Sun Performance WorkShop Fortran Overview

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Contents

Preface

This manual describes the capabllities of Sun Performance WorkShop Fortran and guides you to the documentation you need for further information. Some of these products you already use, but others you may not use or even know about.

Who Should Use This Book

This document addresses application developers who are new users of Sun Performance WorkShop Fortran. It assumes that you have a working knowledge of the Solaris™ operating environment and UNIX® commands.

How This Book Is Organized

This overview is organized as follows:

Chapter 1, “Welcome to Sun Performance WorkShop Fortran,” is an overview of the products included in Sun Performance WorkShop Fortran and how they fit together.

Chapter 2, “Building and Compiling,” discusses building and compiling processes.

Chapter 3, “Editing and Browsing,” describes editors and benefits of the source browser.

Chapter 4, “Debugging and Tuning,” reviews debugging and performance tools.

Chapter 5, “Managing Source Code,” sketches the benefits of Sun™ WorkShop™ TeamWare code management tools.

Glossary is a list of words and phrases found in this book and their definitions.

Multiplatform Release

Note - The name of the latest Solaris operating environment release is Solaris 7 but code and path or package path names may use Solaris 2.7 or SunOS 5.7.

The Sun™ WorkShop™ documentation applies to Solaris 2.5.1, Solaris 2.6, and Solaris 7 operating environments on:

- The SPARC™ platform
- The x86 platform, where x86 refers to the Intel implementation of one of the following: Intel 80386, Intel 80486, Pentium, or the equivalent

Note - The term “x86” refers to the Intel 8086 family of microprocessor chips, including the Pentium, Pentium Pro, and Pentium II processors and compatible microprocessor chips made by AMD and Cyrix. In this document, the term “x86” refers to the overall platform architecture. Features described in this book that are particular to a specific platform are differentiated by the terms “SPARC” and “x86” in the text.

Sun Performance WorkShop Fortran Related Books

This overview briefly describes the components of the Sun Performance WorkShop Fortran. The Fortran programming books present information specific to the FORTRAN 77 and Fortran 90 compilers and language. Other Sun WorkShop books give instructions for installation and detailed information about the remaining Sun Performance WorkShop elements. The Solaris books provide information on linking, libraries, and SunOS programming tools.

Fortran Programming Books

- *Fortran User’s Guide* provides information on command-line options and how to use the compilers.

- *Fortran Programming Guide* discusses issues relating to input/output, libraries, program analysis, debugging, and performance.
- *Fortran Library Reference* gives detail on the language and routines.
- *FORTRAN 77 Language Reference Manual* provides a complete language reference.
- *Numerical Computation Guide* details floating-point computation numerical accuracy issues.

Other Sun WorkShop Books

- *Sun WorkShop Quick Install* provides installation instructions.
- *Sun WorkShop Installation and Licensing Reference* provides supporting installation and licensing information.
- *Using Sun WorkShop* gives information on performing development operations through Sun WorkShop.
- *Debugging a Program With* dbx provides information on using the debugger and dbx commands.
- *Analyzing Program Performance With Sun WorkShop* describes the profiling tools; the LoopTool, LoopReport, and LockLint utilities; and use of the Sampling Analyzer to enhance program performance.
- *Sun WorkShop TeamWare User's Guide* describes how to use the Sun WorkShop TeamWare code management tools.
- *Sun WorkShop Performance Library Reference Manual* discusses the library of subroutines and functions to perform useful operations in computational linear algebra and Fourier transforms.

Solaris Books

The following Solaris manuals and guides provide additional useful information:

- The Solaris *Linker and Libraries Guide* gives information on linking and libraries.
- The Solaris *Programming Utilities Guide* provides information for developers about the special built-in programming tools available in the SunOS™ system.

Ordering Sun Documents

The SunDocsSM program provides more than 250 manuals from Sun Microsystems, Inc. If you live in the United States, Canada, Europe, or Japan, you can purchase documentation sets or individual manuals using this program.

For a list of documents and how to order them, see the catalog section of the SunExpress™ Internet site at `http://www.sun.com/sunexpress`.

