-D pin 17.</td>
</tr>
<tr>
<td>tsetcoff</td>
<td>Transmitter signal element timing clock not provided.</td>
</tr>
<tr>
<td>tsetcrc</td>
<td>Output receive clock on transmitter signal element timing (DTE source) lead, CCITT V.24 circuit 113, EIA-232-D pin 24, clock source.</td>
</tr>
<tr>
<td>tsetxcx</td>
<td>Output transmit clock on transmitter signal element timing (DTE source) lead, CCITT V.24 circuit 113, EIA-232-D pin 24, clock source.</td>
</tr>
<tr>
<td>rsetcoff</td>
<td>Receiver signal element timing clock not provided.</td>
</tr>
<tr>
<td>rsetcrc</td>
<td>Output receive clock on receiver signal element timing (DTE source) lead, CCITT V.24 circuit 128, no EIA-232-D pin, clock source.</td>
</tr>
<tr>
<td>rsetxcx</td>
<td>Output transmit clock on receiver signal element timing (DTE source) lead, CCITT V.24 circuit 128, no EIA-232-D pin, clock source.</td>
</tr>
</tbody>
</table>

Control Assignments

| control-character c | Set control-character to c, where control-character is intr, quit, erase, kill, eol, eol2, swtx, start, stop, susp, dsusp, rprnt, flush, werase, lnext, min, ctab, time, or brk (ctab is used with -stappl; min and time are used with -iconon; see termio(7)). If c is preceded by an (escaped from the shell) caret (^), then the value used is the corresponding CTRL character (for example, "^d" is a Control-d). "^?" is interpreted as DEL and "^~" is interpreted as undefined. For information on SWTCH, see NOTES. |

line i | Set line discipline to i (0 < i < 127). |

Combination Modes

| evenp or parity | Enable parenb and cs7. |
| -evenp, or -parity | Disable parenb, and set cs8. |
| even (-even) | Same as evenp (-even). |
oddp
Enable parenb, cs7, and parodd.

-oddp
Disable parenb and parodd, and set cs8.

odd (-odd)
Same as odd (-oddp).

spacep
Enable parenb, cs7, and parenxt.

-spacep
Disable parenb and parenxt, and set cs8.

markp
Enable parenb, cs7, parodd, and parenxt.

-markp
Disable parenb, parodd, and parenxt, and set cs8.

raw (-raw or cooked)
Enable (disable) raw input and output (no ERASE, KILL, INTR, QUIT, SWTCH, EOT, or output post processing). For information on SWTCH, see NOTES.

nl (-nl)
Unset (set) icrnl, onlcr. In addition -nl unsets inlcr, igncr, ocrnl, and onlret.

lcase (-lcase)
Set (unset) xcase, iuclc, and olcuc.

LCASE (-LCASE)
Same as lcase (-lcase).

tabs (-tabs or tab3)
Preserve (expand to spaces) tabs when printing.

ek
Reset ERASE and KILL characters back to normal DEL and CTRL-u, respectively.

sane
Reset all modes to some reasonable values.

term
Set all modes suitable for the terminal type term, where term is one of tty33, tty37, vt05, tn300, ti700, or tek.

async
Set normal asynchronous communications where clock settings are xclbrg, rcibrgr, tsetcoff and rsetcoff.

litout (-litout)
Disable (enable) parenb, istrip, and opost, and set cs8 (cs7).

pass8 (-pass8)
Disable (enable) parenb and istrip, and set cs8 (cs7).

crt
Set options for a CRT (echoe, echoctl, and, if >= 1200 baud, echoke.)

dec
Set all modes suitable for Digital Equipment Corp. operating systems users ERASE, KILL, and INTR characters to ^?, ^U, and ^C, decctlq, and crt.)

Window Size

rowsn
Set window size to n rows.

columnsn
Set window size to n columns.

colsn
An alias for columns n.
ypixelsn  Set vertical window size to n pixels.

xpixelsn  Set horizontal window size to n pixels.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>

See Also  tabs(1), ioctl(2), attributes(5), termio(7I), termiox(7I)

Notes  Solaris does not support any of the actions implied by swtch, which was used by the sxt driver on System V release 4. Solaris allows the swtch value to be set, and prints it out if set, but it does not perform the swtch action.

The job switch functionality on Solaris is actually handled by job control. susp is the correct setting for this.
Name  sum – print checksum and block count for a file

Synopsis  /usr/bin/sum [-r] [file...]

Description  The sum lists the checksum for each of its file arguments. The standard input is read if there are no file arguments.

Options  The following option is supported:
- r  Use an alternate (machine-dependent) algorithm in computing the checksum.

Operands  The following operands are supported:
file  A path name of a file. If no files are named, the standard input is used.

Usage  See largefile(5) for the description of the behavior of sum when encountering files greater than or equal to 2 Gbyte (2^{31} bytes).

Environment Variables  See environ(5) for descriptions of the following environment variables that affect the execution of sum: LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status  The following exit values are returned.
0  Successful completion.
>0  An error occurred.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

See Also  cksum(1), getconf(1), sum(1B), wc(1), libmd(3LIB), attributes(5), environ(5), largefile(5)

Diagnostics  Read error is indistinguishable from end of file on most devices. Check the block count.

Notes  Portable applications should use cksum(1). The default algorithm for this command is defined in the POSIX standard and is identical across platforms.

sum and /usr/ucb/sum (see sum(1B)) return different checksums.
sum – calculate a checksum for a file

/susr/ucb/sum file...

sum calculates and displays a 16-bit checksum for the named file and displays the size of the file in kilobytes. It is typically used to look for bad spots, or to validate a file communicated over some transmission line. The checksum is calculated by an algorithm which may yield different results on machines with 16-bit ints and machines with 32-bit ints, so it cannot always be used to validate that a file has been transferred between machines with different-sized ints.

Usage
See largefile(5) for the description of the behavior of sum when encountering files greater than or equal to 2 Gbyte (2^31 bytes).

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>

See Also
sum(1), wc(1), attributes(5), largefile(5)

Diagnostics
Read error is indistinguishable from EOF on most devices; check the block count.

Notes
sum and /usr/bin/sum (see sum(1)) return different checksums.

This utility is obsolete.
suspend(1)

Name  suspend – shell built-in function to halt the current shell

Synopsis

    sh  suspend
    csh suspend
    ksh suspend

Description

    sh  Stops the execution of the current shell (but not if it is the login shell).

    csh  Stop the shell in its tracks, much as if it had been sent a stop signal with ^Z. This is most often used to stop shells started by su.

    ksh  Stops the execution of the current shell (but not if it is the login shell).

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  csh(1), kill(1), ksh(1), sh(1), su(1M), attributes(5)
svcprop – retrieve values of service configuration properties

**Synopsis**

svcprop [-afqtv] [-C | -c | -s snapshot] [-p [name/]+name]...

[-g ptype]... -l layer[,...] {FMRI | pattern}...

svcprop -w [-fqtv] [-p [name/]+name] {FMRI | pattern}

**Description**
The `svcprop` utility prints values of properties in the service configuration repository. Properties are selected by `-p` options and the operands. If `-p` is not used to specifically select a property or property group, `svcprop` will not print SMF template definition properties. More SMF infrastructure properties may be hidden from the default output in future releases. If `-a` is used, all properties, including SMF template definition properties, will be displayed.

Without the `-C`, `-c`, or `-s` options, `svcprop` accesses effective properties. The effective properties of a service are its directly attached properties. The effective properties of a service instance are the union of properties in the composed view of its `running` snapshot and the properties in non-persistent property groups in the composed view of the instance’s directly attached properties. See `smf(5)` for an explanation of property composition. If the `running` snapshot does not exist then the instance’s directly attached properties are used instead.

**Output Format**
By default, when a single property is selected, the values for each are printed on separate lines. Empty ASCII string values are represented by a pair of double quotes (“”). Bourne shell metacharacters (‘’, ‘&’, ‘()’, ‘<’, ‘>’, newline, space, tab, backslash, “”, single-quote, ””) in ASCII string values are quoted by backslashes (\).

When multiple properties are selected, a single line is printed for each. Each line comprises a property designator, a property type, and the values (as described above), separated by spaces. By default, if a single FMRI operand has been supplied, the property designator consists of the property group name and the property name joined by a slash (/). If multiple FMRI operands are supplied, the designator is the canonical FMRI for the property.

If access controls prohibit reading the value of a property, and no property or property group is specified explicitly by a `-p` option, the property is displayed as if it had no values. If one or more property or property group names is specified by a `-p` option, and any property value cannot be read due to access controls, an error results.

Error messages are printed to the standard error stream.

**Options**
The following options are supported:

- `-a`
  Display all properties, including those in SMF template definition property groups.

- `-C`
  Uses the directly attached properties, without composition.

- `-c`
  For service instances, uses the composed view of their directly attached properties.
- f
  Selects the multi-property output format, with full FMRIs as designators.

- g pgtype
  Display only the selected properties belonging to property groups of type pgtype. Multiple
  - g options will display properties from multiple properties group types. This option
  implies multi-property output format (-t).

- \ layer[...]
  Display only the properties defined at the selected layers. Available layers are manifest,
  system-profile, site-profile, and admin. The alias all is available to select all layers.
  Properties that belong to non-persistent property groups will not be displayed when this
  option is used.

- p name
  For each service or service instance specified by the operands, selects all properties in the
  name property group. For property groups specified by the operands, selects the name
  property. If used with - g, selects the name property for all matching property group types.

- p pg/prop
  Selects property prop in property group pg for each of the services or service instances
  specified by the operands.

- q
  Quiet. Produces no output.

- s name
  Uses the composed view of the name snapshot for service instances.

- t
  Selects the multi-property output format.

- v
  Verbose. Prints error messages for nonexistent properties, even if option -q is also used.

- w
  Waits until the specified property group or the property group containing the specified
  property changes before printing.

  This option is only valid when a single entity is specified. If more than one operand is
  specified, or an operand matches more than one instance, an error message is printed and
  no action is taken. The -C option is implied.

Operands

The following operands are supported:

FMRI
  The FMRI of a service, a service instance, a property group, or a property.
Instances and services can be abbreviated by specifying the instance name, or the trailing portion of the service name. Properties and property groups must be specified by a full FMRI. For example, given the FMRI:

svc:/network/smtp:sendmail

The following are valid abbreviations:

`sendmail`

`:sendmail`

`smp`

`smt:sendmail`

`network/smt`

The following are invalid abbreviations:

`mailnetwork`

`network/smt`

Abbreviated forms of FMRI s are Uncommitted and should not be used in scripts or other permanent tools. If an abbreviation matches multiple instances, `svcprop` acts on each instance.

pattern

A glob pattern which is matched against the FMRI s of services and instances in the repository. See `fnmatch(5)`. If a pattern matches multiple services or instances, `svcprop` acts on each service or instance.

**Examples**

**EXAMPLE 1** Displaying the Value of a Single Property

The following example displays the value of the state property in the restarter property group of instance default of service system/cron.

```bash
example% svcprop -p restarter/state system/cron:default
online
```

**EXAMPLE 2** Retrieving Whether a Service isEnabled

Whether a service is enabled is determined by its `general/enabled` property. This property takes immediate effect, so the `-c` option must be used:

```bash
example% svcprop -c -p general/enabled system/cron:default
true
```

**EXAMPLE 3** Displaying All Properties in a Property Group

On a default installation of Solaris, the following example displays all properties in the `general` property group of each instance of the `network/ntp` service:

```bash
example% svcprop -p general ntp
general/package astring SUNWntpr
general/enabled boolean true
general/entity_stability astring Uncommitted
```
EXAMPLE 3  Displaying All Properties in a Property Group  (Continued)

general/single_instance  boolean  true

EXAMPLE 4  Testing the Existence of a Property
The following example tests the existence of the general/enabled property for all instances of
service identity:

example% svcprop -q -p general/enabled identity:
example% echo $?
0

EXAMPLE 5  Waiting for Property Change
The following example waits for the sendmail instance to change state.

example% svcprop -w -p restarter/state sendmail

EXAMPLE 6  Retrieving the Value of a Boolean Property in a Script
The following example retrieves the value of a boolean property in a script:

set -- 'svcprop -c -t -p general/enabled service'

code=?
if [ $code -ne 0 ]; then
  echo "svcprop failed with exit code $code"
  return 1
fi
if [ $2 != boolean ]; then
  echo "general/enabled has unexpected type $2"
  return 2
fi
if [ $# -ne 3 ]; then
  echo "general/enabled has wrong number of values"
  return 3
fi
value=$3
...

EXAMPLE 7  Using svcprop in a Script
The following example gets the value of a service property and uses it in a script
(/usr/bin/Xserver):

fmri=$1
prop=$2
if svcprop -q -p $prop $fmri ; then
  propval="$(svcprop -p $prop "$fmri")"
  if [[ "$propval" == "\"\" ]]; then
    propval=""
...
Using \texttt{svcprop} in a Script (Continued)

\begin{verbatim}
fi
fi
\end{verbatim}

**EXAMPLE 8** Filtering Output by Property Group Type

The following example gets the methods for \texttt{svc:/network/ssh:default}

\begin{verbatim}
example\% svcprop -p exec -g method svc:/network/ssh:default
start/exec astring /lib/svc/method/sshd\ start
stop/exec astring :kill
refresh/exec astring /lib/svc/method/sshd\ restart
unconfigure/exec astring /lib/svc/method/sshd\ -u
\end{verbatim}

**EXAMPLE 9** Displaying Administratively Customized Properties

The following command uses SMF layers to display administratively customized properties.

\begin{verbatim}
example\% svcprop -p config -l admin svc:/network/dns/client
config/domain astring admin my.domain.com
config/nameserver net_address admin 10.22.33.44 10.44.33.11
\end{verbatim}

**Exit Status**

The following exit values are returned:

0
  Successful completion.

1
  An error occurred.

2
  Invalid command line options were specified.

**Attributes**

See \texttt{attributes(5)} for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

**See Also** \texttt{svcs(1)}, \texttt{inetd(1M)}, \texttt{svcadm(1M)}, \texttt{svccfg(1M)}, \texttt{svc.startd(1M)}, \texttt{service_bundle(4)}, \texttt{attributes(5)}, \texttt{fnmatch(5)}, \texttt{smf(5)}, \texttt{smf_method(5)}, \texttt{smf_security(5)}
Name  svcs – report service status

Synopsis  svcs [-aHpv?] [-o col[,col]]... [-R FMRI-instance]...
       [-sS col]... [FMRI | pattern]...
svcs {-d | -D} [-Hpv?] [-o col[,col]]... [-sS col]...
       [FMRI | pattern]...
svcs -n [FMRI]...
svcs -l [-v] [FMRI | pattern]...
svcs -x [-v] [FMRI]...

Description  The svcs command displays information about service instances as recorded in the service configuration repository.

The first form of this command prints one-line status listings for service instances specified by the arguments. Each instance is listed only once. With no arguments, all enabled service instances, even if temporarily disabled, are listed with the columns indicated below.

The second form prints one-line status listings for the dependencies or dependents of the service instances specified by the arguments.

The third form prints detailed information about specific services and instances.

The fourth form explains the states of service instances. For each argument, a block of human-readable text is displayed which explains what state the service is in, and why it is in that state. With no arguments, problematic services are described.

Error messages are printed to the standard error stream.

The output of this command can be used appropriately as input to the svcadm(1M) command.

Options  The following options are supported:

-?  Displays an extended usage message, including column specifiers.

-a  Show all services, even disabled ones and incomplete ones. Incomplete services can be further explained using svcs -x<service>.

   This option has no effect if services are selected.

-d  Lists the services or service instances upon which the given service instances depend.

-D  Lists the service instances that depend on the given services or service instances.

-H  Omits the column headers.
-l

(The letter ell.) Displays all available information about the selected services and service instances, with one service attribute displayed for each line. Information for different instances are separated by blank lines.

The following specific attributes require further explanation:

dependency
Information about a dependency. The grouping and restart_on properties are displayed first and are separated by a forward slash (/). Next, each entity and its state is listed. See smf(5) for information about states. In addition to the standard states, each service dependency can have the following state descriptions:

absent
No such service is defined on the system.

invalid
The fault management resource identifier (FMRI) is invalid (see smf(5)).

multiple
The entity is a service with multiple instances.

File dependencies can only have one of the following state descriptions:

absent
No such file on the system.

online
The file exists.

If the file did not exist the last time that svc.startd evaluated the service's dependencies, it can consider the dependency to be unsatisfied. svcadm refresh forces dependency re-evaluation.

unknown
stat(2) failed for a reason other than ENOENT.

See smf(5) for additional details about dependencies, grouping, and restart_on values.

enabled
Whether the service is enabled or not, and whether it is enabled or disabled temporarily (until the next system reboot). The former is specified as either true or false, and the latter is designated by the presence of (temporary).

A service might be temporarily disabled because an administrator has run svcadm disable -t, used svcadm milestone, or booted the system to a specific milestone. See svcadm(1M) for details.
-n
Prints notification parameters. See smf(5). It always prints the FMA events notification parameters and the system-wide SMF state transition notification parameters, regardless of the FMRI or pattern selected.

-o col[,col]...
Prints the specified columns. Each col should be a column name. See COLUMNS below for available columns.

-p
Lists processes associated with each service instance. A service instance can have no associated processes. The process ID, start time, and command name (PID, STIME, and CMD fields from ps(1)) are displayed for each process.

-R FMRI-instance
Selects service instances that have the given service instance as their reclaimer.

-s col
Sorts output by column. col should be a column name. See COLUMNS below for available columns. Multiple -s options behave additively.

-S col
Sorts by col in the opposite order as option -s.

-v
Without -x or -l, displays verbose columns: STATE, NSTATE, STIME, CTID, and FMRI.
With -x, displays extra information for each explanation.
With -l, displays user-visible properties in property groups of type application and their description.

-x
Displays explanations for service states.

Without arguments, the -x option explains the states of services which:
- are enabled, but are not running.
- are preventing another enabled service from running.

Operands
The following operands are supported:

FMRI
A fault management resource identifier (FMRI) that specifies one or more instances (see smf(5)). FMRIs can be abbreviated by specifying the instance name, or the trailing portion of the service name. For example, given the FMRI:

```
svc:/network/smtp:sendmail
```

The following are valid abbreviations:
sendmail
:sendmail
smtp
smtp:sendmail
network/smtp

The following are invalid abbreviations:

mail
network
network/smt

If the FMRI specifies a service, then the command applies to all instances of that service, except when used with the -D option.

Abbreviated forms of FMRIs are unstable, and should not be used in scripts or other permanent tools.

**pattern**

A pattern that is matched against the FMRIs of service instances according to the globbing rules described by `fnmatch(5)`. If the pattern does not begin with `svc:`, then `svc:/` is prepended. The following is a typical example of a glob pattern:

```
qexample% svcs "*keyserv*"
```

**FMRI-instance**

An FMRI that specifies an instance.

**Columns**

Column names are case insensitive. The default output format is equivalent to "-o state,stime,fmri". The default sorting columns are STATE, STIME, FMRI.

**CTID**

The primary contract ID for the service instance. Not all instances have valid primary contract IDs.

**DESC**

A brief description of the service, from its template element. A service might not have a description available, in which case a hyphen (-) is used to denote an empty value.

**FMRI**

The FMRI of the service instance.

**INST**

The instance name of the service instance.

**NSTA**

The abbreviated next state of the service instance, as given in the STA column description. A hyphen denotes that the instance is not transitioning. Same as STA otherwise.
NSTATE
   The next state of the service. A hyphen is used to denote that the instance is not
   transitioning. Same as STATE otherwise.

SCOPE
   The scope name of the service instance.

SVC
   The service name of the service instance.

STA
   The abbreviated state of the service instance (see smf(5)):
   DGD    degraded
   DIS    disabled
   LRC    legacy rc*.d script-initiated instance
   MNT    maintenance
   OFF    offline
   ON     online
   UN     uninitialized

   Absent or unrecognized states are denoted by a question mark (?) character. An asterisk (*)
   is appended for instances in transition, unless the NSTA or NSTATE column is also being
   displayed.

   See smf(5) for an explanation of service states.

STATE
   The state of the service instance. An asterisk is appended for instances in transition, unless
   the NSTA or NSTATE column is also being displayed.

   See smf(5) for an explanation of service states.

STIME
   If the service instance entered the current state within the last 24 hours, this column
   indicates the time that it did so. Otherwise, this column indicates the date on which it did
   so, printed with underscores (_) in place of blanks.
Examples

**EXAMPLE 1** Displaying the Default Output
This example displays default output:

```
example% svcs
State  STIME  FMRI
... legacy_run 13:25:04 lrc:/etc/rc3_d/S42myscript
... online 13:21:50 svc:/system/svc/restarter:default
... online 13:25:03 svc:/milestone/multi-user:default
... online 13:25:07 svc:/milestone/multi-user-server:default
...
```

**EXAMPLE 2** Listing All Local Instances
This example lists all local instances of the service1 service.

```
example% svcs -o state,nstate,fmri service1
State  NState  FMRI
online  -       svc:/service1:instance1
disabled -       svc:/service1:instance2
```

**EXAMPLE 3** ListingVerbose Information
This example lists verbose information.

```
example% svcs -v network/rpc/rstat:udp
State  NState  STIME  CTID  FMRI
online  -  Aug_09  -       svc:/network/rpc/rstat:udp
```

**EXAMPLE 4** Listing Detailed Information
This example lists detailed information about all instances of system/service3. Additional fields can be displayed, as appropriate to the managing restarter.

```
example% svcs -l network/rpc/rstat:udp
FMRI  svc:/network/rpc/rstat:udp
enabled  true
state  online
next_state  none
restarter  svc:/network/inetd:default
contract_id
dependency  require_all/error svc:/network/rpc/bind (online)
```

**EXAMPLE 5** Listing Processes

```
example% svcs -p sendmail
State  STIME  FMRI
```
Listing Processes (Continued)

13:25:13 svc:/network/smtp:sendmail
13:25:15 100939 sendmail
13:25:15 100940 sendmail

Explaining Service States Using svcs -x

(a) In this example, svcs -x has identified that the print/server service being disabled is the root cause of two services which are enabled but not online. svcs -xv shows that those services are print/rfc1179 and print/ipp-listener. This situation can be rectified by either enabling print/server or disabling rfc1179 and ipp-listener.

```
example% svcs -x
svc:/application/print/server:default (LP print server)
  State: disabled since Mon Feb 13 17:56:21 2006
  Reason: Disabled by an administrator.
    See: http://support.oracle.com/msg/SMF-8000-05
    See: lpsched(1M)
  Impact: 2 dependent services are not running. (Use -v for list.)
```

(b) In this example, NFS is not working:

```
example$ svcs nfs/client
STATE   STIME    FMRI
offline 16:03:23 svc:/network/nfs/client:default
```

(c) The following example shows that the problem is nfs/status. nfs/client is waiting because it depends on nfs/nlockmgr, which depends on nfs/status:

```
example$ svcs -xv nfs/client
svc:/network/nfs/client:default (NFS client)
  State: offline since Mon Feb 27 16:03:23 2006
  Reason: Service svc:/network/nfs/status:default is not running because a method failed repeatedly.
    See: http://support.oracle.com/msg/SMF-8000-GE
    Path: svc:/network/nfs/nlockmgr:default
          svc:/network/nfs/status:default
    See: man -M /usr/share/man -s 1M mount_nfs
  Impact: This service is not running.
```

Exit Status The following exit values are returned:

0  Successful command invocation.
1  Fatal error.
Invalid command line options were specified.

**Attributes**  See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>See below.</td>
</tr>
</tbody>
</table>

Screen output is Uncommitted. The invocation is Committed.

**See Also**  `ps(1), svcprop(1), svcadm(1M), svccfg(1M), svc.startd(1M), stat(2), libscf(3LIB), attributes(5), fnmatch(5), smf(5)`
Name  symorder – rearrange a list of symbols

Synopsis  symorder [-s] objectfile symbolfile

Description  symorder was used in SunOS 4.x specifically to cut down on the overhead of getting symbols from vmunix. This is no longer applicable as kernel symbol entries are dynamically obtained through /dev/ksyms.

This script is provided as a convenience for software developers who need to maintain scripts that are portable across a variety of operating systems.

Exit Status  symorder has exit status 0.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/base-developer-utilities</td>
</tr>
</tbody>
</table>

See Also  nlist(3ELF), attributes(5), ksym(7D).
**Name**  
sys-suspend – suspend or shutdown the system and power off

**Synopsis**  
/usr/bin/sys-suspend [-fnhx][-d displayname]

**Description**  
sys - suspend provides options to suspend or shutdown the whole system.

A system can be suspended to conserve power or to prepare the system for transport. The suspend should not be used when performing any hardware reconfiguration or replacement.

In case of suspend, the current system state is preserved either by keeping memory powered (Suspend to RAM), or by saving the state to non-volatile storage (Suspend to Disk) until a resume operation is performed by power on or a wake-up event.

On a resume in the windows environment, the system brings up lockscreen to ensure that only the authorized person has access to the system. In a non-windows environment, the user is prompted for password.

It is possible that when devices or processes are performing critical or time sensitive operations (such as real time operations) the system fails to suspend. When this occurs, the system remains in its current running state. Messages reporting the failure are displayed on the console or system log. Once the system is successfully suspended, the resume operation always succeed barring external influences such as hardware reconfiguration or the like.

In case of shutdown, the system responds as if `poweroff(1M)` was performed.

This command enforces the `solaris.system.power.suspend`. authorizations. On a default install these are associated with the console user. Other users need to include these authorizations or include the Suspend profile.

**Options**  
The following operands are supported:

- `-d displayname`  
  Connect to the X server specified by `displayname`.

- `-f`  
  Force suspend. Causes a `poweroff(1M)` to occur if the suspend fails. System state are not be saved, and a normal boot follows.

- `-h`  
  Change the default from suspend to shutdown.

- `-n`  
  Do not display messages or request user intervention.

- `-x`  
  Disable `lockscreen`. This flag disables the execution of `lockscreen` at resume time.

**Attributes**  
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/kernel/power</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>
See Also  halt(1M), poweroff(1M), shutdown(1M), attributes(5), cpr(7)
**Name**

sysV-make – maintain, update, and regenerate groups of programs

**Synopsis**

```
/usr/lib/svr4_make [-f makefile] [-eiknpqrst] [names]
```

**Description**

This is the vanilla System V version of make. If the environment variable USE_SVR4_MAKE is set, then the command make will invoke this version of make. (See also the ENVIRONMENT section.)

make allows the programmer to maintain, update, and regenerate groups of computer programs. make executes commands in makefile to update one or more target names (names are typically programs). If the -f option is not present, then makefile, Makefile, and the Source Code Control System (SCCS) files s.makefile and s.Makefile are tried in order. If makefile is `'` the standard input is taken. More than one -f makefile argument pair may appear.

make updates a target only if its dependents are newer than the target. All prerequisite files of a target are added recursively to the list of targets. Missing files are deemed to be outdated.

The following list of four directives can be included in makefile to extend the options provided by make. They are used in makefile as if they were targets:

- **.DEFAULT:** If a file must be made but there are no explicit commands or relevant built-in rules, the commands associated with the name .DEFAULT are used if it exists.

- **.IGNORE:** Same effect as the -i option.

- **.PRECIOUS:** Dependents of the .PRECIOUS entry will not be removed when quit or interrupt are hit.

- **.SILENT:** Same effect as the -s option.

**Options**

The options for make are listed below:

- **-e** Environment variables override assignments within makefiles.

- **-f makefile** Description filename (makefile is assumed to be the name of a description file).

- **-i** Ignore error codes returned by invoked commands.

- **-k** Abandon work on the current entry if it fails, but continue on other branches that do not depend on that entry.

- **-n** No execute mode. Print commands, but do not execute them. Even command lines beginning with an '@' are printed.

- **-p** Print out the complete set of macro definitions and target descriptions.

- **-q** Question. make returns a zero or non-zero status code depending on whether or not the target file has been updated.

- **-r** Do not use the built-in rules.

- **-s** Silent mode. Do not print command lines before executing.
Creating the makefile

The makefile invoked with the -f option is a carefully structured file of explicit instructions for updating and regenerating programs, and contains a sequence of entries that specify dependencies. The first line of an entry is a blank-separated, non-null list of targets, then a ‘:', then a (possibly null) list of prerequisite files or dependencies. Text following a ‘:' and all following lines that begin with a tab are shell commands to be executed to update the target. The first non-empty line that does not begin with a tab or '#' begins a new dependency or macro definition. Shell commands may be continued across lines with a backslash-new-line (\-NEWLINE) sequence. Everything printed by make (except the initial TAB) is passed directly to the shell as is. Thus,

```
    echo a\n    b
```

will produce

```
ab
```

exactly the same as the shell would.

Number-sign (#) and NEWLINE surround comments including contained ‘–NEWLINE’ sequences.

The following makefile says that pgm depends on two files a.o and b.o, and that they in turn depend on their corresponding source files (a.c and b.c) and a common file incl.h:

```
pgm: a.o b.o
    cc a.o b.o -o pgm
a.o: incl.h a.c
    cc -c a.c
b.o: incl.h b.c
    cc -c b.c
```

Command lines are executed one at a time, each by its own shell. The SHELL environment variable can be used to specify which shell make should use to execute commands. The default is /usr/bin/sh. The first one or two characters in a command can be the following: '@', '-', '@-', or '-@'. If '@' is present, printing of the command is suppressed. If '-' is present, make ignores an error. A line is printed when it is executed unless the -s option is present, or the entry .SILENT: is included in makefile, or unless the initial character sequence contains a @. The -n option specifies printing without execution; however, if the command line has the string $(MAKE) in it, the line is always executed (see the discussion of the MAKEFLAGS macro in the make Environment sub-section below). The -t (touch) option updates the modified date of a file without executing any commands.
Commands returning non-zero status normally terminate make. If the -i option is present, if the entry .IGNORE: is included in makefile, or if the initial character sequence of the command contains ‘-‘, the error is ignored. If the -k option is present, work is abandoned on the current entry, but continues on other branches that do not depend on that entry.

Interrupt and quit cause the target to be deleted unless the target is a dependent of the directive .PRECIOUS.

**make Environment**

The environment is read by make. All variables are assumed to be macro definitions and are processed as such. The environment variables are processed before any makefile and after the internal rules; thus, macro assignments in a makefile override environment variables. The -e option causes the environment to override the macro assignments in a makefile. Suffixes and their associated rules in the makefile will override any identical suffixes in the built-in rules.

The MAKEFLAGS environment variable is processed by make as containing any legal input option (except -f and -p) defined for the command line. Further, upon invocation, make “invents” the variable if it is not in the environment, puts the current options into it, and passes it on to invocations of commands. Thus, MAKEFLAGS always contains the current input options. This feature proves very useful for “super-makes”. In fact, as noted above, when the -n option is used, the command $(MAKE) is executed anyway; hence, one can perform a make -n recursively on a whole software system to see what would have been executed. This result is possible because the -n is put in MAKEFLAGS and passed to further invocations of $(MAKE). This usage is one way of debugging all of the makefiles for a software project without actually doing anything.

**Include Files**

If the string include appears as the first seven letters of a line in a makefile, and is followed by a blank or a tab, the rest of the line is assumed to be a filename and will be read by the current invocation, after substituting for any macros.

**Macros**

Entries of the form string1 = string2 are macro definitions. string2 is defined as all characters up to a comment character or an unescaped NEWLINE. Subsequent appearances of $(string1 : subst1 = [subst2]) are replaced by string2. The parentheses are optional if a single-character macro name is used and there is no substitute sequence. The optional : subst1 = subst2 is a substitute sequence. If it is specified, all non-overlapping occurrences of subst1 in the named macro are replaced by subst2. Strings (for the purposes of this type of substitution) are delimited by BLANKs, TABs, NEWLINE characters, and beginnings of lines. An example of the use of the substitute sequence is shown in the Libraries sub-section below.

**Internal Macros**

There are five internally maintained macros that are useful for writing rules for building targets.

$*  
The macro $* stands for the filename part of the current dependent with the suffix deleted. It is evaluated only for inference rules.
The $@ macro stands for the full target name of the current target. It is evaluated only for explicitly named dependencies.

The $< macro is only evaluated for inference rules or the .DEFAULT rule. It is the module that is outdated with respect to the target (the “manufactured” dependent file name). Thus, in the .c.o rule, the $< macro would evaluate to the .c file. An example for making optimized .o files from .c files is:

```
.c.o:
    cc c 0 $*.c
```
or:

```
.c.o:
    cc c 0 $<
```

The $? macro is evaluated when explicit rules from the makefile are evaluated. It is the list of prerequisites that are outdated with respect to the target, and essentially those modules that must be rebuilt.

The $% macro is only evaluated when the target is an archive library member of the form lib(file.o). In this case, $@ evaluates to lib and $% evaluates to the library member, file.o.

Four of the five macros can have alternative forms. When an upper case D or F is appended to any of the four macros, the meaning is changed to “directory part” for D and “file part” for F. Thus, $(@(D) refers to the directory part of the string $@. If there is no directory part, ./ is generated. The only macro excluded from this alternative form is $?.

Certain names (for instance, those ending with .o) have inferable prerequisites such as .c, .s, etc. If no update commands for such a file appear in makefile, and if an inferable prerequisite exists, that prerequisite is compiled to make the target. In this case, make has inference rules that allow building files from other files by examining the suffixes and determining an appropriate inference rule to use. The current default inference rules are:

<table>
<thead>
<tr>
<th>.c</th>
<th>.c-</th>
<th>.f</th>
<th>.f-</th>
<th>.s</th>
<th>.s-</th>
<th>.sh</th>
<th>.sh-</th>
<th>.C</th>
<th>.C-</th>
</tr>
</thead>
<tbody>
<tr>
<td>.c.a</td>
<td>.c.o</td>
<td>.c-.a</td>
<td>.c-.c</td>
<td>.c-.o</td>
<td>.f.a</td>
<td>.f.o</td>
<td>.f-.a</td>
<td>.f-.f</td>
<td>.f-.o</td>
</tr>
<tr>
<td>.h-.h</td>
<td>.l.c</td>
<td>.l.o</td>
<td>.l-.c</td>
<td>.l-.l</td>
<td>.l-.o</td>
<td>.s.a</td>
<td>.s.o</td>
<td>.s-.a</td>
<td>.s-.o</td>
</tr>
<tr>
<td>.s-.s</td>
<td>.sh-.sh</td>
<td>.y.c</td>
<td>.y.o</td>
<td>.y-.c</td>
<td>.y-.o</td>
<td>.y-.y</td>
<td>.C.a</td>
<td>.C.o</td>
<td>.C-.a</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Suffixes
The internal rules for make are contained in the source file make.rules for the make program. These rules can be locally modified. To print out the rules compiled into the make on any machine in a form suitable for re-compilation, the following command is used:

```
make -pf -2>/dev/null < /dev/null
```

A tilde in the above rules refers to an SCCS file (see sccsfile(4)). Thus, the rule .c~.o would transform an SCCS C source file into an object file (.o). Because the s. of the SCCS files is a prefix, it is incompatible with the make suffix point of view. Hence, the tilde is a way of changing any file reference into an SCCS file reference.

A rule with only one suffix (for example, .c:) is the definition of how to build x from x.c. In effect, the other suffix is null. This feature is useful for building targets from only one source file, for example, shell procedures and simple C programs.

Additional suffixes are given as the dependency list for .SUFFIXES. Order is significant: the first possible name for which both a file and a rule exist is inferred as a prerequisite. The default list is:

```
.SUFFIXES: .o .c .c~ .y .y~ .l .l~ .s .s~ .sh .sh~ .h .h~ .f .f~ .C .C~ .Y .Y~ .L .L~
```

Here again, the above command for printing the internal rules will display the list of suffixes implemented on the current machine. Multiple suffix lists accumulate; .SUFFIXES: with no dependencies clears the list of suffixes.

**Inference Rules**

The first example can be done more briefly.

```
pgm: a.o b.o
    cc a.o b.o o pgm
a.o b.o: incl.h
```

This abbreviation is possible because make has a set of internal rules for building files. The user may add rules to this list by simply putting them in the makefile.

Certain macros are used by the default inference rules to permit the inclusion of optional matter in any resulting commands. Again, the previous method for examining the current rules is recommended.

The inference of prerequisites can be controlled. The rule to create a file with suffix .o from a file with suffix .c is specified as an entry with .c.o: as the target and no dependents. Shell commands associated with the target define the rule for making a .o file from a .c file. Any target that has no slashes in it and starts with a dot is identified as a rule and not a true target.

**Libraries**

If a target or dependency name contains parentheses, it is assumed to be an archive library, the string within parentheses referring to a member within the library. Thus, lib(file.o) and $(LIB)(file.o) both refer to an archive library that contains file.o. (This example assumes the LIB macro has been previously defined.) The expression $(LIB)(file1.o file2.o) is not
legal. Rules pertaining to archive libraries have the form `.XX.a` where the `XX` is the suffix from which the archive member is to be made. An unfortunate by-product of the current implementation requires the `XX` to be different from the suffix of the archive member. Thus, one cannot have `lib(file.o)` depend upon `file.o` explicitly. The most common use of the archive interface follows. Here, we assume the source files are all C type source:

```sh
lib:  lib(file1.o)  lib(file2.o)  lib(file3.o)
     @echo lib is now up-to-date
.c.a:
    $(CC) -c $(CFLAGS) $<
    $(AR) $(ARFLAGS) $@ $*.o
    rm -f $*.o
```

In fact, the `.c.a` rule listed above is built into `make` and is unnecessary in this example. A more interesting, but more limited example of an archive library maintenance construction follows:

```sh
lib:  lib(file1.o)  lib(file2.o)  lib(file3.o)
     $(CC) -c $(CFLAGS) $(?:.o=.c)
     $(AR) $(ARFLAGS) lib $?
     rm $?
     @echo lib is now up-to-date
.c.a:;
```

Here the substitution mode of the macro expansions is used. The `$?` list is defined to be the set of object filenames (inside `lib`) whose C source files are outdated. The substitution mode translates the `.o` to `.c`. (Unfortunately, one cannot as yet transform to `.c~`; however, this transformation may become possible in the future.) Also note the disabling of the `.c.a:` rule, which would have created each object file, one by one. This particular construct speeds up archive library maintenance considerably. This type of construct becomes very cumbersome if the archive library contains a mix of assembly programs and C programs.

### Environment Variables

<table>
<thead>
<tr>
<th>Environment Variables</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE_SVR4_MAKE</td>
<td>If this environment variable is set, then the <code>make</code> command will invoke this System V version of <code>make</code>. If this variable is not set, then the default version of <code>make(1S)</code> is invoked.</td>
</tr>
</tbody>
</table>

`USE_SVR4_MAKE` can be set as follows ( Bourne shell):

```sh
$ USE_SVR4_MAKE=""; export USE_SVR4_MAKE
```

or (C shell):

```sh
% setenv USE_SVR4_MAKE
```

### Files

<table>
<thead>
<tr>
<th>Files</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>makefile</code></td>
<td>default <code>makefile</code></td>
</tr>
<tr>
<td><code>/usr/bin/sh</code></td>
<td>default <code>shell</code> for <code>make</code></td>
</tr>
<tr>
<td><code>/usr/share/lib/make/make.rules</code></td>
<td>default rules for <code>make</code></td>
</tr>
</tbody>
</table>
Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/build/make</td>
</tr>
</tbody>
</table>

See Also cd(1), make(1S), sh(1), printf(3C), sccsfile(4), attributes(5)

Notes

Some commands return non-zero status inappropriately; use -i or the `-' command line prefix to overcome the difficulty.

Filenames containing the characters `=', `:', and `@' do not work. Commands that are directly executed by the shell, notably cd(1), are ineffectual across NEWLINEs in make. The syntax lib(file1.o file2.o file3.o) is illegal. You cannot build lib(file.o) from file.o.
**Name**  
`tabs` – set tabs on a terminal

**Synopsis**  
```bash
tabs [-n | --file  
    [-a | -a2 | -c | -c2 | -f | -p | -s | -u]]  
q!! [+m [n]] [-T type]  
tabs [-T type] [+ m [n]] n1 [, n2, ...]
```

**Description**  
The `tabs` utility sets the tab stops on the user’s terminal according to a tab specification, after clearing any previous settings. The user’s terminal must have remotely settable hardware tabs.

**Options**  
The following options are supported. If a given flag occurs more than once, the last value given takes effect:

- `-T type`  
  `tabs` needs to know the type of terminal in order to set tabs and margins. `type` is a name listed in `term(5)`. If no `-T` flag is supplied, `tabs` uses the value of the environment variable `TERM`. If the value of `TERM` is `NULL` or `TERM` is not defined in the environment (see `environ(5)`), `tabs` uses `ansi+tabs` as the terminal type to provide a sequence that will work for many terminals.

- `+m[n]`  
  The margin argument may be used for some terminals. It causes all tabs to be moved over `n` columns by making column `n+1` the left margin. If `+m` is given without a value of `n`, the value assumed is 10. For a TermiNet, the first value in the tab list should be 1, or the margin will move even further to the right. The normal (leftmost) margin on most terminals is obtained by `+m0`. The margin for most terminals is reset only when the `+m` flag is given explicitly.

**Tab Specification**  
Four types of tab specification are accepted. They are described below: canned, repetitive (`-n`), arbitrary (`n1,n2,...`), and file (`--file`).

If no tab specification is given, the default value is `-8`, that is, UNIX system “standard” tabs. The lowest column number is 1. Note: For `tabs`, column 1 always refers to the leftmost column on a terminal, even one whose column markers begin at 0, for example, the DASI 300, DASI 300s, and DASI 450.

**Canned - code**  
Use one of the codes listed below to select a canned set of tabs. If more than one code is specified, the last code option will be used. The legal codes and their meanings are as follows:

- `-a`  
  1, 10, 16, 36, 72  
  Assembler, IBM S/370, first format

- `-a2`  
  1, 10, 16, 40, 72  
  Assembler, IBM S/370, second format

- `-c`  
  1, 8, 12, 16, 20, 55  
  COBOL, normal format

- `-c2`  
  1, 6, 10, 14, 49
COBOL compact format (columns 1-6 omitted). Using this code, the first typed character corresponds to card column 7, one space gets you to column 8, and a tab reaches column 12. Files using this tab setup should include a format specification as follows (see fspec(4)):

\[ \langle :t-c2 \quad m6 \quad s66 \quad d: \rangle \]

- c3 1, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42, 46, 50, 54, 58, 62, 67

COBOL compact format (columns 1-6 omitted), with more tabs than -c2. This is the recommended format for COBOL. The appropriate format specification is (see fspec(4)):

\[ \langle :t-c3 \quad m6 \quad s66 \quad d: \rangle \]

- f 1, 7, 11, 15, 19, 23

FORTRAN

- p 1, 5, 9, 13, 17, 21, 25, 29, 33, 37, 41, 45, 49, 53, 57, 61

PL/I

- s 1, 10, 55

SNOBOL

- u 1, 12, 20, 44

UNIVAC 1100 Assembler

**Repetitive** -n A repetitive specification requests tabs at columns 1+n, 1+2*n, etc., where n is a single-digit decimal number. Of particular importance is the value 8: this represents the UNIX system "standard" tab setting, and is the most likely tab setting to be found at a terminal. When -0 is used, the tab stops are cleared and no new ones are set.

**Arbitrary** See OPERANDS.

**File** –file If the name of a file is given, tabs reads the first line of the file, searching for a format specification (see fspec(4)). If it finds one there, it sets the tab stops according to it, otherwise it sets them as -8. This type of specification may be used to make sure that a tabbed file is printed with correct tab settings, and would be used with the pr command:

```
example% tabs –file; pr file
```

Tab and margin setting is performed via the standard output.

**Operands** The following operand is supported:
The arbitrary format consists of tab-stop values separated by commas or spaces. The tab-stop values must be positive decimal integers in ascending order. Up to 40 numbers are allowed. If any number (except the first one) is preceded by a plus sign, it is taken as an increment to be added to the previous value. Thus, the formats 1, 10, 20, 30, and 1, 10, +10, +10 are considered identical.

**Examples**

**Example 1** Using the tabs command

The following command is an example using `-code` (canned specification) to set tabs to the settings required by the IBM assembler: columns 1, 10, 16, 36, 72:

```
example% tabs -a
```

The next command is an example of using `-n` (repetitive specification), where `n` is 8, causes tabs to be set every eighth position: `1+(1*8), 1+(2*8),...` which evaluate to columns 9, 17, ...:

```
example% tabs -8
```

This command uses `n1, n2, ...` (arbitrary specification) to set tabs at columns 1, 8, and 36:

```
example% tabs 1, 8, 36
```

The last command is an example of using `-file` (file specification) to indicate that tabs should be set according to the first line of `$HOME/fspec.list/att4425` (see `fspec(4)`).

```
example% tabs --$HOME/fspec.list/att4425
```

**Environment Variables**

See `environ(5)` for descriptions of the following environment variables that affect the execution of tabs: `LANG`, `LC_ALL`, `LC_CTYPE`, `LC_MESSAGES`, and `NLSPATH`.

