Using Sun WorkShop

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Contents

Preface

Using Sun WorkShop introduces you to the basic program development features of Sun™ WorkShop™. This book describes how to:

- Select a default text editor
- Run a build job
- Debug a program
- Browse source code
- Analyze performance data
- Merge source files
- Set some Sun WorkShop resources

Who Should Use This Book

This manual is for application developers who want to use the main development features of Sun WorkShop. For a discussion of Sun WorkShop program analysis tools, see *Analyzing Program Performance With Sun WorkShop*. For a discussion of Sun WorkShop debugging tools, see *Debugging a Program With dbx*.

How This Book Is Organized

Using Sun WorkShop contains the following chapters:

Chapter 1” is an overview of the Sun WorkShop programming environment. This chapter also highlights the components available in the various Sun WorkShop products.

Chapter 2” explains what you need to do to start developing in Sun WorkShop, including how to start Sun WorkShop, how to select a text editor, and how to use WorkSets.

Chapter 3” shows you how to use the Browsing window, the Call Grapher, the Class Grapher, and the Class Browser to examine source files, function call relationships, and class hierarchies.

Chapter 4” shows you how to build an application with Sun WorkShop default settings or your own build settings, and how to fix build errors.

Chapter 5” highlights the debugging features offered in Sun WorkShop and describes the basic debugging tasks. It also explains how to debug in Quick Mode, which allows you to run your program normally, but keeps debugging ready in the background to take over the process at any time.

Chapter 6” gives an overview of how to gather and examine the various types of data with the Sampling Collector and Sampling Analyzer, and how to use other performance analysis tools to improve the performance of an application.

Chapter 7” shows you how to compare different versions of a source file and merge the changes.

Appendix A” shows you how to modify some of the resource settings in Sun WorkShop.

Appendix B” describes the options that you can set for the make utility.

Appendix C” describes the way DistributedMake (`dmake`) distributes builds over several hosts to build programs concurrently over a number of workstations or multiple CPUs.

Appendix D,” describes `sbquery`, one of the command-line utilities for browsing source code. It also tells you how to work with source files whose database information is stored in multiple directories, and describes the `sbtags` command, which provides a quick and convenient method for collecting browsing information from source files.

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

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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.

Related Books

The following Sun manuals and guides provide additional useful information:

- *Sun WorkShop Quick Install* provides installation instructions.
- *Sun WorkShop Installation and Licansing Reference* provides supporting installation and licensing information..
- *Debugging a Program With dbx* provides information on using `dbx` commands to debug a program.
- *Analyzing Program Performance With Sun WorkShop* describes the profiling tools; LoopTool, LoopReport, 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 Visual User’s Guide* describes how to use Visual to create C++ and Java™ graphical user interfaces.
- *Sun WorkShop Performance Library Reference Manual* discusses the library of subroutines and functions to perform useful operations in computational linear algebra and Fourier transforms.
- *Sun Visual WorkShop C++ Overview* gives a high-level outline of the C++ package suite.
- *Sun Performance WorkShop Fortran Overview* gives a high-level outline of the Fortran package suite.
- *C++ User’s Guide* provides information on command-line options and how to use the compiler.

- *C++ Programming Guide* discusses issues relating to the use of templates, exception handling, and interfacing with FORTRAN 77.
- *C++ Migration Guide* describes migrations between compiler releases.
- *C++ Library Reference* explains the `iostream` libraries.
- *Tools.h++ User's Guide* provides details on the `Tools.h++` class library.
- *Tools.h++ Class Library Reference* discusses use of the C++ classes for enhancing the efficiency of your programs.
- *C User's Guide* describes compiler options, pragmas, and more.
- *FORTRAN 77 Language Reference Manual* provides a complete language reference.
- *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.
- *Numerical Computation Guide* details floating-point computation numerical accuracy issues.
- *Standard C++ Library User's Guide* describes how to use the Standard C++ Library.
- *Standard C++ Class Library Reference* provides detail on the Standard C++ Library.

Solaris Books

- 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 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 Æ 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 Æ 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 System 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**

About Sun WorkShop

Sun WorkShop makes complex development tasks much easier by providing a tightly integrated development environment for building, editing, source browsing, and debugging. It provides an integrated set of tools and services, including the Visual GUI builder, which can help you to quickly create new GUIs. Integrated editors make it easier to perform common development tasks, and Sun WorkShop WorkSets help you keep track of the files, programs, directories, and targets associated with your development projects. This chapter presents a general introduction to the features of this release including the following topics:

- "Integrated Development Tools" on page 1
- "Sun WorkShop Picklists and WorkSets" on page 2
- "Performance, Debugging, and File Management Tools" on page 3
- "Sun WorkShop Visual" on page 3
- "Sun WorkShop TeamWare" on page 4
- "Multithreaded Development Tools" on page 5
- "Sun WorkShop Compilers" on page 5
- "Sun WorkShop Debugger" on page 7

Integrated Development Tools

Sun WorkShop provides an integrated environment for the development and evolution of C++, C, Fortran 90, and FORTRAN 77 applications. It provides a high level of integration of core development functions such as editing, source browsing, building, and debugging.

The most common development operations are obvious and easy to perform because the vi, XEmacs, and GNU Emacs editors are the center of an integrated development tool set that includes Building, Debugging, and Browsing. The integrated editors also provide access to common development tasks such as evaluating expressions, setting breakpoints, and stepping through functions, as well as powerful new features such as Fix and Continue. This integration allows you to spend most of your programming time in your editors and makes code development quicker and more efficient.

Three Integrated Editors

To increase ease of use and improve developer productivity, Sun WorkShop uses a new architecture that makes most development tasks accessible from your editor of choice (XEmacs, GNU Emacs, or vi). This “edit server” architecture means that you always view, edit, and operate on source code from a single view—your preferred editor. These editors are really your editors, not emulations. They have the familiar look and feel of your editor, including your existing keyboard shortcuts. The editors can perform many development functions and share task information with the other integrated development tools.

This means that most common tasks, such as evaluating expressions, setting breakpoints, and stepping through functions are available from several different windows, including your editor of choice (vi, XEmacs, or GNU Emacs). Complex application development becomes easier and more efficient.

For more information on using the Sun WorkShop editors, see:

- “Selecting and Using Text Editors” on page 12
- "Text Editing" in the online help

Sun WorkShop Picklists and WorkSets

Sun WorkShop provides a new method of organizing and accessing the files, targets, programs, experiments, and (if Sun™ WorkShop™ TeamWare is installed) workspaces associated with a given development project. Sun WorkShop remembers recent work completed on a given project and populates menu picklists with the files and operations used on that project. Whenever you start Sun WorkShop, it remembers the last set of operations performed and populates the appropriate menu picklist—whether it is five minutes or a week later. You do not have to remember long path names or argument sequences; Sun WorkShop remembers them for you.

Additionally, sets of picklists can be saved as WorkSets. WorkSets allow you to save sets of picklists associated with a given development project under a single name. By loading a WorkSet file, you can reload the files connected to a development project to the appropriate menu picklist.

For more information on using WorkSets, see:

- "Using WorkSets and Menu Picklists" on page 13
- "Using WorkSets" in the online help

Performance, Debugging, and File Management Tools

Sun WorkShop uses a Tools menu (and button bar) to provide easy access to performance and debugging tools and their object files. The individual tools in the Tools menu contain picklists for the objects specific to the tool. You can build a list of objects or files used by a particular tool, thus making it easier to bring up the tool with the object loaded. For example, after you have loaded a design file into Visual once, start Visual with that design file loaded again by choosing the file from the Visual picklist on the main Sun WorkShop Tools menu.

By default, the Sun WorkShop main window includes button bar or menu access to the Analyzer and Merging. If you have Sun™ Performance WorkShop™ Fortran, the Tools menu or button bar also provides access to the Sun WorkShop TeamWare file management tools, and the multithreaded tool, LoopTool. If you have Sun™ Visual WorkShop™ C++, you have access to Visual..

For more information about using the tools, or about picklists, see:

- "Using WorkSets and Menu Picklists" on page 13
- "Multithreaded Development Tools" on page 5
- *Sun WorkShop TeamWare User's Guid*e
- *Analyzing Program Performance With Sun WorkShop*
- "Analyzing Performance Data" or "Analyzing Program Loops" in the online help

Sun WorkShop Visual

Available only with Sun Visual WorkShop C++.

Visual helps developers quickly and easily design GUIs, generate portable object-oriented code, and develop Motif or Microsoft Foundation Class GUIs.

A large percentage of your application's source code base can be GUI code. Visual is an interactive tool that allows you to see what the interface looks like and how it behaves while it is being built. Visual automatically generates the code when the design is complete.

For more information about this release of Visual, see Sun WorkShop *Visual User's Guide.*

Sun WorkShop TeamWare

Available only with Sun Performance WorkShop Fortran and Sun Visual WorkShop C++.

Sun WorkShop TeamWare provides services for source code management either visually, through a set of GUIs, or from a command line. TeamWare enables teams to work together more efficiently even when team members are distributed among multiple sites. TeamWare provides structure as well as automated functions that allow a team to work in parallel to coordinate, integrate, and build a product. The services include:

Configuring	For managing and integrating source code configurations and releases
Versioning	For creating and tracking file version histories
Freezepointing	For baselining a software configuration or release for later retrieval
Building	For reducing the time required to build large projects by executing build jobs on multiple Solaris hosts
Merging	For merging source files and coordinating source changes

For more information about using TeamWare, see the *Sun WorkShop TeamWare User's Guide* or start Sun WorkShop TeamWare and choose Help from the main window.

Multithreaded Development Tools

The Sun Performance WorkShop Fortran and Sun Visual WorkShop C++ include tools for developing multithreaded applications. Sun WorkShop Debugging supports dynamic analysis and control of multithreaded programs. LockLint analyzes source code for potential synchronization errors, such as deadlock and data race conditions. LoopTool displays a graph of loop runtimes and shows which loops were parallelized. Together they provide powerful support for multithreaded program development.

For more information on using the multithreaded tool set, see:

- *Analyzing Program Performance With Sun WorkShop*
- "Debugging Multithreaded Programs" in the online help

Sun WorkShop Compilers

This release of Sun WorkShop supports the following compilers.

Compiler C++

Available only with Sun Visual WorkShop C++.

This release implements the complete feature set found in *The Annotated C++ Reference Manual*.[1] It includes support for exception handling, an incremental linker, a fast template instantiation scheme, and an enhanced version of the commercially available `Tools.h++` class library. As an optimizing, native C++ compiler, the version offers significant boosts in both compilation and execution speed.

The C++ language features in this release offer improved support for the ISO C++ standard, including:

- Standard C++ Library
- Namespaces
- Bool type
- Koenig lookup
- Mutable members
- Typename

[1] Stroustrop, Bjarne, and Margaret Ellis, *The Annotated C++ Reference Manual*, Addison-Wesley, 1990.

- Template default parameters

For more information about the C++ compiler, including a list of the C++ documentation, see *C++ User's Guide.*

Fortran 90 Compiler

Available only with Sun Performance WorkShop Fortran.

This release is a complete implementation of the Fortran 90 ANSI X3.198-1992 standard. This standard has added many powerful features, such as an improved ability to express mathematical formulas more directly in the programming language. In addition, the Fortran 90 compiler works with the rest of Sun WorkShop to automatically parallelize your code.

For more information about the Fortran 90 compiler, including a list of the Fortran documentation, see the *Fortran User's Guide* or *Fortran Programming Guide.*

FORTRAN 77 Compiler

Available only with the Sun Performance WorkShop Fortran.

This compiler is a complete implementation of the FORTRAN 77 ANSI X3.9-1978, ISO 1539-1980 standards. It has an improved ability to express mathematical formulas more directly in the programming language, as well as extensions that provide compatibility with VAX VMS Fortran and Cray Fortran.

For more information about the FORTRAN 77 compiler, including a list of the Fortran documentation, see the *Fortran User's Guide* or *Fortran Programming Guide.*

C Compiler

This compiler is fully compliant with the ANSI C language and environment standard, and it also supports traditional K&R C. The C optimizer provides significant performance increases over nonoptimized code. The code optimizer removes redundancies, efficiently allocates registers, and schedules instructions. Also featured is an incremental linker to reduce link time during the debugging phase.

For more information about the C compiler, including a list of the C documentation, see *C User's Guide.*

Sun WorkShop Debugger

Sun WorkShop uses a window-based source code debugging service that provides the ability to run a program in a controlled fashion and to inspect the state of a stopped program. Sun WorkShop provides complete integration with three text editors to allow you to edit a program"s source code while using full debugging functionality. You have complete control of the dynamic execution of a program, including the collection of performance data. A line-oriented, source-level debugger called `dbx` is included.

You perform most debugging operations from the Debugging window and the windows accessed from it. You can also perform basic debugging operations from a text editor window containing the source code, which opens automatically when you load a program for debugging.

Web Updates

The Web Updates Dialog Box lets you display updated information on Sun WorkShop using your Web browser. To open the Web Updates dialog box, choose Web Updates from the Help menu in any Sun WorkShop window. For more information, see “Web Updates Dialog Box” in the Sun WorkShop online help.

CHAPTER **2**

Getting Started

This chapter describes how to begin working in Sun WorkShop. For instructions on installing Sun WorkShop, see the *Sun WorkShop Quick Install.*

This chapter is organized into the following sections:

- "Starting Sun WorkShop" on page 9
- "Sun WorkShop Main Window" on page 10
- "Selecting and Using Text Editors" on page 12
- "Using WorkSets and Menu Picklists" on page 13
- "Adding Items to WorkSets and Menu Picklists" on page 15
- "Information Saved from Your Sun WorkShop Session" on page 19

Starting Sun WorkShop

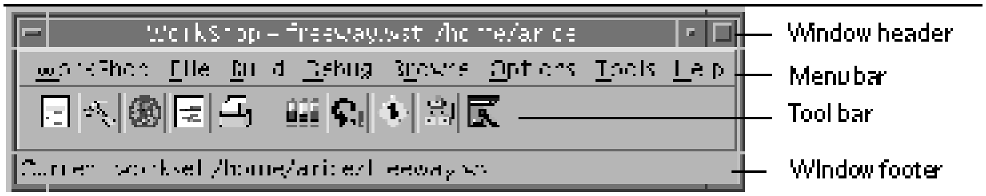
Once you have installed Sun WorkShop and added it to your command path, you can start it by typing `workshop &` at a command prompt.

If this is the first time you have used WorkShop, the About WorkShop window appears in front of the WorkShop main window. If you have not registered, take a few minutes and do so. If you have not read the Overview, now might be a good time to do so.

You can set colors and fonts used in the windows of WorkShop and its integrated text editor, including the foreground and background colors of windows, and colors used to highlight various types of text in the editor windows. You can also set other types of resources, such as a blinking cursor and the automatic wrapping of text in Sun WorkShop windows. For information on changing the default resources of Sun WorkShop in both CDE and non-CDE environments, see Appendix A."

Sun WorkShop Main Window

The Sun WorkShop main window is your primary access to the programming operations that allow you to create, develop, debug, and fine-tune your applications. Figure 2–1 identifies the components of the window.



Current WorkSet /home/arice/freeway.ws

Figure 2–1 Sun WorkShop Main Window

Window header	Identifies the WorkSet and directory of the process running in Sun WorkShop
Menu bar	Provides commands for all of the Sun WorkShop operations
Tool bar	Provides quick access to the most common program development operations: opening a file, starting a build, debugging a program, browsing source files, managing WorkSets, analyzing data, managing code and versions, and designing GUIs
Window footer	Displays error messages and provides tool bar button definitions when the pointer is positioned over a button

Sun WorkShop Menus

The menu bar in the Sun WorkShop main window provides the following menus, which provide commands for all of the Sun WorkShop operations.

WorkShop menu	Provides commands to manage Sun WorkShop windows, to change the current Sun WorkShop directory, to exit Sun WorkShop, and to manage WorkSets
File menu	Provides commands to start an editor and create a new file or open an existing file
Build menu	Provides commands to open the Building window and to specify a new target, or to edit an existing target
Debug menu	Provides commands to open the Debugging window and to run or debug a program

Browse menu	Provides commands to open the Browsing window and to browse source files or classes
Options menu	Allows you to select a default editor, debugging options, WorkSet options, and window layout options
Tools menu	Provides quick access to Sun WorkShop operations and to Sun WorkShop development tools available with the Sun Performance WorkShop Fortran and the Sun Visual WorkShop C++
Help menu	Provides commands to get help on programming in Sun WorkShop and to view help on a selected item; also provides a way for you to send in your comments about Sun WorkShop

Tool Bar

The tool bar in the Sun WorkShop main window, shown in Figure 2–2, provides quick access to windows where you can edit files, build a target, debug a program, browse for program symbols, and more.

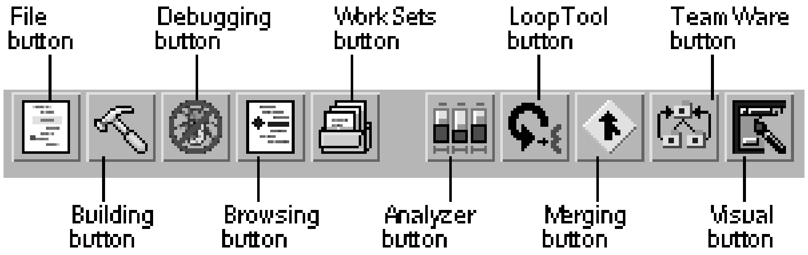


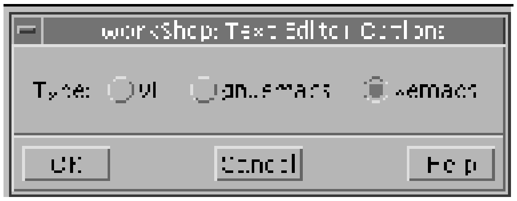
Figure 2–2 Sun WorkShop Main Window Tool Bar

File button	Opens the File to Open dialog box, where you can select a file to edit in the text editor of your choice—vi, GNU Emacs, and XEmacs.
Building button	Opens the Building window, then rebuilds the current targets.
Debugging button	Opens the Debugging window and loads the current program for debugging. If there is no current program, opens the Debug New Program dialog box, where you can select a program file and enter parameters for debugging.
Browsing button	Opens the Browsing window so you can perform queries using pattern searching or source browsing.
WorkSets button	Opens the WorkSets window and displays the current WorkSet.

Analyzer button	Opens the Sampling Analyzer window and the Analyzer Load Experiment dialog box allowing you to analyze application performance data.
LoopTool button	Opens the LoopTool window, where you can analyze multithreaded applications (available with Sun Visual WorkShop C++ and Sun Performance WorkShop Fortran)
Merging button	Opens the Merging window and a dialog box to select text files to compare and merge.
TeamWare button	Opens the Sun WorkShop TeamWare source code management tool, where you can access the TeamWare tools (available with Sun Visual WorkShop C++ and Sun Performance WorkShop Fortran)
Visual button	Opens the Visual window for you to design visual applications (available with the Sun Visual WorkShop C++)

Selecting and Using Text Editors

Unless you have previously set your `EDITOR` environment variable to GNU Emacs or XEmacs, Sun WorkShop uses the vi editor (For information on how to set your `EDITOR` environment variable, see the man page for your command shell). To use the integrated GNU Emacs or XEmacs editors, you must use the Text Editor Options dialog box shown in Figure 2–3.



Type: ○ vi ○ gnu-emacs ● xemacs

Figure 2–3 Text Editor Options Dialog Box

The editor you choose will remain the default editor for subsequent sessions of Sun WorkShop. To change editors, choose Options > Text Editor Options from the Sun WorkShop main window and select a new default editor in the Text Editor Options dialog box.

The Sun WorkShop implementation of vi includes a Re-usable button. If the button is enabled, subsequently opened files are displayed in the original Vi window. If the button is disabled and you open a new vi file, the new file is displayed in a new Vi window. The Re-usable button in the lower-right corner of the window toggles between enabling and disabling the reuse feature.

Vi and XEmacs include tool bars specific to Sun WorkShop. GNU Emacs and XEmacs include minibuffer commands specfic to Sun WorkShop that help you to browse and debug source code. In addition, you can open Sun WorkShop from an existing Emacs session by typing `M-x workshop-start` in the minibuffer. To use GNU Emacs with Sun WorkShop, you need to set the load path in your `.emacs` file. See the online help section “Starting WorkShop From Emacs” for instructions.

Using WorkSets and Menu Picklists

Most of the Sun WorkShop menus contain *picklists* that provide access to the items used by the menu. For example, the picklist on the File menu contains all the files associated with the current Sun WorkShop WorkSet. The picklist on the Debug menu contains all the programs associated with the current Sun WorkShop WorkSet.A Sun WorkShop *WorkSet* is the set of items contained on the menu picklists.

WorkSets and menu picklists help you keep track of the files and other items you use for your development projects. WorkShop uses WorkSets and menu picklists to provide quick access to the various directories and files associated with a given development project, including the following:

- Source files
- Build targets
- Programs
- Experiments
- Source browser directories
- Workspaces (if TeamWare is installed)
- Sun WorkShop Visual design files

Each type of item is saved to a different menu picklist. For example, if you load a program called `Freeway` into the Debugging window, `Freeway` is added to the Debug menu picklist. The next time you want to debug the `Freeway` program, you can choose `Freeway` from the Debug menu picklist.

Although you can create your own WorkSet, you do not have to. Sun WorkShop will create one for you. Sun WorkShop uses WorkSets to save complete sets of menu picklists. Whenever you start Sun WorkShop, it either creates a default WorkSet (usually `.default.wst`) or it opens the last WorkSet you had open. By default, when you close WorkShop, it automatically saves your current WorkSet.

You can create new WorkSets of your own using the New WorkSet item in the WorkShop menu. By saving a WorkSet you can save all the picklist items associated with a given development project under a single name. Saving your picklist items and files as a WorkSet makes them easier to access later.

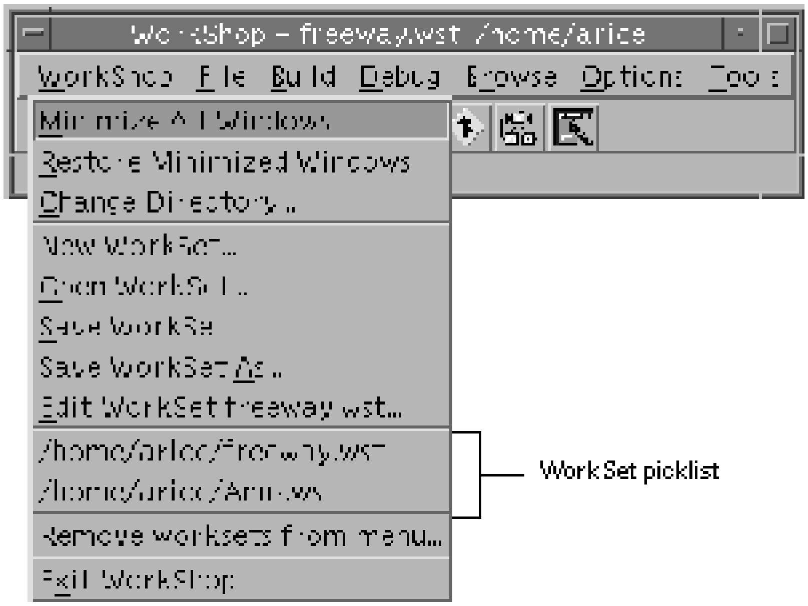


Figure 2–4 WorkShop Menu

For example, suppose you use Sun WorkShop to:

- Create and edit several source files
- Build a program target
- Debug the program

By default, the files, build target, and program you created are added to the appropriate menu picklist. In this case, the source files are placed on the File menu picklist, the build target is placed on the Build menu picklist, and the program is placed on the Debug menu picklist. To save all of these as a WorkSet, choose WorkShop Æ Save WorkSet As, and then type a name in the Name text box of the Save WorkSet As dialog box. Sun WorkShop stores the files, target and program under the name you choose. Loading this WorkSet later reloads the files, target, and program references connected to the appropriate menu picklists.

To start WorkShop with a specific WorkSet loaded, specify the WorkSet name on the command line at startup. For example, the following command starts WorkShop with all the files, targets, programs, and so on associated with the `freeway` WorkSet loaded on the appropriate menu picklists:

```
workshop freeway.wst
```

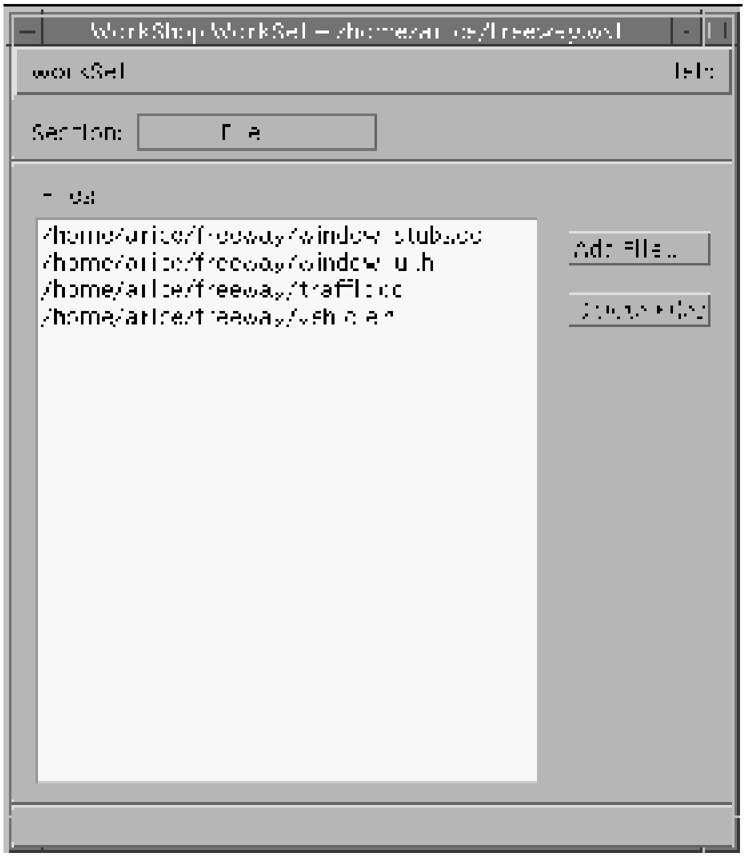
Adding Items to WorkSets and Menu Picklists

Whenever you start WorkShop, it remembers the last WorkSet you had open and the last set of development tasks you performed. It populates Sun WorkShop menu picklists with the items (files, programs, and so on) contained in that WorkSet.

Picklist items (for example, files on the File menu) can be added to or removed from menu picklists (and therefore to and from the current WorkSet) either by editing the WorkSet, or by adding or removing an item directly from any of the WorkShop menus.

Adding Items to a WorkSet Using the WorkSet Window

To edit the WorkSet directly, choose WorkShop Æ Edit WorkSet *WorkSet_Name*. When the WorkSet window appears, use it to add or delete the desired object.



/home/alice/freeway/window_stubs.cc
/home/alice/freeway/window_u.h
/home/alice/freeway/traffic.cc
/home/alice/freeway/vehicle.h

Figure 2–5 WorkSet Window

Adding Items to a WorkSet Using a Sun WorkShop Menu

To add an object to a WorkSet using a WorkShop menu, choose New from the menu. When you open a new item, it is automatically added to the menu picklist and the current WorkSet. To remove an item from a menu picklist (and therefore from the current WorkSet), choose Remove *item* from menu where *item* represents the object controlled by the menu. When the file chooser appears, select the item or items you want to remove.

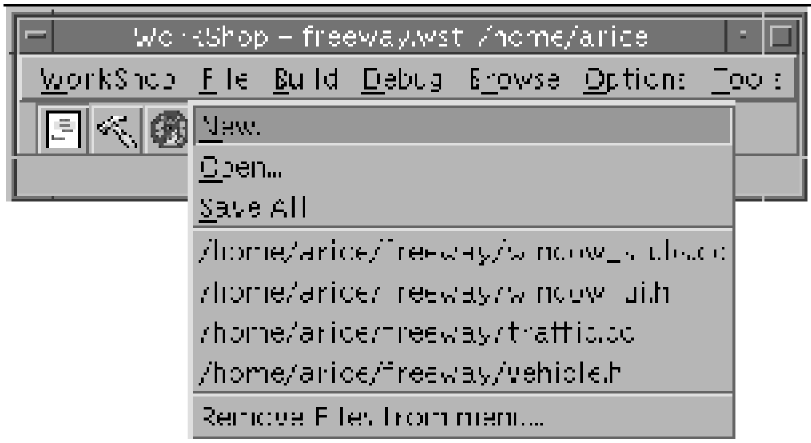

WorkShop - freeway.wst /home/arice
WorkShop
File
Build
Debug
Browse
Options
Tools
New
Open...
Save All
/home/arice/freeway/window_utils.cc
/home/arice/freeway/window_ui.h
/home/arice/freeway/traffic.cc
/home/arice/freeway/vehicle.h
Remove Files from menu...

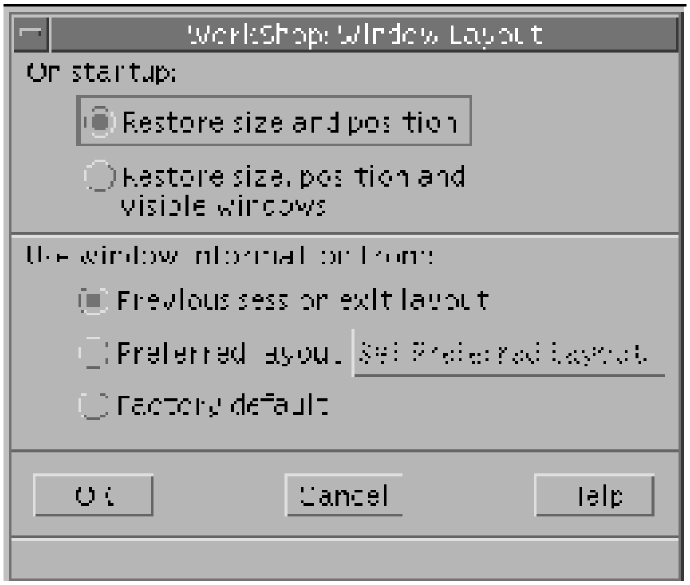
Figure 2–6 File Menu Picklist

For more information about creating, editing, or modifying WorkSets, see "Using WorkSets" in the Sun WorkShop online help.

Setting Window Layout Options

When you exit WorkShop, it remembers the size and position of its windows when it shuts down. By default, when you start WorkShop again, it uses this information in displaying its windows.

You may want Sun WorkShop to always use a particular window layout on startup, regardless of the layout when you exited your previous session. You can use the Window Layout dialog box (see Figure 2–7) to save a startup layout for Sun WorkShop to use every time it starts up.



On startup:

● Restore size and position

○ Restore size, position and visible windows

Use window information from:

● Previous session exit layout

○ Preferred layout Set Preferred Layout

○ Factory default

Figure 2–7 Window Layout Dialog Box

By default, Sun WorkShop records the size and position of each window on exit and uses this information the next time you open a window. If you want Sun WorkShop also to record the state of each window on exit (open, closed, or iconified), select the Restore size, position and visible windows radio button. When you start Sun WorkShop the next time, the windows are displayed in the recorded state. For example, if you have the Debugging window open and displayed, and the Browsing window open but iconified, when you exit Sun WorkShop, the next time you start Sun WorkShop, the Debugging window will be opened and displayed immediately, and the Browsing window will be opened and iconified.

If you select the Previous session exit layout radio button, then when Sun WorkShop starts, it uses the window layout in use at the exit from the previous session.

If you select the Preferred layout radio button, Sun WorkShop uses the window layout saved as the preferred layout for startup. When you click the Set Preferred Layout button, the current layout is saved as the preferred layout.

If you select the Factory default radio button, Sun WorkShop uses the window layout from the first time you started it.

Information Saved from Your Sun WorkShop Session

Sun WorkShop saves information from session to session in WorkSets (see "Using WorkSets and Menu Picklists" on page 13), in the `.workshop-options` file, and in the `.workshoprc` file.

Information saved in a WorkSet when you exit Sun WorkShop includes:

- Source files
- Build targets
- Programs
- Experiments
- Source browser directories
- Workspaces (if Sun WorkShop TeamWare is installed)
- WorkShop Visual design files

Information saved in your `.workshop-options` file when you exit Sun WorkShop includes:

- The name of the current WorkSet
- WorkSet option settings (see "WorkSet Options Dialog Box" in the Sun WorkShop online help)
- Your WorkSet picklist
- Window layout options (see "Setting Window Layout Options" on page 17)
- Debugging options (see "Debugging Options Dialog Box" in the Sun WorkShop online help)
- Size and position of Sun WorkShop windows

Information saved in your `.workshoprc` file when you exit Sun WorkShop includes all of the `dbx` environment variable settings.

CHAPTER 3

Browsing Source Code

The Sun WorkShop browsing feature is a powerful tool. By browsing, you can find all occurrences of any symbol or string in a large program, including those found in header files.

This chapter is organized into the following sections:

Browsing uses a "what you see is what you browse" paradigm. The source code that you edit and compile is the same source code that Sun WorkShop uses in its searches.

Browsing can be used with multiple languages. When you browse a program that is written in more than one language, the browsing feature automatically determines the language in which each source file is written. The browsing operations do not change from one language to another.