Accessing Sun Documents Online

Sun WorkShop documentation is available online from several sources:

- The `docs.sun.com` Web site
- AnswerBook2™ collections
- HTML documents
- Online help and release notes

Using the `docs.sun.com` Web site

The `docs.sun.com` Web site enables you to access Sun technical documentation online. You can browse the `docs.sun.com` archive or search for a specific book title or subject. The URL is `http://docs.sun.com`.

Accessing AnswerBook2 Collections

The Sun WorkShop documentation is also available using AnswerBook2 software. To access the AnswerBook2 collections, your system administrator must have installed the AnswerBook2 documents during the installation process (if the documents are not installed, see your system administrator or Chapter 3 of *Sun WorkShop Quick Install* for installation instructions). For information about accessing AnswerBook2 documents, see Chapter 6 of *Sun WorkShop Quick Install*, Solaris installation documentation, or your system administrator.

Note - To access AnswerBook2 documents, Solaris 2.5.1 users must first download AnswerBook2 documentation server software from a Sun Web page. For more information, see Chapter 6 of *Sun WorkShop Quick Install*.

Accessing HTML Documents

The following Sun Workshop documents are available online only in HTML format:

- Tools.h++ Class Library Reference
- Tools.h++ User's Guide
- *Numerical Computation Guide*
- Standard C++ Library User's Guide
- *Standard C++ Class Library Reference*
- *Sun WorkShop Performance Library Reference Manual*
- *Sun WorkShop Visual User's Guide*
- Sun WorkShop Memory Monitor User's Manual

To access these HTML documents:

1. **Open the following file through your HTML browser:**
   install-directory`/SUNWspro/DOC5.0/lib/locale/C/html/index.html`

   Replace *install-directory* with the name of the directory where your Sun WorkShop software is installed (the default is `/opt`).

   The browser displays an index of the HTML documents for the Sun WorkShop products that are installed.

2. **Open a document in the index by clicking the document's title.**

Accessing Sun WorkShop Online Help and Release Notes

This release of Sun WorkShop includes an online help system as well as online manuals. To find out more see:

- Online Help. A help system containing extensive task-oriented, context-sensitive help. To access the help, choose Help Help Contents. Help menus are available in all Sun WorkShop windows.
- Release Notes. The Release Notes contain general information about Sun WorkShop and specific information about software limitations and bugs. To access the Release Notes, choose Help Release Notes.

What Typographic Changes Mean

The following table describes the typographic changes used in this book.

TABLE P–1 Typographic Conventions

Typeface or Symbol	Meaning	Example
`AaBbCc123`	The names of commands, files, and directories; on-screen computer output	Edit your `.login` file. Use `ls -a` to list all files. `machine_name% You have mail.`
`AaBbCc123`	What you type, contrasted with on-screen computer output	`machine_name% su` `Password:`
AaBbCc123	Command-line placeholder: replace with a real name or value	To delete a file, type `rm` *filename*.
AaBbCc123	Book titles, new words or terms, or words to be emphasized	Read Chapter 6 in *User's Guide*. These are called *class* options. You *must* be root to do this.

Shell Prompts in Command Examples

The following table shows the default system prompt and superuser prompt for the C shell, Bourne shell, and Korn shell.

TABLE P–2 Shell Prompts

Shell	Prompt
C shell prompt	`machine_name%`
C shell superuser prompt	`machine_name#`
Bourne shell and Korn shell prompt	`$`
Bourne shell and Korn shell superuser prompt	`#`

CHAPTER 1

Welcome to Sun Performance WorkShop Fortran

Sun Performance WorkShop Fortran is a tightly integrated environment designed to speed software development for you and your team. This package simplifies the tasks you perform most often: compiling, building, browsing, editing, debugging, and performance tuning.

Sun Performance WorkShop Fortran includes the following major components: Sun WorkShop; Sun WorkShop Compilers Fortran 90 and FORTRAN 77; multithreaded tools; and Sun WorkShop TeamWare.

Take Advantage of an Integrated Environment: Sun WorkShop

Sun Performance WorkShop Fortran supplies an integrated programming environment with a full set of graphical tools to create and maintain your Fortran applications.

