Pro Fortran

Linux

Absoft Pro Fortran User Guide

absoft
development tools and languages

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Contents

CHAPTER 1

Introduction

INTRODUCTION TO ABSOFT PRO FORTRAN

Absoft specializes in the development of Fortran compilers and related tools. Full implementations of Fortran 77 and Fortran 90/95 are available for Macintosh, Windows, and Linux platforms. Absoft will continue to focus on Fortran in the future, but the popularity of C/C++ in the Unix environment has required many of today's Fortran programmers who are moving code to their desktop, to link Fortran code with C libraries. Absoft compilers support most popular inter-language calling conventions implemented on Linux systems, providing compatibility with existing libraries and object files, simplifying porting efforts.

This User Guide explains the operation of Absoft Fortran 90/95, and Absoft FORTRAN 77 on the Linux operating system for the x86 and x64 families of processors. In the event you have licensed only one of these compilers, please refer only to the appropriate section(s) and disregard the others. All compilers operate in a similar manner, share a common tool set, and are link compatible. A brief summary of each compiler appears below.

Absoft Fortran 90/95

A complete, optimizing ANSI Fortran 90/95 implementation with extensions. Absoft Fortran 90/95 is the result of a five-year joint development effort with Cray Research. It utilizes a version of the CF90 front-end and is source compatible with several Cray F90 releases. It provides full support for interfacing with FORTRAN 77 and C Programming Language libraries.

Absoft FORTRAN 77

Refined over 16 years, with emphasis on porting legacy code from workstations. Absoft Fortran 77 is full ANSI 77 incorporating MIL-STD-1753, Cray-style POINTERs, plus most extensions from VAX FORTRAN as well as many from IBM, Sun, HP, and Cray. Absoft Fortran 77 supports legacy extensions that are not part of the Fortran 90/95 standard. See the chapter on **Porting Code** in this manual for further information. Fortran 77 is fully link compatible with Fortran 90/95 and C/C++ so existing, extended FORTRAN 77 routines can be easily compiled and linked with new Fortran 90/95 or C/C++ code.

CONVENTIONS USED IN THIS MANUAL

There are a few typographic and syntactic conventions used throughout this manual for clarity.

- `[]` square brackets indicate that a syntactic item is optional.
- ... indicates a repetition of a syntactic element.
- Term definitions are underlined.
- **-option** font indicates a compiler option.
- *Italics* are used for emphasis and book titles.
- Unless otherwise indicated, all numbers are in decimal form.
- FORTRAN examples appear in the following form:

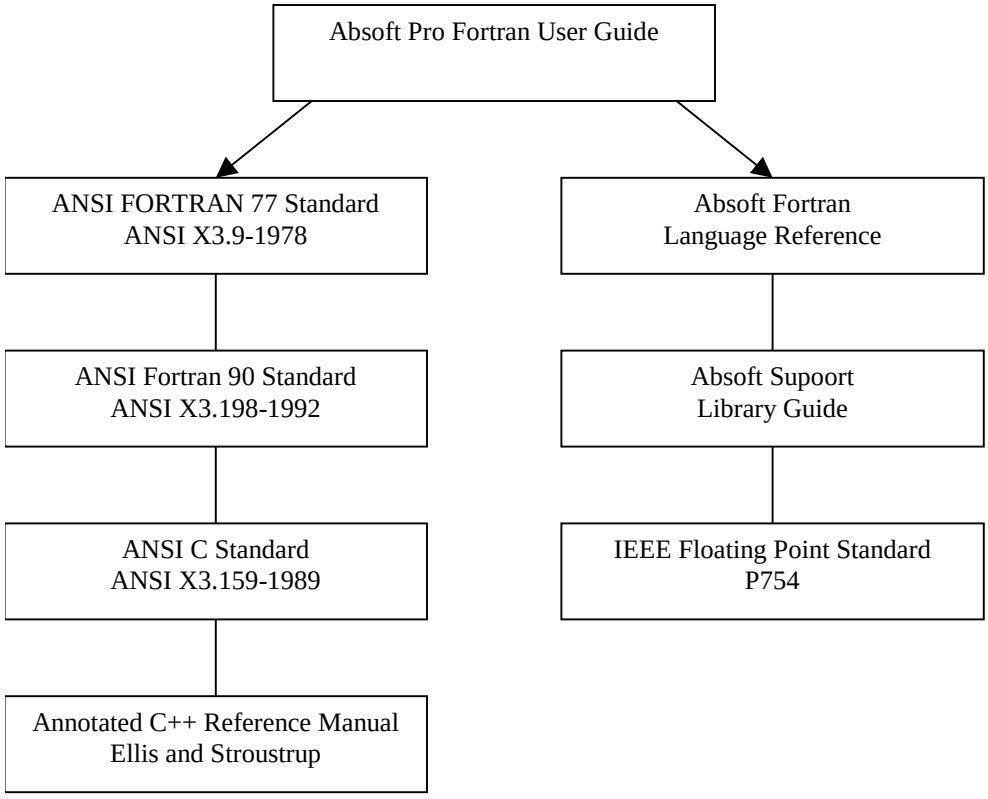
```
PROGRAM SAMPLE
WRITE (9,*) "Hello World!"
END
```

ROAD MAPS

Although this manual contains all the information needed to build programs with Absoft Pro Fortran on Linux, there are a number of other manuals that describe Fortran 90/95 and FORTRAN 77 in further detail. The *road map* in this chapter will guide you to these manuals for introductory or advanced reference. The bibliography in appendices lists further information about each manual.

Fortran Road Maps

The Absoft implementation of FORTRAN 77 and Fortran 90/95 is detailed in the online manual, *Absoft Fortran Language Reference*, in the doc directory of the Pro Fortran installation. A discussion of floating point precision is at the end of the chapter **Porting Code**. Figures 1-1 shows additional manuals that can be used for referencing the FORTRAN language and internal math operations.



FORTRAN language road map
Figure 1-1

YEAR 2000 PROBLEM

All versions of Absoft Fortran products for Macintosh, Window, Linux, and UNIX will operate correctly across the date transition to the year 2000. Neither the compilers nor the runtime libraries have ever used 2-digit years in their internal operation. This means the version of Absoft Pro Fortran that you already have will continue to operate correctly. No patches or version updates are required.

The only caveat may be for those porting code from VAX/VMS systems. Since the early 1980s, Absoft Pro Fortran products have included software libraries designed to facilitate porting code from the VAX/VMS environment. Included in these VAX compatibility libraries are two subroutines that emulate the VAX/VMS DATE and IDATE subroutines. These subroutines return the year using a two-digit format. If you use DATE or IDATE in a program that stores or compares dates, you may need to recode portions of your application. Below are listed some of the alternatives supplied with Pro Fortran:

Fortran 90/95 `DATE_AND_TIME` Subroutine

This subroutine is part of the Fortran 90/95 language and returns integer data from the date and real time clock. Refer to the *Fortran 95 Concise Reference* for further information.

Unix Compatibility Library

There are a number of subroutines in the Unix Compatibility Library that return the date and time in both `INTEGER` and `CHARACTER` format. Refer to the manual **Absoft Support Libraries** for information on their format and use.

CHAPTER 2

Getting Started

The tutorial in this chapter introduces the two main functions of the Absoft Pro Fortran Software Development package for Linux: compiling source code and running compiled applications. If you are familiar with the basics of compiling and running programs, please see the table below as a guide to topics you may find useful.

TO DO THIS…	TURN TO THIS SECTION…
Use the editor	**Using the Absoft Editor**, Chapter 3
Use the tools interface	**Developer Tools Interface**, Chapter 4
Use the compiler and options	**Using the Compilers**, Chapter 5
Port from other platforms	**Porting Code**, Chapter 6
Create applications	**Interfacing With Other Languages**, Chapter 7
Debug programs	**FX Debugger Manual**

Road map for experienced users

COMPILING BASICS

The Absoft compilers can be run either from a command line or from the Absoft Developer Tools Interface. This chapter describes how to use the Developer Tools Interface — the command line interface is described in the Chapter 5, **Using the Compilers**.

The **Developer Tools Interface**, AbsoftTools, is started by entering `atools` from the command prompt in a terminal window. The environment variable $ABSOFT must be set to point to the directory where the compiler was installed and the environment variable $PATH must be set to include the compiler's bin directory. If they are not set, the command `atools` will not be found. They can be set sourcing the Absoft supplied setup script:

```
source /opt/absoft19.0/bin/atools/absvars.sh
```

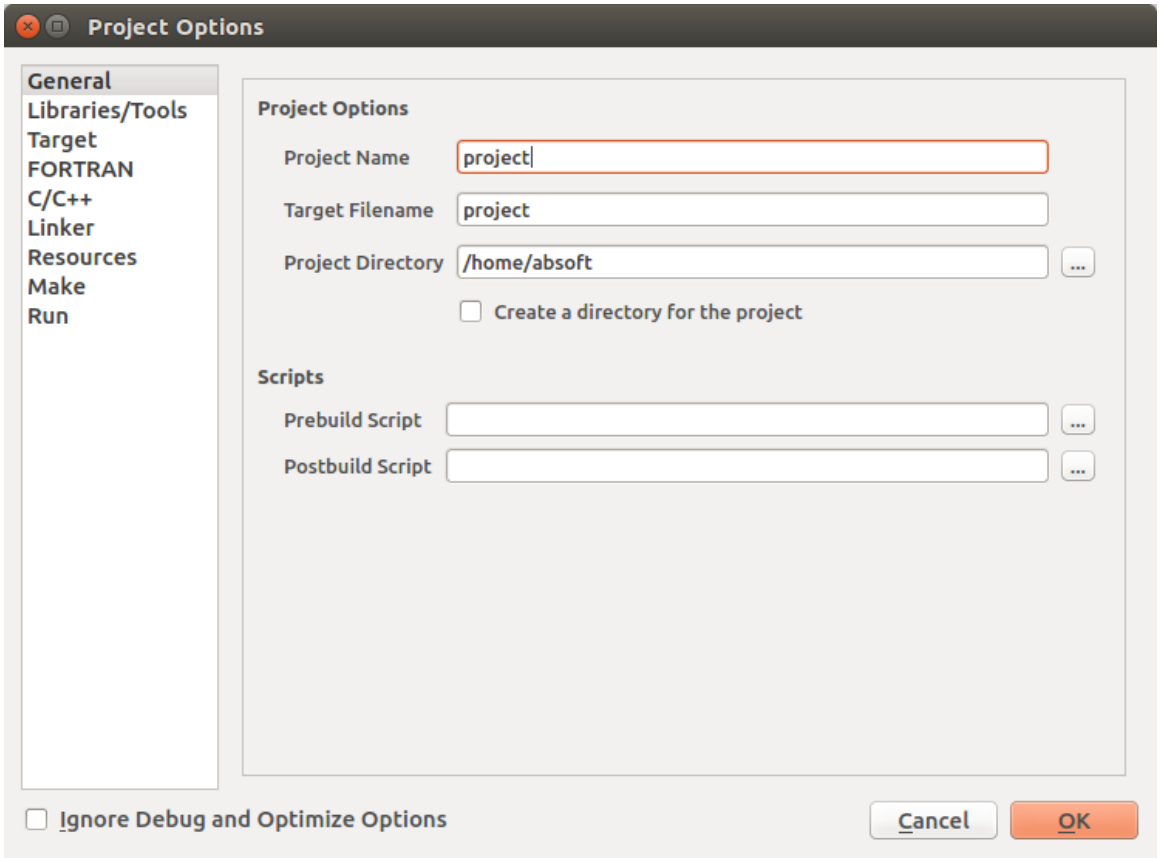
During the installation process, several example programs were placed in the `/opt/absoft19.0/examples` directory. The example program used in this tutorial is `Fibonacci.f95`. Follow the tutorial on the following pages to learn how to use the graphical interface to quickly compile small to medium size programs.

First, start up the interface to the compiler:

What to do	**How to do it**
Invoke the Absoft Developer Tools Interface.	Enter `atools` from a terminal prompt.

The Absoft Developer Tools Interface is project oriented, so the first thing you must do is to establish a name and location for your project.

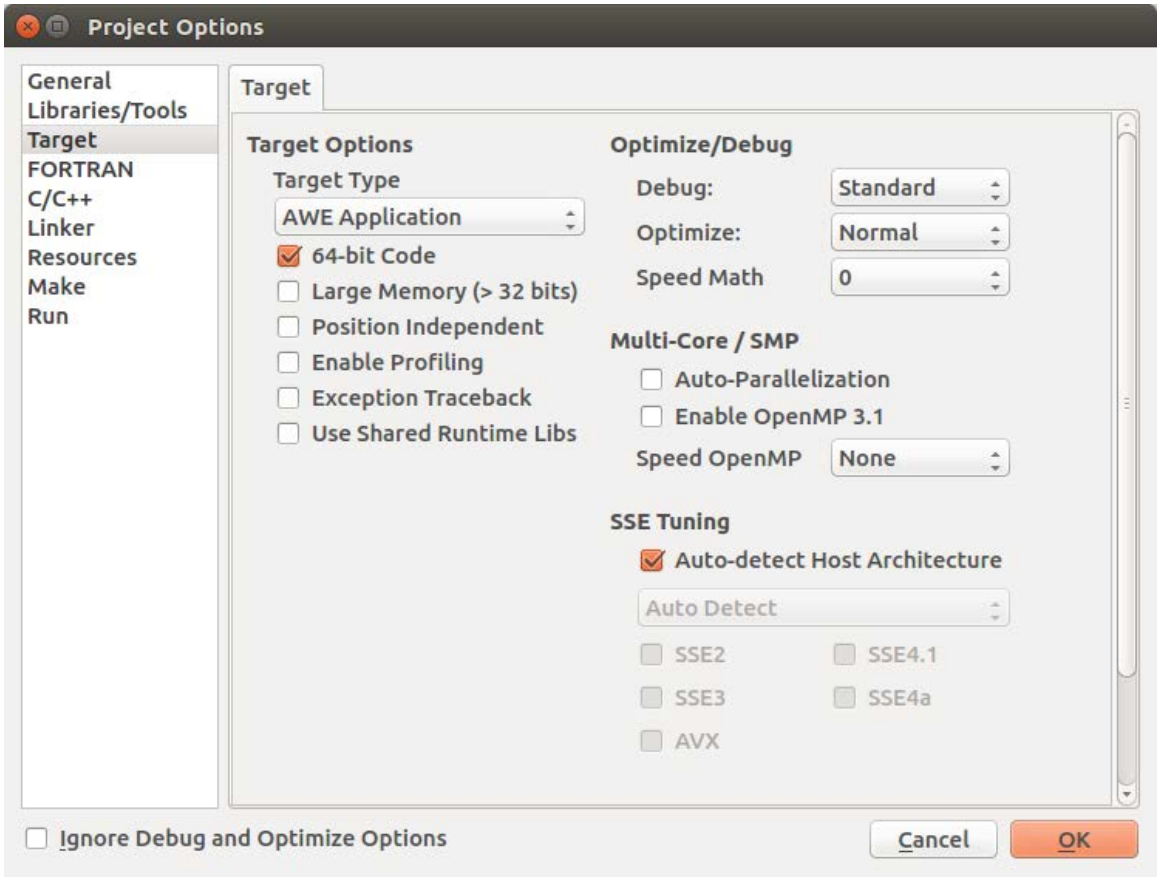
What to do	How to do it
Set the project name and location.	Select **Create A New Project** from the Welcome to Absoft Developer Tools Dialog.



