# Introduction to the Oracle® Solaris 11 Developer Environment

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# Preface

The *Introduction to Oracle Solaris 11 Developer Environment* describes the developer tools available in the Oracle Solaris 11 release and is intended to help developers set up an Oracle Solaris 11 developer environment on an x86 system.

## Access to Oracle Support

Oracle customers have access to electronic support through My Oracle Support. For information, visit `http://www.oracle.com/pls/topic/lookup?ctx=acc&id=info` or visit `http://www.oracle.com/pls/topic/lookup?ctx=acc&id=trs` if you are hearing impaired.

## Typographic Conventions

The following table describes the typographic conventions that are used in this book.

**TABLE P–1** Typographic Conventions

| Typeface | Description | Example |
|---|---|---|
| `AaBbCc123` | The names of commands, files, and directories, and onscreen computer output | Edit your `.login` file.<br>Use `ls -a` to list all files.<br>`machine_name% you have mail.` |
| **`AaBbCc123`** | What you type, contrasted with onscreen computer output | `machine_name%` **`su`**<br>`Password:` |
| *aabbcc123* | Placeholder: replace with a real name or value | The command to remove a file is `rm` *filename*. |
| *AaBbCc123* | Book titles, new terms, and terms to be emphasized | Read Chapter 6 in the *User's Guide*.<br>A *cache* is a copy that is stored locally.<br>Do *not* save the file.<br>**Note:** Some emphasized items appear bold online. |

# Shell Prompts in Command Examples

The following table shows the default UNIX system prompt and superuser prompt for shells that are included in the Oracle Solaris OS. Note that the default system prompt that is displayed in command examples varies, depending on the Oracle Solaris release.

**TABLE P–2** Shell Prompts

| Shell | Prompt |
|---|---|
| Bash shell, Korn shell, and Bourne shell | `$` |
| Bash shell, Korn shell, and Bourne shell for superuser | `#` |
| C shell | `machine_name%` |
| C shell for superuser | `machine_name#` |

◆ ◆ ◆ CHAPTER 1

# Introduction

This document is intended to help Oracle Solaris 11 developers set up their application development environment on an x86 system. The Oracle Solaris 11 operating system (OS) enables developers to build applications and solutions in a variety of programming languages including C, C++, Java, PHP, and Ruby. This document provides an overview of the features in the Oracle Solaris 11 OS. It will help you identify and install packages needed for your development work after you have installed the OS on your system.

Instructor-led courses, online courses, white papers, and other information on the Oracle Solaris OS and other technologies are among the resources available at Oracle University.

## Installation and Configuration

The following sections provide a brief overview of the installation and packaging technologies in the Oracle Solaris 11 operating system. See the corresponding documents for detailed information about these topics.

### Installing the OS

The Oracle Solaris 11 OS provides several installation options to install the OS depending on your system's environment and requirements. You can install from Live Media, the text installer, or the Automated Installer (AI). See the *Adding and Updating Oracle Solaris 11.1 Software Packages* guide for detailed instructions on installing the Oracle Solaris 11 OS.

### Image Packaging System

After the OS has been installed on your system, you can download additional software packages, including developer tools, by using the Image Packaging System (IPS). IPS accesses software packages from networked repositories and then installs them on your system.

IPS enables you to download and install packages using either the command line or the Package Manager. The Package Manager is the graphical user interface (GUI) for IPS.

The software packages are available in the release repository at `http://pkg.oracle.com/solaris/release/en/index.shtml`. Customers who buy support packages for the Oracle Solaris 11 OS will be provided access to a support repository.

See the *Adding and Updating Oracle Solaris 11.1 Software Packages* for detailed information about installing and updating packages.

### Starting the Package Manager

Package Manager provides a subset of the tasks that can be performed from the command line:

- List, search, install, update, and remove packages
- Add and configure package repositories
- Activate, rename, and remove boot environments. For information on boot environments, see the *Creating and Administering Oracle Solaris 11.1 Boot Environments* document.

| | |
|---|---|
| Tool bar | Click the Package Manager icon in the tool bar. The Package Manager icon is a box with a circling arrow. |
| Desktop icon | Double-click the Package Manager icon on the desktop. |
| Menu bar | Choose System⇒Administration⇒Package Manager. |
| Command line | `$ /usr/lib/pm-launch packagemanager` |

For complete Package Manager documentation, choose Help⇒Contents from the Package Manager menu bar.