In Figure 1-1, Sun WorkShop tools are shown on the outer edge of the circle. The tasks they perform are shown inside the circle. Employ these tools separately or in combination:

- A GUI-based debugger that lets you run your programs in a controlled manner and inspect the state of a stopped program
- An analyzer that measures, records, and helps you improve the performance of your application program

- A source browser that helps you understand the hierarchy of your code and lets you search the code base
- A file-merging tool that loads and displays two text files side-by-side for easy comparison
- A choice of three integrated editors (XEmacs, Emacs, vi) to write and alter code
- A `make` utility that aids code compilation by automating and distributing compilation of source files that have changed

Build High-Performance Applications With Sun WorkShop Fortran Compilers

Sun WorkShop Compilers Fortran help you build high-performance Fortran applications with:

- Multiprocessor parallelization
- Optimized code compilation
- Fortran and C support
- Incremental linker (`ild`) to reduce link time
- Sun Performance Library
- Sun Math Library

Parallelize With Multithreaded Development Tools

With multithreaded tools you can take advantage of the parallelism inherent in your programs to analyze and improve performance. (Multithreaded tools are available on the SPARC™ platform only.)

Manage Code With Sun WorkShop TeamWare

Sun WorkShop TeamWare code management tools extend the Sun WorkShop tools and Fortran language systems with a suite of graphical tools for source code version control, release integration, and release management. These speed software development by helping your team to work together.