On the **General** options page, change the **Project Name** to “Fibonacci” and the **Target Filename** to “Fibonacci”. You may also want to change the **Project Directory** from the default to a Fortran specific directory. If you check the “Create a directory for the project” box, the project will be created in a directory with the same name as the project. This enclosing project directory will be created if it does not already exist.

You will now want to set the target type to **AWE Application**. AWE is the Absoft Window Environment. It provides an automatic windowed interface for your program with menus, a scrollable text window for program output, and the ability to print.

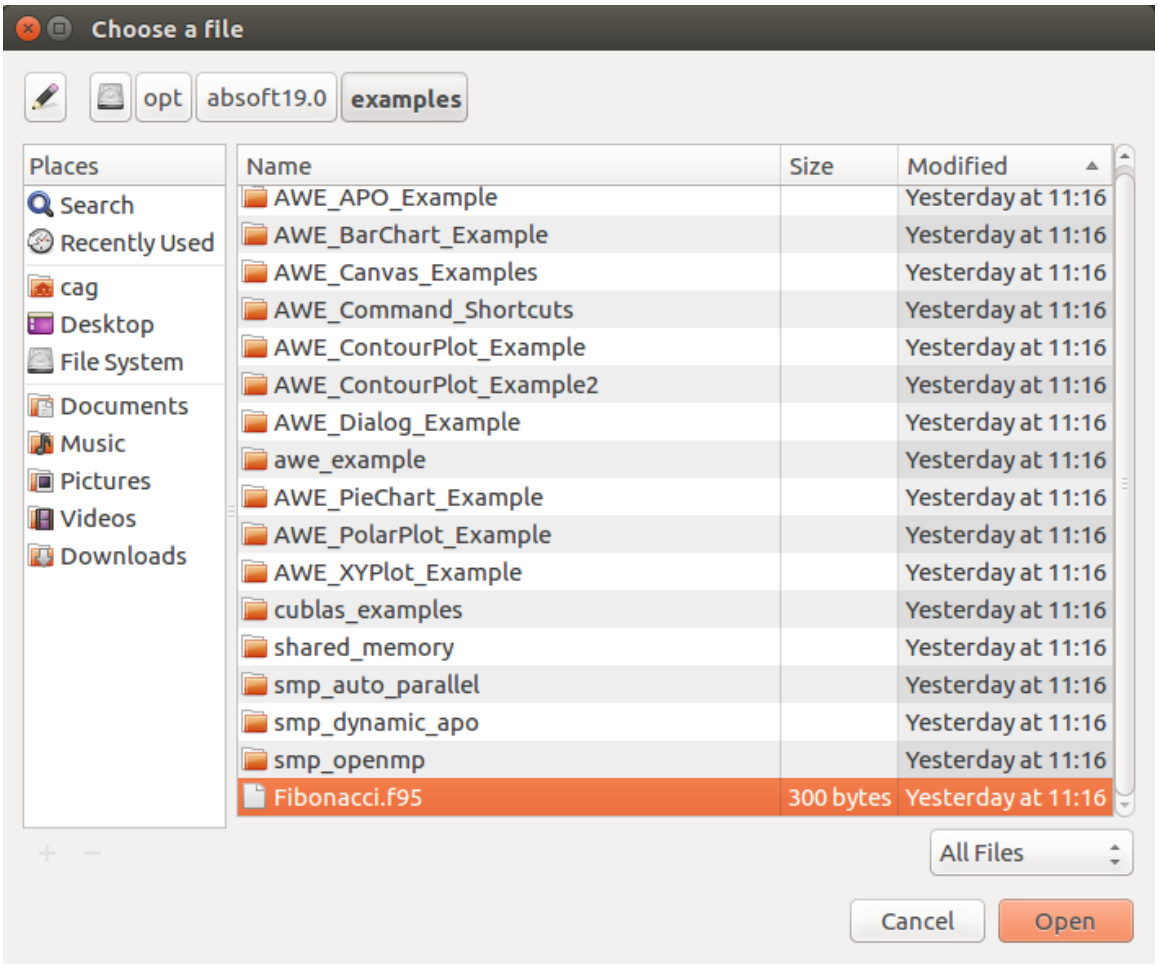
What to do	How to do it
Set the project **Target Type** to **AWE Application** (a Windows program).	Click on **Target** in the left panel to select the target options and then choose **AWE Application** from the **Target Type** drop menu in the upper left corner.



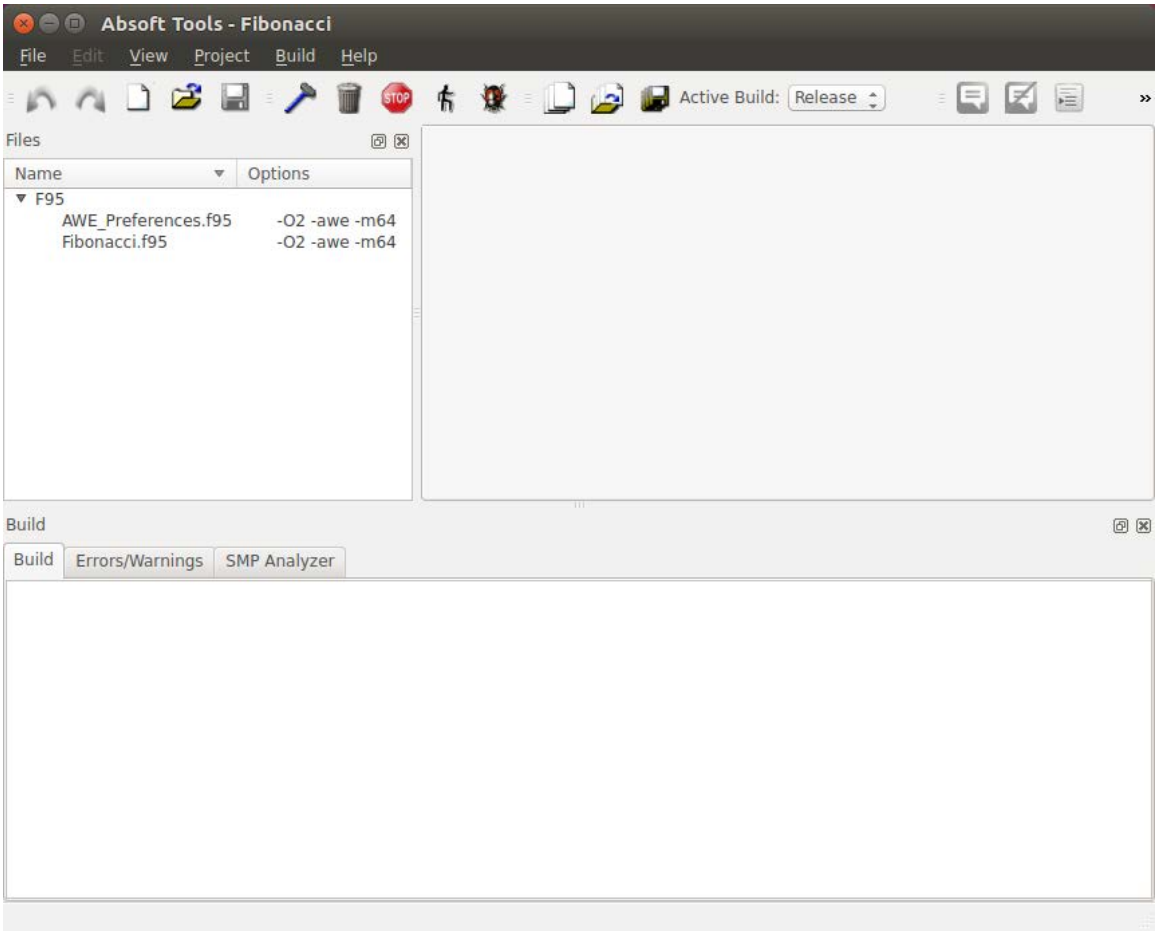
These are the only options you will want to set for this application, so click on the OK button to dismiss the **Default Tools Options** dialog.

The next step is to specify the file (or files) that the project consists of:

What to do	How to do it
Add the file **Fibonacci.f95** to the project.	Choose **Add File(s)...** from the **Project** menu. The file section dialog will open automatically

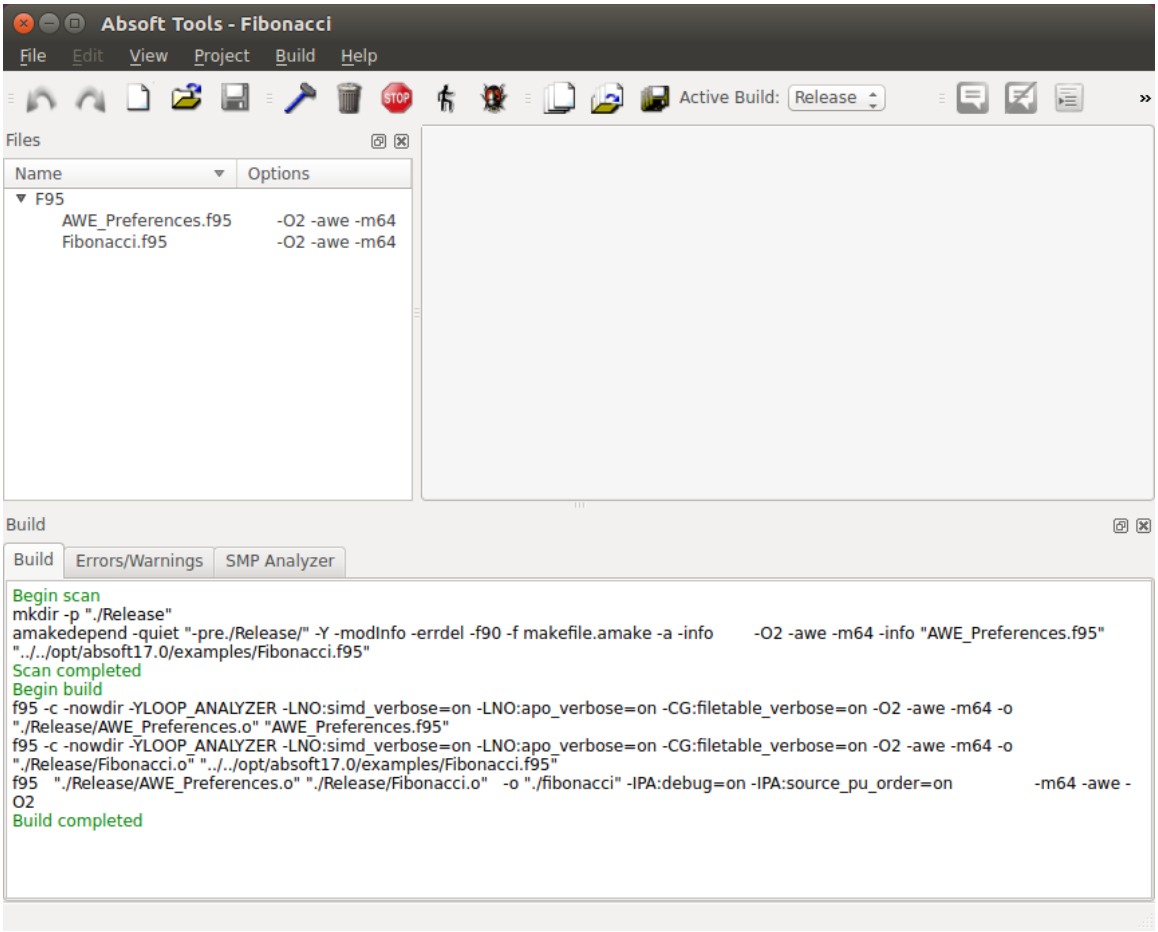


If you are not already in the **/opt/absoft19.0/examples** folder, browse to that directory. Click on the file named Fibonacci.f95 and click **OK** to add it to the project. The project **Files** pane will now contain your source file and the options that will be used to compile it. This pane maintains all of the files in your project. Each file type will be kept in a separate folder. If you wish, you can also manage the files in your project directly from this window; you delete selected files and drag new files into this window.



The last step is to build (compile) your application:

What to do	How to do it
Compile the source file **Fibonacci.f95** into the application file **Fibonacci**.	Choose the **Build** command from the **Build** menu.