**TERM** Determine the terminal type. If this variable is unset or null, and if the `-T` option is not specified, terminal type `ansi+tabs` will be used.

**Exit Status**

The following exit values are returned:

<table>
<thead>
<tr>
<th>Exit Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Successful completion.</td>
</tr>
<tr>
<td>&gt;0</td>
<td>An error occurred.</td>
</tr>
</tbody>
</table>

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>ATTRIBUTE TYPE</td>
<td>ATTRIBUTE VALUE</td>
</tr>
<tr>
<td>----------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

**See Also**  
expand(1), newform(1), pr(1), stty(1), tput(1), fspec(4), terminfo(4), attributes(5), environ(5), term(5), standards(5)

**Notes**  
There is no consistency among different terminals regarding ways of clearing tabs and setting the left margin.

tabs clears only 20 tabs (on terminals requiring a long sequence), but is willing to set 64.

The `tabspec` used with the `tabs` command is different from the one used with the `newform` command. For example, `tabs -8` sets every eighth position; whereas `newform -1-8` indicates that tabs are set every eighth position.
Name  tail – deliver the last part of a file

Synopsis  

```
/usr/bin/tail [± number [lbc]] [file]
```

```
/usr/bin/tail [-lbc] [file]
```

```
/usr/bin/tail [± number [lbcf]] [file]
```

```
/usr/bin/tail [-lbcf] [file]
```

```
/usr/xpg4/bin/tail [-f | -r] [-c number | -n number] [file]
```

```
/usr/xpg4/bin/tail [± number [l | b | c] [f]] [file]
```

```
/usr/xpg4/bin/tail [± number [l] [f | r]] [file]
```

Description  The tail utility copies the named file to the standard output beginning at a designated place. If no file is named, the standard input is used.

Copying begins at a point in the file indicated by the -c number, -n number, or ± number options (if + number is specified, begins at distance number from the beginning; if - number is specified, from the end of the input; if number is NULL, the value 10 is assumed). number is counted in units of lines or byte according to the -c or -n options, or lines, blocks, or bytes, according to the appended option l, b, or c. When no units are specified, counting is by lines.

Options  The following options are supported for both /usr/bin/tail and /usr/xpg4/bin/tail. The -r and -f options are mutually exclusive. If both are specified on the command line, the -f option is ignored.

- **b**  Units of blocks.

- **c**  Units of bytes.

- **f**  Follow. If the input-file is not a pipe, the program does not terminate after the line of the input-file has been copied, but enters an endless loop, wherein it sleeps for a second and then attempts to read and copy further records from the input-file. Thus it can be used to monitor the growth of a file that is being written by some other process.

- **l**  Units of lines.

- **r**  Reverse. Copies lines from the specified starting point in the file in reverse order. The default for r is to print the entire file in reverse order.

The following options are supported for /usr/xpg4/bin/tail only:

- **c number**  The number option-argument must be a decimal integer whose sign affects the location in the file, measured in bytes, to begin the copying:

  +  Copying starts relative to the beginning of the file.

  -  Copying starts relative to the end of the file.

  none  Copying starts relative to the end of the file.
The origin for counting is 1; that is, \(-c +1\) represents the first byte of the file, \(-c -1\) the last.

\(-n\) number  Equivalent to \(-c\) number, except the starting location in the file is measured in lines instead of bytes. The origin for counting is 1. That is, \(-n +1\) represents the first line of the file, \(-n -1\) the last.

**Operands**  The following operand is supported:

- `file`  A path name of an input file. If no `file` operands are specified, the standard input is used.

**Usage**  See `largefile(5)` for the description of the behavior of `tail` when encountering files greater than or equal to 2 Gbyte \(2^{31}\) bytes).

**Examples**  **EXAMPLE 1**  Using the `tail` Command

The following command prints the last ten lines of the file `fred`, followed by any lines that are appended to `fred` between the time `tail` is initiated and killed:

```
example% tail -f fred
```

The next command prints the last 15 bytes of the file `fred`, followed by any lines that are appended to `fred` between the time `tail` is initiated and killed:

```
example% tail -15cf fred
```

**Environment Variables**  See `environ(5)` for descriptions of the following environment variables that affect the execution of `tail`: `LANG`, `LC_ALL`, `LC_CTYPE`, `LC_MESSAGES`, and `NLSPATH`.

**Exit Status**  The following exit values are returned:

- 0  Successful completion.
- >0  An error occurred.

**Attributes**  See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>/usr/bin/tail</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
<td></td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>/usr/xpg4/bin/tail</th>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/xopen/xcu4</td>
<td></td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
<td></td>
</tr>
</tbody>
</table>
### See Also
- cat(1), head(1), more(1), pg(1), dd(1M), attributes(5), environ(5), largefile(5), standards(5)

### Notes
Piped tails relative to the end of the file are stored in a buffer, and thus are limited in length. Various kinds of anomalous behavior can happen with character special files.
The `talk` utility is a two-way, screen-oriented communication program. When first invoked, `talk` sends a message similar to:

```
Message from TalkDaemon@her_machine at time...
talk: connection requested by your_address
talk: respond with: talk your_address
```

to the specified `address`. At this point, the recipient of the message can reply by typing:

```
talk your_address
```

Once communication is established, the two parties can type simultaneously, with their output displayed in separate regions of the screen. Characters are processed as follows:

- Typing the alert character will alert the recipient's terminal.
- Typing Control-L will cause the sender's screen regions to be refreshed.
- Typing the erase and kill characters will affect the sender's terminal in the manner described by the `termios(3C)` interface.
- Typing the interrupt or end-of-file (EOF) characters will terminate the local `talk` utility. Once the `talk` session has been terminated on one side, the other side of the `talk` session will be notified that the `talk` session has been terminated and will be able to do nothing except exit.
- Typing characters from `LC_CTYPE` classifications `print` or space will cause those characters to be sent to the recipient's terminal.
- When and only when the `stty` `ixexten` local mode is enabled, additional special control characters and multi-byte or single-byte characters are processed as printable characters if their wide character equivalents are printable.
- Typing other non-printable characters will cause them to be written to the recipient's terminal as follows: control characters will appear as a caret (^) followed by the appropriate ASCII character, and characters with the high-order bit set will appear in "meta" notation. For example, `\003` is displayed as `^C` and `\372` as `M–z`.

Permission to be a recipient of a `talk` message can be denied or granted by use of the `msg(1)` utility. However, a user's privilege may further constrain the domain of accessibility of other users' terminals. Certain commands, such as `pr(1)`, disallow messages in order to prevent interference with their output. `talk` will fail when the user lacks the appropriate privileges to perform the requested action.

Certain block-mode terminals do not have all the capabilities necessary to support the simultaneous exchange of messages required for `talk`. When this type of exchange cannot be
supported on such terminals, the implementation may support an exchange with reduced levels of simultaneous interaction or it may report an error describing the terminal-related deficiency.

**Operands**
The following operands are supported:

`address` The recipient of the `talk` session. One form of `address` is the `username`, as returned by the `who(1)` utility. If you wish to talk to someone on your own machine, then `username` is just the person’s login name. If you wish to talk to a user on another host, then `username` is one of the following forms:

- `host!user`
- `host.user`
- `host:user`
- `user@host`

Although `user@host` is perhaps preferred.

`terminal` If the recipient is logged in more than once, `terminal` can be used to indicate the appropriate terminal name. If `terminal` is not specified, the `talk` message will be displayed on one or more accessible terminals in use by the recipient. The format of `terminal` will be the same as that returned by `who`.

**Environment Variables**
See `environ(5)` for descriptions of the following environment variables that affect the execution of `talk`: `LANG`, `LC_ALL`, `LC_CTYPE`, `LC_MESSAGES`, and `NLSPATH`.

`TERM` Determine the name of the invoker’s terminal type. If this variable is unset or null, an unspecified terminal type will be used.

**Exit Status**
The following exit values are returned:

0  Successful completion.

>0  An error occurred, or `talk` was invoked on a terminal incapable of supporting it.

**Files**

- `/etc/hosts`  host name database
- `/var/adm/utmpx`  user and accounting information for `talk`

**Attributes**
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/network-servers</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See <code>standards(5)</code></td>
</tr>
</tbody>
</table>
Typing Control-L redraws the screen, while the erase, kill, and word kill characters will work in `talk` as normal. To exit, type an interrupt character. `talk` then moves the cursor to the bottom of the screen and restores the terminal to its previous state.

**See Also**  `mail(1), mesg(1), pr(1), stty(1), who(1), write(1), talkd(1M), termios(3C), attributes(5), environ(5), standards(5)`
Name

tar – create tape archives and add or extract files

Synopsis

tar c[BDEFljlnopPTvwzZ@/0-7][bf][X...][blocksize]
   [tarfile] [size] [exclude-file]...
   [file | -I include-file | -C directory file]...

tar r[BDEFljlnTvwzZ@/0-7][bf][blocksize] [tarfile]
   [size]
   [file | -I include-file | -C directory file]...

tar t[BFlmnTvwZ@/0-7][f][X...][tarfile] [size]
   [exclude-file]... [file | -I include-file]...

tar u[BDEFljlnTvwzZ@/0-7][bf][blocksize] [tarfile]
   [size] [file]...

tar x[BFljmnopTvwzZ@/0-7][f][X...][tarfile] [size]
   [exclude-file]... [file]...

Description

The tar command archives and extracts files to and from a single file called a tarfile. A tarfile is usually a magnetic tape, but it can be any file. tar’s actions are controlled by the key argument. The key is a string of characters containing exactly one function letter (c, r, t, u, or x) and zero or more function modifiers (letters or digits), depending on the function letter used. The key string contains no SPACE characters. Function modifier arguments are listed on the command line in the same order as their corresponding function modifiers appear in the key string.

The -I include-file, -C directory file, and file arguments specify which files or directories are to be archived or extracted. In all cases, appearance of a directory name refers to the files and (recursively) subdirectories of that directory. Arguments appearing within braces ({} ) indicate that one of the arguments must be specified.

Operands

The following operands are supported:

-C directory file

Performs a chdir (see cd(1)) operation on directory and performs the c (create) or r (replace) operation on file. Use short relative path names for file. If file is "." , archive all files in directory. This operand enables archiving files from multiple directories not related by a close common parent.

-I include-file

Opens include-file containing a list of files, one per line, and treats it as if each file appeared separately on the command line. Be careful of trailing white spaces. Also beware of leading white spaces, since, for each line in the included file, the entire line (apart from the newline) is used to match against the initial string of files to include. In the case where excluded files (see X function modifier) are also specified, they take precedence over all included files. If a file is specified in both the exclude-file and the include-file (or on the command line), it is excluded.
A path name of a regular file or directory to be archived (when the c, r or u functions are specified), extracted (x) or listed (t). When file is the path name of a directory, the action applies to all of the files and (recursively) subdirectories of that directory.

When a file is archived, and the E flag (see Function Modifiers) is not specified, the filename cannot exceed 256 characters. In addition, it must be possible to split the name between parent directory names so that the prefix is no longer than 155 characters and the name is no longer than 100 characters. If E is specified, a name of up to PATH_MAX characters can be specified.

For example, a file whose basename is longer than 100 characters could not be archived without using the E flag. A file whose directory portion is 200 characters and whose basename is 50 characters could be archived (without using E) if a slash appears in the directory name somewhere in character positions 151-156.

The function portion of the key is specified by one of the following letters:

- **c**: Create. Writing begins at the beginning of the tarfile, instead of at the end.
- **r**: Replace. The named files are written at the end of the tarfile. A file created with extended headers must be updated with extended headers (see E flag under Function Modifiers). A file created without extended headers cannot be modified with extended headers.
- **t**: Table of Contents. The names of the specified files are listed each time they occur in the tarfile. If no file argument is specified, the names of all files and any associated extended attributes in the tarfile are listed. With the v function modifier, additional information for the specified files is displayed.
- **u**: Update. The named files are written at the end of the tarfile if they are not already in the tarfile, or if they have been modified since last written to that tarfile. An update can be rather slow. A tarfile created on a 5.x system cannot be updated on a 4.x system. A file created with extended headers must be updated with extended headers (see E flag under Function Modifiers). A file created without extended headers cannot be modified with extended headers.
- **x**: Extract or restore. The named files are extracted from the tarfile and written to the directory specified in the tarfile, relative to the current directory. Use the relative path names of files and directories to be extracted.

Absolute path names contained in the tar archive are unpacked using the absolute path names, that is, the leading forward slash (/) is not stripped off.
By default, absolute pathnames (those that begin with a / character) have the leading slash removed, therefore extracting those files and directories relative to the current directory.

If a named file matches a directory whose contents has been written to the tarfile, this directory is recursively extracted. The owner, modification time, and mode are restored, if possible. Otherwise, to restore owner, you must be the super-user. Character-special and block-special devices (created by mknod(1M)) can only be extracted by the super-user. If no file argument is specified, the entire content of the tarfile is extracted. If the tarfile contains several files with the same name, each file is written to the appropriate directory, overwriting the previous one. Filename substitution wildcards cannot be used for extracting files from the archive. Rather, use a command of the form:

```
tar xvf ... /dev/rmt/0' tar tf ... /dev/rmt/0 | \ 
  grep '%pattern'
```

When extracting tapes created with the r or u functions, directory modification times cannot be set correctly. These same functions cannot be used with many tape drives due to tape drive limitations such as the absence of backspace or append capabilities.

When using the r, u, or x functions or the X function modifier, the named files must match exactly the corresponding files in the tarfile. For example, to extract .//thisfile, you must specify .//thisfile, and not thisfile. The t function displays how each file was archived.

**Function Modifiers**

The characters below can be used in conjunction with the letter that selects the desired function.

- **b** *blocking*
  - Blocking Factor. Use when reading or writing to raw magnetic archives (see f below). The blocking size argument specifies the number of 512-byte tape blocks to be included in each read or write operation performed on the tarfile. The minimum is 1, the default is 20. The maximum value is a function of the amount of memory available and the blocking requirements of the specific tape device involved (see mtio(7I) for details.) The maximum cannot exceed INT_MAX/512 (4194303).

  When a tape archive is being read, its actual blocking factor is automatically detected, provided that it is less than or equal to the nominal blocking factor (the value of the blocking size argument, or the default value if the b modifier is not specified). If the actual blocking factor is greater than the nominal blocking factor, a read error results. See Example 5 in EXAMPLES.

- **B**
  - Block. Force tar to perform multiple reads (if necessary) to read exactly enough bytes to fill a block. This function modifier enables tar to work across the Ethernet, since pipes and sockets return partial blocks even when more data is coming. When reading from standard input, "-", this function modifier is selected by default to ensure that tar can recover from short reads.
Data change warnings. Used with c, r, or u function letters. Ignored with t or x function letters. If the size of a file changes while the file is being archived, treat this condition as a warning instead of as an error. A warning message is still written, but the exit status is not affected.

Write a tarfile with extended headers. (Used with c, r, or u function letters. Ignored with t or x function letters.) When a tarfile is written with extended headers, the modification time is maintained with a granularity of microseconds rather than seconds. In addition, filenames no longer than PATH_MAX characters that could not be archived without E, and file sizes greater than 8GB, are supported. The E flag is required whenever the larger files and/or files with longer names, or whose UID/GID exceed 2097151, are to be archived, or if time granularity of microseconds is desired.

File. Use the tarfile argument as the name of the tarfile. If f is specified, /etc/default/tar is not searched. If f is omitted, tar uses the device indicated by the TAPE environment variable, if set. Otherwise, tar uses the default values defined in /etc/default/tar. The number matching the archiveN string is used as the output device with the blocking and size specifications from the file. For example,

```
tar -c 2/tmp/*
```
writes the output to the device specified as archive2 in /etc/default/tar.

If the name of the tarfile is “−”, tar writes to the standard output or reads from the standard input, whichever is appropriate. tar can be used as the head or tail of a pipeline. tar can also be used to move hierarchies with the command:

```
example% cd fromdir; tar cf − - | (cd todir; tar xfBp −)
```

With one F argument, tar excludes all directories named SCCS and RCS from the tarfile. With two arguments, FF, tar excludes all directories named SCCS and RCS, all files with .o as their suffix, and all files named errs, core, and a.out.

Follow symbolic links as if they were normal files or directories. Normally, tar does not follow symbolic links.

Ignore directory checksum errors.

Compress the resulting archive with bzip2. In extract or list modes, this option is ignored. The implementation recognizes bzip2 compression type automatically when reading archives. Upgrade/replace first decompresses and then applies the same mechanism to compress the archive automatically.
Link. Output error message if unable to resolve all links to the files being archived. If \`l\' is not specified, no error messages are printed.

Modify. The modification time of the file is the time of extraction. This function modifier is valid only with the x function.

The file being read is a non-tape device. Reading of the archive is faster since \texttt{tar} can randomly seek around the archive.

Ownership. Assign to extracted files the user and group identifiers of the user running the program, rather than those on tarfile. This is the default behavior for users other than root. If the o function modifier is not set and the user is root, the extracted files take on the group and user identifiers of the files on tarfile (see \texttt{chown(1)} for more information). The o function modifier is only valid with the x function.

Restore the named files to their original modes, and ACLs if applicable, ignoring the present \texttt{umask(1)}. This is the default behavior if invoked as super-user with the x function letter specified. If super-user, SETUID, and sticky information are also extracted, and files are restored with their original owners and permissions, rather than owned by root. When this function modifier is used with the c function, ACLs are created in the tarfile along with other information. Errors occur when a tarfile with ACLs is extracted by previous versions of \texttt{tar}.

For archive creation, suppress the addition of a trailing / on directory entries in the archive.

For archive extraction, preserve pathnames. By default, absolute pathnames (those that begin with a / character) have the leading slash removed when extracting archives. Also, \texttt{tar} refuses to extract archive entries whose pathnames contain a dot-dot (..).

This option suppresses these behaviors.

This modifier is only available if the system is configured with Trusted Extensions.

When this modifier is used with the function letter c, r, or u for creating, replacing or updating a tarfile, the sensitivity label associated with each archived file and directory is stored in the tarfile.

Specifying T implies the function modifier p.

When used with the function letter x for extracting a tarfile, the \texttt{tar} program verifies that the file's sensitivity label specified in the archive equals the sensitivity label of the destination directory. If not, the file is not restored. This operation must be invoked from
the global zone. If the archived file has a relative pathname, it is restored to the
corresponding directory with the same label, if available. This is done by prepending to the
current destination directory the root pathname of the zone whose label equals the file. If
no such zone exists, the file is not restored.

Limited support is provided for extracting labeled archives from Trusted Solaris 8. Only
sensitivity labels, and multi-level directory specifications are interpreted. Privilege
specifications and audit attribute flags are silently ignored. Multilevel directory
specifications including symbolic links to single level directories are are mapped into
zone-relative pathnames if a zone with the same label is available. This support is intended
to facilitate migration of home directories. Architectural differences preclude the
extraction of arbitrarily labeled files from Trusted Solaris 8 into identical pathnames in
Trusted Extensions. Files cannot be extracted unless their archived label matches the
destination label.

v

Verbose. Output the name of each file preceded by the function letter. With the t function,
v provides additional information about the tarfile entries. The listing is similar to the
format produced by the -l option of the ls(1) command.

w

What. Output the action to be taken and the name of the file, then await the user's
confirmation. If the response is affirmative, the action is performed; otherwise, the action is
not performed. This function modifier cannot be used with the t function.

X

Exclude. Use the exclude-file argument as a file containing a list of relative path names for
files (or directories) to be excluded from the tarfile when using the functions c, x, or t. Be
careful of trailing white spaces. Also beware of leading white spaces, since, for each line in
the excluded file, the entire line (apart from the newline) is used to match against the initial
string of files to exclude. Lines in the exclude file are matched exactly, so an entry like
"/var" does not exclude the /var directory if tar is backing up relative pathnames. The
entry should read "./var" under these circumstances. The tar command does not expand
shell metacharacters in the exclude file, so specifying entries like "*.o" does not have the
effect of excluding all files with names suffixed with ".o". If a complex list of files is to be
excluded, the exclude file should be generated by some means such as the find(1)
command with appropriate conditions.

Multiple X arguments can be used, with one exclude-file per argument. In the case where
included files (see −l include-file operand) are also specified, the excluded files take
precedence over all included files. If a file is specified in both the exclude-file and the
include-file (or on the command line), it is excluded.

z

c mode only. Compress the resulting archive with gzip. In extract or list mode, this option
is ignored. The implementation recognizes gzip compression type automatically when
reading archives. Upgrade/replace first decompresses and then applies the same mechanism to compress the archive automatically.

Z
Move to c mode only. Compress the resulting archive with compress. See compress(1). In extract or list modes, this option is ignored. The implementation recognizes compress compression type automatically when reading archives. Upgrade/replace first decompresses and then applies the same mechanism to compress the archive automatically.

@
Include extended attributes in archive. By default, tar does not place extended attributes in the archive. With this flag, tar looks for extended attributes on the files to be placed in the archive and add them to the archive. Extended attributes go in the archive as special files with a special type label. When this modifier is used with the x function, extended attributes are extracted from the tape along with the normal file data. Extended attribute files can only be extracted from an archive as part of a normal file extract. Attempts to explicitly extract attribute records are ignored.

/
Include extended system attributes in archive. By default, tar does not place extended system attributes in the archive. With this flag, tar looks for extended system attributes on the files to be placed in the archive and adds them to the archive. Extended system attributes go in the archive as special files with a special type label. When this modifier is used with the x function, extended system attributes are extracted from the tape along with the normal file data. Extended system attribute files can only be extracted from an archive as part of a normal file extract. Attempts to explicitly extract attribute records are ignored.

[0-7]
Select an alternative drive on which the tape is mounted. The default entries are specified in /etc/default/tar. If no digit or f function modifier is specified, the entry in /etc/default/tar with digit “0” is the default.

Usage
See largefile(5) for the description of the behavior of tar when encountering files greater than or equal to 2 Gbyte (2^31 bytes).

The automatic determination of the actual blocking factor can be fooled when reading from a pipe or a socket (see the B function modifier below).

1/4” streaming tape has an inherent blocking factor of one 512-byte block. It can be read or written using any blocking factor.

This function modifier works for archives on disk files and block special devices, among others, but is intended principally for tape devices.

For information on tar header format, see archives.h(3HEAD).
Creating an Archive of Your Home Directory

The following is an example using `tar` to create an archive of your home directory on a tape mounted on drive `/dev/rmt/0`:

```
example% cd
example% tar cvf /dev/rmt/0 .
```

The `c` function letter means create the archive. The `v` function modifier outputs messages explaining what `tar` is doing. The `f` function modifier indicates that the tarfile is being specified (`/dev/rmt/0` in this example). The dot (.) at the end of the command line indicates the current directory and is the argument of the `f` function modifier.

Display the table of contents of the tarfile with the following command:

```
example% tar tvf /dev/rmt/0
```

The output is similar to the following for the POSIX locale:

```
-rw-r--r-- 1677/40 2123 Nov 7 18:15 1985 ./test.c
... 
```

The columns have the following meanings:
- column 1 is the access permissions to `.test.c`
- column 2 is the user-id/group-id of `.test.c`
- column 3 is the size of `.test.c` in bytes
- column 4 is the modification date of `.test.c`. When the `LC_TIME` category is not set to the POSIX locale, a different format and date order field can be used.
- column 5 is the name of `.test.c`

To extract files from the archive:

```
example% tar xvf /dev/rmt/0
```

If there are multiple archive files on a tape, each is separated from the following one by an EOF marker. To have `tar` read the first and second archives from a tape with multiple archives on it, the `non-rewinding` version of the tape device name must be used with the `f` function modifier, as follows:

```
example% tar xvfp /dev/rmt/0n read first archive from tape
messages from tar
example% tar xvfp /dev/rmt/0n read second archive from tape
messages from tar
```

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EXAMPLE 1  Creating an Archive of Your Home Directory  (Continued)

Notice that in some earlier releases, the above scenario did not work correctly, and intervention with mt(1) between tar invocations was necessary. To emulate the old behavior, use the non-rewind device name containing the letter b for BSD behavior. See the Close Operations section of the mt(7I) manual page.

EXAMPLE 2  Archiving Files from /usr/include and from /etc to Default Tape Drive 0

To archive files from /usr/include and from /etc to default tape drive 0:

example% tar c -C /usr include -C /etc .

The table of contents from the resulting tarfile would produce output like the following:

include/
include/a.out.h
and all the other files in /usr/include ...
./chown and all the other files in /etc

To extract all files in the include directory:

example% tar xv include
x include/, 0 bytes, 0 tape blocks \
and all files under include ...

EXAMPLE 3  Transferring Files Across the Network

The following is an example using tar to transfer files across the network. First, here is how to archive files from the local machine (example) to a tape on a remote system (host):

example% tar cvfb - 20 files| \
    ssh host dd of=/dev/rmt/0 obs=20b
messages from tar
example%

In the example above, we are creating a tarfile with the c key letter, asking for verbose output from tar with the v function modifier, specifying the name of the output tarfile using the f function modifier (the standard output is where the tarfile appears, as indicated by the ‘−’ sign), and specifying the blocksize (20) with the b function modifier. If you want to change the blocksize, you must change the blocksize arguments both on the tar command and on the dd command.

EXAMPLE 4  Retrieving Files from a Tape on the Remote System Back to the Local System

The following is an example that uses tar to retrieve files from a tape on the remote system back to the local system:

example% ssh -n host dd if=/dev/rmt/0 bs=20b | \
    tar xv8fb - 20 files
EXAMPLE 4  Retrieving Files from a Tape on the Remote System Back to the Local System
(Continued)

messages from tar
example%

In the example above, we are extracting from the tarfile with the x key letter, asking for verbose output from tar with the v function modifier, telling tar it is reading from a pipe with the B function modifier, specifying the name of the input tarfile using the f function modifier (the standard input is where the tarfile appears, as indicated by the "−" sign), and specifying the blocksize (20) with the b function modifier.

EXAMPLE 5  Creating an Archive of the Home Directory

The following example creates an archive of the home directory on /dev/rmt/0 with an actual blocking factor of 19:

example% tar cvfb /dev/rmt/0 19 $HOME

To recognize this archive's actual blocking factor without using the b function modifier:

example% tar tvf /dev/rmt/0

tar: blocksize = 19
...

To recognize this archive's actual blocking factor using a larger nominal blocking factor:

example% tar tvf /dev/rmt/0 30

tar: blocksize = 19
...

Attempt to recognize this archive's actual blocking factor using a nominal blocking factor that is too small:

example% tar tvf /dev/rmt/0 10

tar: tape read error

EXAMPLE 6  Creating Compressed Archives

The following example creates a compressed archive using bzip:

example% tar cjf tarfile /tmp/*

The compressed file name is tarfile.bz2

The same compressed archive would be created in this case if the following sequence of commands had been used instead:

example% tar cf tarfile /tmp/*
example% bzip2 tarfile

however, the creation and removal of the intermediate file is eliminated. The function modifiers z and Z behave similarly, but use gzip and compress, respectively.
Creating Compressed Archives

The following example creates a compressed archive using `compress`:

```bash
eexample% tar czf tarfile /tmp/*
```

The compressed filename is `tarfile.Z`.

The following example creates a compressed archive using `gzip`:

```bash
eexample% tar czf tarfile /tmp/*
```

The compressed filename is `tarfile.gz`.

Extracting Files from a Compressed Archive

The following examples extract files from a compressed archive: For archives compressed using `bzip2` compression mode:

```bash
eexample% tar xvf tarfile.bz2
eexample% tar xvfj tarfile.bz2
eexample% bzcat tarfile.bz2 | tar xvf -
```

For archives compressed using `compress` compression mode:

```bash
eexample% tar xvf tarfile.Z
eexample% tar xvfZ tarfile.Z
eexample% zcat tarfile.Z | tar xvf -
```

For archives compressed using `gzip` compression mode:

```bash
eexample% tar xvf tarfile.gz
eexample% tar xvfz tarfile.gz
eexample% gzcat tarfile.gz | tar xvf -
```

**Environment Variables**

- **TMPDIR**
  - Creates a temporary file in `/tmp` by default. Otherwise, `tar` uses the directory specified by `TMPDIR`.

See `environ(5)` for descriptions of the following environment variables that affect the execution of `tar`: `LC_COLLATE`, `LC_CTYPE`, `LC_MESSAGES`, `LC_TIME`, `TZ`, and `NLSPATH`.

Affirmative responses are processed using the extended regular expression defined for the `yesexpr` keyword in the `LC_MESSAGES` category of the user's locale. The locale specified in the `LC_COLLATE` category defines the behavior of ranges, equivalence classes, and multi-character collating elements used in the expression defined for `yesexpr`. The locale specified in `LC_CTYPE` determines the locale for interpretation of sequences of bytes of text data a characters, the behavior of character classes used in the expression defined for the `yesexpr`. See `locale(5)`. 
Exit Status  The following exit values are returned:

0
  Successful completion.

>0
  An error occurred.

Files

■ /dev/rmt/[0-7][b][n]
■ /dev/rmt/[0-7][l][b][n]
■ /dev/rmt/[0-7][m][b][n]
■ /dev/rmt/[0-7][h][b][n]
■ /dev/rmt/[0-7][u][b][n]
■ /dev/rmt/[0-7][c][b][n]
■ /etc/default/tar

Setting for /etc/default/tar might look like the following:

archive0=/dev/rmt/0
archive1=/dev/rmt/0n
archive2=/dev/rmt/1
archive3=/dev/rmt/1n
archive4=/dev/rmt/0
archive5=/dev/rmt/0n
archive6=/dev/rmt/1
archive7=/dev/rmt/1n

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  ar(1), basename(1), cd(1), chown(1), compress(1), cpio(1), csh(1), dirname(1), find(1),
| ls(1), mt(1), pax(1), setfacl(1), umask(1), mknod(1M), archives.h(3HEAD), attributes(5), environ(5), fsattr(5), largefile(5), mtio(7I)

Diagnostics  Diagnostic messages are output for bad key characters and tape read/write errors, and for insufficient memory to hold the link tables.

Notes  There is no way to access the n-th occurrence of a file.

Tape errors are handled ungracefully.
The `tar` archive format allows UIDs and GIDs up to 2097151 to be stored in the archive header. Files with UIDs and GIDs greater than this value is archived with the UID and GID of 60001.

If an archive is created that contains files whose names were created by processes running in multiple locales, a single locale that uses a full 8-bit codeset (for example, the en_US locale) should be used both to create the archive and to extract files from the archive.

Neither the `r` function letter nor the `u` function letter can be used with quarter-inch archive tapes, since these tape drives cannot backspace.

Since `tar` has no options, the standard "—" argument that is normally used in other utilities to terminate recognition of options is not needed. If used, it is recognized only as the first argument and is ignored.

Since `−C directory file` and `−I include-file` are multi-argument operands, any of the following methods can be used to archive or extract a file named `−C` or `−I`:

1. Specify them using file operands containing a `/` character on the command line (such as `/home/joe/−C` or `./−I`).
2. Include them in an include file with `−I include-file`.
3. Specify the directory in which the file resides:
   - `−C directory −C`
   - `−C directory −I`
4. Specify the entire directory in which the file resides:
   - `−C directory`.

Name  tbl – format tables for nroff or troff

Synopsis  tbl [-me] [-mm] [-ms] [filename]...

Description  tbl is a preprocessor for formatting tables for nroff(1) or troff(1). The input filenames are copied to the standard output, except that lines between .TS and .TE command lines are assumed to describe tables and are reformatted.

If no arguments are given, tbl reads the standard input, so tbl may be used as a filter. When tbl is used with eqn(1) or neqn, the tbl command should be first, to minimize the volume of data passed through pipes.

Options  
- me   Copy the -me macro package to the front of the output file.
- mm   Copy the -mm macro package to the front of the output file.
- ms   Copy the -ms macro package to the front of the output file.

Examples  EXAMPLE 1  Using tbl

As an example, letting '@' (at-sign) represent a TAB, which should be typed as an actual TAB character in the input file

```
.TS
  c s s
  c c s
  c c c
  l n n.
Household Population
Town@Households
@Number@Size
Bedminster@789@3.26
Bernards Twp.@3087@3.74
Bernardsville@2018@3.30
Bound Brook@3425@3.04
Branchburg@1644@3.49
.TE
```

yields

```
Household Population

<table>
<thead>
<tr>
<th>Town</th>
<th>Households</th>
<th>Number</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedminster</td>
<td></td>
<td>789</td>
<td>3.26</td>
</tr>
<tr>
<td>Bernards Twp.</td>
<td></td>
<td>3087</td>
<td>3.74</td>
</tr>
</tbody>
</table>
```

User Commands  1847
EXAMPLE 1  Using tbl  (Continued)

<table>
<thead>
<tr>
<th>Location</th>
<th>Zip Code</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bernardsville</td>
<td>2018</td>
<td>3.30</td>
</tr>
<tr>
<td>Bound Brook</td>
<td>3425</td>
<td>3.04</td>
</tr>
<tr>
<td>Branchburg</td>
<td>1644</td>
<td>3.49</td>
</tr>
</tbody>
</table>

Files
/usr/share/lib/tmac/e -me macros
/usr/share/lib/tmac/m -mm macros
/usr/share/lib/tmac/s -ms macros

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>text/doctools</td>
</tr>
</tbody>
</table>

See Also  eqn(1), nroff(1), troff(1), attributes(5)
The `tcopy` utility copies the magnetic tape mounted on the tape drive specified by the `source` argument. The only assumption made about the contents of a tape is that there are two tape marks at the end.

When only a source drive is specified, `tcopy` scans the tape, and displays information about the sizes of records and tape files. If a destination is specified, `tcopy` makes a copies the source tape onto the `destination` tape, with blocking preserved. As it copies, `tcopy` produces the same output as it does when only scanning a tape.

The `tcopy` utility requires the use of Berkeley-compatible device names. For example,

```
example% tcopy /dev/rmt/1b /dev/rmt/2b
```

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

**See Also**

`mt(1), ioctl(2), attributes(5)`

**Notes**

`tcopy` will only run on systems supporting an associated set of `ioctl(2)` requests.
Name       tee – replicate the standard output

Synopsis   /usr/bin/tee [-ai] [file ...]

Description tee copies standard input to standard output and to zero or more files. The options determine whether the specified files are overwritten or appended to. The tee utility does not buffer output. If a write to a file fails, tee continues to write to other files although it exits with a non-zero exit status.

The number of file operands that can be specified is limited by the underlying operating system.

Options   The following options are supported:
- a     Appends the output to the files rather than overwriting them.
- i     Ignores interrupts.

Operands  The following operands are supported:
file     A path name of an output file.

Usage     See largefile(5) for the description of the behavior of tee when encountering files greater than or equal to 2 Gbyte (2^{31} bytes).

Environment Variables See environ(5) for descriptions of the following environment variables that affect the execution of tee: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status The following exit values are returned:
0     Successful completion. The standard input was successfully copied to all output files.
>0     An error occurred. The number of files that could not be opened or whose status could not be obtained.

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also cat(1), attributes(5), environ(5), largefile(5), standards(5)
The telnet utility communicates with another host using the TELNET protocol. If telnet is invoked without arguments, it enters command mode, indicated by its prompt, telnet>. In this mode, it accepts and executes its associated commands. See USAGE. If it is invoked with arguments, it performs an open command with those arguments.

If, for example, a host is specified as @hop1@hop2@host, the connection goes through hosts hop1 and hop2, using loose source routing to end at host. If a leading ! is used, the connection follows strict source routing. Notice that when telnet uses IPv6, it can only use loose source routing, and the connection ignores the !.

Once a connection has been opened, telnet enters input mode. In this mode, text typed is sent to the remote host. The input mode entered will be either "line mode", "character at a time", or "old line by line", depending upon what the remote system supports.

In "line mode", character processing is done on the local system, under the control of the remote system. When input editing or character echoing is to be disabled, the remote system will relay that information. The remote system will also relay changes to any special characters that happen on the remote system, so that they can take effect on the local system.

In "character at a time" mode, most text typed is immediately sent to the remote host for processing.

In "old line by line" mode, all text is echoed locally, and (normally) only completed lines are sent to the remote host. The "local echo character" (initially ^E) may be used to turn off and on the local echo. (Use this mostly to enter passwords without the password being echoed.)

If the "line mode" option is enabled, or if the local chars toggle is TRUE (the default in "old line by line" mode), the user’s quit, intr, and flush characters are trapped locally, and sent as TELNET protocol sequences to the remote side. If "line mode" has ever been enabled, then the user's susp and eof are also sent as TELNET protocol sequences. quit is then sent as a TELNET ABORT instead of BREAK. The options toggle autoflush and toggle autosynch cause this action to flush subsequent output to the terminal (until the remote host acknowledges the TELNET sequence); and to flush previous terminal input, in the case of quit and intr.

While connected to a remote host, the user can enter telnet command mode by typing the telnet escape character (initially ^]). When in command mode, the normal terminal editing conventions are available. Pressing RETURN at the telnet command prompt causes telnet to exit command mode.
The following options are supported:

- **-8**
  Specifies an 8-bit data path. Negotiating the TELNET BINARY option is attempted for both input and output.

- **-a**
  Attempts automatic login. This sends the user name by means of the USER variable of the ENVIRON option, if supported by the remote system. The name used is that of the current user as returned by getlogin(3C) if it agrees with the current user ID. Otherwise, it is the name associated with the user ID.

- **-c**
  Disables the reading of the user's telnetrc file. (See the toggle skiprc command on this reference page.)

- **-d**
  Sets the initial value of the debug toggle to TRUE.

- **-e escape_char**
  Sets the initial escape character to escape_char. escape_char may also be a two character sequence consisting of ^ (Control key) followed by one character. If the second character is ?, the DEL character is selected. Otherwise, the second character is converted to a control character and used as the escape character. If escape_char is defined as the null string (that is, -e ’’), this is equivalent to -e ‘@’ (Control-@). To specify that no character can be the escape character, use the -E option.

- **-E**
  Stops any character from being recognized as an escape character.

- **-f**
  Forwards a copy of the local credentials to the remote system.

- **-F**
  Forwards a forwardable copy of the local credentials to the remote system.

- **-k realm**
  If Kerberos authentication is being used, requests that telnet obtain tickets for the remote host in realm instead of the remote host’s default realm as determined in krb5.conf(4).

- **-K**
  Specifies no automatic login to the remote system.

- **-l user**
  When connecting to a remote system that understands the ENVIRON option, then user will be sent to the remote system as the value for the ENVIRON variable USER.

- **-L**
  Specifies an 8-bit data path on output. This causes the BINARY option to be negotiated on output.
-n tracefile
   Opens tracefile for recording trace information. See the set tracefile command below.

-r
   Specifies a user interface similar to rlogin. In this mode, the escape character is set to the
tilde (~) character, unless modified by the -e option. The rlogin escape character is only
recognized when it is preceded by a carriage return. In this mode, the telnet escape
character, normally '\', must still precede a telnet command. The rlogin escape
character can also be followed by '\', '\r' or '\Z', and, like rlogin(1), closes or suspends
the connection, respectively. This option is an uncommitted interface and may change in the
future.

-x
   Turns on encryption of the data stream. When this option is turned on, telnet will exit
   with an error if authentication cannot be negotiated or if encryption cannot be turned on.

-X atype
   Disables the atype type of authentication.

Usage

telnet Commands
   The commands described in this section are available with telnet. It is necessary to type only
   enough of each command to uniquely identify it. (This is also true for arguments to the mode,
   set, toggle, unset, environ, and display commands.)

auth argument ...
   The auth command manipulates the information sent through the TELNET AUTHENTICATE
   option. Valid arguments for the auth command are as follows:

disable type
   Disables the specified type of authentication. To obtain a list of available types, use the
   auth disable ? command.

enable type
   Enables the specified type of authentication. To obtain a list of available types, use the
   auth enable ? command.

status
   Lists the current status of the various types of authentication.

open [-l user] [[!] @hop1 [@hop2 ...]@host [ port ]
   Open a connection to the named host. If no port number is specified, telnet will attempt
to contact a TELNET server at the default port. The host specification may be either a host
name (see hosts(4)) or an Internet address specified in the "dot notation" (see inet(7P) or
inet6(7P)). If the host is specified as @hop1@hop2@host, the connection goes through
hosts hop1 and hop2, using loose source routing to end at host. The @ symbol is required as
a separator between the hosts specified. If a leading ! is used with IPv4, the connection
follows strict source routing.
The -l option passes the user as the value of the ENVIRON variable USER to the remote system.

close
Close any open TELNET session. An EOF (in command mode) will also close a session and exit.

encrypt
The encrypt command manipulates the information sent through the TELNET ENCRYPT option.

Valid arguments for the encrypt command are as follows:

disable type [input|output]
Disables the specified type of encryption. If you omit the input and output, both input and output are disabled. To obtain a list of available types, use the encrypt disable ? command.

enable type [input|output]
Enables the specified type of encryption. If you omit input and output, both input and output are enabled. To obtain a list of available types, use the encrypt enable ? command.

input
This is the same as the encrypt start input command.

-input
This is the same as the encrypt stop input command.

output
This is the same as the encrypt start output command.

-output
This is the same as the encrypt stop output command.

start [input|output]
Attempts to start encryption. If you omit input and output, both input and output are enabled. To obtain a list of available types, use the encrypt enable ? command.

status
Lists the current status of encryption.

stop [input|output]
Stops encryption. If you omit input and output, encryption is on both input and output.

type type
Sets the default type of encryption to be used with later encrypt start or encrypt stop commands.

quit
Same as close.
Suspend telnet. This command only works when the user is using a shell that supports job control, such as sh(1).

mode type
The remote host is asked for permission to go into the requested mode. If the remote host is capable of entering that mode, the requested mode will be entered. The argument type is one of the following:

character
  Disable the TELNET LINEMODE option, or, if the remote side does not understand the LINEMODE option, then enter “character at a time” mode.

line
  Enable the TELNET LINEMODE option, or, if the remote side does not understand the LINEMODE option, then attempt to enter “old-line-by-line” mode.

isig (-isig)
  Attempt to enable (disable) the TRAPSIG mode of the LINEMODE option. This requires that the LINEMODE option be enabled.

edit (-edit)
  Attempt to enable (disable) the EDIT mode of the LINEMODE option. This requires that the LINEMODE option be enabled.

softtabs (-softtabs)
  Attempt to enable (disable) the SOFT TAB mode of the LINEMODE option. This requires that the LINEMODE option be enabled.

litecho (-litecho)
  Attempt to enable (disable) the LIT_ECHO mode of the LINEMODE option. This requires that the LINEMODE option be enabled.

?  Prints out help information for the mode command.

status
Show the current status of telnet. This includes the peer one is connected to, as well as the current mode.

display
  [argument ...] Display all, or some, of the set and toggle values (see toggle argument ...).

?  [command] Get help. With no arguments, telnet prints a help summary. If a command is specified, telnet will print the help information for just that command.

send argument ...
Send one or more special character sequences to the remote host. The following are the arguments that can be specified (more than one argument may be specified at a time):
escape
Send the current telnet escape character (initially ^]).

synch
Send the TELNET SYNCH sequence. This sequence discards all previously typed, but not yet read, input on the remote system. This sequence is sent as TCP urgent data and may not work if the remote system is a 4.2 BSD system. If it does not work, a lowercase “r” may be echoed on the terminal.

brk or break
Send the TELNET BRK (Break) sequence, which may have significance to the remote system.

ip
Send the TELNET IP (Interrupt Process) sequence, which aborts the currently running process on the remote system.

abort
Send the TELNET ABORT (Abort Process) sequence.

ao
Send the TELNET AO (Abort Output) sequence, which flushes all output from the remote system to the user’s terminal.

ayt
Send the TELNET AYT (Are You There) sequence, to which the remote system may or may not respond.

ec
Send the TELNET EC (Erase Character) sequence, which erases the last character entered.

e1
Send the TELNET EL (Erase Line) sequence, which should cause the remote system to erase the line currently being entered.

eof
Send the TELNET EOF (End Of File) sequence.

eor
Send the TELNET EOR (End Of Record) sequence.

ga
Send the TELNET GA (Go Ahead) sequence, which probably has no significance for the remote system.

getstatus
If the remote side supports the TELNET STATUS command, getstatus will send the subnegotiation to request that the server send its current option status.

nop
Send the TELNET NOP (No Operation) sequence.
susp
   Send the TELNET SUSP (Suspend Process) sequence.

do option
dont option
will option
wont option
   Send the TELNET protocol option negotiation indicated. Option may be the text name of
   the protocol option, or the number corresponding to the option. The command will be
   silently ignored if the option negotiation indicated is not valid in the current state. If the
   option is given as help or ?, the list of option names known is listed. This command is
   mostly useful for unusual debugging situations.