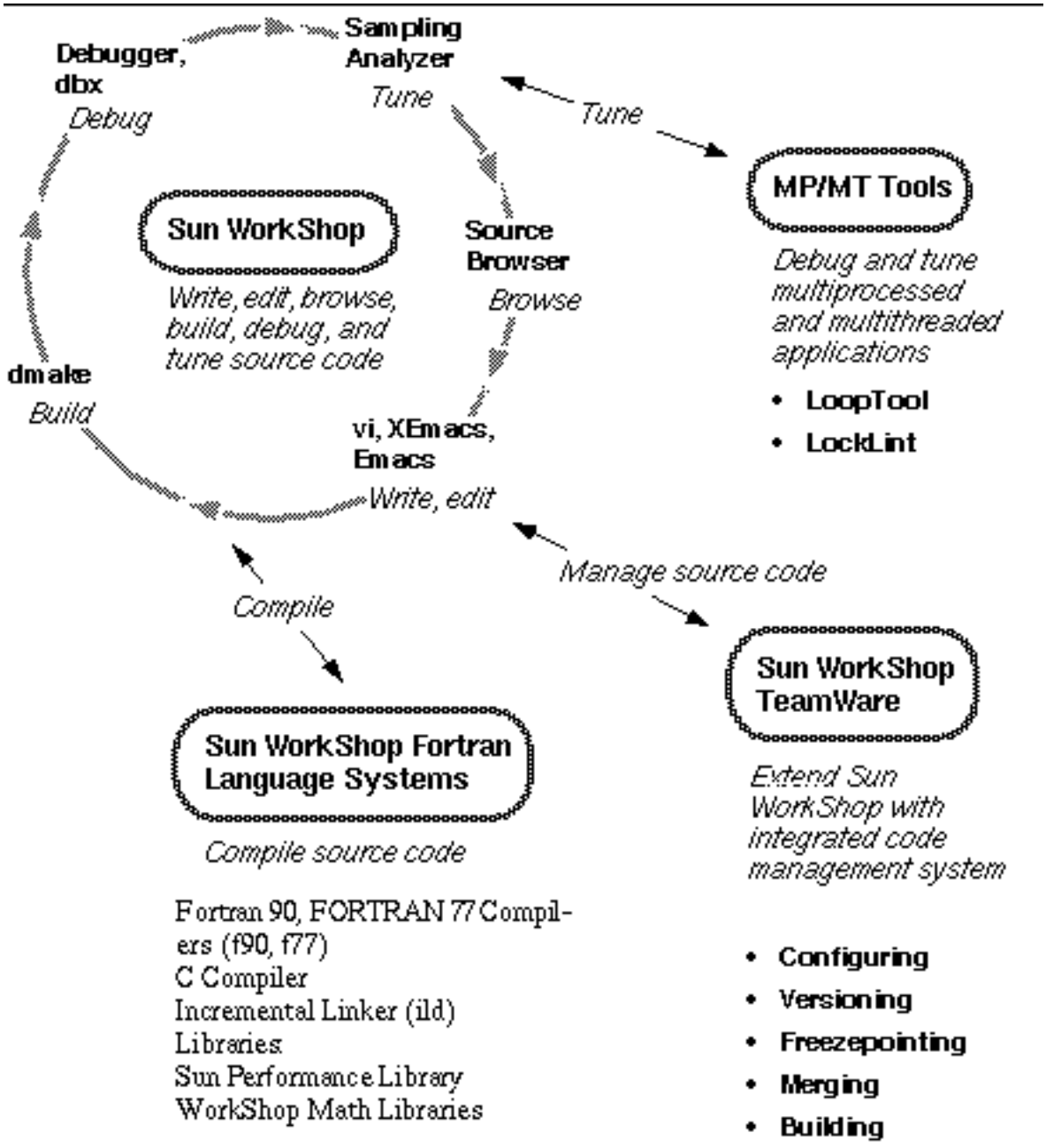

Figure 1–1 Sun Performance WorkShop Fortran

CHAPTER 2

Building and Compiling

With Sun Performance WorkShop Fortran, you can build and compile efficient programs, starting with the use of a single graphical interface as a control panel.

Program in an Integrated Environment

With Sun Performance WorkShop Fortran, you can manage and execute a complete suite of development tools through a single graphical user interface (GUI).

Since developers tend to have their favorite editors, Sun WorkShop offers three of the most popular: vi, Emacs, and XEmacs. When using Sun WorkShop, you can choose your editor from the Text Editor Options dialog box.

Simplify Building With the Sun WorkShop Building Window

Your makefile describes explicitly how to build each module of your program as well as the final executable. Sun WorkShop Building is a graphical interface to the UNIX `make` utility, the utility that oversees program compilation and ensures that your programs are compiled from the newest sources. After you initiate a program build in the Building window, the build process reads the makefile for the program and executes the commands it finds there.

The Building tool marks the evolution of the `make` command into a powerful and flexible tool that permits you to use the processing power of today's workstations

more efficiently. With the Building tool, you can distribute the building of large programs over a number of processes and, in the case of multiprocessor systems, over multiple CPUs.

Use the Building tool to:

- Expand the makefile rules and macros
- Increase productivity and reduce errors

The Sun WorkShop Building tool gives you the following advantages over issuing `make` commands from the command line:

- Storage of high-level makefile target names in a menu for easy access
- Visual feedback about the progress of your build
- Links from the build errors listed in the Building window that open the source files containing the errors in the text editor window
- Dialog boxes for changing the make options, makefile macros, and environment variables passed into the build (Sun WorkShop does not generate a makefile for you, however)
- A choice of three build modes:
  - Execute one job at a time on the local host
  - Execute multiple build jobs concurrently on the local host
  - Execute multiple build jobs over several build servers

Automatically Parallelize Applications

Performing multiple tasks in parallel speeds program execution and improves performance. Iterative loops tend to dominate application runtime and are the natural focus of automatic parallelization. Use parallelization to distribute the computational work of a loop over several processors without having to modify your source program.

By parallelizing (or multithreading) your application, you can recast the compiled program to take full advantage of a multiprocessor system. Parallelization enables single tasks, such as loops, to run over multiple processors with a significant increase in execution speed.

Analyze your source code with the FORTRAN 77, Fortran 90, and C compilers to determine which loops have iterations that are independent of one another, and therefore safe to parallelize.

Automatically Restructure Code

The FORTRAN 77, Fortran 90, and C compilers perform extensive automatic restructuring of source code, exposing higher degrees of loop-level parallelization. Some of the techniques the compilers use for this transformation are:

- Loop distribution. Separating statements that can execute in parallel from those that cannot
- Loop fusion. Combining several small, adjacent loops into a single parallel loop, reducing execution overhead
- Loop interchange. Interchanging nested loops to produce a loop that can be parallelized with significantly less overhead
- Scalar and array privatization. Using multiple copies of a scalar or array variable to, parallelize a loop that has data dependency

Put Pragma Support to Work

Frequently, the compiler has insufficient information to decide whether parallelization is advantageous. In such cases, you can use parallelization directives, or *pragmas*—comment lines that tell the compiler whether to parallelize the loop that follows the directive.