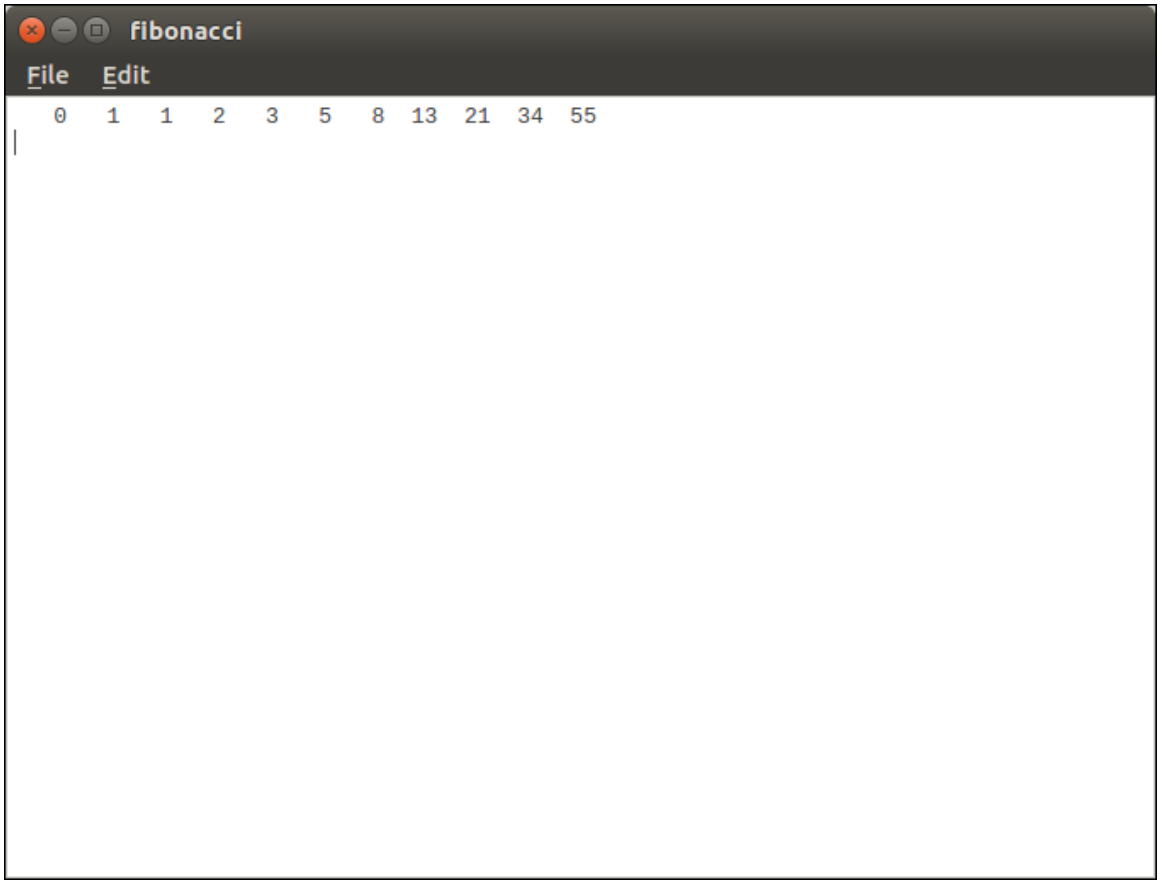


The compiler will then create `Fibonacci` from `Fibonacci.f95`. More detailed information concerning the creation of an application can be found in the chapters **Developer Tools Interface** and **Using the Compilers**.

APPLICATION BASICS

The application is now ready to execute.

What to do	How to do it
Execute the compiled application.	Choose the **Execute** command from the **Build** menu.



Additional examples that may be helpful in writing Fortran 90/95 or FORTRAN 77 programs can be found in the `/opt/absoft19.0/examples` directory. Each example source file starts out with a large comment, referred to as the header. Before compiling an example, look at the header in the source code. It will list all of the compiler options necessary to insure that the example will compile and run correctly. In addition, the header describes the purpose of the example and other useful information.

CHAPTER 3

Using The Editor

This chapter describes how to use the editor in Absoft Tools to create and edit source files written in FORTRAN. Since word processors embed formatting characters in a document, using a word processor to create source files is not recommended. You can create source files in a word processor or another editor and export them in text format, but the features of the Absoft Editor make this unnecessary. The Absoft Editor incorporates powerful features for editing FORTRAN 77, FORTRAN 90/95, C, and C++ source files. However, this chapter will concentrate specifically on editing FORTRAN programs.

The Absoft Editor is a powerful tool for creating and maintaining program source files. It is source language sensitive and will display keywords and comments in different text colors, making them easier to distinguish in your source code.

Basic editing functions are available as menu commands and there is usually more than one way to initiate any command:

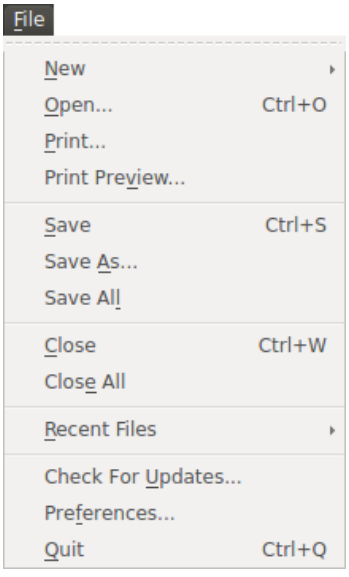
- Select the command from the menu or tool bar.
- Type in the key equivalent (such as typing the Control and the letter O for the Open command).
- Right click on the text edit window to display a context menu

TEXT SELECTION

Text may be selected by dragging the cursor over the text while holding the mouse button down. Choosing Select All from the Edit menu or Ctrl+A will select the whole document.

FILE MENU

The File menu contains commands for creating, opening, saving, and closing files. There are also commands for printing and for establishing your preferences for the way that Absoft Tools operates.



New…(Ctrl+N)

This menu contains commands for creating new tabs for entering and editing text. The tab will be untitled (it will have the name “Untitled”) with the extension of the type of file you choose until the first time you save it.

Open…(Ctrl+O)

Use this command to open an existing file. This command displays a standard file selection dialog box to select the file to be opened. If you select a file that is already open, the tab that contains that file will be brought to the front of the editor.

Save (Ctrl+S)

Choose this command to save the text in the active tab. If the file does not exist, you will be asked to provide a name and a path for the file.

Save As…

Use the Save As command to save the text in the active tab to a different file. A standard file save dialog will appear, allowing you to specify the name of file. The active tab becomes the newly named file.

Save All

Use this command to save the text in all open tabs.

Close (Ctrl+W)

This command closes the file displayed in the active tab. If any unsaved changes had been made to the text, you will be asked to save it. This action is also available by right-clicking on the tab name.

Close All

This command closes all files. If any unsaved changes had been made to any files, you will be asked to save them.

Close Others

This command is only available by right-clicking on the tab name. The command closes all files except for the active tab. If any unsaved changes had been made to any files, you will be asked to save them.

Recent Files

Up to 8 files will appear in this list. Each menu item represents the file that has been most recently opened or saved. They are listed as a convenience for quickly opening files for editing. The **Clear Recent Files** selection in this menu will remove all 8 files from the list without any warning.

Check For Updates

This menu selection opens a dialog to check for updates to your Absoft product.

Preferences

Opens a dialog to edit the preferences for Absoft Tools.

EDIT MENU AND POP-UP MENUS

Right-clicking the mouse button in a text edit window will display a pop-up menu of context sensitive commands. These commands are also available under the Edit menu. The Edit menu is not available if a file is not open for editing.

Find

This command displays the Find sub-menu with commands for finding and replacing text within the file.

Find/Replace (Ctrl+F)

Use this command to open the Find dialog for locating or replacing specified text within the front-most window. The controls in the Find dialog are used as follows:

Text in File

Enter the text string you wish to locate here.

Replace With

Enter the text string that will replace found text. This text is used with the Replace All and Replace buttons.

Replace

Replaces selected text with **Replace With**

Find and Replace

Executes a **Find** and then a **Replace**.

Replace and Find

Executes a **Replace** on selected text and executes a **Find**

Replace All

Replaces all text in the file.

Match Case

Check this box to find text occurrences in your source file that match your specified text exactly. Uncheck to search regardless of case.

Find Previous

Check this box to find text searching backwards from the cursor.

Whole Words

Match only whole word matches of the find text. For example, if the find text is soft, Absoft will not match when this is checked.

Find/Replace Again (Ctrl+G)

This command repeats the last Find/Replace command in the active tab.

Go to Line (Ctrl+L)

This command opens the Goto dialog. Enter the line number of the line you wish to go to and click on the Ok button.

Undo (Ctrl+Z)

The undo command undoes the last edit in the active tab. You can undo all actions since the document was opened.

Redo (Ctrl+Y)

The redo command redoes the last edit in the active tab. You can redo all actions since the document was opened.

Cut (Ctrl+X)

The cut command removes the selected text from the active tab and places it on the clipboard. Text on the clipboard may be pasted into other windows.

Copy (Ctrl+C)

The Copy command copies the selected text from the active tab and places it on the clipboard. Text on the clipboard may be pasted into other windows.

Paste (Ctrl+V)

The paste command replaces the selected text in the active tab with the text on the clipboard. If no text is selected in the active tab, the clipboard text is inserted at the insertion point.

Delete

The delete command removes the selected text from the active tab without placing it on the clipboard. Text previously available on the clipboard is still available for pasting into other windows.

Select All

The Select All command selects all text in the document.

Comment (Ctrl+D)

This command inserts a comment character in column one of the current line if there is no selected text section. Otherwise, it will comment the entire selected text. . For C/C++ files this is a double forward slash ("//") and for all other files it is an exclamation mark ('!').

Uncomment (Ctrl+Shift+D)

This command deletes a comment character in column one of the current line or the selected lines. For C/C++ files this is a double slash ("//") and for all other files it is an exclamation mark ('!').

Indent (Tab or Ctrl+I)

Use this command to shift either the selected text or current line to the right by one tab stop.

Unindent (Shift+Tab or Ctrl+Shift+I)

Use this command to shift either the selected text or current line to the left by one tab stop.

To Uppercase (Ctrl+U)

Use this command to change the selected text to upper case.

To Lowercase (Ctrl+Shift+U)

Use this command to change the selected text to lower case.

Back (Ctrl+J)

Use this command to navigate back to the last cursor position in the file or project.

Forward (Ctrl+Shift+J)

Use this command to navigate forward to the last cursor position in the file or project.

Bookmarks

Bookmarks provide an easy way to "save your place" in a file so that you can later return there quickly. Positioning the insertion caret on the line where you want the bookmark set and then typing Alt+K sets (or unsets) a bookmark. In other words, Alt+K toggles a bookmark.

A bookmark appears as a small flag at the beginning of the line. Pressing the Ctrl+K key alone moves the insertion caret to the next bookmarked line in the file. Holding the Shift key down and pressing the Ctrl+K key moves the insertion caret to the previous bookmarked line in the file. The Clear File Bookmarks action in the Edit menu or context menu clears all bookmarks in the file. The Clear All Bookmarks action clears all the bookmarks for all files.

The View->Bookmarks action will open a display showing all available bookmarks in all files. Clicking on a bookmark opens the file (if not already opened) and sets the cursor to the line of the bookmark clicked. Double clicking on a bookmark name will allow you to edit the name.

Note: Bookmarks are either associated with a specific project (see Developer Tools Interface in the next chapter) or with no project (editor bookmarks). Editor bookmarks are only accessible with no project open, and project bookmarks are only accessible with the associated project open. Bookmarks are saved in a project save file.

Bookmarks Menu

The Bookmarks sub-menu provides commands for setting, clearing, and moving between bookmarks.

Toggle Bookmark (Alt+K)

Use this command to set or unset a bookmark on the line where the insertion caret is positioned.

Previous Bookmark (Ctrl+Shift+K)

Use this command to move to a previous bookmark location in the file.

Next Bookmark (Ctrl+K)

Use this command to move to the next bookmark location in the file.

Clear File Bookmarks

Use this command to remove all bookmarks in the file.

Clear All Bookmarks

Use this command to remove all bookmarks in all files.

CODE COMPLETION (CTRL+E)

Code completion is a pop-up box that suggests possible ways of completing the words or strings based on previously used words in that file. It is automatically turned on once the length of the word typed is more than 3 characters. Typing Ctrl+E can also manually bring up the pop-up box. To navigate the pop-up box, use up and down arrow keys. The selection can be made by either pressing the enter key or left clicking the mouse. When the pop-up box is open, you can dismiss it by pressing the Esc key.

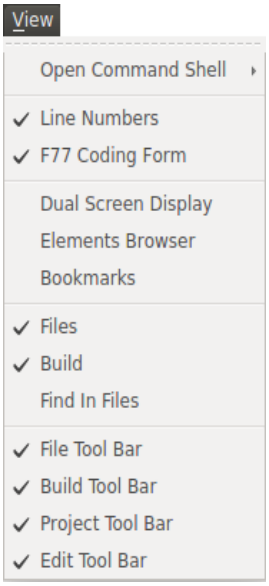
SYNTAX HIGHLIGHT (CONTEXT MENU ONLY)

The Syntax Highlight command will specify which programming language to highlight the document with. This is automatic for common FORTRAN and C file extensions. The current highlighting language may be changed through this menu. Choices are F95, F77, C/C++, and None. It is recommended to use standard file extensions so you do not have to change this setting.

Standard file extensions are:

F95:	*.f95, *.f90, .F95, .F90
F77:	*.f, *.for, .F, .FOR
FORTRAN headers:	*.inc
C:	*.c, *.C
C++:	*.cpp
C/C++ headers:	*.h

VIEW MENU AND POP-UP MENUS



The view menu allows you to change what is displayed in Absoft Tools.

Line Numbers

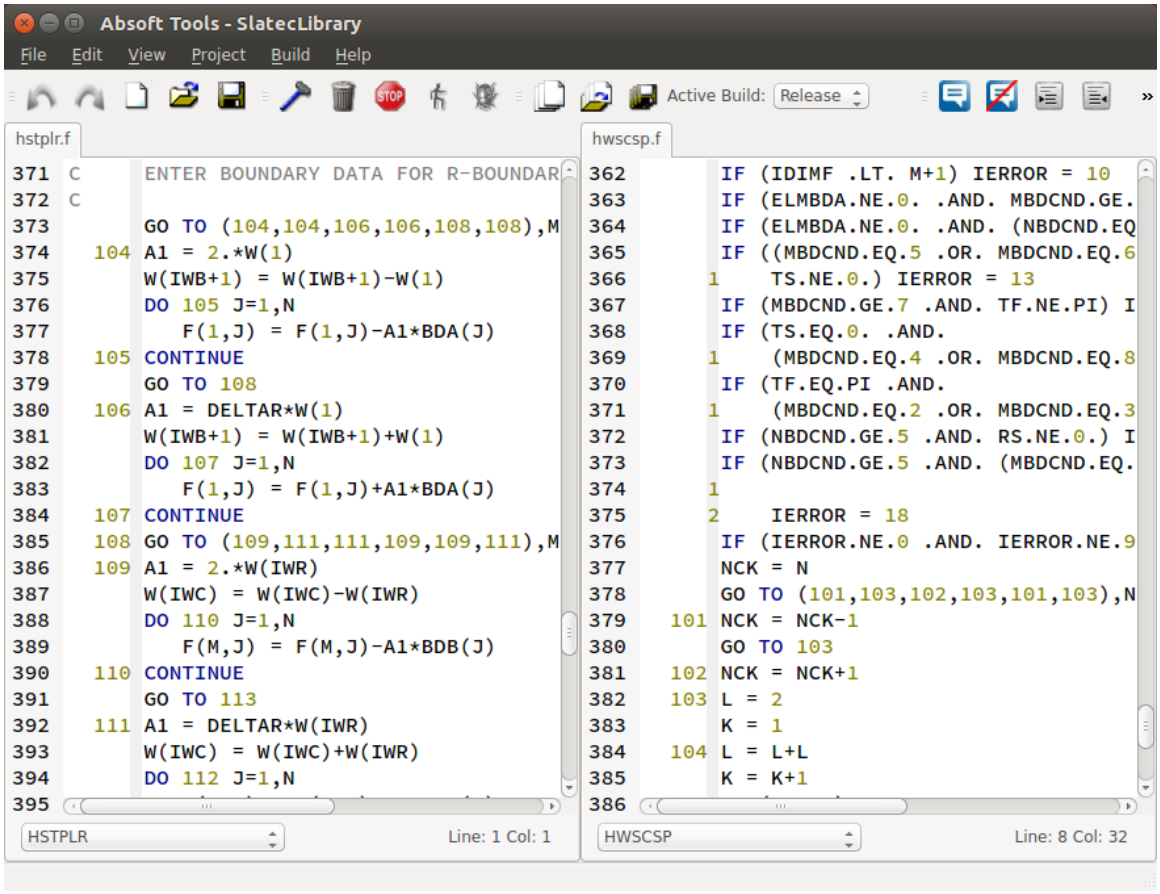
Toggles line number display in the margin for the active tab.