?  Print out help information for the send command.

set argument [value]
unset argument
   Set any one of a number of telnet variables to a specific value. The special value off turns
   off the function associated with the variable. The values of variables may be interrogated
   with the display command. If value is omitted, the value is taken to be true, or “on”. If the
   unset form is used, the value is taken to be false, or off. The variables that may be specified
   are:

   echo
      This is the value (initially ^E) that, when in “line by line” mode, toggles between local
      echoing of entered characters for normal processing, and suppressing echoing of
      entered characters, for example, entering a password.

   escape
      This is the telnet escape character (initially ^]) that enters telnet command mode
      when connected to a remote system.

   interrupt
      If telnet is in localchars mode (see toggle, localchars) and the interrupt
      character is typed, a TELNET IP sequence (see send and ip) is sent to the remote host.
      The initial value for the interrupt character is taken to be the terminal’s intr character.

   quit
      If telnet is in localchars mode and the quit character is typed, a TELNET BRK
      sequence (see send, brk) is sent to the remote host. The initial value for the quit
      character is taken to be the terminal’s quit character.

   flushoutput
      If telnet is in localchars mode and the flushoutput character is typed, a TELNET AO
      sequence (see send, ao) is sent to the remote host. The initial value for the flush
      character is taken to be the terminal’s flush character.
erase
If telnet is in localchars mode and operating in "character at a time" mode, then when the erase character is typed, a TELNET EC sequence (see send, ec) is sent to the remote system. The initial value for the erase character is taken to be the terminal's erase character.

kill
If telnet is in localchars mode and operating in "character at a time" mode, then when the kill character is typed, a TELNET EL sequence (see send, el) is sent to the remote system. The initial value for the kill character is taken to be the terminal's kill character.

eof
If telnet is operating in "line by line" mode, entering the eof character as the first character on a line sends this character to the remote system. The initial value of eof is taken to be the terminal's eof character.

ayt
If telnet is in localchars mode, or LINEMODE is enabled, and the status character is typed, a TELNET AYT ("Are You There") sequence is sent to the remote host. (See send, ayt above.) The initial value for ayt is the terminal's status character.

forw1
forw2
If telnet is operating in LINEMODE, and the forw1 or forw2 characters are typed, this causes the forwarding of partial lines to the remote system. The initial values for the forwarding characters come from the terminal's eol and eol2 characters.

lnext
If telnet is operating in LINEMODE or "old line by line" mode, then the lnext character is assumed to be the terminal's lnext character. The initial value for the lnext character is taken to be the terminal's lnext character.

reprint
If telnet is operating in LINEMODE or "old line by line" mode, then the reprint character is assumed to be the terminal's reprint character. The initial value for reprint is taken to be the terminal's reprint character.

rlogin
This is the rlogin escape character. If set, the normal telnet escape character is ignored, unless it is preceded by this character at the beginning of a line. The rlogin character, at the beginning of a line followed by a "^Z" closes the connection. When followed by a "^Z", the rlogin command suspends the telnet command. The initial state is to disable the rlogin escape character.

start
If the TELNET TOGGLE-FLOW-CONTROL option has been enabled, then the start character is taken to be the terminal's start character. The initial value for the kill character is taken to be the terminal's start character.
stop
  If the TELNET TOGGLE-FLow-CONTROL option has been enabled, then the stop character is taken to be the terminal’s stop character. The initial value for the kill character is taken to be the terminal’s stop character.

susp
  If telnet is in localchars mode, or LINEMODE is enabled, and the suspend character is typed, a TELNET SUSP sequence (see send, susp above) is sent to the remote host. The initial value for the suspend character is taken to be the terminal’s suspend character.

tracefile
  This is the file to which the output, generated when the netdata or the debug option is TRUE, will be written. If tracefile is set to “-”, then tracing information will be written to standard output (the default).

worderase
  If telnet is operating in LINEMODE or “old line by line” mode, then this character is taken to be the terminal’s worderase character. The initial value for the worderase character is taken to be the terminal’s worderase character.

?
  Displays the legal set and unset commands.

slc state
  The slc (Set Local Characters) command is used to set or change the state of special characters when the TELNET LINEMODE option has been enabled. Special characters are characters that get mapped to TELNET commands sequences (like ip or quit) or line editing characters (like erase and kill). By default, the local special characters are exported. The following values for state are valid:

check
  Verifies the settings for the current special characters. The remote side is requested to send all the current special character settings. If there are any discrepancies with the local side, the local settings will switch to the remote values.

export
  Switches to the local defaults for the special characters. The local default characters are those of the local terminal at the time when telnet was started.

import
  Switches to the remote defaults for the special characters. The remote default characters are those of the remote system at the time when the TELNET connection was established.

?  Prints out help information for the slc command.

toggle argument...
  Toggle between TRUE and FALSE the various flags that control how telnet responds to events. More than one argument may be specified. The state of these flags may be interrogated with the display command. Valid arguments are:
<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>authdebug</td>
<td>Turns on debugging information for the authentication code.</td>
</tr>
<tr>
<td>autodecrypt</td>
<td>When the TELNET ENCRYPT option is negotiated, by default the actual encryption (decryption) of the data stream does not start automatically. The autoencrypt (autodecrypt) command states that encryption of the output (input) stream should be enabled as soon as possible.</td>
</tr>
<tr>
<td>autologin</td>
<td>If the remote side supports the TELNET AUTHENTICATION option, telnet attempts to use it to perform automatic authentication. If the AUTHENTICATION option is not supported, the user's login name is propagated through the TELNET ENVIRON option. This command is the same as specifying the -a option on the open command.</td>
</tr>
<tr>
<td>autoflush</td>
<td>If autoflush and localchars are both TRUE, then when the ao, intr, or quit characters are recognized (and transformed into TELNET sequences; see set for details), telnet refuses to display any data on the user's terminal until the remote system acknowledges (using a TELNET Timing Mark option) that it has processed those TELNET sequences. The initial value for this toggle is TRUE if the terminal user has not done an “stty nofish”. Otherwise, the value is FALSE (see stty(1)).</td>
</tr>
<tr>
<td>autosynch</td>
<td>If autosynch and localchars are both TRUE, then when either the interrupt or quit characters are typed (see set for descriptions of interrupt and quit), the resulting TELNET sequence sent is followed by the TELNET SYNCH sequence. This procedure should cause the remote system to begin throwing away all previously typed input until both of the TELNET sequences have been read and acted upon. The initial value of this toggle is FALSE.</td>
</tr>
<tr>
<td>binary</td>
<td>Enable or disable the TELNET BINARY option on both input and output.</td>
</tr>
<tr>
<td>inbinary</td>
<td>Enable or disable the TELNET BINARY option on input.</td>
</tr>
<tr>
<td>outbinary</td>
<td>Enable or disable the TELNET BINARY option on output.</td>
</tr>
<tr>
<td>crlf</td>
<td>Determines how carriage returns are sent. If the value is TRUE, then carriage returns will be sent as &lt;CR&gt;&lt;LF&gt;. If the value is FALSE, then carriage returns will be sent as &lt;CR&gt;&lt;NUL&gt;. The initial value for this toggle is FALSE.</td>
</tr>
<tr>
<td>crmod</td>
<td>Toggle RETURN mode. When this mode is enabled, most RETURN characters received from the remote host will be mapped into a RETURN followed by a line feed. This mode does not affect those characters typed by the user, only those received from the remote host.</td>
</tr>
</tbody>
</table>
host. This mode is useful only for remote hosts that send RETURN but never send LINEFEED. The initial value for this toggle is FALSE.

debug

Toggle socket level debugging (only available to the super-user). The initial value for this toggle is FALSE.
encdebug

Turns on debugging information for the encryption code.

localchars

If this toggle is TRUE, then the flush, interrupt, quit, erase, and kill characters (see set) are recognized locally, and transformed into appropriate TELNET control sequences, respectively ao, ip, brk, ec, and el (see send). The initial value for this toggle is TRUE in "line by line" mode, and FALSE in "character at a time" mode. When the LINEMODE option is enabled, the value of localchars is ignored, and assumed always to be TRUE. If LINEMODE has ever been enabled, then quit is sent as abort, and eof and suspend are sent as eof and susp (see send above).

netdata

Toggle the display of all network data (in hexadecimal format). The initial value for this toggle is FALSE.

options

Toggle the display of some internal TELNET protocol processing (having to do with telnet options). The initial value for this toggle is FALSE.

prettydump

When the netdata toggle is enabled, if prettydump is enabled, the output from the netdata command will be formatted in a more user readable format. Spaces are put between each character in the output. The beginning of any TELNET escape sequence is preceded by an asterisk (*) to aid in locating them.

skiprc

When the skiprc toggle is TRUE, TELNET skips the reading of the .telnetrc file in the user's home directory when connections are opened. The initial value for this toggle is FALSE.

termdata

Toggles the display of all terminal data (in hexadecimal format). The initial value for this toggle is FALSE.

verbose_encrypt

When the verbose_encrypt flag is TRUE, TELNET prints out a message each time encryption is enabled or disabled. The initial value for this toggle is FALSE.

? Display the legal toggle commands.

environ command... The environ command is used to manipulate variables that may be sent through the TELNET ENVIRON option. The initial set of variables is taken from the users environment. Only the DISPLAY and PRINTER variables are exported by default. Valid arguments for the environ command are:
define variable value
   Define variable to have a value of value. Any variables defined by this command are automatically exported. The value may be enclosed in single or double quotes, so that tabs and spaces may be included.

undefine variable
   Remove variable from the list of environment variables.

export variable
   Mark the variable to be exported to the remote side.

unexport variable
   Mark the variable to not be exported unless explicitly requested by the remote side.

list
   List the current set of environment variables. Those marked with an asterisk (*) will be sent automatically. Other variables will be sent only if explicitly requested.

? 
   Prints out help information for the environ command.

logout
   Sends the telnet logout option to the remote side. This command is similar to a close command. However, if the remote side does not support the logout option, nothing happens. If, however, the remote side does support the logout option, this command should cause the remote side to close the TELNET connection. If the remote side also supports the concept of suspending a user’s session for later reattachment, the logout argument indicates that the remote side should terminate the session immediately.

Files
   $HOME/.telnetrc file that contains commands to be executed before initiating a telnet session

Attributes
   See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>network/telnet</td>
</tr>
</tbody>
</table>

See Also
   rlogin(1), sh(1), stty(1), getlogin(3C), hosts(4), krb5.conf(4), nologin(4), telnetrc(4), attributes(5), inet(7P), inet6(7P)

Diagnostics
   NO LOGINS: System going down in N minutes
   The machine is in the process of being shut down and logins have been disabled.

Notes
   On some remote systems, echo has to be turned off manually when in “line by line” mode.
   In “old line by line” mode, or LINEMODE, the terminal’s EOF character is only recognized (and sent to the remote system) when it is the first character on a line.
The telnet protocol only uses single DES for session protection—clients request service tickets with single DES session keys. The KDC must know that host service principals that offer the telnet service support single DES, which, in practice, means that such principals must have single DES keys in the KDC database.
The test utility evaluates the condition and indicates the result of the evaluation by its exit status. An exit status of zero indicates that the condition evaluated as true and an exit status of 1 indicates that the condition evaluated as false.

In the first form of the utility shown using the SYNOPSIS:
```
  test [condition]
```
the square brackets denote that condition is an optional operand and are not to be entered on the command line.

In the second form of the utility shown using the SYNOPSIS:
```
  [ [ condition ] ]
```
the first open square bracket, [, is the required utility name. condition is optional, as denoted by the inner pair of square brackets. The final close square bracket, ], is a required operand.

See largefile(5) for the description of the behavior of test when encountering files greater than or equal to 2 Gbyte ($2^{31}$ bytes).

The test and [ utilities evaluate the condition condition and, if its value is true, set exit status to 0. Otherwise, a non-zero (false) exit status is set. test and [ also set a non-zero exit status if there are no arguments. When permissions are tested, the effective user ID of the process is used.

All operators, flags, and brackets (brackets used as shown in the last SYNOPSIS line) must be separate arguments to these commands. Normally these arguments are separated by spaces.
Operands

The primaries listed below with two elements of the form:

- primary_operator primary_operand

are known as unary primaries. The primaries with three elements in either of the two forms:

primary_operand primary_operator primary_operand
primary_operand primary_operand primary_operator

are known as binary primaries.

If any file operands except for -h and -L primaries refer to symbolic links, the symbolic link is expanded and the test is performed on the resulting file.

If you test a file you own (the -r -w or -x tests), but the permission tested does not have the owner bit set, a non-zero (false) exit status is returned even though the file can have the group or other bit set for that permission.

The = and != primaries have a higher precedence than the unary primaries. The = and != primaries always expect arguments; therefore, = and != cannot be used as an argument to the unary primaries.

The following primaries can be used to construct condition:

-a file True if file exists. (Not available in sh.)
-b file True if file exists and is a block special file.
-c file True if file exists and is a character special file.
-d file True if file exists and is a directory.
-e file True if file exists. (Not available in sh.)
-f file True if file exists and is a regular file. Alternatively, if
/usr/bin/sh users specify /usr/ucb before /usr/bin in their
PATH environment variable, then test returns true if file exists
and is (not—a—directory). The csh test and ] built-ins always
use this alternative behavior.
-g file True if file exists and its set group ID flag is set.
-G file True if file exists and its group matches the effective group ID of
this process. (Not available in sh.)
-h file True if file exists and is a symbolic link.
-k file True if file exists and has its sticky bit set.
-L file True if file exists and is a symbolic link.
-n string True if the length of string is non-zero.
<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>o option</code></td>
<td>True if option named option is on. This option is not available in csh or sh.</td>
</tr>
<tr>
<td><code>-0 file</code></td>
<td>True if file exists and is owned by the effective user ID of this process. This option is not available in sh.</td>
</tr>
<tr>
<td><code>-p file</code></td>
<td>True if file is a named pipe (FIFO).</td>
</tr>
<tr>
<td><code>-r file</code></td>
<td>True if file exists and is readable.</td>
</tr>
<tr>
<td><code>-s file</code></td>
<td>True if file exists and has a size greater than zero.</td>
</tr>
<tr>
<td><code>-S file</code></td>
<td>True if file exists and is a socket. This option is not available in sh.</td>
</tr>
<tr>
<td><code>-t [file_descriptor]</code></td>
<td>True if the file whose file descriptor number is file_descriptor is open and is associated with a terminal. If file_descriptor is not specified, 1 is used as a default value.</td>
</tr>
<tr>
<td><code>-u file</code></td>
<td>True if file exists and its set-user-ID flag is set.</td>
</tr>
<tr>
<td><code>-w file</code></td>
<td>True if file exists and is writable. True indicates only that the write flag is on. The file is not writable on a read-only file system even if this test indicates true.</td>
</tr>
<tr>
<td><code>-x file</code></td>
<td>True if file exists and is executable. True indicates only that the execute flag is on. If file is a directory, true indicates that file can be searched.</td>
</tr>
<tr>
<td><code>-z string</code></td>
<td>True if the length of string string is zero.</td>
</tr>
<tr>
<td><code>file1 -nt file2</code></td>
<td>True if file1 exists and is newer than file2. This option is not available in sh.</td>
</tr>
<tr>
<td><code>file1 -ot file2</code></td>
<td>True if file1 exists and is older than file2. This option is not available in sh.</td>
</tr>
<tr>
<td><code>file1 -ef file2</code></td>
<td>True if file1 and file2 exist and refer to the same file. This option is not available in sh.</td>
</tr>
<tr>
<td><code>string</code></td>
<td>True if the string string is not the null string.</td>
</tr>
<tr>
<td><code>string1 = string2</code></td>
<td>True if the strings string1 and string2 are identical.</td>
</tr>
<tr>
<td><code>string1 != string2</code></td>
<td>True if the strings string1 and string2 are not identical.</td>
</tr>
<tr>
<td><code>n1 -eq n2</code></td>
<td>True if the numbers n1 and n2 are algebraically equal. A number may be integer, floating point or floating-point constant (such as [+/-]Inf, [+/-]NaN) in any format specified by C99/XPG6/SUS.</td>
</tr>
</tbody>
</table>
n1 - ne n2  True if the numbers n1 and n2 are not algebraically equal. A number may be integer, floating point or floating-point constant (such as +/-Inf, +/-NaN) in any format specified by C99/XPG6/SUS.

n1 - gt n2  True if the number n1 is algebraically greater than the number n2. A number may be integer, floating point or floating-point constant (such as +/-Inf, +/-NaN) in any format specified by C99/XPG6/SUS.

n1 - ge n2  True if the number n1 is algebraically greater than or equal to the number n2. A number may be integer, floating point or floating-point constant (such as +/-Inf, +/-NaN) in any format specified by C99/XPG6/SUS.

n1 - lt n2  True if the number n1 is algebraically less than the number n2. A number may be integer, floating point or floating-point constant (such as +/-Inf, +/-NaN) in any format specified by C99/XPG6/SUS.

n1 - le n2  True if the number n1 is algebraically less than or equal to the number n2. A number may be integer, floating point or floating-point constant (such as +/-Inf, +/-NaN) in any format specified by C99/XPG6/SUS.

condition1 - a condition2  True if both condition1 and condition2 are true. The -a binary primary is left associative and has higher precedence than the -o binary primary.

condition1 - o condition2  True if either condition1 or condition2 is true. The -o binary primary is left associative.

These primaries can be combined with the following operators:

! condition  True if condition is false.

( condition )  True if condition is true. The parentheses ( ) can be used to alter the normal precedence and associativity. The parentheses are meaningful to the shell and, therefore, must be quoted.

The algorithm for determining the precedence of the operators and the return value that is generated is based on the number of arguments presented to test. (However, when using the [ . . . ] form, the right-bracket final argument is not counted in this algorithm.)

In the following list, $1$, $2$, $3$ and $4$ represent the arguments presented to test as a condition, condition1, or condition2.

0 arguments:  Exit false (1).
1 argument: Exit true (0) if $1 is not null. Otherwise, exit false.

2 arguments:
- If $1 is !, exit true if $2 is null, false if $2 is not null.
- If $1 is a unary primary, exit true if the unary test is true, false if the unary test is false.
- Otherwise, produce unspecified results.

3 arguments:
- If $2 is a binary primary, perform the binary test of $1 and $3.
- If $1 is !, negate the two-argument test of $2 and $3.
- Otherwise, produce unspecified results.

4 arguments:
- If $1 is !, negate the three-argument test of $2, $3, and $4.
- Otherwise, the results are unspecified.

Usage Scripts should be careful when dealing with user-supplied input that could be confused with primaries and operators. Unless the application writer knows all the cases that produce input to the script, invocations like `test "$1" -a "$2"` should be written as `test "$1" && test "$2"` to avoid problems if a user supplied values such as $1 set to ! and $2 set to the null string. That is, in cases where maximal portability is of concern, replace `test expr1 -a expr2` with `test expr1 && test expr2`, and replace `test expr1 -o expr2` with `test expr1 || test expr2`. But notice that, in `test`, -a has *higher* precedence than -o, while && and || have *equal* precedence in the shell.

Parentheses or braces can be used in the shell command language to effect grouping.

Parentheses must be escaped when using sh. For example:

```
test \( expr1 -a expr2 \) -o expr3
```

This command is not always portable outside XSI-conformant systems. The following form can be used instead:

```
( test expr1 && test expr2 ) || test expr3
```

The two commands:

```
test "$1"
test ! "$1"
```

could not be used reliably on some historical systems. Unexpected results would occur if such a *string* condition were used and $1 expanded to !, (, or a known unary primary. Better constructs are, respectively,
Historical systems have also been unreliable given the common construct:

```
test "$response" = "expected string"
```

One of the following is a more reliable form:

```
test "X$response" = "Xexpected string"
test "expected string" = "$response"
```

The second form assumes that `expected string` could not be confused with any unary primary. If `expected string` starts with −, (, ! or even =, the first form should be used instead. Using the preceding rules without the marked extensions, any of the three comparison forms is reliable, given any input. (However, observe that the strings are quoted in all cases.)

Because the string comparison binary primaries, = and ! =, have a higher precedence than any unary primary in the >4 argument case, unexpected results can occur if arguments are not properly prepared. For example, in

```
test -d $1 -o -d $2
```

If `$1` evaluates to a possible directory name of =, the first three arguments are considered a string comparison, which causes a syntax error when the second `-d` is encountered. is encountered. One of the following forms prevents this; the second is preferred:

```
test \( -d "$1" \\) -o \( -d "$2" \\)
test -d "$1" || test -d "$2"
```

Also in the >4 argument case:

```
test "$1" = "bat" -a "$2" = "ball"
```

Syntax errors occur if `$1` evaluates to ( or !. One of the following forms prevents this; the third is preferred:

```
test "X$1" = "Xbat" -a "X$2" = "Xball"
test "$1" = "bat" && test "$2" = "ball"
test "X$1" = "Xbat" && test "X$2" = "Xball"
```

**Examples**

In the `if` command examples, three conditions are tested, and if all three evaluate as true or successful, then their validities are written to the screen. The three tests are:

- if a variable set to 1 is greater than 0,
- if a variable set to 2 is equal to 2, and
- if the word `root` is included in the text file `/etc/passwd`. 

```
EXAMPLE 1  Using /usr/bin/test

Perform a mkdir if a directory does not exist:

test ! -d tempdir & & mkdir tempdir

Wait for a file to become non-readable:

while test -r thefile
do
  sleep 30
done

echo "thefile is no longer readable"'

Perform a command if the argument is one of three strings (two variations), using the open bracket version \ of the test command:

if [ "$1" = "pear" ] || [ "$1" = "grape" ] || [ "$1" = "apple" ]
then
  command
fi

Case "$1" in
  pear|grape|apple) command;; esac

EXAMPLE 2  Using /usr/bin/test for the -e option

If one really wants to use the -e option in sh, use /usr/bin/test, as in the following:

if [ ! -h $PKG_INSTALL_ROOT$rLink ] & & /usr/bin/test -e $PKG_INSTALL_ROOT/usr/bin/$rFile ; then
  ln -s $rFile $PKG_INSTALL_ROOT$rLink
fi

The two forms of the test built-in follow the Bourne shell’s if example.

EXAMPLE 3  Using the sh built-in

ZERO=0  ONE=1  TWO=2  ROOT=root

if [ $ONE -gt $ZERO ]

[ $TWO -eq 2 ]

grep $ROOT /etc/passwd >&1 > /dev/null  # discard output

then

  echo "$ONE is greater than 0, $TWO equals 2, and $ROOT is":
  "a user-name in the password file"
EXAMPLE 3  Using the sh built-in  (Continued)

    else

        echo "At least one of the three test conditions is false"
    fi

EXAMPLE 4  Using the test built-in

Examples of the test built-in:

test ` grep $ROOT /etc/passwd >&1 /dev/null`l # discard output

    echo $?  # test for success
    [ ` grep nosuchname /etc/passwd >&1 /dev/null ` ]

    echo $?  # test for failure

EXAMPLE 5  Using the csh built-in

@c ZERO = 0; @ ONE = 1; @ TWO = 2; set ROOT = root
grep $ROOT /etc/passwd >&1 /dev/null  # discard output
# $status must be tested for immediately following grep
if ( "$status" == "0" && $ONE > $ZERO && $TWO == 2 ) then
    echo "$ONE is greater than 0, $TWO equals 2, and $ROOT is" \
        "a user-name in the password file"
endif

EXAMPLE 6  Using the ksh88/ksh built-in

ZERO=0 ONE=1 TWO=$((ONE+ONE)) ROOT=root
if ((ONE > ZERO))  # arithmetical comparison
    [[ $TWO == 2 ]]
    # string comparison
    [ ` grep $ROOT /etc/passwd >&1 /dev/null`l ] # discard output
then
    echo "$ONE is greater than 0, $TWO equals 2, and $ROOT is" \
        "a user-name in the password file"
else
    echo "At least one of the three test conditions is false"
fi

Environment Variables  See environ(5) for descriptions of the following environment variables that affect the execution of test: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status  The following exit values are returned:

0  condition evaluated to true.
1  condition evaluated to false or condition was missing.
An error occurred.

Attributes

See attributes(5) for descriptions of the following attributes:

```
/usr/bin/test, csh, ksh88, sh
```

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

```
ksh
```

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Uncommitted</td>
</tr>
</tbody>
</table>

See Also

csh(1), ksh(1), ksh88(1), sh(1), test(1B), attributes(5), environ(5), largefile(5), standards(5)

Notes

The not-a-directory alternative to the -f option is a transition aid for BSD applications and may not be supported in future releases.

Use arithmetic expressions such as

```
$(( x > 3.1 )) #
```

instead of

```
$ /usr/bin/test "$x" -gt 3.1 #
```

when comparing two floating-point variables or a constant and a floating-point variable to prevent rounding errors (caused by the base16 to base10 transformation) to affect the result. Additionally the built-in arithmetic support in XPG4 sh, ksh88 and ksh is significantly faster because it does not require the explicit transformation to strings for each comparison.
Name  test – condition evaluation command

Synopsis  /usr/ucb/test expression

Description  test evaluates the expression expression and, if its value is true, sets 0 (true) exit status;
 otherwise, a non-zero (false) exit status is set. test also sets a non-zero exit status if there are
no arguments. When permissions are tested, the effective user ID of the process is used.

All operators, flags, and brackets (brackets used as shown in the second SYNOPSIS line) must
be separate arguments to the test command; normally these items are separated by spaces.

Usage

Primitives  The following primitives are used to construct expression:

- r filename  True if filename exists and is readable.
- w filename  True if filename exists and is writable.
- x filename  True if filename exists and is executable.
- f filename  True if filename exists and is a regular file. Alternatively, if /usr/bin/sh users
  specify /usr/ucb before /usr/bin in their PATH environment variable, then
  test will return true if filename exists and is (not a directory). This is also
  the default for /usr/bin/csh users.
- d filename  True if filename exists and is a directory.
- c filename  True if filename exists and is a character special file.
- b filename  True if filename exists and is a block special file.
- p filename  True if filename exists and is a named pipe (fifo).
- u filename  True if filename exists and its set-user-ID bit is set.
- g filename  True if filename exists and its set-group-ID bit is set.
- k filename  True if filename exists and its sticky bit is set.
- s filename  True if filename exists and has a size greater than zero.
- t [fildes ]  True if the open file whose file descriptor number is fildes (1 by default) is
  associated with a terminal device.
- z s1  True if the length of string s1 is zero.
- n s1  True if the length of the string s1 is non-zero.
- s1 = s2  True if strings s1 and s2 are identical.
- s1 != s2  True if strings s1 and s2 are not identical.
s1    True if s1 is not the null string.

n1 −eq n2    True if the integers n1 and n2 are algebraically equal. Any of the comparisons −ne, −gt, −ge, −lt, and −le may be used in place of −eq.

Operators    These primaries may be combined with the following operators:

!    Unary negation operator.
−a    Binary and operator.
−o    Binary or operator (−a has higher precedence than −o).
(expression)    Parentheses for grouping. Notice also that parentheses are meaningful to the shell and, therefore, must be quoted.

Attributes    See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>

See Also    find(1), sh(1), attributes(5)

Notes    The not−a−directory alternative to the −f option is a transition aid for BSD applications and may not be supported in future releases.

If you test a file you own (the −r, −w, or −x tests), but the permission tested does not have the owner bit set, a non-zero (false) exit status will be returned even though the file may have the group or other bit set for that permission. The correct exit status will be set if you are super-user.

The = and != operators have a higher precedence than the −r through −n operators, and = and != always expect arguments; therefore, = and != cannot be used with the −r through −n operators.

If more than one argument follows the −r through −n operators, only the first argument is examined; the others are ignored, unless a −a or a −o is the second argument.
**Name**
tftp – trivial file transfer program

**Synopsis**
tftp [host [port]]

**Description**
tftp is the user interface to the Internet TFTP (Trivial File Transfer Protocol), which allows users to transfer files to and from a remote machine. The remote host and optional port may be specified on the command line, in which case tftp uses host as the default host, and if specified, port as the default port, for future transfers. See the connect command below.

**Usage**
Once tftp is running, it issues the prompt tftp> and recognizes the following commands:

- **connect host-name [port]**
  - Set the host, and optionally port, for transfers. The TFTP protocol, unlike the FTP protocol, does not maintain connections between transfers; thus, the connect command does not actually create a connection, but merely remembers what host is to be used for transfers. You do not have to use the connect command; the remote host can be specified as part of the get or put commands.

- **mode transfer-mode**
  - Set the mode for transfers; transfer-mode may be one of ascii or binary. The default is ascii.

- **put filename**
- **put localfile remotefile**
- **put filename1 filename2 ... filenameN remote-directory**
  - Transfer a file, or a set of files, to the specified remote file or directory. The destination can be in one of two forms: a filename on the remote host if the host has already been specified, or a string of the form:

  - **host:filename**
    - to specify both a host and filename at the same time. If the latter form is used, the specified host becomes the default for future transfers. If the remote-directory form is used, the remote host is assumed to be running the UNIX system.

  The host can be a host name (see hosts(4)) or an IPv4 or IPv6 address string (see inet(7P) or inet6(7P)). Since IPv6 addresses already contain “:”s, the host should be enclosed in square brackets when an IPv6 address is used. Otherwise, the first occurrence of a colon will be interpreted as the separator between the host and the filename. For example,

  ```
  [1080::8:800:200c:417A]:myfile
  ```

  Files may be written only if they already exist and are publicly writable. See *in.tftpd*(1M).

- **get filename**
- **get remotename localname**
- **get filename1 filename2 filename3 ... filenameN**
  - Get a file or set of files (three or more) from the specified remote sources. source can be in one of two forms: a filename on the remote host if the host has already been specified, or a string of the form:
host:filename

to specify both a host and filename at the same time. If the latter form is used, the last host specified becomes the default for future transfers. See the put command regarding specifying a host.

quit

Exit tftp. An EOF also exits.

verbose

Toggle verbose mode.

trace

Toggle packet tracing.

status

Show current status.

rexmt retransmission-timeout

Set the per-packet retransmission timeout, in seconds.

timeout total-transmission-timeout

Set the total transmission timeout, in seconds.

ascii

Shorthand for mode ascii.

binary

Shorthand for mode binary.

blksize transfer-blocksize

The value of the transfer blocksize option to negotiate with the server. A value of 0 disables the negotiation of this option.

srexmt server-retransmission-timeout

The value of the retransmission timeout option to request that the server uses. A value of 0 disables the negotiation of this option.

tsize

A toggle that sends the transfer size option to the server. By default, the option is not sent. The transfer size option is not sent with a write request when the transfer-mode is ascii.

? [ command-name . . ]

Print help information.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/tftp</td>
</tr>
</tbody>
</table>
See Also in.tftpd(1M), hosts(4), attributes(5), inet(7P), inet6(7P)

Malkin, G. and Harkin, A. RFC 2348, TFTPBlockSize Option. The Internet Society. May 1998
Malkin, G. and Harkin, A. RFC 2349, TFTP Timeout Interval and Transfer Size Options. The Internet Society. May 1998

Notes The default transfer-mode is ascii. This differs from pre-SunOS 4.0 and pre-4.3BSD systems, so explicit action must be taken when transferring non-ASCII binary files such as executable commands.

Because there is no user-login or validation within the TFTP protocol, many remote sites restrict file access in various ways. Approved methods for file access are specific to each site, and therefore cannot be documented here.

When using the get command to transfer multiple files from a remote host, three or more files must be specified. If two files are specified, the second file is used as a local file.

With the default block size of 512 octets and a 16-bit block counter, some TFTP implementations might have problems with files over 33,553,919 octets (513 octets short of 32MB) in size. The Solaris implementation can transfer files up to 4GB in size.

By default, the Solaris TFTP client does not enable the blocksize or transfer size options. Setting the blocksize option to a higher value is sometimes useful as a workaround when dealing with peers that have a 32MB limit.
The `time` utility invokes `utility` operand with `argument`, and writes a message to standard error that lists timing statistics for `utility`. The message includes the following information:

- The elapsed (real) time between invocation of `utility` and its termination.
- The User CPU time, equivalent to the sum of the `tms_utime` and `tms_cutime` fields returned by the `times(2)` function for the process in which `utility` is executed.
- The System CPU time, equivalent to the sum of the `tms_stime` and `tms_cstime` fields returned by the `times()` function for the process in which `utility` is executed.

When `time` is used as part of a pipeline, the times reported are unspecified, except when it is the sole command within a grouping command in that pipeline. For example, the commands on the left are unspecified; those on the right report on utilities `a` and `c`, respectively:

```
time a | b | c { time a } | b | c
```
```
a | b | time c  a | b | (time c)
```

**Options**

The following option is supported:

```
-p
```

Writes the timing output to standard error in the following format:

```
real %f\nuser %f\nsys %f\nn < real seconds>, <user seconds>, <system seconds>
```

**Operands**

The following operands are supported:

- `utility` The name of the utility that is to be invoked.
- `argument` Any string to be supplied as an argument when invoking `utility`.

**Usage**

The `time` utility returns exit status 127 if an error occurs so that applications can distinguish “failure to find a utility” from “invoked utility exited with an error indication.” The value 127 was chosen because it is not commonly used for other meanings. Most utilities use small values for “normal error conditions” and the values above 128 can be confused with termination due to receipt of a signal. The value 126 was chosen in a similar manner to indicate that the utility could be found, but not invoked.

**Examples**

**EXAMPLE 1**

Using the `time` command

It is frequently desirable to apply `time` to pipelines or lists of commands. This can be done by placing pipelines and command lists in a single file. This single file can then be invoked as a utility, and the `time` applies to everything in the file.

Alternatively, the following command can be used to apply `time` to a complex command:

```
example% time sh -c 'complex-command-line'
```
EXAMPLE 2 Using time in the csh shell

The following two examples show the differences between the csh version of time and the version in /usr/bin/time. These examples assume that csh is the shell in use.

element% time find / -name csh.1 -print
/usr/share/man/man1/csh.1
95.0u 692.0s 1:17:52 16% 0+0k 0+0io 0pf+0w

See csh(1) for an explanation of the format of time output.

element% /usr/bin/time find / -name csh.1 -print
/usr/share/man/man1/csh.1
real 1:23:31.5
user 1:33.2
sys 11:28.2

Environment Variables

See environ(5) for descriptions of the following environment variables that affect the execution of time: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, LC_NUMERIC, NLSPATH, and PATH.

Exit Status

If utility is invoked, the exit status of time will be the exit status of utility. Otherwise, the time utility will exit with one of the following values:

1–125 An error occurred in the time utility.
126 utility was found but could not be invoked.
127 utility could not be found.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also
csh(1), shell_builtins(1), timex(1), times(2), attributes(5), environ(5), standards(5)

Notes When the time command is run on a multiprocessor machine, the total of the values printed for user and sys can exceed real. This is because on a multiprocessor machine it is possible to divide the task between the various processors.

When the command being timed is interrupted, the timing values displayed may not always be accurate.
**Bugs**  Elapsed time is accurate to the second, while the CPU times are measured to the 100th second. Thus the sum of the CPU times can be up to a second larger than the elapsed time.
Name  times – shell built-in function to report time usages of the current shell

Synopsis

sh times
ksh times

Description

sh  Print the accumulated user and system times for processes run from the shell.

ksh  Print the accumulated user and system times for the shell and for processes run from the shell.

On this man page, ksh(1) commands that are preceded by one or two * (asterisks) are treated specially in the following ways:

1. Variable assignment lists preceding the command remain in effect when the command completes.
2. I/O redirections are processed after variable assignments.
3. Errors cause a script that contains them to abort.
4. Words, following a command preceded by ** that are in the format of a variable assignment, are expanded with the same rules as a variable assignment. This means that tilde substitution is performed after the = sign and word splitting and file name generation are not performed.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  ksh(1), sh(1), time(1), attributes(5)
Name  
timex – time a command; report process data and system activity

Synopsis  
timex [-o] [-p [-fhkmrt]] [-s] command

Description  
The given command is executed; the elapsed time, user time and system time spent in execution are reported in seconds. Optionally, process accounting data for the command and all its children can be listed or summarized, and total system activity during the execution interval can be reported.

The output of timex is written on standard error.

Options  
The following options are supported:

- **o**  Report the total number of blocks read or written and total characters transferred by command and all its children. This option works only if the process accounting software is installed.

- **p**  List process accounting records for command and all its children. This option works only if the process accounting software is installed. Suboptions f, h, k, m, r, and t modify the data items reported. The options are as follows:
  - **f**  Print the fork(2)/exec(2) flag and system exit status columns in the output.
  - **h**  Instead of mean memory size, show the fraction of total available CPU time consumed by the process during its execution. This “hog factor” is computed as (total CPU time)/(elapsed time).
  - **k**  Instead of memory size, show total kcore-minutes.
  - **m**  Show mean coresize (the default).
  - **r**  Show CPU factor (user time/(system-time + user-time)).
  - **t**  Show separate system and user CPU times. The number of blocks read or written and the number of characters transferred are always reported.

- **s**  Report total system activity (not just that due to command) that occurred during the execution interval of command. All the data items listed in sar(1) are reported.

Examples  
**EXAMPLE 1**  Examples of timex.

A simple example:

example% timex -ops sleep 60

A terminal session of arbitrary complexity can be measured by timing a sub-shell:

example% timex -opskmt sh

session commands

EOT
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/accounting/legacy-accounting</td>
</tr>
</tbody>
</table>

See Also  sar(1), time(1), exec(2), fork(2), times(2), attributes(5)

Notes  Process records associated with command are selected from the accounting file /var/adm/pacct by inference, since process genealogy is not available. Background processes having the same user ID, terminal ID, and execution time window will be spuriously included.
The tip utility establishes a full-duplex terminal connection to a remote host. Once the connection is established, a remote session using tip behaves like an interactive session on a local terminal.

The remote file contains entries describing remote systems and line speeds used by tip. Each host has a default baud rate for the connection, or you can specify a speed with the -speed-entry command line argument.

When phone-number is specified, tip looks for an entry in the remote file of the form:

    tip -speed-entry

When tip finds such an entry, it sets the connection speed accordingly. If it finds no such entry, tip interprets -speed-entry as if it were a system name, resulting in an error message.

If you omit -speed-entry, tip uses the tip0 entry to set a speed for the connection.

When device is specified, tip attempts to open that device, but will do so using the access privileges of the user, rather than tip's usual access privileges (setuid uucp). The user must have read/write access to the device. The tip utility interprets any character string beginning with the slash character (/) as a device name.

When establishing the connection, tip sends a connection message to the remote system. The default value for this message can be found in the remote file.

When tip attempts to connect to a remote system, it opens the associated device with an exclusive-open ioctl(2) call. Thus, only one user at a time may access a device. This is to prevent multiple processes from sampling the terminal line. In addition, tip honors the locking protocol used by uucp(1C).

When tip starts up, it reads commands from the file .tiprc in your home directory.

Options

- v  Display commands from the .tiprc file as they are executed.

Usage

Typed characters are normally transmitted directly to the remote machine, which does the echoing as well.

At any time that tip prompts for an argument (for example, during setup of a file transfer), the line typed may be edited with the standard erase and kill characters. A null line in response to a prompt, or an interrupt, aborts the dialogue and returns you to the remote machine.

Commands

A tilde (~) appearing as the first character of a line is an escape signal which directs tip to perform some special action. tip recognizes the following escape sequences:
<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>~D</code></td>
<td>Drop the connection and exit (you may still be logged in on the remote machine). Note: If you rlogin and then run <code>tip</code> on the remote host, you must type <code>~.</code> (tilde tilde dot) to end the <code>tip</code> session. If you type <code>~</code> (tilde dot), it terminates the rlogin.</td>
</tr>
<tr>
<td><code>~.</code></td>
<td>Escape to an interactive shell on the local machine. Exiting the shell returns you to <code>tip</code>.</td>
</tr>
<tr>
<td><code>~c [name]</code></td>
<td>Change directory to <code>name</code>. No argument implies change to your home directory.</td>
</tr>
<tr>
<td><code>~!</code></td>
<td>Copy file from local to remote.</td>
</tr>
<tr>
<td><code>~&lt;</code></td>
<td>Copy file from remote to local.</td>
</tr>
</tbody>
</table>
| `~p from [ to ]` | Send a file to a remote host running the UNIX system. When you use the put command, the remote system runs the command string `cat > to`
while `tip` sends it the `from` file. If the `to` file is not specified, the `from` file name is used. This command is actually a UNIX-system-specific version of the `'->'` command. |
| `~t from [ to ]` | Take a file from a remote host running the UNIX system. As in the put command the `to` file defaults to the `from` file name if it is not specified. The remote host executes the command string `cat from ; echo ^A` to send the file to `tip`. |
| `~|`      | Pipe the output from a remote command to a local process. The command string sent to the local system is processed by the shell. |
| `~C`     | Connect a program to the remote machine. The command string sent to the program is processed by the shell. The program inherits file descriptors 0 as remote line input, 1 as remote line output, and 2 as tty standard error. |
| `~$`     | Pipe the output from a local process to the remote host. The command string sent to the local system is processed by the shell. |
| `~#`     | Send a BREAK to the remote system. |
| `~s`     | Set a variable (see the discussion below). |
| `~^Z`    | Stop `tip`. Only available when run under a shell that supports job control, such as the C shell. |
~^Y Stop only the “local side” of t.i.p. Only available when run under a shell that supports job control, such as the C shell. The “remote side” of t.i.p, that is, the side that displays output from the remote host, is left running.

~? Get a summary of the tilde escapes.

Copying files requires some cooperation on the part of the remote host. When a -> or < escape is used to send a file, t.i.p prompts for a file name (to be transmitted or received) and a command to be sent to the remote system, in case the file is being transferred from the remote system. While t.i.p is transferring a file, the number of lines transferred will be continuously displayed on the screen. A file transfer may be aborted with an interrupt.

Auto-call Units t.i.p may be used to dial up remote systems using a number of auto-call unit’s (ACUs). When the remote system description contains the du capability, t.i.p uses the call-unit (cu), ACU type (at), and phone numbers (pn) supplied. Normally, t.i.p displays verbose messages as it dials.

Depending on the type of auto-dialer being used to establish a connection, the remote host may have garbage characters sent to it upon connection. The user should never assume that the first characters typed to the foreign host are the first ones presented to it. The recommended practice is to immediately type a kill character upon establishing a connection (most UNIX systems either support @ or Control-U as the initial kill character).

tip currently supports the Ventel MD-212+ modem and DC Hayes-compatible modems.

When tip initializes a Hayes-compatible modem for dialing, it sets up the modem to auto-answer. Normally, after the conversation is complete, t.i.p drops DTR, which causes the modem to "hang up."

Most modems can be configured so that when DTR drops, they re-initialize themselves to a preprogrammed state. This can be used to reset the modem and disable auto-answer, if desired.

Additionally, it is possible to start the phone number with a Hayes S command so that you can configure the modem before dialing. For example, to disable auto-answer, set up all the phone numbers in /etc/remote using something like pn=S0=0DT5551212. The S0=0 disables auto-answer.

Remote Host Description Descriptions of remote hosts are normally located in the system-wide file /etc/remote. However, a user may maintain personal description files (and phone numbers) by defining and exporting the REMOTE shell variable. The remote file must be readable by tip, but a secondary file describing phone numbers may be maintained readable only by the user. This secondary phone number file is /etc/phones, unless the shell variable PHONES is defined and exported. The phone number file contains lines of the form:

system-name phone-number
Each phone number found for a system is tried until either a connection is established, or an end of file is reached. Phone numbers are constructed from '0123456789-='*, where the '=' and '*' are used to indicate a second dial tone should be waited for (ACU dependent).

**tip Internal Variables**

*tip* maintains a set of variables which are used in normal operation. Some of these variables are read-only to normal users (root is allowed to change anything of interest). Variables may be displayed and set through the ~s escape. The syntax for variables is patterned after *vi*(1) and *mail*(1). Supplying *all* as an argument to the ~s escape displays all variables that the user can read. Alternatively, the user may request display of a particular variable by attaching a ? to the end. For example, '~s escape?' displays the current escape character.

Variables are numeric (num), string (str), character (char), or Boolean (bool) values. Boolean variables are set merely by specifying their name. They may be reset by prepending a ! to the name. Other variable types are set by appending an = and the value. The entire assignment must not have any blanks in it. A single set command may be used to interrogate as well as set a number of variables.

Variables may be initialized at run time by placing set commands (without the ~s prefix) in a .tiprc file in one's home directory. The -v option makes tip display the sets as they are made. Comments preceded by a # sign can appear in the .tiprc file.

Finally, the variable names must either be completely specified or an abbreviation may be given. The following list details those variables known to tip.

- **beautify** (bool) Discard unprintable characters when a session is being scripted; abbreviated be. If the nb capability is present, beautify is initially set to off. Otherwise, beautify is initially set to on.

- **baudrate** (num) The baud rate at which the connection was established; abbreviated ba. If a baud rate was specified on the command line, baudrate is initially set to the specified value. Or, if the br capability is present, baudrate is initially set to the value of that capability. Otherwise, baudrate is set to 300 baud. Once tip has been started, baudrate can only changed by the super-user.

- **dialtimeout** (num) When dialing a phone number, the time (in seconds) to wait for a connection to be established; abbreviated dial. dialtimeout is initially set to 60 seconds, and can only changed by the super-user.

- **disconnect** (str) The string to send to the remote host to disconnect from it; abbreviated di. If the di capability is present, disconnect is initially set to the value of that capability. Otherwise, disconnect is set to a null string ("").
<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>echocheck</td>
<td>(bool) Synchronize with the remote host during file transfer by waiting for the echo of the last character transmitted; abbreviated ec. If the ec capability is present, echocheck is initially set to on. Otherwise, echocheck is initially set to off.</td>
</tr>
<tr>
<td>eofread</td>
<td>(str) The set of characters which signify an end-of-transmission during a ~&lt; file transfer command; abbreviated eofr. If the ie capability is present, eofread is initially set to the value of that capability. Otherwise, eofread is set to a null string (&quot;&quot;).</td>
</tr>
<tr>
<td>eofwrite</td>
<td>(str) The string sent to indicate end-of-transmission during a -&gt; file transfer command; abbreviated eofw. If the oe capability is present, eofwrite is initially set to the value of that capability. Otherwise, eofwrite is set to a null string (&quot;&quot;).</td>
</tr>
<tr>
<td>eol</td>
<td>(str) The set of characters which indicate an end-of-line. tip will recognize escape characters only after an end-of-line. If the el capability is present, eol is initially set to the value of that capability. Otherwise, eol is set to a null string (&quot;&quot;).</td>
</tr>
<tr>
<td>escape</td>
<td>(char) The command prefix (escape) character; abbreviated es. If the es capability is present, escape is initially set to the value of that capability. Otherwise, escape is set to ' ~ '.</td>
</tr>
<tr>
<td>etimeout</td>
<td>(num) The amount of time, in seconds, that tip should wait for the echo-check response when echocheck is set; abbreviated et. If the et capability is present, etimeout is initially set to the value of that capability. Otherwise, etimeout is set to 10 seconds.</td>
</tr>
<tr>
<td>exceptions</td>
<td>(str) The set of characters which should not be discarded due to the beautification switch; abbreviated ex. If the ex capability is present, exceptions is initially set to the value of that capability. Otherwise, exceptions is set to '\t\n\f\b'.</td>
</tr>
<tr>
<td>force</td>
<td>(char) The character used to force literal data transmission; abbreviated fo. If the fo capability is present, force is initially set to the value of that capability. Otherwise, force is set to \377 (which disables it).</td>
</tr>
<tr>
<td>framesize</td>
<td>(num) The amount of data (in bytes) to buffer between file system writes when receiving files; abbreviated fr. If the fs capability is present, framesize is initially set to the value of that capability. Otherwise, framesize is set to 1024.</td>
</tr>
<tr>
<td>halfduplex</td>
<td>(bool) Do local echoing because the host is half-duplex; abbreviated hdx. If the hd capability is present, halfduplex is initially set to on. Otherwise, halfduplex is initially set to off.</td>
</tr>
</tbody>
</table>
hardwareflow  (bool) Do hardware flow control; abbreviated hf. If the hf capability is present, hardwareflow is initially set to on. Otherwise, hardwareflowcontrol is initially set to off.

host  (str) The name of the host to which you are connected; abbreviated ho. host is permanently set to the name given on the command line or in the HOST environment variable.

localecho  (bool) A synonym for halfduplex; abbreviated le.

log  (str) The name of the file to which to log information about outgoing phone calls. log is initially set to /var/adm/alog, and can only be inspected or changed by the super-user.

parity  (str) The parity to be generated and checked when talking to the remote host; abbreviated par. The possible values are:

   none>
   zero    Parity is not checked on input, and the parity bit is set to zero on output.
   one     Parity is not checked on input, and the parity bit is set to one on output.
   even    Even parity is checked for on input and generated on output.
   odd     Odd parity is checked for on input and generated on output.

If the pa capability is present, parity is initially set to the value of that capability; otherwise, parity is set to none.

phones  The file in which to find hidden phone numbers. If the environment variable PHONES is set, phones is set to the value of PHONES. Otherwise, phones is set to /etc/phones. The value of phones cannot be changed from within tip.

prompt  (char) The character which indicates an end-of-line on the remote host; abbreviated pr. This value is used to synchronize during data transfers. The count of lines transferred during a file transfer command is based on receipt of this character. If the pr capability is present, prompt is initially set to the value of that capability. Otherwise, prompt is set to \n.

raise  (bool) Upper case mapping mode; abbreviated ra. When this mode is enabled, all lower case letters will be mapped to upper case by tip for transmission to the remote machine. If the ra capability is present, raise is initially set to on. Otherwise, raise is initially set to off.
raisechar (char) The input character used to toggle upper case mapping mode; abbreviated rc. If the rc capability is present, raisechar is initially set to the value of that capability. Otherwise, raisechar is set to \377 (which disables it).

rawftp (bool) Send all characters during file transfers; do not filter non-printable characters, and do not do translations like \n to \r. Abbreviated raw. If the rw capability is present, rawftp is initially set to on. Otherwise, rawftp is initially set to off.

record (str) The name of the file in which a session script is recorded; abbreviated rec. If the re capability is present, record is initially set to the value of that capability. Otherwise, record is set to tip.record.

remote The file in which to find descriptions of remote systems. If the environment variable REMOTE is set, remote is set to the value of REMOTE. Otherwise, remote is set to /etc/remote. The value of remote cannot be changed from within tip.

script (bool) Session scripting mode; abbreviated sc. When script is on, tip will record everything transmitted by the remote machine in the script record file specified in record. If the beautify switch is on, only printable ASCII characters will be included in the script file (those characters between 040 and 0177). The variable exceptions is used to indicate characters which are an exception to the normal beautification rules. If the sc capability is present, script is initially set to on. Otherwise, script is initially set to off.

tabexpand (bool) Expand TAB characters to SPACE characters during file transfers; abbreviated tab. When tabexpand is on, each tab is expanded to eight SPACE characters. If the tb capability is present, tabexpand is initially set to on. Otherwise, tabexpand is initially set to off.

tandem (bool) Use XON/XOFF flow control to limit the rate that data is sent by the remote host; abbreviated ta. If the nt capability is present, tandem is initially set to off. Otherwise, tandem is initially set to on.

verbose (bool) Verbose mode; abbreviated verb; When verbose mode is enabled, tip prints messages while dialing, shows the current number of lines transferred during a file transfer operations, and more. If the nv capability is present, verbose is initially set to off. Otherwise, verbose is initially set to on.

SHELL (str) The name of the shell to use for the ~! command; default value is /bin/sh, or taken from the environment.

HOME (str) The home directory to use for the ~c command. Default value is taken from the environment.
**Examples**

**EXAMPLE 1**  Using the tip command

An example of the dialog used to transfer files is given below.