Enhance Performance With the Fortran Compilers

Take advantage of the Fortran 90 and FORTRAN 77 compilers, designed to ensure the highest levels of accuracy and performance. Some of the features that contribute to compiler performance are:

- Compilation for the 64-bit Solaris 7 environment
- Large file support
- Large arrays (on 64-bit Solaris 7 software)
- A new optimization pragma (directive)
- A range of options for managing code and application performance
- Interoperation with C and C++ programs

Test Changes Faster

Once a debugging session is completed, you can rebuild your application using the incremental link editor (`ild`). (In the Sun Performance WorkShop Fortran, the incremental link editor (`ild`) replaces the link editor (`ld`)). You can test the changes to your application more quickly because the incremental link editor reduces the time necessary to relink an application. Only the changed `.o` files are linked into the previous executable to create a new executable file. Using the incremental link editor, the time it takes to rebuild an application after a change is proportional to the magnitude of the change rather than to the total size of the application.

Improve Performance With Libraries

Sun Performance WorkShop Fortran provides two important library collections to increase application performance: the Sun Performance Library and the Sun Math Library.

Sun Performance Library

If you develop computationally intensive applications, such as those performing computational linear algebra and Fourier transforms, try the Sun Performance Library. You can use this library on single- or multi-processor systems, and call it from all Sun WorkShop compiler language systems.

Some of the most widely used libraries are the mathematical collections known as BLAS, LINPACK, LAPACK, FFTPACK, and VFFTPACK. While these libraries provide a multitude of functions, typically, they are not highly optimized or parallelized. The Sun Performance Library contains highly optimized versions of these libraries. With native interfaces to FORTRAN 77 and accessibility from Fortran 90, the Sun Performance Library can boost your application speed by a factor of four or more.

Sun Math Library

If you focus on compute-intensive application, you can increase performance by using the optimized math libraries provided with Sun Performance WorkShop Fortran. The `libm` math library bundled with the Solaris operating environment contains the functions required by the various standards to which the Solaris software conforms. Some features of the math library are:

- Single, double, and quadruple floating-point numeric formats
- Algebraic, transcendental, rounding, conversion, and random number functions
- Table-driven algorithms for maximum speed and accuracy

Enhance Performance With the C Compiler

The C compilation system offers a compiler, assembler, and link editor. Enhance the performance of your C programs with the following C compiler features:

- Incremental linking
- Support for automatic and explicit parallelization of loops
- Ability to turn off specific warning messages
- Support for UltraSPARC™ code generation
- Year 2000 support
- Easy portability of C application programs to other machines
- Customizable exception handling

CHAPTER 3

Editing and Browsing

Ease of editing and browsing are critical to efficient program development and maintenance. With Sun WorkShop editors and the source browser you can navigate quickly through large bodies of code.

Choose Your Editor

In Sun Performance WorkShop Fortran, you can write and edit source code more productively with your preferred editor: XEmacs, Emacs, or vi. Link to your source code line in the editor window to perform error and source browsing, and referencing. With these editors, you can perform many development functions and share task information with the other components of Sun WorkShop.

Try Out the Source Browser

Use the source browser to develop and maintain software systems, especially large ones. During the course of a programming project, you might join a new programming team to enhance, maintain, or port code. Before you become a productive team member, you must fully understand the code that you will modify. The source browser is a powerful tool for browsing large programs.

The source browser uses a “What you see is what you browse” paradigm. The source code you edit is the same source code the source browser uses in its searches.

Search by Pattern

You can use the source browser in pattern search mode to search for regular expressions or simple text strings. Pattern searching uses standard `grep` syntax to find all source lines that match the source string.

Search by Query

You can use the source browser in source browsing mode to issue queries. A query instructs the source browser to locate all occurrences of, definitions of, uses of, or assignments to the symbol, string, or search pattern you specify. You then view the occurrences and surrounding source code.

Search Local or Network Files

You can search and browse source files residing locally or on the network. You can make global changes and pinpoint problem spots, even on large, distributed development projects.

Search Multiple-Language Programs

When you browse a program that uses more than one language in the implementation, the source browser automatically determines the language in which each source file is written. The browsing operations do not change from one language to another.

Experience Flexible Browsing

You can use the source browser in either the Sun WorkShop Browsing window or a command-line environment.

You can edit source code with your favorite editor from within the source browser.