Understanding Browsing

You browse source code written in C, C++, FORTRAN 77, and Fortran 90 by issuing queries that instruct Sun WorkShop to find all occurrences of the symbol, string constant, or search pattern that you have specified. You then view the occurrences or *matches* of the item you requested, with their surrounding source code.

You can also graph the function and subroutine relationships in your program. If your source code is written in C++, then you can browse and graph the classes defined in your program.

Browsing responds to queries by searching in a database that contains information about the files you are browsing. You create this database when you compile your source file with the Browsing option.

Browsing Window

To open the Browsing window, shown in Figure 3–1, click the Browsing button on the tool bar in the Sun WorkShop main window or choose a command from the Browse menu. The Graph Function Calls, Graph Classes, and Browse Classes commands open the Call Graph, Class Graph, and Class Browser windows, respectively (see Figure 3–5, Figure 3–6, and Figure 3–7).

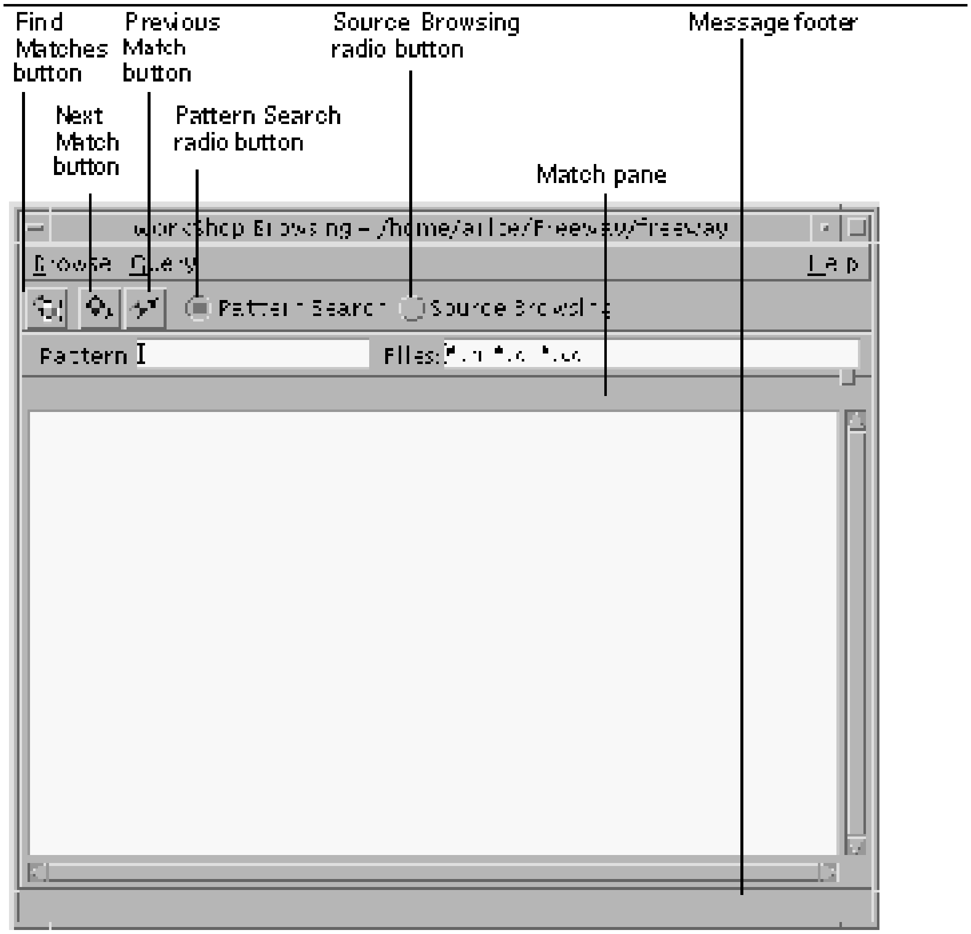


Figure 3–1 Browsing Window

Browse menu	Provides commands for changing directories, starting the graphers, rebuilding indexes, creating a tags database, exiting the source browsing server, and closing the browsing window.
Query menu	Provides commands for navigating matches, filtering matches, and displaying the query history.
Find Matches button	Starts the search for matches of your query.
Next Match button	Highlights the next match in the Match pane and shows the matching source code.
Previous Match button	Highlights the previous match in the Match pane and shows the matching source code

Pattern Search radio button	Sets the Browsing window to Pattern Search mode.
Source Browsing radio button	Sets the Browsing window to Source Browsing mode.
Match pane	Displays all matches in a scrollable pane. The total number of matches found for the current query is displayed immediately above the pane. Match information is displayed from left to right with the file name, the line number, and the text on that line.
Message footer	Displays the status of the current search or errors that occurred during a search.

Using the Browsing Window

Two types of browsing are available through the Browsing window: pattern searches and source browsing.

Use pattern searching when you:

- Want to do a quick search (grep-style) for a regular expression
- Do not have a source browsing database in the directory you want to search
- Do not want to graphically view function call relationships or class hierarchies
- Do not want to examine the data or member functions of a class

Use source browsing when you:

- Have a source browsing database created by adding the `-xsb` option to your compilation command or your makefile
- Want to search for language elements such as subroutines, functions, classes, structs, unions, and records or for their usage, definitions, or assignments
- Want to graphically view function and subroutine call relationships, or class hierarchies
- Want to examine the data or member functions of a class

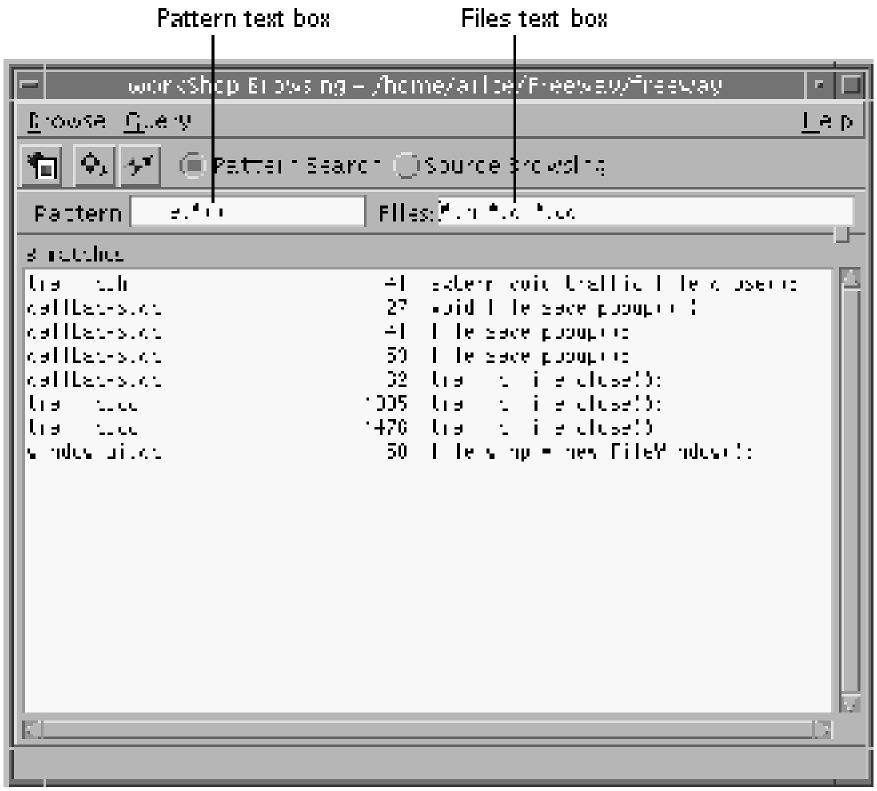
Pattern Search Mode

With pattern searching, you can search for regular expressions and simple text strings using the Browsing window.

Pattern searching searches all of the directories listed in the `sb_init` file (see “Importing Databases” on page 30).

Browsing Window in Pattern Search Mode

Figure 3–2 shows the Browsing window in Pattern Search mode (see Figure 3–1 to identify the other components of the window).



```
8 matches
[illegible]          41   extern void [illegible]
callbacks.cc         27   void file_save_popup();
callbacks.cc         41   file_save_popup();
callbacks.cc         50   file_save_popup();
callbacks.cc         32   [illegible] close();
[illegible]        1005   [illegible] close();
[illegible]        1470   [illegible] close()
[illegible]          50   [illegible] = new FileWindow();
```

Figure 3–2 Browsing Window in Pattern Search Mode

Pattern text box	Allows you to enter a regular expression to be matched
Files text box	Allows you to specify a file filter for the search

Searching for a Pattern

To search for a pattern:

1. **In the Sun WorkShop main window, choose Browse > Pattern Search or click the Browsing button; then click the Pattern Search radio button in the Browsing window.**

2. **Look in the Browsing window title bar to be sure you are in the correct browsing directory.**

If not, choose Browse > Change Browsing Directory and select the correct directory in the Pattern Search Directory dialog box.

3. **Type the pattern for which you want to search in the Pattern text box.**

   If you cannot remember the exact symbol for which you want to search, you can use wildcard characters (`.`, `*`. `^`, and `$`) in your pattern (see "Special Characters in Patterns" on page 26).

4. **Type a filter in the Files text box.**

   The default filter searches the current directory for all files ending in `.h`, `.c`, `.cc`, or `.f`. Sun WorkShop saves the filter in your WorkSet whenever you save the WorkSet.

   Pattern searching uses the `sb_init` file to search multiple directories. It applies the Files filter to each directory.

5. **Press Return, choose Query > Find Matches, or click the Find Matches button.**

6. **Move through the Match pane using the mouse, the Next Match and Previous Match buttons or menu items, or by pressing F5 and Shift+F5.**

7. **Click a match to view the source in the editor window.**

Note - If you are overwhelmed by the number of matches found, restrict the types of files searched by changing the file types in the Files text box, and repeat the search.

You can search text displayed in the editor window. Double-click the text in the editor window to copy it, and paste it in the Browsing window"s text box. If you are using vi or XEmacs as your text editor, you can also select text in the editor window and click the Find Refs button in the tool bar.

Special Characters in Patterns

Although you can enter a pattern exactly as it appears in the code, you can also use special characters to specify a set of patterns. You can use the special characters in Table 3–1 in patterns.

TABLE 3–1 Special Characters in Patterns

Character	Meaning	Example
Period (.)	Matches any character	`l.nes` matches all occurrences of `lanes` or `lines.`
Asterisk (*)	Matches any number of characters, including zero or more consecutive occurrences of the character that precedes it, *except* when it is the first character in the pattern	`file.*()` matches any string that fcontains `file` followed by zero or more characters and `()`, such as `traffic_file_close()` and `file_save_popup`. `*file.` matches only strings that begin with `file.`
Circumflex (^)	Constrains the search to match the beginning of a line	`^tr*` finds all lines that begin with `traffic`, `truck`, or any other string beginning with `tr.`
Dollar sign ($)	Constrains the search to match the end of a line	`lanes$` finds all the lines that end with the string `lanes.`

For example, suppose you want to search for `window_popup` in the code, but only those instances that begin a line. You would type the following query:

```
^window_popup*
```

The circumflex (^) tells the browser to look only at those matches that start a line of code, while the asterisk (*) asks for all matches with `window_popup`, including `window_popup_name_objects` and `window_popup1_objects`.

Note - Surrounding an expression with a circumflex and a dollar sign constrains the search to match the entire line.

Source Browsing Mode

Using source browsing, you can search for language elements such as functions, classes, structs, unions, and records or for their usage, definitions, or assignments. You can also graphically view function call relationships or class hierarchies. And you can examine the data or member functions of a class.

Source Browsing Databases

The Source Browser obtains the information it uses from a database that describes the static structure of your program. To use source browsing, you must first create a source browsing database by adding the `-xsb` option to your compilation command or your makefile.

The browser has different levels of functionality depending upon the database it accesses:

Compiler-generated database	use full browser functionality
Tags-generated database	Allows queries on functions and global variables and can display function calls. Graphing features are not available.
No database	Must use the Pattern Search mode of the Source Browser.

Using a tags-generated database has some advantages over using a database generated by a compiler:

- You can always generate a tags database, even if the source code cannot be compiled because it is incomplete or semantically incorrect.
- You can create a tags database much faster than running the compiler to generate a database.
- A tags database is much smaller than a compiler-generated database.

Generating a Browser Database

When you compile your source files with the source browser option, Sun WorkShop creates a database containing information about the files. The Source Browser responds to queries by searching through this database.

When you create a compiler-generated database, you can access all browsing features.

To generate the browsing database, add the source browser option to your makefile:

Language	**Compiler Source Browser Option**
C++	`-xsb` or `-sb`
ANSI C	`-xsb`

Language	Compiler Source Browser Option
FORTRAN 77	`-xsb` or `-sb`
Assembler	`-b`

Creating a Tags Database

A tags database provides a quick and convenient method for browsing source files without compilation. The database is based on a lexical analysis of the source file. It will not always correctly identify all language constructs, but it will operate on files that you cannot compile.

Note - The source browsing tags are not in the same format as `ctags`; the tags discussed here are in a format that works specifically with source browsing.

If you browse using a tags database, you:

- Cannot issue queries about local variables
- Cannot browse classes
- Have a limited ability to issue complex queries
- Have a limited ability to focus queries

A tags database recognizes only global definitions for variables, types, and functions, and collects information on function calls. Function calls for C++ members are recognized only when called explicitly.

To create a tags database:

1. **From the Browsing window, choose Browse > Create Tags Database.**

2. **In the Create Tags Database dialog box, click OK to accept the default file filter or enter the type of files you want to scan and click OK.**

   The browser creates the tags database.

Searching Multiple Directories

If you keep your source files in several different directories, you are likely to execute the compiler in each of these directories. As a result, the default compiler behavior generates a separate source browser database in each directory.

Since the Source Browser looks at only one database at a time, only the part of your application located in the current directory is searched. You can override this default behavior by importing databases.

Importing Databases

Instead of merging separate databases, you can import databases. Use the `sb_init` file to read more than one database. You can start browsing in the same directory that holds the `sb_init` file.

To import databases:

1. **Identify where your `sb_init` file resides.**

2. **Add an `import` command to the `sb_init` file for each directory in which the compiler is executed:**

   `import` *absolute_or_relative_pathname*

3. **Set your `SUNPRO_SB_INIT_FILE_NAME` environment variable to point to your `sb_init` file.**

   Add the following line to your `.login` file:

   `setenv SUNPRO_SB_INIT_FILE_NAME` *path to sb_init file*/`sb_init`

Note - Use the import option to search your entire source tree for source files and browser databases. Just add an import command to the `sb_init` file for each directory in your source tree.

Note - Because pattern searching uses `sb_init` to search source files in multiple directories, and source browsing uses `sb_init` to search browser databases (which include object files) in multiple directories, you may want to include import commands for both source and object directories in your `sb_init` file.

Browsing Window in Source Browsing Mode

Figure 3–3 shows the Browsing window in Source Browsing mode (see Figure 3–1 to identify the other components of the window).

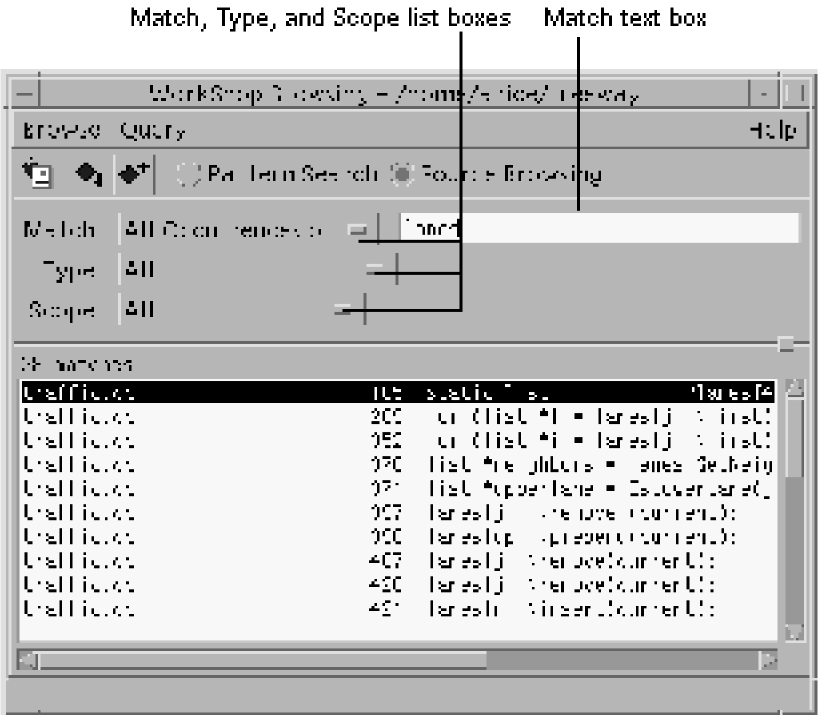


Figure 3–3 Browsing Window in Source Browsing Mode

Match list	Allows you to filter the search to specific uses of the query. You can select from the following usage types: All Occurrences of—No restrictions on the match type of the given entry Uses of—Show all uses of the given entry Definitions of— Show all definitions for the given entry Assignments to—Show all assignments to the given entry
Match text box	Contains the query on which you want to search.
Type list	Allows you to set a filter for the entry being queried. You can select from the following types: All—No restrictions on the language element type of the given entry Member/Field—Instances of the given entry as class member, or record fields Class/Struct/Record—Instances of the given entry as classes, structs, or records Static—Instances of the given entry as functions or variables that have static storage Function—Instance of the given entry as a function Symbolic Constant—Constant referred to by a symbolic name; for example, `ENUM` members, `PARAMETER` statement defined constants, set members, and `#define` macros (with or without arguments)
Scope list	Allows you to restrict the search to specific elements in the source. Enter the string for the element in the Scope text box. Shell-style expressions are supported. You can select one of the following components: All—No restrictions on the scope of the given entry Program/Library—Search only in the specified program or library files Class/Struct—Search only in the specified class or struct Function—Search only in specified functions Source File—Search only in the specified source files

Using Source Browsing

To use source browsing:

1. **Compile the application using the `-sb` or `-xsb` option, which instructs the compiler to generate a browsing database during compilation.**

   (See “Generating a Browser Database” on page 28.)

2. **Choose Browse > Browse Sources, or click the Browsing button in the Sun WorkShop main window tool bar, and then click the Source Browsing radio button in the Browsing window.**

3. **Look in the Browsing window title bar to be sure you are in the correct browsing directory.**

   If not, choose Browse > Change Browsing Directory and use the Browsing Directory dialog box to select the directory that contains the source browser database.

Note - You can search files in multiple directories in the browsing database. See "Searching Multiple Directories" on page 29.

---

4. **Type a query in the Match text box and press Return, choose Query > Find Matches, or click the Find Matches button.**

   For details on writing a query, see "Composing a Query" on page 33.

5. **Restrict the number of matches returned by choosing a match, type, or scope from the appropriate pulldown list.**

   For information on the lists, see "Browsing Window in Source Browsing Mode" on page 30. For detailed information on restricting a query, see "Restricting a Query" in the Sun WorkShop online help.

6. **Move through the Match pane using the mouse, the Next Match and Previous Match buttons or menu items, or by pressing F5 and Shift+F5.**

   Each match line contains the name of the source file, the line number, and the text on that line. Matches are sorted with definitions first, declarations last, and everything else in between. Within each group, the matches are listed alphabetically by file name, then by line number.

7. **Click a match to view the source in the editor window.**

8. **Start the Call Grapher, Class Grapher, or the Class Browser to view relationships in the source.**

Composing a Query

When you use source browsing, a *query* instructs the browser to find all occurrences of the symbol, string constant, or search pattern entered in the search field. The item actively being searched for is called the *current query*.

All symbols in the code identical to the query are referred to as *matches*.

In general, you cannot query for reserved words. The exception is language-defined type names in ANSI C or C++. For example, you can query on `int`, `float`, `double`, or `long` in ANSI C or C++ programs; however, you cannot query on `integer` or `print` in Fortran programs.

You can search for a variable, function, type, constant or macro. If you are unsure of what to browse for, begin by selecting `main` or another identifier used early in your program.

Special Characters in Queries

Although you can enter a name or function exactly as it appears in the code, you can also use wildcard characters to specify a set of character strings.

Use the wildcard characters in Table 3–2 in queries you type in the Match text box:

TABLE 3–2 Special Character in Queries

Character	Meaning	Example
period (.)	Matches any character	.ehicle matches all occurrences of vehicle or `Vehicle`
asterisk (*)	Matches any number of characters, including zero or more consecutive occurrences of the character that precedes it.	`vehi.*` matches any string that begins with `veh`, such as `vehicle_length()`. `vehi*` matches `veh` but not `vehicle_length()`.

Using the Double Colon Operator

The double colon operator (::) qualifies a C++ member function or top-level function with the following:

- An overloaded name—-the same name used with different argument types
- An ambiguous name—the same name used in different classes

The syntax is as follows:

`class_name::function_name`

For example, `hand::grasp`.

To find `RW::ListPtr::insert()`, the following regular expressions will work:

```
insert ListPtr::insert RW::ListPtr::insert
```

The first two regular expressions are equivalent to .*::.*::insert and .*::ListPtr::insert and might match more symbols. The entry insert matches all functions or member functions with the name insert instead of requiring .*insert.

Source Browser Options Dialog Box

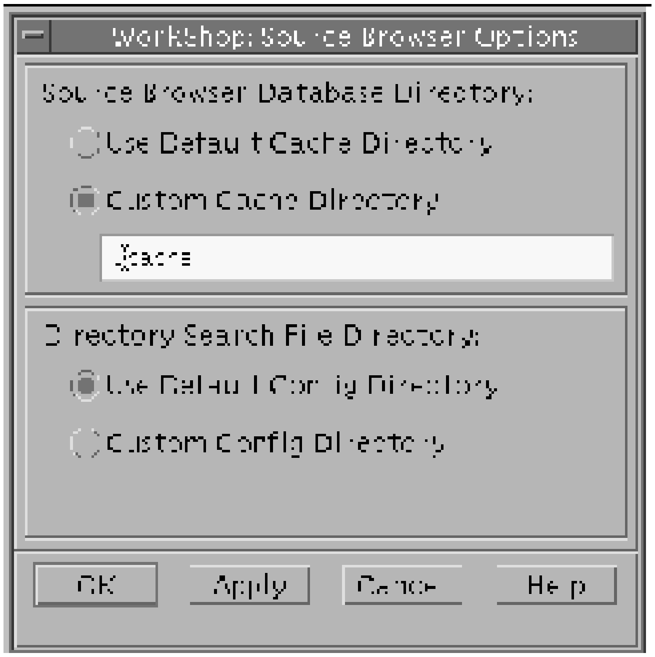
The Source Browser Options dialog box (see Figure 3–4) lets you specify:

- The name of the cache directory that contains files that Sun WorkShop automatically creates when you build an application
- The name of the directory that contains configuration files (both those generated by Sun WorkShop tools and those you may create manually)

Specifying these names sets the SUNWS_CACHE_NAME and SUNWS_CONFIG_NAME environment variables, respectively, for the source browser engine.

Note - You can safely delete the cache directory to save disk space. It can be automatically regenerated. Do not delete the configuration directory; it cannot be regenerated.

If the SUNWS_CACHE_NAME or SUNWS_CONFIG_NAME variable is set to a directory that does not exist, the dialog box opens with the corresponding default directory selected even though you have specified a custom directory.



WorkShop: Source Browser Options

Source Browser Database Directory:

○ Use Default Cache Directory

● Custom Cache Directory

cache

Directory Search File Directory:

● Use Default Config Directory

○ Custom Config Directory

Figure 3–4 Source Browser Options Dialog Box

Use Default Cache Directory radio button	Allows you to choose to use the default cache directory (`SunWS_cache`).
Custom Cache Directory radio buton	Allows you to name a custom cache directory. If you select the radio button, a text box is displayed into which you can type the new directory name, which must not be a path name.
Use Default Config Directory radio button	Allows you to choose to use the default config directory (`SunWS_config`).
Custom Config Directory radio button	Allows you to name a custom config directory. If you select the radio button, a text box is displayed into which you can type the new directory name, which must not be a path name.
OK	Applies changes and closes the Source Browser Options dialog box.
Apply	Applies changes without closing the Source Browser Options dialog box.
Cancel	Closes the Source Browser Options dialog box without applying changes.
Help	Displays help for the Source Browser Options dialog box.

Graphing a Function

Using the Call Grapher, you can graphically inspect the relationships of the functions in programs using ANSI C, C++, and Fortran. You can display the functions that either call or are called by one or more selected functions.

You must have a source browsing database to view function relationships (see “Source Browsing Databases” on page 28).

Note - You can graph virtual functions, but you should be aware that Sun WorkShop cannot determine the actual function that would be called. For example: If `main` calls `b::d()`, a virtual function that could actually call `b1::d()` or `b2::d()`, Sun WorkShop cannot tell which function is called. The graph shows `main` calling b::d(), but no connection between main and b1::d() or main and `b2::d()`.

Call Graph Window

The Call Graph window provides a graphic representation of the call relationship of functions and subroutines. Figure 3–5 shows the Call Graph window.

To change the colors used for node background, graph pane background, node border, node text, and arrows between nodes in the Call Graph window, edit the `WORKSHOP` resource file (see “Call Graph and Class Graph Window Colors” on page 131). Any color changes you make apply to both the Call Graph and Class Graph windows (see “Class Graph Window” on page 40).

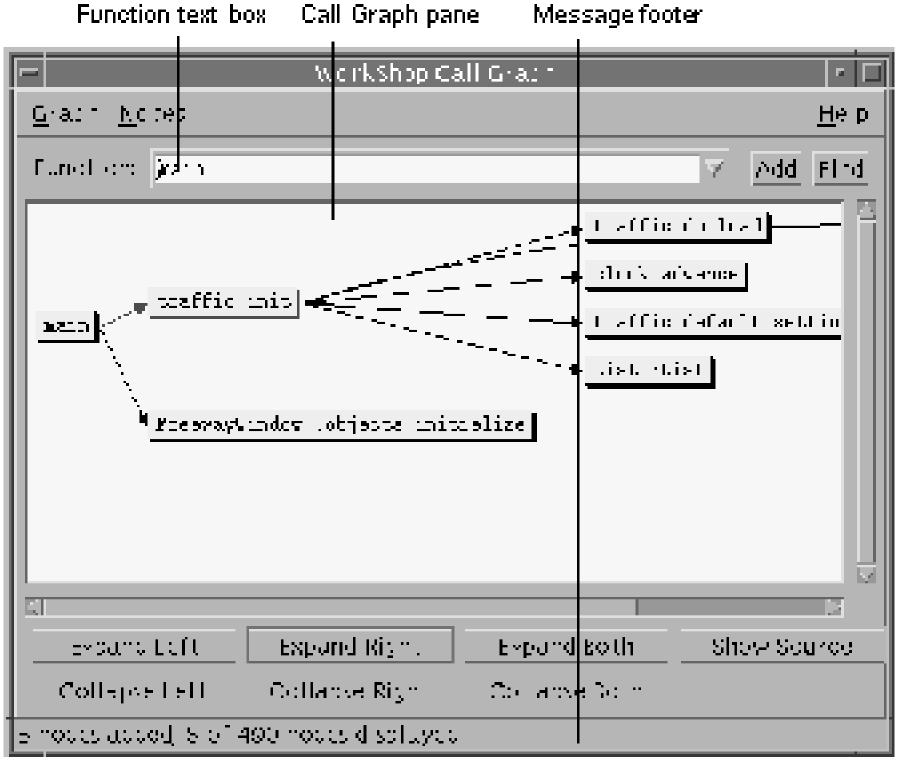


Figure 3–5 Call Graph Window

Graph menu	Provides commands for modifying the graph of the function call.
Nodes menu	Provides commands for modifying the nodes displayed.
Function text box	Allows you to enter the function or subroutine you want to graph. Click the arrow at the end of the Function text box to access the list of functions and subroutines previously graphed.
Add button	Adds a node with the given function to the Call Graph pane.
Find button	Moves the Call Graph pane to show the node for the given function or subroutine.
Call Graph pane	Displays the relationships of functions and subroutines in the source. You can select a single function or subroutine, or multiple functions and subroutines, and reposition them in the Call Graph pane.
Expand Left button	Shows all nodes that directly call the selected node (one level of parents).

Expand Right button	Shows all nodes called directly by the selected function or subroutine (one level of children).
Expand Both button	Shows all nodes directly called by and all nodes that directly call the selected node (one level of parents and children). Double-clicking on a node is equivalent to Expand Both.
Collapse Left button	Hides all nodes that directly call the selected node (one level of parents).
Collapse Right button	Hides all nodes called directly by the selected (one level of children).
Show Source button	Displays the source file containing the selected node in an editor window. Starts an editor if none is running.
Message footer	Reports the number of nodes displayed, the number of nodes added, and the number of nodes not displayed, as well as error messages.

Graphing a Function or Subroutine Call

To graph a function or subroutine:

1. **Click the Source Browsing radio button in the Browsing window.**

2. **Look in the Browsing window title bar to be sure you are in the correct browsing directory.**

   If not, choose Browse > Change Browsing Directory and use the Browsing Directory dialog box to select the directory that contains the source browser database.

3. **Choose Browse > Graph Function Calls, or select a function in the source code or Debugging window and choose Browse > Graph Function Calls.**

4. **Type the name of a function or subroutine in the Function text box and click Add or press Return.**

   If you do not type a function or subroutine name in the text box, the Call Grapher defaults to main.

To display information about the function or subroutine:

- Click a node to select it.
- Click one of the buttons below the Call Graph pane to view the information you want. The footer of the window displays the number of nodes added and the number of nodes displayed out of the number that exist for the current application.

- From the Nodes menu, choose commands for other viewing options such as showing, hiding, expanding, or collapsing nodes (see “Showing or Hiding Nodes” on page 43).
- Display the source of the class by selecting it in the Call Graph pane and choosing Show Source from the Nodes menu.

Note - You can change the display of the Call Graph using the commands on the Graph menu (see “Changing the Look of a Call or Class Graph” on page 43). You can also print the Call Graph, as described in “Printing a Graph” on page 45.

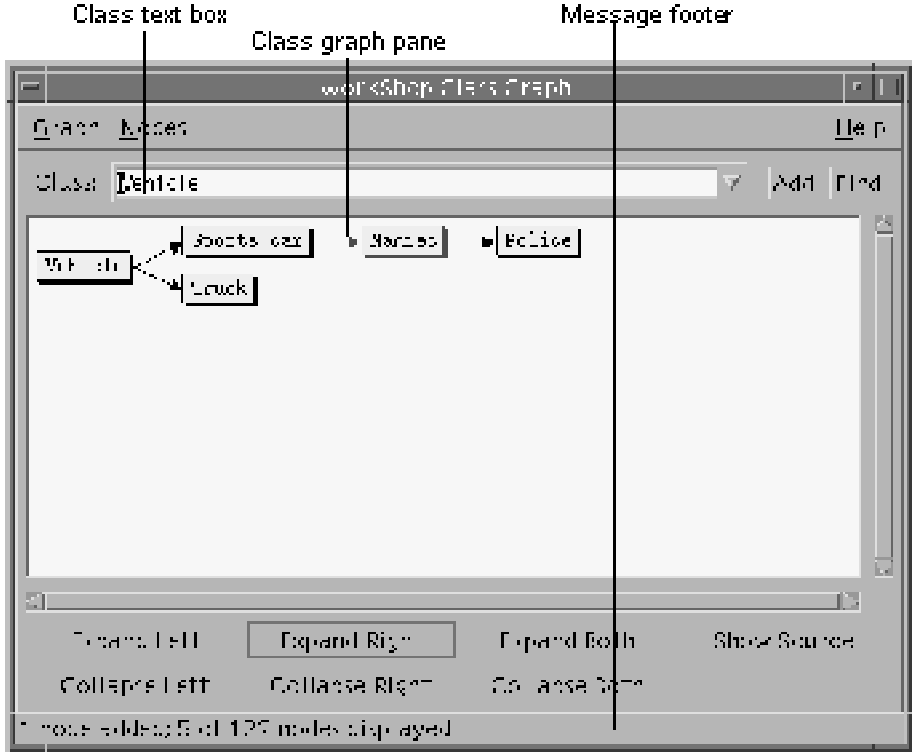
Graphing Classes

Using the Class Grapher, you can graphically inspect the inheritance structure of classes in C++ programs.

Class Graph Window

The Class Graph window provides a graphic representation of class hierarchies. Figure 3–6 shows the Class Graph window.

To change the colors used for node background, graph pane background, node border, node text, and arrows between nodes in the Class Graph window, edit the `WORKSHOP` resource file (see “Call Graph and Class Graph Window Colors” on page 131). Any color changes you make apply to both the Class Graphi and Call Graph windows (see “Call Graph Window” on page 37).



Class: Vehicle

1 node added; 5 of 125 nodes displayed

Figure 3–6 Class Graph Window

Graph menu	Provides commands for modifying the graph of the class hierarchies.
Nodes menu	Provides commands for modifying the nodes displayed.
Class text box	Allows you to enter the class you want to graph. Click the arrow at the end of the Class text box to access the list of classes previously graphed.
Add button	Adds a node with the given class to the Class Graph pane.
Find button	Moves the ClassGraph pane to show the node for the given class.
Class Graph pane	Displays a graphical presentation of class hierarchies.
Expand Left button	Shows all parent classes of the selected class (one level of parents).
Expand Right button	Shows all child classes of the selected class (one level of children).