F77 Coding Form

Toggle coding form background for the active tab. Coding form highlights significant F77 columns in gray. The highlighted columns are columns 6, and 72-80. You must have a fixed form font for this the columns to be highlighted correctly. You can change fonts in the File->Preferences menu. F77 Coding Form cannot be toggled on in other file formats.

Dual Screen Display

Dual Screen display provides a convenient way to open files side-by-side. Toggling dual screen display on will create another text editor window pane to the right of the existing one. By default, toggling it on will give the focus to this second text editor pane. For example, if you open a file, the file will be opened in this new pane. This can be used for comparing two different files. Note that the same file cannot be opened twice. All the edit actions such as cut, copy, and paste apply on both panes.

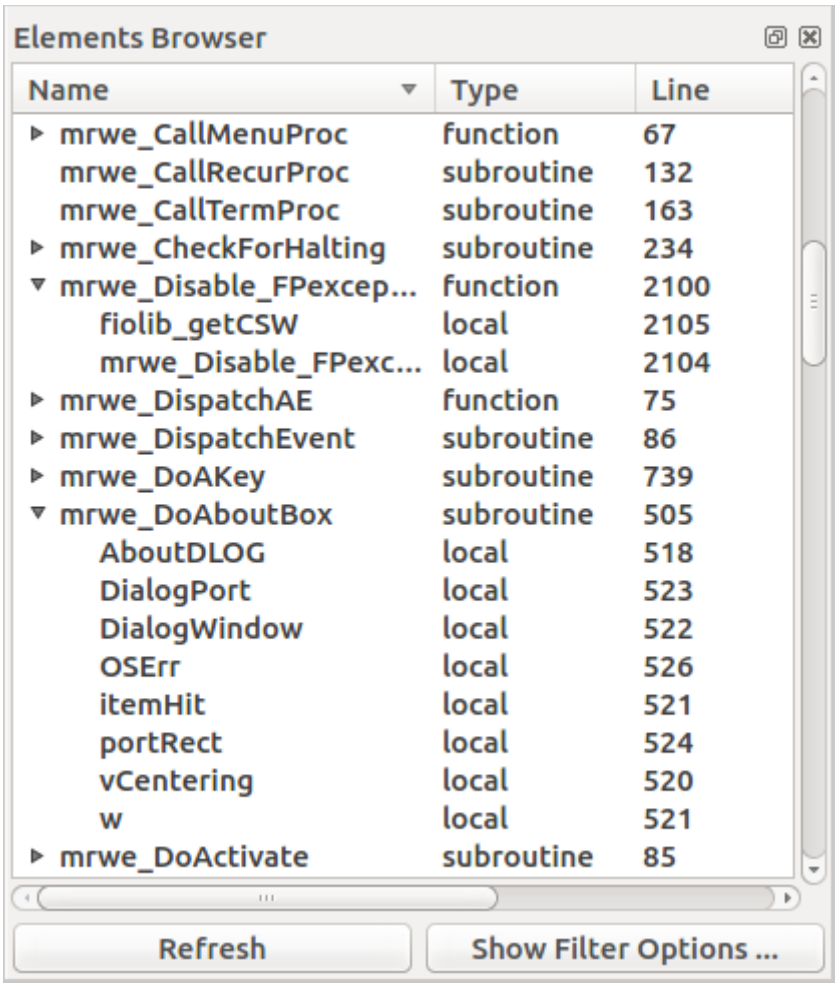


To switch back and forth between these two text editors, you can click on the desired text editor or the tab that you want to open. You can also move the current file to the other text editor by clicking on the tab and dragging it to the other text editor or by right clicking on the current tab and choose “Move to the other screen” action. To close this second text editor, you can uncheck it under the view menu. You will be asked whether you want to save the files before closing them.

Note: Dual Screen Display doesn’t keep record of its own previous state. Toggling it on after toggling it off doesn’t mean that it will open all the files that it had opened last time. This applies when you are working in the project mode as well.

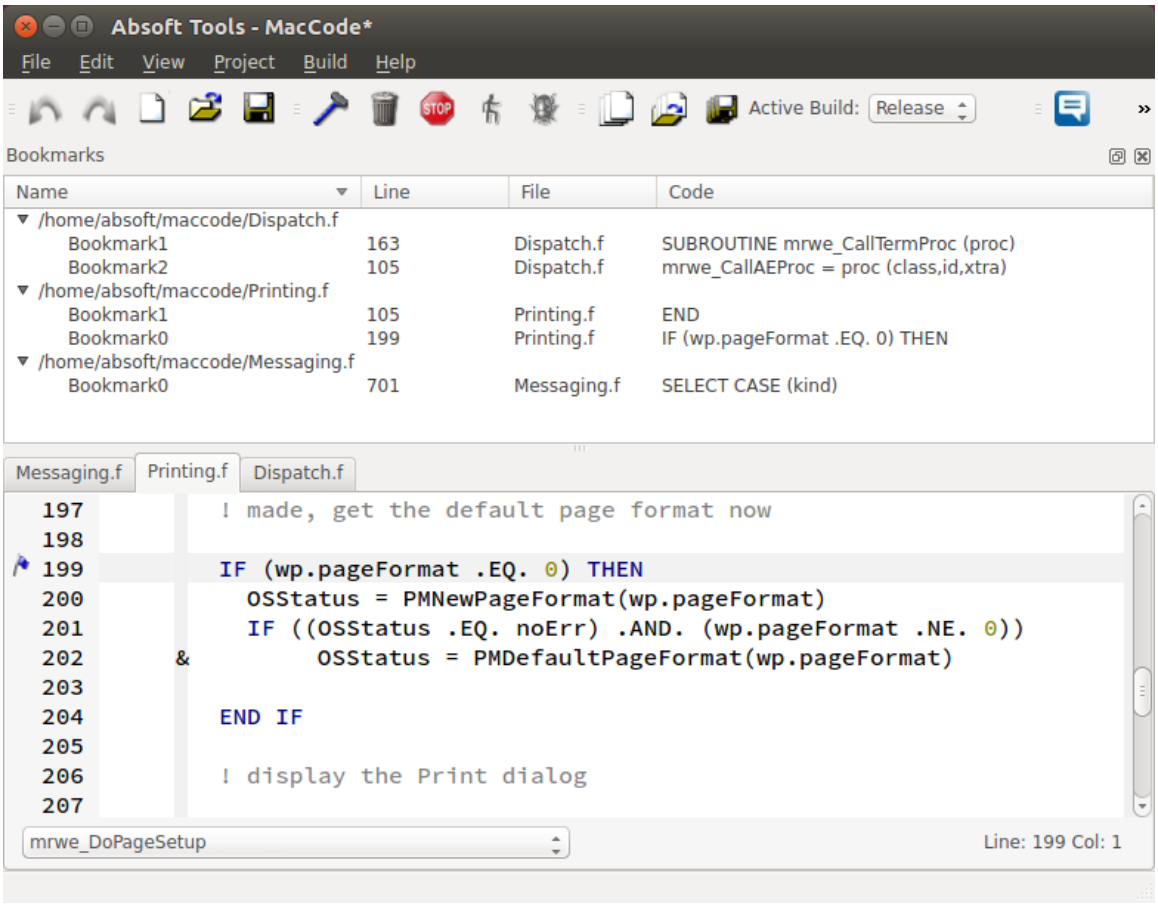
Elements Display

Toggles the elements display. The elements display contains a hierarchal list of all elements in the program. Clicking on a ‘+’ will expand the element to show all its children. Clicking on a ‘–‘ will collapse an element. Clicking on an element will open the file if it is not already open and move the text cursor to the element declaration or implementation line. Clicking the refresh button will cause the project or editor file to be re-parsed. Saving the file will also cause it to be reparsed. Clicking the Show Filter Options will show a selection of item types to filter. To exclude variables from the elements list, uncheck the Variable checkbox. To enable, check the Variable checkbox.


Elements Browser
Name
Type
Line
mrwe_CallMenuProc function 67
mrwe_CallRecurProc subroutine 132
mrwe_CallTermProc subroutine 163
mrwe_CheckForHalting subroutine 234
mrwe_Disable_FPexcep... function 2100
fiolib_getCSW local 2105
mrwe_Disable_FPexc... local 2104
mrwe_DispatchAE function 75
mrwe_DispatchEvent subroutine 86
mrwe_DoAKey subroutine 739
mrwe_DoAboutBox subroutine 505
AboutDLOG local 518
DialogPort local 523
DialogWindow local 522
OSErr local 526
itemHit local 521
portRect local 524
vCentering local 520
w local 521
mrwe_DoActivate subroutine 85
Refresh
Show Filter Options ...

Bookmarks

Toggles the bookmark display. The bookmark display contains all the bookmarks that are currently available sorted by file. (See Bookmarks description in the Edit menu for additional information). Whenever a bookmark is added or removed, this list will be updated. Clicking on a bookmark in this window will open the file if it is not already open and move the text cursor to the bookmarked line. The name of the bookmark may be edited by double clicking on the name and entering the text for the name.



Files

Toggles the files display for an open project. See project documentation for more details. Note: this will not be selectable if you do not have a project open.

Build

Toggles the build display for an open project. See project documentation for more details Note: this will not be selectable if you do not have a project open.

Find in Files

Toggles the Find in Files display for an open project. See project documentation for more details. Note: this will not be selectable if you do not have a project open.

File Tool Bar

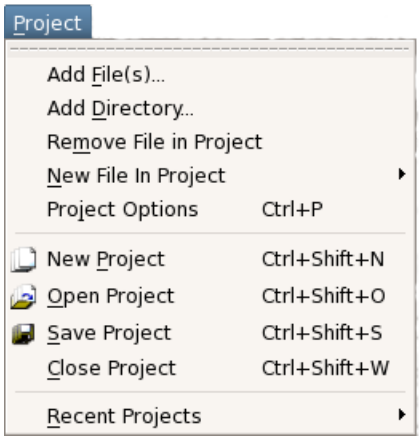
Toggles the visibility of the File tool bar.

Build Tool Bar

Toggles the visibility of the Build tool bar. Note: this will not be selectable if you do not have a project open.

Project Tool Bar

Toggles the visibility of the Project tool bar.



PROJECT MENU

New Project

This command opens a new project dialog to create a new project. Your open files will not be closed or added to the new project.

Open Project

This command opens a file browser to select a saved project file dialog to open. Your open files will not be closed or added to the project.

Recent Projects

Up to 8 files will appear in this list. Each menu item represents the project file that has been most recently opened or saved. They are listed as a convenience for quickly opening projects. The ‘Clear Recent Projects’ menu item clears all recent projects without a confirmation.

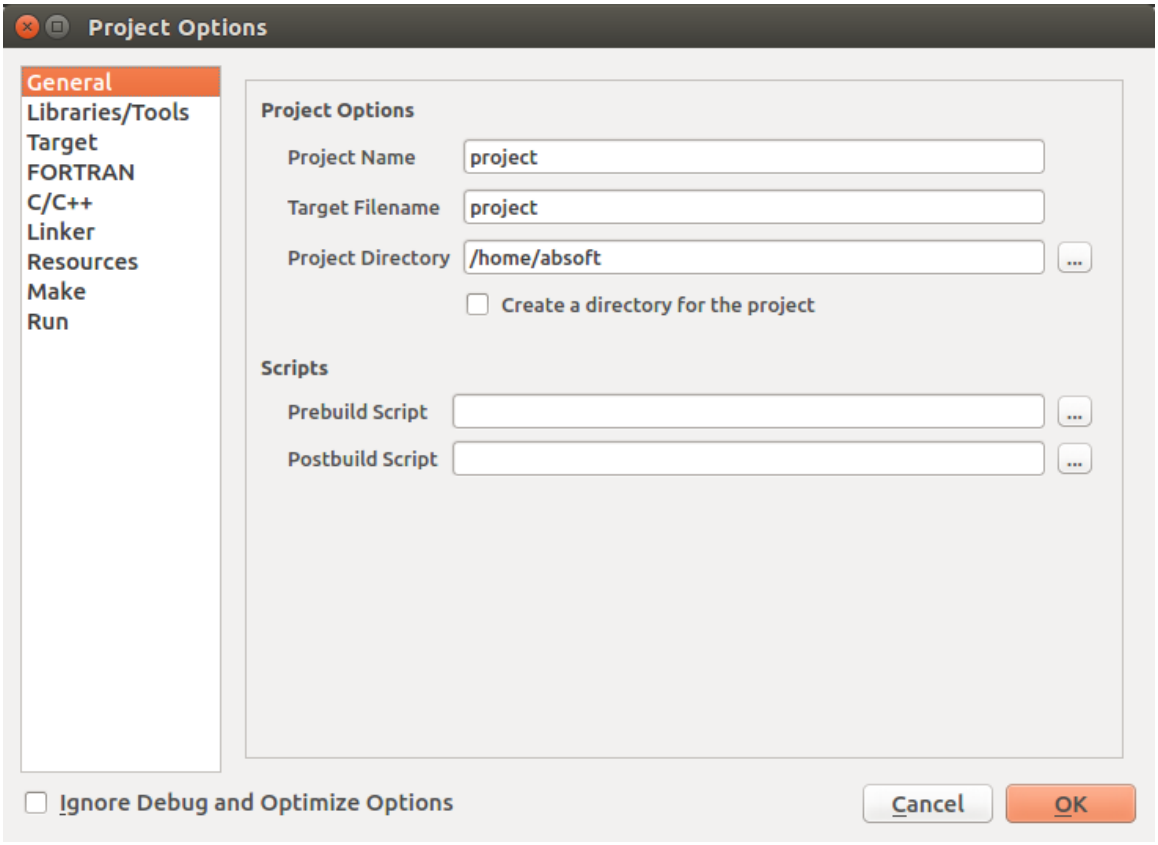
CHAPTER 4

Developer Tools Interface

WORKING WITH PROJECTS

A project allows you to organize the entire source, object, include, library, and resource files that constitute an application. It keeps track of which files are associated with the application, which ones are dependent on other files, which ones have been recently modified and need to be rebuilt. Also, it allows you to set specific options to be used with the compilation tool associated with the various files in the project.