```
arpa% tip monet
[connected]
...(assume we are talking to a UNIX system)...
ucbmonet login: sam
Password:
monet% cat sylvester.c
~> Filename: sylvester.c
32 lines transferred in 1 minute 3 seconds
monet%
monet% ~< Filename: reply.c
List command for remote host: cat reply.c
65 lines transferred in 2 minutes
monet%
...(or, equivalently)...
monet% ~p sylvester.c
...(actually echoes as ~[put] sylvester.c)...
32 lines transferred in 1 minute 3 seconds
monet%
monet% ~t reply.c
...(actually echoes as ~[take] reply.c)...
65 lines transferred in 2 minutes
monet%
...(to print a file locally)...
monet% ~|Local command: pr h sylvester.c | lpr
List command for remote host: cat sylvester.c
monet% ~^D
[EOT]
...(back on the local system)...
```

**Environment Variables**

The following environment variables are read by tip.

- `REMOTE`  The location of the remote file.
- `PHONES`  The location of the file containing private phone numbers.
- `HOST`  A default host to connect to.
- `HOME`  One's log-in directory (for chdirs).
- `SHELL`  The shell to fork on a `~!` escape.

**Files**

- `/etc/phones`
- `/etc/remote`
- `/var/spool/locks/LCK.*`  lock file to avoid conflicts with UUCP
- `/var/adm/aculog`  file in which outgoing calls are logged
/.tiprc initialization file

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTETYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also cu(1C), mail(1), uucp(1C), vi(1), ioctl(2), attributes(5)

Bugs There are two additional variables, chardelay and linedelay, that are currently not implemented.
Name  touch, settime – change file access and modification times

Synopsis  touch [-acm] [-r ref_file | -t time | -d date_time] file...
         touch [-acm] [time_spec] file...
         settime [-f ref_file] [time_spec] file...

Description  The touch utility sets the access and modification times of each file. The file operand is created if it does not already exist.

The time used can be specified by -t time, by -d date_time, by the corresponding time fields of the file referenced by -r ref_file, or by the time_spec operand. If none of these are specified, touch uses the current time.

If neither the -a nor -m options are specified, touch updates both the modification and access times.

A user with write access to a file, but who is not the owner of the file or a super-user, can change the modification and access times of that file only to the current time. Attempts to set a specific time with touch results in an error.

The settime utility is equivalent to touch -c [time_spec] file.

Options  The following options are supported in the touch and settime utilities:

   touch  The following options are supported for the touch utility:

   -a     Changes the access time of file. Does not change the modification time unless -m is also specified.

   -c     Does not create a specified file if it does not exist. Does not write any diagnostic messages concerning this condition.

   -d date_time
       Uses the specified date_time instead of the current time. The option-argument must be a string of the form:

       YYYY-MM-DDThh:mm:ss[.frac][tz]

       or

       YYYY-MM-DDThh:mm:ss[.frac][tz]

       where

       ■ YYYY is at least four decimal digits giving the year
       ■ MM, DD, hh, mm, and SS are as with -t time
       ■ T is either the letter T or a single SPACE character
- [.frac] and [.frac] are either empty, or a period (.) or a comma (,) respectively, followed by one or more decimal digits, specifying a fractional second
- [tz] is either empty, signifying local time, or the letter Z, signifying UTC. If [tz] is empty, the resulting time is affected by the value of the TZ environment variable

-m
Changes the modification time of file. Does not change the access time unless -a is also specified.

-r ref_file
Uses the corresponding times of the file named by ref_file instead of the current time.

-t time
Uses the specified time instead of the current time. time is a decimal number of the form:

[ [CC]YY]MMDDhhmm[.SS]

where each two digits represent the following:

MM
The month of the year [01-12].

DD
The day of the month [01-31].

hh
The hour of the day [00-23].

mm
The minute of the hour [00-59].

CC
The first two digits of the year.

YY
The second two digits of the year.

SS
The second of the minute [00-61].

Both CC and YY are optional. If neither is given, the current year is assumed. If YY is specified, but CC is not, CC is derived as follows:

<table>
<thead>
<tr>
<th>If YY is:</th>
<th>CC becomes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>69-99</td>
<td>19</td>
</tr>
<tr>
<td>00-38</td>
<td>20</td>
</tr>
<tr>
<td>39-68</td>
<td>ERROR</td>
</tr>
</tbody>
</table>
The resulting time is affected by the value of the TZ environment variable. The range of valid times is the Epoch to January 18, 2038.

The range for SS is [00-61] rather than [00-59] because of leap seconds. If SS is 60 or 61, and the resulting time, as affected by the TZ environment variable, does not refer to a leap second, the resulting time is one or two seconds after a time where SS is 59. If SS is not given, it is assumed to be 0.

**settime**  The following option is supported for the `settime` utility:

```
-t ref_file
```
Uses the corresponding times of the file named by `ref_file` instead of the current time.

**Operands**  The following operands are supported for the `touch` and `settime` utilities:

```
file
A path name of a file whose times are to be modified.

time_spec
Uses the specified `time_spec` instead of the current time. This operand is a decimal number of the form:

```
MMDDhhmm[YY]
```
where each two digits represent the following:

```
MM
The month of the year [01-12].

DD
The day of the month [01-31].

hh
The hour of the day [00-23].

mm
The minute of the hour [00-59].

YY
The second two digits of the year.
```

`YY` is optional. If it is omitted, the current year is assumed. If `YY` is specified, the year is derived as follows:

<table>
<thead>
<tr>
<th>YY</th>
<th>Corresponding Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>00-38</td>
<td>2000-2038</td>
</tr>
<tr>
<td>39-68</td>
<td>ERROR</td>
</tr>
</tbody>
</table>
If no `-d`, `-r`, or `-t` option is specified, at least two operands are specified, and the first operand is an eight- or ten-digit decimal integer, the first operand is assumed to be a `time_spec` operand. Otherwise, the first operand is assumed to be a `file` operand.

**Usage**

See `largefile(5)` for the description of the behavior of `touch` when encountering files greater than or equal to 2 Gbyte (\(2^{31}\) bytes).

**Environment Variables**

See `environ(5)` for descriptions of the following environment variables that affect the execution of `touch`: LANG, LC_ALL, LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

TZ

Determine the timezone to be used for interpreting the time or date_time option-argument or the `time_spec` operand.

**Exit Status**

The following exit values are returned:

- 0
  The `touch` utility executed successfully and all requested changes were made.

- >0
  An error occurred. The `touch` utility returned the number of files for which the times could not be successfully modified.

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See <code>standards(5)</code>.)</td>
</tr>
</tbody>
</table>

**See Also**

`futimens(2), stat(2), attributes(5), environ(5), largefile(5), standards(5)`

**Notes**

Users familiar with the BSD environment find that for the `touch` utility, the `-f` option is accepted but ignored. The `-f` option is unnecessary because `touch` succeeds for all files owned by the user regardless of the permissions on the files.
**Name**
touch – change file access and modification times

**Synopsis**
/usr/ucb/touch [-acfm] file...

**Description**
touch sets the access and modification times of each file to the current time. file is created if it does not already exist.

**Options**
- `-a`
  Change the access time of file. Do not change the modification time unless `-m` is also specified.
- `-c`
  Do not create file if it does not exist.
- `-f`
  Attempt to force the touch in spite of read and write permissions on file.
- `-m`
  Change the modification time of file. Do not change the access time unless `-a` is also specified.

**Usage**
See largefile(5) for the description of the behavior of touch when encountering files greater than or equal to 2 Gbyte ($2^{31}$ bytes).

**Exit Status**
The following exit values are returned:

  0  touch executed successfully and all requested changes were made.

  >0  An error occurred. touch returns the number of files for which the times could not be successfully modified.

**Attributes**
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>

**See Also**
touch(1), attributes(5), largefile(5)
tplot(1)

Name  tplot, t300, t300s, t4014, t450, tek, ver – graphics filters for various plotters

Synopsis  /usr/bin/tplot [-T terminal]

Description  tplot reads plotting instructions from the standard input and produces plotting instructions suitable for a particular terminal on the standard output.

If no terminal is specified, the environment variable TERM is used. The default terminal is tek.

Files  /usr/lib/t300
       /usr/lib/t300s
       /usr/lib/t4014
       /usr/lib/t450
       /usr/lib/tek
       /usr/lib/vplot

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  vi(1), attributes(5)
tput – initialize a terminal or query terminfo database

Synopsis

tput [-T type] capname [parm] ...
tput -S <<

Description

The `tput` utility uses the `terminfo` database to make the values of terminal-dependent capabilities and information available to the shell (see `sh(1)`); to clear, initialize or reset the terminal; or to return the long name of the requested terminal type. `tput` outputs a string if the capability attribute (`capname`) is of type string, or an integer if the attribute is of type integer. If the attribute is of type boolean, `tput` simply sets the exit status (0 for TRUE if the terminal has the capability, 1 for FALSE if it does not), and produces no output. Before using a value returned on standard output, the user should test the exit status (`$?`, see `sh(1)`) to be sure it is 0. See the EXIT STATUS section.

Options

The following options are supported:

- `-T type` Indicates the type of terminal. Normally this option is unnecessary, because the default is taken from the environment variable `TERM`. If `-T` is specified, then the shell variables `LINES` and `COLUMNS` and the layer size will not be referenced.

- `-S` Allows more than one capability per invocation of `tput`. The capabilities must be passed to `tput` from the standard input instead of from the command line (see the example in the EXAMPLES section). Only one `capname` is allowed per line. The `-S` option changes the meaning of the 0 and 1 boolean and string exit statuses (see the EXAMPLES section).

Operands

The following operands are supported:

- `capname` Indicates the capability attribute from the `terminfo` database. See `terminfo(4)` for a complete list of capabilities and the `capname` associated with each.

The following strings will be supported as operands by the implementation in the "C" locale:

- `clear` Display the clear-screen sequence.

- `init` If the `terminfo` database is present and an entry for the user’s terminal exists (see `-T type`, above), the following will occur:
  
  1. if present, the terminal’s initialization strings will be output (`is1`, `is2`, `is3`, `if`, `iprog`),
  2. any delays (for instance, newline) specified in the entry will be set in the tty driver,
  3. tabs expansion will be turned on or off according to the specification in the entry, and
4. If tabs are not expanded, standard tabs will be set (every 8 spaces). If an entry does not contain the information needed for any of the four above activities, that activity will silently be skipped.

reset

Instead of putting out initialization strings, the terminal's reset strings will be output if present (rs1, rs2, rs3, rf). If the reset strings are not present, but initialization strings are, the initialization strings will be output. Otherwise, reset acts identically to init.

longname

If the terminfo database is present and an entry for the user's terminal exists (see -T type above), then the long name of the terminal will be put out. The long name is the last name in the first line of the terminal's description in the terminfo database (see term(5)).

parm

If the attribute is a string that takes parameters, the argument parm will be instantiated into the string. An all numeric argument will be passed to the attribute as a number.

Examples

**EXAMPLE 1** Initializing the terminal according to TERM

This example initializes the terminal according to the type of terminal in the environment variable TERM. This command should be included in everyone's .profile after the environment variable TERM has been exported, as illustrated on the profile(4) manual page.

```
example% tput init
```

**EXAMPLE 2** Resetting a terminal

This example resets an AT&T 5620 terminal, overriding the type of terminal in the environment variable TERM:

```
example% tput -T5620 reset
```

**EXAMPLE 3** Moving the cursor

The following example sends the sequence to move the cursor to row 0, column 0 (the upper left corner of the screen, usually known as the "home" cursor position).

```
example% tput cup 0 0
```

This next example sends the sequence to move the cursor to row 23, column 4.

```
example% tput cup 23 4
```
EXAMPLE 4  Echoing the clear-screen sequence
This example echos the clear-screen sequence for the current terminal.
example%  tput clear

EXAMPLE 5  Printing the number of columns
This command prints the number of columns for the current terminal.
example%  tput cols
The following command prints the number of columns for the 450 terminal.
example%  tput -T450 cols

EXAMPLE 6  Setting shell variables
This example sets the shell variables bold, to begin stand-out mode sequence, and offbold, to end standout mode sequence, for the current terminal. This might be followed by a prompt:

```bash
echo "${bold}Please type in your name: ${offbold}\c"
example%  bold='tput smso'
example%  offbold='tput rmso'
```

EXAMPLE 7  Setting the exit status
This example sets the exit status to indicate if the current terminal is a hardcopy terminal.
example%  tput hc

EXAMPLE 8  Printing the long name from terminfo
This command prints the long name from the terminfo database for the type of terminal specified in the environment variable TERM.
example%  tput longname

EXAMPLE 9  Processing several capabilities with one invocation
This example shows tput processing several capabilities in one invocation. This example clears the screen, moves the cursor to position 10, 10 and turns on bold (extra bright) mode. The list is terminated by an exclamation mark (!) on a line by itself.

example%  tput -S <<!
> clear
> cup 10 10
> bold
> !

Environment Variables  See environ(5) for descriptions of the following environment variables that affect the execution of tput: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.
TERM Determine the terminal type. If this variable is unset or null, and if the -T option is not specified, an unspecified default terminal type will be used.

Exit Status The following exit values are returned:

0
- If capname is of type boolean and -S is not specified, indicates TRUE.
- If capname is of type string and -S is not specified, indicates capname is defined for this terminal type.
- If capname is of type boolean or string and -S is specified, indicates that all lines were successful.
- capname is of type integer.
- The requested string was written successfully.

1
- If capname is of type boolean and -S is not specified, indicates FALSE.
- If capname is of type string and -S is not specified, indicates that capname is not defined for this terminal type.

2 Usage error.

3 No information is available about the specified terminal type.

4 The specified operand is invalid.

>4 An error occurred.

−1 capname is a numeric variable that is not specified in the terminfo database. For instance, tput -T450 lines and tput -T2621 xmc.

Files
/usr/include/curses.h curses(3CURSES) header
/usr/include/term.h terminfo header
/usr/lib/tabset/* Tab settings for some terminals, in a format appropriate to be output to the terminal (escape sequences that set margins and tabs). For more information, see the "Tabs and Initialization" section of terminfo(4)

/usr/share/lib/terminfo/?/* compiled terminal description database

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>ATTRIBUTE TYPE</td>
<td>ATTRIBUTE VALUE</td>
</tr>
<tr>
<td>-----------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also clear(1), sh(1), stty(1), tabs(1), curses(3CURSES), profile(4), terminfo(4), attributes(5), environ(5), standards(5), term(5)
The `tr` utility copies the standard input to the standard output with substitution or deletion of selected characters. The options specified and the `string1` and `string2` operands control translations that occur while copying characters and single-character collating elements.

### Options

The following options are supported:

- `-c` Complements the set of values specified by `string1`.
- `-C` Complements the set of characters specified by `string1`.
- `-d` Deletes all occurrences of input characters that are specified by `string1`.
- `-s` Replaces instances of repeated characters with a single character.

When the `-d` option is not specified:

- Each input character found in the array specified by `string1` is replaced by the character in the same relative position in the array specified by `string2`. When the array specified by `string2` is shorter than the one specified by `string1`, the results are unspecified.
- If the `-c` option is specified, the complements of the values specified by `string1` are placed in the array in ascending order by binary value.
- If the `-C` option is specified, the complements of the characters specified by `string1` (the set of all characters in the current character set, as defined by the current setting of LC_CTYPE, except for those actually specified in the `string1` operand) are placed in the array in ascending collation sequence, as defined by the current setting of LC_COLLATE.
- Because the order in which characters specified by character class expressions or equivalence class expressions is undefined, such expressions should only be used if the intent is to map several characters into one. An exception is case conversion, as described previously.

When the `-d` option is specified:

- Input characters found in the array specified by `string1` are deleted.
When the `-C` option is specified with `-d`, all values except those specified by `string1` are deleted. The contents of `string2` are ignored, unless the `-s` option is also specified.

If the `-c` option is specified, the complements of the values specified by `string1` are placed in the array in ascending order by binary value.

The same string cannot be used for both the `-d` and the `-s` option. When both options are specified, both `string1` (used for deletion) and `string2` (used for squeezing) are required.

When the `-s` option is specified, after any deletions or translations have taken place, repeated sequences of the same character is replaced by one occurrence of the same character, if the character is found in the array specified by the last operand. If the last operand contains a character class, such as the following example:

```
tr -s '[:space:]'
```

the last operand’s array contains all of the characters in that character class. However, in a case conversion, as described previously, such as

```
tr -s '[:upper:]' '[:lower:]'
```

the last operand’s array contains only those characters defined as the second characters in each of the `toupper` or `tolower` character pairs, as appropriate. (See `toupper(3C)` and `tolower(3C)`).

An empty string used for `string1` or `string2` produces undefined results.

### Operands

The following operands are supported:

`string1`  Translation control strings. Each string represents a set of characters to be converted into an array of characters used for the translation.

`string2`  Translation control strings. Each string represents a set of characters to be converted into an array of characters used for the translation.

The operands `string1` and `string2` (if specified) define two arrays of characters. The constructs in the following list can be used to specify characters or single-character collating elements. If any of the constructs result in multi-character collating elements, `tr` excludes, without a diagnostic, those multi-character elements from the resulting array.

`character`  Any character not described by one of the conventions below represents itself.

`\octal`  Octal sequences can be used to represent characters with specific coded values. An octal sequence consists of a backslash followed by the longest sequence of one-, two-, or three-octal-digit characters (01234567). The sequence causes the character whose encoding is represented by the one-, two- or three-digit octal integer to be placed into the array. Multi-byte characters require multiple, concatenated escape sequences of this type, including the leading `\` for each byte.
The backslash-escape sequences \a, \b, \f, \n, \r, \t, and \v are supported. The results of using any other character, other than an octal digit, following the backslash are unspecified.

In the POSIX locale, this construct represents the range of collating elements between the range endpoints (as long as neither endpoint is an octal sequence of the form \octal), inclusively, as defined by the collation sequence. The characters or collating elements in the range are placed in the array in ascending collation sequence. If the second endpoint precedes the starting endpoint in the collation sequence, it is unspecified whether the range of collating elements is empty, or this construct is treated as invalid. In locales other than the POSIX locale, this construct has unspecified behavior.

If either or both of the range endpoints are octal sequences of the form \octal, represents the range of specific coded binary values between two range endpoints, inclusively.

Represents all characters belonging to the defined character class, as defined by the current setting of the LC_CTYPE locale category. The following character class names are accepted when specified in string1:

alnum blank digit lower punct upper
alpha cntrl graph print space xdigit

In addition, character class expressions of the form [:name:] are recognized in those locales where the name keyword has been given a character class definition in the LC_CTYPE category.

When both the -d and -s options are specified, any of the character class names are accepted in string2. Otherwise, only character class names lower or upper are valid in string2 and then only if the corresponding character class upper and lower, respectively, is specified in the same relative position in string1. Such a specification is interpreted as a request for case conversion. When [:lower:] appears in string1 and [:upper:] appears in string2, the arrays contain the characters from the toupper mapping in the LC_CTYPE category of the current locale. When [:upper:] appears in string1 and [:lower:] appears in string2, the arrays contain the characters from the tolower mapping in the LC_CTYPE category of the current locale. The first character from each mapping pair is in the array for string1 and the second character from each mapping pair is in the array for string2 in the same relative position.

Except for case conversion, the characters specified by a character class expression are placed in the array in an unspecified order.
If the name specified for `class` does not define a valid character class in the current locale, the behavior is undefined.

`[=equiv=]` Represents all characters or collating elements belonging to the same equivalence class as `equiv`, as defined by the current setting of the LC_COLLATE locale category. An equivalence class expression is allowed only in `string1`, or in `string2` when it is being used by the combined `-d` and `-s` options. The characters belonging to the equivalence class are placed in the array in an unspecified order.

`[x*n]` Represents $n$ repeated occurrences of the character $x$. Because this expression is used to map multiple characters to one, it is only valid when it occurs in `string2`. If $n$ has a leading 0, it is interpreted as an octal value. Otherwise, it is interpreted as a decimal value.

If $n$ is omitted or is 0, `/usr/bin/tr` interprets this as huge; `/usr/xpg4/bin/tr` and `/usr/xpg6/bin/tr` interprets this as large enough to extend the `string2`-based sequence to the length of the `string1`-based sequence.

**Usage** See `largefile(5)` for the description of the behavior of `tr` when encountering files greater than or equal to 2 Gbyte (2^{31} bytes).

**Examples**

**EXAMPLE 1** Creating a list of words

The following example creates a list of all words in `file1`, one per line in `file2`, where a word is taken to be a maximal string of letters.

```bash
tr -cs "[:alpha:]" "[\n*]" <file1 >file2
```

**EXAMPLE 2** Translating characters

This example translates all lower-case characters in `file1` to upper-case and writes the results to standard output.

```bash
tr "[:lower:]" "[:upper:]" <file1
```

Notice that the caveat expressed in the corresponding example in XPG3 is no longer in effect. This case conversion is now a special case that employs the `tolower` and `toupper` classifications, ensuring that proper mapping is accomplished (when the locale is correctly defined).

**EXAMPLE 3** Identifying equivalent characters

This example uses an equivalence class to identify accented variants of the base character e in `file1`, which are stripped of diacritical marks and written to `file2`.

```bash
tr "[=e=]" e <file1 >file2
```

Environment Variables

See environ(5) for descriptions of the following environment variables that affect the execution of tr: LANG, LC_ALL, LC_COLLATE, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status

The following exit values are returned:

- 0 All input was processed successfully.
- >0 An error occurred.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/xopen/xcu4</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/xopen/xcu6</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also ed(1), sed(1), sh(1), tolower(3C),toupper(3C), ascii(5), attributes(5), environ(5), largefile(5), regex(5), standards(5)

Notes

Unlike some previous versions, /usr/xpg4/bin/tr correctly processes NUL characters in its input stream. NUL characters can be stripped by using tr -d ‘\000’.
**Name**  
tr – translate characters

**Synopsis**  
/usr/ucb/tr [-cds] [string1 [string2]]

**Description**  
The tr utility copies the standard input to the standard output with substitution or deletion of selected characters. The arguments string1 and string2 are considered sets of characters. Any input character found in string1 is mapped into the character in the corresponding position within string2. When string2 is short, it is padded to the length of string1 by duplicating its last character.

In either string the notation:

\[ a−b \]

denotes a range of characters from \( a \) to \( b \) in increasing ASCII order. The character \( \backslash\ ), followed by 1, 2 or 3 octal digits stands for the character whose ASCII code is given by those digits. As with the shell, the escape character \( \backslash\ ), followed by any other character, escapes any special meaning for that character.

**Options**  
Any combination of the options -c, -d, or -s may be used:

- **-c**  
  Complement the set of characters in string1 with respect to the universe of characters whose ASCII codes are 01 through 0377 octal.

- **-d**  
  Delete all input characters in string1.

- **-s**  
  Squeeze all strings of repeated output characters that are in string2 to single characters.

**Examples**  
**EXAMPLE 1**  
Creating a list of all the words in a filename

The following example creates a list of all the words in filename1, one per line, in filename2, where a word is taken to be a maximal string of alphabatics. The second string is quoted to protect ‘ \ ‘ from the shell. 012 is the ASCII code for NEWLINE.

```
example% tr -cs A-Za-z \"012\" < filename1 > filename2
```

**Attributes**  
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>

**See Also**  
ed(1), ascii(5), attributes(5)

**Notes**  
Will not handle ASCII NUL in string1 or string2. tr always deletes NUL from input.
The `trap` command is to be read and executed when the shell receives numeric or symbolic signal(s) (n). (Note: `argument` is scanned once when the trap is set and once when the trap is taken.) Trap commands are executed in order of signal number or corresponding symbolic names. Any attempt to set a trap on a signal that was ignored on entry to the current shell is ineffective. An attempt to trap on signal 11 (memory fault) produces an error. If `argument` is absent all trap(s) n are reset to their original values. If `argument` is the null string this signal is ignored by the shell and by the commands it invokes. If n is 0 the command `argument` is executed on exit from the shell. The `trap` command with no arguments prints a list of commands associated with each signal number.

The `onintr` control the action of the shell on interrupts. With no arguments, `onintr` restores the default action of the shell on interrupts. (The shell terminates shell scripts and returns to the terminal command input level). With the – argument, the shell ignores all interrupts. With a `label` argument, the shell executes a `goto label` when an interrupt is received or a child process terminates because it was interrupted.

Trapping uses `arg` as a command to be read and executed when the shell receives signal(s) `sig`. `arg` is scanned once when the trap is set and once when the trap is taken. Each `sig` can be specified as a number or as the name of the signal. `trap` commands are executed in order of signal number. Any attempt to set a trap on a signal that was ignored on entry to the current shell is ineffective. If `arg` is omitted or is –, then the trap(s) for each `sig` are reset to their original values. If `arg` is the null (the empty string, for example, "") string then this signal is ignored by the shell and by the commands it invokes. If `sig` is ERR then `arg` are executed whenever a command has a non-zero exit status. If `sig` is DEBUG then `arg` are executed after each command. If `sig` is 0 or EXIT for a `trap` set outside any function then the command `arg` is executed on exit from the shell. The `trap` command with no arguments prints a list of commands associated with each signal number.

On this manual page, `ksh88(1)` commands that are preceded by one or two * (asterisks) are treated specially in the following ways:

1. Variable assignment lists preceding the command remain in effect when the command completes.
2. I/O redirections are processed after variable assignments.
3. Errors cause a script that contains them to abort.

4. Words, following a command preceded by `**` that are in the format of a variable assignment, are expanded with the same rules as a variable assignment. This means that tilde substitution is performed after the `=` sign and word splitting and file name generation are not performed.

```
trap is a special built-in that defines actions to be taken when conditions such as receiving a signal occur. `trap` can also be used to display the current trap settings on standard output.

If `action` is `-`, `trap` resets each condition to the default value. If `action` is an empty string, the shell ignores each of the conditions if they arise. Otherwise, the argument `action` is read and executed by the shell as if it were processed by `eval` when one of the corresponding conditions arise. The action of the trap overrides any previous action associated with each specified condition. The value of `$?` is not altered by the trap execution.

`condition` can be the name or number of a signal, or one of the following:

- `EXIT` Execute this trap when the shell exits. If defined within a function with the `function` reserved word, executes the trap in the caller's environment when the function returns. The trap action is restored to the value it had when it called the function.

- `0` Same as `EXIT`.

- `DEBUG` Execute before each simple command is executed but after the arguments are expanded.

- `ERR` Execute whenever `set -e` would cause the shell to exit.

- `KEYBD` Execute when a key is entered from a terminal device.

Signal names are case insensitive and the `sig` prefix is optional. Signals that were ignored on entry to a non-interactive shell cannot be trapped or reset although doing so does not report an error. The use of signal numbers other than 1, 2, 3, 6, 9, 14, and 15 are not portable.

Although `trap` is a special built-in, specifying a condition that the shell does not know about causes `trap` to exit with a non-zero exit status, but does not terminate the invoking shell.

If no action or conditions are specified then all the current trap settings are written to standard output.

The following options are supported by the `trap` built-in command in `ksh`:

- `-p` Causes the current traps to be output in a format that can be processed as input to the shell to recreate the current traps.

The `trap` built-in in `ksh` exits with one of the following values:

- `0` Successful completion.
An error occurred.

On this manual page, `ksh(1)` commands that are preceded by one or two + (plus signs) are treated specially in the following ways:

1. Variable assignment lists preceding the command remain in effect when the command completes.
2. I/O redirections are processed after variable assignments.
3. Errors cause a script that contains them to abort.
4. They are not valid function names.
5. Words, following a command preceded by ++ that are in the format of a variable assignment, are expanded with the same rules as a variable assignment. This means that tilde substitution is performed after the = sign and word splitting and file name generation are not performed.

**Attributes**  See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

**See Also**  `csh(1), eval(1), exit(1), ksh(1), ksh88(1), sh(1), attributes(5)`
**troff** – typeset or format documents

**Synopsis**

```
       [-sN] [-uN] [-z] [filename]...
```

**Description**

`troff` formats text in the filenames for typesetting or laser printing. Input to `troff` is expected to consist of text interspersed with formatting requests and macros. If no filename argument is present, `troff` reads standard input. A minus sign (−) as a filename indicates that standard input should be read at that point in the list of input files.

**Options**

The following options are supported. They may appear in any order, but all must appear before the first filename.

- **-a**
  Send an ASCII approximation of formatted output to standard output. (Note: a rough ASCII version can also be printed out on ordinary terminals with an old and rarely used command, /usr/bin/ta.)

- **-f**
  Do not print a trailer after the final page of output or cause the postprocessor to relinquish control of the device.

- **-Fdir**
  Search directory dir for font width or terminal tables instead of the system default directory.

- **-i**
  Read standard input after all input files are exhausted.

- **-mname**
  Prepend the macro file /usr/share/lib/tmac/name to the input filenames.
  Note: most references to macro packages include the leading m as part of the name; for example, the man(5) macros reside in /usr/share/lib/tmac/man. The macro directory can be changed by setting the TROFFMACS environment variable to a specific path. Be certain to include the trailing `’/’` (slash) at the end of the path.

- **-nN**
  Number the first generated page N.

- **-olist**
  Print only pages whose page numbers appear in the comma-separated list of numbers and ranges. A range N–M means pages N through M; an initial −N means from the beginning to page N; and a final N– means from N to the end.

- **-q**
  Quiet mode in nroff; ignored in troff.

- **-raN**
  Set register a (one-character names only) to N.

- **-sN**
  Stop the phototypesetter every N pages. On some devices, troff produces a trailer so you can change cassettes; resume by pressing the typesetter’s start button.

- **-uN**
  Set the emboldening factor for the font mounted in position 3 to N. If N is missing, then set the emboldening factor to 0.

- **-z**
  Suppress formatted output. Only diagnostic messages and messages output using the .tm request are output.
Operands  The following operand is supported:

   filename  The file containing text to be processed by troff.

Files  
/tmp/trtmp          temporary file
/usr/share/lib/tmac/*   standard macro files
/usr/lib/font/*     font width tables for alternate mounted troff fonts
/usr/share/lib/nterm/*  terminal driving tables for nroff

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTETYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>text/doctools</td>
</tr>
</tbody>
</table>

See Also  checknr(1), col(1), eqn(1), man(1), nroff(1), tbl(1), attributes(5), man(5), me(5), ms(5)

Notes  troff is not 8-bit clean because it is by design based on 7-bit ASCII.

Previous documentation incorrectly described the numeric register yr as being the Last two digits of current year. yr is in actuality the number of years since 1900. To correctly obtain the last two digits of the current year through the year 2099, the definition given below of string register yy may be included in a document and subsequently used to display a two-digit year. Note that any other available one- or two-character register name may be substituted for yy.

```troff
." definition of new string register yy--last two digits of year
." use yr (# of years since 1900) if it is < 100
.ie \n(yr<100 .ds yy \n(yr
.el \{                             ." else, subtract 100 from yr, store in ny
.nr ny \n(yr-100
.ie \n(ny>9 \{ ." use ny if it is two digits
.ds yy \n(ny
." remove temporary number register ny
.rr ny \}
.el \{.ds yy 0
." if ny is one digit, append it to 0
.as yy \n(ny
.rr ny \}
```


true(1)

**Name**  true, false – provide truth values

**Synopsis**  
true  
false  

description  The true utility does nothing, successfully. The false utility does nothing, unsuccessfully. They are typically used in a shell script as:

```
while true
  do
    command
  done
```

which executes command forever.

**Exit Status**  
true has exit status 0.
false always will exit with a non-zero value.

**Attributes**  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

**See Also**  sh(1), attributes(5), standards(5)
truss – trace system calls and signals

**Synopsis**
```
truss [-fcaeldDE] [- [tTvx] [!] syscall ,...]
   [- [sS] [!] signal ,...] [- [mM] [!] fault ,...]
   [- [rw] [!] fd ,...]
   [- [uU] [!] lib ,... : [:] [!] func ,...]
   [-o outfile] command [ -p pid|lwps]...
```

**Description**
The truss utility executes the specified command and produces a trace of the system calls it performs, the signals it receives, and the machine faults it incurs. Each line of the trace output reports either the fault or signal name or the system call name with its arguments and return value(s). System call arguments are displayed symbolically when possible using defines from relevant system headers. For any path name pointer argument, the pointed-to string is displayed. Error returns are reported using the error code names described in `Intro(3)`. If, in the case of an error, the kernel reports a missing privilege, a privilege name as described in `privileges(5)` is reported in square brackets (`[]`) after the error code name. See `NOTES` for more information on error reporting.

Optionally (see the `-u` option), truss also produce an entry/exit trace of user-level function calls executed by the traced process, indented to indicate nesting.

**Options**
For those options that take a list argument, the name `all` can be used as a shorthand to specify all possible members of the list. If the list begins with a `!`, the meaning of the option is negated (for example, exclude rather than trace). Multiple occurrences of the same option can be specified. For the same name in a list, subsequent options (those to the right) override previous ones (those to the left).

The following options are supported:

- `-a` Shows the argument strings that are passed in each `exec()` system call.
- `-c` Counts traced system calls, faults, and signals rather than displaying the trace line-by-line. A summary report is produced after the traced command terminates or when truss is interrupted. If `-f` is also specified, the counts include all traced system calls, faults, and signals for child processes.
- `-d` Includes a time stamp on each line of trace output. The time stamp appears as a field containing `seconds.fraction` at the start of the line. This represents a time in seconds relative to the beginning of the trace. The first line of the trace output shows the base time from which the individual time stamps are measured, both as seconds since the epoch (see `time(2)`) and as a date string (see `ctime(3C)` and `date(1)`). The times that are reported are the times that the event in question occurred. For all system calls, the event is the completion of the system call, not the start of the system call.
<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-D</td>
<td>Includes a time delta on each line of trace output. The value appears as a field containing <code>seconds . fraction</code> and represents the elapsed time for the LWP that incurred the event since the last reported event incurred by that LWP. Specifically, for system calls, this is not the time spent within the system call.</td>
</tr>
<tr>
<td>-e</td>
<td>Shows the environment strings that are passed in each <code>exec()</code> system call.</td>
</tr>
<tr>
<td>-E</td>
<td>Includes a time delta on each line of trace output. The value appears as a field containing <code>seconds . fraction</code> and represents the difference in time elapsed between the beginning and end of a system call. In contrast to the -D option, this is the amount of time spent within the system call.</td>
</tr>
<tr>
<td>-f</td>
<td>Follows all children created by <code>fork()</code> or <code>vfork()</code> and includes their signals, faults, and system calls in the trace output. Normally, only the first-level command or process is traced. When -f is specified, the process-id is included with each line of trace output to indicate which process executed the system call or received the signal.</td>
</tr>
<tr>
<td>-i</td>
<td>Does not display interruptible sleeping system calls. Certain system calls, such as <code>open()</code> and <code>read()</code> on terminal devices or pipes, can sleep for indefinite periods and are interruptible. Normally, truss reports such sleeping system calls if they remain asleep for more than one second. The system call is reported again a second time when it completes. The -i option causes such system calls to be reported only once, when they complete.</td>
</tr>
<tr>
<td>-l</td>
<td>Includes the id of the responsible lightweight process (LWP) with each line of trace output. If -f is also specified, both the process-id and the LWP-id are included.</td>
</tr>
<tr>
<td>-m ![fault,...]</td>
<td>Machine faults to trace or exclude. Those faults specified in the comma-separated list are traced. Faults can be specified by name or number (see <code>&lt;sys/fault.h&gt;</code>). If the list begins with a !, the specified faults are excluded from the trace output. Default is <code>-m all -m !fltpage</code>.</td>
</tr>
<tr>
<td>-M ![fault,...]</td>
<td>Machine faults that stop the process. The specified faults are added to the set specified by -m. If one of the specified faults is incurred, truss leaves the process stopped and abandoned (see the -T option). Default is <code>-M !all</code>.</td>
</tr>
</tbody>
</table>
-o outfile  
File to be used for the trace output. By default, the output goes to standard error.

-p  
Interprets the command arguments to truss as a list of process-ids for existing processes (see ps(1)) rather than as a command to be executed. truss takes control of each process and begins tracing it provided that the userid and groupid of the process match those of the user or that the user is a privileged user. Users can trace only selected threads by appending /thread-id to the process-id. Multiple threads can be selected using the - and , delimiters. For example /1, 2, 7-9 traces threads 1, 2, 7, 8, and 9. Processes can also be specified by their names in the /proc directory, for example, /proc/12345.

-r [!]fd,...  
Shows the full contents of the I/O buffer for each read() on any of the specified file descriptors. The output is formatted 32 bytes per line and shows each byte as an ASCII character (preceded by one blank) or as a 2-character C language escape sequence for control characters such as horizontal tab (\t) and newline (\n). If ASCII interpretation is not possible, the byte is shown in 2-character hexadecimal representation. (The first 12 bytes of the I/O buffer for each traced print >read() are shown even in the absence of -r.) Default is -r!all.

-s [!]signal,...  
Signals to trace or exclude. Those signals specified in the comma-separated list are traced. The trace output reports the receipt of each specified signal, even if the signal is being ignored (not blocked). (Blocked signals are not received until they are unblocked.) Signals can be specified by name or number (see <sys/signal.h>). If the list begins with a !, the specified signals are excluded from the trace output. Default is -sall.

-S [!]signal,...  
Signals that stop the process. The specified signals are added to the set specified by -s. If one of the specified signals is received, truss leaves the process stopped and abandoned (see the -T option). Default is -S!all.

-t [!]syscall,...  
System calls to trace or exclude. Those system calls specified in the comma-separated list are traced. If the list begins with a !, the specified system calls are excluded from the trace output. Default is -tall.
-T [!]syscall,...

Specifies system calls that stop the process. The specified system calls are added to the set specified by -t. If one of the specified system calls is encountered, truss leaves the process stopped and abandoned. That is, truss releases the process and exits but leaves the process in the stopped state at completion of the system call in question. A debugger or other process inspection tool (see proc(1)) can then be applied to the stopped process. truss can be reapplied to the stopped process with the same or different options to continue tracing. Default is -T!all.

A process left stopped in this manner cannot be restarted by the application of kill -CONT because it is stopped on an event of interest via /proc, not by the default action of a stopping signal (see signal.h(3)). The prun(1) command described in proc(1) can be used to set the stopped process running again.

-u [!]lib,...:[:][!]func,...

User-level function call tracing. lib,... is a comma-separated list of dynamic library names, excluding the " .so. n" suffix. func,... is a comma-separated list of function names. In both cases the names can include name-matching metacharacters *,?[,] with the same meanings as those of sh(1) but as applied to the library/function name spaces, not to files. An empty library or function list defaults to *, trace all libraries or functions in a library. A leading ! on either list specifies an exclusion list, names of libraries or functions not to be traced. Excluding a library excludes all functions in that library; any function list following a library exclusion list is ignored.

A single : separating the library list from the function list means to trace calls into the libraries from outside the libraries, but omit calls made to functions in a library from other functions in the same library. A double :: means to trace all calls, regardless of origin.

Library patterns do not match either the executable file or the dynamic linker unless there is an exact match (l* does not match ld.so.1). To trace functions in either of these objects, the names must be specified exactly, as in:

truss -u a.out -u ld ...
a.out is the literal name to be used for this purpose; it does not stand for the name of the executable file. Tracing a.out function calls implies all calls (default is : :).

Multiple -u options can be specified and they are honored left-to-right. The id of the lightweight process and id of the thread that performed the function call is included in the trace output for the call, separated by a slash (/) and an at-sign (@) character, respectively.