Expand Both button	Shows all parent and child classes of the selected class (one level of parents and children).
Collapse Left button	Hides all parent classes of the selected class (one level of parents).
Collapse Right button	Hides all child classes of the selected class (one level of children).
Collapse Both button	Hides all parent and child classes of the selected class (one level of parents and children).
Show Source button	Displays the source file containing the selected class in an editor window. Sun WorkShop starts an editor if one is not presently open.
Message footer	Reports the number of nodes displayed, the number of nodes added, and the number of nodes not displayed, as well as error messages.

Graphing a Class Hierarchy

To graph a class hierarchy:

1. **Choose Browse > Graph Classes, or select a class in the source code or Debugging window and choose Browse > Graph Classes.**

2. **Type a class name in the Class text box and click Add Current Class or press Return.**

To display information about a class:

- Click a node to select it.
- Click one of the buttons below the Class Graph pane to display the information you want. The footer of the window displays the number of nodes added and the number of nodes displayed out of the number that exist for the current function.
- From the Nodes menu, choose commands for other viewing options such as showing, hiding, expanding, or collapsing nodes (see “Showing or Hiding Nodes” on page 43).
- Select a node and click Show Source to view the source in the editor window.

Note - You can change the display of the Class Graph window using the commands on the Graph menu (see “Changing the Look of a Call or Class Graph” on page 43). You can also print the class graph, as described in “Printing a Graph” on page 45.

Changing and Printing Graph Displays

The commands in the Graph and Nodes menus of the two grapher windows allow you to magnify or shrink the graph; expand, collapse, show, or hide nodes; and print the graph.

Changing the Look of a Call or Class Graph

You can change the magnification and rearrange the layout of your nodes to vary your view of the graph. If you want to get a birds-eye view of a graph, you can shrink it. You can also fit the entire graph into the window.

To enlarge the graph, choose Graph > Magnify. Use the scrollbars to view the entire display or resize the window. You can incrementally enlarge the graph with the Magnify command.

To reduce the graph, choose Graph > Shrink. You can shrink the graph until it is reduced to a dot on the pane. Reset it to a readable size with the Reset Magnification command.

To see the entire graph, choose Graph > Fit to Window. The graph shrinks or enlarges to fit within the pane. If you resize the window, choosing Fit to Window will resize the graph to fit within the new size of the pane.

To reset the magnification, choose Graph > Reset Magnification. If you changed the size of the graph, use this command to reset the display to its original size. You might have to use the scrollbars to find the location of the graph in the pane.

Showing or Hiding Nodes

You can simplify a complicated graph by showing only relevant nodes and hiding the rest of the nodes in the background. You can view just nodes that have nodes connected to them, or those with connected nodes in only one direction.

Expanding Nodes

Nodes that are expandable appear with a thicker box border. Double-clicking these nodes displays the child and parent nodes (do the same thing by choosing Expand Both).

To expand nodes:

1. **Select one or more nodes by holding down the Shift key and clicking on each node.**

2. **From the Nodes menu, choose one of the Expand commands, or double-click on the node to expand a single node in both directions.**

Showing Nodes

To show all nodes in the database, choose Nodes > Show All.

To restore a previous node:

1. **Click the arrow button at the end of the Function or Class text box to open the history list.**

2. **Click the desired function name or class name to return the node to the pane.**

   Only the original nodes for the selected item are redisplayed in the pane. The relationship of the chosen node to other nodes must be reconstructed.

Hiding Nodes

To hide nodes, choose one of the following commands from the Nodes menu:

Hide Selected	Hides the selected nodes from view.
Hide Non-Selected	Hides all nodes but selected nodes from view
Hide Unconnected	Hides all nodes that do not have connections to another node. You don"t have to select a node to use this command.

To clear all nodes from the pane, choose Nodes > Clear All.

Changing the Node Layout

You can set default options to:

- Display the nodes vertically instead of using the horizontal default.
- Change the lines connecting the nodes to arrows to exemplify the directional flow from one node to another.
- Display function names in short or long form. The long form shows the function name and its argument-type signature. For example:

Short form	`handler_load_save`
Long form	`handler_load_save(unsigned long, inputevent)`

To change the layout of the nodes:

1. **Choose Graph > Options.**

2. **Choose from among the following:**

Graph Layout	Select horizontal or vertical
Use Arrowheads	Select yes or no
Function Names	Select short or long (Call Grapher only)

3. **Click OK.**

To reset the layout, choose Graph > Reset Layout. All nodes return to their original positions in the graph. You can select nodes and drag them to other positions in the pane.

To select multiple nodes in the graph, hold down the Shift key and click each additional node.

Printing a Graph

You can print the graph display from either the Call Graph or Class Graph window.

To print the graph:

1. **Choose Graph > Print to open the Print Graph dialog box.**

2. **Type the number of copies and select the print parameters.**

3. **Type the name of the printer or the name of a file to which to print.**

4. **Click OK.**

Browsing Classes

Using the Class Browser, you can:

- Browse a class—Show the class list and data function members. View class interfaces and relationships.
- Examine class relationships—Select a class and examine its base, derived, and friend classes. Browse classes, structs, and unions referenced in the current class.
- Graph a class—Graph the class hierarchy of a class selected in the Class Browser window.
- Show the source of a class—Show the source of a particular class in an editor window.

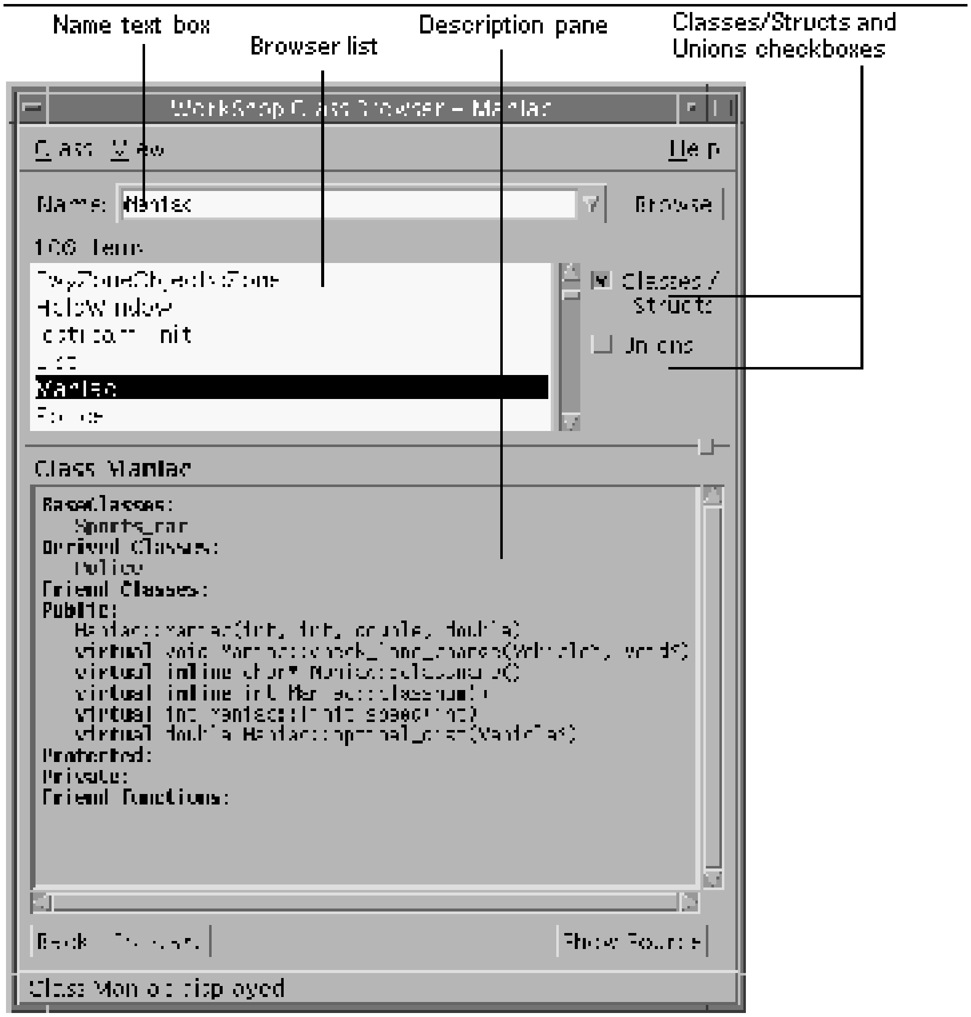
Class Types that Can Be Examined

When you open the Class Browser window (see Figure 3–7), the Browser list contains all classes of the type `Class` or `Struct` in the current source browser database.

Using the two checkboxes to the right of the Browser list, you can show all types, just the classes and structs, or just the Unions.

Class Browser Window

You can view information about classes and their member and friend functions in the Class Browser window. By navigating through the classes in the source code and libraries, you can understand how the classes were defined and used. Figure 3–7 shows the Class Browser window.



```
BaseClasses:
   Sports_car
Derived Classes:
   Police
Friend Classes:
Public:
   Maniac::maniac(int, int, double, double)
   virtual void Maniac::check_lane_change(Vehicle*, word*)
   virtual inline char* Maniac::classname()
   virtual inline int Maniac::classnum()
   virtual int Maniac::limit_speed(int)
   virtual double Maniac::optimal_dist(Vehicle*)
Protected:
Private:
Friend Functions:
```

Class Maniac displayed

Figure 3–7 Class Browser Window

Class menu	Provides commands for opening another Class Browser window, displaying the source for a selected class, and closing the Class Browser window.
View menu	Provides a list of member and friend functions to examine.
Name text box	Allows you to enter the name of the class, struct, or union to examine. Click the arrow at the end of the text box to access a list of previously entered items.

Browse button	Displays information about the selected class in the Description pane.
Browser list	Displays all of the class types you can examine. Click a class in the list to select it and the class name appears in the Name text box. The Classes / Structs and Unions checkboxes determine the class types shown.
Classes / Structs checkbox	Shows user-definable types, and any class declared with the class-key struct, in the Browser list. All C and C++ style structs are listed. Its members and base classes are public by default.
Unions checkbox	Shows classes declared with the class-key union in the Browser list; it can contain objects of different types at different times. All C and C++ style unions are listed.
Description pane	Displays information about the given language element.
Back button	Displays information about the class you selected before the currently displayed class.
Forward button	Displays information about the class you selected after the currently displayed class.
Message footer	Displays messages about operations in the Class Browser window.

Browsing a Class

To browse a class, do the following:

1. **Choose Browse > Browse Classes, or select a class in the source code or Debugging window and choose Browse > Browse Classes.**

2. **Type the name of a class in the Name text box, or select a class from the Browser list. Click the Classes/Structs and Unions checkboxes to filter the classes and data function members listed, and click Browse.**

To view information about the class, click an underlined base or derived class in the Description pane. Use the Back and Forward buttons to redisplay information about about the class you selected before or after the currently displayed class, respectively.

To view the source in the editor window, select a line (or a portion of a line) containing a data member or friend function in the Description pane and click Show Source.

Browsing Classes in Multiple Windows

Opening multiple browsing windows can help you examine and compare several classes at a time. Any Class Browser windows opened in the same browsing session share the same class list but do not share properties or class histories.

To open a new Class Browser window, do one of the following:

1. **From the Class Browser, choose Class > Browse in New Window.**

1. **From the Class Grapher, select a class node and choose View > Show in Class Browser.**

1. **From the Browsing window, turn on Source Browsing and choose Browse > Browse Classes.**

Relationship of Browsers and Graphers

Figure 3–8 shows how the Browsing window, the Call Graph window, the Class Graph window, and the Class Browser window interrelate.

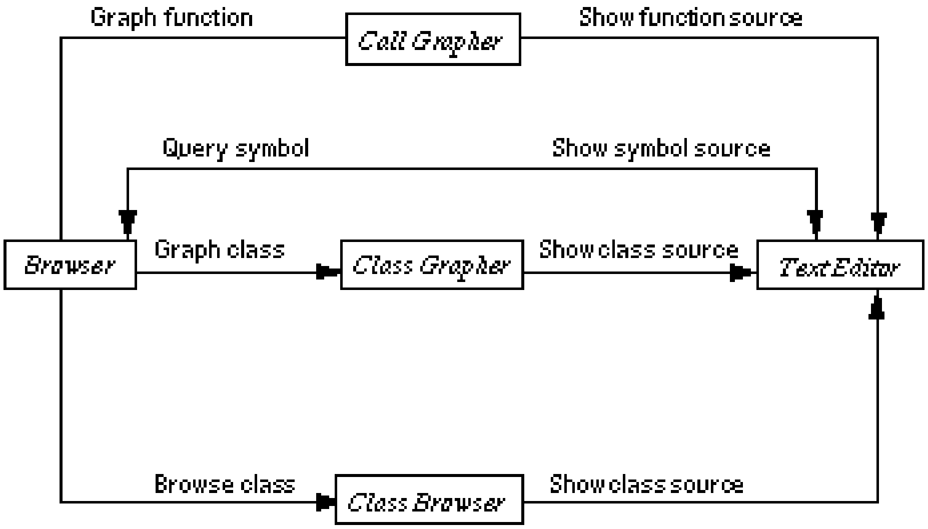


Figure 3–8 How Browsing, the Graphers, and the Class Browser Interrelate

Exiting Browsing

To quit the current browsing process and close all browsing windows, choose Browse > Exit Browsing in the Browsing window.

If you want to close the Browsing windows without killing the current browse process, choose Browse > Close.

CHAPTER 4

Building Programs in Sun Workshop

Sun WorkShop provides you with the ability to run one build job at a time or several build jobs concurrently. This chapter shows you how to quickly build a single application, how to customize a build, and how to fix build errors using the Building window and the Sun WorkShop editor of your choice.

This chapter is organized into the following sections:

Building a Sun WorkShop Target

When you build a program in Sun WorkShop, you are actually building a *WorkShop target*, which is an object derived from the following:

- *Build directory*—The directory from which the build process is invoked and also the default directory for the makefile.
- *Build command*—The command that invokes the `make` utility, which reads the makefile and builds the make targets.

- *Makefile*—A file that contains entries that describe how to bring a make target up to date with respect to those files on which it depends (called *dependencies*). Since each dependency is a make target, it may have dependencies of its own. Targets and file dependencies and subdependencies form a tree structure that `make` traces when deciding whether or not to rebuild a make target.
- *Make target*—An object that `make` knows how to build from the directions (rules) contained in a particular makefile. For example, a make target could be all or clean. Makefiles are generally designed so that the default target (the one you get when you do not specify a target) is the most commonly built target.

When a WorkShop target is built, it is added to the list of WorkShop targets in the Build menu and in the Edit Target command. When you begin a build, Sun WorkShop looks for the first target in the WorkShop target list and builds it.

For information on the `make` utility, makefiles, and make targets, see Appendix B."

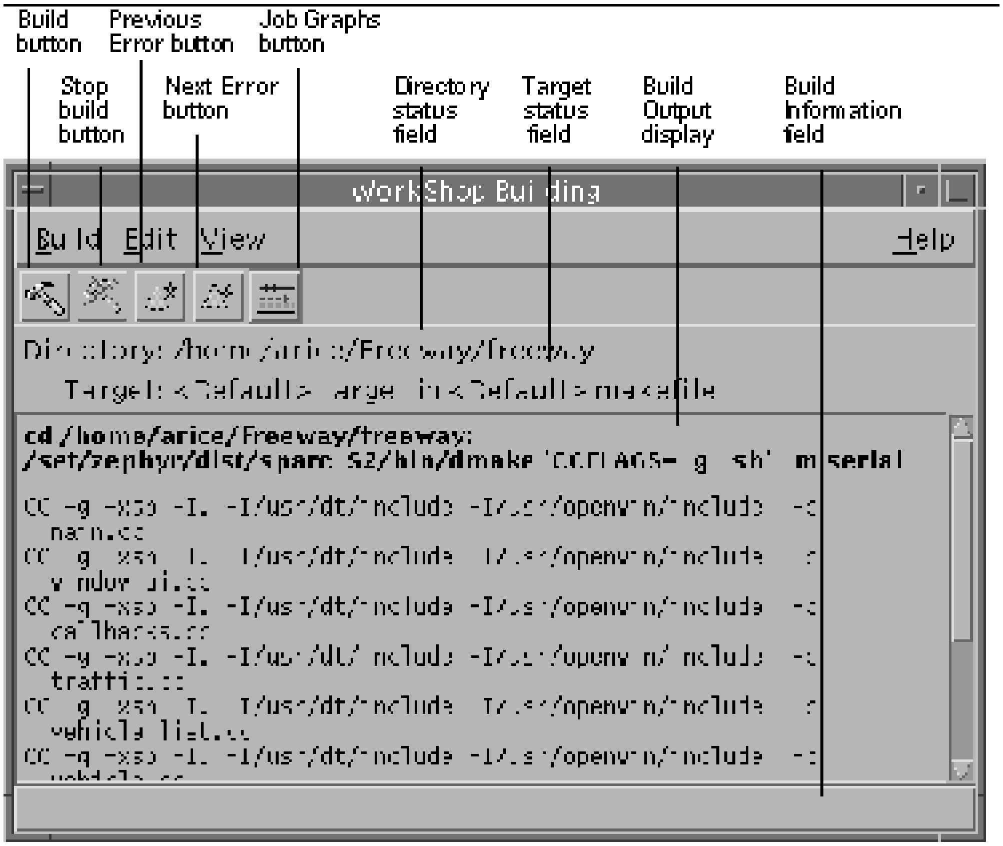
Building Window

The Building window displays information on program compilation. You can open the window by choosing Build > Show Build Window in the Sun WorkShop main window or by starting a build operation.

From the Building window, you can:

- Stop a build in progress
- Edit build parameters
- Save the build output to another file
- View build errors

Figure 4–1 shows the Building window.



Directory: /home/arice/Freeway/freeway

Target: <Default> target in <Default> makefile

```
cd /home/arice/Freeway/freeway;
/set/zephyr/dist/sparc_S2/bin/dmake 'CCFLAGS=-g -sb' -m serial

CC -g -xsb -I. -I/usr/dt/include -I/usr/openwin/include -c
  main.cc
CC -g -xsb -I. -I/usr/dt/include -I/usr/openwin/include -c
  window_ui.cc
CC -g -xsb -I. -I/usr/dt/include -I/usr/openwin/include -c
  callbacks.cc
CC -g -xsb -I. -I/usr/dt/include -I/usr/openwin/include -c
  traffic.cc
CC -g -xsb -I. -I/usr/dt/include -I/usr/openwin/include -c
  vehicle_list.cc
CC -g -xsb -I. -I/usr/dt/include -I/usr/openwin/include -c
  vehicle.cc
```

Figure 4–1 Building Window

Build menu	Provides commands for common build operations
Edit menu	Provides commands to accumulate data and to clear the Build Output Display pane
View menu	Provides commands for navigating build errors in the Build Output Display pane and for viewing information on multiple build processes when running a distributed make
Build button	Begins a build of the current WorkShop target
Stop Build button	Stops the current build in progress
Previous Error button	Moves the cursor to the previous build error in the Build Output Display pane and shows that error location in the text editor

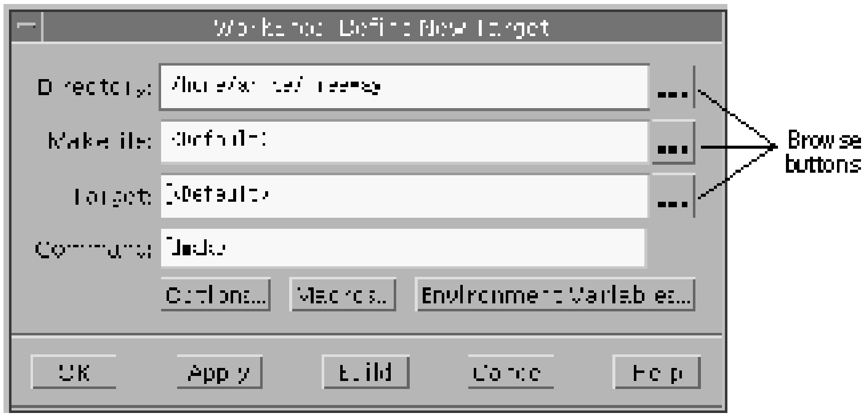
Next Error button	Moves the cursor to the next build error in the Build Output Display pane and shows that error location in the text editor
Dmake Jobs Graph button	Opens the Dmake Jobs Graph window
Directory status field	Displays the path name of the current build directory
Target status field	Displays the name of the current make target
Build Output Display pane	Displays output for the current build operation
Build Information field	Displays information about the current build

Building a Program

You can begin a build without having to specify a build command, makefile, or target. Or you can specify one or all of these. You can also customize a build by specifying make options, specifying a build mode, overriding makefile macros, or editing environment variables (see "Customizing a Build" on page 59).

Define New Target and Edit Target Dialog Boxes

You specify build parameters using the Define New Target and Edit Target dialog boxes, which are basically identical. You use the Define New Target dialog box to specify a new WorkShop target and the Edit Target dialog box to modify an existing WorkShop target. Figure 4–2 shows the Define New Target dialog box.



Directory: [illegible]

Makefile: <Default>

Target: <Default>

Command: dmake

Figure 4–2 Define New Target Dialog Box

Directory text box	Lets you type a build directory path. You can also select a directory by clicking on the browse button.
Makefile text box	Lets you specify a makefile (the default file name is `makefile` or `Makefile`. You can also select a makefile by clicking on the browse button.
Target text box	Lets you specify a make target. You can also select a target by clicking on the browse button.
Browse (..) buttons	Let you display dialog boxes in which you can choose a build directory, makefile, or make target
Command text box	Lets you type a `make` command; the default command is `dmake` (described in "Running a Distributed Build" on page 73).
Options button	Opens the Make Options dialog box (see "Specifying Make Options" on page 60). The Make Options dialog box allows you to modify the parameters of a build using the options provided.
Macros button	Opens the Make Macros dialog box (see "Using Makefile Macros" on page 64), which allows you to add, change, or delete macros to be passed into the build.
Environment Variables button	Opens the Environment Variables dialog box (see "Using Environment Variables" on page 67), which allows you to add, change, or delete environment variables to be passed into the build.

OK button	Applies the build parameters and closes the dialog box.
Apply button	Applies the build parameters.
Build button	Applies the build parameters and builds the target.
Cancel button	Closes the dialog box without applying changes.
Help button	Displays online help for the dialog box.

Building With Default Values

You can begin a build without having to specify a build command, makefile, or target. Sun WorkShop provides a default makefile name (`makefile`), a default make target, and a default make command, `dmake` (see “Running a Distributed Build” on page 73). All you need to supply is the path name for the build directory.

Default Makefile and Make Target

The Define New Target dialog box contains the value `Default` in the Makefile and Target text boxes. If you do not specify a particular makefile or make target, Sun WorkShop looks for a file named `makefile` in the build directory and uses the first make target in that makefile. However, if make finds an SCCS history file (`s.makefile`) that is newer than the file named `makefile`, Sun WorkShop uses the most recent version of `s.makefile`. If `makefile` does not exist, Sun WorkShop searches for a file named `Makefile`. Again, if an SCCS history file (`s.Makefile`) exists that is newer than Makefile, Sun WorkShop uses the most recent version of `s.Makefile`.

Using Default Values

To build a program using default build values:

1. **Look in the Directory status field in the Building window to be sure you have the correct build directory set.**

2. **If the current build directory is correct, click the Build button, choose Build > Build in the Sun WorkShop main window or the Building window, or select a WorkShop target from the list at the bottom of the Build menu in either window.**

3. **If no build directory is displayed in the Directory status field or you want to change build directories, choose Build > New Target to open the Define New Target dialog box. Type the build path in the Directory text box.**

You can also click the browse button to open a directory chooser. Choose a directory in the list and click OK to load it into the Directory text box. Then click Build at the bottom of the dialog box.

The build output is displayed in the Build Output display pane in the Building window. Click the Stop Build button in the Building window or choose Build > Stop Build to stop the build process.

Note - The next time you open the Building window, the build directory is set to the last directory in which you ran a build job. You can see the path name in the Directory status field.

Building With Nondefault Values

If you have a makefile with a unique name, a certain make target, or a specific build command, specify it in the Define New Target dialog box or Edit Target dialog box by clicking on the appropriate browse button (see Figure 4–2). Each browse button displays a dialog box.

1. **Type the name of the directory in which you want to build and click Apply to apply the change.**

   You can also select another directory from the Set Build Directory dialog box. If you have not specified a build directory, Sun WorkShop either tries to build in the directory currently displayed in the build directory field or, if no directory is displayed, displays an error message pop-up window.

2. **Type the name of the makefile you want in the Makefile text box.**

   If you want to choose another makefile from the current build directory, type the name of the makefile in the Makefile text box, or choose a makefile from the list in the Set Makefile dialog box, and click OK.

   You can run your build in a directory that is different from the one the makefile is in. Just specify the full path name of the makefile in the Makefile text box.

3. **Type the name of the make target you want in the Target text box.**

   Type the name of the make target in the Target text box, or choose another make target in the current makefile in the Target Chooser dialog box, and click OK.

4. **Type the name of the build command you want in the Command text box.**

   If the build command you specify is something other than `make` or `dmake`, you can specify the command and any of its arguments in the Command text box. The build command is formed by prepending `setenv` commands for any environment variables specified through the Environment Variables dialog box and by appending any of the make options specified through the Make Options and Make Macros dialog boxes.

Note - If the path to the build command is not in your PATH environment variable, you might have to specify the full command path.

---

5. **Click Build in the dialog box to start a build with the settings you supplied.**

The build output is displayed in the Build Output display pane in the Building window. Click the Stop Build button in the Building window or choose Build > Stop Build to stop the build process.

Collecting Build Output

Build output is cleared from the Build Output display pane each time you run a build job. You can keep the build output from previous builds by setting the Accumulate Output switch to on.

To collect build output, choose Edit > Accumulate Output.

The Accumulate Output command toggles the switch on and off. When a build is performed, output for that build is displayed below the output for the previous build. You can scroll through the pane to see the output for each build. To identify specific build jobs, each build output begins with the build path and the name of the build target.

To clear the build output log, choose Edit > Clear Results.

Saving Build Output

You can maintain a history of build output information for one or more build jobs by saving the output to a file.

To save build output:

1. **Choose Build > Save Output As.**

2. **Choose or create a file in which to save the output using the Save Build Output dialog box.**

The build output log is saved as a text file.

Modifying a WorkShop Target

To edit an existing WorkShop target, choose Build > Edit Target and choose a WorkShop target from the list. The Edit Target dialog box opens, displaying the current settings for the build directory, makefile, make target, and build command. Edit any of these fields, as described in “Building With Nondefault Values” on page 57. Click Build to rebuild the WorkShop target with your new settings.

Removing a WorkShop Target

You can remove targets from the WorkShop target list and the Edit Target list in the Build menu.

To remove a target:

1. **Choose Build > Remove targets from menu in either the Sun WorkShop main window or the Building window.**

2. **Select one or more targets from the list in the Remove targets from menu dialog box.**

   Hold down the Control key and click to select more than one target name.

3. **Click OK.**

Customizing a Build

You can customize a build by changing make options, specifying a build mode, using makefile macros, or using environment variables. To customize a build, choose Build > Edit Target and choose a WorkShop target from the list. The Edit Target dialog box opens. After making your changes, click Build to rebuild the WorkShop target with your new settings.

Specifying Make Options

You can specify make options using the Options dialog box, shown in Figure 4–3.

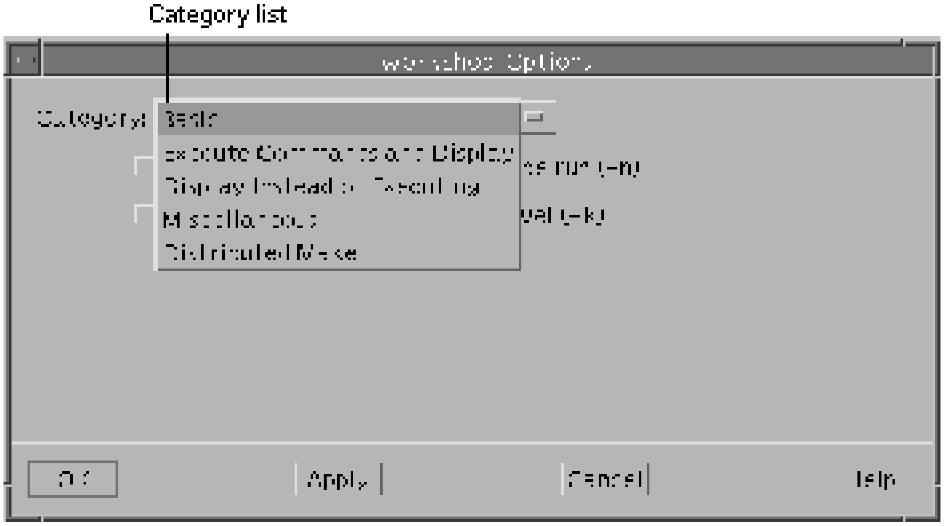


Figure 4–3 Options Dialog Box

Category list	Allows you to select a category of make options.
OK button	Applies the changes and closes the dialog box
Apply button	Applies the changes but leaves the dialog box open
Cancel button	Closes the dialog box without applying changes
Help button	Displays online help for the dialog box

Table 4–1 describes the make options you can set using the dialog box.

TABLE 4–1 Options That You Can Set in the Options Dialog Box

Category	Option
Basic	Echo command lines but do not execute them (-n)
	When an error occurs, continue with dependency branches that do not depend on the target (-k).
Execute Commands and Display	Display reasons why make chooses to rebuild a target; make displays any and all dependencies that are newer. The make displays options are also read in from the MAKEFLAGS environment variable (-d).
	Display detailed information on the dependency check and processing (-ss).
	Display the text of the makefiles read in (-D).
	Display the text of the makefiles, make.rules file, the state file, and all hidden-dependency reports (-DD).
	Silent mode. Do not echo command lines before executing them. Equivalent to the special-function target .SILENT: (-s).
Display instead of executing	Print the complete set of macro definitions and target descriptions (-p).
	Report dependencies only, do not build them (-P).
	Question mode. make returns a zero or nonzero status code depending on whether or not the target file is up to date (-q).
Miscellaneous	Touch the target files (making them appear up to date) instead of performing their rules. This procedure 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 (-t).
	Do not use the default rules in the default makefile /usr/share/lib/make/make.rules (-r).
	Let environment variables override macro definitions within makefiles (-e).
	Ignore error codes returned by commands. Equivalent to the special-function target .IGNORE: (-i).
Distributed Make	Mode: Choose the type of make process to run: serial, parallel, or distributed (see "Specifying a Build Mode" on page 62) (-m).

TABLE 4–1 Options That You Can Set in the Options Dialog Box *(continued)*

Category	Option
	Maximum jobs: Specify the maximum numbers of jobs that are distributed to the build servers (`-j`).
	Runtime configuration file: Specify a runtime configuration file.
	Build server group: Specify the name of the server group to which jobs are distributed.
	Temporary output directory: Specify the name of the directory to which temporary output is to be written.

To specify a make option:

1. **Click Options to open the Options dialog box.**
2. **Select the options you want from the Options dialog box.**

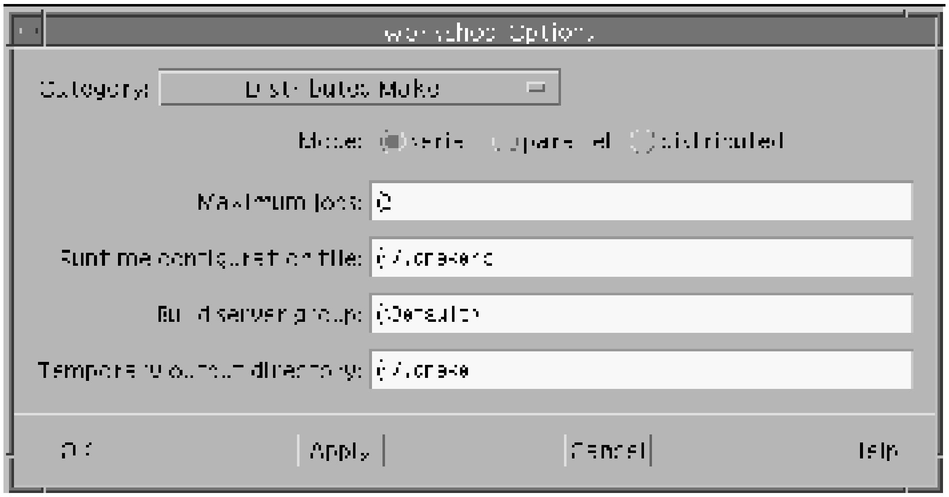
   Click the Category list to select a category of make options. The Options dialog box gives you access to all the options to `make` and `dmake`. For information on the distributed make options, see "Specifying a Build Mode" on page 62."
3. **Click Build to apply the options and start the build.**

You can also specify make options through the Define New Target dialog box available from the New Target command in the Build menu.