## Introduction to Boot Environments

A boot environment is a bootable instance of the Oracle Solaris operating system image along with any other software packages installed in that image. You can maintain multiple boot environments on your systems, and each boot environment can have different software versions installed. Software updates can be performed without any risk of loss of data or system environment, because you can take a backup of the current environment. You can also update a boot environment that is not currently active. The `beadm(1)` utility is used to create and manage boot environments.

See *Creating and Administering Oracle Solaris 11.1 Boot Environments* for detailed information about boot environments.

## Distribution Constructor

The distribution constructor is a command-line tool for building preconfigured Oracle Solaris images and Virtual Machine images. The tool takes an XML manifest file as input and builds an ISO image or Virtual Machine image that is based on the parameters specified in the manifest file. An ISO image is an archive file, also known as a disc image, of an optical disc, in a format defined by the International Organization for Standardization (ISO). Optionally, a USB image can be created based on a generated x86 ISO image. Depending on the image configuration, these ISO or USB images can be bootable. They can be installed on a system or run in a live media environment. An ISO image can be burned to a CD or DVD. A USB image can be copied to a flash drive.

---

**Note –** The Distribution Constructor creates a USB image that could work in various types of flash memory devices, if those devices have driver support provided by the Oracle Solaris release. The `usbcopy` utility is the only utility that can be used to copy the USB image into a USB flash drive. This `usbcopy` utility is available with the Oracle Solaris release.

---

### Required Packages

To start using the distribution constructor application, install the distribution constructor package on your system. You can install the package using the Package Manager, or through the command line. Type the following command to install the package from the command line:

```
# pkg install distribution-constructor
```

# Frequently Used Applications

The following applications are available as packages in the Oracle release repository. Use the Package Manager or the `pkg install` command at the command–line to download and install the packages. The following table lists name of the applications and the corresponding package name as found in the repository.

**TABLE 1–1** Package Names for Commonly Used Applications

| Software | Package Name |
|---|---|
| Apache Web Server V 2.2 | `web/server/apache22` |
| GNOME text editor | `editor/gedit` |
| Java | `developer/java/jdk`. See "Installing Java in This Release" on page 17. |
| JRuby | `runtime/java/jruby` |

**TABLE 1–1** Package Names for Commonly Used Applications *(Continued)*

| Software | Package Name |
|---|---|
| Python 2.6 – Enhanced Interactive Python Shell<br><br>**Note –** Multiple versions of Python can be installed on the system. Check the repository for the available versions. | `library/python-2/python-26` |
| Modular Debugger | `developer/debug/mdb` |
| Perl – Perl 5.12 | `runtime/perl–512` |
| Ruby | `runtime/ruby-18` |
| Vim editor | `/editor/vim` |
| BlueFish – A powerful editor for experienced web designers | `web/editor/bluefish` |
| GNU C Compiler Version 3 | `developer/gcc-3` |
| GNU C Compiler Version 4.5 | `developer/gcc-45`<br><br>**Note –** C, C++, Fortran, GNU, and Objective C compilers are included in this package. |
| GNU Automake 1.10<br><br>**Note –** Multiple versions are available in the repository. For the Oracle Solaris 11.1 release, Automake 1.11 is available in the repository. | `developer/build/automake110`<br><br>For the Oracle Solaris 11.1 release: `developer/build/automake111` |
| PHP – PHP Web Server 5.2<br><br>Extension module packages such as the PHP server module for Apache and memcached are available in the repository | `web/php-52` |
| System Header Files<br><br>**Note –** The system header files have traditionally been bundled with the Oracle Solaris OS. However , you will need to download the files from the repository when using the Oracle Solaris 11 OS. | `system/header` |

# Tools for Web Server Development

The following tools are useful for developers developing and deploying on the Web. Check the repository to see whether updates are available to the installed packages.