```
-U [!]lib, ... :[:][!]func, ...
```

User-level function calls that stop the process. The specified functions are added to the set specified by -u. If one of the specified functions is called, truss leaves the process stopped and abandoned (see the -T option).

```
-v [!]syscall,...
```

Verbose. Displays the contents of any structures passed by address to the specified system calls (if traced by -t). Input values as well as values returned by the operating system are shown. For any field used as both input and output, only the output value is shown. Default is -v all.

```
-w [!]fd,...
```

Shows the contents of the I/O buffer for each write() on any of the specified file descriptors (see the -r option). Default is -w all.

```
-x [!]syscall,...
```

Displays the arguments to the specified system calls (if traced by -t) in raw form, usually hexadecimal, rather than symbolically. This is for unredeemed hackers who must see the raw bits to be happy. Default is -x all.

See man pages section 2: System Calls for system call names accepted by the -t, -T, -v, and -x options. System call numbers are also accepted.

If truss is used to initiate and trace a specified command and if the -o option is used or if standard error is redirected to a non-terminal file, then truss runs with hangup, interrupt, and quit signals ignored. This facilitates tracing of interactive programs that catch interrupt and quit signals from the terminal.

If the trace output remains directed to the terminal, or if existing processes are traced (the -p option), then truss responds to hangup, interrupt, and quit signals by releasing all traced processes and exiting. This enables the user to terminate excessive trace output and to release previously-existing processes. Released processes continue normally, as though they had never been touched.

When tracing existing processes, truss releases processes and sets them running when truss exits. This includes exiting due to signals, such as SIGINT, SIGHUP, or SIGQUIT. This enables
the user to terminate excessive trace output and to release previously-existing processes. Released processes continue normally, as though they had never been touched.

**Examples**

**EXAMPLE 1** Tracing a Command

The following example produces a trace of the `find(1)` command on the terminal:

```
example$ truss find . -print >find.out
```

**EXAMPLE 2** Tracing Common System Calls

The following example shows only a trace of the open, close, read, and write system calls:

```
example$ truss -t open,close,read,write find . -print >find.out
```

**EXAMPLE 3** Tracing a Shell Script

The following example produces a trace of the `spell(1)` command on the file `truss.out`:

```
example$ truss -f -o truss.out spell document
```

`spell` is a shell script, so the `-f` flag is needed to trace not only the shell but also the processes created by the shell. (The spell script runs a pipeline of eight processes.)

**EXAMPLE 4** Abbreviating Output

The following example abbreviates output:

```
example$ truss nroff -mm document >nroff.out
```

because 97% of the output reports `lseek()`, `read()`, and `write()` system calls. To abbreviate it:

```
example$ truss -t !lseek,read,write nroff -mm document >nroff.out
```

**EXAMPLE 5** Tracing Library Calls From Outside the C Library

The following example traces all user-level calls made to any function in the C library from outside the C library:

```
example$ truss -u libc ...
```

**EXAMPLE 6** Tracing library calls from within the C library

The following example includes calls made to functions in the C library from within the C library itself:

```
example$ truss -u libc:: ...
```
**Example 7**  Tracing Library Calls Other Than the C Library

The following example traces all user-level calls made to any library other than the C library:

```
example$ truss -u '*' -u !libc ...
```

**Example 8**  Tracing printf and scanf Function Calls

The following example traces all user-level calls to functions in the printf and scanf family contained in the C library:

```
example$ truss -u 'libc:*printf,*scanf' ...
```

**Example 9**  Tracing Every User-level Function Call

The following example traces every user-level function call from anywhere to anywhere:

```
example$ truss -u a.out -u ld:: -u :: ...
```

**Example 10**  Tracing a System Call Verbosely

The following example verbosely traces the system call activity of process #1, `init(1M)` (if you are a privileged user):

```
example# truss -p -v all 1
```

Interrupting truss returns init to normal operation.

**Files**  /proc/*  Process files

**Attributes**  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

**See Also**  date(1), find(1), proc(1), ps(1), sh(1), spell(1), init(1M), Intro(3), exec(2), fork(2), lseek(2), open(2), read(2), time(2), vfork(2), write(2), ctime(3C), signal.h(3HEAD), proc(4), attributes(5), mwac(5), privileges(5), threads(5)

man pages section 2: System Calls

**Notes**  Some of the system calls described in man pages section 2: System Calls differ from the actual operating system interfaces. Do not be surprised by minor deviations of the trace output from the descriptions in that document.

Every machine fault (except a page fault) results in the posting of a signal to the LWP that incurred the fault. A report of a received signal immediately follows each report of a machine fault (except a page fault) unless that signal is being blocked.
The operating system enforces certain security restrictions on the tracing of processes. In particular, any command whose object file (a.out) cannot be read by a user cannot be traced by that user; setuid and setgid commands can be traced only by a privileged user. Unless it is run by a privileged user, truss loses control of any process that performs an exec() of a set-id or unreadable object file; such processes continue normally, though independently of truss, from the point of the exec().

To avoid collisions with other controlling processes, truss does not trace a process that it detects is being controlled by another process via the /proc interface. This allows truss to be applied to proc(4)-based debuggers as well as to another instance of itself.

The trace output contains tab characters under the assumption that standard tab stops are set (every eight positions).

The trace output for multiple processes or for a multithreaded process (one that contains more than one LWP) is not produced in strict time order. For example, a read() on a pipe can be reported before the corresponding write(). For any one LWP (a traditional process contains only one), the output is strictly time-ordered.

When tracing more than one process, truss runs as one controlling process for each process being traced. For the example of the spell command shown above, spell itself uses 9 process slots, one for the shell and 8 for the 8-member pipeline, while truss adds another 9 processes, for a total of 18.

Not all possible structures passed in all possible system calls are displayed under the -v option.

When truss reports on errors returned by system calls that are caused by missing privilege, truss displays either the simple privilege name after the error-code or a complex privilege description. See privileges(5). This complex description can consist of:

- [ALL] The process needs all privileges for the requested operation.
- [MULTIPLE] The process lacks multiple privileges.
- [ZONE] The process lacks one of the available privileges in the zone (zone-local variant of ALL).
- [GLOBAL] The requested operation requires that the process is running in the global zone.
- [MwAC] The requested operation violates a mwac(5) policy that is in place for the process.
tset, reset – establish or restore terminal characteristics

**Synopsis**

```
tset [-InQrs] [-ec] [-kc]
       [-m \[port-ID \[baudrate] : type\]...] [type]
reset [-] [-ec] [-I] [-kc]
       [-n] [-Q] [-r] [-s]
       [-m [indent] [test baudrate] : type]... [type]
```

**Description**

The `tset` utility sets up your terminal, typically when you first log in. It does terminal dependent processing such as setting erase and kill characters, setting or resetting delays, sending any sequences needed to properly initialized the terminal, and the like. `tset` first determines the type of terminal involved, and then does necessary initializations and mode settings. If a port is not wired permanently to a specific terminal (not hardwired) it is given an appropriate generic identifier such as `dialup`.

`reset` clears the terminal settings by turning off CBREAK and RAW modes, output delays and parity checking, turns on NEWLINE translation, echo and TAB expansion, and restores undefined special characters to their default state. It then sets the modes as usual, based on the terminal type (which will probably override some of the above). See `stty(1)` for more information. All arguments to `tset` may be used with `reset`. `reset` also uses `rs=` and `rf=` to reset the initialization string and file. This is useful after a program dies and leaves the terminal in a funny state. Often in this situation, characters will not echo as you type them. You may have to type `LINEFEED reset LINEFEED` since `RETURN` may not work.

When no arguments are specified, `tset` reads the terminal type from the `TERM` environment variable and re-initializes the terminal, and performs initialization of mode, environment and other options at login time to determine the terminal type and set up terminal modes.

When used in a startup script (`.profile` for `sh(1)` users or `.login` for `csh(1)` users) it is desirable to give information about the type of terminal you will usually use on ports that are not hardwired. Any of the alternate generic names given in the file `/etc/termcap` are possible identifiers. Refer to the `-m` option below for more information. If no mapping applies and a final type option, not preceded by a `-m`, is given on the command line then that type is used.

It is usually desirable to return the terminal type, as finally determined by `tset`, and information about the terminal’s capabilities, to a shell’s environment. This can be done using the `-r`, `-s`, or `-S` options.

For the Bourne shell, put this command in your `.profile` file:

```
eval 'tset -s options..'
```

or using the C shell, put these commands in your `.login` file:

```
set noglob
eval 'tset -s options..' unset noglob
```
With the C shell, it is also convenient to make an alias in your .cshrc file:

```
alias ts 'eval `tset -s \!*`'
```

This also allows the command:

```
ts 2621
```

to be invoked at any time to set the terminal and environment. It is not possible to get this aliasing effect with a Bourne shell script, because shell scripts cannot set the environment of their parent. If a process could set its parent’s environment, none of this nonsense would be necessary in the first place.

Once the terminal type is known, tset sets the terminal driver mode. This normally involves sending an initialization sequence to the terminal, setting the single character erase (and optionally the line-kill (full line erase)) characters, and setting special character delays. TAB and NEWLINE expansion are turned off during transmission of the terminal initialization sequence.

On terminals that can backspace but not overstrike (such as a CRT), and when the erase character is ‘#’, the erase character is changed as if -e had been used.

### Options

- `tset (1B)`

**Options**

- `-e`
  
  Set the erase character to be the named character `c` on all terminals. Default is the BACKSPACE key on the keyboard, usually ^H (CTRL-H). The character `c` can either be typed directly, or entered using the circumflex-character notation used here.

- `-i`
  
  Set the interrupt character to be the named character `c` on all terminals. Default is ^C (CTRL-C). The character `c` can either be typed directly, or entered using the circumflex-character notation used here.

- `-k`
  
  Set the line kill character to be the named character `c` on all terminals. Default is ^U (CTRL-U). The kill character is left alone if -k is not specified. Control characters can be specified by prefixing the alphabetical character with a circumflex (as in CTRL-U) instead of entering the actual control key itself. This allows you to specify control keys that are currently assigned.

- `-n`
  
  Specify that the newtty driver modes should be initialized for this terminal. Probably useless since stty new is the default.

- `-Q`
  
  Suppress printing the ‘Erase set to’ and ‘Kill set to’ messages.

- `-r`
  
  In addition to other actions, reports the terminal type.

- `-s`
  
  Output commands to set and export TERM. This can be used with
set noglob
eval 'tset -s ...
unset noglob

tobring the terminal information into the environment. Doing so makes programs
such as vi(1) start up faster. If the SHELL environment variable ends with csh, C shell
commands are output, otherwise Bourne shell commands are output.

-m [ port-ID ] [ baudrate ] : type ] ... Specify (map) a terminal type when connected to a
generic port (such as dialup or plugboard) identified
by port-ID. The baudrate argument can be used to
check the baudrate of the port and set the terminal
type accordingly. The target rate is prefixed by any
combination of the following operators to specify the
conditions under which the mapping is made:

>   Greater than
@   Equals or "at"
<   Less than
!   It is not the case that (negates the above
operators)
?   Prompt for the terminal type. If no response is
given, then type is selected by default.

In the following example, the terminal type is set to
adm3a if the port is a dialup with a speed of greater
than 300 or to dw2 if the port is a dialup at 300 baud or
less. In the third case, the question mark preceding
the terminal type indicates that the user is to verify
the type desired. A NULL response indicates that the
named type is correct. Otherwise, the user’s response
is taken to be the type desired.

tset -m 'dialup>300:adm3a' -m 'dialup:dw2' -m 'plugboard:?adm3a'

To prevent interpretation as metacharacters, the
entire argument to -m should be enclosed in single
quotes. When using the C shell, exclamation points
should be preceded by a backslash (\).

Examples These examples all use the ‘−’ option. A typical use of tset in a .profile or .login will also
use the -e and -k options, and often the -n or -Q options as well. These options have been
omitted here to keep the examples short.
EXAMPLE 1  Selecting a terminal
To select a 2621, you might put the following sequence of commands in your .login file (or .profile for Bourne shell users).

```
set noglob
eval 'tset -s 2621'
unset noglob
```
If you want to make the selection based only on the baud rate, you might use the following:

```
set noglob
eval 'tset -s -m '>1200:wy' 2621'
unset noglob
```

EXAMPLE 2  Selecting terminals according to speed or baud rate
If you have a switch which connects to various ports (making it impractical to identify which port you may be connected to), and use various terminals from time to time, you can select from among those terminals according to the speed or baud rate. In the example below, the tset will prompt you for a terminal type if the baud rate is greater than 1200 (say, 9600 for a terminal connected by an RS-232 line), and use a Wyse® 50 by default. If the baud rate is less than or equal to 1200, it will select a 2621. Note the placement of the question mark, and the quotes to protect the > and ? from interpretation by the shell.

```
set noglob
eval 'tset -s -m 'switch>1200:?wy' -m 'switch<=1200:2621''
unset noglob
```

EXAMPLE 3  Selecting the terminal used most often
The following entry is appropriate if you always dial up, always at the same baud rate, on many different kinds of terminals, and the terminal you use most often is an adm3a.

```
set noglob
eval 'tset -s ?adm3a'
unset noglob
```

EXAMPLE 4  Selecting a terminal with specific settings
The following example quietly sets the erase character to BACKSPACE, and kill to CTRL-U. If the port is switched, it selects a Concept™ 100 for speeds less than or equal to 1200, and asks for the terminal type otherwise (the default in this case is a Wyse 50). If the port is a direct dialup, it selects Concept 100 as the terminal type. If logging in over the ARPANET, the terminal type selected is a Datamedia® 2500 terminal or emulator. Note the backslash escaping the NEWLINE at the end of the first line in the example.

```
set noglob
eval 'tset -e -k^U -Q -s -m 'switch<=1200:concept100'' -m\n   'switch:?wy' -m dialup:concept100 -m arpanet:dm2500'
```
Selecting a terminal with specific settings  

(Continued)

unset noglob

**Files**

- .login
- .profile
- /etc/termcap

**Attributes**

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>

**See Also**

csh(1), sh(1), stty(1), vi(1), attributes(5), environ(5)

**Notes**

The tset command is one of the first commands a user must master when getting started on a UNIX system. Unfortunately, it is one of the most complex, largely because of the extra effort the user must go through to get the environment of the login shell set. Something needs to be done to make all this simpler, either the login program should do this stuff, or a default shell alias should be made, or a way to set the environment of the parent should exist.

This program cannot intuit personal choices for erase, interrupt and line kill characters, so it leaves these set to the local system standards.

It could well be argued that the shell should be responsible for ensuring that the terminal remains in a sane state; this would eliminate the need for the reset program.
Name  tsort – topological sort

Synopsis  tsort [file]

Description  The tsort command produces on the standard output a totally ordered list of items consistent with a partial ordering of items mentioned in the input file.

The input consists of pairs of items (non-empty strings) separated by blanks. Pairs of different items indicate ordering. Pairs of identical items indicate presence, but not ordering.

Operands  The following operand is supported:

  file   A path name of a text file to order. If no file operand is given, the standard input is used.

Examples  EXAMPLE 1  An example of the tsort command

The command:

example% tsort <<EOF
 a b c c d e
 g g
 f g e f
 EOF

produces the output:

a
b
c
d
e
f
g

Environment Variables  See environ(5) for descriptions of the following environment variables that affect the execution of tsort: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status  The following exit values are returned:

  0   Successful completion.

 >0   An error occurred.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>ATTRIBUTE TYPE</td>
<td>ATTRIBUTE VALUE</td>
</tr>
<tr>
<td>--------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also  `lorder(1), attributes(5), environ(5), standards(5)`

Diagnostics  `Odd data`: there are an odd number of fields in the input file.
Name  tty – return user's terminal name

Synopsis  /usr/bin/tty [-l] [-s]

Description  The tty utility writes to the standard output the name of the terminal that is open as standard input. The name that is used is equivalent to the string that would be returned by the ttyname(3C) function.

Options  The following options are supported:

- `l`  Prints the synchronous line number to which the user's terminal is connected, if it is on an active synchronous line.
- `s`  Inhibits printing of the terminal pathname, allowing one to test just the exit status.

Environment Variables  See environ(5) for descriptions of the following environment variables that affect the execution of tty: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status  The following exit values are returned:

- 0  Standard input is a terminal.
- 1  Standard input is not a terminal.
- >1  An error occurred.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>standards(5)</td>
</tr>
</tbody>
</table>

See Also  isatty(3C), ttyname(3C), attributes(5), environ(5), standards(5)

Diagnostics  
- not on an active synchronous line  The standard input is not a synchronous terminal and -l is specified.
- not a tty  The standard input is not a terminal and -s is not specified.

Notes  The -s option is useful only if the exit status is wanted. It does not rely on the ability to form a valid path name. Portable applications should use test -t.
**Name**

`type` – write a description of command type

**Synopsis**

`type name ...`

**Description**

The `type` utility indicates how each `name` operand would be interpreted if used as a command. `type` displays information about each operand identifying the operand as a shell built-in, function, alias, hashed command, or keyword, and where applicable, may display the operand's path name.

There is also a shell built-in version of `type` that is similar to the `type` utility.

**Operands**

The following operand is supported:

`name` A name to be interpreted.

**Environment Variables**

See `environ(5)` for descriptions of the following environment variables that affect the execution of `type`: `LANG`, `LC_ALL`, `LC_CTYPE`, `LC_MESSAGES`, and `NLSPATH`.

`PATH` Determine the location of `name`.

**Exit Status**

The following exit values are returned:

- `0` Successful completion.
- `>0` An error occurred.

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability Type</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See <code>standards(5)</code>.</td>
</tr>
</tbody>
</table>

**See Also**

`typeset(1), attributes(5), environ(5), standards(5)`
**Name**

typeset, whence – shell built-in functions to set/get attributes and values for shell variables and functions

**Synopsis**


whence [-p-v] name...

**Description**

typeset sets attributes and values for shell variables and functions. When typeset is invoked inside a function, a new instance of the variables name is created. The variables value and type are restored when the function completes. The following list of attributes is supported:

- **-C**
  Compound variable. Each name is a compound variable. If value names a compound variable it is copied to name. Otherwise if the variable already exists, it is first to be unset

- **-D**
  Reserved for future use.

- **-H**
  Provide UNIX to hostname file mapping on non-UNIX machines.

- **-L**
  Left justify and remove leading blanks from value. If n is non-zero it defines the width of the field. Otherwise, it is determined by the width of the value of first assignment. When the variable is assigned to, it is filled on the right with blanks or truncated, if necessary, to fit into the field. Leading zeros are removed if the -Z flag is also set. The -R flag is turned off.

- **-R**
  Right justify and fill with leading blanks. If n is non-zero it defines the width of the field, otherwise it is determined by the width of the value of first assignment. The field is left filled with blanks or truncated from the end if the variable is reassigned. The -L flag is turned off.

- **-Z**
  Right justify and fill with leading zeros if the first non-blank character is a digit and the -L flag has not been set. If n is non-zero it defines the width of the field. Otherwise, it is determined by the width of the value of first assignment.

- **-f**
  All uppercase characters are converted to lowercase. The uppercase flag, -u is turned off.

  The FPATH variable is searched to find the function definition when the function is referenced. The flag -x allows the function definition to remain in effect across shell procedures invoked by name.

- **-i**
  Parameter is an integer. This makes arithmetic faster. If n is non-zero it defines the output arithmetic base. Otherwise, the first assignment determines the output base.

- **-l**
  All uppercase characters are converted to lowercase. The uppercase flag, -u is turned off.

- **-m**
  Move. The value is the name of a variable whose value is moved to name. The original variable is unset. Cannot be used with any other options.
The specified names are marked read-only and these names cannot be changed by subsequent assignment.

- t Tags the variables. Tags are user definable and have no special meaning to the shell.

- u All lowercase characters are converted to uppercase characters. The lowercase flag, - l is turned off.

- x The specified names are marked for automatic export to the environment of subsequently-executed commands.

The i attribute cannot be specified along with - R, - L, - Z, or - f.

Using + rather than - causes these flags to be turned off. If no name arguments are specified but flags are specified, a list of names (and optionally the values) of the variables which have these flags set is printed. Using + rather than - keeps the values from being printed. If no names and flags are specified, the names and attributes of all variables are printed.

For each name, whence indicates how it would be interpreted if used as a command name.

The - v flag produces a more verbose report.

The - p flag does a path search for name even if name is an alias, a function, or a reserved word.

On this manual page, ksh(1) commands that are preceded by one or two * (asterisks) are treated specially in the following ways:

1. Variable assignment lists preceding the command remain in effect when the command completes.
2. I/O redirections are processed after variable assignments.
3. Errors cause a script that contains them to abort.
4. Words, following a command preceded by ** that are in the format of a variable assignment, are expanded with the same rules as a variable assignment. This means that tilde substitution is performed after the = sign and word splitting and file name generation are not performed.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  ksh(1), ksh88(1), set(1), sh(1), attributes(5)
ul(1)

Name   ul – do underlining

Synopsis  ul [-i] [-t terminal] [filename]...

Description  ul reads the named filenames (or the standard input if none are given) and translates
occurrences of underscores to the sequence which indicates underlining for the terminal in
use, as specified by the environment variable TERM. ul uses the /usr/share/lib/terminfo
entry to determine the appropriate sequences for underlining. If the terminal is incapable of
underlining, but is capable of a standout mode then that is used instead. If the terminal can
overstrike, or handles underlining automatically, ul degenerates to cat(1). If the terminal
cannot underline, underlining is ignored.

Options  -t terminal  Override the terminal kind specified in the environment. If the terminal
cannot underline, underlining is ignored. If the terminal name is not found, no
underlining is attempted.

-i     Indicate underlining by a separate line containing appropriate dashes ‘−’; this
       is useful when you want to look at the underlining which is present in an
       nroff(1) output stream on a CRT-terminal.

Return Values  ul returns exit code 1 if the file specified is not found.

Files  /usr/share/lib/terminfo/*

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>text/doctools</td>
</tr>
</tbody>
</table>

See Also  cat(1), man(1), nroff(1), attributes(5)

Bugs  nroff usually generates a series of backspaces and underlines intermixed with the text to
indicate underlining. ul makes attempt to optimize the backward motion.
umask(1)

Name umask – get or set the file mode creation mask

Synopsis /usr/bin/umask [-S] [mask]

sh umask [0oo]
csh umask [0oo]
ksh88 umask [-S] [mask]
ksh umask [-S] [mask]

Description The umask utility sets the file mode creation mask of the current shell execution environment to the value specified by the mask operand. This mask affects the initial value of the file permission bits of subsequently created files. If umask is called in a subshell or separate utility execution environment, such as one of the following:

(umask 002)
nohup umask ...
find . -exec umask ...

it does not affect the file mode creation mask of the caller's environment. For this reason, the /usr/bin/umask utility cannot be used to change the umask in an ongoing session. Its usefulness is limited to checking the caller's umask. To change the umask of an ongoing session you must use one of the shell builtins.

If the mask operand is not specified, the umask utility writes the value of the invoking process's file mode creation mask to standard output.

sh The user file-creation mode mask is set to 000. The three octal digits refer to read/write/execute permissions for owner, group, and other, respectively (see chmod(1), chmod(2), and umask(2)). The value of each specified digit is subtracted from the corresponding “digit” specified by the system for the creation of a file (see creat(2)). For example, umask 022 removes write permission for group and other. Files (and directories) normally created with mode 777 become mode 755. Files (and directories) created with mode 666 become mode 644.

- If 000 is omitted, the current value of the mask is printed.
- umask is recognized and executed by the shell.
- umask can be included in the user’s .profile (see profile(4)) and invoked at login to automatically set the user’s permissions on files or directories created.

csh See the description above for the Bourne shell (sh)umask built-in.

ksh88 The user file-creation mask is set to mask. mask can either be an octal number or a symbolic value as described in chmod(1). If a symbolic value is given, the new umask value is the complement of the result of applying mask to the complement of the previous umask value. If mask is omitted, the current value of the mask is printed.
umask

```plaintext
setsthefilecreationmaskofthecurrentshellexecutionenvironmenttothevalue
specifiedbythemaskoperand.Thismaskaffectsthefilepermissionbitsofsubsequently
createdfiles.maskcaneitherbeanoctalnumberorasymbolicvaluedescribedin
chmod(1).Ifasymbolicvalueisspecified,thenewfilecreationmaskisthecomplementofthe
resultofapplyingmasktothecomplementofthecurrentfilecreationmask.Ifmaskisnot
specified,umaskwritesthevalueofthefilecreationmaskforthecurrentprocess tostandard
output.

Options

ksh88 The following option is supported for /usr/bin/umask and umask in ksh88:

- S Produces symbolic output.

The default output style is unspecified, but will be recognized on a subsequent invocation of
umask on the same system as a mask operand to restore the previous file mode creation mask.

ksh The following option is supported in ksh:

- S Causes the file creation mask to be written or treated as a symbolic value rather than an
  octal number.

Operands

The following operand is supported:

mask A string specifying the new file mode creation mask. The string is treated in the same
wayas the mode operand described in the chmod(1) manual page.

For a symbolic_mode value, the new value of the file mode creation mask is the
logical complement of the file permission bits portion of the file mode specified by
the symbolic_mode string.

In a symbolic_mode value, the permissions op characters + and − are interpreted
relative to the current file mode creation mask. + causes the bits for the indicated
permissions to be cleared in the mask. − causes the bits of the indicated permissions
to be set in the mask.

The interpretation of mode values that specify file mode bits other than the file
permission bits is unspecified.

The file mode creation mask is set to the resulting numeric value.

The default output of a prior invocation of umask on the same system with no
operand will also be recognized as a mask operand. The use of an operand obtained
in this way is not obsolescent, even if it is an octal number.

Output When the mask operand is not specified, the umask utility will write a message to standard
output that can later be used as a umask mask operand.
```
If -S is specified, the message will be in the following format:

"u=%s, g=%s, o=%s
other permissions"

where the three values will be combinations of letters from the set \{r, w, x\}. The presence of a letter will indicate that the corresponding bit is clear in the file mode creation mask.

If a mask operand is specified, there will be no output written to standard output.

**Examples**

**EXAMPLE 1** Using the `umask` Command

The examples in this section refer to the `/usr/bin/umask` utility and the `ksh88 umask` builtin.

Either of the commands:

```
umask a=rx,ug+w
umask 002
```

sets the mode mask so that subsequently created files have their `S_IWOTH` bit cleared.

After setting the mode mask with either of the above commands, the `umask` command can be used to write the current value of the mode mask:

```
example$ umask
0002
```

The output format is unspecified, but historical implementations use the obsolescent octal integer mode format.

```
example$ umask -S
u=rwx,g=rwx,o=rx
```

Either of these outputs can be used as the mask operand to a subsequent invocation of the `umask` utility.

Assuming the mode mask is set as above, the command:

```
umask g-w
```

sets the mode mask so that subsequently created files have their `S_IWGRP` and `S_IWOTH` bits cleared.

The command:

```
umask --w
```

sets the mode mask so that subsequently created files have all their write bits cleared. Notice that `mask` operands `r`, `w`, `x`, or anything beginning with a hyphen (-), must be preceded by – to keep it from being interpreted as an option.
See environ(5) for descriptions of the following environment variables that affect the execution of umask: LANG, LC_ALL, LC_COLLATELC_CTYPE, LC_MESSAGES, and NLSPATH.

**Exit Status**

The following exit values are returned:

- 0  The file mode creation mask was successfully changed, or no mask operand was supplied.
- >0  An error occurred.

**Attributes**

See attributes(5) for descriptions of the following attributes:

### /usr/bin/umask, csh, ksh88, sh

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

### ksh

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Volatile</td>
</tr>
</tbody>
</table>

**See Also**

chmod(1), csh(1), ksh(1), ksh88(1), sh(1), chmod(2), creat(2), umask(2), profile(4), attributes(5), environ(5), standards(5)
uname(1)

Name
uname – print name of current system

Synopsis
uname [-aimnprsvX]
uname [-S system_name]

Description
The uname utility prints information about the current system on the standard output. When options are specified, symbols representing one or more system characteristics will be written to the standard output. If no options are specified, `uname` prints the current operating system’s name. The options print selected information returned by `uname(2)`, `sysinfo(2)`, or both.

Options
The following options are supported:

- `-a`
  Prints basic information currently available from the system.

- `-i`
  Prints the name of the platform. For machines of the sun4v architecture, the `-i` option returns: `sun4v`. Use `prtconf(1M)` with the `-b` option to obtain the platform name for a sun4v machine.

- `-m`
  Prints the machine hardware name (class). Use of this option is discouraged. Use `uname -p` instead. See NOTES section below.

- `-n`
  Prints the nodename (the nodename is the name by which the system is known to a communications network).

- `-p`
  Prints the current host’s ISA or processor type.

- `-r`
  Prints the operating system release level.

- `-s`
  Prints the name of the operating system. This is the default.

- `-S system_name`
  The nodename may be changed by specifying a system name argument. The system name argument is restricted to SYS_NMLN characters. SYS_NMLN is an implementation specific value defined in `<sys/utsname.h>`. Only the super-user is allowed this capability. This change does not persist across reboots of the system.

- `-v`
  Prints the operating system version.

- `-X`
  Prints expanded system information, one information element per line, as expected by SCO UNIX. The displayed information includes:

  - system name, node, release, version, machine, and number of CPUs.
BusType, Serial, and Users (set to unknown in Solaris)
OEM# and Origin# (set to 0 and 1, respectively)

**Examples**

**EXAMPLE 1** Printing the OS Name and Release Level

The following command prints the operating system name and release level, separated by one
SPACE character:

```
example% uname -sr
```

**Environment Variables**

See `environ(5)` for descriptions of the following environment variables that affect the
execution of `uname`: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

**Exit Status**

The following exit values are returned:

0
  Successful completion.

>0
  An error occurred.

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See <code>standards(5)</code></td>
</tr>
</tbody>
</table>

**See Also** `arch(1), isalist(1), prtconf(1M), sysinfo(2), uname(2), nodename(4), attributes(5),
environ(5), standards(5)`

**Notes**

Independent software vendors (ISVs) and others who need to determine detailed
characteristics of the platform on which their software is either being installed or executed
should use the `uname` command.

To determine the operating system name and release level, use `uname -sr`. To determine only
the operating system release level, use `uname -r`. Notice that operating system release levels are
not guaranteed to be in x.y format (such as 5.3, 5.4, 5.5, and so forth); future releases could be
in the x.y.z format (such as 5.3.1, 5.3.2, 5.4.1, and so forth).

In SunOS 4.x releases, the `arch(1)` command was often used to obtain information similar to
that obtained by using the `uname` command. The `arch(1)` command output `sun4` was often
incorrectly interpreted to signify a SunOS SPARC system. If hardware platform information is
desired, use `uname -sp`. 
The `arch -k` and `uname -m` commands return equivalent values; however, the use of either of these commands by third party programs is discouraged, as is the use of the `arch` command in general. To determine the machine's Instruction Set Architecture (ISA or processor type), use `uname` with the `-p` option.
unifdef – resolve and remove ifdef-ed lines from C program source

**Synopsis**

`unifdef [-clt] [-Dname] [-Uname] [-iDname] [-iUname] ... [filename]`

**Description**

`unifdef` removes ifdef-ed lines from a file while otherwise leaving the file alone. It is smart enough to deal with the nested ifdefs, comments, single and double quotes of C syntax, but it does not do any including or interpretation of macros. Neither does it strip out comments, though it recognizes and ignores them. You specify which symbols you want defined with `-D` options, and which you want undefined with `-U` options. Lines within those ifdefs will be copied to the output, or removed, as appropriate. Any `ifdef`, `ifndef`, `else`, and `endif` lines associated with `filename` will also be removed.

ifdefs involving symbols you do not specify are untouched and copied out along with their associated `ifdef`, `else`, and `endif` lines.

If an `ifdef X` occurs nested inside another `ifdef X`, then the inside `ifdef` is treated as if it were an unrecognized symbol. If the same symbol appears in more than one argument, only the first occurrence is significant.

`unifdef` copies its output to the standard output and will take its input from the standard input if no `filename` argument is given.

**Options**

The following options are supported:

- `-c` Complement the normal operation. Lines that would have been removed or blanked are retained, and vice versa.
- `-l` Replace “lines removed” lines with blank lines.
- `-t` Plain text option. `unifdef` refrains from attempting to recognize comments and single and double quotes.
- `-Dname` Lines associated with the defined symbol `name`.
- `-Uname` Lines associated with the undefined symbol `name`.
- `-iDname` Ignore, but print out, lines associated with the defined symbol `name`. If you use ifdefs to delimit non-C lines, such as comments or code which is under construction, then you must tell `unifdef` which symbols are used for that purpose so that it will not try to parse for quotes and comments within them.
- `-iUname` Ignore, but print out, lines associated with the undefined symbol `name`.

**Exit Status**

The following exit values are returned:

- `0` Successful operation.
- `1` Operation failed.
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/base-developer-utilities</td>
</tr>
</tbody>
</table>

See Also  diff(1), attributes(5)

Diagnostics  Premature EOF   Inappropriate else or endif.
**uniq** reads an input, comparing adjacent lines, and writing one copy of each input line on the output. The second and succeeding copies of the repeated adjacent lines are not written.

If the output file, `output_file`, is not specified, `uniq` writes to standard output. If no `input_file` is given, or if the `input_file` is `-`, `uniq` reads from standard input with the start of the file is defined as the current offset.

The following options are supported:

- **-c** Precedes each output line with a count of the number of times the line occurred in the input.
- **-d** Suppresses the writing of lines that are not repeated in the input.
- **-f** Ignores the first `fields` fields on each input line when doing comparisons, where `fields` is a positive decimal integer. A field is the maximal string matched by the basic regular expression:
  
  `[:blank:]*[^[:blank:]]*`
  
  If `fields` specifies more `fields` than appear on an input line, a null string are used for comparison.
- **-s** Ignores the first `chars` characters when doing comparisons, where `chars` is a positive decimal integer. If specified in conjunction with the `-f` option, the first `chars` characters after the first `fields` fields are ignored. If `chars` specifies more characters than remain on an input line, a null string are used for comparison.
- **-u** Suppresses the writing of lines that are repeated in the input.
- **-n** Equivalent to `-f fields` with `fields` set to `n`.
- **+m** Equivalent to `-s chars` with `chars` set to `m`.

The following operands are supported:

- **input_file** A path name of the input file. If `input_file` is not specified, or if the `input_file` is `−`, the standard input is used.
- **output_file** A path name of the output file. If `output_file` is not specified, the standard output is used. The results are unspecified if the file named by `output_file` is the file named by `input_file`.  

**uniq(1)**

---

**Name** uniq – report or filter out repeated lines in a file

**Synopsis**

```
/usr/bin/uniq [ -c | -d | -u ] [ -f fields ] [ -s char ]
[ input_file  [output_file]]
```

```
/usr/bin/uniq [ -c | -d | -u ] [ -n ] [ +m ]
[ input_file  [output_file]]
```

**Description**

uniq reads an input, comparing adjacent lines, and writing one copy of each input line on the output. The second and succeeding copies of the repeated adjacent lines are not written.

If the output file, `output_file`, is not specified, `uniq` writes to standard output. If no `input_file` is given, or if the `input_file` is `-`, `uniq` reads from standard input with the start of the file is defined as the current offset.

**Options**

The following options are supported:

- **-c** Precedes each output line with a count of the number of times the line occurred in the input.
- **-d** Suppresses the writing of lines that are not repeated in the input.
- **-f** Ignores the first `fields` fields on each input line when doing comparisons, where `fields` is a positive decimal integer. A field is the maximal string matched by the basic regular expression:
  
  `[:blank:]*[^[:blank:]]*`
  
  If `fields` specifies more `fields` than appear on an input line, a null string are used for comparison.
- **-s** Ignores the first `chars` characters when doing comparisons, where `chars` is a positive decimal integer. If specified in conjunction with the `-f` option, the first `chars` characters after the first `fields` fields are ignored. If `chars` specifies more characters than remain on an input line, a null string are used for comparison.
- **-u** Suppresses the writing of lines that are repeated in the input.
- **-n** Equivalent to `-f fields` with `fields` set to `n`.
- **+m** Equivalent to `-s chars` with `chars` set to `m`.

**Operands**

The following operands are supported:

- **input_file** A path name of the input file. If `input_file` is not specified, or if the `input_file` is `−`, the standard input is used.
- **output_file** A path name of the output file. If `output_file` is not specified, the standard output is used. The results are unspecified if the file named by `output_file` is the file named by `input_file`.  

**uniq(1)**
**Examples**

**EXAMPLE 1** Using the uniq Command

The following example lists the contents of the uniq.test file and outputs a copy of the repeated lines.

```
ex ample% cat uniq.test
This is a test.
This is a test.
TEST.
Computer.
TEST.
TEST.
Software.
```

```
ex ample% uniq -d uniq.test
This is a test.
TEST.
ex ample%
```

The next example outputs just those lines that are not repeated in the uniq.test file.

```
ex ample% uniq -u uniq.test
TEST.
Computer.
Software.
ex ample%
```

The last example outputs a report with each line preceded by a count of the number of times each line occurred in the file:

```
ex ample% uniq -c uniq.test
  2 This is a test.
  1 TEST.
  1 Computer.
  2 TEST.
  1 Software.
ex ample%
```

**Environment Variables**

See `envir on(5)` for descriptions of the following environment variables that affect the execution of uniq: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

**Exit Status**

The following exit values are returned:

- **0**  Successful completion.
- **>0**  An error occurred.
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also  comm(1), pack(1), pcat(1), sort(1), uncompress(1), attributes(5), environ(5), standards(5)
units(1)

Name  units – converts quantities expressed in standard scales to other scales

Synopsis  units

Description  units converts quantities expressed in various standard scales to their equivalents in other scales. It works interactively in this fashion:

You have:~~inch
You want:~~cm
   *  2.540000e+00
   /  3.937008e−01

A quantity is specified as a multiplicative combination of units optionally preceded by a numeric multiplier. Powers are indicated by suffixed positive integers, division by the usual sign:

You have:~~15 lbs force/in2
You want:~~atm
   *  1.020689e+00
   /  9.797299e−01

units only does multiplicative scale changes; thus it can convert Kelvin to Rankine, but not Celsius to Fahrenheit. Most familiar units, abbreviations, and metric prefixes are recognized, together with a generous leavening of exotica and a few constants of nature including:

pi  ratio of circumference to diameter,
c  speed of light,
e  charge on an electron,
g  acceleration of gravity,
force same as g,
mole  Avogadro’s number,
water pressure head per unit height of water,
au  astronomical unit.

Pound is not recognized as a unit of mass; lb is. Compound names are run together, (for example, Lightyear). British units that differ from their U.S. counterparts are prefixed thus:
brgallon. For a complete list of units, type:

cat /usr/share/lib/unittab

Files  /usr/share/lib/unittab

Attributes  See attributes(5) for descriptions of the following attributes:
### Availability system/core-os

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

**See Also**  [attributes(5)](https://www.kernel.org/doc/man-pages/section5/attributes.html)
unix2dos(1)

Name  unix2dos – convert text file from ISO format to DOS format

Synopsis  unix2dos [-ascii] [-iso] [-7]
             [-437 | -850 | -860 | -863 | -865] originafile convertedfile

Description  The unix2dos utility converts ISO standard characters to the corresponding characters in the
              DOS extended character set.

This command may be invoked from either DOS or SunOS. However, the filenames must
conform to the conventions of the environment in which the command is invoked.

If the original file and the converted file are the same, unix2dos will rewrite the original file
after converting it.

Options  The following options are supported:

-ascii    Adds carriage returns and converts end of file characters in SunOS format text files
to conform to DOS requirements.

-iso      This is the default. Converts ISO standard characters to the corresponding
character in the DOS extended character set.

-7        Converts 8 bit SunOS characters to 7 bit DOS characters.

On non-i386 systems, unix2dos will attempt to obtain the keyboard type to determine which
code page to use. Otherwise, the default is US. The user may override the code page with one
of the following options:

-437      Use US code page

-850      Use multilingual code page

-860      Use Portuguese code page

-863      Use French Canadian code page

-865      Use Danish code page

Operands  The following operands are required:

originalfile  The original file in ISO format that is being converted to DOS format.

convertedfile  The new file in DOS format that has been converted from the original ISO
file format.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>
File filename not found, or no read permission
   The input file you specified does not exist, or you do not have read permission. Check with the SunOS command, ls -l (see ls(1)).

Bad output filename filename, or no write permission
   The output file you specified is either invalid, or you do not have write permission for that file or the directory that contains it. Check also that the drive is not write-protected.

Error while writing to temporary file
   An error occurred while converting your file, possibly because there is not enough space on the current drive. Check the amount of space on the current drive using the DIR command. Also be certain that the default drive is write-enabled (not write-protected). When this error occurs, the original file remains intact.

Translated tmpfile name = filename.
Could not rename tmpfile to filename.
   The program could not perform the final step in converting your file. Your converted file is stored under the name indicated on the second line of this message.
**updatehome(1)**

<table>
<thead>
<tr>
<th>Name</th>
<th>updatehome – update the home directory copy and link files for the current label</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synopsis</td>
<td>/usr/bin/updatehome [-cirs]</td>
</tr>
<tr>
<td>Description</td>
<td>updatehome reads the user's minimum-label copy and link-control files (.copy_files and .link_files). These files contain a list of files to be copied and symbolically linked from the user's minimum-label home directory to the user's home directory at the current label. By default, the minimum user label is specified in label_encodings(4), and can be explicitly specified in user_attr(4). When created using txzonemgr(1M), the public zone is assigned the default minimum label, and is configured as a multilevel NFS server. An authorized administrator in the public zone can use the share(1M) command to export home directories, so that they can be mounted in read-only mode by higher-level zones. Additional zones created by means of txzonemgr(1M) are configured with an automount(1M) entry that mounts the public zone's home directories at /zone/public/home. If the user's minimum home directory has been shared in this fashion, a user can run the updatehome command in higher-level zones, either manually or by executing it in a startup file. For example, the user probably wants a symbolic link to such files as .profile, .login, .cshrc, .exrc, .mailrc, and ~/bin. The updatehome command provides a convenient mechanism for accomplishing this symlink. The user can add files to those to be copied (.copy_files) and to those to be symbolically linked (.link_files).</td>
</tr>
<tr>
<td>Options</td>
<td>-c Replace existing home-directory copies at the current label. The default is to skip over existing copies.</td>
</tr>
<tr>
<td></td>
<td>-i Ignore errors encountered. The default aborts on error.</td>
</tr>
<tr>
<td></td>
<td>-r Replace existing home-directory copies or symbolic links at the current label. This option implies options -c and -s. The default is to skip over existing copies or symbolic links.</td>
</tr>
<tr>
<td></td>
<td>-s Replace existing home-directory symbolic links at the current label. The default is to skip over existing symbolic links.</td>
</tr>
<tr>
<td>Exit Status</td>
<td>Upon success, updatehome returns 0. Upon failure, updatehome returns 1 and writes diagnostic messages to standard error.</td>
</tr>
<tr>
<td>Examples</td>
<td>EXAMPLE 1 A Sample .copy_files File</td>
</tr>
<tr>
<td></td>
<td>The files that are listed in .copy_files can be modified at every user's label.</td>
</tr>
<tr>
<td></td>
<td>.cshrc</td>
</tr>
<tr>
<td></td>
<td>.mailrc</td>
</tr>
<tr>
<td></td>
<td>.mozilla/bookmarks.html</td>
</tr>
<tr>
<td></td>
<td>EXAMPLE 2 A Sample .link_files File</td>
</tr>
<tr>
<td></td>
<td>The files that are listed in .link_files can be modified at the lowest label. The changes propagate to the other labels that are available to the user.</td>
</tr>
</tbody>
</table>
EXAMPLE 2  A Sample .link_files File  (Continued)

```
~/bin
.mozilla/preferences
.xrc
.rhosts
```

EXAMPLE 3  Updating the Linked and Copied Files

The .copy_files and .link_files were updated by the user at the minimum label. At a higher label, the user refreshes the copies and the links. No privileges are required to run the command.