Specifying a Build Mode

To change the default build mode of `dmake` from serial to parallel or distributed::

1. **Click Options to open the Options dialog box.**
2. **Select the Distributed Make category from the Category list.**
3. **Click the build mode you want and fill in any required text boxes in the Options dialog box, as shown in Figure 4–4.**
4. **Click Build to set the options and start the build.**



Category: Distributed Make

Mode: ● serial ○ parallel ○ distributed

Maximum jobs: 2

Runtime configuration file: ~/.dmakerc

Build server group: (Default)

Temporary output directory: ~/.dmake

Figure 4–4 Options Dialog Box for Build Mode

Serial Mode

To build in serial mode, you simply click the serial radio button. There are no text boxes for you to fill in.

Parallel Mode

To build in parallel mode, click the parallel radio button. Then specify the maximum number of build jobs to be run in the Maximum jobs text box. If you do not specify a maximum number of jobs, dmake uses two as the default.

Distributed Mode

To build in distributed mode, click the distributed radio button. Then specify the maximum number of build jobs to be run in the Maximum jobs text box. If you do not specify a maximum number of jobs, dmake uses the sum of the jobs specified for the servers in the group.

If you choose not to use the default name and location provided in the Runtime configuration file text box, type the name or path of your .dmakerc file (see ".dmakerc File" on page 74) in this text box.

If you do not type the name of a group in the Build server group text box, dmake uses the first group listed in the .dmakerc file. When running in distributed mode, dmake distributes jobs to the following groups in order of precedence):

1. The group specified on the command line as an argument to the `-g` option
2. The group specified by the `DMAKE_GROUP` makefile macro
3. The group specified by the `DMAKE_GROUP` environment variable
4. The first group specified in the runtime configuration file

If you do not choose to use the default name and location provided in the Temporary output directory text box, type the name of an output directory in this field.

For more information on distributed builds, see "Running a Distributed Build" on page 73.

Using Makefile Macros

Makefile macros let you refer conveniently to files or command options that appear more than once in the description file. (For information on defining macros, see Appendix B.)

Using the Make Macros dialog box (see Figure 4–5), you can add makefile macros to or delete them from the Persistent Build Macros list in your WorkShop target, and then reassign values for makefile macros in the list. You can also add macros currently defined in the makefile to the list and override their values.

All macros in the Persistent Build Macros list are saved with your WorkSet.

To open the Make Macros dialog box, click Macros in the Edit Target dialog box.

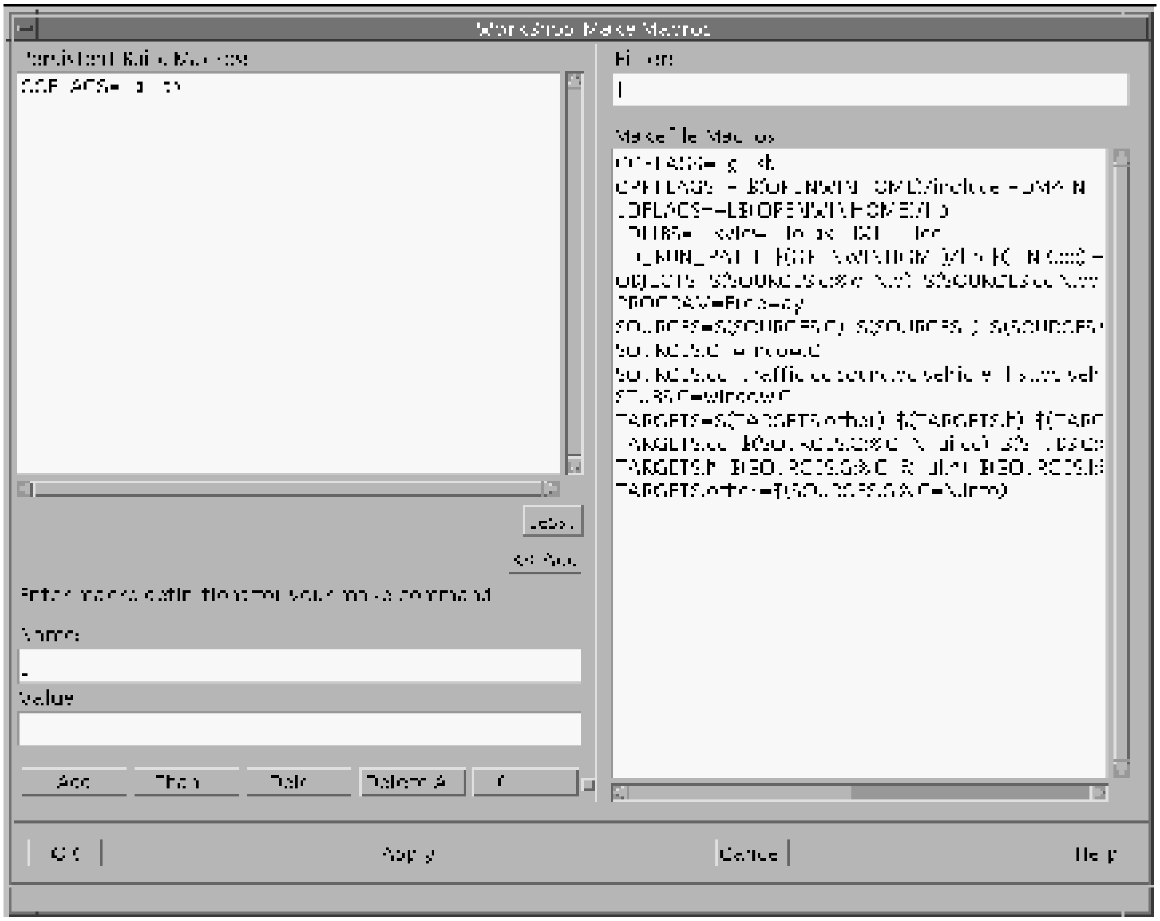


Figure 4–5 Make Macros Dialog Box

Persistent Build Macros pane	Lists macros that will be saved with your WorkSet
More/Less button	More opens the Filter text box and Makefile Macros list pane; the button toggles to Less, which closes the pane
<<Add button	Lets you add a macro in the Makefile Mactros list to the Persistent Build Macros list
Name text box	Lets you assign a name to a new macro or change the name of the selected macro on the Persistent Build Macros list
Value text box	Lets you assign a value to the macro named in the Name text box
Add button	Adds the macro defined in the Name and Value text boxes to the Persistent Build Macros list

Change button	Applies the values in the Name and Value text boxes to the selected macro on the Persistent Build Macros list
Delete button	Deletes the selected macro on the Persistent Build Macros list
Delete All button	Deletes all macros on the Persistent Build Macros list
Clear button	Clears the Name and Value text boxes
Filter text box	Lets you type a search pattern to filter the Makefile Macros list
Makefile Macros list	Lists the macros defined in the makefile in the current WorkSet
OK button	Applies the changes and closes the dialog box
Apply button	Applies the changes but leaves the dialog box open
Cancel button	Closes the dialog box without applying changes
Help button	Displays online help for the dialog box

Adding a Macro

To add a macro to the Persistent Build Macros list:

1. **Type the name of a macro in the Name text box.**

2. **Type a value for the macro in the Value text box.**

   If you make a mistake, click Clear to remove entries in the Name and Value text boxes.

3. **Click Add to add the new macro to the list.**

4. **Repeat the previous three steps to add other macros.**

5. **Click OK to close the dialog box.**

Deleting a Macro

To delete a macro from the Persistent Build Macros list:

1. **Select a macro in the list.**

2. **Click Delete (Delete All removes all macros in the list).**

3. **Click OK to establish the change and close the dialog box.**

Changing a Macro

To change the value of a macro in the Persistent Build Macros list::

1. **Select a macro in the list.**

2. **Type a new value in the Value text box and click Change.**

3. **Click OK to establish the change and close the dialog box.**

4. **Click Build in the Edit Target dialog box to start the build with the new values.**

Reviewing and Overriding Makefile Macros

A macro definition that appears in the Persistent Build Macros list overrides any macro with the same name that appears in the makefile.

To review the current macro definitions, click More to open the Makefile Macros list, which displays all the macros that are defined in the makefile associated with the build target. You can filter the list using the Filter text box.

To override the value of a makefile macro:

1. **Select a macro in the Makefile Macros list.**

2. **Click <<Add to add the macro to the Persistent Build Macros list.**

3. **Type a new value in the Value text box and click Change.**

4. **Click OK to establish the change and close the dialog box.**

   The macro definition in the Persistent Build Macros list overrides the macro definition in the makefile, and is saved with your WorkSet.

5. **Click Build in the Edit Target dialog box to start the build with the new values.**

Using Environment Variables

You can specify environment variables for your build. When you start the build, `setenv` commands for these environment variables are prepended to the build command.

Using the Environment Variables dialog box, you can add environment variables to or delete them from the Persistent Environment Variables list in your WorkShop target, and reassign values for environment variables in the list.

All macros in the Persistent Environment Variables list are saved with your WorkSet.

Note - The Persistent Environment Variables list for building your program is not the same as the Persistent Environment Variables list for running your program described in "Setting Environment Variables" on page 90.

To open the Environment Variables dialog box, click Environment Variables in the Edit Target dialog box.

Adding an Environment Variable

To add an environment variable to the Persistent Environment Variables list::

1. **Type the name of an environment variable in the Name text box.**

2. **Type a value for the variable in the Value text box.**

   If you make a mistake, click Clear to remove entries in the Name and Value text boxes.

3. **Click Add to add the environment variable to the Persistent Environment Variables list.**

4. **Repeat the previous three steps to add other environment variables.**

5. **Click OK to close the dialog box.**

Deleting an Environment Variable

To delete a variable from the Persistent Environment Variables list:

1. **Select a variable from the list.**

2. **Click Delete (Delete All removes all environment variables in the list).**

3. **Click OK to establish the change and close the dialog box.**

Changing the Value of an Environment Variable

To change the value of an environment variable in the Persistent Environment Variables list:

1. **Select an environment variable in the list.**

2. **Type a new value in the Value text box and click Change.**

3. **Click OK to establish the change and close the dialog box.**

4. **Click Build to start the build with the new build environment.**

Reviewing and Overriding Environment Variables

An environment variable definition that appears in the Persistent Environment Variables list overrides any environment variable with the same name that appears in the current WorkShop process environment.

To review the current WorkShop process environment variable definitions, click More to open the Current Environment list, which includes all the environment variables that are currently defined in the WorkShop process environment. You can filter the list using the Filter text box.

To override the value of an environment variable:

1. **Select an environment variable in the Current Environment list.**

2. **Click <<Add to add the environment variable to the Persistent Environment Variables list.**

3. **Type a new value in the Value text box and click Change.**

4. **Click OK to establish the change and close the dialog box.**

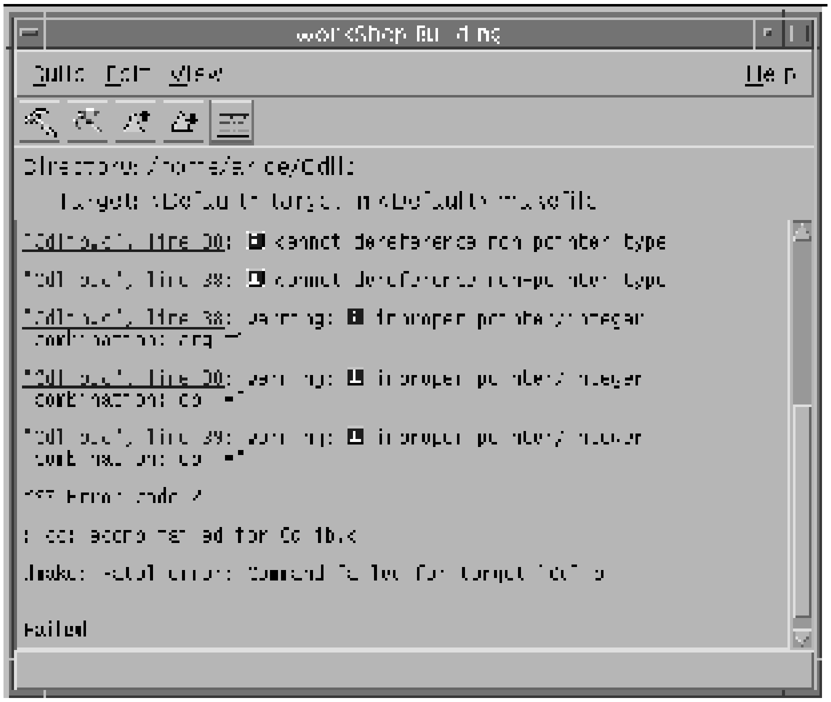
   The environment variable definition in the Persistent Environment Variables list overrides the environment variable definition in the current WorkShop process environment, and is saved with your WorkSet.

5. **Click Build in the Edit Target dialog box to start the build with the new values.**

Fixing Build Errors

The process of fixing build errors is simplified by the integration of the text editor with the build process. When a build fails, the build errors are displayed in the Build Output display pane of the Building window, as shown in Figure 4–6. Build errors that have links to the source files containing the errors are highlighted and underscored. Unrecognized errors are displayed with the rest of the build output without highlighting or underscoring.

Note - Do not run a build job and a fix (recompilation of edited source files) concurrently. The output for both jobs intermingles in the Build Output display pane in the Building window. It can be difficult to discern the output of one job from the other.



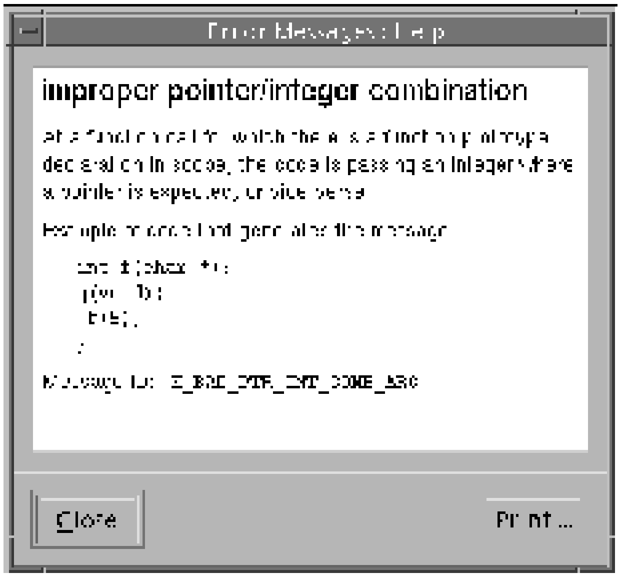
```
Directory: /home/[illegible]ce/Cdlib:
   Target: <Default target in <Default> makefile>
"cdlib.c", line 30: ℹ cannot dereference non-pointer type
"cdlib.c", line 38: ℹ cannot dereference non-pointer type
"cdlib.c", line 38: warning: ℹ improper pointer/integer
 combination: arg #1
"cdlib.c", line 30: warning: ℹ improper pointer/integer
 combination: op "="
"cdlib.c", line 39: warning: ℹ improper pointer/integer
 combination: op "="
*** Error code 2
: cc: acomp failed for Cdlib.c
dmake: Fatal error: Command failed for target `cdlib.o'

Failed
```

Figure 4–6 Build Errors in the Build Output Display Pane

Each error line gives the name of the file containing the error, the line number on which the error occurs, and the error message.

Error messages issued by the C compiler include an additional glyph (ℹ) in the build error message. Clicking on the glyph opens a pop-up window that defines the associated error message.



improper pointer/integer combination

At a function call for which there is a function prototype declaration in scope, the code is passing an integer where a pointer is expected, or vice versa.

Example of code that generates this message:

```
    int f(char *);
    g(void){
     f(5);
    }
```

Message ID: E_BAD_PTR_INT_COMB_ARG

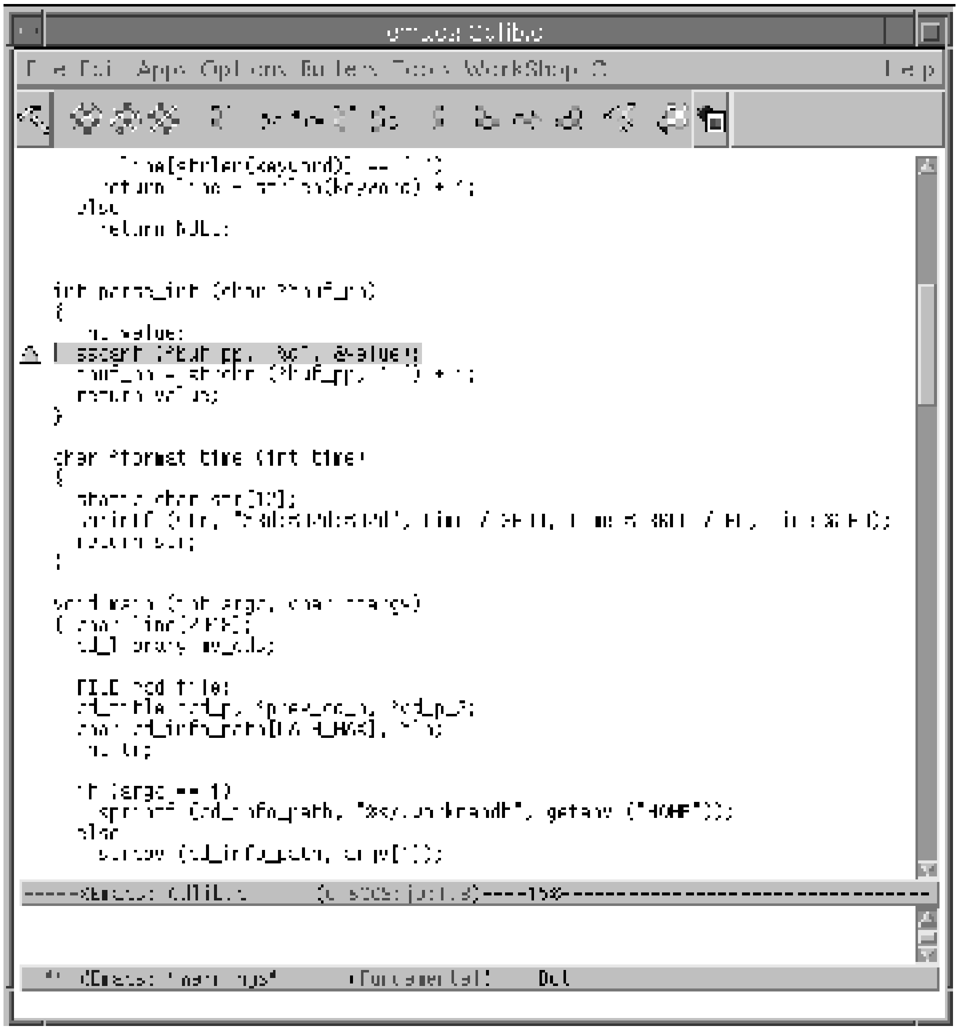
Figure 4–7 Error Message Pop-up Window

Note - Only Sun compilers produce output that can be converted to hypertext links. If you use a build command that does not call Sun compilers, you will not have links to the source files from the build errors listed in the Building window.

Displaying the Source of an Error

Clicking on the underscored error immediately starts a text editor that displays the source file containing the error. The source file is shown with the error line highlighted and an error glyph appears to the left of the line (see Figure 4–8).

Note - By using the keyboard shortcuts F4 (next error) and Shift+F4 (previous error) to navigate through the build errors, you can keep focus on the text editor window.



```
      line[strlen(keyword)] == ' ')
    return line + strlen(keyword) + 1;
  else
    return NULL;


int parse_int (char **buf_pp)
{
  int value;
  sscanf (*buf_pp, "%d", &value);
  *buf_pp = strchr (*buf_pp, ' ') + 1;
  return value;
}

char *format_time (int time)
{
  static char str[10];
  sprintf (str, "%2d:%02d:%02d", time / 3600, time % 3600 / 60, time % 60);
  return str;
}

void main (int argc, char **argv)
{ char line[256];
  cd_library my_cds;

  FILE *cd_file;
  cd_title *cd_p, *prev_cd_p, *cd_p2;
  char cd_info_path[MAXPATHLEN], *cp;
  int i;

  if (argc == 1)
    sprintf (cd_info_path, "%s/.workmandb", getenv ("HOME"));
  else
    strcpy (cd_info_path, argv[1]);
-----XEmacs: cdlib.c      (C SCCS:[illegible])----15%---------------------------------
**  XEmacs: *Warnings*      (Fundamental)    Bot
```

Figure 4–8 Text Editor Window Displaying Source File With Error

Fixing an Error

The following steps show how you can use the Building window and the text editor to quickly fix build errors:

1. **Click a highlighted error in the Build Output display pane.**

   The editor window opens, displaying the source file containing the error. You do not have to search for the line containing the error—the error line is highlighted in the editor and the cursor is already positioned at the line. The error message is repeated in the footer of the text editor.

2. **In the text editor, make sure the source file can be edited.**

   If the file is under SCCS control, check it out using the appropriate menu commands in the text editor:

   - In the vi editor, choose Version > Checkout.
   - In the XEmacs editor, choose Tools > VC > Check out File *file*.
   - In the GNU Emacs editor, choose Tools > Version Control > Check Out.

3. **Edit the source file containing the error.**

4. **In the Building window, click the Next Error button in the tool bar (or use the keyboard shortcut F4) to go to the location of the next build error in the text editor.**

   As you click Next Error, notice how each successive error in the build output is highlighted and how the corresponding source line in the text editor is also highlighted.

5. **Save the edited file.**

   - In the vi editor, choose File > Save.
   - In the XEmacs editor, choose File > Save *file*.
   - In the GNU Emacs editor, choose Files > Save buffer.

6. **If the file is under SCCS control, check it in using the appropriate menu commands in the text editor:**

   - In the vi editor, choose Version > Checkin.
   - In the XEmacs editor, choose Tools > VC > Check in File *file*.
   - In the GNU Emacs editor, choose Tools > Version Control > Check In.

7. **Click the Build button in the text editor's tool bar to rebuild.**

   You can also build by clicking on the Build button in the Building window's tool bar or using the keyboard shortcut F3.

   You can watch the Build Output display pane to follow the progress of the build.

Running a Distributed Build

Distributed Make (`dmake`) allows you to concurrently distribute the process of building large projects, consisting of many programs, over a number of workstations and, in the case of multiprocessor systems, over multiple CPUs. For a full description of Distributed Make, see Appendix C."

The default Sun WorkShop build command (`dmake`) provides three different build modes:

- *Serial mode* - `dmake` executes one job at a time on the local host (similar to make)
- *Parallel mode* - `dmake` executes multiple jobs concurrently on the local host
- *Distributed mode* - `dmake` executes multiple jobs over several build servers

In distributed mode, you can concurrently distribute over several servers the process of building large projects that consist of many programs. `dmake` parses your makefiles, determines which targets can be built concurrently, and distributes the build for those targets over a number of build servers designated by you.

By default, `dmake` runs in serial mode. You can set it to run in parallel or distributed mode in the Options dialog box (see “Specifying Make Options” on page 60).

Preparing for a Distributed Build

Before running a distributed build for the first time, you must create a configuration file that specifies which machines are to participate as dmake build servers. In addition, before a machine can be used as a build server, it must be configured to allows jobs to be distributed to it.

A build server should be of the same architecture and running the same operating system version as the dmake host. Be default, it is assumed that the path to the dmake executables is the same for the dmake host as it is for the build server. If it is not, you must customize the path attribute for that server (for further details see the `dmake(1)` man page).

`.dmakerc` File

The `.dmakerc` file is a runtime configuration file. You must set up a runtime configuration file to run a distributed build. The file contains groups (lists) of build servers and the number of jobs distributed to each build server. The `dmake` utility searches for this file on the dmake host to know where to distribute jobs. Generally, this file is in your home directory.

You may enclose the names of groups and hosts in the `.dmakerc` file in double quotes. Doing so allows more flexibility with respect to the character sequences that may be part of the group and host names. For example, if the name of a group starts with a digit it should be double-quoted:

```
group "123_sparc"
```

The dmake utility searches for a runtime configuration file in the following locations and in the following order:

- The path name specified on the command line using the -c option
- The path name specified with the DMAKE_RCFILE makefile macro
- The path name specified with the DMAKE_RCFILE environment variable
- $(HOME)&/.dmakerc

If dmake does not find a runtime configuration file, it distributes two jobs to the local host.

For information on setting up a runtime configuration file, see the dmake man page.

The following is a sample of a simple runtime configuration file where jupiter, venus, saturn, mercury, and pluto are listed as build servers:

```
# My machine. This entry causes dmake to distribute to it.
jupiter { jobs = 1 }
venus
# Manager"s machine. She"s usually at meetings.
mercury { jobs = 4 }
pluto
```

The following runtime configuration file contains groups:

```
earth                   { jobs = 2 }
mars                    { jobs = 3 }
group sunos4.x {
               host parasol
                host summer
}
group lab1 {
               host falcon    { jobs = 3 }
                host hawk
                host eagle      { jobs = 3 }
}
group lab2 {
               host heron
               host avocet    { jobs = 3 }
               host stilt     { jobs = 2 }
}
group labs {
               group lab1
                group lab2
}
group sunos5.x
                             group labs
                host jupiter
                host venus      [ jobs = 2 }
                host pluto      { jobs = 3 }
}
```

dmake.conf File

To set up a machine to be used as a build server, you must create a configuration file called /etc/opt/SPROdmake/dmake.conf file on the server's file system.. Without this file, dmake refuses to distribute jobs to that machine.

In the dmake.conf file, you specify the maximum number of jobs (from all users) that can run concurrently on that build server. In addition, you may specify the "nice" priority under which all dmake jobs should run. The following is an example of a dmake.conf file:

```
max_jobs: 8
nice_prio: 5
```

Examining Multiple Build Jobs

If you are running Distributed Make (dmake in any mode), you can use the Jobs Graph window to monitor the progress of the dmake run and to view the state of each build job.

The graph identifies each build server. Build jobs are graphed in clusters per server. The graph shows the length of time each build takes. Each job is indicated in the graph by a line. The appearance of the line indicates whether the build is in progress (series of dots), or whether it completed (solid green), or failed (solid red).

To open the Jobs Graph window from the Building window, click the Jobs Graph button (see Figure 4–1) or choose View > Dmake Jobs Graph.

You can select a segment of one of the jobs in the graph to see its build output in the Selected Job Output display at the bottom of the window.

Exiting Building

To kill the current build process and close all build windows, choose Build > Exit Building in the Building window.

If you want to close the building windows without killing the current build process, choose Build > Close.

CHAPTER **5**

Debugging a Program

Sun WorkShop provides an integrated debugging service that can run a program in a controlled fashion and inspect the state of a stopped program. Sun WorkShop gives you complete control of the dynamic execution of a program, including the collection of performance data.

You can determine where a program crashed, view the values of variables and expressions, set breakpoints in the code, and run and trace a program. In addition, machine-level and other commands are available to help you debug code. You can use standard `dbx` commands in the Dbx Commands window.

This chapter is organized into the following sections:

Debugging Features

When debugging in Sun WorkShop, you have access to an extensive range of event management, process control, and data inspection features that allow you to:

- Run a program in Quick Mode with the debugger in the background, ready to take over processing when a program is about to core dump
- Run, stop, and continue execution

- Set breakpoints at lines or in functions; *trace* program execution line by line across a whole program or within a function; *set watchpoints* to stop or trace a program if a specified value or expression changes or meets some other condition
- Set multiple breakpoints or trace tags in *C*++ code—in all member functions of the same name across a class, or in all members of a specified class
- Save breakpoints for use in subsequent debugging sessions of the same program.
- Single-step through program code one line at a time; step over or into function calls; step up and out of a function call arriving at the line of the calling function line after the call
- Collect runtime performance data for later analysis by the Sampling Collector, Sampling Analyzer, LoopReport, and LockLint utilities
- Use runtime checking to automatically detect memory access errors, memory leaks, and memory block usage
- Look up declarations of identifiers and definitions of types, classes, and templates
- Spot check the value of variables or expressions whenever the program is stopped; monitor variables or expressions for changes over time; examine the call stack; move up and down the call stack; and call functions in the program
- Graphically display program variables including complex structures and arrays, and monitor values during program execution using the data grapher and the Data Display window
- Debug multithreaded programs
- Use the Fix and Continue feature to edit a file, recompile it with the same options, install the new code in the program, and continue
- Support C++ by supporting virtual functions, supporting C++ exceptions, debugging with C++ templates, using function overloading for argument resolution, and using default arguments
- Use an embedded Korn shell for programmability (see “Using the Korn Shell” in *Debugging a Program With dbx* for the differences between ksh-88 and `dbx` command language)
- Use the Program Input/Output window to provide an I/O command interface separate from the `dbx` interaction in the Dbx Commands window
- Follow programs as they fork

Preparing a Program for Debugging

To prepare an application for debugging, compile the application using the `-g` or `-g0` (zero) option, which instructs the compiler to generate debugging information during compilation. For information on how to specify these options in your makefile, see Appendix B” For more detailed information on preparing your program for debugging, see *Debugging a Program With dbx*.

Starting Debugging

You can debug the current program, a program previously run or debugged in Sun WorkShop, or a program that is new to Sun WorkShop (not part of your picklist).

The current program name appears in the Debugging window header. If you just built a target, a program with the same name as the target (if it exists in the current directory) is the current program.

To start debugging a program:

1. **Select a debugging state.**

   Choose Debug > Quick Mode to run a program normally, with the option of switching to debugging at any point. For more information on Quick Mode, see “Quick Mode” on page 109.

   Choose Debug > Debug Mode or click the Debug button in the Sun WorkShop main window to debug the program using the full functionality of the debugger.

2. **Select the program to debug.**

   To start debugging the current program, click the Debug button in the Sun WorkShop main window.

   To start debugging a program other than the current program, do one of the following:

   - To debug a program previously run or debugged in Sun WorkShop, select the program from the picklist in the Sun WorkShop main window or the Debugging window.
   - To debug a program that is not on your picklist, load the new program by choosing Debug > New Program.
   - To attach to another running process, choose Debug > Attach Process.
   - To debug a core dump file from an unsuccessful program execution, choose Debug > Load Core File.

   Your program is loaded and the primary Sun WorkShop debugging windows are displayed (see “Sun WorkShop Debugging Windows” on page 80”).

3. **Run your program by clicking on the Start or Go button, or choosing Execute > Start or Execute > Go in the Debugging window.**

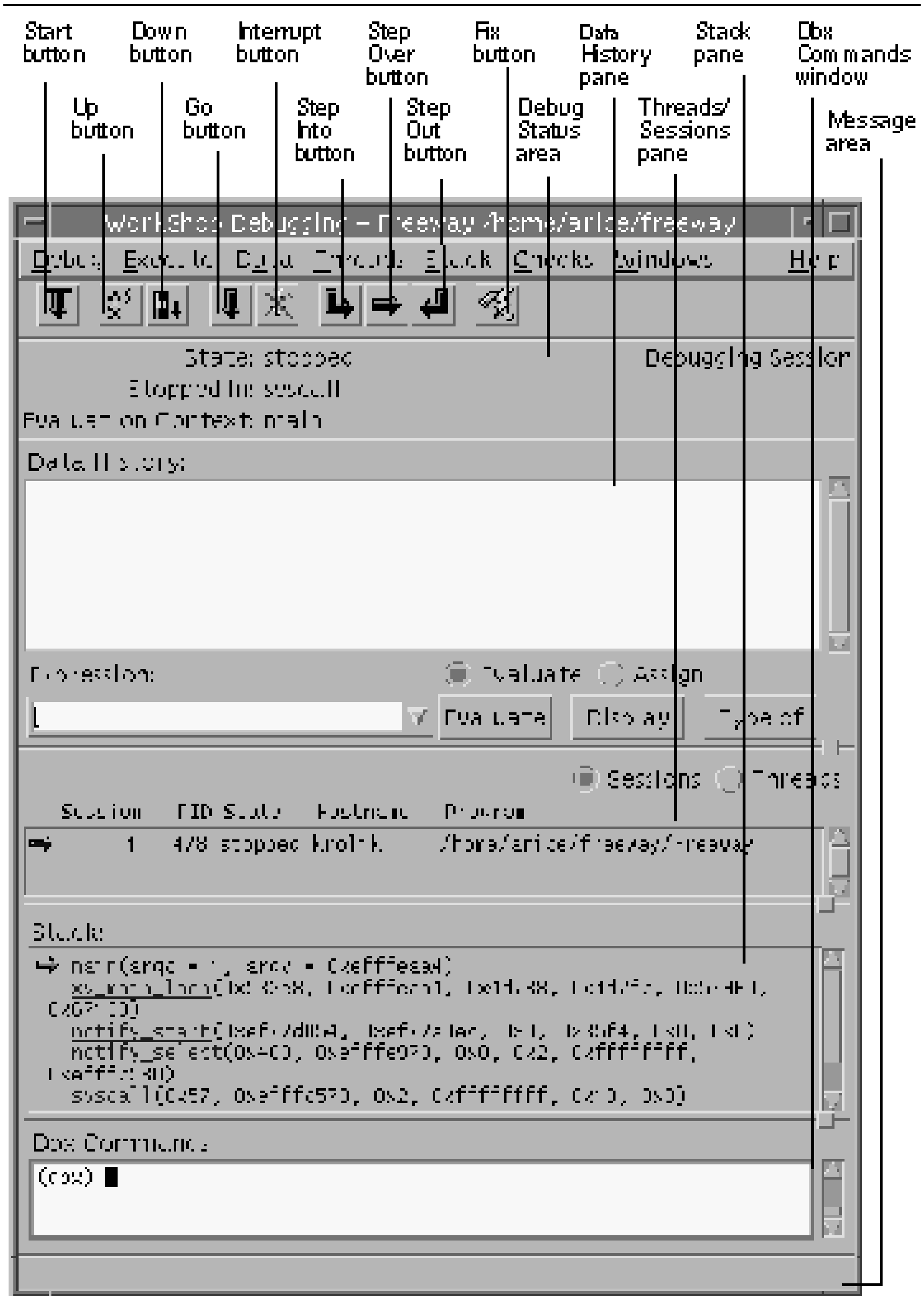
Note - Before you begin debugging, you can change run parameters such as arguments, the run directory, or environment variables (see “Changing Run Parameters” on page 89).