The first step in working with a project is to create a new one. Use the **Project** menu **New Project** command to create a new project. The **Project Options** dialog will appear as shown below:



Project Name is the name that will be applied to the project. It will be shown whenever the project is identified in Absoft Tools. **Target Filename** is the name of the executable program or library to be created. **Project Directory** is the base directory of the project. Clicking the "..." button will allow you to choose a directory from a standard file dialog. This can only be set when creating a new project. Options Packages are libraries that are included or purchased as add-ons to the Absoft product. Checking the boxes will add the add-on to the project.

The left column contains groups of options for the general project or specific tools. Options specified under **General**, **Target**, **Run**, **Resources**, and **Make** apply to the project globally. **FORTRAN**, **C/C++** and **Linker** apply to the specific tools used for compiling their respective files. Clicking **OK** will create a project with the options specified.

DOCKED DISPLAYS

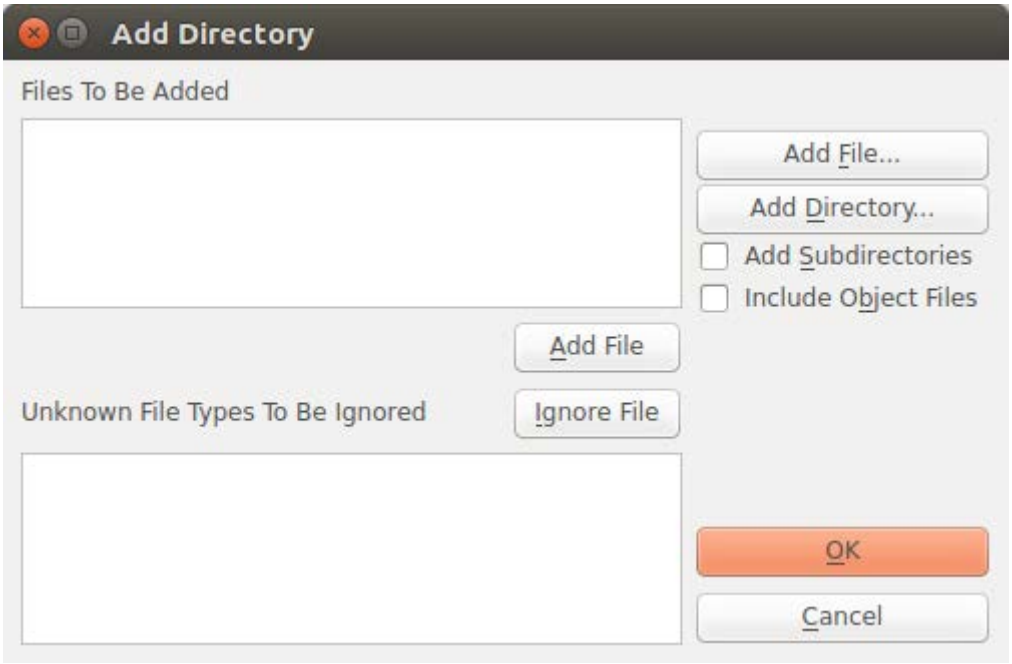
A dock is a movable, resizable, and detachable display window. Several project specific docks will appear after you have created a new project. The default docks are the Files dock, Find in Files dock and the Build dock.

Docks can be moved to customize the appearance of Absoft Tools. Docks can be moved to the top, bottom, left, or right edged of the screen by clicking and dragging the name of the dock to a new location. Dropping a dock on top of an existing dock will create a tabbed set of docks. Selecting the name of the dock under the View menu will toggle the visibility of the dock.

When a project is created or opened, the default docks **Files**, **Find in Files**, and **Build** will be shown on the screen.

ADDING FILES TO THE PROJECT

Files can be added in two ways. The first is right clicking on the files window and choosing **Add File(s)** from the context menu or select **Add File(s)** from the **Project** menu. This will display a standard file dialog where you can select a single file by clicking or multiple files by holding down the Control key as you select the files to add. The second way is to select **Add Directory** from the **Project** menu or right click on the files display and choose **Add Directory** from the menu. This will bring up the following dialog:

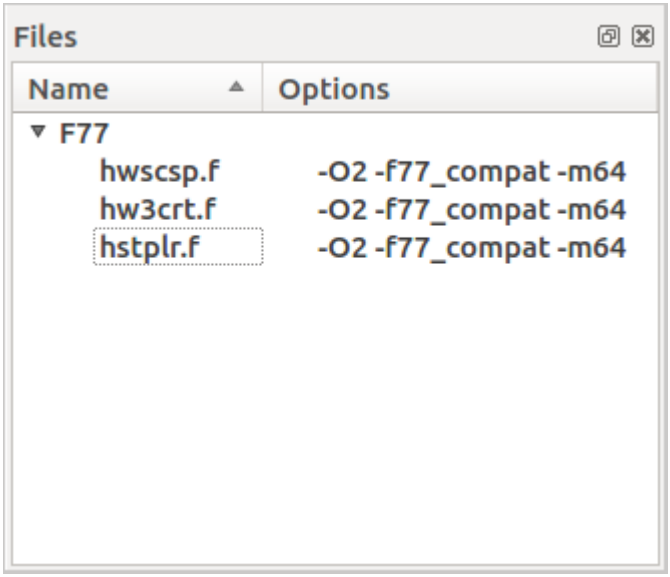


Click the **Add File** button to add files through a standard file dialog. Click the **Add Directory** button to add all files in a directory. Check **Add Directories** to add all files in the subdirectories under the chosen directory. Check **Include Object Files** to add object files to the project.

Once you finish with either the **Add File** or **Add Directories** selection and click **OK**, the chosen files will be added to the **Files to be Added** list box if Absoft Tools has a tool to compile the files. If a file is unknown, it will be added to the **Unknown File Types To Be Ignored** list box. Selecting a file in the **Files to be Added** list box and clicking the Ignore File button will move the file to the **Unknown File Types To Be Ignored** list box. Selecting a file in the **Unknown File Types To Be Ignored** list box and clicking the Add File button will move the file to the **Files to be Added** list box. All files in the **Files to be Added** list box will be added to the project once Ok is clicked.

FILES DOCK

Files that are in the project are located in the **Files** dock window. Files are organized by file type. Each type can be expanded or collapsed by clicking the + or – next to the type name.



Multiple files may be selected. Right-clicking on the file list will bring up a context menu. The menu commands are listed below:

New File in Project

This menu allows you to choose the type of new file to add to the project. Selecting the type of file will cause a standard file dialog to appear. Choose the name and directory to save the file as, and the new file will be saved and opened in the active window for editing.

Add File(s)

Opens a standard file dialog for adding files (see Adding Files To Project).

Add Directory

Opens a directory dialog for adding files (see Adding Files To Project).

Check Syntax

Compiles selected files using the options displayed in the files view. The results will appear in the build view. This is used to check the syntax of a file without recompiling the whole project.

Set Options for

Opens a option dialog to set options for the selected files only (see Setting Compiler Options).

Use Default Options

Removes any file specific options set by "Set Options for." The project options set in **Project Options** from the **Project** menu will be used.

Remove File in Project

Removes files from project.

Show Full Paths

Adds another column to the file list that contains the full paths of each file.

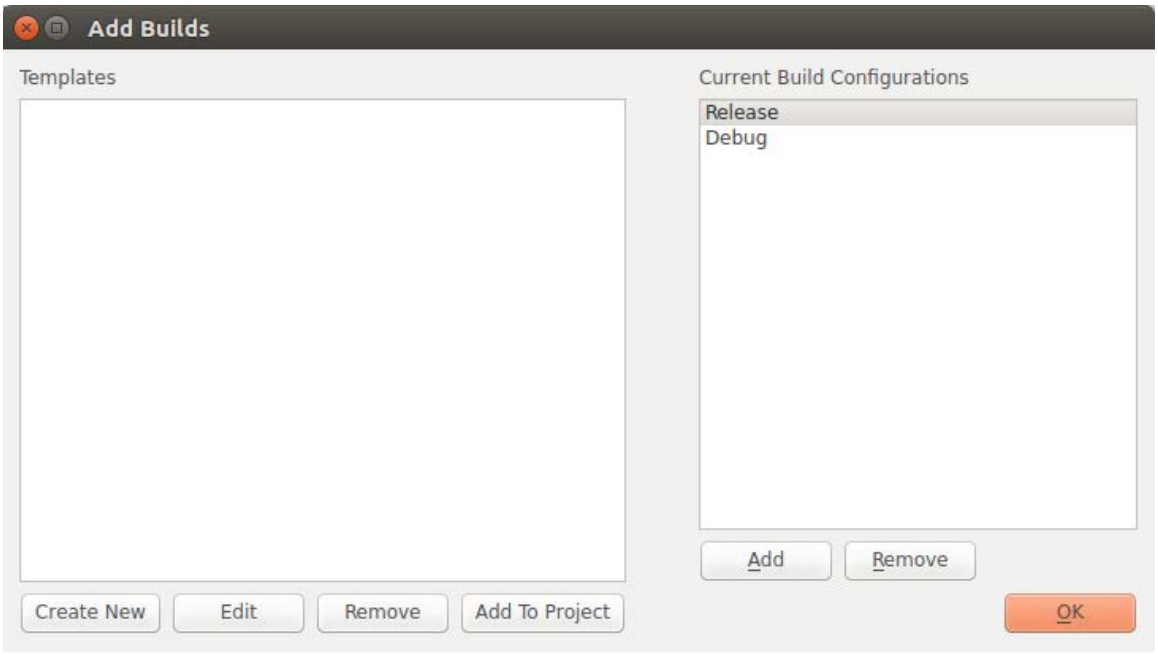
Show Relative Paths

Adds another column to the file list that contains the relative paths of each file.

BUILD CONFIGURATIONS

Absoft Tools has two built in build configurations, Release and Debug. The Release build configuration is an optimized build. It uses the optimization options that are set in the options dialog and builds object and module files in <project directory>/Release. The Debug build configuration is a debug build. It uses the debug options that are set in the options dialog and builds object and module files in <project directory>/Debug. You can switch between build configurations by selecting **Set Build** from the **Build** menu or selecting the build name from the Active Build combo box on the project tool bar.

Absoft Tools allows you to create your own build configurations. To create a new configuration, select **Create New Build** from the **Build** menu. This will open a dialog that will allow you to add custom builds.



Adding a New Build Configuration

To add a new build configuration, click the **Add** button below the **Current Build Configurations** pane. A text cursor will appear in the list of current build configurations, allowing you to enter the name of the new configuration. If the name you enter ends with "debug", the new configuration will be considered a Debug build when using the **Project Options** dialog to modify build options. You can also add a build configuration to a project using a previously defined configuration template by selecting the name of the template in the **Templates** pane and clicking **Add To Project**.

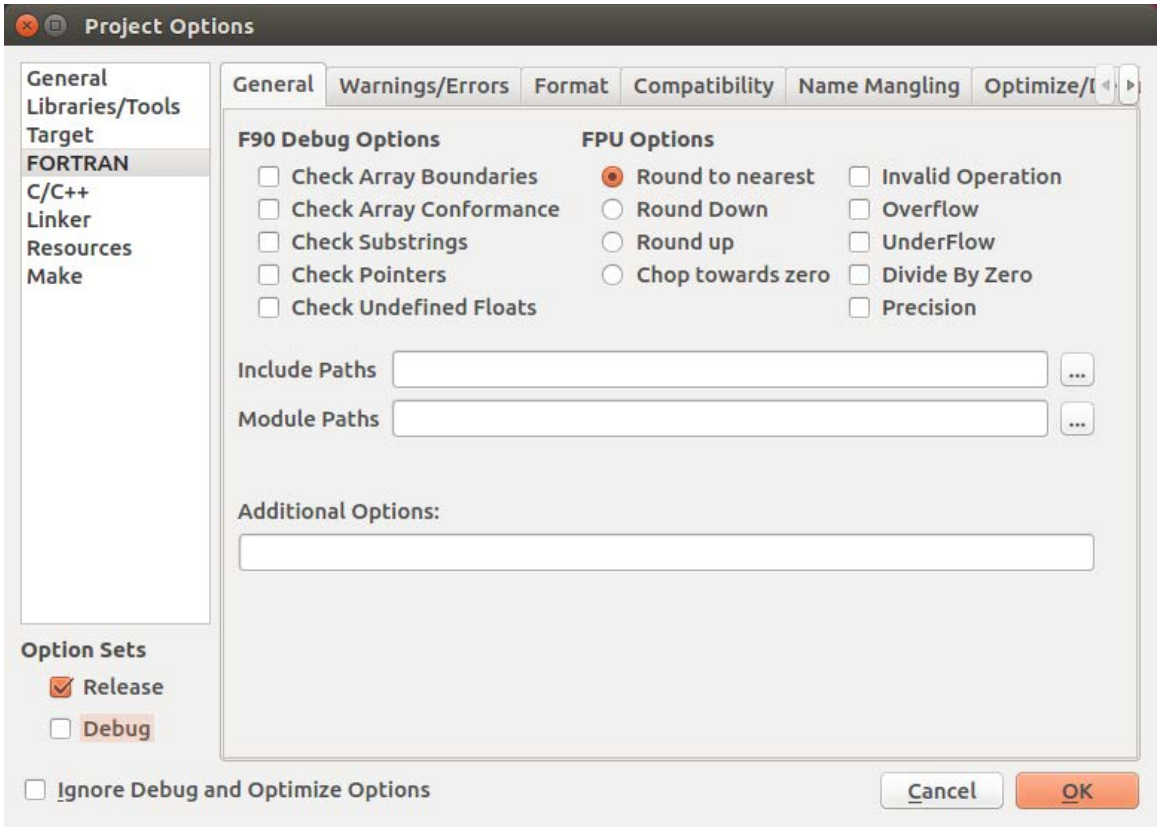
After a new build configuration has been added to a project, you can make it the active build using **Set Build** command the **Build** menu or selecting the build name from the **Active Build** combo box on the project tool bar.