```
% updatehome -r
```

**Files**

- $HOME/.copy_files  List of files to be copied
- $HOME/.link_files  List of files to be symbolically linked

**Attributes**  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/trusted</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

**See Also**  automount(1M), share(1M), txzonemgr(1M), label_encodings(4), user_attr(4), attributes(5)

“.copy_files and .link_files Files” in Trusted Extensions Configuration and Administration

**Notes**  The functionality described on this manual page is available only if the system is configured with Trusted Extensions.
uptime(1)

Name uptime – show how long the system has been up

Synopsis uptime

Description The uptime command prints the current time, the length of time the system has been up, and the average number of jobs in the run queue over the last 1, 5 and 15 minutes. It is, essentially, the first line of a w(1) command.

Examples Below is an example of the output uptime provides:

    example% uptime
    10:47am up 27 day(s), 50 mins, 1 user, load average: 0.18, 0.26, 0.20

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also w(1), who(1), who do(1M), attributes(5)

Notes who -b gives the time the system was last booted.
userattr(1)

Name  userattr – print attribute value granted to a user or role

Synopsis  userattr [-v] attribute_name [user]

Description  The userattr command prints on standard output the first value found for the attribute attribute_name. If user is not specified, the user is taken from the real user ID of the process. Attribute names are those found defined in user_attr(4) and prof_attr(4). Use the profiles(1) command for the profiles assigned to a user. Use the auths(1) command for the authorizations assigned to a user. The order of search is the user's user_attr entry followed by the user's profiles.

If the attribute, attribute_name, is not assigned to the user, and for any errors, userattr returns a non-zero exit code. Otherwise, userattr returns a zero exit code.

The -v option additionally prints where the attribute was found.

Examples  EXAMPLE 1  Using userattr

```
example% userattr lock_after_retries root
no
```

Files  /etc/user_attr

/etc/security/policy.conf

/etc/security/prof_attr

Exit Status  The following exit values are returned:

- 0  Successful completion.
- 1  An error occurred.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>See below.</td>
</tr>
</tbody>
</table>

The exit code is Committed. The output for the -v option is Not-an-Interface.

See Also  auths(1), profiles(1), policy.conf(4), prof_attr(4), user_attr(4), attributes(5)
Name  users – display a compact list of users logged in

Synopsis  /usr/ucb/users [filename]

Description  The users utility lists the login names of the users currently on the system in a compact, one-line format.

Specifying filename tells users where to find its information; by default it checks /var/adm/utmpx.

Typing users is equivalent to typing who -q.

Examples  EXAMPLE 1  Listing current users

example% users
paul  george  ringo
example%

Files  /var/adm/utmpx

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>

See Also  who(1), attributes(5)
The `uucp` utility copies files named by the `source-file` arguments to the `destination-file` argument.

The `uulog` utility queries a log file of `uucp` or `uuxqt` transactions in file `/var/uucp/.Log/uucico/system` or `/var/uucp/.Log/uuxqt/system`.

The `uname` utility lists the names of systems known to `uucp`.

### Options

#### uucp

The following options are supported by `uucp`:

- `-c` Does not copy local file to the spool directory for transfer to the remote machine (default).
- `-C` Forces the copy of local files to the spool directory for transfer.
- `-d` Makes all necessary directories for the file copy (default).
- `-f` Does not make intermediate directories for the file copy.
- `-g grade` `grade` can be either a single letter, number, or a string of alphanumeric characters defining a service grade. The `uuglist` command can determine whether it is appropriate to use the single letter, number, or a string of alphanumeric characters as a service grade. The output from the `uuglist` command is a list of service grades that are available, or a message that says to use a single letter or number as a grade of service.
- `-j` Prints the `uucp` job identification string on standard output. This job identification can be used by `uustat` to obtain the status of a `uucp` job or to terminate a `uucp` job. The `uucp` job is valid as long as the job remains queued on the local system.
- `-m` Sends mail to the requester when the copy is complete.
- `-n user` Notifies `user` on the remote system that a file was sent.

When multiple `-n` options are passed in, `uucp` only retains the value specified for the last `-n` option. This is the only user notified.

- `-r` Does not start the file transfer, just queue the job.
The following options cause uulog to print logging information:

- `-s sys` Prints information about file transfer work involving system `sys`.
- `-t system` Executes a `tail -f` command of the file transfer log for `system`. You must press `BREAK` to exit this function.

Other options used in conjunction with the above options are:

- `-x` Looks in the `uuxqt` log file for the given system.
- `-number` Executes a `tail` command of `number` lines.

The source file name may be a path name on your machine, or may have the form:

```
source_name!pathname
```

where `source_name` is taken from a list of system names that `uucp` knows about. `source_file` is restricted to no more than one `source_name`. The destination `system_name` may also include a list of system names such as

```
system_name!system_name!...!system_name!pathname
```

In this case, an attempt is made to send the file, using the specified route, to the destination. Care should be taken to ensure that intermediate nodes in the route are willing to forward information. See NOTES for restrictions.

For C-Shell users, the exclamation point (!) character must be surrounded by single quotes (`'`) or preceded by a backslash (`\`).

The shell metacharacters `?`, `*` and `[...]` appearing in `pathname` are expanded on the appropriate system.

Pathnames may be one of the following:

1. An absolute pathname.
2. A pathname preceded by ~user where user is a login name on the specified system and is replaced by that user's login directory.

3. A pathname preceded by ~/destination where destination is appended to /var/spool/uucppublic. This destination is treated as a filename unless more than one file is being transferred by this request or the destination is already a directory. To ensure that the destination is a directory, follow it with a forward slash (/). For example, ~/dan/ as the destination creates the directory /var/spool/uucppublic/dan if it does not exist and put the requested file(s) in that directory.

Anything else is prefixed by the current directory.

If the result is an erroneous path name for the remote system, the copy fails. If the destination-file is a directory, the last part of the source-file name is used.

Invoking uucp with shell wildcard characters as the remote source-file invokes the uux(1C) command to execute the uucp command on the remote machine. The remote uucp command spools the files on the remote machine. After the first session terminates, if the remote machine is configured to transfer the spooled files to the local machine, the remote machine initiates a call and send the files; otherwise, the user must "call" the remote machine to transfer the files from the spool directory to the local machine. This call can be done manually using Uutry(1M), or as a side effect of another uux(1C) or uucp call.

Notice that the local machine must have permission to execute the uucp command on the remote machine in order for the remote machine to send the spooled files.

uucp removes execute permissions across the transmission and gives 0666 read and write permissions (see chmod(2)).

Environment Variables
See environ(5) for descriptions of the following environment variables that affect the execution of uucp: LANG, LC_ALL, LC_COLLATE, LC_CTYPE, LC_MESSAGES, LC_TIME, NLSPATH, and TZ.

Exit Status
The following exit values are returned:

  0  Successful completion.
  >0  An error occurred.

Files
/etc/uucp/*          other data files
/var/spool/uucp      spool directories
/usr/lib/uucp/*      other program files
/var/spool/uucppublic/* public directory for receiving and sending
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTETYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/uucp</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>
| Standard           | See standards(5).

See Also  mail(1), uuglist(1C), uustat(1C), uux(1C), uutry(1M), uuxqt(1M), chmod(2), attributes(5), environ(5), standards(5)

Notes  For security reasons, the domain of remotely accessible files may be severely restricted. You probably are not able to access files by path name. Ask a responsible person on the remote system to send them to you. For the same reasons you are probably not able to send files to arbitrary path names. As distributed, the remotely accessible files are those whose names begin /var/spool/uucppublic (equivalent to ~/.).

All files received by uucp are owned by uucp.

The -m option only works when sending files or receiving a single file. Receiving multiple files specified by special shell characters ?, &, and [ . . . ] does not activate the -m option.

The forwarding of files through other systems may not be compatible with the previous version of uucp. If forwarding is used, all systems in the route must have compatible versions of uucp.

Protected files and files that are in protected directories that are owned by the requester can be sent by uucp. However, if the requester is root, and the directory is not searchable by "other" or the file is not readable by "other", the request fails.

Strings that are passed to remote systems may not be evaluated in the same locale as the one in use by the process that invoked uucp on the local system.

Configuration files must be treated as C (or POSIX) locale text files.
uuencode(1C)

Name
uuencode, uudecode – encode a binary file, or decode its encoded representation

Synopsis
uuencode [source-file] decodepathname
uuencode [-m] [source-file] decodepathname
uudecode [-p] [encoded-file]
uudecode [-o outfile] [encoded-file]

Description
These commands encode and decode files as follows:

uuencode
The uuencode utility converts a binary file into an encoded representation that can be sent using mail(1). It encodes the contents of source-file, or the standard input if no source-file argument is given. The decodepathname argument is required. The decodepathname argument is included in the encoded file's header as the name of the file into which uuencode is to place the binary (decoded) data. uuencode also includes the permission modes of source-file (except setuid, setgid, and sticky-bits), so that decodepathname is recreated with those same permission modes.

uudecode
The uudecode utility reads an encoded-file, strips off any leading and trailing lines added by mailer programs, and recreates the original binary data with the filename and the mode specified in the header.

The encoded file is an ordinary portable characterset text file; it can be edited by any text editor. It is best only to change the mode or decodepathname in the header to avoid corrupting the decoded binary.

Options
The following options are supported:

uuencode
- m
  Encodes source-file using Base64 encoding and sends it to standard output.

uudecode
- o outfile
  Specifies a file pathname that should be used instead of any pathname contained in the input data. Specifying an outfile option-argument of /dev/stdout indicates standard output. This allows uudecode to be used in a pipeline.

- p
  Decodes encoded-file and sends it to standard output. This allows uudecode to be used in a pipeline.

Operands
The following operands are supported by uuencode and uudecode:

uuencode decodepathname
  The pathname of the file into which the uudecode utility will place the decoded file. If there are characters in decodepathname that are not in the portable filename character set, the results are unspecified.

source-file
  A pathname of the file to be encoded.

uudecode encoded-file
  The pathname of a file containing the output of uuencode.
Usage
See `largefile(5)` for the description of the behavior of `uuencode` and `uudecode` when encountering files greater than or equal to 2 Gbyte ($2^{31}$ bytes).

Environment Variables
See `environ(5)` for descriptions of the following environment variables that affect the execution of `uuencode` and `uudecode`: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Output
`stdout`

The standard output is a text file, encoded in the character set of the current locale, that begins with the line:
```
begin-base64 %s %s
```
mode, decode_pathname

and ends with the line:
```
====
```

In both cases, the lines have no preceding or trailing blank characters.

The encoding process represents 24-bit groups of input bits as output strings of four encoded characters. Proceeding from left to right, a 24-bit input group is formed by concatenating three 8-bit input groups. Each 24-bit input group is then treated as four concatenated 6-bit groups, each of which is translated into a single digit in the Base64 alphabet. When encoding a bit stream by means of the Base64 encoding, the bit stream is presumed to be ordered with the most-significant bit first. That is, the first bit in the stream is the high-order bit in the first byte, and the eighth bit is the low-order bit in the first byte, and so on. Each 6-bit group is used as an index into an array of 64 printable characters, as shown in the following table.

<table>
<thead>
<tr>
<th>Value</th>
<th>Encoding</th>
<th>Value</th>
<th>Encoding</th>
<th>Value</th>
<th>Encoding</th>
<th>Value</th>
<th>Encoding</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>A</td>
<td>17</td>
<td>R</td>
<td>34</td>
<td>i</td>
<td>51</td>
<td>z</td>
</tr>
<tr>
<td>1</td>
<td>B</td>
<td>18</td>
<td>S</td>
<td>35</td>
<td>j</td>
<td>52</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>C</td>
<td>19</td>
<td>T</td>
<td>36</td>
<td>k</td>
<td>53</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>D</td>
<td>20</td>
<td>U</td>
<td>37</td>
<td>l</td>
<td>54</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>E</td>
<td>21</td>
<td>V</td>
<td>38</td>
<td>m</td>
<td>55</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>F</td>
<td>22</td>
<td>W</td>
<td>39</td>
<td>n</td>
<td>56</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>G</td>
<td>23</td>
<td>X</td>
<td>40</td>
<td>o</td>
<td>57</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>H</td>
<td>24</td>
<td>Y</td>
<td>41</td>
<td>p</td>
<td>58</td>
<td>6</td>
</tr>
<tr>
<td>8</td>
<td>I</td>
<td>25</td>
<td>Z</td>
<td>42</td>
<td>q</td>
<td>59</td>
<td>7</td>
</tr>
<tr>
<td>9</td>
<td>J</td>
<td>26</td>
<td>a</td>
<td>43</td>
<td>r</td>
<td>60</td>
<td>8</td>
</tr>
<tr>
<td>10</td>
<td>K</td>
<td>27</td>
<td>b</td>
<td>44</td>
<td>s</td>
<td>61</td>
<td>9</td>
</tr>
<tr>
<td>11</td>
<td>L</td>
<td>28</td>
<td>c</td>
<td>45</td>
<td>t</td>
<td>62</td>
<td>+</td>
</tr>
<tr>
<td>12</td>
<td>M</td>
<td>29</td>
<td>d</td>
<td>46</td>
<td>u</td>
<td>63</td>
<td>/</td>
</tr>
<tr>
<td>13</td>
<td>N</td>
<td>30</td>
<td>e</td>
<td>47</td>
<td>v</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>O</td>
<td>31</td>
<td>f</td>
<td>48</td>
<td>w</td>
<td>(pad)</td>
<td>=</td>
</tr>
<tr>
<td>15</td>
<td>P</td>
<td>32</td>
<td>g</td>
<td>49</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Q</td>
<td>33</td>
<td>h</td>
<td>50</td>
<td>y</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The character referenced by the index is placed in the output string.
The output stream (encoded bytes) is represented in lines of no more than 76 characters each. All line breaks or other characters not found in the table are ignored by decoding software (see uudecode).

Special processing is performed if fewer than 24 bits are available at the end of a message or encapsulated part of a message. A full encoding quantum is always completed at the end of a message. When fewer than 24 input bits are available in an input group, zero bits are added on the right to form an integral number of 6-bit groups. Output character positions that are not required to represent actual input data are set to the equals (=) character. Since all Base64 input is an integral number of octets, only the following cases can arise:

1. The final quantum of encoding input is an integral multiple of 24 bits. Here, the final unit of encoded output is an integral multiple of four characters with no '=' padding.
2. The final quantum of encoding input is exactly 16 bits. Here, the final unit of encoded output is three characters followed by one '=' padding character.
3. The final quantum of encoding input is exactly 8 bits. Here, the final unit of encoded output is two characters followed by two '=' padding characters.

A terminating "====" evaluates to nothing and denotes the end of the encoded data.

The standard output is a text file (encoded in the character set of the current locale) that begins with the line:

```
begin %s %s
mode, decode_pathname
```

and ends with the line:

```
end
```

In both cases, the lines have no preceding or trailing blank characters.

The algorithm that is used for lines between begin and end takes three octets as input and writes four characters of output by splitting the input at six-bit intervals into four octets, containing data in the lower six bits only. These octets are converted to characters by adding a value of 0x20 to each octet, so that each octet is in the range 0x20–0x5f, and each octet is assumed to represent a printable character. Each octet is then translated into the corresponding character codes for the codeset in use in the current locale. For example, the octet 0x41, representing 'A', would be translated to 'A' in the current codeset, such as 0xc1 if the codeset were EBCDIC.

Where the bits of two octets are combined, the least significant bits of the first octet are shifted left and combined with the most significant bits of the second octet shifted right. Thus, the three octets A, B, C are converted into the four octets:

```
0x20 + ((A >> 2) & 0x3F)
0x20 + (((A << 4) & 0xF) & 0x3F)
0x20 + (((B << 2) & 0x3) & 0x3F)
```

The standard output is at text file (encoded in the character set of the current locale) that begins
These octets are then translated into the local character set.

Each encoded line contains a length character, equal to the number of characters to be decoded plus 0x20 translated to the local character set as described above, followed by the encoded characters. The maximum number of octets to be encoded on each line is 45.

**Exit Status** The following exit values are returned:

0 Successful completion.

>0 An error occurred.

**Attributes** See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

**See Also** `mail(1), mailx(1), uucp(1C), uux(1C), attributes(5), environ(5), largefile(5), standards(5)`

**Notes** The size of the encoded file is expanded by 35% (3 bytes become 4, plus control information), causing it to take longer to transmit than the equivalent binary.

The user on the remote system who is invoking `uudecode` (typically `uucp`) must have write permission on the file specified in the `decode_pathname`.

If you invoke `uuencode` and then execute `uudecode` on a file in the same directory, you will overwrite the original file.
**Name**

uuglist – print the list of service grades that are available on this UNIX system

**Synopsis**

`uuglist [-u]`

**Description**

`uuglist` prints the list of service grades that are available on the system to use with the `-g` option of `uucp(1C)` and `uux(1C)`. `-u` List the names of the service grades that the user is allowed to use with the `-g` option of the `uucp` and `uux` commands.

**Files**

`/etc/uucp/Grades` contains the list of service grades

**Attributes**

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/uucp</td>
</tr>
</tbody>
</table>

**See Also**

`uucp(1C), uux(1C), attributes(5)`
# uustat(1C)

## Name
uustat – uucp status inquiry and job control

## Synopsis
```
uustat [ [-m] | [-p] | [-q] | [-k jobid [-n]] | [-r jobid [-n]]]

uustat [-a] [-s system [-j]] [-u user] [-S qric]

uustat -t system [-c] [-d number]
```

## Description
The `uustat` utility functions in the following three areas:

1. Displays the general status of, or cancels, previously specified uucp commands.
2. Provides remote system performance information, in terms of average transfer rates or average queue times.
3. Provides general remote system-specific and user-specific status of uucp connections to other systems.

## Options
The following options are supported:

### General Status
These options obtain general status of, or cancel, previously specified uucp commands:

- `-a`
  Lists all jobs in queue.

- `-j`
  Lists the total number of jobs displayed. The `-j` option can be used in conjunction with the `-a` or the `-s` option.

- `-k jobid`
  Kills the uucp request whose job identification is `jobid`. The killed uucp request must belong to the user issuing the `uustat` command unless the user is the super-user or uucp administrator. If the job is killed by the super-user or uucp administrator, electronic mail is sent to the user.

- `-m`
  Reports the status of accessibility of all machines.

- `-n`
  Suppresses all standard output, but not standard error. The `-n` option is used in conjunction with the `-k` and `-r` options.

- `-p`
  Executes the command `ps -flp` for all the process-ids that are in the lock files.

- `-q`
  Lists the jobs queued for each machine. If a status file exists for the machine, its date, time and status information are reported. In addition, if a number appears in parentheses next to the number of `C` or `X` files, it is the age in days of the oldest `C./X` file for that system. The `Retry` field represents the number of hours until the next possible call. The `Count` is the number of failure attempts. *Note:* For systems with a moderate number of outstanding jobs, this could take 30 seconds or more of real-time to execute. An example of the output produced by the `-q` option is:

```bash
eagle  3C  04/07-11:07  NO DEVICES AVAILABLE
mh3bs3  2C  07/07-10:42  SUCCESSFUL
```

This indicates the number of command files that are waiting for each system. Each command file may have zero or more files to be sent (zero means to call the system...
The date and time refer to the previous interaction with the system followed by the status of the interaction.

- **rjobid** Rejuvenates *jobid*. The files associated with *jobid* are touched so that their modification time is set to the current time. This prevents the cleanup daemon from deleting the job until the jobs' modification time reaches the limit imposed by the daemon.

### Remote System Status

These options provide remote system performance information, in terms of average transfer rates or average queue times. The `-c` and `-d` options can only be used in conjunction with the `-t` option:

- **-t** system
  Reports the average transfer rate or average queue time for the past 60 minutes for the remote *system*. The following parameters can only be used with this option:

- **-c**
  Average queue time is calculated when the `-c` parameter is specified and average transfer rate when `-c` is not specified. For example, the command:
  ```
  example% uustat -teagle -d50 -c
  ```
  produces output in the following format:
  ```
  average queue time to eagle for last 50 minutes:
  5 seconds
  ```
  The same command without the `-c` parameter produces output in the following format:
  ```
  average transfer rate with eagle for last 50 minutes:
  2000.88 bytes/sec
  ```

- **-d** number
  `number` is specified in minutes. Used to override the 60 minute default used for calculations. These calculations are based on information contained in the optional performance log and therefore may not be available. Calculations can only be made from the time that the performance log was last cleaned up.

### User or System-Specific Status

These options provide general remote system-specific and user-specific status of uucp connections to other systems. Either or both of the following options can be specified with uustat. The `-j` option can be used in conjunction with the `-s` option to list the total number of jobs displayed:

- **-s** system
  Reports the status of all uucp requests for remote system *system*.

- **-u** user
  Reports the status of all uucp requests issued by *user*.

Output for both the `-s` and `-u` options has the following format:

<table>
<thead>
<tr>
<th>System</th>
<th>Time</th>
<th>Mode</th>
<th>User</th>
<th>Status</th>
<th>Job ID</th>
<th>File Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>eagleN1bd7</td>
<td>4/07-11:07</td>
<td>S</td>
<td>eagle</td>
<td>dan</td>
<td>522</td>
<td>/home/dan/A</td>
</tr>
<tr>
<td>eagleC1bd8</td>
<td>4/07-11:07</td>
<td>S</td>
<td>eagle</td>
<td>dan</td>
<td>59</td>
<td>D.3b2al2ce4924</td>
</tr>
<tr>
<td></td>
<td>4/07-11:07</td>
<td>S</td>
<td>eagle</td>
<td>dan</td>
<td>rmail</td>
<td>mike</td>
</tr>
</tbody>
</table>
With the above two options, the first field is the *jobid* of the job. This is followed by the date/time. The next field is an S if the job is sending a file or an R if the job is requesting a file. The next field is the machine where the file is to be transferred. This is followed by the user-id of the user who queued the job. The next field contains the size of the file, or in the case of a remote execution (*rmail* is the command used for remote mail), the name of the command. When the size appears in this field, the file name is also given. This can either be the name given by the user or an internal name (for example, D.3b2a1ce4924) that is created for data files associated with remote executions (*rmail* in this example).

*S-qric*  Reports the job state:

- q for queued jobs
- r for running jobs
- i for interrupted jobs
- c for completed jobs

A job is queued if the transfer has not started. A job is running when the transfer has begun. A job is interrupted if the transfer began but was terminated before the file was completely transferred. A completed job is a job that successfully transferred. The completed state information is maintained in the accounting log, which is optional and therefore may be unavailable. The parameters can be used in any combination, but at least one parameter must be specified. The -S option can also be used with -s and -u options. The output for this option is exactly like the output for -s and -u except that the job states are appended as the last output word.

Output for a completed job has the following format:

```
eagleC1bd3 completed
```

When no options are given, *uustat* writes to standard output the status of all *uucp* requests issued by the current user.

### Environment Variables
See *environ(5)* for descriptions of the following environment variables that affect the execution of *uustat*: LANG, LC_ALL, LC_COLLATE, LC_CTYPE, LC_MESSAGES, LC_TIME, NLSPATH, and TZ.

### Exit Status
The following exit values are returned:

- **0** Successful completion.
- **>0** An error occurred.

### Files
- */var/spool/uucp/* spool directories
- */var/uucp/.Admin/account* accounting log
- */var/uucp/.Admin/perflog* performance log
**Attributes**  See *attributes(5)* for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/uucp</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See <em>standards(5)</em></td>
</tr>
</tbody>
</table>

**See Also**  *uucp(1C), attributes(5), environ(5), standards(5)*

**Diagnostics**  The -t option produces no message when the data needed for the calculations is not being recorded.

**Notes**  After the user has issued the uucp request, if the file to be transferred is moved, deleted or was not copied to the spool directory (-C option) when the uucp request was made, uustat reports a file size of −99999. This job will eventually fail because the file(s) to be transferred cannot be found.
**Name**  
*uuto, uupick* – public UNIX-to-UNIX system file copy

**Synopsis**  
*uuto [-mp] source-file... destination*

*uupick [-s system]*

**Description**

*uuto*  
*uuto* sends *source-file* to *destination*. *uuto* uses the *uucp(1C)* facility to send files, while it allows the local system to control the file access. A source-file name is a path name on your machine. Destination has the form:

```
system[!system]...!user
```

where *system* is taken from a list of system names that *uucp* knows about. *User* is the login name of someone on the specified system.

The files (or sub-trees if directories are specified) are sent to *PUBDIR* on *system*, where *PUBDIR* is a public directory defined in the *uucp* source. By default, this directory is `/var/spool/uucppublic`. Specifically the files are sent to

```
PUBDIR/receive/user/mysystem/files.
```

The recipient is notified by *mail(1)* of the arrival of files.

*uupick*  
*uupick* accepts or rejects the files transmitted to the user. Specifically, *uupick* searches *PUBDIR* for files destined for the user. For each entry (file or directory) found, the following message is printed on standard output:

```
from system sysname: [file file-name] [dir dirname] ?
```

*uupick* then reads a line from standard input to determine the disposition of the file:

```
<new-line> Go to next entry.
d Delete the entry.
m [ dir ] Move the entry to named directory dir. If dir is not specified as a complete path name (in which $HOME is legitimate), a destination relative to the current directory is assumed. If no destination is given, the default is the current directory.
a [ dir ] Same as m above, except it moves all the files sent from system.
p Print the content of the file.
q Stop.
EOT (control-d) Same as q.
! command Escape to the shell to do command.
```
* Print a command summary.

Options

**uuto**  The following options are supported by uuto:

- *m*    Send mail to the sender when the copy is complete.
- *p*    Copy the source file into the spool directory before transmission.

**uupick**  The following option is supported by uupick:

- *s system*    Search only the PUBDIR for files sent from system.

Operands

The following operands are supported for uuto:

**destination**  A string of the form:

```
  system-name ! user
```

where **system-name** is taken from a list of system names that uucp knows about; see **uname**. The argument **user** is the login name of someone on the specified system. The destination **system-name** can also be a list of names such as

```
  system-name ! system-name ! ... ! system-name ! user
```

in which case, an attempt is made to send the file via the specified route to the destination. Care should be taken to ensure that intermediate nodes in the route are willing to forward information.

**source-file**  A pathname of a file on the local system to be copied to **destination**.

Environment Variables

See environ(5) for descriptions of the following environment variables that affect the execution of uuto and uupick: LC_TYPE, LC_MESSAGES, and NLSPATH.

Exit Status

The following exit values are returned:

0    Successful completion.

>0   An error occurred.

Files

**PUBDIR**  /var/spool/uucppublic public directory

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/uucp</td>
</tr>
</tbody>
</table>
In order to send files that begin with a dot (for instance, .profile), the files must be qualified with a dot. For example, the following files are correct:

```
.profile .prof* .profil?
```

The following files are incorrect:

```
*prof* ?profile
```
uux – UNIX-to-UNIX system command execution

**Synopsis**
```
uux [-] [-bcJnprz] [-a name] [-g grade]
    [-s filename] [-x debug_level] command-string
```

**Description**
The uux utility will gather zero or more files from various systems, execute a command on a specified system and then send standard output to a file on a specified system.

*Note:* For security reasons, most installations limit the list of commands executable on behalf of an incoming request from uux, permitting only the receipt of mail (see `mail(1)`). (Remote execution permissions are defined in `/etc/uucp/Permissions`.)

The `command-string` is made up of one or more arguments that look like a shell command line, except that the command and filenames may be prefixed by `system-name!`. A null `system-name` is interpreted as the local system.

File names may be one of the following:
- An absolute path name.
- A path name preceded by `~xxx`, where `xxx` is a login name on the specified system and is replaced by that user's login directory.

Anything else is prefixed by the current directory.

As an example, the command:
```
example% uux "!diff sys1!~/home/dan/filename1
    sys2!/a4/dan/filename2 > !~/dan/filename.diff"
```
will get the `filename1` and `filename2` files from the `sys1` and `sys2` machines, execute a `diff(1)` command and put the results in `filename.diff` in the local `PUBDIR/dan/` directory. `PUBDIR` is a public directory defined in the uucp source. By default, this directory is `/var/spool/uucppublic`.

Any special shell characters (such as `<> ; |`) should be quoted either by quoting the entire `command-string`, or quoting the special characters as individual arguments. The redirection operators `>>, <<, >|`, and `>>&` cannot be used.

uux will attempt to get all appropriate files to the specified system where they will be processed. For files that are output files, the file name must be escaped using parentheses. For example, the command:
```
example% uux "a!cut -f1 b!usr/filename > c!usr/filename"
```
gets `/usr/filename` from system b and sends it to system a, performs a cut command on that file and sends the result of the cut command to system c.

uux will notify you if the requested command on the remote system was disallowed. This notification can be turned off by the `-n` option. The response comes by remote mail from the remote machine.
The following options are supported:

- The standard input to `uux` is made the standard input to the `command-string`.

- `a name` Uses `name` as the user job identification replacing the initiator user-id. (Notification will be returned to user-id `name`.)

- `b` Returns whatever standard input was provided to the `uux` command if the exit status is non-zero.

- `c` Does not copy local file to the spool directory for transfer to the remote machine (default).

- `C` Forces the copy of local files to the spool directory for transfer.

- `g grade` `grade` can be either a single letter, number, or a string of alphanumeric characters defining a service grade. The `uuglist(1C)` command determines whether it is appropriate to use the single letter, number, or a string of alphanumeric characters as a service grade. The output from the `uuglist` command will be a list of service grades that are available or a message that says to use a single letter or number as a grade of service.

- `j` Outputs the jobid string on the standard output which is the job identification. This job identification can be used by `uustat(1C)` to obtain the status or terminate a job.

- `n` Does not notify the user if the command fails.

- `p` Same as `-`. The standard input to `uux` is made the standard input to the `command-string`.

- `r` Does not start the file transfer, but just queues the job.

- `s filename` Reports status of the transfer in `filename`. This option is accepted for compatibility, but it is ignored because it is insecure.

- `x debug_level` Produces debugging output on the standard output. `debug_level` is a number between 0 and 9. As `debug_level` increases to 9, more detailed debugging information is given.

- `z` Sends success notification to the user.

**Environment Variables**

See `environ(5)` for descriptions of the following environment variables that affect the execution of `uux`: `LANG`, `LC_ALL`, `LC_TYPE`, `LC_MESSAGES`, and `NLSPATH`.

**Exit Status**

The following exit values are returned:

- `0` Successful completion.

- `>0` An error occurred.
Files  
/etc/uucp/* other data and programs
/etc/uucp/Permissions remote execution permissions
/usr/lib/uucp/* other programs
/var/spool/uucp spool directories

Attributes  
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/uucp</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also  
cut(1), mail(1), uucp(1C), uuglist(1C), uustat(1C), attributes(5), environ(5), standards(5)

Notes  
The execution of commands on remote systems takes place in an execution directory known to the uucp system.

All files required for the execution will be put into this directory unless they already reside on that machine. Therefore, the simple file name (without path or machine reference) must be unique within the uux request. The following command will NOT work:

eexample% uux "a!diff b!/home/dan/xyz c!/home/dan/xyz > !xyz.diff"

But the command:

eexample% uux "a!diff a!/home/dan/xyz c!/home/dan/xyz > !xyz.diff"

will work (if diff is a permitted command.)

Protected files and files that are in protected directories that are owned by the requester can be sent in commands using uux. However, if the requester is root, and the directory is not searchable by "other", the request will fail.

The following restrictions apply to the shell pipeline processed by uux:

- In gathering files from different systems, pathname expansion in not performed by uux. Thus, a request such as

  uux "c89 remsys!-*/.c"

  would attempt to copy the file named literally * .c to the local system.

- Only the first command of a shell pipeline may have a system-name !. All other commands are executed on the system of the first command.

- The use of the shell metacharacter * will probably not do what you want it to do.
- The shell tokens << and >> are not implemented.
- The redirection operators >>, <<, >, |, and >& cannot be used.
- The reserved word ! cannot be used at the head of the pipeline to modify the exit status.
- Alias substitution is not performed.
**Name**  
vacation – reply to mail automatically

**Synopsis**  
vacation [-I]

```bash
vacation [-a alias] [-e filter_file] [-f database_file]
       [-j] [-m message_file] [-s sender] [-tN] username
```

```bash
vacation [-f database_file] -l
```

**Description**  
The vacation utility automatically replies to incoming mail.

**Installation**  
The installation consists of an interactive program which sets up vacation's basic configuration.

To install vacation, type it with no arguments on the command line. The program creates a `.vacation.msg` file, which contains the message that is automatically sent to all senders when vacation is enabled, and starts an editor for you to modify the message. (See USAGE section.) Which editor is invoked is determined by the VISUAL or EDITOR environment variable, or `vi(1)` if neither of those environment variables are set.

A `.forward` file is also created if one does not exist in your home directory. Once created, the `.forward` file will contain a line of the form:

```
One copy of an incoming message is sent to the `username` and another copy is piped into vacation:

\username, "!/usr/bin/vacation username"
```

If a `.forward` file is present in your home directory, it will ask whether you want to remove it, which disables vacation and ends the installation.

The program automatically creates `.vacation.pag` and `.vacation.dir`, which contain a list of senders when vacation is enabled.

**Activation and Deactivation**  
The presence of the `.forward` file determines whether or not vacation is disabled or enabled. To disable vacation, remove the `.forward` file, or move it to a new name.

**Initialization**  
The -I option clears the vacation log files, `.vacation.pag` and `.vacation.dir`, erasing the list of senders from a previous vacation session. (See OPTIONS section.)

**Additional Configuration**  
vacation provides configuration options that are not part of the installation, these being -a, -e, -f, -j, -m, -s, and -t. (See OPTIONS section.)

**Reporting**  
vacation provides a reporting option, -l. See OPTIONS.

**Options**  
The following options are supported:

- `-I`  
  Initializes the `.vacation.pag` and `.vacation.dir` files and enables vacation. If the -I flag is not specified, and a user argument is given, vacation reads the first line from the standard input (for a From: line, no colon). If absent, it produces an error message.
Options -a, -e, -f, -j, -m, -s, and -t are configuration options to be used in conjunction with vacation in the .forward file, not on the command line. For example,

\username, "|/usr/bin/vacation -t1m username"

repeats replies to the sender every minute.

-a alias Indicates that alias is one of the valid aliases for the user running vacation, so that mail addressed to that alias generates a reply.

-e filter_file Uses filter_file instead of .vacation.filter as the source of the domain and email address filters.

-t database_file Uses database_file instead of .vacation as the base name for the database file.

-j Does not check whether the recipient appears in the To: or the Cc: line. Warning: use of this option can result in vacation replies being sent to mailing lists and other inappropriate places; its use is therefore strongly discouraged.

-m message_file Uses ~/message_file as the message to send for the reply instead of ~/vacation.msg. message_file is a relative path to the desired vacation message file. To prevent directory/file “not found” errors, message_file should be on the same disk partition as ~/forward.

-s sender Replies to sender instead of the value read from the UNIX From line of the incoming message.

-tN Changes the interval between repeat replies to the same sender. The default is 1 week. A trailing s, m, h, d, or w scales N to seconds, minutes, hours, days, or weeks, respectively.

The -l option is neither for initialization nor configuration, but for reporting. The -f option can also be used in conjunction with the -l.

-l Lists the addresses to which a reply has been sent since the last invocation of vacation -I, along with a date and time stamp.

Usage .vacation.msg should include a header with at least a Subject: line (it should not include a To: line). For example:

Subject: I am on vacation
I am on vacation until July 22. If you have something urgent, please contact Joe Jones (jones@F0).
--John

If the string $SUBJECT appears in the .vacation.msg file, it is replaced with the subject of the original message when the reply is sent. Thus, a .vacation.msg file such as
Subject: I am on vacation
I am on vacation until July 22.
Your mail regarding "$SUBJECT" will be read when I return.
If you have something urgent, please contact
Joe Jones (jones@fb0).
--John

will include the subject of the message in the reply.

No message is sent if the To: or the Cc: line does not list the user to whom the original message
was sent or one of a number of aliases for them, if the initial From line includes the string
-REQUEST@, or if a Precedence: bulk or Precedence: junk line is included in the header.

vacation will also not respond to mail from either postmaster or Mailer-Daemon.

In addition to the above criteria, if a .vacation.filter file exists, it is used to constrain
further the set of addresses to which a reply is sent. Each line in that file should be either a
domain name, an email address, a negated domain name or a negated email address. A
negated line starts with the single character !.

Each line is compared in the order listed to the sender address. A line containing an email
address matches if the sender address is exactly the same except for case, which is ignored. A
line containing a domain name matches if the sender address is something@domain-name or
something@something.domain-name. A reply is sent if the first match is an entry that is not
negated. If the first match is a negated entry, or if no lines match, then no reply is sent.

A sample filter file might look like the following:

!host.subdomain.sun.com
sun.com
!wife@mydomain.com
mydomain.com
onefriend@hisisp.com
anotherfriend@herisp.com

Blank lines and lines starting with "#" are ignored.

Files  ~/.forward
       ~/.vacation.filter
       ~/.vacation.msg

A list of senders is kept in the dbm format files .vacation.pag and .vacation.dir in your
home directory. These files are dbm files and cannot be viewed directly with text editors.
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/smtp/sendmail</td>
</tr>
</tbody>
</table>

See Also  vi(1), sendmail(1M), getusershell(3C), aliases(4), shells(4), attributes(5)
Name  vc – version control

Synopsis  vc [-a] [-t] [-c char] [-s]
          [keyword=value ... keyword=value]

Description  This command is obsolete and will be removed in the next release.

The vc command copies lines from the standard input to the standard output under control of its arguments and of "control statements" encountered in the standard input. In the process of performing the copy operation, user-declared keywords may be replaced by their string value when they appear in plain text and/or control statements.

The copying of lines from the standard input to the standard output is conditional, based on tests (in control statements) of keyword values specified in control statements or as vc command arguments.

A control statement is a single line beginning with a control character, except as modified by the -t keyletter (see below). The default control character is colon (:), except as modified by the -c keyletter (see below). Input lines beginning with a backslash (\) followed by a control character are not control lines and are copied to the standard output with the backslash removed. Lines beginning with a backslash followed by a non-control character are copied in their entirety.

A keyword is composed of 9 or less alphanumerics; the first must be alphabetic. A value is any ASCII string that can be created with ed; a numeric value is an unsigned string of digits. Keyword values may not contain blanks or tabs.

Replacement of keywords by values is done whenever a keyword surrounded by control characters is encountered on a version control statement. The -a keyletter (see below) forces replacement of keywords in all lines of text. An uninterpreted control character may be included in a value by preceding it with \. If a literal \ is desired, then it too must be preceded by \\.

Options  The following options are supported:

- -a  Forces replacement of keywords surrounded by control characters with their assigned value in all text lines and not just in vc statements.
- -t  All characters from the beginning of a line up to and including the first tab character are ignored for the purpose of detecting a control statement. If a control statement is found, all characters up to and including the tab are discarded.
- -c char  Specifies a control character to be used in place of the ":" default.
- -s  Silences warning messages (not error) that are normally printed on the diagnostic output.

vc recognizes the following version control statements:

: dcl  keyword[ , ... , keyword]  Declare keywords. All keywords must be declared.
:asg  keyword=value

Assign values to keywords. An asg statement overrides the assignment for the corresponding keyword on the vc command line and all previous asg statements for that keyword. Keywords that are declared but are not assigned values have null values.

::if  condition

...  
:end

Skip lines of the standard input. If the condition is true, all lines between the if statement and the matching end statement are copied to the standard output. If the condition is false, all intervening lines are discarded, including control statements. Note: Intervening if statements and matching end statements are recognized solely for the purpose of maintaining the proper if-end matching.

The syntax of a condition is:

<cond> ::= [ "not" ] <or>
<or> ::= <and> | <and> "|" <or>
<and> ::= <exp> | <exp> "&" <and>
<exp> ::= "(" <or> ")" | <value> <op> <value>
<op> ::= "=" | "!=" | "<" | ">"
[value] ::= <arbitrary ASCII string> | <numeric string>

The available operators and their meanings are:

=     equal
!=    not equal
&     and
|      or
>     greater than
<     less than
()    used for logical groupings
not   may only occur immediately after the if, and when present, inverts the value of the entire condition
The > and < operators only operate on unsigned integer values (for example, : 012 > 12 is false). All other operators take strings as arguments (for example, : 012 != 12 is true).

The precedence of the operators (from highest to lowest) is:

\[
= \neq > < \quad \text{all of equal precedence}
\]

&

| Parentheses may be used to alter the order of precedence.

Values must be separated from operators or parentheses by at least one blank or tab.

```
::text
```

Replace keywords on lines that are copied to the standard output. The two leading control characters are removed, and keywords surrounded by control characters in text are replaced by their value before the line is copied to the output file. This action is independent of the -a keyletter.

```
:on
:off
```

Turn on or off keyword replacement on all lines.

```
:ctl char
```

Change the control character to char.

```
:msg message
```

Print message on the diagnostic output.