Sun WorkShop Debugging Windows

Sun WorkShop simplifies the debugging task by providing you with an intuitive, easy-to-use interface. When you start debugging, the Debugging window and a text editor window (see “Editor Window” on page 83) are displayed. If you have created custom buttons (see “Using the Button Editor” on page 85), the Custom Buttons window is also displayed.

Debugging Window

You perform most debugging operations from the Debugging window, shown in Figure 5–1, and the windows you can access from it.



State: stopped
Stopped in syscall
Evaluation Context: main

Debugging Session

Data History:

Expression:

● Evaluate ○ Assign

● Sessions ○ Threads

```
    Session   PID State   Hostname   Program
➡       1    478 stopped  kroltk     /home/arice/freeway/freeway
```

Stack:

```
↪ main(argc = 1, argv = 0xeffffead4)
    xv_main_loop(0x[illegible], 0xeffffea[illegible], 0x[illegible], 0x[illegible], 0x[illegible],
  0x[illegible])
    notify_start(0xef[illegible], 0xef[illegible], 0x1, 0x[illegible]f4, 0x0, 0x0)
    notify_select(0x[illegible], 0xeffffe[illegible], 0x0, 0x2, 0xffffffff,
  0xeffff[illegible])
    syscall(0x[illegible]57, 0xeffffe5[illegible], 0x2, 0xffffffff, 0x[illegible], 0x0)
```

Dbx Commands:

```
(dbx) █
```

Figure 5–1 Sun WorkShop Debugging Window

Debug menu	Provides commands to debug a program, process, or core file; customize options; and manage sessions.
Execute menu	Provides commands to run or single-step through lines of code.
Data menu	Provides commands to evaluate the selection in the Debugging window.
Threads menu	Provides commands to hide and expose threads in the Threads/Sessions pane.
Stack menu	Provides commands to move up, down, and pop the stack.
Checks menu	Provides commands to enable and use runtime checking.
Windows menu	Provides commands to open the Breakpoints, Data Display, and other debugging windows.
Help menu	Provides commands to display online help.
Start button	Runs the program from the beginning.
Up button	Moves up the call stack one function.
Down button	Moves down the call stack one function.
Go button	Runs the program from the current location.
Interrupt button	Interrupts the program; equivalent to the `dbx` command Ctrl+C.
Step Into button	Single-steps into a function.
Step Over button	Single-steps over the current function.
Step Out button	Steps past the end of the current function.
Fix button	Recompiles all changed files and continue debugging.
Debug Status area	Displays information about the state of your program.
Data History pane	Displays history when evaluating expressions, querying for type, and modifying values.
Threads/ Sessions pane	If the Threads radio button is selected, lists information about the threads in a multithreaded program. If the Sessions radio button is selected, lists current debugging sessions.
Stack pane	Shows you the current state of the call stack and lets you move to different stack frames.

Dbx Commands window	Lets you enter and view the output of `dbx` commands (displayed only if Show Dbx Commands Window in a separate window is set to No in the Window Layout Category in the Debugging Options dialog box).
Message area	Displays messages about operations in the window.

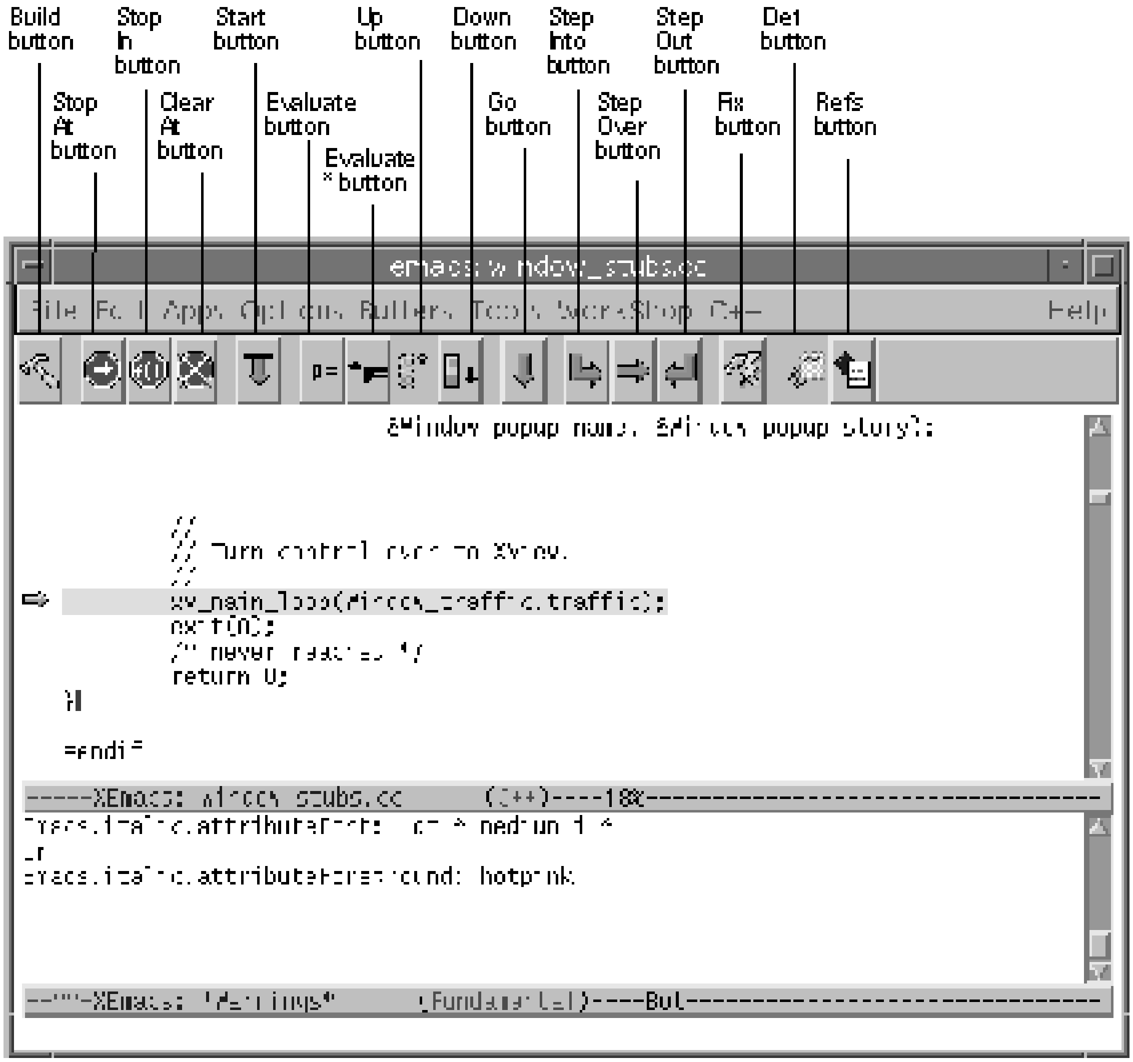
Editor Window

The integration of Sun WorkShop with three text editors (vi, GNU Emacs, and XEmacs) allows you to edit a program"s source code while using full debugging functionality.

You can perform basic debugging operations from a text editor window displaying the source code. Figure 5–2 shows the XEmacs editor window displaying source code during debugging. In the editor window, you can view and modify source code. When you start a debugging session, Sun WorkShop automatically displays the programs"s main routine in an editor window. You can change the colors used to highlight lines in the source code displayed in the editor window (current function, breakpoint, and so on) by editing the `WORKSHOP` resource file (see "Highlight Colors in Editor Windows" on page 130).

The editor window tool bar provides access to common debugging operations, especially those that use a source component as an argument, plus buttons from other parts of Sun WorkShop.

For information on choosing the editor for a Sun WorkShop session, see "Selecting and Using Text Editors" on page 12.



```
                        &window_popup_menu, &window_popup_story);



        //
        // Turn control over to XView.
        //
        xv_main_loop(window_traffic.traffic);
        exit(0);
        /* never reached */
        return 0;
}

#endif
-----XEmacs: window_stubs.cc      (C++)----18%------------------------------
Emacs.italic.attributeFont: -*-*-medium-i-*-
-r
Emacs.italic.attributeForeground: hotpink
--**-XEmacs: *Warnings*       (Fundamental)----Bot------------------------
```

Figure 5–2 Emacs Editor Window Displaying Source Code

Custom Buttons Window

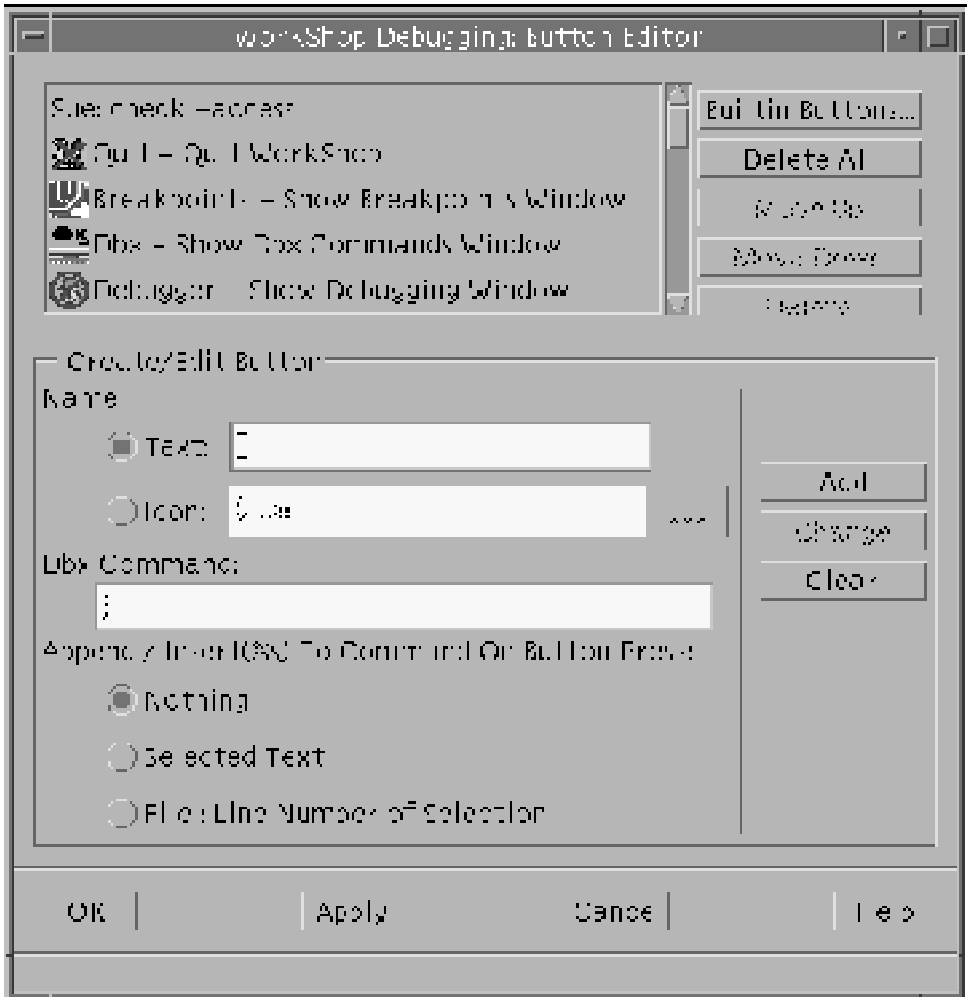
The Custom Buttons window contains custom buttons you create using the Button Editor or the dbx command button. If you have created custom buttons, the window opens automatically when you start Sun WorkShop.

If you used a previous version of the debugger and your .dbxrc file includes commands to create custom buttons, these buttons automatically appear in the Custom Buttons window.

You can resize the Custom Buttons window and position the window wherever you want, but you must close it separately.

Using the Button Editor

You can use the Button Editor (see Figure 5–3) to add, remove, or edit buttons in the Custom Buttons window. Buttons you add to the Custom Buttons window are stored in your Sun WorkShop options file. You no longer need to store buttons in your `.dbxrc` file. You cannot add buttons to, or remove buttons from, your `.dbxrc` file with the Button Editor.



Sue: check -access
Quit – Quit WorkShop
Breakpoints – Show Breakpoints Window
Dbx – Show Dbx Commands Window
Debugger – Show Debugging Window

Name
● Text:
○ Icon:
Dbx Command:
Append / Insert (A%) To Command On Button Press:
● Nothing
○ Selected Text
○ File : Line Number of Selection

Figure 5–3 Button Editor Window

To open the Button Editor, choose Windows > Button Editor in the Debugging window.

You can add buttons from the button list to the Custom Buttons window. If you want to add a button that is not on the button list, you must first import the button, if it already exists (see "Adding Builtin Buttons to the Button Editor" on page 86"), or create the button using the Create/Edit Button panel in the Button Editor (see "Adding a Button to the Button Editor" on page 86").

Adding Builtin Buttons to the Button Editor

To import buttons to the Button Editor:

1. **Click Builtin Buttons to display the Button Palette.**

   The builtin button list in the Button Palette lists:

   - All the buttons that populate the tool bars in the Debugger window
   - A number of buttons that access functionality available only from the menus (such as the Breakpoints button to open the Breakpoints window)
   - Some buttons that offer functionality not available on the tool bar or the menus (such as the Dump button to print local variables)

2. **Select the buttons you want to import to the Button Editor and click OK.**

   The buttons are added to the button list in the Button Editor.

Adding a Button to the Button Editor

To add a button to the Button Editor:

1. **Decide whether you want to put text or an icon on the button.**

2. **To put text on the button, click the Text radio button and type the text in the corresponding text box.**

3. **To put an icon on the button, click the Icon radio button, and type the file name of an icon.**

   Click the browse button to display a dialog box you can use to choose an icon file. The icon file must be in the `.xpm` file format. Sun WorkShop tool bar icons are 20x20 pixels, and use only colors from the Sun WorkShop palette.

Tip - You can use the CDE application `dticon` to create an `.xpm` file. Most graphics programs can also save files in `.xpm` format.

---

4. **In the Dbx Command text box, type the `dbx` command you want executed when the button is clicked.**

Tip - Type `commands` in the Dbx Commands window to see what commands are available.

---

5. **If you want the button to execute a `dbx` command that takes an argument, you must select one of the radio buttons under Append/Insert(%s) To Command On Button Press to specify the text to append to the command.**
   - The Nothing radio button is selected by default indicating that no text is to be added to the command.
   - If you click the Selected Text radio button, the current Sun WorkShop selection is appended to the command.
   - If you click the File: Line Number radio button, the file name and line number of the selection are appended to the command.

6. **If you want the argument embedded in the command rather than appended to it, type `%s` in the command string to indicate the position of the argument.**

   For example, if you type the following command string in the Dbx Command text box

   ```
   stop at %s -temp
   ```

   and select the File: Line Number of Selection radio button, the button will execute the following command if it is clicked when line 25 in `main.cc` is selected:

   ```
   stop at "main.cc":25 -temp
   ```

   Note - The command string should contain only one `%s`, and it cannot contain an escape sequence. For example, `stop %%s -temp` produces `stop %"main.cc":25`.

   ---

7. **Click Add and the button is added to the button list.**

Adding the Buttons to the Custom Buttons Window

You can add the buttons in the button list in the Button Editor to the Custom Buttons window.

To add a button to the Custom Buttons window, click Apply to add the new button to the Custom Buttons window.

1.

Note - You can also add a button to the Custom Buttons window using the `dbx button` command.

Editing an Existing Button

To edit an existing button in the Button Editor:

1. **Select the button in the button list.**

2. **Edit its properties using the text boxes and radio buttons in the Create/Edit Button panel, as described in "Adding a Button to the Button Editor" on page 86.**

3. **Click Change to apply the new properties to the button.**

4. **Click Apply to replace the button in the Custom Buttons window with the edited button.**

Rearranging Buttons

You can change the position of a button in the Custom Buttons window by moving it up or down on the button list in the Button Editor.

To rearrange the buttons:

1. **In the button list, select the button you want to move.**

2. **Click Move Up or Move Down until the button's position in the button list corresponds to where you want it to be displayed in the Custom Buttons window.**

3. **Click Apply and the button is displayed in its new position in the Custom buttons window.**

Removing a Button

You can remove a button from the Custom Buttons window by deleting it from the button list in the Button Editor.

To remove a button:

1. **In the button list, select the button you want to delete.**

2. **Click Delete and the button is deleted from the button list.**

3. **To remove the button from the Custom Buttons window, click Apply.**

Note - You can also remove a button from the Custom Buttons window using the `dbx unbutton` command.

Note - You cannot permanently delete a button stored in your `.dbxrc` file using the Button Editor. The button will reappear in your next debugging session. You can remove such a button by editing your `.dbxrc` file.

Basic Debugging Steps

The following sections describe the basic steps to perform after you start debugging a program. For more detailed information on any of the steps, see *Debugging a Program With dbx*.

Changing Run Parameters

You can change run parameters such as arguments, the run directory, and environment variables during a debugging session.

Specifying Program Arguments

You can specify program arguments when you load your program for debugging, and edit them at any time once your program is loaded.

When you enter arguments in the text box that contain characters that have special meaning to the shell, make sure you set them off with either a backslash (\) or quotes (" "). The special characters are | & ; < > ( )$ ‘ \ " ’* ? [ ]Space Tab Newline.

To specify program arguments when loading a program, type the arguments in the Arguments text box of the Debug New Program dialog box as if you were typing them on the command line. Do not include the program name.

To edit program arguments once a program is loaded:

1. **Choose Debug > Edit Run Parameters to open the Edit Run Parameters dialog box.**

2. **Add or change arguments in the Arguments text box.**

3. **Click OK.**

Specifying a Run Directory

You can specify a run directory when loading your program for debugging and change the run directory at any time once a program is loaded. When your program is loaded, the directory you selected as the run directory is made the current working directory of the debugger.

To specify a run directory when loading a program:

1. **Type the directory name in the Run Directory text box or click the browse button to display the Run Directory dialog box, in which you can select the directory name.**

2. **Click OK.**

To change the run directory once a program is loaded:

1. **Choose Debug > Edit Run Parameters to open the Edit Run Parameters dialog box.**

2. **Type the directory name in the Run Directory text box or click the browse button to display the Run Directory dialog box, in which you can select the directory name.**

3. **Click OK.**

Setting Environment Variables

You can specify the environment variables that are in effect when the program runs. When you run the program, `setenv` commands for these environment variables are prepended to the run command.

Using the Environment Variables dialog box, you can add or delete environment variables to the Persistent Environment Variables list. All environment variables in the Persistent Environment Variables list are saved with your WorkSet.

Note - The Persistent Environment Variables list for running your program is not the same as the Persistent Environment Variables list for building your program described in "Using Environment Variables" on page 67.

To open the Environment Variables dialog box:

- If you are setting environment variables when loading the program, choose Debug > New Program. In the Debug New Program dialog box, click Environment Variables.
- If you are changing an environment variables after a program is loaded, choose Debug > Edit Run Parameters. In the Edit Run Parameters dialog box, click Environment Variables.

Adding An Environment Variable

To add an environment variable to the Persistent Environment Variables list:

1. **Type the name of an environment variable in the Name text box.**
2. **Type a value for the variable in the Value text box.**

   If you make a mistake, click Clear to remove entries in the Name and Value text boxes.
3. **Click Add to add the environment variable to the Persistent Environment Variables list.**
4. **Repeat the previous three steps to add other environment variables.**
5. **Click OK to close the dialog box.**

   Note - Pressing the Return key after each step move the input focus to the next step.

Deleting an Environment Variable

To delete a variable from the Persistent Environment Variables list:

1. **Select a variable from the list.**
2. **Click Delete (Delete All removes all environment variables in the list).**
3. **Click OK to establish the change and close the dialog box.**

Changing the Value of an Environment Variable

To change the value of an environment variable in the Persistent Environment Variables list:

1. **Select an environment variable in the list.**

2. **Type a new value in the Value text box and click Change.**

3. **Click OK to establish the change and close the dialog box.**

Reviewing and Overriding Environment Variables

An environment variable definition that appears in the Persistent Environment Variables list overrides any environment variable with the same name that appears in the current debugging environment.

To review the current debugging environment variable definitions, click More to open the Current Environment list, which includes all the environment variables in the debugging environment for your program. You can filter the list using the Filter text box.

To override the value of an environment variable:

1. **Select an environment variable in the Current Environment list.**

2. **Click <<Add to add the environment variable to the Persistent Environment Variables list.**

3. **Type a new value in the Value text box and click Change.**

4. **Click OK to establish the change and close the dialog box.**

   The environment variable definition in the Persistent Environment Variables list overrides the environment variable definition in the current debugging environment, and is saved with your WorkSet.

Note - To delete a variable and unset its value, you can use the `dbx` command `unset` *variable.*

Stepping Through Your Code

You can view your code by stepping—that is, moving through your code one line at a time. As you step, a green highlighted line known as the program counter marks your place in the program. With each step, the program counter moves to the source line which is next to be executed, always showing you the next line to be executed.

There are three ways to step:

Step Into	Proceed forward one source line; if the source line is a function call, the debugger stops before the first statement of the function.
Step Over	Proceed forward one source line; if the source line is a function call, the debugger executes the entire function without stepping through the individual function instructions.
Step Out	Finish execution of the present function and stop on the source line immediately following the call to that function.

Note - Sometimes after the current function finishes executing, the highlight returns to the line of the call. In such cases, some extra post-call instructions remain to be executed. Stepping into or over again does not call the function again.

To view your code by stepping:

1. **Wait until your program stops, or interrupt execution by choosing Execute > Interrupt, clicking the Interrupt button, or pressing Ctrl+Break.**

2. **In the editor window, step through your code one line at a time, moving through functions, around functions, or out of functions**:
   - To step forward in your program one source line, choose Execute > Step Into or click the Step Into button (see Figure 5–1 or Figure 5–2) or press F8.
   - To step forward one source line in the current function, choose Execute > Step Over or click the Step Over button or press F7.
   - To finish executing the current function and stop execution on the source line immediately following the call to the function, choose Execute > Step Out or click the Step Out button.

3. **Continue executing your program by clicking on Go or choosing Execute > Go.**

Setting Breakpoints

Set breakpoints to force the debugger to stop execution. You can set simple breakpoints to stop at a line of code, or in a procedure or function.

Set advanced breakpoints to break in C++ classes, track changes in data, break on a condition, break on special events, or create your own custom breakpoints.

You can set and clear breakpoints in the editor window (see Figure 5–2) or the Breakpoints window (see Figure 5–4). In the editor window, you can set or clear a breakpoint at a line of code or in a function. In the Breakpoints window, you can set more complex breakpoints, such as a breakpoint when a signal occurs.

Setting Breakpoints in the Editor Window

To set a location breakpoint:

1. **Click the line where you want the breakpoint.**

2. **Click the Stop At button.**

   The line is highlighted in red to indicate the breakpoint is set. If the line selected is not an executable line of source code, the debugger sets the breakpoint at the next line after the specified line that is executable.

To set a function breakpoint:

1. **Select the name of the function where you want the breakpoint.**

2. **Click the Stop In button.**

   A message in the message area tells you that the breakpoint is set.

To remove a breakpoint, do the following:

1. **Move the pointer to the line containing the breakpoint you want to remove.**

2. **Click the Clear At button to remove all breakpoints on the line.**

Setting Breakpoints in the Breakpoints Window

To open the Breakpoints window, shown in Figure 5–4, choose Windows > Breakpoints or Execute > Set Breakpoints in the Debugging window.

To set a location breakpoint:

1. **If the Details pane is not in view, click the Add/Change Breakpoint button.**

2. **Choose At Location from the Event list and type the file name and the line number in the text box, such as** `Foo.cc:21`**.**

3. **If it is not already set, choose Stop from the Action list.**

4. **Click Add.**

   The line is highlighted in red to indicate the breakpoint is set. If the line selected is not an executable line of source code, the debugger sets the breakpoint at the next line after the specified line that is executable.

To set a function breakpoint:

1. **If the Details pane is not in view, click the Add/Change Breakpoint button.**

2. **Choose In Function from the Event list and type the function or procedure name in the text box.**

3. **If it is not already set, choose Stop from the Action list.**

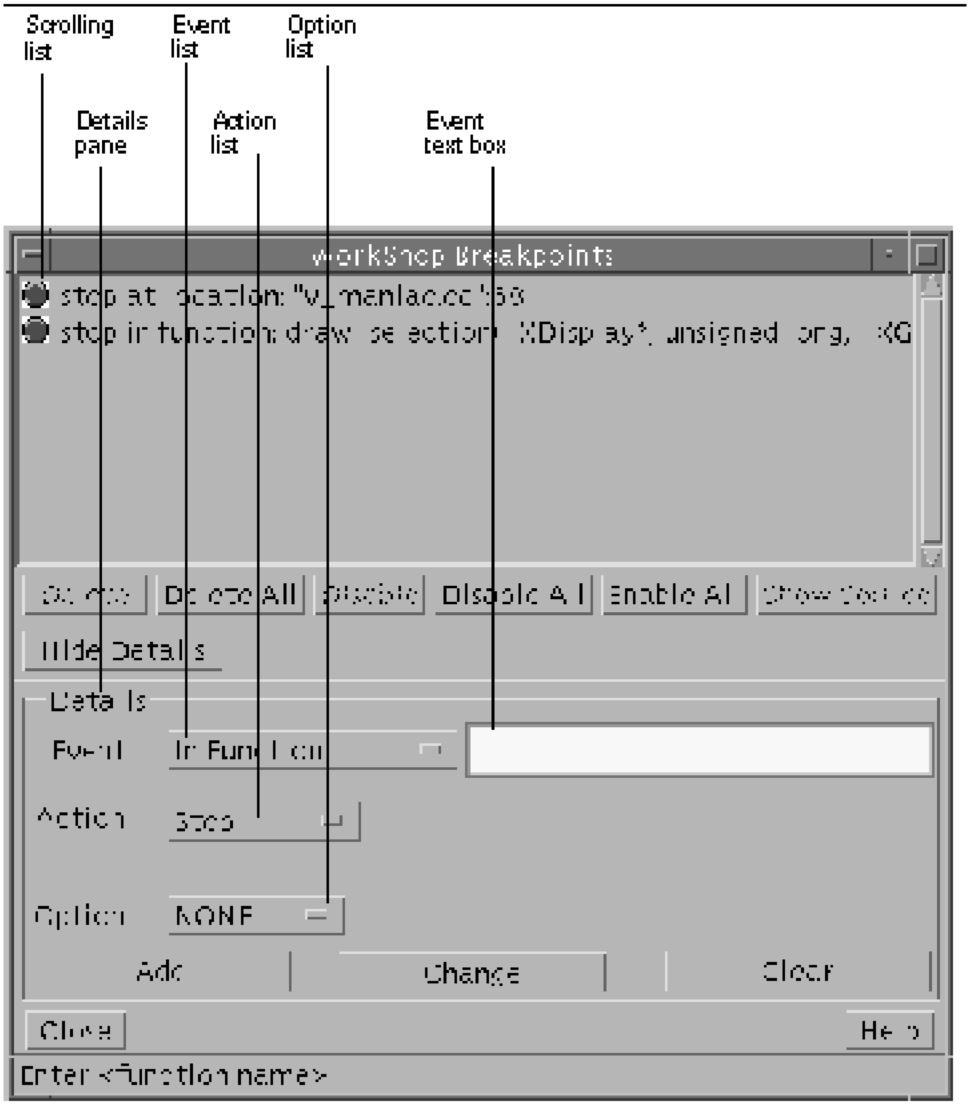
4. **Click Add.**

   The breakpoint is added to the list of currently active breakpoints.

To remove a breakpoint, do one of the following:

- Select a breakpoint in the scrolling list and click Delete.
- Click Delete All to remove all breakpoints.

Disable and re-enable breakpoints as you move through your program.



● stop at location: "vi_manlac.cc":59
● stop in function: draw_selection(XDisplay*, unsigned long, XG

Event: In Function
Action: Stop
Option: NONE

Enter <function name>

Figure 5–4 Breakpoints Window

Scrolling list	Shows the breakpoints and tracepoints assigned in your program. A breakpoint or tracepoint can be in one of three states: — Enabled, indicated by a red stop sign — Disabled, indicated by a gray, crossed-out stop sign — Executed, indicated by an arrow
Delete button	Deletes the breakpoint or tracepoint from the source code and removes it from the scrolling list.
Delete All button	Deletes all breakpoints and tracepoints from the source code and removes them from the scrolling list.
Enable button	Enables the selected breakpoint or tracepoint and changes its glyph to a red stop sign.
Disable button	Disables the selected breakpoint or tracepoint and changes its glyph to a gray, crossed-out stop sign.
Disable All button	Disables all breakpoints or tracepoints listed and changes their glyphs to gray, crossed-out stop signs.
Enable All button	Enables all disabled breakpoints or tracepoints listed and changes their glyphs to red stop signs.
Show Source button	Shows the source line of the selected breakpoint or tracepoint in the editor window.
Add/Change Breakpoints button	Expands the Breakpoints window. Click to display options for adding or changing a breakpoint in your program. This button toggles to Hide Details.
Details pane	Lets you specify the details of a breakpoint.
Event list	Allows you to set where and when you want to pause program execution.
Event text box	Lets you specify the file name, line number, function name, class name, and so forth, of an event.
Action list	Lets you set breakpoint actions such as stopping and tracing.
Option list	Lets you place additional restrictions on a breakpoint or tracepoint.
Add button	Adds a breakpoint or tracepoint with the specified action, event, and option to the source code. In the editor window, a stop sign glyph appears to the left of the source line where the breakpoint or tracepoint appears, and the line is highlighted in red. The breakpoint or tracepoint also appears in the Breakpoints scrolling list.

Change button	Updates the event, action, and option of the selected breakpoint or tracepoint.
Clear button	Removes all entries from the Event, Action, and Option text boxes.
Close button	Closes the Breakpoints window.
Help button	Displays online help for the Breakpoints window.

Collecting Performance Data

While running your program in the debugger, you can use the Sampling Collector to collect performance data and write it to experiment files to be used by the Sampling Analyzer. The Sampling Collector can gather program memory-usage data, execution profile data excluding called function times, and execution profile data including called function times. For more information on collecting and analyzing performance data, see Chapter 6,"the *Analyzing Program Performance With Sun WorkShop* manual, and the Sun WorkShop online help.

You can collect performance data only when you are running in the Sun WorkShop Debugging window and runtime checking is turned off.

To collect performance data:

1. **Choose Windows > Sampling Collector.**

2. **Type the complete path name for your experiment file in the Experiment File text box.**

3. **Select whether you want to collect data for one run only or for all runs.**

   If you run the Sampling Collector for one run only, the Collector shuts off after the experiment is created. If you leave the Collector on for all runs, the Collector remains on even after the experiment is created.

4. **Select the type(s) of data you want to collect.**

   If you have chosen to collect Execution Profile data, use the Collect Profile data slider to specify an interval at which the Collector gathers samples.

5. **Select either the Manually, on "New Sample" command radio button or the Periodically radio button to determine when the Collector interrupts data gathering to stop and summarize.**

   If you have selected the Periodically button, use the Period slider to define the interval at which the Collector summarizes samples.

6. **Start your program running in the debugger by clicking either Start or Go.**

Runtime Checking

Runtime checking, or RTC, allows you to automatically detect runtime errors in an application during the development phase. Using RTC, you can:

- Detect memory access errors
- Detect memory leaks
- Collect data on memory use
- Work with all languages
- Work on code for which you do not have the source, such as libraries

To use runtime checking, you must turn on the type of checking you want to use before you execute the program,. Then, when you run the program, runtime checking compiles reports on your memory usage.

Setting Runtime Checking Options

You can customize runtime checking to set defaults for reporting options, error reporting, and stack depth for reports.

To set Runtime Checking options:

1. **Choose Debug > Debugging Options.**

   The Debugging Options dialog box is displayed.

2. **Click the Category button and select Runtime Checking.**

3. **Click the desired settings in the Runtime Checking category. (For descriptions of the Runtime Checking Options, see “Setting Runtime Checking Options” in the online help.)**

Starting Runtime Checking

To turn on memory use checking:

1. **In the Debugging window, choose Windows > Runtime Checking.**

   The Runtime Checking window is displayed (see Figure 5–5).