Use Static Analysis to Examine Source Code

Use the source browser to examine your source code in an organized fashion. You can gain better understanding of a piece of software by:

- Observing the structure of a program, as defined by its source code
- Identifying:

- Called and calling functions
- Graphs of class genealogy
- Organization of header files and defining statements

CHAPTER 4

Debugging and Tuning

Many variables affect the performance of an application program. The one over which you have the most influence is the design of your program. With debugging and performance tuning, you can make your program efficient, reliable, and fast. Sun Performance WorkShop Fortran includes a variety of performance tools to debug, analyze source code, isolate problems, and provide you with the information you need to finely tune your applications for maximum performance.

Debugging

For your debugging tasks, use one of the two closely related debugging tools contained in Sun Performance WorkShop Fortran: dbx or the debugger.

For Command-Line Debugging, Use dbx

The dbx debugger is an interactive, source-level, command-line tool. You can use it to run a program in a controlled manner and to inspect the state of a stopped program. dbx gives you complete control of the dynamic execution of a program, including the collection of performance data.

Make use of the multithreaded features that are built into the standard dbx. You can identify all known threads, including their current state, base functions, and current functions. You can also examine thread stack traces. To ensure proper execution, you can debug threads by stepping through or over a thread, navigating between threads, and then resuming execution at any time.

Note - If you wish to debug your multithreaded application with `dbx`, you must include the `-lthread` option at link time.

If You Prefer a GUI, Use the Debugger

Should you favor a graphical interface to `dbx`, try the debugger (the Sun WorkShop Debugging window). During program execution, `dbx` obtains detailed information about program behavior and delivers this information to the debugger by a communications protocol. You can debug more easily because you can enter most commands by clicking redefinable buttons in the GUI.

You can also edit your programs with your favorite editor from the debugger and minimize the need to change tools.

Fix and Continue

With the Fix and Continue feature of the debugger you can modify source code, recompile the file, and continue program execution—all without leaving the debugger. When you use this feature, you eliminate relinking and reloading the program.

Runtime Checking

Use runtime checking (RTC) to find elusive memory access violations and memory leaks in both single-threaded and multithreaded applications. With runtime checking, you can detect runtime errors in an application during the development phase. As errors are detected, the debugger interrupts program execution and displays the relevant source code so you can fix bugs as they are found.

Data Visualization

As a scientific or numerical software developer, you work with large volumes of data. To facilitate your analyses, you need to “see” results. Data visualization is a debugging technique that lets you explore and comprehend large and complex data sets, simulate results, and interactively steer computations. During this process, you can update the data on demand— at specified breakpoints, or at specified time intervals.

Debug Faster With Global Program Checking

Use global program checking to facilitate the debugging of your Fortran applications and analyze source programs for inconsistencies and possible runtime problems. global program checking also promotes consistency in definition and use of arguments, commons, and parameters across routines.

Tuning

After you have successfully debugged your program, you can evaluate its performance with the Sampling Analyzer, a program designed to help you tune application performance, including memory allocation. The Sampling Analyzer measures and graphically displays your application's performance profile and suggests ways to improve performance. Its special data collection instrumentation eliminates the need to continually compile and link an application—any program that has been compiled can be analyzed.

Analyze a Variety of Performance Data

The performance data you can examine in the Sampling Analyzer include:

- User time. Time spent executing user program instruction
- Fault time. Time required to service fault-driven memory activities, classified into text and data page faults
- I/O time. Time the operating system spent waiting for input/output operations, such as writing to a disk or tape
- System time. Time the operating system spent executing system calls
- Trap time. Time spent in executing traps (automatic exceptions or memory faults)
- Lock wait time. Time spent waiting for lightweight process locks
- Sleep time. Time the program spent inactive, waiting for a wake up signal
- Suspend time. Time spent temporarily halted (includes time spent in the debugger during breakpoint and the time used by the Sampling Collector to gather data)
- Idle time. Time spent waiting to run while the system was busy
- Function sizes. Sizes of functions in the program
- Module sizes. Sizes of modules in the program
- Segment sizes. Sizes of segments in the program
- Memory usage. Memory page reference and modification data

- Resource usage. Information about the system resources that are used by the program, including major and minor page faults, process swaps, number input and output blocks, number of messages sent and received, number of signals handled, number of voluntary and involuntary context switches, number of system calls, number of characters of input/output, and number of working set memory pages

Control Your Analysis

The debugger serves as the data-gathering front end for the Sampling Analyzer. You can control the data collection process with the Sampling Collector window in dbx or the debugger while your program is running. You can collect data only between breakpoints, or you can limit data collection to a particular part of the program. The program run in which you collect data is known as an experiment, and the data file created by the Collector is called the experiment record. You then use the Sampling Analyzer to identify performance bottlenecks in the collected data.