**TABLE 1–2** Tools for Web Server Development

| Software | Package Name |
|---|---|
| AMP Deployment Kit – Includes Apache, MySQL and PHP | `group/feature/amp` |
| Java | `developer/java/jdk`. See "Installing Java in This Release" on page 17. |
| memcached | `library/libmemcached` |
| MySQL Database Server 5.0 | `database/mysql-50` |
| NetBeans – NetBeans is not available as a package in the Oracle Solaris package repository. See `http://www.netbeans.org` for instructions to install NetBeans on your Oracle Solaris system. | None |
| Tomcat Servlet/JSP Container | `web/java-servlet/tomcat` |
| Perl – Perl 5.12 | `runtime/perl–512` |
| Python | `library/python-2/ipython-26` |
| Ruby 1.8 | `runtime/ruby-18` |
| Grails 1.0.3 – Java Web Application Framework | `library/java/grails` |
| Tcl – Tool Command Language | `runtime/tcl-8` |
| Squid 2.7.9 – Proxy server and web cache daemon | `web/proxy/squid` |
| JRuby – Java implementation of the Ruby programming language | `runtime/java/jruby` |
| Lighttpd Web Server 1.4 | `web/server/lighttpd-14` |
| BlueFish – A powerful editor for experienced web designers | `web/editor/bluefish` |

# Versioning Software

The following table lists the versioning tools that are available in the IPS repository:

**TABLE 1–3** Versioning Software

| Software | Package Name |
|---|---|
| CVS | `developer/versioning/cvs` |
| Git | `developer/versioning/git` |

**TABLE 1–3** Versioning Software *(Continued)*

| Software | Package Name |
|---|---|
| Mercurial | `developer/versioning/mercurial` |
| Subversion | `developer/versioning/subversion` |
| SCCS | `developer/versioning/sccs` |

# Isolating Your Development Work

Zones partitioning technology is used to virtualize operating system services and provide an isolated and secure environment for running applications. Each Oracle Solaris system is a global zone. Within a global zone, specific non-global zones can be created. For information about creating and administering non-global zones on your system, see the zones section in the *Oracle Solaris Administration: Oracle Solaris Zones, Oracle Solaris 10 Zones, and Resource Management*.

# Building Applications in the Oracle Solaris OS

This section provides information on Oracle Solaris facilities for developing applications, including packaging, compiling, debugging, and tuning applications.


- "Oracle Solaris Developer Tools" on page 12
- "Using the Oracle Solaris Studio Tools" on page 13
- "Using the NetBeans IDE" on page 14
- "Oracle Message Passing Toolkit" on page 15
- "Packaging Applications for the Oracle Solaris OS" on page 16
- "Dynamic Tracing" on page 16
- "Writing Java Programs for the Oracle Solaris OS" on page 16


## Oracle Solaris Developer Tools

### Using the Runtime Linker and Link Editor

The Oracle Solaris OS provides a link editor and runtime linker. The *Linker and Libraries Guide* covers the link editor `ld(1)`, the runtime linker `ld.so.1(1)`, the ELF object file format, and shared objects, which are sometimes referred to as shared libraries.

The manual is intended for a range of programmers who are interested in the Solaris linkers, from the beginner to the advanced user. Beginners learn the principal operations of the link editor and runtime linker. Intermediate programmers learn to create and use efficient custom libraries. Advanced programmers, such as language-tools developers, learn how to interpret

and generate object files. A chapter on application binary interfaces describes how to manage the evolution of an interface that is provided by a dynamic object. Other chapters cover thread-local storage and `mapfile` directives.

### Kernel-Level Debugging

The Modular Debugger `mdb` is an extensible, general purpose debugging tool for the Oracle Solaris OS. The *Oracle Solaris Modular Debugger Guide* describes how to use the `mdb(1)` command to debug complex software systems. The guide emphasizes the facilities that are available for debugging the Oracle Solaris kernel and associated device drivers and modules. The guide includes a complete reference for the `mdb` language syntax, debugger features, and the `mdb` module programming API.

## Using the Oracle Solaris Studio Tools

The Oracle Solaris Studio software provides modules for creating, editing, building, debugging, and analyzing the performance of a C, C++, or Fortran application. Many Oracle Solaris Studio tools have both a GUI and command-line equivalent. Those tools with GUIs provide online help. For the command-line versions, use the associated man pages. If you start `dbx` from the command line, type `commands` at the `(dbx)` prompt to get a brief description of each `dbx` command.