2. **In the Debugging window or the Runtime Checking window, choose Checks > Enable Memuse Checking.**

A blue recycling symbol with three arrows pointing in a circle appears in the Debugging window status area and in the Runtime Checking window to remind you that memory use checking is enabled

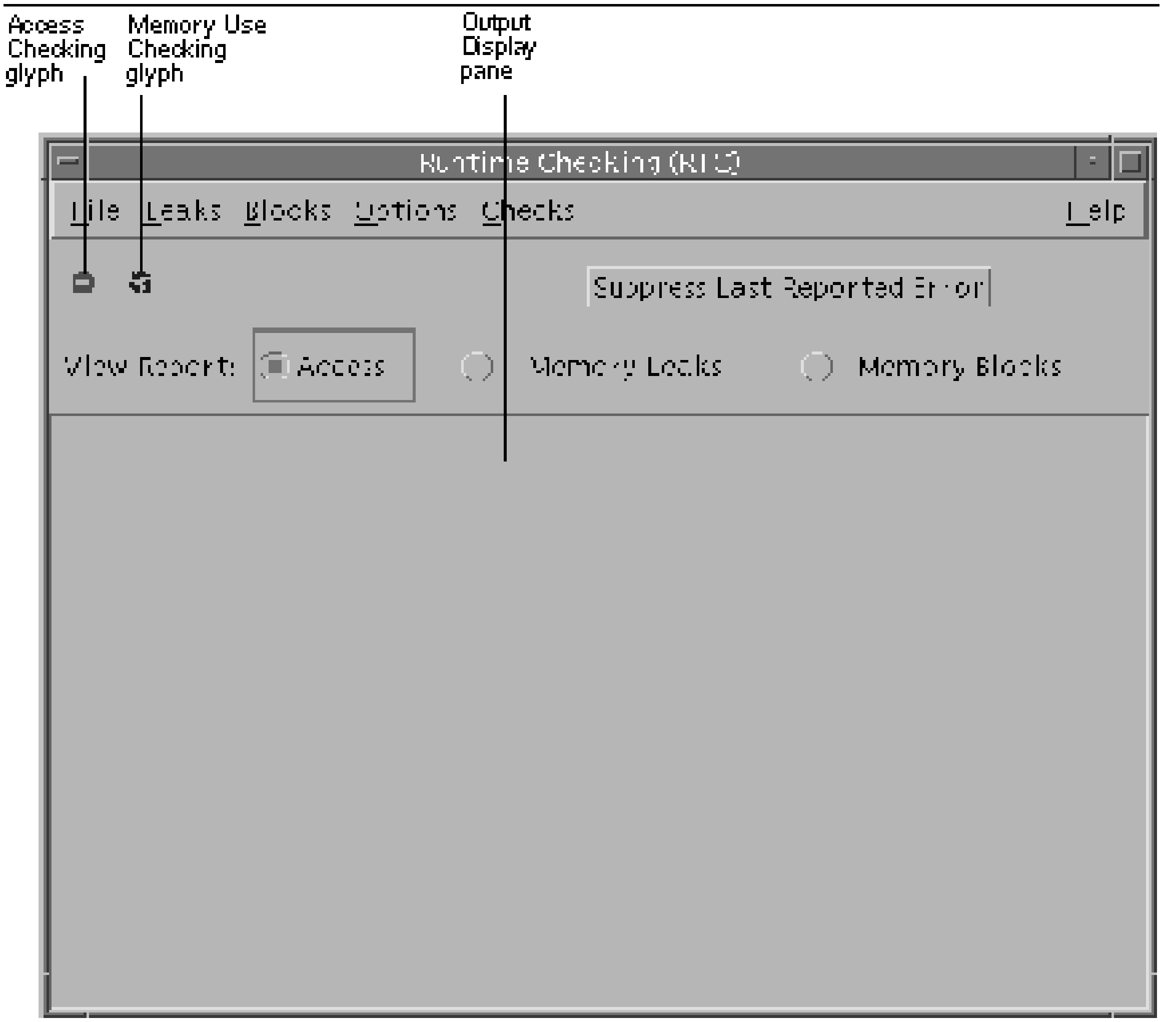
To turn on memory access checking:

1. **In the Debugging window, choose Windows > Runtime Checking.**

   The Runtime Checking window is displayed (see Figure 5–5).

2. **In the Debugging window or the Runtime Checking window, choose Checks > Enable Access Checking.**

   A red circle with a white minus sign in the middle (the international Do Not Enter sign) appears in the Debugging window and in the Runtime Checking window to remind you that memory access checking is enabled.



View Report: ● Access ○ Memory Leaks ○ Memory Blocks

Figure 5–5 Runtime Checking Window

File menu	Provides commands for opening and saving error logs, clearing information from the Runtime Checking window, and closing the window.
Leaks menu	Provides commands for controlling the detail level and content of the memory leaks report.
Blocks menu	Provides commands for controlling the detail level and content of the memory blocks report.
Options menu	Provides a command to display the Runtime Checking category of the Debugging Options dialog box.

Checks menu	Provides commands for turning on memory use checking and memory access checking.
Suppress Last Reported Error button	Suppresses reporting of the last reported error when you continue running your program. You can use this button after an error is reported and when the program is stopped or interrrupted.
View Report radio buttons	Control which runtime checking report is displayed in the output display pane (Access, Memory Leaks, or Memory Blocks)
Output Display Pane	Lists the access, memory leak, or memory use report, with a separator line indicating each run of the program or new report requested.

Tracing Code

Tracing collects information about what is happening in your program and displays it in the Dbx Commands window. Program execution does not stop.

An unfiltered trace displays each line of source code as it is about to be executed, which in all but the simplest programs produces volumes of output.

It is more useful to filter a trace to display information about events in your program. For example, you can trace each call to a function, every member function of a given name, every function in a class, or each exit from a function. You can also trace changes to a variable.

An *event* is the association of a program event with a debugging action. A typical event is a change in the value of a specified variable. A handler manages debugging events. The trace listing in the Breakpoints window is called a trace handler because it manages the trace, a type of event.

To set up a trace:

1. **In the Breakpoints window, if the Details pane is not displayed, click the Add/ Change Breakpoint button.**

2. **From the Event list box, choose the type of event you want to trace.**

3. **Type any event information, such as the name of a function, or the file name and line number of a location, in the text box.**

4. **Choose Action > Trace.**

5. **Click Add.**

Note - You can control the speed of the trace using the Debugging Behavior category in the Debugging Options dialog box (See the Debugging online help for information on setting debugging options.)

Examining Values and Data

An evaluation is a one-time spot-check of the value of an expression. You can evaluate expressions at any time from the editor window or the Debugging window. You can track the changes in a value each time the program stops using the Data Display window.

The results of an evaluation are listed in the Data History pane of the Debugging window. A dashed line indicates that the evaluation context has changed since the last evaluation. The Data History pane maintains a list of expressions you previously evaluated in a history list. You can clear the Data History pane at any time by choosing Data > Clear History.

To evaluate an expression using the editor window, select the target variable or expression in the source display. Then do one of the following:

- Click the Evaluate button or choose WorkShop > Evaluate > Selected to find the value of the selected expression.
- Click the Evaluate * button or choose WorkShop > Evaluate > As Pointer to evaluate where a pointer-type expression points.

The value is shown in the Data History pane. A separator line is inserted into the Data History pane list whenever the evaluation context changes.

To evaluate an expression using the Debugging window:

1. **In the Expression text box, type or paste the variable or expression.**

   If the expression you want to examine is visible in the Debugging or editor window, you can select the expression, then choose Data > Evaluate Selected.

2. **Click the Evaluate radio button.**

3. **Click the Evaluate button or choose Data > Evaluate Selected.**

Note - While the program is stopped, you can change the value of a variable or expression using the Assign button.

Monitoring Data Values

The Data Display window allows you to watch the changes in the value of an expression during program execution. A set of expressions you choose is automatically evaluated every time a program stops executing—at a breakpoint, at a step, and when the program is interrupted. When the value of an expression changes, the value is highlighted in boldface.

From the Data Display window, you can display pop-up windows to view additional information about an expression, giving you control over the information you are viewing.

To monitor the value of an expression:

1. **Open the Data Display window by choosing Windows > Data Display or clicking Display in the Debugging window.**

2. **Type an expression in the window by doing one of the following:**
   - Type the expression in the Expression text box and click the Display button.
   - Choose Display > New Expression in the Data Display window and type the expression in the text box in the New Expression panel that is displayed.

3. **Place the pointer anywhere in the Data Display window and press the right mouse button to display the Selected Display Item pop-up menu.**

   Choose commands from the menu to view context and type information, compare current and previous values, show pointer aliases, and graph arrays.

Examining the Call Stack

The call stack represents all currently active routines—those that have been called but have not yet returned to their respective caller. In the stack, the functions and their arguments are listed in the order that they were called. The initial function (`main()` for C and C++ programs) is at the top of the Stack pane; the function executing when the program stopped is at the bottom of the Stack pane. This function is known as the stopped in function.

The stopped in function is listed in the Stopped In status line in the Debug Status area of the Debugging window (see Figure 5–1). The source code of the stopped in function is displayed in the editor window with the next line to be executed highlighted in green.

The Evaluation Context line in the status area provides the name of the context function, which determines the scope resolution search order that applies when you provide a symbol name in various debugging operations.

You can examine the call stack by doing any of the following:

- Move up one level in the stack by clicking the Up button or choosing Stack > Up.

- Move down one level in the stack by clicking the Down button or choosing Stack > Down.
- Remove multiple frames by placing your cursor next to the frame you want to return to and choosing Stack > Pop to Current Frame.
- Remove the function you are stopped in from the stack by choosing Stack > Pop.
- Remove multiple frames by placing your pointer next to the frame you want to return to and choosing Stack > Pop to Current Frame.

Debugging Multithreaded Programs

When a multithreaded program is detected, the Sessions/Threads pane on the Debugging window opens. This pane can be toggled between displaying sessions and displaying threads. For a multithreaded program, the pane lists information about the threads in the currently selected process. The current thread is marked with a green arrow.

To view the context of another thread:

1. **Click the thread in the Threads pane.**

   The call stack dynamically updates to reflect the context of the selected thread. The source display also updates. The context function and stopped in function are changed to their respective values for the new thread.

2. **To resume program execution, click Go.**

To hide a thread:

1. **Click the thread in the Threads pane.**

2. **Choose Threads > Hide Selected.**

You can expose threads to help in managing them. To show all hidden threads, choose Threads > Expose Hidden.

Customizing Debugging Sessions

You can set new defaults for debugging performance, output, language, and so on by choosing Debug > Debugging Options. The Debugging Options dialog box is displayed. Using this window, you can customize a debugging session or change defaults for the entire debugger. You can also set many of the defaults by setting environment variables with the dbxenv command.

For detailed information on customizing your debugging session, see *Debugging a Program With dbx*.

Debugging Processes Simultaneously

You can debug more than one program at a time, with each program connected to a separate debugging session. Following are three examples of programs you may want to debug simultaneously:

- A process and the child process it forks
- A client and server program
- Two related programs

Although you are debugging multiple sessions, you can see the context of only one session at a time. The Active Sessions dialog box (see Figure 5–6) maintains a list of all debugging sessions so that you can move between them. The current program is marked with an arrow. When you switch to a different session, the Debugging window, the editor window, the Dbx Commands window, and the other displays reflect the context of the new session.

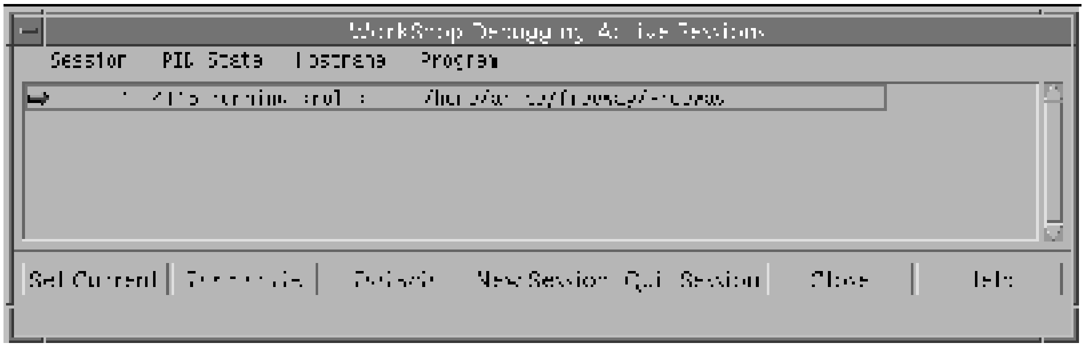


Figure 5–6 Active Sessions Dialog Box

Debugging multiple sessions consumes resources and may slow down your system. The Debugging window states how many active sessions you have. To remove sessions you no longer need, click Quit Session or Detach in the Active Sessions dialog box.

If you are debugging a program, and you ask to debug another program, a message tells you that you are currently debugging a program. You will be prompted to terminate or detach the current session and load a new debugging session, reuse the current session, or debug both sessions. Choose to debug both only if you want to debug both programs simultaneously.

Managing Sessions

During a Sun WorkShop session, you can debug any number of programs. A list of these programs is maintained in the Active Sessions dialog box and in the Sessions Display in the Debugging window, so you can easily terminate, detach, quit, or move between programs. The current program is marked with an arrow.

To manage your sessions using the Active Sessions dialog box:

1. **In the Debugging window, choose Debug > Manage Sessions.**

   The Active Sessions dialog box opens.

2. **Select a program from the scrolling list.**

3. **Click one of the following buttons:**

Set Current	Makes the selected program the current program. The Stack pane, the editor window, and other displays update to reflect the context of the selected program.
Terminate	Terminates the program without terminating the debugging session.
Detach	Detaches the selected program without terminating the program or the debugging session.
Quit Session	Terminates the selected program and removes the debugging session. If you have only one session and you click this button, the session is removed and the Debugging window notes that there are no debugging sessions.

4. **Click Close.**

To manage your sessions in the Sessions display of the Debugging window:

1. **If the Sessions/Threads Pane is not open, drag the sash above the Stack Pane to open it.**

2. **If the pane is showing the Threads Display, click the Sessions radio button at the top of the pane.**

Note - Be careful when debugging multiple programs. Debugging more than two programs may slow down your system considerably. Always be sure to terminate, detach, or quit a session you no longer need.

Quitting a Debugging Session

Debugging multiple sessions can consume resources and slow down your system. If you no longer need a debugging session, use Quit Session to detach a running process or terminate a loaded process. The debugging session is not preserved.

To quit the current debugging session:

1. **In the Debugging window, choose Debug > Manage Sessions.**

2. **From the list, select the session you want to quit.**

3. **Click Quit Session.**

Note - The Terminate command terminates debugging of the current process, but preserves the debugging session. When you load another program, it should load faster than the first one you loaded because the session is already started. Keeping the debugging session around, however, takes up swap space. If you are running out of swap space, use Quit Session to terminate the program and quit the debugging session.

Debugging a Child Process

When a process forks a child process, you can choose to debug the parent process, the child process, or both. You can also override the normal deletion of all breakpoints from the forked process.

The Sampling Collector is disabled for a forked process.

If you consistently follow the same process across executions, you can bypass the Follow Fork dialog box by designating the default action you want to take.

To set the default for a forked process:

1. **From the Debugging window, choose Debug > Debugging Options.**

2. **Choose Category > Forks and Threads.**

3. **Click the appropriate radio button:**

Parent	The fork is ignored and the parent is followed. This is the default behavior.
Child	Debugging switches to the forked child. The process ID of the current process changes to the child’s process ID. The parent continues as if it had been detached, and the child process is suspended as if it had been attached. Use Go or Step Into to execute the child process.
Both	A second debugging session is launched to debug the child process, and becomes the current session. The parent’s debugging session remains as an active process. The child process is suspended as if it had been attached.
Ask User	Whenever a fork is detected, the Follow Fork dialog box opens, allowing you to choose between the parent, the child, or both processes at the same time. You can examine the state of your program each time to see which fork you want to follow.

4. **Click OK to apply your choices to the current session, or click Save As Defaults and then click OK to use them as the new defaults.**

The selected action occurs whenever the process executes `fork()`.

To allow the child to inherit the parent’s breakpoints when the new fork will not execute a different process:

1. **From the Debugging window, choose Debug > Debugging Options.**

2. **Choose Category > Forks and Threads.**

3. **At Child process inherits parent’s breakpoints, click the checkbox to enable it.**

4. **Click OK to apply your choices to the current session, or click Save As Defaults and then click OK to save your choices as the new defaults.**

Quick Mode

Quick Mode is a debugging feature that allows you to run your program normally but with debugging ready in the background to take over the process at any point. If your program terminates abnormally, the debugger is there to save the program before it core dumps.

If all you want to do is run your program as quickly as possible, but you might still need to do some debugging, select Quick Mode when you start the debugger. The Debugging window opens, but otherwise your program runs exactly as if you were running it from the shell; the symbols for the program are not loaded.

If the program encounters a condition that would cause it to terminate, the debugger switches to Debug Mode, and the symbols for the program are loaded. This causes a delay, but leaves you with an active program and full debugging functionality.

When you are running your program in Quick Mode, you can switch to Debug mode whenever execution is interrupted—for example, at a breakpoint or when you manually interrupt execution by clicking on the Interrupt button.

Advantages of Quick Mode

Quick Mode offers the following advantages:

- When a program encounters a segmentation fault or some other abnormal condition, Sun WorkShop steps in before the program terminates, leaving you with an active program and full debugging functionality. If you had run the program without Quick Mode, Sun WorkShop would have terminated the program. You would then have to debug a core file using a restricted set of debugging actions.
- You can interrupt your program at any point in the process and automatically bring the debugger into control to set breakpoints, watch data, and browse through source code. You don"t have to restart your program to get access to debugging functionality.
- When you run in Quick Mode, your program runs quickly, but you have the security of knowing all of the debugging functionality is available if you need it.
- Your only initial time lag comes from opening the Debugging window. Symbol tables aren"t loaded.
- Your program never crashes and produces a core dump. The debugger always stops the program first.
- You have full debugger functionality with a program that was about to crash. (When you attach to a core file, you can only use limited debugger functions.)
- When the Debugger takes over for a program that was about to crash, you can pop back through function calls.

When to Use Quick Mode

Use Quick Mode when you:

- Think you are finished debugging
- Want to avoid waiting for symbols to load
- Want to test a fix you made

As you debug your program, you can toggle between Debug Mode and Quick Mode to take advantage of the best features of each.

How to Switch to Quick Mode

You can choose to run your program in Quick Mode or Debug Mode whenever you select a program to run or debug.

You can toggle between Quick Mode and Debug Mode for the current program from the Debug menu in the Sun WorkShop main window or in the Debugging window.

If you want to change your defaults so that future programs automatically start in Quick Mode, choose Options > Debugging Options in the Sun WorkShop main window. Then choose Debugging Performance from the Category list in the Debugging Options window and click Save As Defaults.

Quick Mode Example

Suppose you made a change to a program and are confident that the change works. After rebuilding the program, you choose Quick Mode from the Debug menu, so that the program runs with minimal overhead. As this is the first time you have run or debugged a program since opening Sun WorkShop, there is a slight delay as the Debugging window opens.

You start your program by clicking the Start button or choosing Execute > Start in the Debugging window. It runs normally until it encounters a segmentation fault.

Before the program can terminate and create a core dump, Sun WorkShop switches into Debug Mode and loads the symbols for your program. You now have access to the full debugging functionality of Sun WorkShop and can debug the program as if you had started debugging in Debug Mode. Eventually, after making many changes, fixing them, and continuing, you rebuild your program.

You again select Quick Mode before running the program.

This time, no initial pause is noticeable, but your program appears to be stuck in an infinite loop. Clicking on the Interrupt button stops the program and loads the debugging symbols. You can now view data values, set breakpoints, and do any other needed debugging actions to track down your bug.

Convinced the third time is the charm, you rebuild your program, re-enable Quick Mode, and run the program again. Your program runs without a flaw.

Exiting Debugging

To quit all processes currently under the control of Sun WorkShop and close all debugging windows, choose Debug > Exit Debugging in the Debugging window.

If you want to close the Debugging window without quitting the processes under the control of Sun WorkShop, choose Debug > Close. The processes under the control of Sun WorkShop continue running, using memory and CPU time, and Sun WorkShop continues to store data on these processes.

CHAPTER **6**

Analyzing Program Performance

This chapter describes the basics of how to use the Sampling Collector and Sampling Analyzer to performance-tune applications in Sun WorkShop. For more detailed information on these and other performance-profiling tools included in Sun WorkShop, see *Analyzing Program Performance With Sun WorkShop* and Sun WorkShop online help.

This chapter is organized into the following sections:

- "Performance Profiling in Sun WorkShop" on page 113
- "Collecting Performance Data" on page 115
- "Analyzing Performance Data" on page 116

Performance Profiling in Sun WorkShop

The Sampling Collector, available from the Debugging window, gathers performance data during the execution of an application and saves it to an experiment file. The Sampling Analyzer, a separate tool available from the Sun WorkShop main window, displays collected performance data and, if paging is causing a bottleneck, can create a file to instruct the linker to remap functions in memory.

The UNIX `prof` and `gprof` performance-profiling tools generate only user CPU information. With the Sampling Collector and Sampling Analyzer, you can get information about I/O time, system time, text and data page fault times, program sizes, and execution statistics, in addition to user CPU information.

Figure 6–1 illustrates the basic performance-tuning architecture in Sun WorkShop.

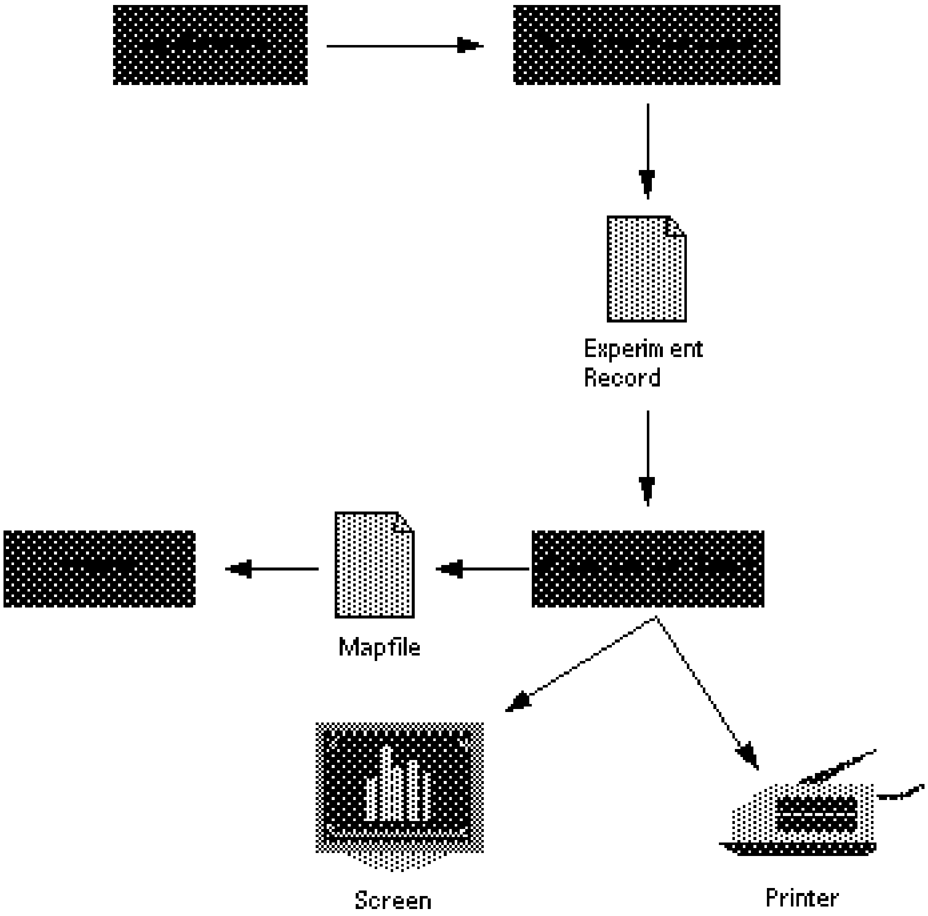


Figure 6–1 Performance-Tuning Architecture

The Sampling Collector gathers performance data from the application and writes it to an experiment record. The Sampling Analyzer displays that experiment data online and can print the data to either a file or a printer. Additionally, the Sampling Analyzer can create a mapfile for the linker, and you can then recompile the application.

The following sections describe the basic steps involved in collecting and analyzing performance data. For more detailed information on any of the steps, see *Analyzing Program Performance With Sun WorkShop*, and "Analyzing Performance Data" and "Collecting Performance Data" in the online help for Sun WorkShop.

Building the Application

Before collecting performance data you must build your application. For information on building, see Chapter 4" and the online help.

Collecting Performance Data

The Sampling Collector gathers performance data about a program as it runs through the Debugging window. To view the results of the experiment file you collect, you must use the Sampling Analyzer, which is available separately through the Sun WorkShop main window or can be displayed by choosing Collect > Analyze from the Sampling Collector.

When you create an experiment file in the Sampling Collector, you also create a hidden directory in the same directory as the experiment file. The hidden directory name is preceded by a dot (.)—for example, if the experiment file is called `test.1.er`, the hidden directory is called `.test.1.er`. Files in this directory contain information on segments, modules, lines, and functions.

Note - The Analyzer list field (selected from the Section list) in the WorkSet window lists the experiments associated with the current WorkSet and allows you to add or delete experiments using the Add Experiment and Delete Experiment buttons.

Types of Data You Can Collect

You can collect three types of data:

- *Address space* — Process address space represented as a series of segments, each of which contains a number of pages
- *Execution profile* (excluding called function times) — Time consumed by functions (but not called functions), modules, and segments during execution
- *Execution profile* (including called function times) — Time consumed by functions (including called functions), modules, and segments during execution

For more information on choosing the type of data to collect, see *Analyzing Program Performance With Sun WorkShop*, and "Choosing the Type of Data to Collect" in the Sun Workshop online help.

Frequency of Sample Collection

Samples are sets of data collected over specific periods of time while an application is running.

You can specify the frequency of sample collection by moving the Collect Profile data slider to the desired number of samples per second. Both data accuracy and collection overhead increase as the number of samples collected per second increases.

Collecting Data

To collect performance data:

1. **From the Debugging window, disable runtime checking and choose Windows > Sampling Collector to open the Sampling Collector.**

2. **In the Experiment File text box, type the complete path name for the experiment file to be created.**

3. **Using the Collect Data radio buttons, select whether you want to collect data for one run only or for all runs.**

   If you select for one run only, the Sampling Collector turns off after an experiment is created. If for all runs is selected, the Sampling Collector remains turned on even after the experiment is created.

4. **Load the program into the Debugging window and run it by clicking either Start or Go.**

Analyzing Performance Data

After you collect performance data with the Sampling Collector, you can view it only through the Sampling Analyzer, a separate tool available from the Sun WorkShop main window or by choosing Collect > Analyze in the Sampling Collector window. The three types of data you can collect with the Sampling Collector separate into nine types of data available to analyze; each of these nine types of data has one or two Analyzer display options associated with it.

Types of Data You Can View and Analyze

You can analyze the following types of data by selecting them from the Data list in the Sampling Analyzer window:

- Process Times — Summary of process state times (includes User Time, System Wait Time, System Time, Text Page Fault Time, and Data Page Fault Time)
- User Time — Time spent in the user process state from the execution of instructions
- System Wait Time — Time the process is sleeping in the kernel but is not in the suspend, idle, lock wait, text fault, or data fault state
- System Time — Time the operating system spent executing system calls
- Text Page Fault Time — Time spent faulting in text pages
- Data Page Fault Time — Time spent faulting in data pages
- Program Sizes — Sizes in bytes of the functions, modules, and segments of your application; in conjunction with Address Space data, allows you to examine the size of your application and helps you establish specific memory requirements
- Address Space — Reference behavior of both text pages and data pages; in conjunction with Program Sizes data, allows you to examine the size of your application and helps you establish specific memory requirements
- Execution Statistics — Overall statistics on the execution of the application

For more information on selecting a data type, see “Selecting Data Types” in the Sun WorkShop online help.

Display Options

The Sampling Analyzer offers five ways to view collected performance data:

- Overview — The default display provides a high-level overview of the performance behavior of the application, including:
  - Number of samples that were taken during the collection process
  - Breakdown of the process activity for each sample during the collection process
  - Breakdown of the process activity averaged over selected samples
  - Percentage of the entire experiment that you’re viewing
- Histogram — Summary of the amount of time spent executing functions, files, and load objects
- Cumulative — Cumulative amount of time spent by a function, file, or load object, including the time spent in called functions, files, or segments

- Address Space — Information about memory usage
- Statistics — Aggregate data about performance and system resource usage

For more information on selecting a display option, see “Selecting Display Options” in the Sun WorkShop online help.

Comparing Samples

By choosing View > New Window in a Sampling Analyzer window, you can open a new Analyzer window to compare two samples or view the same set of samples in two different ways.

Reordering Program Functions

If text page faults are consuming a lot of your application’s time, the Sampling Analyzer can reorder your program, generating a mapfile containing an improved ordering of functions. With the most-used functions grouped together on the same set of pages, a function is more likely to already be in memory when called.

The –-M option passes the mapfile to the linker, which then relinks your application and produces a new executable application with a smaller text address space size.

After you have reordered your application you can run a new experiment and compare the original version with the reordered one.

To reorder an application, compile the application using the –-xF option.

The –-xF option is required for reordering. This option causes the compiler to generate functions that can be relocated independently.

For C applications, type:

```
cc -xF -c a.c b.c cc -o application_name a.o b.o
```

For C++ applications, type:

```
CC -xF -c a.cc b.cc CC -o application_name a.o b.o
```

For Fortran applications, type:>

```
f77 -xF -c a.f b.f f77 -o application_name a.o b.o
```

If you see the following warning message, check any files that are statically linked, such as unshared object and library files, because these files may not have been compiled with the –-xF option:

```
ld: warning: mapfile: text: .text%function_name: object_file_name: Entrance criteria no
named file, function_name, has not been compiled with the –-xF
option.
```

1. **Load the application in Sun WorkShop for debugging.**

2. **Start the Sampling Collector by choosing Windows > Sampling Collector from the Debugging window.**

3. **Run the application in Sun WorkShop.**

4. **Load the specified experiment into the Sampling Analyzer.**

5. **Create a reordered map in the Sampling Analyzer by choosing Experiment > Create Mapfile. In the file chooser, enter the samples to be used, the mapfile directory, and the name of the mapfile to be created, and click OK.**

   The mapfile contains names of functions that have user CPU time associated with them. It specifies a function ordering that reduces the size of the text address space by sorting profiling data and function sizes in descending order. All functions not listed in the mapfile are placed after the listed functions.

6. **Link the application using the new mapfile.**

   For C applications, type:

   ```
   cc -Wl -M mapfile_name a.o b.o
   ```

   For C++ applications, type:

   ```
   CC -M mapfile_name a.o b.o
   ```

   For C applications, the –-M option causes the compiler to pass –-M *mapfile_name* to the linker.

   For Fortran applications, type:

   ```
   f77 -M mapfile_name a.o b.o
   ```

Printing

You can print a plain text version of the current display or a text summary of the experiment (including average sample times for each data type and the frequency of use of functions, modules, and segments). Choose Experiment > Print or Experiment > Print Summary in the Sampling Analyzer window and type the appropriate information in the dialog box.

Exporting Experiment Data

You can export collected experiment data to files for use by other programs (such as spreadsheets or custom-written applications).

To export experiment data to an ASCII file:

1. **Type the directory of the experiment file to be exported in the Directory text box and the name of the file in the File text box.**

2. **Choose Experiment > Export.**

3. **Click OK to save the experiment data under the given file name.**

CHAPTER 7

Merging Source Files

Merging lets you compare two text files, merge two files into a single new file, and compare two edited versions of a file against the original to create a new file that contains all new edits.

This chapter explains how to start Merging, load it with files, and save the output file. The chapter is organized into the following sections:

- “Understanding Merging” on page 121
- “Starting Merging” on page 122
- “Working With Differences” on page 123
- “Merging Automatically” on page 125
- “Saving the Output File” on page 126

Understanding Merging

Merging loads and displays two text files for side-by-side comparison, each in a read-only text pane. Any differences between the two files are marked. A merged version of the two files, which you can edit to produce a final merged version is diaplayed.

When you load the two files to be merged, you can also specify a third file from which the two files were created. When you have specified this *ancestor* file, Merging marks lines in the *descendants* that are different from the ancestor and produces a merged file based on all three files.