Creating A New Build Configuration Template

To create a new build configuration template, click **Create New** below the **Templates** pane. Type in the name of the new build (case is significant) and press enter. If a template name ends with the characters “debug”, it will be considered a Debug build when added to a project. After template name has been entered, the **Project Options** dialog will open and allow you set the various options for your new template. When you are finished, click **OK** and the new template will be added to the list of available templates. You can add the new template to the current project by clicking on **Add To Project**.

SETTING COMPILER OPTIONS

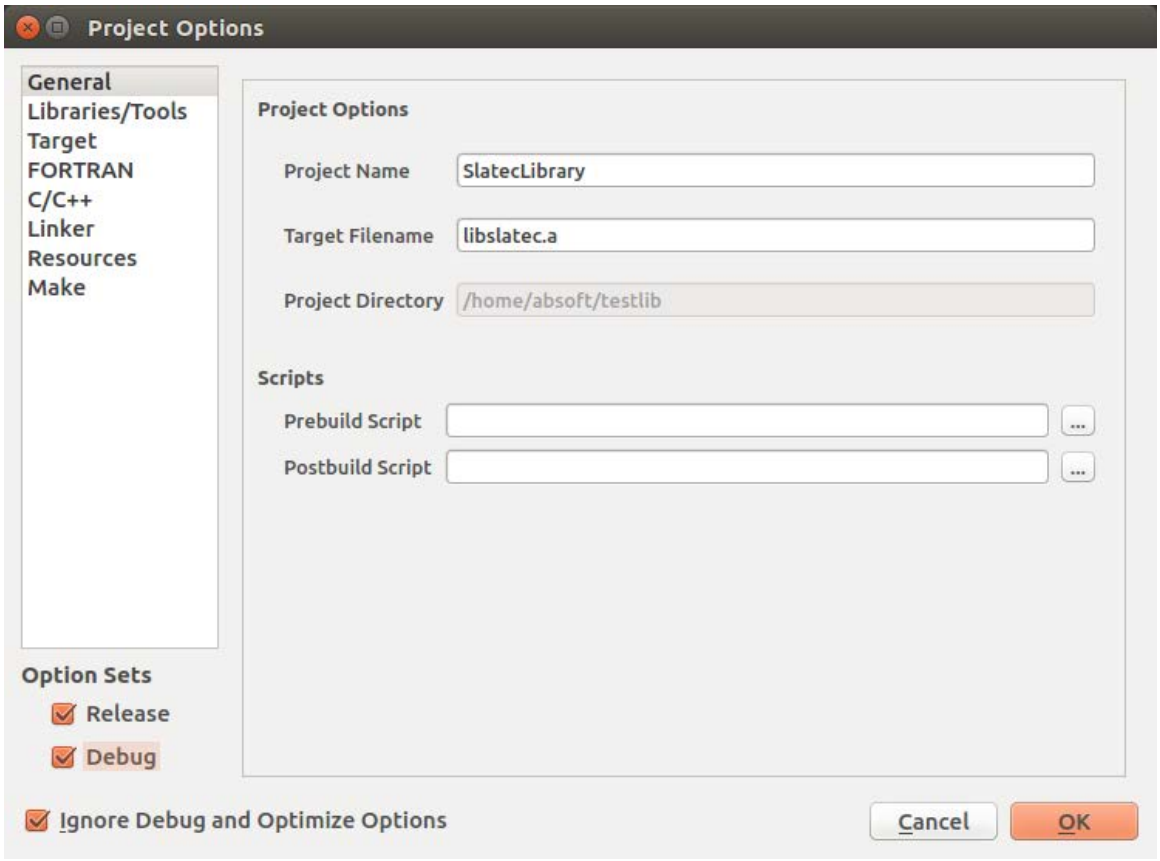
You can set options for tools or specific files. Options are described in the chapter **Using the Compilers**. Options for tools will apply to all files that the tool can compile. For example, setting the **FORTRAN** options will apply to all FORTRAN files (.f, .f90, f95, etc.). To set tool options, select **Project Options** from the **Project** menu. This will bring up the **Project Options** dialog:



Selecting a tool name in the left list will show the corresponding options tabs in the right display. For example, selecting **FORTRAN** will show the **General**, **Warnings/Errors**, **Format**, **Compatibility**, **Name Mangling** and **Optimize/Debug** tabs.

By default, any changes apply only to the option set for the active build configuration (shown in the Active Build combo box on the project tool bar). To apply the changes to the option sets for multiple build configurations, select the desired build configurations under **Option Sets**. If **Ignore Debug and Optimize Options** is checked, all options except for debug and optimization options will be applied to the selected builds. If **Ignore Debug and Optimize Options** is not checked, debug options will be applied to the selected debug builds (builds with names that end case insensitively in "debug"), and optimization options will be applied to the selected release builds.

When two or more build configurations are selected, the **Ignore Debug and Optimize Options** is automatically checked. You must explicitly uncheck it to change the behavior.



Target Options

Target Type

Terminal Application	Creates an application that will be run from the terminal. This is the default.
AWE Application	Creates an application using the *Absoft Window Environment*.
MPI Application	Creates an application that will be built and executed with MPI.
Static Library	Creates a static library
Shared Library	Creates a shared object library

MULTIPLE BUILD AND OPTIONS EXAMPLE

To make multiple builds and setting options easier to understand, let's go through an example for editing the options for a single build:

Start a new project and add a file to it:

1. Open the AbsoftTools application
2. Select **New Project** from the **Project** menu
3. Enter the directory (type the directory name or click the "..." button and select the directory from the dialog)
4. Click Ok. You will now have a new project open
5. Right click in the Files window and select **F95 File** from the **New File In Project** menu.
6. Type a name in the dialog to save the file as. The name should appear in the Files list under F95. Options will be listed as -O2 and -m32 (or -m64 if you have a 64 bit processor)
7. Select "Debug" from the Active build combo box in the project tool bar. The Files list options should change to -g and -m32 (or -m64 if you have a 64 bit processor).

Create multiple builds:

8. From the **Build** menu, select **Create New Build...** An **Add Builds** dialog will appear.
9. Click **Add** under the Current Build Configurations list.
10. When the text cursor appears, type "Fast" and press enter.
11. Click **Add** again under the Current Build Configurations list.
12. When the text cursor appears, type "FullDebug" and press enter.
13. Click Ok.

Examine builds:

The Active Builds combo box will now contain “Release”, “Debug”, “Fast”, and “FullDebug”. When you change active builds by selecting the build from the Active Build combo box, the Files list should contain -O2 for Release and Fast, and -g for Debug and FullDebug.

Set Options for Fast and FullDebug build configurations:

15) Select “FullDebug” from the Active Build combo box.
16) From the **Project** menu, select **Project Options**. The option dialog will appear. We are editing the FullDebug build, since FullDebug is selected as the Active build.
17) Select **FORTRAN** and click on the **General** tab.
18) Select Check Pointers
19) Click Ok. The options in the File list should read -g, -m32 (or -m64) and -Rp.
20) Select “Fast” from the Active Build combo box.
21) From the **Project** menu, select **Project Options**. The option dialog will appear. We are editing the fast build, since fast is selected as the Active build.
22) Select **FORTRAN** and click on the **Optimize/Debug** tab.
23) Select **Level 4** from the **Optimize** combo box.
24) Click **Ok**. The options in the File list should read -O4, -m32 (or -m64).

We now have 4 builds to choose from.

Fast	sets -O4 for fast optimizations
Release	sets -O2 for normal optimizations
Debug	sets -g for debug
FullDebug	sets -g standard debug and -Rp for pointer checking

Add the -s option to all four builds:

25) Select **Project Options** from the **Project** menu. The option dialog should appear.
26) Select **FORTRAN**, click on the **Compatibility** tab, and check **Static Storage**.
27) Select all four builds (Release, Debug, Fast, and FullDebug) under **Option Sets**.
28) Note that **Ignore Debug and Optimize Options** is checked when you have more than one build checked.
29) Click Ok.

All the builds now have -s as an option. You can verify this by selecting the different build configurations in the Active Builds combo box.

BUILDING

To build a project, click the build icon on the tool bar or select **Build** from the **Build** menu. The build dock will display the output from the build. If an error occurs in a FORTRAN compilation, the build tab will switch to the **Errors/Warnings** tab and a summary of the FORTRAN error will be displayed. Clicking on the error in the **Errors/Warnings** tab will

open the file with the error and go to the line and column of the error. Right-clicking on an error and clicking explain will cause a dialog to appear with a detailed explanation of the error.

Selecting **Clean** from the **Build** menu will remove all files created during the build process.

Selecting **Rebuild** from the **Build** menu will clean a project and then build from scratch.

Clicking the stop icon in the tool bar or selecting **Stop** from the **Build** menu may be used to stop a build.

EXECUTE/DEBUG

Once an executable program is built, you may execute the program by selecting **Execute** from the **Build** menu or clicking the execute icon in the tool bar. Clicking **Debug** from the **Build** menu or clicking the debug icon will start Fx3 with the executable program.

A programs environment variables, arguments and current working directory are set in the **Project Options** dialog under the **Run** item. If OpenMP is checked on the **Target** options page, the environment variables will be populated with the OpenMP runtime variables.

FIND IN FILES

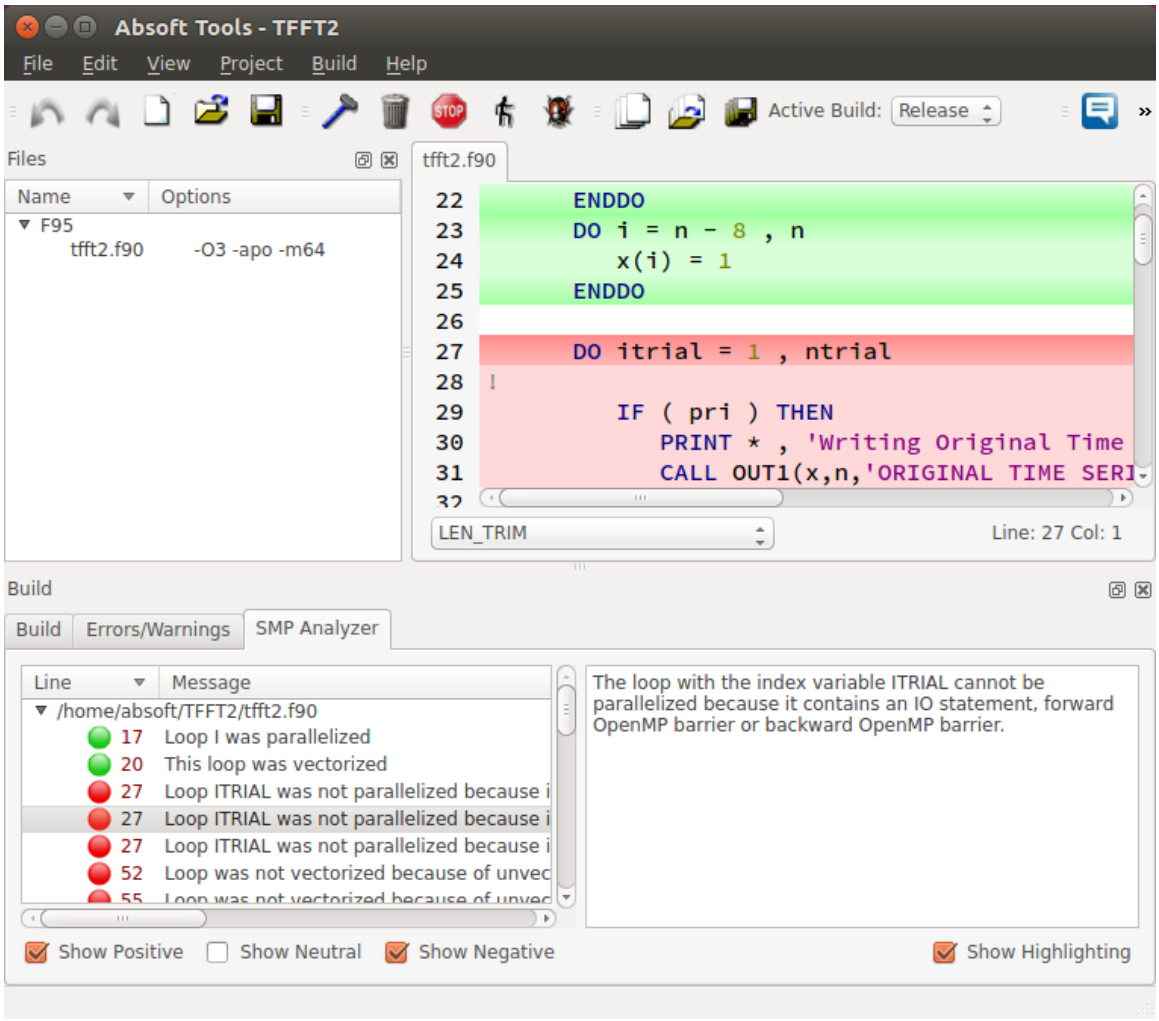
The **Find in Files** dock can be hidden and shown by selecting **Find in Files** from the **View** menu. **Find in Files** will search each file in the project for the text specified. To search for text, make sure the **Find in Files** dock is visible, then enter the text to search for in the Find in File text box and press enter. Checking **Case Sensitive** will make case significant. Checking **Whole Words** will search for whole word references. A list of files will appear above the text. Clicking on a reference will open the file and go to the line the reference is in.

To replace, type the text to be replaced in the **Find in File** text box and the replacement text in the **Replace With** text box then press enter. This will only replace one occurrence in the current file; hitting the **Replace** button achieves the same result. If you hit the enter key again, it will replace the next occurrence. Both the **Case Sensitive** and **Whole Words** check boxes also apply when replacing. If you click **Replace All** button, it will replace every occurrence in all the files in the project, including the ones that are not opened. All the files that have been affected by this action are listed in the above text box. At the end, a summary of how many replacements have been made in how many files is displayed. Clicking on a reference will also open that file.

Note: if you want to replace every occurrence in one file only, use **Find/Replace** action under the **Edit** menu.

SMP ANALYZER

When the **Auto-Parallelization** option (**-apo**) is checked, **Optimize Level 3** (**-O3**, auto-vectorization) is selected, or Optimize Level 5 (**-O5**, auto-parallization and auto-vectorization) is selected, the Absoft SMP Analyzer is enabled. This tool provides detailed feedback and analysis of where advanced optimizations were performed and where they could not be performed. The analysis includes the line number of the code considered for optimization, a brief report, and an expanded explanation. The analyzer is selected by clicking on the **SMP Analyzer** tab in the **Build** window:



When the SMP Analyzer is enabled, the source file is highlighted, indicating loops that were considered for optimization. Three types of highlighting are displayed:

1. Positive indicates the loop was optimized
2. Neutral indicates the loop could be optimized, but was not
3. Negative indicates the loop could not be optimized

`

Unchecking its box can selectively disable each type of highlighting. Typically, loops that could be optimized, but were not, have an iteration count too small to benefit from parallelization. Loops that cannot be optimized at all typically contain constructs that cannot be parallelized such as I/O statements and external function references with unknown side effects.