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**Note –** Oracle Solaris Studio IDE installs its own version of the NetBeans IDE. This NetBeans installation is not intended to be used independently of the Oracle Solaris Studio software, and you might experience errors if you use it separately. Install the NetBeans IDE separately if you want to use it outside of the Oracle Solaris Studio IDE.

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The Oracle Solaris Studio software includes the following tools:

- **IDE** – An integrated development environment that provides access to the Oracle Solaris Studio C, C++, and Fortran tools.

  The IDE includes a NetBeans plugin that enables you to use the Oracle Solaris Dynamic Tracing facility (DTrace) from the IDE. DTrace enables you to explore the inner workings of the software programs running on your system. The DTrace GUI plugin enables you to use DTrace from the IDE by running D scripts in a window. The plugin includes several D scripts that can be easily extended and customized to suit your needs. See the NetBeans DTrace GUI Plugin for more information about the plugin.

  The Oracle Solaris Studio IDE also includes the DLight tool, which offers a variety of instrumentation that takes advantage of the Oracle Solaris Dynamic Tracing (DTrace) debugging and performance analysis functionality.
- **C compiler** – Includes a C compiler, incremental link editor, and lint program.
- **C++ compiler** – Includes a full-featured C++ compiler and interval arithmetic library.

- **Fortran compiler** – Includes a full-featured environment and libraries for both `f95` and `f77`.
- **dbx Debugger** – An interactive, source-level, command-line debugging tool.
- `dmake` **make tool** – A command-line tool for building targets in distributed, parallel, or serial mode.
- **Math libraries** – A floating-point environment that is supported by software and hardware on SPARC and x86 platforms that run the Oracle Solaris OS.
- **OpenMP** – A portable, pragma-based parallel programming model for shared memory multiprocessor architectures, is natively accepted and compiled by all three Oracle Solaris Studio compilers.
- **Performance Analyzer** – A GUI and command-line tool for collecting and analyzing performance data.
- **Thread Analyzer** – A GUI and command-line tool for analyzing the execution of multithreaded programs and checking for a variety of multithreaded programming errors.
- **Oracle Performance Library** – A library of Oracle-specific extensions and features for using optimized, high-speed mathematical subroutines for solving linear algebra and other numerically intensive problems.

Oracle Solaris Studio 12.3 is available as a package; see the Oracle Solaris Studio site for instructions on how to download and install the software on the Oracle Solaris 11 OS.

### Tools for Multithreaded Programming

See Chapter 8, "Compiling and Debugging," in *Multithreaded Programming Guide* section for information on how to set up a developer environment for developing multithreaded applications.

## Using the NetBeans IDE

NetBeans IDE (Integrated Development Environment) provides tools to help you build cross-platform applications for the Oracle Solaris OS and other operating platforms. The NetBeans IDE is available from netbeans.org.

The NetBeans IDE contains the following features:

- Java Desktop Applications – Create professional desktop applications using the NetBeans Java GUI Builder with Swing Application Framework and Beans Binding support. Build rich internet applications with JavaFX.
- PHP Development – A fast and lightweight PHP IDE with code completion and quick fixes, integrated FTP and Xdebug, and support for popular Web Services.
- Java EE and Web Applications – Build web applications using Ajax, JavaScript, and CSS. Support for frameworks including JSF, Struts, Spring and Hibernate. Full set of tools for EJB development.

- Ruby and Ruby on Rails Development – Powerful Ruby editor with code completion and debugger, and full support for Ruby on Rails. Includes the JRuby runtime.
- Visual Mobile Development – Create, test and debug GUI applications that run on mobile phones, set-top boxes, and PDAs.
- C and C++ Development – Full-featured C/C++ editor, debugger, project templates, support for multiple project configurations, remote development, performance profiling, and packaging of completed projects.

Visit the netbeans.org web site for more information. New users might find the following pages particularly useful:

- Video Tour of Key NetBeans IDE Features
- Quick Start tutorial
- NetBeans documentation
- NetBeans Plugin Portal for plugin modules
- NetBeans Wiki with community documentation, and answers to Frequently Asked Questions

## Oracle Message Passing Toolkit

The Oracle Message Passing Toolkit software is a set of development tools that you can use to develop parallel applications designed to run on distributed-memory systems.