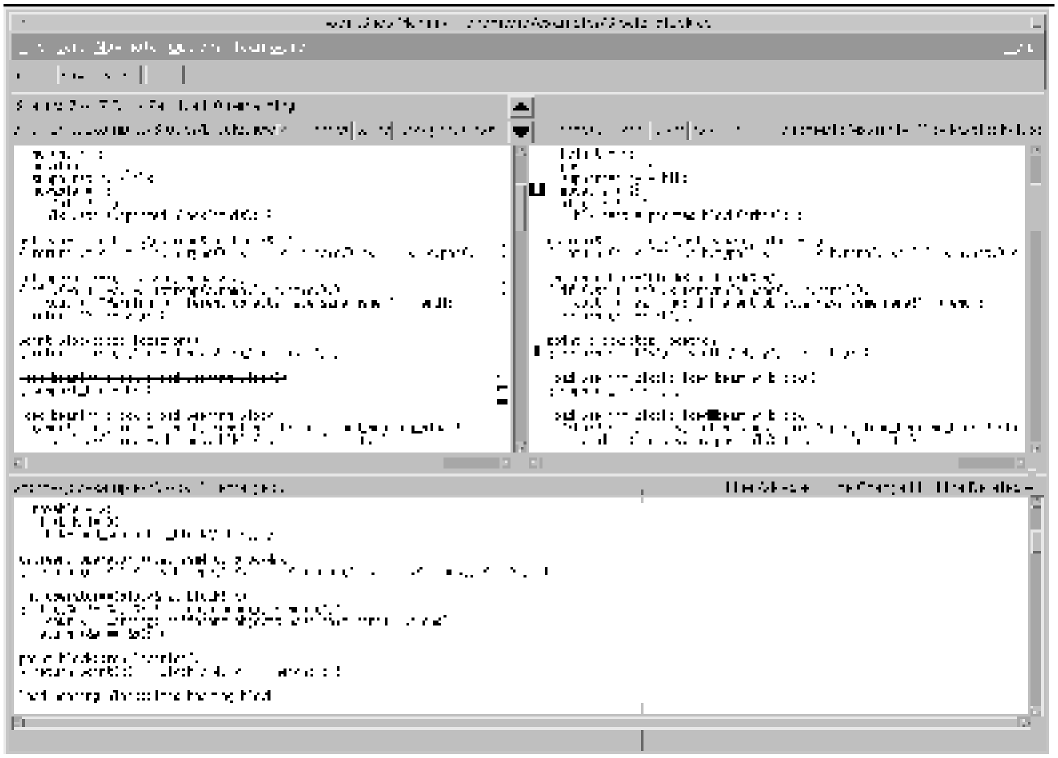


Figure 7–1 Merging Window With Loaded Files

The merged version contains two types of lines:

- Lines common to both input files
- Resolved differences

Starting Merging

To start Merging from the WorkShop main window, choose Tools > Merging.

Loading Files

To load files into Merging:

1. **Choose File > Open.**
2. **In the Directory text box, select a working directory.**

This is the default directory used to select and save files. The browse button to the right of the text box displays a dialog box in which you can select a directory.

3. **In the Left File and Right File text boxes, select the two files you want to compare.**

4. **If you are comparing the files against a common ancestor, type the earlier version of the two files in the Ancestor File text box.**

   An ancestor file is required to use Auto Merge.

5. **If you want to specify the name of the output file, type it in the Output File text box.**

   The name `filemerge.out` is the default, and the file is stored in the working directory.

6. **Click Open to load the files.**

   Figure 7–1 illustrates a loaded Merging window. The names of the left file, right file, and output file are displayed above each text pane. In a three-way comparison, the name of the ancestor file is displayed in the window header.

Setting Merging Options

Use the Options menu to set various Merging options. The menu items enable you to:

- Create a merged version of the files automatically
- Control whether files scroll separately or by corresponding lines
- Customize tab stops
- Set how white space and case differences are handled

Working With Differences

Merging operates on *differences* between files. When Merging discovers a line that differs between the two files to be merged (or between either of the two files and an ancestor), it marks the lines in the two files with glyphs corresponding to how the lines differ. Together, these marked lines are called a *difference*. As you move through the files from one difference to the next, the lines that differ and their glyphs are highlighted.

Current, Next, and Previous Differences

The highlighted difference is called the *current* difference. The differences immediately before and immediately after are called the *previous* difference and the *next* difference.

Resolved and Remaining Differences

A difference is *resolved* if the changes to a line are accepted. A *remaining* difference is one that has not yet been resolved.

If the Auto Merge option is selected, Merging resolves differences automatically.

Understanding Glyphs

Glyphs help you understand the differences between files. There are three types of glyphs:

Glyph Type	**Meaning**
Plus sign (+)	New line
Minus sign (-)	Deleted line
Vertical bar (|)	Change in line
No glyph	No changes in line

When you designate a common ancestor file, glyphs next to the lines in each file indicate when the lines differ from the corresponding lines in the ancestor:

- If a line is identical in all three files, there is no glyph.
- If a line was added to one or both of the descendants, then a plus sign (+) shows where the line was added, and the line is highlighted.
- If a line is present in the ancestor but was removed from one or both of the descendants, then a minus sign (-) shows where the line was removed, and the line is highlighted and in strikethrough font.
- If a line is in the ancestor but has been edited in one or both of the descendants, then a vertical bar (|) shows where the line was changed, and the characters that differ are highlighted.

When a difference is resolved, the glyph changes to an outline font.

Moving Between Differences

You can move between differences using the buttons above the two panes or the Navigate menu. Use the Previous and Next buttons to scroll through the differences without accepting them. Choose Navigate > Find to navigate to a particular text string. Choose Navigate > Goto Line to navigate by line numbers.

You can also navigate between differences by using the popup menu that is available in the Child and Parent panes. Click the right mouse button in either pane to open the menu.

Resolving Differences

To resolve a difference, accept the change in either the left or right pane:

1. **To accept a difference, click the Accept button.**

1. **To accept the difference and move to the next difference, click the Accept & Next button.**

Note - When Merging is invoked by a Resolve transaction in the Configuring window of Sun WorkShop TeamWare, the Reload button is added to the Merging window. Clicking the Reload button at any point during resolution reloads the files, abandons all the conflicts that have been resolved, and starts over. The files are reloaded from disk, and any nonconflicting differences are resolved if the Auto Merge option is selected. You can then proceed by accepting one or the other version of the remaining lines that conflict.

Setting Difference Options

Choose Options > Diff Options to customize Merging to ignore certain kinds of differences between files. You can set Merging to ignore trailing or embedded white space and to ignore differences in case.

Merging Automatically

Merging can resolve differences automatically, based on the following rules:

- If a line has not changed in all three files, it is placed in the output file.

- If a line has changed in one of the descendants, the changed line is placed in the output file. Changes could be the addition or removal of an entire line, or an edit to a line.
- If identical changes have been made to a line in both descendants, the changed line is placed in the output file.
- If a line has been edited in both descendant files so that it is different in all three files, no line is placed in the output file. You must decide how to resolve the difference—either by choosing a line from a descendant, or by editing the merged file by hand.

When Merging automatically resolves a difference, it changes the glyphs to outline font. Merging lets you examine automatically resolved differences to be sure that it has made the correct choices.

You can disable Auto Merge by choosing Options > Auto Merge. When automatic merging is disabled, the output file contains only the lines that are identical in all three files. You must resolve the differences.

If you do not specify an ancestor file, Merging has no reference with which to compare a difference between the two input files. Consequently, Merging cannot determine which line in a difference is likely to represent the desired change. The result of an auto merge with no ancestor is the same as disabling automatic merging: Merging constructs a merged file using only lines that are identical in both input files. You must resolve the differences.

Saving the Output File

Save the output file by clicking the Save button or choosing File > Save. The name of the output file is the name you specify in the Output File text box.

To change the name of the output file while saving, choose Save As and fill in the new file and directory names in the Save As dialog window.

APPENDIX **A**

Setting Sun WorkShop Resources

Sun WorkShop uses two resource files to determine the default colors and fonts used in its windows, and several other options. You may want to change some of these defaults to adapt the Sun WorkShop user interface to your individual preferences.

This appendix describes Sun WorkShop resources that you can set and gives you the information you need before changing the settings.

This appendix organized into the following sections:

- "Sun WorkShop Resource Files" on page 127
- "Resources Available for Editing" on page 128
- "Changing a Resource" on page 129
- "Changing Wide Character Fonts in Hyperlink Windows" on page 129
- "Sun WorkShop Resources" on page 130
- "ESERVE Resources" on page 140

Sun WorkShop Resource Files

Sun WorkShop uses two resource files:

- `WORKSHOP` contains the resource settings for the Sun WorkShop windows, including the browser, debugger, and online help.
- `ESERVE` contains the resource settings for the edit server (see Chapter 1).

Each resource file has two variations, one for CDE (Common Desktop Environment) and one for non-CDE. The files are located in the following directories in your Sun WorkShop installation directory (the default installation directory is `/opt`):

```
/opt/SUNWspro/WS5.0/lib/locale/<lang>/app-defaults/CDE
/opt/SunWspro/WS5.0/lib/locale/<lang>/app-defaults/non-CDE
```

Note - Consult with your system administrator for assistance if you have difficulty locating the resource files; Sun WorkShop may be installed in a different directory at your site.

The Sun WorkShop program loads the correct resource file automatically based on whether the CDE window manager is running or not. The only difference between the CDE and non-CDE variations is that the latter does not define generalized color and font resources for Motif elements; it allows the CDE Style Manager control to these elements.

Resources Available for Editing

Both the WORKSHOP and ESERVE files contain comments that indicate what a group of resources pertains to. For example, the following group of resources controls the colors used in the text editors for highlighting:

```
! Resources for highlight colors used by WORKSHOP in the editors

WORKSHOP.curPCColor:   #8BD98B
WORKSHOP.visitPCColor:  #EDC9FF
WORKSHOP.breakptColor:   #FF9696
```

The types of Sun WorkShop resources you can edit include the following:

- Highlight colors used by Sun WorkShop in the editors
- Colors used in the Data Grapher window of the debugger
- Colors for non-Common Desktop Environments
- Colors for hyperlink windows
- Automatic text wrapping
- Fonts for hyperlinks, and certain monospace fonts and proportional fonts

For details on each of the resources, see “Sun WorkShop Resources” on page 130 and “ESERVE Resources” on page 140.

Resources that affect components in the core Sun WorkShop product do not affect TeamWare components or any components started from the Tools menu. Be sure to read the comments that precede each set of resource definitions.

Changing a Resource

To change a resource definition, do the following:

1. **Create a file called** `WORKSHOP` **or** `ESERVE` **in your home directory or some other directory as specified in your** `XFILESEARCHPATH` **or** `XAPPLRESDIR` **environment variable.**

2. **Change directories to the location of the file that contains the resource you want to change.**

   The default path names for the `WORKSHOP` and `ESERVE` files are listed in “Sun WorkShop Resource Files” on page 127. Consult with your system administrator for assistance if you have difficulty locating the files.

3. **Open the resource file and copy only the resource definitions you want to change.**

4. **Paste the resource definitions into the file you created in your home directory.**

5. **Change the resource settings and start Sun WorkShop.**

   If Sun WorkShop is already running, exit and restart it.

Note - If you modify the default colors in Sun WorkShop to use a non-specified color, you can cause Sun WorkShop to fill up the color map.

Changing Wide Character Fonts in Hyperlink Windows

Many of the windows in Sun WorkShop use hyperlinks to other windows to facilitate the display of related information. For example, clicking on a build error in the Building window causes an editor window to display the source code file that contains the error.

Certain resources serve as flags indicating that non-ASCII characters written to a hyperlink display are to be interpreted as multi-byte characters. The multi-byte characters are displayed in the font indicated by the resource.

The resources should be set *only* in locales in which there is to be multibyte interpretation of non-ASCII characters.

The names of these resources, as they would appear if set in the `WORKSHOP` resource file, are the following:

WORKSHOP*HTML*WCfont:

WORKSHOP*HTML*boldWCFont:

WORKSHOP*HTML*plainWCFont:

WORKSHOP*HTML*plainboldWCFont:

WORKSHOP*HTML*Font:

WORKSHOP*HTML*boldFont:

WORKSHOP*HTML*plainFont:

WORKSHOP*HTML*plainboldFont:

Each WC font resource corresponds to a non-WC font resource. If the WC font resource is set, WC font dimensions determine the line spacing and baseline of text elements written in both the WC font and corresponding non-WC font. The purpose is to produce consistent spacing of a line where ASCII and multi-byte characters are mixed. The WC font dimensions are also used for formatting a line written only in the non-WC fonts.

Note - Where WC font resources are set for hyperlink displays of multi-byte characters and you change a WC font resource, the size and spacing of WC fonts should be proportional to the size and spacing of non-WC fonts. To get proportional formatting you might need to modify the resources for non-WC fonts.

Sun WorkShop Resources

Table A–1 through Table A–17 list the Sun WorkShop color and font resources that you can change in the `WORKSHOP` resource file.

Highlight Colors in Editor Windows

The resources listed in Table A–1 control the colors used to highlight functions, breakpoints, query matches, and build errors in source code displayed in the text editor windows (for an example of highlighting, see Figure 5–2).

TABLE A–1 Highlight Colors in Sun WorkShop Editors

Resource Name	Description	Default Value
WORKSHOP.curPCColor:	Current function	#8BD98B
WORKSHOP.visitPCColor:	Visited function	#EDC9FF
WORKSHOP.breakptColor:	Breakpoint	#FF9696
WORKSHOP.disabledBreakptColor	Disabled breakpoint	#BDBDBD
WORKSHOP.matchColor:	Pattern or symbol match	#99CFFF
WORKSHOP.errorColor:	Current build error	#FFCC40

Data Graph Window Colors

The resources listed in Table A–2 control the colors used in the graph types in the Data Graph window of the debugger (see *Debugging a Program With dbx*).

TABLE A–2 Data Graph Window Colors

Resource Name	Description	Default Value
WORKSHOP.dgLineColor:	Color for Line graph type	#OOOOFF
WORKSHOP.dgFillColor:	Color for Fill graph type	#FDF5E6
WORKSHOP.dgMeshColor:	Color for Mesh graph type	#OOOOFF

Call Graph and Class Graph Window Colors

The resources listed in Table A–3 control the colors of the nodes, the lines (or arrows) connecting the nodes, and background color of the graph pane in the Call Graph window (see Figure 3–5) and the Class Graph window (see Figure 3–6).

TABLE A–3 Resources for Class Graph and Call Graph Windows

Resource Name	Description	Default Value
WORKSHOP*labelNodeBackground:	Background color of each node	#EFEFEF
WORKSHOP*viewBackground:	Graph pane background (Default uses X"s Old Lace)	#FDF5E6
Node properties when unhighlighted		
WORKSHOP*arcForeground:	Arrow between nodes	#000000
WORKSHOP*nodeForegroundColor:	Node border	#000000
WORKSHOP*labelNodeForeground:	Node text	#000000
Node properties when highlighted		
WORKSHOP*arcHighlightColor:	Arrow between nodes	#FF0000
WORKSHOP*nodeHighlightColor:	Node border	#FF0000

Help Window Colors

Table A–4 lists the color resource settings for the standard Help window and the smaller Quick Help window.

TABLE A–4 Colors for General Help Viewer

Resource Name	Description	Default Value
Colors for Help viewer		
WORKSHOP*XmDialogShell.DtHelpDialog*DisplayArea.background:	Background color	White
WORKSHOP*XmDialogShell*XmDialogShell.DtHelpDialog*DisplayArea.background	Background color	White
WORKSHOP*XmDialogShell.DtHelpDialog*DisplayArea.foreground:	Foreground color	Black

TABLE A–4 Colors for General Help Viewer *(continued)*

Resource Name	**Description**	**Default Value**
WORKSHOP*XmDialogShell*XmDialogShell.DtHelpDialog*DisplayArea.foreground	Foreground color	: Black
Colors for Quick Help viewer		
WORKSHOP*XmDialogShell.DtHelpQuickDialog*DisplayArea.background:	Background color	White
WORKSHOP*XmDialogShell*XmDialogShell.DtHelpQuickDialog*DisplayArea.background	Background color	White
WORKSHOP*XmDialogShell.DtHelpQuickDialog*DisplayArea.foreground:	Foreground color	Black
WORKSHOP*XmDialogShell*XmDialogShell.DtHelpQuickDialog*DisplayArea.foreground	Foreground color	Black

Audible Warnings

The resource listed in Table A–5 enables you to turn off audible warning beeps. The possible values are –`XmBell` and –`XmNONE`.

TABLE A–5 Resource for Audible Warnings

Resource Name	Description	Default Value
WORKSHOP*audibleWarning:	Turns audible beeps on and off	XmBell

Debugger Buttons

The resource listed in Table A–6 enables you to set the delay in milliseconds before debugger and text editor buttons are disabled when `dbx` starts. This disabling prevents button flashes when you are stepping through code. If you are running Sun WorkShop on a slow system or over an ISDN line, you may want to increase this delay.

TABLE A–6 Resource for Debugger Button Disable Delay

Resource Name	Description	Default Value
WORKSHOP.ButtonDisableDelay	Delays disabling of debugger and text editor buttons when dbx starts	250

Dbx Commands and Program I/O Window Output Lines

The resource listed in Table A–7 sets the number of lines of output to save in the Dbx Commands window and the Program Input/Output window.

TABLE A–7 Number of Output Lines Saved in Dbx Commands and Program I/O Windows

Resource	Description	Default Value
WORKSHOP*dtTerm.saveLines	Number of output lines saved	1000

Browser Used to Display Web Updates

The resource listed in Table A–8 enables you to change the default path for the browser used to display the Sun WorkShop Web Updates page (see “Web Updates” on page 7).

TABLE A–8 Web Updates Browser

Resource	Description	Default Value
WORKSHOP.browser	Path to browser used to display Web Updates	sdtwebclient

Hyperlink Resources

The resources listed in Table A–9 set the font type, weight, and angle used in hyperlinks in the windows and dialog boxes of the English version of Sun

WorkShop. For examples of hyperlinks in Sun WorkShop windows, see Figure 4–6, which shows build error links in the Building window, and Figure 5–1, which shows function links in the Stack pane of the Debugging window.

TABLE A–9 Hyperlink fonts for "C" locale (English)

Resource Name	Default Value
WORKSHOP*HTML*BoldFont:	-*-lucida-bold-r-normal-*-12-*-*-*-*-*-iso8859-1
WORKSHOP*HTML*PlainFont:	-*-lucidatypewriter-medium-r-normal-*-12-*-*-*-*-*-iso8859-1
WORKSHOP*HTML*PlainboldFont:	-*-lucidatypewriter-bold-r-normal-*-12-*-*-*-*-*-iso8859-1

Table A–10 lists hyperlink WC font resources for locales with multi-byte characters. If set, non-ASCII characters written to HTML displays are interpreted as multi-byte characters and displayed with font indicated by the resource.

TABLE A–10 Hyperlink fonts for Japanese locale

Resource Name	Default Value
WORKSHOP*HTML*boldWCFont:	-jis-fixed-medium-r-normal–16-150-75-75-c-160-*-0
WORKSHOP*HTML*plainWCFont:	-jis-fixed-medium-r-normal–16-150-75-75-c-160-*-0
WORKSHOP*HTML*plainboldWCFont:	-jis-fixed-medium-r-normal–16-150-75-75-c-160-*-0

Automatic Text Wrapping

The resource listed in Table A–11 lets you set text to automatically wrap or start a new line in a Sun WorkShop window. The default value is true, meaning that text automatically wraps when it meets a window border.

TABLE A–11 Automatic Wrapping of Text

Resource Name	Default Value
WORKSHOP*HTML*wrapPreformatText:	True

The resource listed in Table A–12 enables you to turn vertical scrollbars off or on.

TABLE A–12 Availability of Vertical Scrollbars

Resource Name	Default Value
WORKSHOP*HTML*verticalScrollbarAlways:	True

Motif-specific Resources

Table A–13 through Table A–17 list resources that are specific to Motif environments only and are not used by CDE.

TABLE A–13 Fonts for Motif (non-CDE) Windowing Systems

Resource Name	Description	Default Value
WORKSHOP.labelFontList:	Font types for labels	-*-lucida-medium-r-normal-*-12-*-*-*-*-*-*-*
WORKSHOP.buttonFontList:	Font types on buttons	-*-lucida-medium-r-normal-*-12-*-*-*-*-*-*-*
WORKSHOP.textFontList:	Font types in lists	-*-lucidatypewriter-medium-r-normal-*-12-*-*-*-*-*-*-*

In your resource file, uncomment the resources listed in Table A–14 to change the fonts in a specific Sun WorkShop window.

TABLE A–14 Fonts for Specific Windows

Resource Name	Default Value
WORKSHOP*ipeDbxCommandWindow*userFont:	-*-lucidatypewriter-medium-r-normal-*-12-*-*-*-*-*-iso8859-1:
WORKSHOP*ipeProgramIOShell*userFont:	-*-lucidatypewriter-medium-r-normal-*-12-*-*-*-*-*-iso8859-1:
WORKSHOP*threadsList*fontList:	-*-lucidatypewriter-medium-r-normal-*-12-*-*-*-*-*-iso8859-1
WORKSHOP*handlerList*fontList:	-*-lucidatypewriter-medium-r-normal-*-12-*-*-*-*-*-iso8859-1
WORKSHOP*processList*fontList:	-*-lucidatypewriter-medium-r-normal-*-12-*-*-*-*-*-iso8859-1

This resource listed in Table A–15 is applicable to text in a tabular format, such as tables.

TABLE A–15 Font Used in Tabular Windows

Resource Name	Default Value
WORKSHOP.DataMonospacedFont:	-*-lucidatypewriter-medium-r-normal-*-12-*-*-*-*-*-*

Window Foreground and Background Colors

Table A–16 lists the resources that control the foreground and background colors used in most Sun WorkShop windows.

TABLE A–16 Colors for Sun WorkShop Windows, Dialog Boxes, Menus, and Buttons

Resource Name	Description	Default Value
WORKSHOP*foreground:	Foreground color of windows (text such as labels)	#000000
WORKSHOP*XmTextField*background:	Background color of text boxes	#FFFFFF
WORKSHOP*XmText*background:	Text color	#FFFFFF
WORKSHOP*threadsList.background:	Background color of Threads pane	#FFFFFF
WORKSHOP*ipeDbxCommandWindow*dtTerm.background:	Background color of Dbx Commands window	#FFFFFF
WORKSHOP*ipeProgramIOShell*dtTerm.background:	Background color of Program Input/ Output window	#FFFFFF
WORKSHOP*XmDrawingArea.background:	Background color of Stack pane, Data Display, and so forth	#FFFFFF
WORKSHOP*background:	Background color of Sun WorkShop windows	#DEDEDE
WORKSHOP*XmPushButton*background:	Background color of buttons	#DEDEDE
WORKSHOP*XmMenuShell*background:	Background color of menus	#DEDEDE

TABLE A–16 Colors for Sun WorkShop Windows, Dialog Boxes, Menus, and Buttons *(continued)*

Resource Name	Description	Default Value
WORKSHOP*XmList*background:	Background color of lists such as Match list in Browsing window	#DEDEDE
WORKSHOP*topShadowColor:	Color of shadows at top and left edges of buttons, text boxes, and so forth	#FFFFFF

Scrollbar Background and Toggle Button Colors

Table A–17 lists the resources for the colors of the scrollbar background (trough), and the colors in toggle buttons to indicate toggle on or off.

TABLE A–17 Colors for Trough and Toggle Buttons Used in Sun WorkShop

Resource Name	Description	Default Value
WORKSHOP*HTML*troughColor:	Background color for scrollbars	#DEDEDE
WORKSHOP*XmToggleButton.selectColor:	Color for checkboxes when selected	#FF9696
WORKSHOP*XmToggleButton.fillOnSelect:	Fill checkbox when selected	true
WORKSHOP*XmToggleButtonGadget.selectColor:	Color for radio buttons when selected	#FF9696
WORKSHOP*XmToggleButtonGadget.fillOnSelect:	Fill radio button when selected	true

ESERVE Resources

The following tables lists the ESERVE resources that you can change.

Emacs Editor Default Path Names

The resources listed in Table A–18 are used by the edit server to invoke the GNU Emacs and XEmacs text editors. If a fully qualified path is specified, it is executed.

TABLE A–18 Default Paths for Emacs Editors

Resource Name	**Default Value**
ESERVE*defaultGnuEmacsPath:	emacs
ESERVE*defaultXEmacsPath:	xemacs

The values for these resources can either be fully qualified paths or the base name of the command (for instance, `myfavoriteemacs`).

If a basename is used then it is invoked from the `PATH` environment variable.

Blinking Pointer

Table A–19 lists the resource to change the pointer in text editor windows to a non-blinking pointer. Default setting is for a blinking pointer. Set to 0 for a non-blinkng pointer.

TABLE A–19 Blinking Pointer Resource

Resource Name	**Default Value**
ESERVE*DtTerm.blinkRate:	250

Fonts for Motif Environments

Table A–20 lists font resources for the text editor windows that are specific to Motif environments only and are not used by CDE.

TABLE A–20 Fonts for Motif (non-CDE) windowing systems

Resource Name	Default Value
ESERVE.labelFontList:	-*-lucida-medium-r-normal-*-12-*-*-*-*-*-*
ESERVE.buttonFontList:	-*-lucida-medium-r-normal-*-12-*-*-*-*-*-*
ESERVE.textFontList:	-*-lucidatypewriter-medium-r-normal-*-12-*-*-*-*-*-*
ESERVE*dtTerm*userFont:	-*-lucidatypewriter-medium-r-normal-*-12-*-*-*-*-*-*

Text Editor Window Colors

Table A–21 lists the resource for foreground and background colors in the text editor windows.

TABLE A–21 Colors for Sun WorkShop Windows, Dialog Boxes, Menus, and Buttons

Resource Name	Description	Default Value
ESERVE*foreground	**Foregroundcolor of windows (text such as labels)**	**black**
ESERVE*background:	**Background color of windows**	**#dededededede**
ESERVE*XmPushButton*background:	Background color of buttons	#dededededede
ESERVE*XmMenuShell*background:	Background color of manus	#dededededede

Scrolling List Background Color

Table A–22 lists the resource for the background color for scrolling lists available from a text editor.

TABLE A–22 Read-only Text Areas (lists)

Resource Name	**Description**	**Default Value**
ESERVE*XmList*background:	Background color of scrolling lists	#dededededede

Writable Text Area Background Color

Table A–23 lists colors for areas in the text editor windows containing text, other than menus and buttons (not applicable to Emacs and XEmacs).

TABLE A–23 Writable Text Areas

Resource Name	**Default Value**
ESERVE*XmTextField*background:	white
ESERVE*XmText*background:	white
ESERVE*dtTerm*background:	white
ESERVE*readwriteBackground:	white

Audible Warnings

The resource listed in Table A–24 enables you to turn off audible warning beeps. The possible values are –`XmBell` and –`XmNONE`.

TABLE A–24 Resource for Audible Warnings

Resource Name	Description	Default Value
ESERVE*audibleWarning:	Turns audible beeps on and off	XmBell

Browser Used to Display Web Updates

The resource listed in Table A–25 enables you to change the default path for the browser used to display the Sun WorkShop Web Updates page (see "Web Updates" on page 7).

TABLE A–25 WebUpdates Browser

Resource	Description	Default Value
ESERVE.browser	Path to browser used to display Web Updates	sdtwebclient

APPENDIX **B**

The make Utility and Makefiles

You can use the make utility and makefiles to help automate building of an application with Sun WorkShop. This appendix provides some basic information about the make utility, makefiles, and makefile macros. It also refers you to dialog boxes in Sun WorkShop that allow you to set makefile options and to add, delete, and override makefile macros.

The make Utility

The make utility applies intelligence to the task of program compilation and linking. Typically, a large application may exist as a set of source files and INCLUDE files, which require linking with a number of libraries. Modifying any one or more of the source files requires recompilation of that part of the program and relinking. You can automate this process by specifying the interdependencies between files that make up the application along with the commands needed to recompile and relink each piece. With these specifications in a file of directives, make insures that only the files that need recompiling are recompiled and that relinking uses the options and libraries you want.

The Makefile

A file called makefile tells the make utility in a structured manner which source and object files depend on other files. It also defines the commands required to compile and link the files.

Each file to build, or step to perform, is called a *target*. Each entry in a makefile is a rule expressing a target object's dependencies and the commands needed to build or make that object. The structure of a rule is:

target: *dependencies-list*TAB *build-commands*

- Dependencies. Each entry starts with a line that names the target file, followed by all the files the target depends on.
- Commands. Each entry has one or more subsequent lines that specify the Bourne shell commands that will build the target file for this entry. Each of these command lines must be indented by a tab character.

FORTRAN 77 Example

Suppose you have a program of four source files and the makefile:

makefile

commonblock

computepts.f

pattern.f

startupcore.f

Assume both pattern.f and computepts.f have an INCLUDE of commonblock, and you wish to compile each .f file and link the three relocatable files, along with a series of libraries, into a program called pattern.

The makefile looks like this:

```
pattern: pattern.o computepts.o startupcore.o
   f77 pattern.o computepts.o startupcore.o -lcore77 \
   -lcore -lsunwindow -lpixrect -o pattern
pattern.o: pattern.f commonblock
   f77 -c -u pattern.f
computepts.o: computepts.f commonblock
   f77 -c -u computepts.f
startupcore.o: startupcore.f
   f77 -c -u startupcore.f
```

The first line of this makefile indicates that making pattern depends on pattern.o, computepts.o, and startupcore.o. The next line and its continuations give the command for making pattern from the relocatable.o files and libraries.

C++ Example

Suppose you have a program of five source files and the makefile:

manythreads.cc

Makefilemany.cc

thr.cc

misc.h

defines.h

The target files are many, manythreads, and thrI.

The makefile looks like this:

```
all: many manythreads thrI

many: many.cc
      CC -o many many.cc -g -D_REENTRANT -lm -lnsl -lsocket -lthread
thrI: thr.cc
      CC -o thrI thr.cc -g -D_REENTRANT -lm -lnsl -lsocket -lthread
manythreads: manythreads.cc
      CC -o manythreads -g -D_REENTRANT manythreads.cc -lnsl \
      -lsocket -lthread
```

The first line of this makefile groups a set of targets with the label all. The succeeding lines give the commands for making the three targets, each of which has a dependency on one of the source files.

The make Command

The make command can be invoked with no arguments, simply:

```
demo% make
```

You can add a number of options to the make command for your application using the Options dialog box in Sun WorkShop (see “Specifying Make Options” on page 60).

The make utility looks for a file named makefile or Makefile in the current directory and takes its instructions from that file.

The make utility:

- Reads makefile to determine all the target files it must process, the files they depend on, and the commands needed to build them

- Finds the date and time each file was last changed
- Rebuilds any target file that is older than any of the files it depends on, using the commands from `makefile` for that target

Macros

The `make` utility's *macro* facility allows simple parameterless string substitutions. For example, the list of relocatable files that make up the target program `pattern` can be expressed as a single macro string, making it easier to change.

A macro string definition has the form:

NAME = string

Use of a macro string is indicated by

$(*NAME*)

which is replaced by `make` with the actual value of the macro string named.

This example adds a macro definition naming all the object files to the beginning of `makefile`:

```
OBJ = pattern.o computepts.o startupcore.o
```

Now the macro can be used in both the list of dependencies as well as on the `f77 link` command for target `pattern` in `makefile`:

```
pattern: $(OBJ)
   f77 $(OBJ) --lcore77 --lcore --lsunwindow
\
   --lpixrect --o pattern
```

For macro strings with single-letter names, the parentheses may be omitted.

Creating Macros With the Make Macros Dialog Box

You can use the Make Macros dialog box in Sun WorkShop to add macros to or delete macros from the Macros list in your WorkShop target, and reassign values for makefile macros in the list. For detailed information on using the dialog box, see "Using Makefile Macros" on page 64.

Overriding of Macro Values

The initial values of makefile macros can be overridden with command-line options to make. For example, suppose you have the following line at the top of makefile:

```
FFLAGS=-u
```

and the compile-line of computepts.f:

```
f77 $(FFLAGS) -c computepts.f
```

and the final link:

```
f77 $(FFLAGS) $(OBJ) -lcore77 -lcore -lsunwindow \ lpixrect -o pattern
```

Now a simple make command without arguments uses the value of FFLAGS set above. However, this can be overridden from the command line:

```
demo% make "FFLAGS=-u -O"
```

Here, the definition of the FFLAGS macro on the make command line overrides the makefile initialization, and both the -O flag and the -u flag are passed to f77. Note that "FFLAGS=" can also be used on the command line to reset the macro so that it has no effect.

Note - You can use the Make Macros dialog box in Sun WorkShop to override the value of a macro (see “Using Makefile Macros” on page 64).

Suffix Rules in the make Utility

To make writing a makefile easier, the make utility has default rules that it uses depending on the suffix of a target file. Recognizing the .f suffix, make uses the f77 compiler—passing as arguments any flags specified by the FFLAGS macro, the -c flag, and the name of the source file to be compiled.

The example below demonstrates this rule twice:

```
OBJ = pattern.o computepts.o startupcore.o
FFLAGS=--u
pattern: $(OBJ)
    f77 $(OBJ) -lcore77 -lcore -lsunwindow
\
   --lpixrect --o pattern
pattern.o: pattern.f commonblock
    f77 $(FFLAGS) -c pattern.f
computepts.o: computepts.f commonblock
startupcore.o: startupcore.f
```

`make` uses default rules to compile `computepts.f` and `startupcore.f`.

Similarly, the suffix rules for `.f90` files invoke the `f90` compiler.

More Information

A number of good, commercially published books on how to use `make` as a program development tool are currently available, including *Managing Projects with* `make`, by Oram and Talbott, from O'Reilly & Associates.

APPENDIX **C**

Using the dmake Utility

This appendix describes the way the Distributed Make (dmake) utility distributes builds over several hosts to build programs concurrently over a number of workstations or multiple CPUs.

Basic Concepts

Distributed make (dmake) allows you to concurrently distribute the process of building large projects, consisting of many programs, over a number of workstations and, in the case of multiprocessor systems, over multiple CPUs. The dmake utility parses your makefiles and:

- Determines which targets can be built concurrently
- Distributes the build of those targets over a number of hosts designated by you

The dmake utility is a superset of the make utility.

To understand dmake, you should know about:

- Configuration files (runtime and build server)
- The dmake host
- The build server

Configuration Files

The dmake utility consults two files to determine to which build servers jobs are distributed and how many jobs can be distributed to each.