Note - Performance tuning and runtime checking are mutually exclusive processes. You can perform only one or the other at a time. The information you receive from tuning your application can be adversely affected if you try to perform runtime checking simultaneously.

Focus on Problems

Test your hypotheses about a program's behavior by focusing on the areas where performance problems occur. To rebuild your programs with improved performance, use the Sampling Analyzer to identify areas where you can improve ordering for loading functions into the program's address space. In some cases, the Sampling Analyzer can improve performance automatically by creating a mapfile that instructs the linker to remap functions in memory more efficiently.

Find Which Modules Do the Calling

Performance analysis tools provide a range of analysis levels, from simple timing of a command to a statement-by-statement analysis of a program. While a flat profile can provide valuable data for performance improvements, sometimes the data is not sufficient to point out exactly where improvements can be made. You can obtain a more detailed analysis by using the call graph profile to identify which modules are called by other modules, and which modules call other modules.

Multiprocessing and Multithreading

Multiprocessing (MP) is the hardware technology on the SPARC platform that supports tightly coupled multi-CPU systems with shared memory. Multiple CPUs provide more power to drive application performance.

Multithreading (MT) is the software technology that enables the development of parallel applications, whether on single- or multiple-processor systems. Independent threads of execution can be scheduled on multiple CPUs in a multiprocessor system, but they share resources such as memory and files, allowing single applications to execute code in parallel. Threads share resources, synchronize, and communicate with each other through the use of mutual exclusion (mutex) locks provided by the operating system. Multiprocessing and multithreading together give you a scalable solution for higher application performance.

Take Advantage of Parallelism

If your applications use parallelism, use the new multiprocessing systems and multithreaded operating environments to improve performance, responsiveness, and flexibility. With multithreading you can:

- Increase performance on multiprocessor systems
- Increase performance on uniprocessor systems
- Use resources more efficiently

Speed Error Detection With Multithreaded Development Tools

Use multithreaded development tools to extend the Sun WorkShop Compilers Fortran (and multiprocessing C compiler) for multiprocessing optimizations. The multiprocessing/multithreading tool set includes multithreaded extensions to the Sun WorkShop debugger and `dbx`, and two additional tools: LockLint and LoopTool.

Find Inconsistent Lock Use With LockLint

Use LockLint to do static analysis of the use of mutex and read/write locks. In searching for inconsistent lock use, LockLint detects the most common causes of data races and deadlocks.

Analyze Loop Information

Take advantage of LoopTool and LoopReport, performance analysis tools used with the multiprocessing Fortran and C compilers. The compilers automatically parallelize loops when they determine that it is safe and profitable to do so. With LoopTool you can:

- Browse parallel and sequential loops and view a graph of loop runtimes
- View displays of performance data showing which loops were parallelized
- Obtain compiler hints about why a loop was not parallelized
- Go directly from the graphical display to the source code for any loop, simplifying source code editing

Use the LoopReport command-line tool to create a summary table of all loop runtimes correlated with compiler hints about why a loop was not parallelized.

For More Details, Use Call Grapher and `gprof`

You can use the `-pg` option to the Fortran compilers to compile an application for call graph profiling. Once your program is compiled in this manner, call graph profile data is sent to a file called `gmon.out` after each run. Use the `gprof` command to interpret the results of the profile.

CHAPTER 5

Managing Source Code

Large development projects require complex coordination of the work of many programmers using common and interdependent files. Keeping track of the complex information under the Source Code Control System (SCCS) can be time-consuming and frustrating. The Sun WorkShop TeamWare source management tools provide a solution to this problem.

Extend the Sun WorkShop Compilers Fortran language systems and Sun Performance WorkShop Fortran products with Sun WorkShop TeamWare, a suite of graphical tools for source code version control, release integration, and release management.