CHAPTER 5

Using the Compilers

This chapter describes how to use the Absoft Fortran 90/95 and FORTRAN 77 compilers to create executable files on the Linux operating system for the Intel and AMD families of processors. Beginning with an overview of the compilers, this chapter explains how to compile a small number of Fortran source files into an executable application. File name conventions and process control options are described first. The final sections of this chapter describe the compiler options in detail.

COMPILING PROGRAMS

The Fortran 90/95 and the FORTRAN 77 compilers are invoked from the Linux command line in the same manner:

```
f95 [options] files…

f77 [options] files…
```

FILE NAME CONVENTIONS

Compilation is controlled by the two compiler drivers: `f77` and `f95`. These drivers take a collection of files and, by default, produce an executable output file. Acceptable inputs to `f95` are:

File Type	Default form
Free format Fortran 90/95 source files	*file*`.f90 or` *file*`.f95`
Free format Fortran 90/95 preprocessor files	*file*`.F90 or` *file*`.F95`
Fixed format Fortran 90/95 source files	*file*`.f`
Fixed format Fortran 90/95 preprocessor files	*file*`.F`
C language source files	*file*`.c`
Assembly language source files	*file*`.s`
Relocatable object files	*file*`.o`

Acceptable inputs to `f77` are:

File Type	Default form
FORTRAN 77 source files	*file*`.f or` *file*`.for`
FORTRAN 77 preprocessor files	*file*`.F or` *file*`.FOR`
C language source files	*file*`.c`
Assembly language source files	*file*`.s`
Relocatable object files	*file*`.o`

File names that do not have one of these default forms are passed to the linker. It is assumed that the C compiler (*cc*), assembler (*as*), and linker (ld) are installed on the system and use standard command line syntax.

Output file names take the form:

File Type	Default form
Assembly language source files	*file*.s
Relocatable object files	*file*.o
Precompiled module file	*file*.mod
Executable object files	a.out

COMPILER PROCESS CONTROL

By default the f77 and f95 compiler drivers construct and execute the necessary commands to produce an executable application. This process requires compilation, assembly and linkage. As each of these processes finishes, all files that were created by the preceding stage are deleted. In some cases it may be desirable to save these intermediate files. Options controlling this are described here. These switches, in conjunction with the input file names, can also be used to stop the compilation process at any stage.

Generate Assembly Language (-S)

Specifying the **–S** option will cause the compilers to generate assembly language output in a form suitable for the system assembler. The file created will have the suffix ".s". For example, compiling test.f with the **–S** option will create test.s. If any C source files are given as arguments to f77 or f95, this option will be passed to the C compiler. If no other compiler process control options are specified and there are no relocatable object files specified on the command line, the compilation process will halt after all Fortran 90/95, FORTRAN 77, and any C source code files have been compiled to assembly language source.

Generate Relocatable Object (-c)

Specifying the **–c** option will cause the compilers to generate relocatable object files. In the Linux environment, this option indicates that all source files (Fortran 90/95, FORTRAN 77, C, and assembly) should be processed to relocatable object files. If no linker options are present (see below), then the compilation process stops after all object files have been created. If any C source files are given as arguments to f77 or f95, this option will be passed to the C compiler.

Passing Options To The Linker

For ease of use within the Linux environment, many of the options that are available to the system linker are also available to the `f77` and `f95` compiler drivers. Specifying any of these options indicates that all files specified on the command line should be processed through the linkage phase. Unless the **–S** or **–c** options are specified, all intermediate files (relocatable objects and/or assembly source) will be deleted. See the system documentation on *ld* for more information regarding these options. In brief, the options are as follows:

Executable File Name (-o *name*)

Use of the **–o *name*** option will cause the linker to produce an executable file called ***name***. The default is to produce an executable file called `a.out`.

Library Specification (-l)

Specifying the **–l***name* option will cause the linker to search the library file `lib`*name*`.a`.

Library Path Specification (-L)

The **–L***path* option will cause the linker to search the specified directory named in *path* for library files given with succeeding **–l** options.

Absoft shared object libraries (-use_absoft_shared)

When passed this option, the Absoft compiler will link the shared object library versions of the Absoft runtime libraries. This option allows one or more FORTRAN shared object libraries to share connected FORTRAN I/O units. This option is required if more than 2 GB of statically allocated local memory is used. Executable files will need to have the environment variable `LD_LIBRARY_PATH` set appropriately to locate the shared object library versions of the Absoft runtime libraries.

Undefine A Symbol (-u)

Specifying the **–u***symbol_name* option will enter *symbol_name* as an undefined symbol to the linker.

Linker Options (-X) (-Wl,)

Use the **–X *option*** switch to pass an option directly to the linker. The FORTRAN 77 or Fortran 90/95 driver will pass ***option*** to the linker. If you want to pass an option that takes an argument, use the **–X** option twice. As an alternative, you may also use the **–Wl,*option*** syntax used by the GNU compiler collection to pass options directly to the linker.

Preprocessor Options (-cpp and –no-cpp)

If a source file name has an upper case extension (F, FOR, F90, F95), the compiler first passes it to the C preprocessor to handle C-style includes, macros, and conditional directives. Use the **–cpp** option to force the compiler to invoke the C preprocessor regardless of the source file extension. Use the **–no-cpp** option to force the compiler to *not* invoke the C preprocessor regardless of the source file extension.

Generate Debugging Information (-g)

Specifying the **–g** option will cause the compilers to include Dwarf2 symbol and line information appropriate for debugging a compiled program with Fx3, the Absoft debugger, or other source level debuggers which can read Dwarf2 symbol information.

Position Independent Code (-fpic, -fPIC)

The **–fpic** option is used to cause the compiler generate position independent code.

FPU CONTROL OPTIONS

These options provide control over several aspects of the operation of the *Floating-Point Unit* of the processor including rounding mode, exception handling, control word state, and FPU stack integrity.

FPU Rounding Mode (-OPT:roundoff=#)

Set the level of acceptable rounding (# can be 0,1,2, or 3)

0 - Turn off optimizations that may be harmful to floating point calculations.
1 - Allow simple optimization that may affect floating point accuracy.
2 - Allow more extensive optimization that may affect floating point accuracy.
3 - Allow all optimizations affecting floating point accuracy.

Enable Exception Traceback (-et)

The **–et** option causes the compilers to include symbol and line information, exception handling initialization, and library to code to perform execution tracebacks. The traceback includes file name and line number of the program units in the call tree to the point of the exception. There is no program execution time overhead when enabling this option, but all files that are incorporated in the executable must be compiled with this option for the diagnostic output to be meaningful.

FPU Exception Handling

When a floating-point exception is produced, the default action of an application is to supply an IEEE P754 defined value and continue. For undefined or illegal operations (such as divide by zero or square root of a negative number) this value will usually be either Infinity (INF) or Not A Number (NaN) depending on the floating-point operation.

Checking any of the exception boxes will cause the program to stop and produce a core dump, rather than continue, if the exception is encountered. If the program is being debugged, it will stop in the debugger at the statement line that caused the exception. The syntax for using this option on the command line is:

-TENV:*exception*=off

where ***exception*** is one of:

simd_imask – Invalid operation exception.
simd_dmask – Denormalized operand exception.
simd_zmask – Divide by zero exception.
simd_omask – Overflow exception.
simd_umask – Underflow exception.
simd_pmask - Precision exception.

PROCESSOR SPECIFIC OPTIONS

The options described in this section are specific to the x86 family of processors.

CPU Specific Optimizations (-march=*type*)

Use the **–march=** option to target object code to a specific type of processor. Valid values for ***type*** are:

anyx86	any processor using the x86 instruction set
pentium4	Intel Pentium 4
em64t	Intel Pentium 4 with 64-bit extensions
core	Intel Core and Core 2
opteron	AMD Athlon 64/FX/X2 and AMD opteron
barcelona	AMD Opteron and Phenom with K10 Barcelona architecture
wolfdale	Intel Core I7 technology
host	automatically establishes ***type*** based on the processor in the machine that the program is compiled with. If the CPU type cannot be determined, *anyx86* is used.

64-BIT AMD AND INTEL PROCESSOR SPECIFIC OPTIONS

The options described in this section are specific to the AMD and Intel 64-bit family of processors.

Code Generation Model (-mcmodel={small | medium})

This option specifies the code generation model for 64-bit processors. The **small** code model limits the combined code and data size to 2 gigabytes. The **medium** code model allows data to be larger than 2 gigabytes. The default is the **small** model.

Generate 32-bit code (-m32)

Use the **–m32** option to generate code that can be run on any X86 class processor.

Generate 64-bit code (-m64)

Use the **–m64** option to generate code that can only be run on AMD or Intel 64-bit processors.

ABSOFT FORTRAN 90/95 OPTIONS

The compiler options detailed in this section give you a great deal of control over the compilation and execution of Fortran 90/95 programs. The options fall into five general categories: Compiler Control, Optimizations, Compatibility, Modules paths and file, and Miscellaneous.

Each option is listed with the corresponding option letter(s) and a description. Options that take arguments may optionally have a space to separate the option from its argument. The only exceptions are the `B` and `N` options; they cannot have a space between the option and its argument (e.g. `-N33`).

Compiler control

These options control various aspects of the compilation process such as warning level, verbosity, code generation, where module files can be found, and the definition of compiler directive variables. The generation of debugging information, for the symbolic source-level debugger, Fx3, is also controlled by compiler control options.

Show progress (-v)

Enabling the **-v** option will cause the `f95` command, described above, to display the commands it is sending to the compiler, assembler, and linker.

Output Version number (-V, --version)

The **-V** and **–version** options will cause the `f95` compiler to display its version number. This option may be used with or without other arguments.

Suppress warnings (-w)

Suppresses the listing of warning messages. For example, unreachable code will generate a warning message. Error diagnostics will still be displayed on standard error.

Warn of non-standard usage (-en)

Use of the **-en** option will cause the compiler to issue a warning whenever the source code contains an extension to the Fortran 90/95 standard. This option is useful for developing code that must be portable to other environments.

Warning level (-m*nn*)

Use the **-m*nn*** option to suppress messages by message level, where ***nn*** is a message level. Diagnostics issued at the various levels are:

0	errors, warnings, cautions, notes, comments
1	errors, warnings, cautions, notes
2	errors, warnings, cautions
3	errors, warnings
4	errors

The default level is **-m3**; the compiler will issue error and warning diagnostics, but not cautions, notes, and comments. See also the **-M*nn*** option.

Suppress Warning number(s) (-M*nn*)

Use the **-M*nn*** option to suppress messages by message number, where ***nn*** is a message number. This option is useful if the source code generates a large number of messages with the same message number, but you still want to see other messages. See also the **-m*nn*** option.

Stop on error (-ea)

The **-ea** option will cause the `f95` compiler to abort the compilation process on the first error that it encounters.

Allow greater than 100 errors (-dq)

Normally, the Absoft Fortran 90/95 compiler will stop if more than 100 errors are encountered. This many errors usually indicate a problem with the source file itself or the inability to locate an `INCLUDE` file. If you want the compiler to continue in this circumstance, select the **-dq** option.

Default Recursion (-eR)

If you select the **-eR** option, all FUNCTIONs and SUBROUTINEs are given the RECURSIVE attribute. Normally, if the compiler detects a recursive invocation of a procedure not explicitly given the RECURSIVE attribute, a diagnostic message will be issued. The **-eR** option disables this.

Append Underscore To Names (-B108)

Use of the **–B108** option directs the compiler to append an underscore to SUBROUTINE and FUNCTION definitions and references in a manner consistent with the g77 FORTRAN compiler. A single underscore is appended unless the name contains an underscore in which case two underscores are appended. This option can be used to avoid name conflicts with the system libraries or other FORTRAN environments. See also the **-YEXT_SFX=** option.

Generate Debugging Information (-g)

Specifying the **–g** option will cause the compilers to include symbol and line information appropriate for debugging a compiled program with Fx3, the Absoft debugger, and other source level debuggers which understand Dwarf2 symbol information.

The Absoft Fortran 90/95 and FORTRAN 77 compilers have the capability to output special symbol information for use with the Fx3 debugger from Absoft. This information allows Fx3 to display the contents of adjustable arrays, arrays with more than four dimensions, arrays with lower bounds other than 1, and arrays with dimensions greater than 32767.

Generate Profiler Information (-P)

Specifying the **–P** option will place information for profiling execution into a compiled program. For information on using the Linux profiler, see the Linux manual page for *gprof*.

Optimizations

These options control compile time optimizations to generate an application with code that executes more quickly. Absoft Fortran 90/95 is a globally optimizing compiler, so various optimizers can be turned on which affect single statements, groups of statements or entire programs. There are pros and cons when choosing optimizations; the application will execute much faster after compilation but the compilation speed itself will be slow. Some of the optimizations described below will benefit almost any Fortran code, while others should only be applied to specific situations.

Basic Optimizations (-O1)

The **–O1** option will cause most code to run faster and enables optimizations that do not rearrange your program. The optimizations include common subexpression elimination, constant propagation, and branch straightening. This option is generally usable with debugging options. **–cpu:host** is implied with this option.

Normal Optimizations (-O2)

The **–O2** option enables normal optimizers that can substantially rearrange the code generated for a program. The optimizations include strength reduction, loop invariant removal, code hoisting, and loop closure. This option is not usable with debugging options. **–cpu:host** is implied with this option.

Advanced Optimizations (-O3)

The **–O3** option enables advanced optimizers that can significantly rearrange and modify the code generated for a program. The optimizations include loop permutation (loop reordering), loop tiling (improved cache performance), loop skewing, loop reversal, unimodular transformations, forward substitution, and expression simplification. This option is not usable with debugging options. **–cpu:host** is implied with this option.

Advanced Optimizations (-Ofast)

The **–Ofast** option enables advanced optimizers that can significantly rearrange and modify the code generated for a program. The optimizations include all optimizations that are included with **–O3** as well as turning on inter-procedural analysis.

Automatic Parallelization (-apo)

The **–apo** option enables automatic parallelization of your source program.

Dynamic AP (-O5)

The **–O5** option enables auto parallelization and dynamic load scheduling. When your program begins execution, the CPU load is measured and your program will automatically only use those processors that are actually available (idle). The optimizations include all optimizations that are included with **–Ofast**.