```
:err message
```

Print message followed by:

```
ERROR: err statement on line ... (915)
```

on the diagnostic output. vc halts execution, and returns an exit code of 1.

**Attributes**  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/build/make</td>
</tr>
</tbody>
</table>

**See Also**  ed(1), attributes(5)
vgrind(1)

Name  vgrind – grind nice program listings

[-s n] [-o pagelist] [-P printer] [-T output-device] filename...

Description  The vgrind utility formats the program sources named by the filename arguments in a nice style using troff(1). Comments are placed in italics, keywords in boldface, and as each function is encountered its name is listed on the page margin.

vgrind runs in two basic modes, filter mode or regular mode. In filter mode, vgrind acts as a filter in a manner similar to tbl(1). The standard input is passed directly to the standard output except for lines bracketed by the troff-like macros:

.vS  starts processing
.vE  ends processing

These lines are formatted as described above. The output from this filter can be passed to troff for output. There need be no particular ordering with eqn(1) or tbl(1).

In regular mode, vgrind accepts input filenames, processes them, and passes them to troff for output. Use a hyphen (‘-’) to specify standard input; otherwise, vgrind will exit without attempting to read from the standard input. Filenames must be specified after all other option arguments.

In regular mode, if the -t or -P option is specified, the output is:

- emitted (in troff format) to stdout if the -t option is specified.
- printed (as PostScript) to the named printer if the -P option is specified.

Otherwise, the output is:

- printed (as PostScript) on the system default printer, if one is defined, and the command’s stdout is a tty.
- emitted (as PostScript) to stdout if it is not a tty (that is, if stdout is a pipe or a redirect to a file).

In both modes, vgrind passes any lines beginning with a decimal point without conversion.

Options  The following options are supported:

- 2  Produces two-column output. Specifying this option changes the default point size to 8 (as if the -s 8 option were supplied). It also arranges for output to appear in landscape mode.
- f  Forces filter mode.
- n  Does not make keywords boldface.
Considers TAB characters to be spaced four columns apart instead of the usual eight.

Outputs the index file in a “pretty” format. The index file itself is produced whenever vgrind is run with a file called index that is present in the current directory. The index of function definitions can then be run off by giving vgrind the -x option and the file index as argument.

Specifies an alternate language definitions file (default is /usr/lib/vgrindefs).

Specifies a header to appear in the center of every output page. Use quotes to specify headers with embedded spaces.

Specifies the language to use. Among the languages currently known are: Bourne shell (-lsh), C (-lc, the default), C++ (-lc++), C shell (-lcs), emacs MLisp (-lml), FORTRAN (-lf), Icon (-lI), ISP (-lI), LDL (-lldl), Model (-lm), Pascal (-lp), and RATFOR (-lr).

Sends output to the named printer.

Specifies a point size to use on output (exactly the same as the argument of a troff .ps point size request).

vgrind passes the following options to the formatter specified by the TROFF environment variable. See ENVIRONMENT VARIABLES.

Similar to the same option in troff; that is, formatted text goes to the standard output.

Prints only those pages whose page numbers appear in the comma-separated pagelist of numbers and ranges. A range N–M means pages N through M; an initial -N means from the beginning to page N; and a final -N means from N to the end.

Formats output for the specified output-device.

The following operand is supported:

Name of the program source to be processed by vgrind. Use ‘-’ to specify the standard input.

In regular mode, vgrind feeds its intermediate output to the text formatter given by the value of the TROFF environment variable, or to /usr/bin/troff if this variable is not defined in the environment. This mechanism allows for local variations in troff’s name.

file where source for index is created

language descriptions

preprocessor
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>text/doctools</td>
</tr>
</tbody>
</table>

See Also: csh(1), ctags(1), eqn(1), tbl(1), troff(1), attributes(5), vgrindefs(5)

vgrind assumes that a certain programming style is followed:

- **C**
  Function names can be preceded on a line only by SPACE, TAB, or an asterisk (*). The parenthesized arguments must also be on the same line.

- **FORTRAN**
  Function names need to appear on the same line as the keywords function or subroutine.

- **MLisp**
  Function names should not appear on the same line as the preceding defun.

- **Model**
  Function names need to appear on the same line as the keywords is beginproc.

- **Pascal**
  Function names need to appear on the same line as the keywords function or procedure.

If these conventions are not followed, the indexing and marginal function name comment mechanisms will fail.

More generally, arbitrary formatting styles for programs usually give unsightly results. To prepare a program for vgrind output, use TAB rather than SPACE characters to align source code properly, since vgrind uses variable width fonts.

The mechanism of ctags(1) in recognizing functions should be used here.

The -w option is annoying, but there is no other way to achieve the desired effect.

The macros defined in tmac.vgrind do not coexist gracefully with those of other macro packages, making filter mode difficult to use effectively.

vgrind does not process certain special characters in csh(1) scripts correctly.

The tmac.vgrind formatting macros wire in the page height and width used in two-column mode, effectively making two column output useless for paper sizes other than the standard American size of 8.5 inches by 11 inches. For other paper sizes, it is necessary to edit the size values given in tmac.vgrind. A better solution would be to create a troff output device specification intended specifically for landscape output and record size information there.
Name  vi, view, vedit – screen-oriented (visual) display editor based on ex

Synopsis  
/usr/bin/vi [-| -s] [-l] [-L] [-R] [-r [filename]] [-S] 
[-t tag] [-v] [-V] [-wn] 
[+command | -c command] filename...

/usr/bin/view [-| -s] [-l] [-L] [-R] [-r [filename]] [-S] 
[-t tag] [-v] [-V] [-wn] 
[+command | -c command] filename...

/usr/bin/vedit [-| -s] [-l] [-L] [-R] [-r [filename]] [-S] 
[-t tag] [-v] [-V] [-wn] 
[+command | -c command] filename...

[-t tag] [-v] [-V] [-wn] 
[+command | -c command] filename...

[-t tag] [-v] [-V] [-wn] 
[+command | -c command] filename...

[-t tag] [-v] [-V] [-wn] 
[+command | -c command] filename...

[-t tag] [-v] [-V] [-wn] 
[+command | -c command] filename...

[-t tag] [-v] [-V] [-wn] 
[+command | -c command] filename...

[-t tag] [-v] [-V] [-wn] 
[+command | -c command] filename...

Description  The vi (visual) utility is a display-oriented text editor based on an underlying line editor ex. It is possible to use the command mode of ex from within vi and to use the command mode of vi from within ex. The visual commands are described on this manual page; how to set options (like automatically numbering lines and automatically starting a new output line when you type carriage return) and all ex line editor commands are described on the ex(1) manual page.

When using vi, changes you make to the file are reflected in what you see on your terminal screen. The position of the cursor on the screen indicates the position within the file.

The view invocation is the same as vi except that the read-only flag is set.
The `vi` invocation is intended for beginners. It is the same as `vi` except that the `report` flag is set to 1, the `showmode` and `novice` flags are set, and `magic` is turned off. These defaults make it easier to learn how to use `vi`.

### Options

The following options are supported:

#### Invocation Options

The following invocation options are interpreted by `vi` (previously documented options are discussed under NOTES):

- `-s` Suppresses all interactive user feedback. This is useful when processing editor scripts.
- `-l` Sets up for editing LISP programs.
- `-L` Lists the name of all files saved as the result of an editor or system crash.
- `-r filename` Edits `filename` after an editor or system crash. (Recovers the version of `filename` that was in the buffer when the crash occurred.)
- `-R` Readonly mode. The `readonly` flag is set, preventing accidental overwriting of the file.
- `-S` This option is used in conjunction with the `-t tag` option to tell `vi` that the tags file can not be sorted and that, if the binary search (which relies on a sorted tags file) for `tag` fails to find it, the much slower linear search should also be done. Since the linear search is slow, users of large tags files should ensure that the tags files are sorted rather than use this flag. Creation of tags files normally produces sorted tags files. See `ctags(1)` for more information on tags files.
- `-t tag` Edits the file containing `tag` and position the editor at its definition. It is an error to specify more than one `-t` option.
- `-v` Starts up in display editing state, using `vi`. You can achieve the same effect by typing the `vi` command itself.
- `-V` Verbose. When `ex` commands are read by means of standard input, the input is echoed to standard error. This can be useful when processing `ex` commands within shell scripts.
- `-wn` Sets the default window size to `n`. This is useful when using the editor over a slow speed line.
- `-command` `| -c command` Begins editing by executing the specified editor `command` (usually a search or positioning command).
If both the `-t` tag and the `-c` command options are given, the `-t` tag option is processed first. That is, the file containing `tag` is selected by `-t` and then the command is executed.

**Operands**
The following operands are supported:

- `filename` A file to be edited.

**Command Summary**
The `vi` command modes are summarized in this section.

**Command** Normal and initial mode. Other modes return to command mode upon completion. `ESC` (escape) is used to cancel a partial command.

**Input** Entered by setting any of the following options:
- `a A i I o O c C s S r R`
  Arbitrary text can then be entered. Input mode is normally terminated with the `ESC` character, or, abnormally, with an interrupt.

**Last line** Reading input for `:` / `?` or `!`. Terminate by typing a carriage return. An interrupt cancels termination.

**Sample Commands**
In the descriptions, `CR` stands for carriage return and `ESC` stands for the escape key.

- `←`, `→`
- `down-arrow` arrow keys move the cursor
- `up-arrow` same as arrow keys
- `h` `j` `k` `l` `i` `text` `ESC` insert `text`
- `c` `w` `new` `ESC` change word to `new`
- `e` `as` `ESC` pluralize word (end of word; append `s`; escape from input state)
- `x` delete a character
- `dw` delete a word
- `dd` delete a line
- `3dd` delete 3 lines
- `u` undo previous change
- `ZZ` exit `vi`, saving changes
- `:q` `CR` quit, discarding changes
- `/text` `CR` search for `text`
- `^U` `^D` scroll up or down
- `:cmd` `CR` any `ex` or `ed` command

/usr/xpg4/bin/vi and
/usr/xpg6/bin/vi

User Commands 1989
Counts Before vi Commands

Numbers can be typed as a prefix to some commands. They are interpreted in one of these ways:

- line/column number: z G | ^D ^U
- scroll amount: most of the rest
- repeat effect

Interrupting, Canceling

ESC: end insert or incomplete command
DEL: (delete or rubout) interrupts

File Manipulation

ZZ: if file modified, write and exit; otherwise, exit
:wCR: write back changes
:w!CR: forced write, if permission originally not valid
:qCR: quit
:q!CR: quit, discard changes
:e nameCR: edit file name
:e!CR: reedit, discard changes
:e + nameCR: edit, starting at end
:e + nCR: edit, starting at line n
:e #CR: edit alternate file
:e! #CR: edit alternate file, discard changes
:w nameCR: write file name
:w! nameCR: overwrite file name
:shCR: run shell, then return
:!cmdCR: run cmd, then return
:nCR: edit next file in arglist
:n argsCR: specify new arglist
^G: show current file and line
:ta tagCR: position cursor to tag

In general, any ex or ed command (such as substitute or global) can be typed, preceded by a colon and followed by a carriage return.
Positioning Within a File

F  forward screen
\^B  backward screen
\^D  scroll down half screen
\^U  scroll up half screen
nG  go to the beginning of the specified line (end default), where n is a line number
/pat  next line matching pat
?pat  previous line matching pat
n  repeat last / or ? command
N  reverse last / or ? command
/pat/+n  nth line after pat
?pat?−n  nth line before pat
]]  next section/function
[[]  previous section/function
(  beginning of sentence
)  end of sentence
{  beginning of paragraph
}  end of paragraph
%  find matching ( ) or { }

Adjusting the Screen

\^L  clear and redraw window
\^R  clear and redraw window if \^L is → key
zCR  redraw screen with current line at top of window
z−CR  redraw screen with current line at bottom of window
z.CR  redraw screen with current line at center of window
/pat/z−CR  move pat line to bottom of window
z\n.CR  use n−line window
\^E  scroll window down one line
\^Y  scroll window up one line

Marking and Returning

``  move cursor to previous context
``  move cursor to first non-white space in line
`x move cursor to mark x

`x move cursor to first non-white space in line marked by x

**Line Positioning**

<table>
<thead>
<tr>
<th>Character</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>top line on screen</td>
</tr>
<tr>
<td>L</td>
<td>last line on screen</td>
</tr>
<tr>
<td>M</td>
<td>middle line on screen</td>
</tr>
<tr>
<td>+</td>
<td>next line, at first non-white space character</td>
</tr>
<tr>
<td>−</td>
<td>previous line, at first non-white space character</td>
</tr>
<tr>
<td>CR</td>
<td>return, same as +</td>
</tr>
<tr>
<td>down-arrow</td>
<td>next line, same column</td>
</tr>
<tr>
<td>j</td>
<td>next line, same column</td>
</tr>
<tr>
<td>up-arrow</td>
<td>previous line, same column</td>
</tr>
<tr>
<td>k</td>
<td>previous line, same column</td>
</tr>
</tbody>
</table>

**Character Positioning**

<table>
<thead>
<tr>
<th>Character</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>^</td>
<td>first non-white space character</td>
</tr>
<tr>
<td>0</td>
<td>beginning of line</td>
</tr>
<tr>
<td>$</td>
<td>end of line</td>
</tr>
<tr>
<td>l or →</td>
<td>forward</td>
</tr>
<tr>
<td>h or ←</td>
<td>backward</td>
</tr>
<tr>
<td>^H</td>
<td>same as ← (backspace)</td>
</tr>
<tr>
<td>space</td>
<td>same as → (space bar)</td>
</tr>
<tr>
<td>fx</td>
<td>find next x</td>
</tr>
<tr>
<td>Fx</td>
<td>find previous x</td>
</tr>
<tr>
<td>tx</td>
<td>move to character following the next x</td>
</tr>
<tr>
<td>Tx</td>
<td>move to character following the previous x</td>
</tr>
<tr>
<td>;</td>
<td>repeat last f, F, t, or T</td>
</tr>
<tr>
<td>,</td>
<td>repeat inverse of last f, F, t, or T</td>
</tr>
<tr>
<td>n</td>
<td>move to column n</td>
</tr>
<tr>
<td>%</td>
<td>find matching ( ) or { }</td>
</tr>
</tbody>
</table>

**Words, Sentences, Paragraphs**

<table>
<thead>
<tr>
<th>Character</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>w</td>
<td>forward a word</td>
</tr>
<tr>
<td>b</td>
<td>back a word</td>
</tr>
</tbody>
</table>
e     end of word
)    to next sentence
}    to next paragraph
(    back a sentence
{    back a paragraph
W    forward a blank-delimited word
B    back a blank-delimited word
E    end of a blank-delimited word

<table>
<thead>
<tr>
<th>Corrections During Insert</th>
</tr>
</thead>
<tbody>
<tr>
<td>^H</td>
</tr>
<tr>
<td>^W</td>
</tr>
<tr>
<td>^H</td>
</tr>
<tr>
<td>^W</td>
</tr>
</tbody>
</table>
\   | quotes your erase and kill characters |
| ESC                       | ends insertion, back to command mode |
| Control−C             | interrupt, suspends insert mode |
| ^D                        | backtab one character; reset left margin of autoindent |
| ^^D                       | caret (^) followed by control-d (^D); backtab to beginning of line; do not reset left margin of autoindent |
| 0^D                      | backtab to beginning of line; reset left margin of autoindent |
| ^V                        | quote non-printable character |

<table>
<thead>
<tr>
<th>Insert and Replace</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
</tr>
<tr>
<td>A</td>
</tr>
<tr>
<td>i</td>
</tr>
<tr>
<td>I</td>
</tr>
<tr>
<td>o</td>
</tr>
<tr>
<td>O</td>
</tr>
<tr>
<td>rx</td>
</tr>
<tr>
<td>RtextESC</td>
</tr>
</tbody>
</table>
Operators are followed by a cursor motion and affect all text that would have been moved over. For example, since \texttt{w} moves over a word, \texttt{dw} deletes the word that would be moved over. Double the operator, for example \texttt{dd}, to affect whole lines.

<table>
<thead>
<tr>
<th>Operator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>\texttt{d}</td>
<td>delete</td>
</tr>
<tr>
<td>\texttt{c}</td>
<td>change</td>
</tr>
<tr>
<td>\texttt{y}</td>
<td>yank lines to buffer</td>
</tr>
<tr>
<td>\texttt{&lt;}</td>
<td>left shift</td>
</tr>
<tr>
<td>\texttt{&gt;}</td>
<td>right shift</td>
</tr>
<tr>
<td>\texttt{!}</td>
<td>filter through command</td>
</tr>
<tr>
<td>\texttt{C}</td>
<td>change rest of line (\texttt{c$})</td>
</tr>
<tr>
<td>\texttt{D}</td>
<td>delete rest of line (\texttt{d$})</td>
</tr>
<tr>
<td>\texttt{s}</td>
<td>substitute characters (\texttt{c1})</td>
</tr>
<tr>
<td>\texttt{S}</td>
<td>substitute lines (\texttt{cc})</td>
</tr>
<tr>
<td>\texttt{J}</td>
<td>join lines</td>
</tr>
<tr>
<td>\texttt{x}</td>
<td>delete characters (\texttt{d1})</td>
</tr>
<tr>
<td>\texttt{X}</td>
<td>delete characters before cursor (\texttt{dh})</td>
</tr>
<tr>
<td>\texttt{Y}</td>
<td>yank lines (\texttt{yy})</td>
</tr>
</tbody>
</table>

Yank and Put

Put inserts the text most recently deleted or yanked; however, if a buffer is named (using the ASCII lower-case letters \texttt{a - z}), the text in that buffer is put instead.

<table>
<thead>
<tr>
<th>Operator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>\texttt{3yy}</td>
<td>yank 3 lines</td>
</tr>
<tr>
<td>\texttt{3yl}</td>
<td>yank 3 characters</td>
</tr>
<tr>
<td>\texttt{p}</td>
<td>put back text after cursor</td>
</tr>
<tr>
<td>\texttt{P}</td>
<td>put back text before cursor</td>
</tr>
<tr>
<td>\texttt{&quot;xp}</td>
<td>put from buffer \texttt{x}</td>
</tr>
<tr>
<td>\texttt{&quot;xy}</td>
<td>yank to buffer \texttt{x}</td>
</tr>
<tr>
<td>\texttt{&quot;xd}</td>
<td>delete into buffer \texttt{x}</td>
</tr>
</tbody>
</table>

Undo, Redo, Retrieve

<table>
<thead>
<tr>
<th>Operator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>\texttt{u}</td>
<td>undo last change</td>
</tr>
<tr>
<td>\texttt{U}</td>
<td>restore current line</td>
</tr>
<tr>
<td>.</td>
<td>repeat last change</td>
</tr>
<tr>
<td>\texttt{&quot;dp}</td>
<td>retrieve \texttt{d}th last delete</td>
</tr>
</tbody>
</table>
**Usage**

See `largefile(5)` for the description of the behavior of `vi` and `view` when encountering files greater than or equal to 2 Gbyte \(2^{31}\) bytes.

**Environment Variables**

See `environ(5)` for descriptions of the following environment variables that affect the execution of `vi`: `LANG`, `LC_ALL`, `LC_COLLATE`, `LC_CTYPE`, `LC_TIME`, `LC_MESSAGES`, `NLSPATH`, `PATH`, `SHELL`, and `TERM`.

- **COLUMNS** Override the system-selected horizontal screen size.
- **EXINIT** Determine a list of `ex` commands that are executed on editor start-up, before reading the first file. The list can contain multiple commands by separating them using a vertical-line (`|`) character.
- **LINES** Override the system-selected vertical screen size, used as the number of lines in a screenful and the vertical screen size in visual mode.

**Files**

- `/var/tmp` default directory where temporary work files are placed; it can be changed using the `directory` option (see the `ex(1)` command)
- `/usr/share/lib/terminfo/?/*` compiled terminal description database
- `/usr/lib/.COREterm/?/*` subset of compiled terminal description database

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>/usr/bin/vi, /usr/bin/view, /usr/bin/vedit</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATTRIBUTE TYPE</td>
</tr>
<tr>
<td>Availability</td>
</tr>
<tr>
<td>CSI</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>/usr/xpg4/bin/vi, /usr/xpg4/bin/view, /usr/xpg4/bin/vedit</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATTRIBUTE TYPE</td>
</tr>
<tr>
<td>Availability</td>
</tr>
<tr>
<td>CSI</td>
</tr>
<tr>
<td>Interface Stability</td>
</tr>
<tr>
<td>Standard</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>/usr/xpg6/bin/vi, /usr/xpg6/bin/view, /usr/xpg6/bin/vedit</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATTRIBUTE TYPE</td>
</tr>
<tr>
<td>Availability</td>
</tr>
<tr>
<td>CSI</td>
</tr>
<tr>
<td>Interface Stability</td>
</tr>
</tbody>
</table>
The message file too large to recover with -r option, which is seen when a file is loaded, indicates that the file can be edited and saved successfully, but if the editing session is lost, recovery of the file with the -r option is not possible.

The editing environment defaults to certain configuration options. When an editing session is initiated, vi attempts to read the EXINIT environment variable. If it exists, the editor uses the values defined in EXINIT; otherwise the values set in $HOME/.exrc are used. If $HOME/.exrc does not exist, the default values are used.

To use a copy of .exrc located in the current directory other than $HOME, set the exrc option in EXINIT or $HOME/.exrc. Options set in EXINIT can be turned off in a local .exrc only if exrc is set in EXINIT or $HOME/.exrc. In order to be used, .exrc in $HOME or the current directory must fulfill these conditions:

- It must exist.
- It must be owned by the same userid as the real userid of the process, or the process has appropriate privileges.
- It is not writable by anyone other than the owner.

Tampering with entries in /usr/share/lib/terminfo/* or /usr/share/lib/terminfo/*/* (for example, changing or removing an entry) can affect programs such as vi that expect the entry to be present and correct. In particular, removing the “dumb” terminal can cause unexpected problems.

Software tabs using ^T work only immediately after the autoindent.

Left and right shifts on intelligent terminals do not make use of insert and delete character operations in the terminal.

Loading an alternate malloc() library using the environment variable LD_PRELOAD can cause problems for /usr/bin/vi.

The vi utility currently has the following limitations:

1. Lines, including the trailing NEWLINE character, can contain no more than 4096 bytes.
If a longer line is found, Line too long is displayed in the status line.

2. The editor’s temporary work file can be no larger than 128Mb.
   If a larger temporary file is needed, Tmp file too large is displayed in the status line.
Name  vipw – edit the password file

Synopsis  /usr/ucb/vipw

Description  vipw edits the password file while setting the appropriate locks, and does any necessary processing after the password file is unlocked. If the password file is already being edited, then you will be told to try again later. The vi(1) editor will be used unless the environment variable VISUAL or EDITOR indicates an alternate editor.

vipw performs a number of consistency checks on the password entry for root, and will not allow a password file with a “mangled” root entry to be installed. It also checks the /etc/shells file to verify the login shell for root.

Files  /etc/ptmp
       /etc/shells

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>

See Also  passwd(1), vi(1), passwd(4), attributes(5)
Name  volcheck – checks for media in a drive

Synopsis  volcheck [-v] [-i secs] [-t secs] pathname

Description  The volcheck utility tells volume management to look at each dev/pathname in sequence and
determine if new media has been inserted in the drive.

The default action is to volcheck all checkable media managed by volume management.

Options  The following options are supported:

- i secs  Set the frequency of device checking to secs seconds. The default is 2 seconds. The
minimum frequency is 1 second.

- t secs  Check the named device(s) for the next secs seconds. The maximum number of
seconds allowed is 28800, which is 8 hours. The frequency of checking is specified
by -i. There is no default total time.

- v  Verbose.

Operands  The following operands are supported:

pathname  The path name of a media device.

Files  /dev/volctl  volume management control port

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/storage/media-volume-manager</td>
</tr>
</tbody>
</table>

See Also  eject(1), rmmount(1M), attributes(5)
**volrmmount(1)**

**Name**  
volrmmount – call rmmount to mount or unmount media

**Synopsis**  
volrmmount [-i | -e] [name | nickname]

volrmmount [-d]

**Description**  
The `volrmmount` utility calls `rmmount(1M)` to, in effect, simulate an insertion (-i) or an ejection (-e). Simulating an insertion often means that `rmmount` will mount the media. Conversely, simulating an ejection often means that `rmmount` will unmount the media. However, these actions can vary depending on the `rmmount` configuration and media type.

For example, using default settings, if you insert a music CD, it might not be mounted. However, you can configure `rmmount` so that it calls `workman` whenever a music CD is inserted.

The `volrmmount` utility allows you to override volume management’s usual handling of media.

**Options**  
The following options are supported:
- `-i`  
  Simulates an insertion of the specified media by calling `rmmount`.
- `-e`  
  Simulates an ejection of the specified media by calling `rmmount`.
- `-d`  
  Displays the name of the default device for `volrmmount` to handle. This device is used if no `name` or `nickname` is supplied.

**Operands**  
The following operands are supported:
- `name`  
  The name that volume management recognizes as the device’s name.
- `nickname`  
  A shortened version of the device’s name. Following is the list of recognized nicknames:

<table>
<thead>
<tr>
<th>Nickname</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>cdrom0</td>
<td>/dev/rdsk/cXtYdZ/label</td>
</tr>
<tr>
<td>zip0</td>
<td>/dev/rdsk/cXtYdZ/label</td>
</tr>
<tr>
<td>jaz0</td>
<td>/dev/rdsk/cXtYdZ/label</td>
</tr>
<tr>
<td>rmdisk0</td>
<td>/dev/rdsk/cXtYdZ/label</td>
</tr>
</tbody>
</table>

**Files**  
/dev/volctl  
volume management control port

**Attributes**  
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/storage/media-volume-manager</td>
</tr>
</tbody>
</table>
See Also  cpio(1), eject(1), tar(1), rmmount(1M), attributes(5)
**Name**  
`w` – display information about currently logged-in users

**Synopsis**  
`w [ -hlsuw ] [ user ]`

**Description**  
The `w` command displays a summary of the current activity on the system, including what each user is doing. The heading line shows the current time, the length of time the system has been up, the number of users logged into the system, and the average number of jobs in the run queue over the last 1, 5 and 15 minutes.

The fields displayed are: the user’s login name, the name of the tty the user is on, the time of day the user logged on (in `hours:minutes`), the idle time—that is, the number of minutes since the user last typed anything (in `hours:minutes`), the CPU time used by all processes and their children on that terminal (in `minutes:seconds`), the CPU time used by the currently active processes (in `minutes:seconds`), and the name and arguments of the current process.

**Options**  
The following options are supported:

- `-h`  
  Suppresses the heading.

- `-l`  
  Produces a long form of output, which is the default.

- `-s`  
  Produces a short form of output. In the short form, the tty is abbreviated, the login time and CPU times are left off, as are the arguments to commands.

- `-u`  
  Produces the heading line which shows the current time, the length of time the system has been up, the number of users logged into the system, and the average number of jobs in the run queue over the last 1, 5 and 15 minutes.

- `-w`  
  Produces a long form of output, which is also the same as the default.

**Operands**  
`user`  
Name of a particular user for whom login information is displayed. If specified, output is restricted to that user.

**Examples**  
**EXAMPLE 1**  
Sample Output From the `w` Command

```
example% w
10:54am up 27 day(s), 57 mins, 1 user, load average: 0.28, 0.26, 0.22
User     tty        login@  idle  JCPU  PCPU  what
ralph    console  7:10am  1     10:05  4:31  w
```

**Environment Variables**  
See `environ(5)` for descriptions of the following environment variables that affect the execution of `w`: `LC_CTYPE`, `LC_MESSAGES`, and `LC_TIME`.

**Files**  
`/var/adm/utmpx`  
user and accounting information
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also ps(1), who(1), whodo(1M), utmpx(4), attributes(5), environ(5)

Notes The notion of the “current process” is unclear. The current algorithm is “the highest numbered process on the terminal that is not ignoring interrupts, or, if there is none, the highest numbered process on the terminal”. This fails, for example, in critical sections of programs like the shell and editor, or when faulty programs running in the background fork and fail to ignore interrupts. In cases where no process can be found, w prints −.

The CPU time is only an estimate, in particular, if someone leaves a background process running after logging out, the person currently on that terminal is “charged” with the time.

Background processes are not shown, even though they account for much of the load on the system.

Sometimes processes, typically those in the background, are printed with null or garbled arguments. In these cases, the name of the command is printed in parentheses.

w does not know about the conventions for detecting background jobs. It will sometimes find a background job instead of the right one.
wait(1)

Name  wait – await process completion

Synopsis

/bin/sh  wait [pid]...
/bin/jsh/bin/ksh88  wait [pid]...
/usr/xpg4/bin/sh  wait [% jobid...]
/bin/csh  wait
/ksh  wait [job...]

Description  The shell itself executes wait, without creating a new process. If you get the error message cannot fork, too many processes, try using the wait command to clean up your background processes. If this doesn’t help, the system process table is probably full or you have too many active foreground processes. There is a limit to the number of process IDs associated with your login, and to the number the system can keep track of.

Not all the processes of a pipeline with three or more stages are children of the shell, and thus cannot be waited for.

/bin/sh, /bin/jsh  Wait for your background process whose process ID is pid and report its termination status. If pid is omitted, all your shell’s currently active background processes are waited for and the return code is 0. The wait utility accepts a job identifier, when Job Control is enabled (jsh), and the argument, jobid, is preceded by a percent sign (%).

If pid is not an active process ID, the wait utility returns immediately and the return code is 0.

/csh  Wait for your background processes.

/ksh88  When an asynchronous list is started by the shell, the process ID of the last command in each element of the asynchronous list becomes known in the current shell execution environment.

If the wait utility is invoked with no operands, it waits until all process IDs known to the invoking shell have terminated and exit with an exit status of 0.

If one or more pid or jobid operands are specified that represent known process IDs (or jobids), the wait utility waits until all of them have terminated. If one or more pid or jobid operands are specified that represent unknown process IDs (or jobids), wait treats them as if they were known process IDs (or jobids) that exited with exit status 127. The exit status returned by the wait utility is the exit status of the process requested by the last pid or jobid operand.

The known process IDs are applicable only for invocations of wait in the current shell execution environment.
wait(1)

wait with no operands, waits until all jobs known to the invoking shell have terminated. If one or more job operands are specified, wait waits until all of them have completed. Each job can be specified as one of the following:

- number 
  refersto a process ID.
- -number 
  refersto a process group ID.
- %number 
  refersto a job number
- %string 
  Refersto a job whose name begins with string
- %?string 
  Refersto a job whose name contains string
- %
  Refersto the current job
- %-
  Refersto the previous job

If one ore more job operands is a process id or process group id not known by the current shell environment, wait treats each of them as if it were a process that exited with status 127.

Operands

The following operands are supported:

- pid
  The unsigned decimal integer process ID of a command, for which the utility is to wait for the termination.

- jobid
  A job control job ID that identifies a background process group to be waited for. The job control job ID notation is applicable only for invocations of wait in the current shell execution environment, and only on systems supporting the job control option.

Usage

On most implementations, wait is a shell built-in. If it is called in a subshell or separate utility execution environment, such as one of the following,

(wait)
nohup wait ...
find . -exec wait ... \

it returns immediately because there is no known process IDs to wait for in those environments.

Examples

EXAMPLE 1 Using A Script To Identify The Termination Signal

Although the exact value used when a process is terminated by a signal is unspecified, if it is known that a signal terminated a process, a script can still reliably figure out which signal is using kill, as shown by the following (/bin/ksh88 and /usr/xpg4/bin/sh):

sleep 1000&
pid=$!
k$ -kill $pid
wait $pid
EXAMPLE 1  Using A Script To Identify The Termination Signal  (Continued)
echo $pid was terminated by a SIG$(kill -l $(($?−128))) signal.

EXAMPLE 2  Returning The Exit Status Of A Process
If the following sequence of commands is run in less than 31 seconds (/bin/ksh88 and
/usr/xpg4/bin/sh):
sleep 257 | sleep 31 &
jobs -l %%
then either of the following commands returns the exit status of the second sleep in the
pipeline:
wait <pid of sleep 31>
wait %

Environment Variables  See environ(5) for descriptions of the following environment variables that affect the
execution of wait: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status

ksh  The following exit values are returned by the wait built-in in ksh:

0  wait was invoked with no operands. All processes known by the invoking process
have terminated.

127  job is a process id or process group id that is unknown to the current shell
environment.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also  csh(1), jobs(1), ksh(1), ksh88(1), pwait(1), sh(1), attributes(5), environ(5), standards(5)
**Name**
wc – display a count of lines, words and characters in a file

**Synopsis**
/usr/bin/wc [-c | -m | -C] [-l w] [file...]

**Description**
wC reads one or more input files and, by default, for each file writes a line containing the number of NEWLINEs, words, and bytes contained in each file followed by the file name to standard output in that order. A word is defined to be a non-zero length string delimited by `isspace(3C)` characters.

If more than one file is specified, wc writes a total count for all of the named files with total written instead of the file name.

By default, wc writes all three counts. Options can specified so that only certain counts are written. The `-c` and `-m` options are mutually exclusive.

If no file is specified, or if the file is `-`, wc reads from standard input and no filename is written to standard output. The start of the file is defined as the current offset.

**Options**
The following options are supported for both `usr/bin/wc` and ksh. The long form of the options are only available with ksh:

- `-c` Counts bytes.
- `-C` Counts characters. Same as `-m`.
- `-l` Counts lines.
- `-m` Counts characters. Same as `-C`.
- `-w` Counts words delimited by white space characters or new line characters. Delimiting characters are Extended Unix Code (EUC) characters from any code set defined by `isspace(3C)`.

If no option is specified, the default is `-lwc` (counts lines, words, and bytes.)

**Operands**
The following operand is supported:

- `file` A path name of an input file. If no `file` operands are specified, the standard input is used.

**Usage**
See `largefile(5)` for the description of the behavior of wc when encountering files greater than or equal to 2 Gbyte (2³¹ bytes).

**Environment Variables**
See `environ(5)` for descriptions of the following environment variables that affect the execution of wc: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.
Exit Status  0  Successful completion.
            >0  An error occurred.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also  cksum(1), ispace(3C), iswalpha(3C), iswspace(3C), setlocale(3C), attributes(5), 
environ(5), largefile(5), standards(5)
**Name**
what – extract SCCS version information from a file

**Synopsis**
what [-s] filename ...

**Description**
The `what` utility searches each filename for occurrences of the pattern `@(#)` that the SCCS `get` command (see `sccs-get(1)`) substitutes for the `@(#)` ID keyword, and prints what follows up to a ",", ">", NEWLINE, ",", or NULL character.

**Options**
The following option is supported:
- `-s` Stops after the first occurrence of the pattern.

**Examples**
**EXAMPLE 1**
Extracting SCCS version information
If a C program in file `program.c` contains
```c
char sccsid[] = "@(#)identification information ";
```
and `program.c` is compiled to yield `program.o` and `a.out`, the command:
```bash
eexample% what program.c program.o a.out
```
produces:
```bash
program.c: identification information
program.o: identification information
a.out: identification information
```

**Exit Status**
The following exit values are returned:
- `0` Any matches were found.
- `1` No matches found.

**Environment Variables**
See `environ(5)` for descriptions of the following environment variables that affect the execution of `what`: `LANG`, `LC_ALL`, `LC_CTYPE`, `LC_MESSAGES`, and `NLSPATH`.

**Attributes**
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/build/make</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See <code>standards(5)</code></td>
</tr>
</tbody>
</table>

**See Also**
`sccs(1), sccs-admin(1), sccs-cdc(1), sccs-comb(1), sccs-delta(1), sccs-get(1),
sccs-help(1), sccs-prs(1), sccs-prt(1), sccs-rmdel(1), sccs-sact(1), sccs-sccsdiff(1),
sccs-unget(1), sccs-val(1), sccsfile(4), attributes(5), environ(5), standards(5)`
Diagnostics  Use the \texttt{sccs\textasciitilde help} command for explanations of SCCS commands. See \texttt{sccs\textasciitilde help(1)}.

Bugs  There is a remote possibility that a spurious occurrence of the @(#) pattern could be found by what.
whatis(1)

**Name**
whatis – display a one-line summary about a keyword

**Synopsis**
whatis command...

**Description**
whatis looks up a given `command` and displays the header line from the manual section. You can then run the `man(1)` command to get more information. If the line starts `name(section)`... you can do `man -s section name` to get the documentation for it. Try `whatis ed` and then you should do `man -s 1 ed` to get the manual page for `ed(1)`.

whatis is actually just the `-f` option to the `man(1)` command.

whatis uses the `/usr/share/man/man_index/*` index files. The index files are either automatically generated by an SMF service as described in `man(1)` and `man(5)` or manually generated by using `catman(1M)` with the `-w` option. If the index files do not exist, `whatis` is run slower since it looks directly into manual page files.

**Files**
/usr/share/man/man_index/* Table of Contents and keyword database.

Generated files include:
- /usr/share/man/man_index/man.idx
- /usr/share/man/man_index/man.dic
- /usr/share/man/man_index/man.frq
- /usr/share/man/man_index/man.pos

**Attributes**
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>text/doctools</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

**See Also**
apropos(1), man(1), catman(1M), attributes(5), man(5)
whereis utility locates source/binary and manuals sections for specified files. The supplied names are first stripped of leading pathname components and any (single) trailing extension of the form .ext, for example, .c. Prefixes of s. resulting from use of source code control are also dealt with. whereis then attempts to locate the desired program in a list of standard places:

```
/etc
/sbin
/usr/bin
/usr/lang
/usr/lib
/usr/sbin
/usr/ucb
/usr/ucblib
/usr/ucbinclude
/usr/games
/usr/local
/usr/local/bin
/usr/new
/usr/old
/usr/hosts
/usr/include
```

### Options

The following options are supported:

- **-b** Searches only for binaries.
- **-B** Changes or otherwise limits the places where whereis searches for binaries.
- **-f** Terminates the last directory list and signals the start of file names, and must be used when any of the -B, -M, or -S options are used.
- **-m** Searches only for manual sections.
- **-M** Changes or otherwise limits the places where whereis searches for manual sections.
- **-s** Searches only for sources.
- **-S** Changes or otherwise limit the places where whereis searches for sources.
- **-u** Searches for unusual entries. A file is said to be unusual if it does not have one entry of each requested type. Thus ‘whereis -m -u *’ asks for those files in the current directory which have no documentation.
Examples

**EXAMPLE 1** Finding files

Find all files in `/usr/bin` which are not documented in `/usr/share/man/man1` with source in `/usr/src/cmd`:

```
example% cd /usr/ucb
example% whereis -u -M /usr/share/man/man1 -S /usr/src/cmd -f *
```

**Files**

/`usr/src/*`

/`usr/{doc,man}/*`

/`etc, /usr/{lib,bin,ucb,old,new,local}`

**Attributes**

See [attributes(5)](attributes(5)) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>

**See Also**

[cdir(2), attributes(5)]

**Bugs**

Since `whereis` uses `chdir(2)` to run faster, pathnames given with the `-M, -S, or -B must be full; that is, they must begin with a `/.`.
which(1)

Name which – locate a command and display its pathname or alias

Synopsis which [name]...

Description which takes a list of names and determines which alias or utility would be executed had these names been given as commands.

For each name operand, if it names an alias the alias is expanded. Otherwise the user’s path is searched for a utility name matching name. Aliases are taken from the user’s .cshrc file. path is taken from the current shell execution environment.

Operands The following operand is supported:

name The name of a command to be located.

Exit Status The following exit values are returned:

0 Successful completion.

>0 One or more name operands were not located or an error occurred.

Files ~/.cshrc source of aliases and path values

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTES TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also csh(1), attributes(5)

Diagnostics A diagnostic is given for names which are aliased to more than a single word, or if an executable file with the argument name was not found in the path.

Notes The which utility is not a shell built-in command.

Bugs To compensate for ~/.cshrc files in which aliases depend upon the prompt variable being set, which sets this variable to NULL. If the ~/.cshrc produces output or prompts for input when prompt is set, which can produce some strange results.
**Name**  
who – who is on the system

**Synopsis**  
/usr/bin/who [-abdHlmpqrstTu] [file]  
/usr/bin/who -q [-n x] [file]  
/usr/bin/who am i  
/usr/bin/who am I  
/usr/xpg4/bin/who [-abdHlmpqrstTu] [file]  
/usr/xpg4/bin/who -q [-n x] [file]  
/usr/xpg4/bin/who -s [-bdHlmpqrtu] [file]  
/usr/xpg4/bin/who am i  
/usr/xpg4/bin/who am I

**Description**  
The **who** utility can list the user’s name, terminal line, login time, elapsed time since activity occurred on the line, and the process-ID of the command interpreter (shell) for each current UNIX system user. It examines the **/var/adm/utmpx** file to obtain its information. If **file** is given, that file (which must be in **utmpx(4)** format) is examined. Usually, **file** will be **/var/adm/wtmpx**, which contains a history of all the logins since the file was last created.

The general format for output is:

```
name [state] line time [idle] [pid] [comment] [exit]
```

where:

- **name**: User’s login name
- **state**: Capability of writing to the terminal
- **line**: Name of the line found in /dev
- **time**: Time since user’s login
- **idle**: Time elapsed since the user’s last activity
- **pid**: User’s process id
- **comment**: Comment line in **inittab(4)**
- **exit**: Exit status for dead processes

**Options**  
The following options are supported:

- **-a**: Processes **/var/adm/utmpx** or the named **file** with **-b**, **-d**, **-l**, **-p**, **-r**, **-t**, **-T**, and **-u** options turned on.
- **-b**: Indicates the time and date of the last reboot.
Displays all processes that have expired and not been respawned by init. The exit field appears for dead processes and contains the termination and exit values (as returned by wait(3C)), of the dead process. This can be useful in determining why a process terminated.

- H Outputs column headings above the regular output.

- l Lists only those lines on which the system is waiting for someone to login. The name field is LOGIN in such cases. Other fields are the same as for user entries except that the state field does not exist.

- m Outputs only information about the current terminal.

- n x Takes a numeric argument, x, which specifies the number of users to display per line. x must be at least 1. The -n option can only be used with -q.

- p Lists any other process that is currently active and has been previously spawned by init. The name field is the name of the program executed by init as found in /usr/sbin/inittab. The state, line, and idle fields have no meaning. The comment field shows the id field of the line from /usr/sbin/inittab that spawned this process. See inittab(4).

- q (Quick who) Displays only the names and the number of users currently logged on. When this option is used, all other options are ignored.

- r Indicates the current run-level of the init process. When this option is used, all other options are ignored.

- s (Default) Lists only the name, line, and time fields.

- T Same as the -s option, except that the state idle, pid, and comment, fields are also written. state is one of the following characters:

  + The terminal allows write access to other users.

  - The terminal denies write access to other users.

  ? The terminal write-access state cannot be determined.

- u Lists only those users who are currently logged in. The name is the user’s login name. The line is the name of the line as found in the directory /dev. The time is the time that the user logged in. The idle column contains the number of hours and minutes since activity last occurred on that particular line. A dot (.) indicates that the terminal has seen activity in the last minute and is therefore current. If more than twenty-four hours have elapsed or the line has not been used since boot time, the entry is marked old.
This field is useful when trying to determine whether a person is working at the
terminal or not. The pid is the process-ID of the user's shell. The comment is the
comment field associated with this line as found in /usr/sbin/inittab (see
inittab(4)). This can contain information about where the terminal is located, the
telephone number of the dataset, type of terminal if hard-wired, and so forth.

Operands  The following operands are supported:

  am i
  am I  In the C locale, limits the output to describing the invoking user, equivalent to the -m
        option. The am and i or I must be separate arguments.

  file  Specifies a path name of a file to substitute for the database of logged-on users that
        who uses by default.

Environment Variables  See environ(5) for descriptions of the following environment variables that affect the
execution of who: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, LC_TIME, and NLSPATH.

Exit Status  The following exit values are returned:

  0  Successful completion.
  >0  An error occurred.

Files  /usr/sbin/inittab  Script for init
       /var/adm/utmpx  Current user and accounting information
       /var/adm/wtmpx  Historic user and accounting information

Attributes  See attributes(5) for descriptions of the following attributes:

/usr/bin/who
<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

/usr/xpg4/bin/who
<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/xopen/xcu4</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also  date(1), login(1), mesg(1), init(1M), su(1M), wait(3C), inittab(4), wtmpx(4),
attributes(5), environ(5), standards(5)
**Notes**  
*Superuser*: After a shutdown to the single-user state, `who` returns a prompt. Since `/var/adm/utmpx` is updated at login time and there is no login in single-user state, `who` cannot report accurately on this state. The command, `who am I`, however, returns the correct information.
Name  whoami – display the effective current username

Synopsis  /usr/ucb/whoami

Description  whoami displays the login name corresponding to the current effective user ID. If you have used su to temporarily adopt another user, whoami will report the login name associated with that user ID. whoami gets its information from the geteuid and getpwuid library routines (see geteuid and getpwnam(3C), respectively).

Files  /etc/passwd  username data base

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>compatibility/ucb</td>
</tr>
</tbody>
</table>

See Also  su(1M), who(1), geteuid(2), getpwnam(3C), attributes(5)
whocalls(1)

Name  whocalls – report on the calls to a specific procedure

Synopsis  whocalls [-l wholib] [-s] funcname executable
           [arguments]...

Description  whocalls is a simple example of a utility based on the Link-Auditing functionality of
             ld.so.1(1) that permits the tracking of a given function call. See the Linker and Libraries
             Guide for a detailed description of the Link-Auditing mechanism. The executable is run as
             normal with any associated arguments. Each time the procedure funcname is called, both the
             arguments to that procedure and a stack trace are displayed on standard output.

Options  The following options are supported:

-  -l wholib  Specifies an alternate who.so Link-Auditing library to use.
-  -s  When available, examines and uses the .symtab symbol table for local symbols.
       This is a little more expensive than using the .dynsym symbol table, but can
       produce more detailed stack trace information.

Examples  EXAMPLE 1  Tracking Function Calls

The following example tracks the calls to printf() made by a simple helloworld program:

eexample% whocalls printf helloworld
printf(0x106e4, 0xef625310, 0xef621ba8)
       helloworld:main+0x10
       helloworld:.start+0x5c
Hello World

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>developer/base-developer-utilities</td>
</tr>
</tbody>
</table>

See Also  ld.so.1(1), sotruss(1), attributes(5)

Linker and Libraries Guide
Name  whois - Internet user name directory service

Synopsis  whois [-h host] identifier

Description  whois searches for an Internet directory entry for an identifier which is either a name (such as “Smith”) or a handle (such as “SRI-NIC”). To force a name-only search, precede the name with a period; to force a handle-only search, precede the handle with an exclamation point.

To search for a group or organization entry, precede the argument with * (an asterisk). The entire membership list of the group will be displayed with the record.

You may of course use an exclamation point and asterisk, or a period and asterisk together.

Examples  

EXAMPLE 1  Using The whois Command

The command:
examp% whois Smith

looks for the name or handle SMITH.

The command:
examp% whois !SRI-NIC

looks for the handle SRI-NIC only.

The command:
examp% whois .Smith, John

looks for the name JOHN SMITH only.

Adding . . . to the name or handle argument will match anything from that point; that is, ZU . . . will match ZUL, ZUM, and so on.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/network-clients</td>
</tr>
</tbody>
</table>

See Also  attributes(5)
**Name**  
write – write to another user

**Synopsis**  
write user [terminal]

**Description**  
The `write` utility reads lines from the user's standard input and writes them to the terminal of another user. When first invoked, it writes the message:

`Message from sender-login-id (sending-terminal) [date]...`

to `user`. When it has successfully completed the connection, the sender's terminal will be alerted twice to indicate that what the sender is typing is being written to the recipient's terminal.

If the recipient wants to reply, this can be accomplished by typing

`write sender-login-id [sending-terminal]`

upon receipt of the initial message. Whenever a line of input as delimited by a NL, EOF, or EOL special character is accumulated while in canonical input mode, the accumulated data will be written on the other user's terminal. Characters are processed as follows:

- Typing the alert character will write the alert character to the recipient's terminal.
- Typing the erase and kill characters will affect the sender's terminal in the manner described by the `termios(3C)` interface.
- Typing the interrupt or end-of-file characters will cause `write` to write an appropriate message (EOT\n in the C locale) to the recipient's terminal and exit.
- Typing characters from LC_CTYPE classifications print or space will cause those characters to be sent to the recipient's terminal.
- When and only when the `stty iexten` local mode is enabled, additional special control characters and multi-byte or single-byte characters are processed as printable characters if their wide character equivalents are printable.
- Typing other non-printable characters will cause them to be written to the recipient's terminal as follows: control characters will appear as a `\` followed by the appropriate ASCII character, and characters with the high-order bit set will appear in “meta” notation. For example, `\003` is displayed as `^C` and `\372` as `M-`.

To write to a user who is logged in more than once, the `terminal` argument can be used to indicate which terminal to write to. Otherwise, the recipient's terminal is the first writable instance of the user found in `/usr/adm/utmpx`, and the following informational message will be written to the sender's standard output, indicating which terminal was chosen:

`user is logged on more than one place.  
You are connected to terminal.  
Other locations are: terminal`
Permission to be a recipient of a write message can be denied or granted by use of the msg utility. However, a user's privilege may further constrain the domain of accessibility of other users' terminals. The write utility will fail when the user lacks the appropriate privileges to perform the requested action.

If the character ! is found at the beginning of a line, write calls the shell to execute the rest of the line as a command.

write runs setgid() (see setuid(2)) to the group ID tty, in order to have write permissions on other users' terminals.

The following protocol is suggested for using write: when you first write to another user, wait for them to write back before starting to send. Each person should end a message with a distinctive signal (that is, (o) for over) so that the other person knows when to reply. The signal (oo) (for over and out) is suggested when conversation is to be terminated.

Operands
The following operands are supported:

user User (login) name of the person to whom the message will be written. This operand must be of the form returned by the who(1) utility.

terminal Terminal identification in the same format provided by the who utility.

Environment Variables
See environ(5) for descriptions of the following environment variables that affect the execution of write: LANG, LC_ALL, LC_CTYPE, LC_MESSAGES, and NLSPATH.

Exit Status
The following exit values are returned:

0 Successful completion.

>0 The addressed user is not logged on or the addressed user denies permission.

Files
/var/adm/utmpx User and accounting information for write
/usr/bin/sh Bourne shell executable file

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>
See Also  mail(1), msg(1), pr(1), sh(1), talk(1), who(1), setuid(2), termios(3C), attributes(5), environ(5), standards(5)

Diagnostics  user is not logged on  The person you are trying to write to is not logged on.

Permission denied  The person you are trying to write to denies that permission (with `mesg`).

Warning: cannot respond, set `mesg` y  Your terminal is set to `mesg n` and the recipient cannot respond to you.

Can no longer write to user  The recipient has denied permission (`mesg n`) after you had started writing.
The `xargs` utility constructs a command line consisting of the `utility` and `argument` operands specified followed by as many arguments read in sequence from standard input as fit in length and number constraints specified by the options. The `xargs` utility then invokes the constructed command line and waits for its completion. This sequence is repeated until an end-of-file condition is detected on standard input or an invocation of a constructed command line returns an exit status of 255.

Arguments in the standard input must be separated by unquoted blank characters, or unescaped blank characters or newline characters. A string of zero or more non-double-quote (') and non-newline characters can be quoted by enclosing them in double-quotes. A string of zero or more non-apostrophe (') and non-newline characters can be quoted by enclosing them in apostrophes. Any unquoted character can be escaped by preceding it with a backslash (\). The `utility` are executed one or more times until the end-of-file is reached. The results are unspecified if the utility named by `utility` attempts to read from its standard input.

The generated command line length is the sum of the size in bytes of the utility name and each argument treated as strings, including a null byte terminator for each of these strings. The `xargs` utility limits the command line length such that when the command line is invoked, the combined argument and environment lists can not exceed \( \text{ARG\_MAX} - 2048 \) bytes. Within this constraint, if neither the `-n` nor the `-s` option is specified, the default command line length is at least \( \text{LINE\_MAX} \).

**Options**

The following options are supported:

- `-0` Input items are terminated by a null character instead of by white space or a NEWLINE, and the quotes and backslash are not special, that is, every character is taken literally. The end of file string is also disabled and is treated like any other argument. This is useful when input items might contain white space, quote marks, or backslashes. The `find` `-print0` option produces input suitable for this mode.

- `-e [eofstr]` Uses `eofstr` as the logical end-of-file string. Underscore (_) is assumed for the logical E0F string if neither `-e` nor `-E` is used. When the `eofstr` option-argument is omitted, the logical EOF string capability is disabled and underscores are taken literally. The `xargs` utility reads standard input until either end-of-file or the logical E0F string is encountered.

- `-E eofstr` Specifies a logical end-of-file string to replace the default underscore. `xargs` reads standard input until either end-of-file or the logical EOF string is encountered. When `eofstr` is a null string, the logical end-of-file string capability is disabled and underscore characters are taken literally.
-I replstr

Insert mode. utility is executed for each line from standard input, taking the entire line as a single argument, inserting it in arguments for each occurrence of replstr. A maximum of five arguments in arguments can each contain one or more instances of replstr. Any blank characters at the beginning of each line are ignored. Constructed arguments cannot grow larger than 255 bytes. Option -x is forced on. The -I and -i options are mutually exclusive; the last one specified takes effect.

-1 replstr

This option is equivalent to -I replstr. The string {} is assumed for replstr if the option-argument is omitted.

-L number

The utility is executed for each non-empty number lines of arguments from standard input. The last invocation of utility is with fewer lines of arguments if fewer than number remain. A line is considered to end with the first newline character unless the last character of the line is a blank character; a trailing blank character signals continuation to the next non-empty line, inclusive. The -L, -l, and -n options are mutually exclusive; the last one specified takes effect.

-\{number\}

(The letter ell.) This option is equivalent to -L number. If number is omitted, 1 is assumed. Option -x is forced on.

-n number

Invokes utility using as many standard input arguments as possible, up to number (a positive decimal integer) arguments maximum. Fewer arguments are used if:

- The command line length accumulated exceeds the size specified by the -s option (or {LINE_MAX} if there is no -s option), or
- The last iteration has fewer than number, but not zero, operands remaining.

-p

Prompt mode. The user is asked whether to execute utility at each invocation. Trace mode (-t) is turned on to write the command instance to be executed, followed by a prompt to standard error. An affirmative response (specific to the user’s locale) read from /dev/tty executes the command; otherwise, that particular invocation of utility is skipped.

-s size

Invokes utility using as many standard input arguments as possible yielding a command line length less than size (a positive decimal integer) bytes. Fewer arguments are used if:

- The total number of arguments exceeds that specified by the -n option, or
- The total number of lines exceeds that specified by the -L option, or
- End of file is encountered on standard input before size bytes are accumulated.

Values of size up to at least {LINE_MAX} bytes are supported, provided that the constraints specified in DESCRIPTION are met. It is not considered an error if
a value larger than that supported by the implementation or exceeding the constraints specified in DESCRIPTION is specified. xargs uses the largest value it supports within the constraints.

- t Enables trace mode. Each generated command line is written to standard error just prior to invocation.

- x Terminates if a command line containing number arguments (see the -n option above) or number lines (see the -L option above) does not fit in the implied or specified size (see the -s option above).

Operands The following operands are supported:

utility The name of the utility to be invoked, found by search path using the PATH environment variable. (see environ(5).) If utility is omitted, the default is the echo(1) utility. If the utility operand names any of the special built-in utilities in shell_builtins(1), the results are undefined.

argument An initial option or operand for the invocation of utility.

Usage The 255 exit status allows a utility being used by xargs to tell xargs to terminate if it knows no further invocations using the current data stream succeeds. Thus, utility should explicitly exit with an appropriate value to avoid accidentally returning with 255.

Notice that input is parsed as lines. Blank characters separate arguments. If xargs is used to bundle output of commands like find dir -print or ls into commands to be executed, unexpected results are likely if any filenames contain any blank characters or newline characters. This can be fixed by using find to call a script that converts each file found into a quoted string that is then piped to xargs. Notice that the quoting rules used by xargs are not the same as in the shell. They were not made consistent here because existing applications depend on the current rules and the shell syntax is not fully compatible with it. An easy rule that can be used to transform any string into a quoted form that xargs interprets correctly is to precede each character in the string with a backslash (\).

On implementations with a large value for (ARG_MAX), xargs can produce command lines longer than (LINE_MAX). For invocation of utilities, this is not a problem. If xargs is being used to create a text file, users should explicitly set the maximum command line length with the -s option.

The xargs utility returns exit status 127 if an error occurs so that applications can distinguish “failure to find a utility” from “invoked utility exited with an error indication.” The value 127 was chosen because it is not commonly used for other meanings; most utilities use small values for “normal error conditions” and the values above 128 can be confused with termination due to receipt of a signal. The value 126 was chosen in a similar manner to indicate that the utility could be found, but not invoked.
**Examples**

**EXAMPLE 1** Using the `xargs` command

The following example moves all files from directory `$1` to directory `$2`, and echo each move command just before doing it:

```
example% ls $1 | xargs -I {} -t mv $1/{} $2/{}
```

The following command combines the output of the parenthesised commands onto one line, which is then written to the end of file `log`:

```
example% (logname; date; printf "%s\n" "$0 $*") | xargs >>log
```

The following command invokes `diff` with successive pairs of arguments originally typed as command line arguments (assuming there are no embedded blank characters in the elements of the original argument list):

```
example% printf "%s\n" "$*" | xargs -n 2 -x diff
```

The user is asked which files in the current directory are to be archived. The files are archived into `arch`; a, one at a time, or b, many at a time:

```
example% ls | xargs -p -L 1 ar -r arch
ls | xargs -p -L 1 | xargs ar -r arch
```

The following executes with successive pairs of arguments originally typed as command line arguments:

```
example% echo $* | xargs -n 2 diff
```

**Environment Variables**

See `environ(5)` for descriptions of the following environment variables that affect the execution of `xargs`: LANG, LC_ALL, LC_COLLATE, LC_CTYPE, LC_MESSAGES, and NLSPATH.

**PATH**

Determine the location of `utility`.

Affirmative responses are processed using the extended regular expression defined for the `yesexpr` keyword in the LC_MESSAGES category of the user’s locale. The locale specified in the LC_COLLATE category defines the behavior of ranges, equivalence classes, and multi-character collating elements used in the expression defined for `yesexpr`. The locale specified in LC_CTYPE determines the locale for interpretation of sequences of bytes of text data a characters, the behavior of character classes used in the expression defined for the `yesexpr`. See `locale(5)`.

**Exit Status**

The following exit values are returned:

- **0**: All invocations of `utility` returned exit status 0.
- **1–125**: A command line meeting the specified requirements could not be assembled, one or more of the invocations of `utility` returned a non-zero exit status, or some other error occurred.
- **126**: The utility specified by `utility` was found but could not be invoked.
The utility specified by *utility* could not be found.

If a command line meeting the specified requirements cannot be assembled, the utility cannot be invoked, an invocation of the utility is terminated by a signal, or an invocation of the utility exits with exit status 255, the `xargs` utility writes a diagnostic message and exit without processing any remaining input.

**Attributes**  See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>CSI</td>
<td>Enabled</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See <code>standards(5)</code>.</td>
</tr>
</tbody>
</table>

**See Also**  `echo(1), shell_builtins(1), attributes(5), environ(5), standards(5)`
xgettext – extract gettext call strings from C programs

**Synopsis**
```
xgettext [-ns] [-a [-x exclude-file]] [-c comment-tag]
    [-d default-domain] [-j] [-m prefix] [-M suffix]
    [-p pathname] [-] filename...
```

**Description**
The `xgettext` utility is used to automate the creation of portable message files (.po). A .po file contains copies of “C” strings that are found in ANSI C source code in `filename` or the standard input if `−` is specified on the command line. The .po file can be used as input to the `msgfmt(1)` utility, which produces a binary form of the message file that can be used by application during run-time.

`xgettext` writes `msgid` strings from `gettext(3C)` calls in `filename` to the default output file `messages.po`. The default output file name can be changed by `-d` option. `msgid` strings in `dgettext()` calls are written to the output file `domainname.po` where `domainname` is the first parameter to the `dgettext()` call.

By default, `xgettext` creates a .po file in the current working directory, and each entry is in the same order that the strings are extracted from `filenames`. When the `-p` option is specified, the .po file is created in the `pathname` directory. An existing .po file is overwritten.

Duplicate `msgid`s are written to the .po file as comment lines. When the `-s` option is specified, the .po is sorted by the `msgid` string, and all duplicated `msgid`s are removed. All `msgstr` directives in the .po file are empty unless the `-m` option is used.

**Options**
The following options are supported:

- `-n` Add comment lines to the output file indicating file name and line number in the source file where each extracted string is encountered. These lines appear before each `msgid` in the following format:
  
  # # File: filename, line: line-number

- `-s` Generate output sorted by `msgid`s with all duplicate `msgid`s removed.

- `-a` Extract all strings, not just those found in `gettext(3C)`, and `dgettext()` () calls. Only one .po file is created.

- `-c comment-tag` The comment block beginning with `comment-tag` as the first token of the comment block is added to the output .po file as `#` delimited comments. For multiple domains, `xgettext` directs comments and messages to the prevailing text domain.

- `-d default-domain` Rename default output file from `messages.po` to `default-domain.po`.

- `-j` Join messages with existing message files. If a .po file does not exist, it is created. If a .po file does exist, new messages are appended. Any duplicate `msgid`s are commented out in the resulting .po file. Domain
Directives in the existing .po file are ignored. Results not guaranteed if the existing message file has been edited.

- \emph{m prefix} Fill in the msgstr with \emph{prefix}. This is useful for debugging purposes. To make msgstr identical to msgid, use an empty string ("") for \emph{prefix}.

- \emph{M suffix} Fill in the msgstr with \emph{suffix}. This is useful for debugging purposes.

- \emph{p pathname} Specify the directory where the output files will be placed. This option overrides the current working directory.

- \emph{x exclude-file} Specify a .po file that contains a list of msgids that are not to be extracted from the input files. The format of \emph{exclude-file} is identical to the .po file. However, only the msgid directive line in \emph{exclude-file} is used. All other lines are simply ignored. The -\emph{x} option can only be used with the -\emph{a} option.

- \emph{h} Print a help message on the standard output.

\textbf{Attributes} See attributes\(5\) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>text/locale</td>
</tr>
</tbody>
</table>

\textbf{See Also} \texttt{msgfmt(1)}, \texttt{gettext(3C)}, attributes\(5\)

\textbf{Notes} \texttt{xgettext} is not able to extract cast strings, for example ANSI C casts of literal strings to \texttt{(const char *)}. This is unnecessary anyway, since the prototypes in \texttt{<libintl.h>} already specify this type.

In messages and translation notes, lines greater than 2048 characters are truncated to 2048 characters and a warning message is printed to stderr.
**Synopsis**
xstr -c filename [-v] [-l array]
xstr [-l array]
xstr filename [-v] [-l array]

**Description**
xstr maintains a file called `strings` into which strings in component parts of a large program are hashed. These strings are replaced with references to this common area. This serves to implement shared constant strings, which are most useful if they are also read-only.

The command:
```bash
example% xstr -c filename
```
ejects the strings from the C source in name, replacing string references by expressions of the form `&xstr[number]` for some number. An appropriate declaration of `xstr` is prepended to the file. The resulting C text is placed in the file `x.c`, to then be compiled. The strings from this file are placed in the `strings` database if they are not there already. Repeated strings and strings which are suffixes of existing strings do not cause changes to the database.

After all components of a large program have been compiled, a file declaring the common `xstr` space called `xs.c` can be created by a command of the form:
```bash
example% xstr
```
This `xs.c` file should then be compiled and loaded with the rest of the program. If possible, the array can be made read-only (shared) saving space and swap overhead.

`xstr` can also be used on a single file. A command:
```bash
example% xstr filename
```
creates files `x.c` and `xs.c` as before, without using or affecting any `strings` file in the same directory.

It may be useful to run `xstr` after the C preprocessor if any macro definitions yield strings or if there is conditional code which contains strings which may not, in fact, be needed. `xstr` reads from the standard input when the argument `−` is given. An appropriate command sequence for running `xstr` after the C preprocessor is:
```bash
example% cc -E name.c | xstr −c −
example% cc −c x.c
example% mv x.o name.o
```
xstr does not touch the file `strings` unless new items are added; thus `make(1S)` can avoid remaking `xs.o` unless truly necessary.
Options  

-\(c\) filename  
Take C source text from filename.

-\(v\)  
Verbose: display a progress report indicating where new or duplicate strings were found.

-\(l\) array  
Specify the named array in program references to abstracted strings. The default array name is \(xstr\).

Files  

strings  
data base of strings

\(x.c\)  
massaged C source

\(xs.c\)  
C source for definition of array \("xstr"\)(\(rq\)

\(/tmp/xs*\)  
temp file when \(xstr\) filename doesn’t touch strings

Attributes  
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

See Also  
make(1S), attributes(5)

Bugs  
If a string is a suffix of another string in the database, but the shorter string is seen first by \(xstr\) both strings will be placed in the database, when just placing the longer one there would do.

Notes  
Be aware that \(xstr\) indiscriminately replaces all strings with expressions of the form \&\(xstr[\text{number}]\) regardless of the way the original C code might have used the string. For example, you will encounter a problem with code that uses sizeof() to determine the length of a literal string because \(xstr\) will replace the literal string with a pointer that most likely will have a different size than the string’s.

To circumvent this problem:

- use strlen() instead of sizeof(); note that sizeof() returns the size of the array (including the null byte at the end), whereas strlen() doesn’t count the null byte. The equivalent of sizeof("xxx") really is (strlen("xxx")+1).
- use #define for operands of sizeof() and use the defined version. xstr ignores #define statements. Make sure you run xstr on filename before you run it on the preprocessor.

You will also encounter a problem when declaring an initialized character array of the form

```c
char x[ ] = "xxx";
```

\(xstr\) will replace \(xxx\) with an expression of the form \&\(xstr[\text{number}]\) which will not compile. To circumvent this problem, use static char *\(x\) = "xxx" instead of static char x[ ] = "xxx".
yacc (1)

Name
yacc – yet another compiler-compiler

Synopsis
yacc [-dltv] [-b file_prefix] [-Q [y | n]]
       [-P parser] [-p sym_prefix] file

Description
The yacc command converts a context-free grammar into a set of tables for a simple
automaton that executes an LALR(1) parsing algorithm. The grammar can be ambiguous.
Specified precedence rules are used to break ambiguities.

The output file, y.tab.c, must be compiled by the C compiler to produce a function
yparse(). This program must be loaded with the lexical analyzer program, yylex(), as well
as main() and yyerror(), an error handling routine. These routines must be supplied by the
user. The lex(1) command is useful for creating lexical analyzers usable by yacc.

Options
The following options are supported:

- b file_prefix
  Uses file_prefix instead of y as the prefix for all output files. The code file
  y.tab.c, the header file y.tab.h (created when -d is specified), and the
description file y.output (created when -v is specified), is changed to
  file_prefix.tab.c, file_prefix.tab.h, and file_prefix.output, respectively.

- d
  Generates the file y.tab.h with the #define statements that associate the
  yacc user-assigned “token codes” with the user-declared “token names”.
  This association allows source files other than y.tab.c to access the token
codes.

- l
  Specifies that the code produced in y.tab.c does not contain any #line
  constructs. This option should only be used after the grammar and the
  associated actions are fully debugged.

- p sym_prefix
  Uses sym_prefix instead of yy as the prefix for all external names produced
  by yacc. The names affected include the functions yyparse(), yylex() and
  yyerror(), and the variables yyval, yychar and yydebug. (In the remainder
  of this section, the six symbols cited are referenced using their default names
  only as a notational convenience.) Local names can also be affected by the -p
  option. However, the -p option does not affect #define symbols generated
  by yacc.

- P parser
  Allows you to specify the parser of your choice instead of
  /usr/share/lib/ccs/yaccpar. For example, you can specify:

  example% yacc -P ~/myparser parser.y

- Q[y|n]
  The -Qy option puts the version stamping information in y.tab.c. This
  allows you to know what version of yacc built the file. The -Qn option (the
  default) writes no version information.

- t
  Compiles runtime debugging code by default. Runtime debugging code is
  always generated in y.tab.c under conditional compilation control. By
default, this code is not included when y.tab.c is compiled. Whether or not
the -t option is used, the runtime debugging code is under the control of YYDEBUG, a preprocessor symbol. If YYDEBUG has a non-zero value, then the debugging code is included. If its value is 0, then the code is not included. The size and execution time of a program produced without the runtime debugging code is smaller and slightly faster.

-v Prepares the file y.output, which contains a description of the parsing tables and a report on conflicts generated by ambiguities in the grammar.

-V Prints on the standard error output the version information for yacc.

Operands
The following operand is required:

file A path name of a file containing instructions for which a parser is to be created.

Examples

Accessing the yacc Library

Access to the yacc library is obtained with library search operands to cc. To use the yacc library main:

```
example% cc y.tab.c -ly
```

Both the lex library and the yacc library contain main. To access the yacc main:

```
example% cc y.tab.c lex.yy.c -ly -ll
```

This ensures that the yacc library is searched first, so that its main is used.

The historical yacc libraries have contained two simple functions that are normally coded by the application programmer. These library functions are similar to the following code:

```c
#include <locale.h>

int main(void)
{
    extern int yyparse();

    setlocale(LC_ALL, "");

    /* If the following parser is one created by lex, the application must be careful to ensure that LC_COLLATE and LC_COLLATE are set to the POSIX locale. */
    (void) yyparse();
    return (0);
}
```

```c
#include <stdio.h>

int yyerror(const char *msg)
{
    (void) fprintf(stderr, "%s\n", msg);
}
```
EXAMPLE 1 Accessing the yacc Library  (Continued)

    return (0);

}

Environment Variables See \textit{environ(5)} for descriptions of the following environment variables that affect the execution of \texttt{yacc}: \texttt{LANG}, \texttt{LC\_ALL}, \texttt{LC\_CTYPE}, \texttt{LC\_MESSAGES}, and \texttt{NLSPATH}.

\texttt{yacc} can handle characters from EUC primary and supplementary codesets as one-token symbols. EUC codes can only be single character quoted terminal symbols. \texttt{yacc} expects \texttt{yylex()} to return a wide character (\texttt{wchar\_t}) value for these one-token symbols.

Exit Status The following exit values are returned:

\begin{itemize}
    \item \texttt{0} Successful completion.
    \item \texttt{>0} An error occurred.
\end{itemize}

Files \texttt{y.output} state transitions of the generated parser

\texttt{y.tab.c} source code of the generated parser

\texttt{y.tab.h} header file for the generated parser

\texttt{yacc.acts} temporary file

\texttt{yacc.debug} temporary file

\texttt{yacc.tmp} temporary file

\texttt{yaccpar} parser prototype for C programs

Attributes See \textit{attributes(5)} for descriptions of the following attributes:

\begin{table}
\centering
\begin{tabular}{|l|l|}
\hline
\textbf{ATTRIBUTE TYPE} & \textbf{ATTRIBUTE VALUE} \\
\hline
Availability & developer/base-developer-utilities \\
Interface Stability & Committed \\
Standard & See \textit{standards(5)}. \\
\hline
\end{tabular}
\end{table}

See Also \texttt{lex(1)}, \textit{attributes(5)}, \textit{environ(5)}, \textit{standards(5)}

Diagnostics The number of reduce-reduce and shift-reduce conflicts is reported on the standard error output. A more detailed report is found in the \texttt{y.output} file. Similarly, if some rules are not reachable from the start symbol, this instance is also reported.

Notes Because file names are fixed, at most one \texttt{yacc} process can be active in a given directory at a given time.

Users are encouraged to avoid using $ as part of any identifier name.
**Name**  yes – generate repetitive affirmative output

**Synopsis**  yes [term]...

**Description**  The yes utility repeatedly outputs y, or if term is specified, term is output repeatedly. In the output, either y or term is followed by a NEWLINE. Multiple arguments are output separated by spaces and followed by a NEWLINE. To terminate yes, issue an interrupt character.

yes can be used to respond programatically to programs that require an interactive response.

**Attributes**  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
</tbody>
</table>

**See Also**  attributes(5)
ypcat – print values in a NIS database

ypcat [-kx] [-d ypdomain] mname

Description
The `ypcat` command prints out values in the NIS name service map specified by `mname`, which may be either a map name or a map nickname. Since `ypcat` uses the NIS network services, no NIS server is specified.

Refer to `ypfiles(4)` for an overview of the NIS name service.

Options
- `-k` Display the keys for those maps in which the values are null or the key is not part of the value. None of the maps derived from files that have an ASCII version in `/etc` fall into this class.
- `-d ypdomain` Specify a domain other than the default domain.
- `-x` Display map nicknames.

Attributes
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/network/nis</td>
</tr>
</tbody>
</table>

See Also `ypmatch(1), ypfiles(4), attributes(5)`
ypmatch – print the value of one or more keys from a NIS map

Synopsis

ypmatch [-k] [-t] [-d domain] key [key]... mname

ypmatch -x

Description

ypmatch prints the values associated with one or more keys from the NIS’s name services map specified by mname, which may be either a map name or a map nickname.

Multiple keys can be specified; all keys will be searched for in the same map. The keys must be the same case and length. No pattern matching is available. If a key is not matched, a diagnostic message is produced.

Options

The following options are supported:

- `k` Before printing the value of a key, print the key itself, followed by a colon (:).
- `t` Inhibit map nickname translation.
- `-d domain` Specify a domain other than the default domain.
- `x` Display the map nickname table. This lists the nicknames the command knows of, and indicates the map name associated with each nickname.

Operands

The following operand is supported:

- `mname` The NIS’s name services map

Exit Status

The following exit values are returned:

- `0` Successful operation.
- `1` An error occurred.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/network/nis</td>
</tr>
</tbody>
</table>

See Also

ypcat(1), ypfiles(4), attributes(5)

Notes

ypmatch will fail with an RPC error message on yp operation if enough file descriptors are not available. The number of file descriptors should be increased if this occurs.
yppasswd(1)

Name  yppasswd – change your network password in the NIS database

Synopsis  yppasswd [username]

Description  The yppasswd utility changes the network password associated with the user username in the Network Information Service (NIS) database. If the user has done a keylogin(1), and a publickey/secretkey pair exists for the user in the NIS publickeybyname map, yppasswd also re-encrypts the secretkey with the new password. The NIS password may be different from the local one on your own machine.

yppasswd prompts for the old NIS password, and then for the new one. You must type in the old password correctly for the change to take effect. The new password must be typed twice, to forestall mistakes.

New passwords must be at least four characters long, if they use a sufficiently rich alphabet, and at least six characters long if monocase. These rules are relaxed if you are insistent enough. Only the owner of the name or the super-user may change a password; superuser on the root master will not be prompted for the old password, and does not need to follow password construction requirements.

The NIS password daemon, rpc.yppasswd must be running on your NIS server in order for the new password to take effect.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/network/nis</td>
</tr>
</tbody>
</table>

See Also  keylogin(1), login(1), passwd(1), getpwnam(3C), getspnam(3C), secure_rpc(3NSL), nsswitch.conf(4), attributes(5)

Warnings  Even after the user has successfully changed his or her password using this command, the subsequent login(1) using the new password will be successful only if the user’s password and shadow information is obtained from NIS. See getpwnam(3C), getspnam(3C), and nsswitch.conf(4).

Notes  The use of yppasswd is discouraged, as it is now only a wrapper around the passwd(1) command, which should be used instead. Using passwd(1) with the -r nis option will achieve the same results, and will be consistent across all the different name services available.

Bugs  The update protocol passes all the information to the server in one RPC call, without ever looking at it. Thus, if you type your old password incorrectly, you will not be notified until after you have entered your new password.
ypwhich(1)

**Name**

ypwhich – return name of NIS server or map master

**Synopsis**

```
ypwhich [-d domain] [ [-t] [-m mname] | [-Vn] hostname]
ypwhich -x
```

**Description**

ypwhich returns the name of the NIS server that supplies the NIS name services to a NIS client, or which is the master for a map. If invoked without arguments, it gives the NIS server for the local machine. If hostname is specified, that machine is queried to find out which NIS master it is using.

Refer to *ypfiles* for an overview of the NIS name services.

**Options**

- `-d domain` Use domain instead of the default domain.
- `-t` This option inhibits map nickname translation.
- `-m mname` Find the master NIS server for a map. No hostname can be specified with -m. mname can be a mapname, or a nickname for a map. When mname is omitted, produce a list of available maps.
- `-x` Display the map nickname translation table.
- `-Vn` Version of ypbind, V3 is default.

**Attributes**

See attributes for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/network/nis</td>
</tr>
</tbody>
</table>

**See Also**

*ypfiles*, attributes
zlogin(1)

Name
zlogin – enter a zone

Synopsis
zlogin [-dCE] [-e c] [-l username] zonename
zlogin [-ES] [-e c] [-l username] zonename utility
[argument]...

Description
The zlogin utility is used to enter an operating system zone. Only a user operating in the
global system zone can use this utility, and it must be executed with all privileges. In addition,
the user must be authorized to use specific options described in the OPTIONS section.

zlogin checks for authorization strings which optionally include the specified zonename as a
suffix, preceded by the slash character. When omitted, the authorization matches any zone.

zlogin operates in one of three modes:

Interactive Mode
If no utility argument is given and the stdin file descriptor for the
zlogin process is a tty device, zlogin operates in interactive mode.
In this mode, zlogin creates a new pseudo terminal for use within
the login session. Programs requiring a tty device, for example,
vi(1), work properly in this mode. In this mode, zlogin invokes
login(1) to provide a suitable login session.

Non-Interactive Mode
If a utility is specified, zlogin operates in non-interactive mode.
This mode can be useful for script authors since stdin, stdout,
and stderr are preserved and the exit status of utility is returned
upon termination. In this mode, zlogin invokes su(1M) in order
to set up the user’s environment and to provide a login
environment.

The specified command is passed as a string and interpreted by a
shell running in the non-global zone. See rsh(1).

Console Mode
If the -C option is specified, the user is connected to the zone
console device and zlogin operates in console mode. The zone
console is available once the zone is in the installed state.
Connections to the console are persistent across reboot of the
zone.

Options
The following options are supported:

- C
Connects to the zone console. Access to the zone console requires the
authorization zone.manage/zonename.

- d
If the zone halts, disconnect from the console. This option can only be
specified along with -C.

- e c
Specifies a different escape character, c, for the key sequence used to access
extended functions and to disconnect from the login. The default escape
character is the tilde (\~).
-E	Disables the ability to access extended functions or to disconnect from the login by using the escape sequence character.

-\ username	Specifies a different username for the zone login. If you do not use this option, the zone username used is root. This option is invalid if the -C option is specified.

The username must be valid in the zone. For interactive logins the authorization solaris.zone.login/zonename is required, and password authentication takes place in the zone. For non-interactive logins, or to bypass password authentication, the authorization solaris.zone.manage/zonename is required.

-S	Safe login mode. zlogin does minimal processing and does not invoke login(1) or su(1M). The zone username is set to root. The -S option cannot be used if a username is specified through the -l option, and cannot be used with console logins. This mode should only be used to recover a damaged zone when other forms of login have become impossible.

Use of this option requires the authorization solaris.zone.manage/zonename.

Escape Sequences

Lines that you type that start with the tilde character (~) are “escape sequences”. The escape character can be changed using the -e option.

~.	Disconnects from the zone. This is not the same as a logout, because the local host breaks the connection with no warning to the zone's end.

Security

Once a process has been placed in a zone other than the global zone, the process cannot change zone again, nor can any of its children.

Operands

The following operands are supported:

zonename	The name of the zone to be entered.
utility	The utility to be run in the specified zone.
argument...	Arguments passed to the utility.

Exit Status

In interactive and non-interactive modes, the zlogin utility exits when the command or shell in the non-global zone exits. In non-interactive mode, the exit status of the remote program is returned as the exit status of zlogin. In interactive mode and console login mode, the exit status is not returned. zlogin returns a 0 exit status as long as no connection-related error occurred.

In all modes, in the event that a connection to the zone cannot be established, the connection fails unexpectedly, or the user is lacking sufficient privilege to perform the requested operation, zlogin exits with status 1.
To summarize, the following exit values are returned:

- **0**: Successful entry.
- **1**: Permission denied, or failure to enter the zone.
- **Any** Return code from utility, or from `su(1M)` if operating in non-interactive mode.

### Attributes
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/zones</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

### See Also
`login(1), rsh(1), vi(1), su(1M), zoneadm(1M), zonecfg(1M), attributes(5), zones(5)`

### Notes
`zlogin` fails if its open files or any portion of its address space corresponds to an NFS file. This includes the executable itself or the shared libraries.
Name  zonename – print name of current zone

Synopsis  zonename

Description  The zonename utility prints the name of the current zone.

Exit Status  The following exit values are returned:

    0      Successful completion.
    >0     An error occurred.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/core-os</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  zlogin(1), zoneadm(1M), zonecfg(1M), attributes(5), zones(5)
zonestat(1)

**Name**
zonestat – report active zone statistics

**Synopsis**
zonestat [-z zonelist] [-r reslist] [-n namelist] [-T u | d | i]
[-R reports] [-q] [-x] [-p [-P lines]]
[-S cols] interval [duration [report]]

**Description**
The `zonestat` utility reports on the cpu, memory, networking, and resource control utilization of the currently running zones. Each zone's utilization is reported both as a percentage of system resources and the zone's configured limits.

The `zonestat` utility prints a series of interval reports at the specified interval. It optionally also prints one or more summary reports at a specified interval.

The default output is a summary of cpu, physical, and virtual memory, and networking utilization. The -r option can be used to choose detailed output for specific resources.

When run from within a non-global zone (NGZ), only processor sets visible to the NGZ are reported. The NGZ output includes all of other system resources, such as memory and limits.

For all reported resources, the NGZ's usage is output. Usage of each resource by the system, global zone, and all other zones, is reported as used by [system].

For networking resources, only NGZ's usage is output. NGZs do not have visibility to other zones' networking resources and statistics.

**Security**
`proc_info` privilege is required to use the `zonestat` utility. This privilege is a member of the basic privilege set.

**Options**
The following options are supported:

- `-n name[,name]`
  Specify a list resource names on which to report. For pset resources, this is the name of the processor set. For physical-memory, locked-memory, and virtual-memory resources, the only names are `mem_default` and `vm_default`. For network resources, this is name of a datalink.

  Dedicated-cpu processor sets can be specified by their pset name (`SUNWtmp_zonename`) or by just their zonename.

  Processor sets created by `psrset` can be specified by their pool pset name (`SUNWlegacy_pset id`), or just by their pset id.

  In addition to a comma-separated list, multiple `-n` options can be specified to report on a set of resources.

- `-p`
  Parseable output.

  Print output in stable, machine--parseable format. Individual fields are delimited with a colon (:). The line format is:
The report types are: report-total, report-average, report-high, and interval.

The resource types are: header, footer, summary, physical-memory, virtual-memory, locked-memory, processor-set, processes, lwps, sysv-shared-memory, sysv-shmids, sysv-semids, sysv-msgids, lofi, network.

The header resource is a special resource used to state the beginning of an interval or summary report. All output lines between header resources belong to the same report. Each header has a matching footer.

The remaining fields are resource type specific. See the zonesstat utility output for details.

All existing output fields are stable. Future versions might introduce new report and resource types. Future versions might also add additional new fields to the end of existing output n lines.

-P line[,line]
For parseable output, specify lines to output in parseable output. One or more of the following line types can be chosen:

header, footer: For each interval, and summary report has a header, which prints details such as the interval and count information. After each report, and footer is also printed

resource: The lines describing each resource.

system: The utilization of each resource by the system. This includes the kernel, and any resource consumption not contributed to a specific zone. When zonesstat is run from within a non-global-zone, this value is the aggregate resource consumed by the system and all other zones. system utilization for network resource type is not supported.

total: The total utilization of each resource.

zones: Lines detailing the per-zone utilization of each resource.

-q
Quiet mode. Only print summary reports (requires the -R option). All interval reports are omitted.

-r resource[,resource]
Specify resource types on which to report. The available resources are: physical-memory, virtual-memory, locked-memory, processor-set, processes, lwps, shm-memory, shm-ids, sem-ids, msg-ids, lofi, and network.

summary: A summary of cpu, physical-memory, virtual-memory, and network usage.
memory: physical-memory, virtual-memory, and locked-memory.

psets: processor-set

default-pset: The default pset only.

limits: processes, lwps, lofi.

network: network datalinks.

sysv: shm-memory, shm-ids, sem-ids msg-ids.

all: All resource types.

By default the summary resource is printed.

In addition to a comma-separated list, multiple -r options can be specified to report on a set of resources types.

The system’s cpus can be partitioned into processor sets (psets). By default, all cpus are in a single pset named pset_default.

Memory is not partition-able into sets. The zonestat utility output for these resources shows them as named mem_default and vm_default.

The all resource specifies that all resource types should be reported.

-R [report[,report]]
Print a summary report. The supported report types are described below. In addition to a comma-separated list, multiple -R options can be specified for a set of summary reports.

total: Prints a summary report detailing the following for each resource:

psets: Total cpu used since start of command invocation. The percent used for each zone includes time that a zone was not running. For instance, if a zone used 100% of the cpu while it was running, but the zone was halted for half of the intervals, then the summary report shows the zone used 50% of the cpu time.

memory, limits, sysv: Average resource used of all intervals reported since command invocation. This average factors in intervals in which a zone was not running. For example if a zone used on average of 100M of physical memory while it was running, and was only running for half the intervals, then the summary report shows that the zone used 50M of physical memory on average.
network
Sum of all bytes that are transmitted and received by all datalink utilizing physical bandwidth. The sum is calculated since start of command invocation and is normalized to number of bytes per second. The percentage used is based on total available bandwidth.

average
Similar to total, but only intervals in which a zone is running are factored in. For example, if a zone was only running for a single interval, and during that interval, the zone used 200M of virtual memory, then it's average virtual-memory is 200M, regardless of the number of intervals reported before the summary report.

high
Print a summary report detailing the highest usage of each resource and zone during any interval of the zonestat utility invocation.

-S col[,col]
Sort zones utilizing each resource.

The following sorting columns can be specified:

name
Sort alpha-numericly by zone name.

used
Sort by quantity of resource used. For networking resource, this is same as sort by bytes.

This is the default.

cap
Sort by configured cap.

pcap
Sort by percent of cap used.

shr
Sort by allocated share.

pshru
Sort by percent of share used.

bytes
Sort networking by total bytes transmitted and received.

prbyte
Sort networking by percentage of received bytes over the wire.

pobyte
Sort networking by percentage of transmitted bytes over the wire.

maxbw
Sort networking by percentage of bandwidth used.

cpu
Sort by cpu usage in the summary, This is the default.

physical-memory
Sort by physical memory usage in the summary.

virtual-memory
Sort by virtual memory usage in the summary.

network
Sort by network usage in the summary.
Includetimestampofeachreport. The following formats are supported:

- **d** Standard date format. See `date(1)`. This option is not valid with `-p`.

- **i** Time formatted as the ISO 8601 compliant format:
  
  YYYYMMDDThhmmssZ

- **u** A printed representation of the internal representation of time. See `time(2)`. This is also known as Unix time.

- **-x** Display an extended view with more detailed information. For example, when used with network resource, the extended view list details of each virtual datalink.

- **-z zonename[,zonename]**
  Specify a list of zones on which to report. By default all zones are reported.

  In addition to a comma-separated list, multiple `-z` options can be specified to report on a set of zones. The output includes any resources which have usage by the specified zones.

**Operands**

The following operands are supported:

- **interval**
  Specifies the length in seconds to pause between each interval report. An interval of default uses the configured interval of the zones monitoring service. See `zonestat(1M)`.

  **interval** is required. An interval of zero is not permitted. **interval** can be specified as `[nh][nm][ns]`, such as `10s` or `1m`.

- **duration**
  Specifies the number of intervals to report. Defaults to infinity if not specified. The command duration is *(interval * duration)*. A duration of zero is invalid. A value of `inf` can also be specified to explicitly choose infinity.

  Duration can also be specified as `[nh][nm][ns]`. In this case, **duration** is interpreted as the duration of execution time. The actual **duration** is rounded up to the nearest multiple of the interval.

- **report**
  Specify the summary report period. For instance, a report of 4 produces reports every 4 intervals. If the command duration is not a multiple of report, then the last report is of any remaining intervals.

  **report** can also be specified as `[nh][nm][ns]`. In this case, reports are output at the specified time period, rounded up to the nearest interval. If the command **duration** is not a multiple of report, then the last report is of any remaining intervals.

  Requires -R. If -R is specified and report is not, the report period is the entire command duration, producing the specified reports at the end of execution.
Output  The following list defines the column heading of the command output:

SYSTEM-MEMORY  
The total amount of memory available on the physical host.

SYSTEM-LIMIT  
The maximum amount of resource available on the physical host.

CPUS  
The number of cpus allocated to a processor set

ONLINE  
Of the cpus allocated to a processor set, the number of cpus which can execute processes.

MIN/MAX  
The minimum and maximum number of cpus which can be allocated to the processor set by the system.

ZONE  
The zone using the resource. In addition to zone names, this column can also contain:

[total]  
The total quantity of resource used system-wide.

/system]  
The quantity of resource used by the kernel or in a manner not associated with any particular zone.

When zonesstat is used within a non-global zone, [system] designates the aggregate resource used by the system and by all other zones.

For network resources, system usage of network is not available.

USED  
The amount of resource used.

%USED  
The amount of resource used as a percent of the total resource.

PCT  
The amount of resource used as a percent of the total resource.

%PART  
The amount of cpu used as a percentage of the total cpu in a processor-set to which the zone is bound. A zone can only have processes bound to multiple processor sets if it is the global zone, or if \texttt{pset(1M)} psets are used. If multiple binding are found for a zone, it's %PART is the fraction used of all bound psets. For [total] and [system], %PART is the percent used of all cpus on the system.

CAP  
If a zone is configured to have a cap on the given resource, the cap is displayed in this column.
%CAP
The amount of resource used as a percent of zone’s configured cap.

SHRS
The number of shares allocated to the zone. For the [total] row, this is the total number of
shares allocated to all zones sharing the resource. If a zone is not configured to use shares,
and is sharing a resource with other zones that are configured to use shares, this column
contains no -fss for the zone.

%SHRS
The fraction of the total shares allocated to the zone. For instance, if 2 zones share a
processor set, each with 10 shares, then each zone has a %SHR of 50%.

%SHRU
Of the share allocated to the zone, the fraction of resource 100%. Because shares are only
enforced when there is resource contention, it is possible for a zone to have a %SHRU in
excess of 100%.

TOBYTES
The number of bytes transmitted and received by datalinks or virtual links.

PRBYTE
The number of received bytes that consumes physical bandwidth.

POBYTE
The number of transmitted bytes that consumes physical bandwidth.

%PRBYTE
The percentage of available physical bandwidth used to receive PRBYTE.

%POBYTE
The percentage of available physical bandwidth used to transmit POBYTE.

%PUSE
The sum of PRBYTE and POBYTE as a percent of the total available physical bandwidth.

LINK
The name of a datalink.

MAXBW
The maximum bandwidth configured on a datalink.

%MAXBW
The sum of all transmitted and received bytes as a percentage of configured maximum
bandwidth.

Examples
EXAMPLE 1  Using zonestat to Display a Summary of cpu and Memory Utilization

The following command shows a summary of cpu and memory utilization every 5 seconds:

```
# zonestat 5 1
SUMMARY  Cpus/Online: 4/4  Physical: 8063M  Virtual: 11.8G
```

EXAMPLE 1  Using zonestat to Display a Summary of cpu and Memory Utilization  (Continued)

<table>
<thead>
<tr>
<th>ZONE</th>
<th>USED %</th>
<th>PART USED %</th>
<th>USED</th>
<th>%USED</th>
<th>USED</th>
<th>%USED</th>
<th>PBYTE</th>
<th>%PUSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>[total]</td>
<td>0.23</td>
<td>5.76%</td>
<td>3211M</td>
<td>39.8%</td>
<td>4191M</td>
<td>34.6%</td>
<td>350M</td>
<td>18.7%</td>
</tr>
<tr>
<td>[system]</td>
<td>0.03</td>
<td>0.83%</td>
<td>2791M</td>
<td>34.6%</td>
<td>3890M</td>
<td>32.1%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>global</td>
<td>0.19</td>
<td>4.86%</td>
<td>324M</td>
<td>4.01%</td>
<td>228M</td>
<td>1.89%</td>
<td>200M</td>
<td>10.7%</td>
</tr>
<tr>
<td>zoneA</td>
<td>0.00</td>
<td>0.03%</td>
<td>47.9M</td>
<td>0.59%</td>
<td>36.3M</td>
<td>0.30%</td>
<td>100M</td>
<td>5.3%</td>
</tr>
<tr>
<td>zoneB</td>
<td>0.00</td>
<td>0.02%</td>
<td>48.1M</td>
<td>0.59%</td>
<td>36.4M</td>
<td>0.30%</td>
<td>50M</td>
<td>2.7%</td>
</tr>
</tbody>
</table>

EXAMPLE 2  Using zonestat to Produce Parseable Output

The following command produces parseable output. It prints one line per zone using each pset resource for a 5 second interval:

```
# zonestat -p -P zones -r psets 5 1
```

EXAMPLE 3  Using zonestat to Report on the Default pset

The following command reports on the default pset once a second for one minute:

```
# zonestat -r default-pset 1 1m
```

EXAMPLE 4  Using zonestat to Report Total and High Utilization

The following command monitors silently at a 10 second interval for 24 hours, producing a total and high report every 1 hour:

```
# zonestat -q -R total,high 10s 24h 1h
```

EXAMPLE 5  Using zonestat to Report Datalink Utilization

The following command reports on a datalink named e1000g0 at a 5 second interval for 5 times:

```
# zonestat -r network -n e1000g0 5 5
```

Exit Status  The following exit values are returned:

0  Successful completion.

1  An error occurred.

2  Invalid usage.

3  svc:system/zones_monitoring: default not running or not responding.
Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/zones</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>See below.</td>
</tr>
</tbody>
</table>

Command invocation and parseable output is Committed. Human readable output (default output) is Uncommitted.

See Also date(1), prctl(1), pooladm(1M), poolcfg(1M), psrset(1M), rcapadm(1M), zoneadm(1M), zonectfg(1M), zonestatd(1M), time(2), timezone(4), attributes(5), privileges(5), resource_controls(5)

Notes The zonestat utility depends on the zones monitoring service: svc/system/zonestat:default. If the zonestat service is stopped while the zonestat utility is running, the zonestat command invocation quits without printing additional reports. The reports (-R) is printed if zonestat is interrupted (by CTRL/c, SIGINT) before reaching the next report period.