It includes the following technologies:

- Open Message Passing Interface (Open MPI) – an open source implementation of the Message Passing Interface (MPI) standard. Open MPI is fully compliant with the MPI 2 standard including complete MPI I/O implementation and one-sided communications between MPI processes.
- Open Run-Time Environment (ORTE) – provides a basic set of parallel job management facilities, and includes plug-in modules to support the following technologies:
  - The Oracle Grid Engine, which allows parallel jobs to be launched and maximizes the utilization of shared resources.
  - The Portable Batch System (PBS), a job scheduler that allocates network resources to batch jobs on networked, multi-platform environments.

The Oracle Message Passing Toolkit software can be used with the Oracle Solaris Studio compilers for C, C++, and Fortran.

See the Oracle Message Passing Toolkit documentation set for complete information about using the ClusterTools software.

# Packaging Applications for the Oracle Solaris OS

Software programs must be incorporated into a package to be installed in the Oracle Solaris OS. For the Oracle Solaris 11 release, applications can be packaged using the Image Packaging System (IPS). With IPS, users can also download additional software packages, including developer tools. IPS accesses software packages from networked repositories and then installs them on your system. See the *Packaging and Delivering Software With the Image Packaging System in Oracle Solaris 11.1* and *Adding and Updating Oracle Solaris 11.1 Software Packages* for more information about packaging with IPS for the Oracle Solaris 11 release.

# Dynamic Tracing

Oracle Solaris Dynamic Tracing (DTrace) is a comprehensive dynamic tracing framework for the Oracle Solaris OS. The DTrace facility provides a powerful infrastructure to enable administrators, developers, and service personnel to concisely answer arbitrary questions about the behavior of the operating system and user programs. DTrace can help developers identify performance issues and bugs in applications. The *Oracle Solaris 11.1 Dynamic Tracing Guide* describes in depth how to use DTrace to observe, debug, and tune system behavior. This guide also includes a complete reference for bundled DTrace observability tools and the D programming language.

# Writing Java Programs for the Oracle Solaris OS

The Java software is optimized to deliver superior performance to server-side and client-side Java technology applications in an enterprise environment. The `http://www.oracle.com/technetwork/java/index.html` web site provides complete documentation for the Java programming language. See also the Java Platform, Standard Edition (Java SE) documentation and the New to Java Programming Center to start learning about Java programming.

Java tutorials can be found at the following links:

- Java Tutorials
- Java EE 5 Tutorial
- Java Web Services Tutorial

If you have written a Java application for the Oracle Solaris 11 OS, you will need to build your application as a package so that the application can published to a repository and is available for download. There are various considerations to be aware of during the process of designing, creating, and publishing a package. For example, you should specify the Java Runtime dependency in your package manifest as follows:

```
depend type=require fmri=runtime/java
```

See Chapter 2, "Packaging Software With IPS," in *Packaging and Delivering Software With the Image Packaging System in Oracle Solaris 11.1* and Chapter 4, "Specifying Package Dependencies," in *Packaging and Delivering Software With the Image Packaging System in Oracle Solaris 11.1* for detailed information.

For information on compatibility between Java 6 and Java 7, see the Java SE 7 and JDK 7 Compatibility page.

### Installing Java in This Release

In the Oracle Solaris 11.1 release, Java 6 and Java 7 are available as packages in the repository.

- Java 6 is available as – `developer/java/jdk-6`
- Java 7 is available as – `developer/java/jdk-7`

The default version of Java is JDK 7.

You can choose to set the Java version on your system to JDK 6 by using the `pkg` command as follows:

```
# pkg set-mediator -V 1.6 java
```

Use the following command to set the Java version back to JDK 7.

```
# pkg set-mediator -V 1.7 java
```

## Deploying Your Application

After you have completed the development of your application, the next steps would be to package, publish, and distribute your application. See the *Copying and Creating Oracle Solaris 11.1 Package Repositories* to get started on the process of copying and creating your repository and publishing your packages to the repository.