Runtime Configuration File

The dmake utility searches for a runtime configuration file on the dmake host to know where to distribute jobs. Generally, this file is in your home directory on the dmake host and is named .dmakerc. It consists of a list of build servers and the number of jobs to be distributed to each build server. See "The dmake Host" on page 152" for more information.

Build Server Configuration File

The /etc/opt/SPROdmake/dmake.conf file is in the file system of build servers. It specifies the maximum total number of dmake jobs that can be distributed to each build server by all dmake users. In addition, it may specify the "nice" priority under which all dmake jobs should run.

See "The Build Server" on page 154 for more information.

The dmake Host

The dmake utility searches for a runtime configuration file to determine where to distribute jobs. Generally, this file must be in your home directory on the dmake host and is named .dmakerc. The dmake utility searches for the runtime configuration file in these locations and in the following order:

1. The path name you specify on the command line using the -c option
2. The path name you specify using the DMAKE_RCFILE makefile macro
3. The path name you specify using the DMAKE_RCFILE environment variable
4. $(HOME)/.dmakerc

If a runtime configuration file is not found, the dmake utility distributes two jobs to the dmake host.

You edit the runtime configuration file so that it consists of a list of build servers and the number of jobs you want distributed to each build server. The following is an example of a .dmakerc file:

```
# My machine. This entry causes dmake to distribute to it.
falcon   { jobs = 1 }
hawk
eagle   { jobs = 3 }
# Manager’s machine. She’s usually at meetings
heron   { jobs = 4 }
```

```
avocet
```

- The entries: `falcon`, `hawk`, `eagle`, `heron`, and `avocet` are listed build servers.
- You can specify the number of jobs you want distributed to each build server. The default number of jobs is two.
- Any line that begins with the # character is interpreted as a comment.

Note - This list of build servers includes `falcon` which is also the dmake host. The dmake host can also be specified as a build server. If you do not include it in the runtime configuration file, no dmake jobs are distributed to it.

You can also construct groups of build servers in the runtime configuration file. This provides you with the flexibility of easily switching between different groups of build servers as circumstances warrant. For instance, you may define groups of build servers for builds under different operating systems, or you may define groups of build servers that have special software installed on them.

The following is an example of a runtime configuration file that contains groups of build servers:

```
earth   { jobs = 2 }
mars   { jobs = 3 }

group lab1 {
   host falcon { jobs = 3 }
   host hawk
   host eagle     { jobs = 3 }
}

group lab2 {
   host heron
   host avocet     { jobs = 3 }
   host stilt     { jobs = 2 }
}

group labs {
   group lab1
   group lab2
}

group sunos5.x {
   group labs
   host jupiter
   host venus { jobs = 2 }
   host pluto  { jobs = 3 }
}
```

- Formal groups are specified by the `group` directive and lists of their members are delimited by braces ({}).

- Build servers that are members of groups are specified by the optional host directive.
- Groups can be members of other groups.
- Individual build servers can be listed in runtime configuration files that also contain groups of build servers; in this case, dmake treats these build servers as members of the *unnamed* group.

In order of precedence, the dmake utility distributes jobs to the following:

1. The formal group specified on the command-line as an argument to the –-g option
2. The formal group specified by the DMAKE_GROUP makefile macro
3. The formal group specified by the DMAKE_GROUP environment variable
4. The first group specified in the runtime configuration file

The dmake utility allows you to specify a different execution path for each build server. By default dmake looks for the dmake support binaries on the build server in the same logical path as on the dmake host. You can specify alternate paths for build servers as a host attribute in the .dmakerc file. For example:

```
group lab1 {
   host falcon { jobs = 10 , path = "/set/dist/sparc-S2/bin" }
   host hawk { path = "/opt/SUNWspro/bin"                    }
}
```

You can use double quotation marks to enclose the names of groups and hosts in the .dmakerc file. This allows you more flexibility in the characters that you can use in group names. Digits are allowed, as well as alphabetic characters. Names that start with digits should be enclosed in double quotes. For example:

```
group "123_lab" {
   host "456_hawk" { path = "/opt/SUNWspro/bin"                  }
}
```

The Build Server

The /etc/opt/SPROdmake/dmake.conf file is in the file system of build servers. Use this file to limit the maximum number of dmake jobs (from all users) that can run concurrently on a build server snd to specify the “nice” priority under which all dmake jobs should run. The following is an example of an /etc/opt/SPROdmake/dmake.conf file. This file sets the maximum number of dmake jobs permitted to run on a build server (from all dmake users) to be eight.

```
max_jobs: 8
nice_prio: 5
```

Note - If the /etc/opt/SPROdmake/dmake.conf file does not exist on a build server, no dmake jobs will be allowed to run on that server.

Understanding the dmake Utility

To run a distributed make, use the executable file dmake in place of the standard make utility. You should understand the Solaris make utility before you use dmake. If you need to read more about the make utility, see the Solaris Programming Utilities Guide. If you use the make utility, the transition to dmake requires little if any alteration.

Impact of the dmake Utility on Makefiles

The methods and examples shown in this section present the kinds of problems that lend themselves to solution with dmake. This section does not suggest that any one approach or example is the best. Compromises between clarity and functionality were made in many of the examples.

As procedures become more complicated, so do the makefiles that implement them. You must know which approach will yield a reasonable makefile that works. The examples in this section illustrate common code-development predicaments and some straightforward methods to simplify them using dmake.

Using Makefile Templates

If you use a makefile template from the outset of your project, custom makefiles that evolve from the makefile templates will be:

- More familiar
- Easier to understand
- Easier to integrate
- Easier to maintain
- Easier to reuse

The less time you spend editing makefiles, the more time you have to develop your program or project.

Building Targets Concurrently

Large software projects typically consist of multiple independent modules that can be built concurrently. The dmake utility supports concurrent processing of targets on multiple machines over a network. This concurrency can markedly reduce the time required to build a large project.

When given a target to build, dmake checks the dependencies associated with that target, and builds those that are out of date. Building those dependencies may, in turn, entail building some of their dependencies. When distributing jobs, dmake starts every target that it can. As these targets complete, dmake starts other targets. Nested invocations of dmake are not run concurrently by default, but this can be changed (see "Restricting Parallelism " on page 159 for more information).

Since dmake builds multiple targets concurrently, the output of each build is produced simultaneously. To avoid intermixing the output of various commands, dmake collects output from each build separately. The dmake utility displays the commands before they are executed. If an executed command generates any output, warnings, or errors, dmake displays the entire output for that command. Since commands started later may finish earlier, this output may be displayed in an unexpected order.

Limitations on Makefiles

Concurrent building of multiple targets places some restrictions on makefiles. Makefiles that depend on the implicit ordering of dependencies may fail when built concurrently. Targets in makefiles that modify the same files may fail if those files are modified concurrently by two different targets. Some examples of possible problems are discussed in this section.

Dependency Lists

When building targets concurrently, it is important that dependency lists be accurate. For example, if two executables use the same object file but only one specifies the dependency, then the build may cause errors when done concurrently. For example, consider the following makefile fragment:

```
all: prog1 prog2
prog1: prog1.o aux.o
 $(LINK.c) prog1.o aux.o -o prog1
prog2: prog2.o
 $(LINK.c) prog2.o aux.o -o prog2
```

When built serially, the target aux.o is built as a dependent of prog1 and is up-to-date for the build of prog2. If built in parallel, the link of prog2 may begin before aux.o is built, and is therefore incorrect. The .KEEP_STATE feature of make detects some dependencies, but not the one shown above.

Explicit Ordering of Dependency Lists

Other examples of implicit ordering dependencies are more difficult to fix. For example, if all of the headers for a system must be constructed before anything else is built, then everything must be dependent on this construction. This causes the makefile to be more complex and increases the potential for error when new targets are added to the makefile. The user can specify the special target `.WAIT` in a makefile to indicate this implicit ordering of dependents. When `dmake` encounters the `.WAIT` target in a dependency list, it finishes processing all prior dependents before proceeding with the following dependents. More than one `.WAIT` target can be used in a dependency list. The following example shows how to use `.WAIT` to indicate that the headers must be constructed before anything else.

```
all: hdrs .WAIT libs functions
```

You can add an empty rule for the `.WAIT` target to the makefile so that the makefile is backward-compatible.

Concurrent File Modification

You must make sure that targets built concurrently do not attempt to modify the same files at the same time. This can happen in a variety of ways. If a new suffix rule is defined that must use a temporary file, the temporary file name must be different for each target. You can accomplish this by using the dynamic macros `$@` or `$*`. For example, a `.c.o` rule that performs some modification of the .c file before compiling it might be defined as:

```
.c.o:
    awk -f modify.awk $*.c > $*.mod.c
    $(COMPILE.c) $*.mod.c -o $*.o
    $(RM) $*.mod.c
```

Concurrent Library Update

Another potential concurrency problem is the default rule for creating libraries that also modifies a fixed file, that is, the library. The inappropriate `.c.a` rule causes `dmake` to build each object file and then archive that object file. When `dmake` archives two object files in parallel, the concurrent updates will corrupt the archive file.

```
.c.a:
    $(COMPILE.c) -o $% $<
    $(AR) $(ARFLAGS) $@ $%
    $(RM) $%
```

A better method is to build each object file and then archive all the object files after completion of the builds. An appropriate suffix rule and the corresponding library rule are:

```
.c.a:
    $(COMPILE.c) -o $% $<

lib.a: lib.a($(OBJECTS))
    $(AR) $(ARFLAGS) $(OBJECTS)
    $(RM) $(OBJECTS)
```

Multiple Targets

Another form of concurrent file update occurs when the same rule is defined for multiple targets. An example is a `yacc(1)` program that builds both a program and a header for use with `lex(1)`. When a rule builds several target files, it is important to specify them as a group using the + notation. This is especially so in the case of a parallel build.

```
y.tab.c y.tab.h: parser.y
    $(YACC.y) parser.y
```

This rule is actually equivalent to the two rules:

```
y.tab.c: parser.y
 $(YACC.y) parser.y
y.tab.h: parser.y
 $(YACC.y) parser.y
```

The serial version of `make` builds the first rule to produce `y.tab.c` and then determines that `y.tab.h` is up-to-date and need not be built. When building in parallel, `dmake` checks `y.tab.h` before `yacc` has finished building `y.tab.c` and notices that `y.tab.h` *does* need to be built, it then starts another `yacc` in parallel with the first one. Since both `yacc` invocations are writing to the same files (`y.tab.c` and `y.tab.h`), these files are apt to be corrupted and incorrect. The correct rule uses the `+` construct to indicate that both targets are built simultaneously by the same rule. For example:

```
y.tab.c + y.tab.h: parser.y
 $(YACC.y) parser.y
```

Restricting Parallelism

Sometimes file collisions cannot be avoided in a makefile. An example is xstr(1), which extracts strings from a C program to implement shared strings. The xstr command writes the modified C program to the fixed file x.c and appends the strings to the fixed file strings. Since xstr must be run over each C file, the following new .c.o rule is commonly defined:

```
.c.o:
 $(CC) $(CPPFLAGS) -E $*.c | xstr -c -
 $(CC) $(CFLAGS) $(TARGET_ARCH) -c x.c
 mv x.o $*.o
```

The dmake utility cannot concurrently build targets using this rule since the build of each target writes to the same x.c and strings files. Nor is it possible to change the files used. You can use the special target .NO_PARALLEL: to tell dmake not to build these targets concurrently. For example, if the objects being built using the .c.o rule were defined by the OBJECTS macro, the following entry would force dmake to build those targets serially:

```
.NO_PARALLEL: $(OBJECTS)
```

If most of the objects must be built serially, it is easier and safer to force all objects to default to serial processing by including the .NO_PARALLEL: target without any dependents. Any targets that can be built in parallel can be listed as dependencies of the .PARALLEL: target:

```
.NO_PARALLEL:
.PARALLEL: $(LIB_OBJECT)
```

Nested Invocations of Distributed Make

When dmake encounters a target that invokes another dmake command, it builds that target serially, rather than concurrently. This prevents problems where two different dmake invocations attempt to build the same targets in the same directory. Such a problem might occur when two different programs are built concurrently, and each must access the same library. The only way for each dmake invocation to be sure that the library is up-to-date is for each to invoke dmake recursively to build that library. The dmake utility recognizes a nested invocation only when the $(MAKE) macro is used in the command line.

If you nest commands that you know will not collide, you can force them to be done in parallel by using the .PARALLEL: construct.

When a makefile contains many nested commands that run concurrently, the load-balancing algorithm may force too many builds to be assigned to the local machine. This may cause high loads and possibly other problems, such as running out of swap space. If such problems occur, allow the nested commands to run serially.

Using the dmake Utility

You execute dmake on a *dmake host* and distribute jobs to *build servers*. You can also distribute jobs to the dmake host, in which case it is also considered to be a build server. The dmake utility distributes jobs based on makefile targets that dmake determines (based on your makefiles) can be built concurrently. You can use a machine as a build server if it meets the following requirements:

- From the dmake host (the machine you are using) you must be able to use rsh, without being prompted for a password, to remotely execute commands on the build server. See man rsh(1) or the system AnswerBook documentation for more information about the rsh command. For example:

```
demo% rsh build_server which dmake
   /opt/SUNWspro/bin/dmake
```

- The bin directory in which the dmake software is installed must be accessible from the build server. See the share(1M) and mount(1M) man pages or the system AnswerBook documentation for more information about creating shared filesystems.
- By default, dmake assumes that the logical path to the dmake executables on the build server is the same as on the dmake host. You can override this assumption by specifying a path name as an attribute of the host entry in the runtime configuration file. For example:

```
group sparc-cluster {
      host wren   { jobs = 10 , path = ‘‘/export/SUNWspro/bin’’}
      host stimpy { path = ‘‘/opt/SUNWspro/bin’’             }
```

- The source hierarchy you are building must be:
  - Accessible from the build server
  - Mounted under the same name

From the dmake host you can control which build servers are used and how many dmake jobs are allotted to each build server. The number of dmake jobs that can run on a given build server can also be limited on that server.

Note - If you specify the `-m` option with the `parallel` argument, or set the `DMAKE_MODE` variable or macro to the value `parallel`, `dmake` does not scan your runtime configuration file. Therefore, you must specify the number of jobs using the `-j` option or the `DMAKE_MAX_JOBS` variable or macro. If you do not specify a value this way, a default of two jobs is used.

Note - If you modify the maximum number of jobs using the `-j` option, or the `DMAKE_MAX_JOBS` variable or macro when using `dmake` in distributed mode, the value you specify overrides the values listed in the runtime configuration file. The value you specify is used as the total number of jobs that can be distributed to all build servers.

Controlling dmake Jobs

The distribution of `dmake` jobs is controlled in two ways:

1. A dmake user on a dmake host can specify the machines to use as build servers and the number of jobs to distribute to each build server.
2. The "owner" on a build server can control the maximum total number of dmake jobs that can be distributed to that build server. The owner is a user who can alter the `/etc/opt/SPROdmake/dmake.conf` file.

Note - If you access `dmake` from the GUI (Building window), use the online help to know how to specify your build servers and jobs. If you access `dmake` from the coommand line, see the `dmake` man page (`dmake.1`).

APPENDIX **D**

Browsing Source With sbquery, sb_init, and sbtags

This appendix:

- Describes sbquery, one of the command-line utilities for browsing source code
- Tells you how to work with source files whose database information is stored in multiple directories
- Describes the sbtags command, which provides a quick and convenient method for collecting browsing information from source files

The information in this chapter pertains mainly to the use of the command line to complete tasks also available from within Sun WorkShop. For more conceptual information on using source browsing, see Chapter 3" and the Sun WorkShop online help.

This appendix is organized into the following sections:

Browsing Source With sbquery

The sbquery command provides you with a command-line browsing environment that you can access from terminals and from workstations emulating terminals.

Understanding sbquery

The command-line interface to the Source Browsing mode of Sun WorkShop is sbquery.

To issue a query from the command line, type sbquery, followed by any command-line options and their arguments, followed by the symbol you want to search for:

```
sbquery [options] symbols
```

All lines that contain *symbols* are displayed.

sbquery displays a list of matches that includes the file in which the symbol appears, the line number, the function containing the symbol, and the source line containing the symbol.

By default, sbquery searches for symbols in the database in the current working directory. If you want to browse a database stored in another directory, see “Controlling the Browser Database With sb_init” on page 168.

Command Reference

To obtain a list of the sbquery command-line options, type sbquery at the shell prompt. Table D–1 lists and describes the options.

TABLE D–1 sbquery Options

Arguments	Description
-break_lock	Breaks the lock on a locked database. This argument might be needed if the update of the index file is aborted. The next time you issue a query you might get a message telling you that the database is locked. After using this option, your database may be in an inconsistent state. To ensure consistency, remove the database directory and recompile your program.
-help	Displays a synopsis of the sbquery command. Equivalent to typing sbquery with no options.
-help_focus	Displays a list of the focus options available for querying only specific program types in a directory. Use focus options to issue a query limited to specific units of code such as programs or functions.

TABLE D–1 sbquery Options *(continued)*

Arguments	Description
-help_filter	Displays a list of the languages for which filter options are available. Use filtering options to search for symbols based on how they are used in a program.
max_memory *size*	Sets the approximate amount of memory, in megabytes, that should be allocated before sbquery uses temporary files when building the index file.
-no_update	Does not rebuild the index file when you issue a query following compilation. If you do not include this option and issue a query following compilation or recompilation, then the database updates and processes your query.
-o *file*	Sends query output to a file.
-show_db_dirs	Lists all database directories scanned when you issue a query. The list includes the following: the database directory in the current working directory and all other database directories specified by the import or export commands in your sb_init file.
-version | -V	Displays the current version number.
-files_only	Lists only the files where the symbols you are searching for appear.
-no_secondaries	Returns only the primary match. A secondary match is an identifier inside a macro. You might want to turn off secondary matches if you are doing a lot of filtered querying, and the symbols you are querying on are used in a lot of macros.
-no_source	Displays only the file name and line number associated with each match.
-symbols_only	Displays a list of all symbols that match the patterns in your search pattern. Useful when you use wildcards in a query.
-pattern *symbol*	Queries on *symbol*, which may contain special characters, including a leading dash (-). This option allows you to query on a symbol that looks like a command-line option. For instance, you can query on the symbol -help, and sbquery distinguishes it from the regular option -help.

TABLE D–1 sbquery Options *(continued)*

Arguments	Description
-no_case	Makes the query case-insensitive.
-sh_pattern	Uses shell-style expressions when issuing a query that includes wildcards. This wildcard setting is the default; include this option if you are doing other pattern matching on the same command line. See sh(1) for more information about shell-style pattern matching.
-reg_expr	Uses regular expressions when issuing a query that includes wildcards. If you do not include this option, shell-style patterns are assumed.
-literal	Does not use any wildcard expressions for the query. Useful when you want to search for a string that contains meta characters from other wildcard schemes.

Two types of options are available to help you narrow your search: filter options (see Table D–2) and focus options (see Table D–3.)

Filter Language Options

The filter options listed in Table D–2 are used to search for symbols based on how they are used in a program. For example, you could limit your search to declarations of variables.

```
sbquery -help_filter language
```

TABLE D–2 Filter Language Options

Filter Option	Description
ansi_c	C
sun_as	Assembly language
sun_c_plus_plus	C++

TABLE D–2 Filter Language Options *(continued)*

Filter Option	Description
`sun_f77`	FORTRAN 77
`sun_f90`	Fortran 90

Focus Options

The focus options listed in Table D–3 limit your search to specific classes of code, such as particular programs, functions, or libraries.

`sbquery` *focus_option symbol*

TABLE D–3 Focus Options

Focus Option	**Description**
`-in_program` *program*	Limit query to matches in *program*.
`-in_directory` *directory*	Limit query to matches in *directory*.
`-in_source_file` *source_file*	Limit query to matches in *source_file*.
`-in_function` *function*	Limit query to matches in *function*.
`-in_class` *class*	Limit query to matches in *class*.
`-in_template` *template*	Limit query to matches in *template*.
`-in_language` *language*	Limit query to matches in *language*.

Note - If you include two or more focus options, a match is returned if it is found with any of the supplied focus options.

Environment Variables

Environment variables provide information that affects the operation of sbquery (and of source browsing in Sun WorkShop). For more information on sb_init, see "Controlling the Browser Database With sb_init" on page 168."

TABLE D–4 Environment Variables

Variable	Description
HOME	The name of your login directory
PWD	The full path name of the current directory
SUNPRO_SB_ATTEMPTS_MAX	The maximum number of times the index builder tries to access a locked database
SUNPRO_SB_EX_FILE_NAME	The absolute path name of the file sun_source_browser.ex
SUNPRO_SB_INIT_FILE_NAME	The absolute path name of the sb_init file

Controlling the Browser Database With sb_init

This section describes how to work with source files whose database information is stored in multiple directories. As a default, the database is built in the current working directory and searches that database when you issue a query.

Understanding sb_init

The text file sb_init is used by the Source Browsing mode of Sun WorkShop, the compilers, and sbtags to obtain control information about the source browsing database structure. Use sb_init if you want to work with source files whose database information is stored in multiple directories.

The sb_init file should be placed in the directory from which source browsing, the compilers, and sbtags are run. These tools look in the current working directory for the sb_init file.

Moving the `sb_init` File

The default is to look in the current working directory for the `sb_init` file. To instruct Sun WorkShop and the compiler to search for the `sb_init` file in another directory, set the environment variable `SUNPRO_SB_INIT_FILE_NAME` to `/absolute/pathname/sb_init`.

File Commands

To use an `sb_init` command, add the command to the file. The `sb_init` file is limited to the following commands:

- `import`—Reads databases in directories other than the current working directory.
- `export`—Writes database component files associated with specified source files to directories other than the current working directory of the compiler. This command also acts as an `import` command.
- `automount-prefix`—Enables you to browse source files on a machine other than the one on which you compiled your program.
- `replacepath`—Specifies how to modify paths to file names found in the database, allowing you to move a database.

Command Reference

`import`

```
import /pathname
 to directory
```

This command allows the Source Browsing mode of Sun WorkShop to read databases in directories other than the current working directory. Use of the `import` command enables you to retain separate databases for separate directories.

For example, you may want to set up administrative boundaries so that programmers working on Project A cannot write into directories for Project B and vice versa. In that case, Project A and Project B each need to maintain their own databases, both of which can then be read but not written by programmers working on the other project.

In Figure D–1, the current working directory is `/project/source1`. The database in `source2` is read by including either of these commands in the `source1 sb_init` file:

```
import /project/source2
import ../source2
```

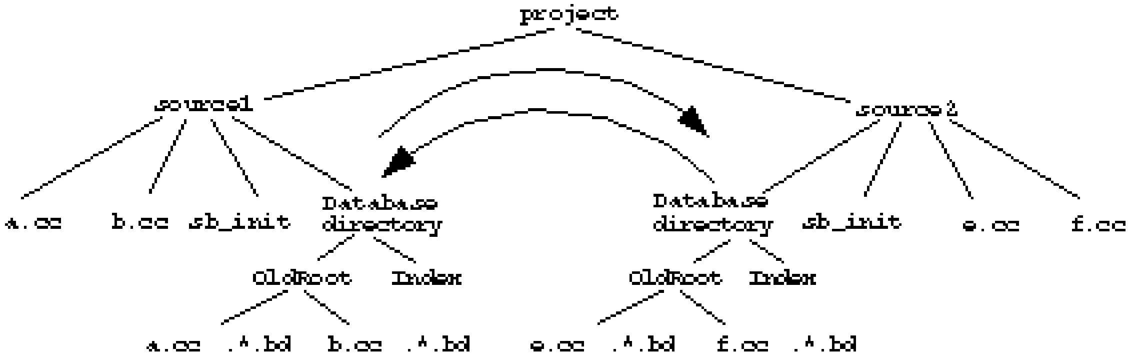


Figure D–1 `import` Example

export

```
export prefix
into path
```

This command causes the compilers and `sbtags` to write database component files associated with source files to directories other than the current working directory used by the Source Browsing mode of Sun WorkShop and the compiler.

Whenever the compiler processes a source file whose absolute path starts with *prefix*, the resulting browser database (`.bd)` file is stored in *path*.

The export command contains an implied `import` command of *path*, so that exported database components are automatically read by the Source Browsing mode of Sun WorkShop.

The `export` command enables you to save disk space by placing database files associated with identical files, such as `#include` files from `/usr/include`, in a single database, while still retaining distinct databases for individual projects.

If your `sb_init` files include multiple `export` commands, then you must arrange them from the most specific to the least specific. The compiler scans `export` commands in the same order that it encounters them in the `sb_init` file.

In Figure D–2, to place the `.bd` file and index file created for files from `/usr/include` in a database subdirectory in the sys subdirectory, the user included this export command in the `sb_init` file for `source1`:

```
export /usr/include into /project/sys
```

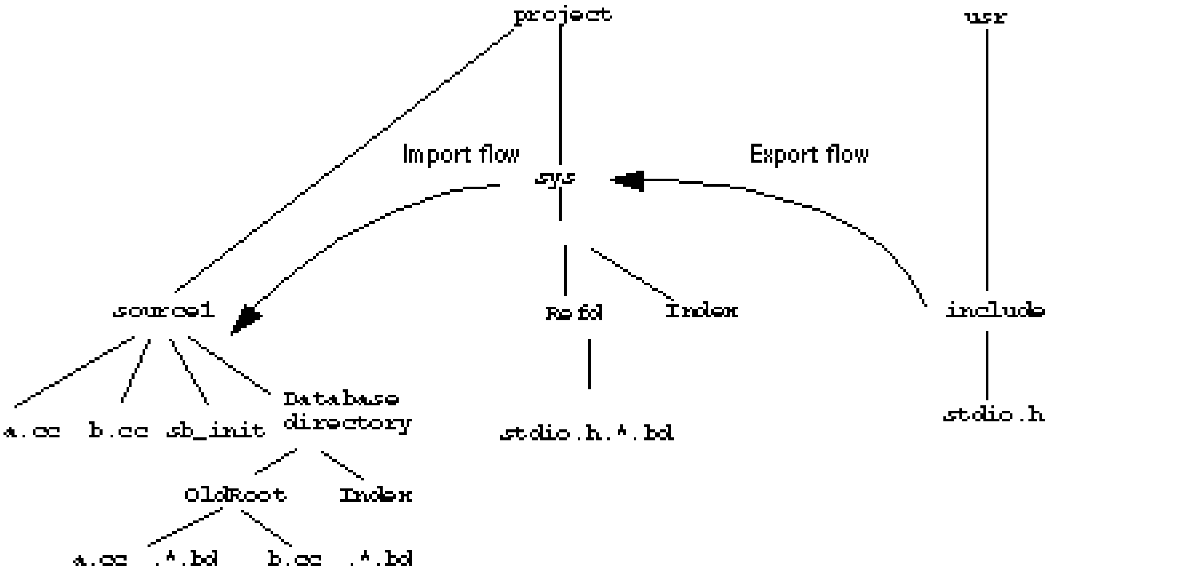


Figure D–2 `export` Example 1

If the configuration had included a `source2` directory with a `sb_init` file containing the same `export` command, then you would save disk space because you did not create two identical database files. For the `stdio.h` files, the compiler would create a single database file for `stdio.h` in the `sys` subdirectory.

The `sb_init` file contains an implied `export/into.` command that instructs the compiler to put database files created for source files not explicitly mentioned by an `export` command in the current working directory. In Figure D–2, the `.bd` files associated with `a.cc` and `b.cc` are placed in the database subdirectory in the `source1` directory.

When you include the `export` command in the `sb_init` file, an implied `import` command causes the specified database to be read. Given the configuration in Figure D–2, the database in the `sys` subdirectory, as well as the database in the `source1` directory, is searched each time you issue a query.

As another example, suppose the user included this `export` command in the `sb_init` file for `source1`:

```
export /project/include into /project/include
```

As shown in Figure D–3, this places the database files and index file created for files from `/project/include` in the database subdirectory in the `/project/include` subdirectory. An implied `import` command caused the database in `/project/include` to be read.

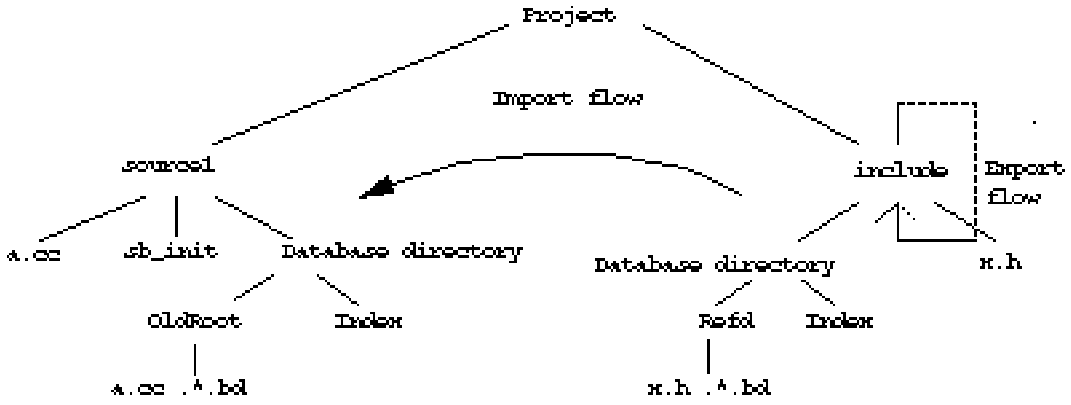


Figure D–3 `export` Example 2

The database files are stored in a common subdirectory even though the command located the `include` file in a nonstandard location. The `export` command saves disk space if the project includes multiple references from many different directories to the same `include` file.

replacepath

`replacepath` *from_prefix* *to_prefix*

This command specifies how to modify path names in the source browsing database.

In general, *from-prefix* corresponds to the automounter "mount point" (the path name where the automounter actually mounts the file system); and *to-prefix* corresponds to the automounter "trigger point" (the path name known and used by the developer).

There is considerable flexibility in how an automounter is used; the method can vary from host to host.

Path replacement rules are matched in the order that they are found and matching stops after a replacement is done.

The default `replacepath` command is used to strip away automounter artifacts:

```
replacepath /tmp_mnt
```

When used for this purpose, the command should be given as the mount point as the first argument and the trigger point as the second argument.

automount-prefix

```
automount-prefix mount_point    trigger_point
```

The automount-prefix command enables you to browse on a machine other than the one on which you compiled your program. This command is identical to the replacepath command except that automount-prefix path translations occur at compile time and are written into the database.

The automount-prefix command defines which automounter prefixes to remove from the source names stored in the database. The directory under which the automounter mounts the file systems is the *mount_point;* the *trigger_point* is the prefix you use to access the exported file system. The default is /.

If the path in the database fails, the path translations from both commands (that is, automount_prefix and replacepath) are used to search for source files while browsing.

At first glance, searching both paths may not seem possible; the browser database that is created when you run the compiler contains the absolute path for each source file. If the absolute path is not uniform across machines, then Sun WorkShop will not be able to display the source files when it responds to a query.

To get around this problem, you can do either of the following:

- Ensure that all source files are mounted at the same mount point on all machines.
- Compile your programs in an automounted path. A reference to such a path causes the *automounter* to automatically mount a file system from another machine.

There is a default automount-prefix command that is used to strip away automounter artifacts:

```
automount-prefix /tmp_mnt
 /
```

The default rule is generated only if no automount-prefix commands are specified.

For more information on using the automounter, see the automount(1M) man page.

cleanup-delay

This command limits the time elapsed between rebuilding the index and the associated database garbage collection. The compilers automatically invoke sbcleanup if the limit is exceeded. The default value is 12 hours.

Collecting Browsing Information With sbtags

The sbtags command provides a quick and convenient method for collecting browsing information from source files, enabling you to collect minimal browsing information for programs that do not compile completely.

Understanding sbtags

The sbtags command collects a subset of the information available through compilation. The reduced information restricts some browsing functionality. A database generated by sbtags enables you to perform queries on functions and variables and to display the function call graph.

A tags database:

- Cannot issue queries about local variables
- Cannot browse classes
- Cannot graph class relationships
- Has limited ability to issue complex queries
- Has limited ability to focus queries
- Has less reliability than compiled information

Once a file has been changed, it often need not be scanned again to incorporate changes into the database.

An sbtags database is based on a lexical analysis of the source file. Though it does not always correctly identify all the language constructs, it will operate on files that will not compile and is faster than recompilation.

sbtags recognizes definitions for variables, types, and functions. It also collects information on function calls. No other information is collected (in particular, other semantic information for complex queries is not collected).

The functionality of sbtags is similar to ctags and etags, except for the Call Grapher information. You may mix direct queries to the database for definitions and graphing with pattern-matching queries.

With an `sbtags` generated database:

- Class Browser and Class Grapher features are not available.
- The database does not contain information on all symbols and strings. It contains information on functions, classes, types, variable definitions, and calls to functions.
- Time is saved since the `sbtags` program runs faster than the compiler.
- The database size is much smaller than the size of your source code.
- The database content is not guaranteed to be semantically correct because the `sbtags` program performs only simple syntactic and semantic analysis and may sometimes be in error.
- A database is generated even if the source code cannot be compiled because the code is incomplete or semantically incorrect.

Generating an `sbtags` Database

To generate a browsing database using `sbtags` , type `sbtags` , followed by the name of the file (or files) for which you want to generate the database:

```
sbtags file ...
```

Index