Use Sun WorkShop TeamWare code management tools to:

- Graphically track and integrate software projects and releases
- Track versions of ASCII and binary files
- Track complete assemblies of source files
- Dramatically cut the time required to build large projects by executing build jobs in parallel on a single Solaris host

Coordinate Large Software Projects

Simplify the complex task of coordinating common and interdependent files with the Configuring tool. Choose a command-line interface (CLI) or a graphical user interface (GUI). Then copy project files from a central workspace into your own workspace, notify other team members that you're using files, make changes to files, and copy your changes back to the central workspace.

Use the Configuring tool to:

- Speed critical code management tasks, track versions of source files, integrate and build releases, and recreate prior releases using simple graphical tools
- Graphically navigate development workspaces, map development, and test and release workspaces in a hierarchical format
- Speed project integration and transfer source files between workspaces by drag and drop
- Work on multiple releases simultaneously and begin work on a new project without disturbing ongoing work
- Respond to changing project conditions and reorganize the workspace hierarchy at any time

Merge Files Easily

Use the Merging tool to merge two versions of the same source file, with or without reference to a common earlier version. You can work on the same files and compare respective versions of the files without introducing discrepancies. The Merging tool displays both versions of a file side-by-side, highlighting any differences in color. You can then automatically or selectively merge your changes into a new file, and view them in an editable window.

With the Merging tool, you can also merge entire directories or lists of files. This feature is useful when two versions of a program have diverged significantly and must be made to converge.

Coordinate File Access Easily

Take advantage of the Versioning tool, a graphical user interface to SCCS, to manipulate files and perform SCCS functions. Even if you don't know SCCS commands, this intuitive method lets you check files in and out, as well as display and move through history branches.

Use the Versioning tool to:

- Check in files under SCCS
- Check out and lock a version of the file for editing
- Retrieve copies of any version of the file from SCCS history
- Peruse the branches of an SCCS history file
- Back out changes to a checked-out copy

- Inquire about the availability of a file for editing
- Inquire about differences between selected versions using Merging
- Display the version log summarizing executed commands

Establish Milestones

During the software development process, you might want to create “freezepoints” of your work at various key junctures. These points serve as snapshots of the project that enable you to later recreate the state of the project at key development points. The Freezepointing tool creates a file that registers all source files for a given software release.

Put the Freezepointing tool to work to:

- Create a bill of materials for a workspace
- Recreate prior versions of source files
- Track and warn users of renamed files

Glossary

AnswerBook	Online documentation tools that display this manual and all other Sun WorkShop manuals.
browse	To inspect source code for all or selected occurrences of a symbol, string constant, or search pattern that you specify.
Collector	A tool used to set up an application for performance data collection. You can collect performance data on an application of your choice.
experiment	A set of samples taken on the target application program.
experiment record	The pointer file and hidden directory for an *experiment*.
Freezepointing	The Sun WorkShop TeamWare utility used to make snapshots of workspaces (or portions of them) at important junctures or "freezepoints."
identifier	A symbol for which the source browser searches. The identifier can be a variable name, constant name, or user-defined type name.
integration workspace	A workspace to which multiple developers put back (merge) their work.
merge	To produce a single version of a file from two conflicting files (deltas). Usually accomplished with the assistance of the Merging tool.
Merging	The Sun WorkShop TeamWare utility used to merge deltas during Resolve transactions.
performance tuning	The steps taken to make a program more efficient, reliable, and fast. These steps estimate the performance of a program, identify the

bottlenecks limiting performance, and identify where the code spends most of its time.

query An instruction to the source browser to find a specified symbol.

Sampling Analyzer A tool used to examine performance data collected by the Sampling Collector. The Sampling Analyzer processes the collected data into displays of your choice. You then use these displays to examine the collected performance data.

SCCS history file The file that contains a given file's delta history; also referred to as an "s-dot-file." All SCCS history files must be located in a directory named SCCS, which is located in the same directory as the g-file.

Versioning The Sun WorkShop TeamWare utility that provides a graphical interface to SCCS.

workspace A specially designated (but standard) directory and its subdirectory hierarchy. Usually all developers on a project work in their own workspaces. The Sun WorkShop TeamWare Configuring utility lets you intelligently copy files from workspace to workspace.

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