Loop unrolling (-U and -h*nn* and -H*nn*)

The Absoft Fortran 95 compiler has the ability to automatically unroll some of the loops in your source code. Loops may be unrolled by any power of two. Generally it is beneficial to unroll loops that execute a large number of iterations, while the benefit is small for loops that iterate only a few times. Due to this, only innermost loops are considered for unrolling. The **-h***nn* option will cause the compiler to unroll your innermost loops *nn* times, where *nn* is any power of two. The **-H***nn* option will cause the compiler to consider loops containing *nn* or fewer operations for unrolling. When the **–O3** option is used, the default is to only consider loops of a forty operations and unroll them four times. Using the **-U** option is equivalent to using **-h4 -H40**, causing innermost loops of forty or fewer operations to be unrolled four times. Loop unrolling will provide a speed increase in most cases, but will make your application larger and it will require more memory to compile. Consider the following example:

Original code:

```
SUBROUTINE SUB(A,N,X)
INTEGER A(100)

DO i=1,N
    A(i) = X*A(i)
END DO
RETURN
END
```

Becomes:

```
SUBROUTINE SUB(A,N,X)
INTEGER A(100)

DO i=1,MOD(N,4)
    A(i) = X*A(i)
END DO
DO i=MOD(N,4)+1,N,4
    A(i)   = X*A(i)
    A(i+1) = X*A(i+1)
    A(i+2) = X*A(i+2)
    A(i+3) = X*A(i+3)
END DO
RETURN
END
```

This is similar to the effect of loop unrolling. At least three comparisons and three branch instructions are saved each time the second loop is executed. Note that if your code contains extended range `DO` loops, unrolling loops will invalidate your program.

SSE2 instructions (-msse2 and –mno-sse2)

The **–msse2** and **–mno-sse2** options enable and disable respectively the use of SSE2 instructions for floating-point operations. This **–msse2** option is automatically enabled on processors which support SSE2. It may be disabled with the **–mno-sse2** option.

SSE3 instructions (-msse3)

The **-msse3** option enables the use of SSE3 instructions for floating-point operations. This option is automatically turned on when the **-march=host** option is specified and the host supports SSE3 instructions.

SSE4a instructions (-msse4a)

The **-msse4a** option enables the use of SSE4a instructions. This option is automatically turned on when the **-march=host** option is specified and the host supports SSE4a instructions.

SSSE4.1 instructions (-msse41)

The **-msse4a** option enables the use of SSE4.1 instructions. This option is automatically turned on when the **-march=host** option is specified and the host supports SSSE4.1 instructions.

Math Optimization Level (-speed_math=*n*)

The **-speed_math=*n*** option enables aggressive math optimizations that may improve performance at the expense of accuracy. Valid arguments for ***n*** are 0-11. See Appendix E for more information.

Enable OpenMP Directives (-openmp)

The **-openmp** option enables the recognition of OpenMP directives. OpenMP directives begin in column one in the form of:

`C$OMP` for fixed source format
`!$OMP` for free source format

OpenMP optimization Level (-speed_openmp=*n*)

The **–speed_openmp=** enables progressively more aggressive OpenMP optimizations on the value of ***n*** as follows:

n	effect
0	allow code optimization and movement through OpenMP Barrier
1	enable loose memory equivalence algorithm during optimization
2	Enable MU generation in SSA generation for OpenMP pragma
3	Enable CHI generation in SSA generation for OpenMP pragma
4	Allow loop unrolling for loops with OpenMP chunksize directive
5	Use a risky but faster algorithm to handle thread private common blocks

Each level includes all previous optimizations (e.g. **3** includes 0,1, and 2).

Safe Floating-Point (-safefp)

The **–safefp** option is used to disable optimizations that may produce inaccurate or invalid floating point results in numerically sensitive codes. The effect of this option is to preserve the FPU control word, enable NAN checks, disable `CABS` inlining, and disable floating-point register variables.

Report Parallelization Results (-LNO:verbose=on)

The **–LNO:verbose=on** option is used to display the results of the **–apo** option. It will report which loops were parallelized and which were not and why not.

Report Vectorization Results (--LNO:simd_verbose=on)

The **–LNO:simd_verbose=on** option is used to display the results of vectorization of loops which occurs at optimization levels greater than **–O3**. It will report which loops were vectorized and which were not and why not.

Compatibility

These options allow Absoft Fortran 90/95 to accept older or variant extensions of Fortran source code from other computers such as mainframes. Many of these can be used for increased compatibility with Fortran compilers on various mainframe computers.

Source Formats

For compatibility with other Fortran environments and to provide more flexibility, the compiler can be directed to accept source code that has been written in a number of different formats. The two basic formats are free-form and fixed-form.

Free-Form (-f free)

The **-f free** option instructs the compiler to accept source code written in the format for the Fortran 90/95 Free Source Form. This is the default for file names with an extension of "`.f90`" or "`.f95`".

Fixed-Form (-f fixed)

The **-f fixed** option instructs the compiler to accept source code written in the format for the Fortran 90/95 Fixed Source Form that is the same as the standard FORTRAN 77 source form.

Alternate Fixed form (-f alt_fixed)

The **-f alt_fixed** option instructs the compiler to accept source code written in following form:

If a tab appears in columns 1 through 5, then the compiler examines the next character. If the next character is not a letter (a-z, or A-Z) then it is considered a continuation character and normal rules apply. If it is a zero, a blank, another tab, or a letter, the line is not a continuation line.

Fixed line length (-W *nn*)

Use the **-W** option to set the line length of source statements accepted by the compiler in Fixed-Form source format. The default value of *nn* is 72. The other legal values for *nn* are 80 and 132 — any other value produces an error diagnostic.

Escape Sequences in Strings (-YCSLASH=1)

If the **-YCSLASH=1** option is turned on, the compiler will transform the following escape sequences marked with a '\' embedded in character constants:

```
\a              Audible Alarm (BEL, ASCII 07)
\b              Backspace (BS, ASCII 8)
\f              Form Feed (FF, ASCII 12)
\n              Newline (LF, ASCII 10)
\r              Carriage Return (CR, ASCII 13)
\t              Horizontal Tab (HT, ASCII 09)
\v              Vertical Tab (VT, ASCII 11)
\xh[h]          Hexadecimal, up to 2 digits
\o[o[o]]        Octal number, up to 3 digits
\\              Backslash
```

No Dot for Percent (-YNDFP=1)

This option instructs the compiler to disallow the use of a '.' (period) as a structure field component dereference operator. The default is to allow both '%' (percent), which is the Fortran 90/95 standard, and a period which is typically used with DEC style RECORD declarations. The use of a period may cause certain Fortran 90/95 conforming programs to be misinterpreted (a period is used to delineate user defined operators and some intrinsic operators). The default is **-YNDFP=0**. This switch implements Fortran 90/95 standard parsing for structure component referencing.

MS Fortran 77 Directives (-YMS7D)

The **-YMS7D** option causes the compiler to recognize Microsoft Fortran 77 style directives in the form of $directive where the dollar-sign character is in column one of the source file. directive must be from the set of supported MS directives.

Integer Sizes (-i2 and -i8)

Without an explicit length declaration, `INTEGER` data types default to thirty-two bits or four bytes (`KIND=4`). The **–i2** option can be used to change this default length to sixteen bits or two bytes (`KIND=2`). The **–i8** option can be used to change the default `INTEGER` size to 64 bits or 8 bytes (`KIND=8`). However, an explicit length specification in a type declaration statement always overrides the default data length.

Demote Double Precision to Real (-dp)

The **-dp** option will cause variables declared in a DOUBLE PRECISION statement and constants specified with the D exponent to be converted to the default real kind. Similarly, variables declared in a DOUBLE COMPLEX statement and complex constants specified with D exponents will be converted to the complex kind in which each part has the default real kind.

Promote REAL to REAL(KIND=8) (-N113)

Without an explicit length declaration, single precision REAL and COMPLEX data types default to thirty-two bits or four bytes (KIND=4) and sixty-four bits or eight bytes (KIND=4), respectively. The **-N113** option is used to promote these to their double precision equivalents (KIND=8). This option does not affect variables which appear in type statements with explicit sizes (such as REAL (KIND=4) or COMPLEX (KIND=4)).

One trip DO loops (-ej)

Fortran 90/95 requires that a DO loop not be executed if the iteration count, as established from the DO parameter list, is zero. The **-ej** option will cause all DO loops to be executed at least once, regardless of the initial value of the iteration count.

Static storage (-s)

The **-s** option is used to allocate local variables statically, even if SAVE was not specified as an attribute. In this way, they will retain their definition status on repeated references to the procedure that declared them. Two types of variables are not allocated to static storage: variables allocated in an ALLOCATE statement and local variables in recursive procedures.

Structure alignment (-strict_align)

Use the **–strict_align** option to force alignment of structures and derived types on data entity boundaries for compatibility with the C Programming Language. Normally, the compiler pads structures to create the most efficient alignments for data transfers, but this alignment may not be compatible with the alignment used by C/C++ compilers for 32-bit compilations. This option is useful only for 32-bit applications.

Disable compiler directive (-x*directive*)

The **-x** option is used to disable compiler directive in the source file. ***directive*** may be any of the following:

ATTRIBUTES
FIXED
FIXEDFORMLINESIZE
FREE[FORM]

NAME
NOFREEFORM
STATIC

See the section **Absoft Fortran 90/95 Compiler Directives** for more information on using compiler directives in your source code.

Max Internal Handle (-T*nn*)

This option is used to change the number of handles used internally by the compiler. Under most conditions, the default value of 100000 handles is sufficient to compile even extremely large programs. However, under certain circumstances, this value may be exceeded and the compiler will issue a diagnostic indicating that the value should be increased.

The default value can be increased by powers of ten by specifying the **-T** *nn*, where *nn* is a positive integer constant. When this option is specified, the number of handles will be `100000x10`^{nn} bytes.

Temporary string size (-t*nn*)

In certain cases the compiler is unable to determine the amount of temporary string space that string operations will require. The compiler will assume that the operation in question will require 1024 bytes of temporary string space. This default value can be increased by powers of ten by specifying the **-t***nn*, where *nn* is a positive integer constant. When this option is specified, the default temporary string size will be `1024x10`^{nn} bytes.

Module File Path(s) (-p*path*)

The Absoft Fortran 90/95 compiler will automatically search the current directory and `$(ABSOFT)/f90includes` for precompiled module files. If module files are maintained in other directories, the **–p *path*** option can be used to specify additional paths to be searched. If ***path*** specifies a directory name only, all module files in the directory will be searched. If ***path*** specifies a filename, only the specified file will be searched.

Disable Default Module File Path (-nodefaultmod)

The Absoft Fortran 90/95 compiler will automatically search the directory `$(ABSOFT)/f90includes` for precompiled module files. Use the **–nodefaultmod** to disable this.

Module File Output Path (-YMOD_OUT_DIR=*path*)

The Absoft Fortran 90/95 compiler will automatically create module files in the current directory. If module files are to be maintained in another directory, the **-YMOD_OUT_DIR=*path*** option can be used to specify target directory.

Check Array Boundaries (-Rb)

When the **–Rb** compiler option is turned on, code will be generated to check that array indexes are within the bounds of an array. Assumed size arrays whose last dimension is * cannot be checked. In addition, file names and source code line numbers will be displayed with all run time error messages.

Check Array Conformance (-Rc)

The **–Rc** compiler option is used to check array conformance. When array shapes are not known at compile time and where they must conform, runtime checks are created to insure that two arrays have the same shape.

Check Substrings (-Rs)

When the **–Rs** compiler option is turned on, code will be generated to check that character substring expressions do not specify a character index outside of the scope of the character variable or character array element.

Check Pointers (-Rp)

Use **–Rp** compiler option is used to generate additional program code to insure that Fortran 90 style POIINTER references are not null.

Character Argument Parameters (-YCFRL={0|1})

Use the **–YCFRL=1** option to force the compiler to pass `CHARACTER` arguments in a manner that is compatible with `g77` and `f2c` protocols. Use the **–YCFRL=0** option (the default) to pass `CHARACTER` arguments in a manner that is compatible with Absoft Compilers on other platforms. **Note:** this option should be used consistently on all files that will be linked together into the final application.

External Symbol Character Case (-YEXT_NAMES={ASIS | UCS | LCS})

The **-YEXT_NAMES** option is used to specify how the external name of globally visible symbols, such as `FUNCTION` and `SUBROUTINE` names, are emitted. By default, names are emitted entirely in lower case (-**YEXT_NAMES=LCS**). Set this option to **UCS** to emit names entirely in upper case. Set this option to **ASIS** to force external names to be emitted exactly as they appear in the source program. This option controls how external names will appear to other object files.

External Symbol Prefix (-YEXT_PFX=*string*)

The **-YEXT_PFX** option can be used to prepend a user specified ***string*** to the external representation of external procedure names.

External Symbol Suffix (-YEXT_SFX=*string*)

The **-YEXT_SFX** option can be used to append a user specified ***string*** to the external representation of external procedure names.

COMMON Block Name Character Case (-YCOM_NAMES={ASIS | UCS | LCS})

The **-YCOM_NAMES** option is used to specify how the external names `COMMON` blocks are emitted. The default (-**YCOM_NAMES=LCS**) is to emit `COMMON` block names entirely in lower case. Set this option to **UCS** to emit names entirely in lower case. Set this option to **ASIS** to force variable names to be processed exactly as they appear in the source program.

COMMON Block Name Prefix (-YCOM_PFX=*string*)

The **-YEXT_PFX** option can be used to prepend a user specified ***string*** to the external representation of `COMMON` block names.

COMMON Block Name Suffix (-YCOM_SFX=*string*)

The **-YEXT_SFX** option can be used to append a user specified ***string*** to the external representation of `COMMON` block names.

Module files only (-YMOD_ONLY)

The **–YMOD_ONLY** option can be used to prevent the compiler for searching archive libraries for module files.

Variable Names Case Sensitivity (-YVAR_NAMES={ASIS | UCS | LCS})

The **-YVAR_NAMES** option is used to specify how the case of variable names is treated. By default, variable names are processed entirely in lower case (**LCS**), regardless of the how they appear in the source code. Set this option to **UCS** to fold variable names to upper case. Set this option to **ASIS** to force variable names to be processed exactly as they appear in the source program.

Variable Names Case Sensitivity (-YALL_NAMES={ASIS | UCS | LCS})

The **-YALL_NAMES** option is used to specify how the case of all symbolic names is treated. By default, symbolic names are processed entirely in upper case (**UCS**), regardless of the how they appear in the source code. Set this option to **LCS** to fold all symbolic names to lower case. Set this option to **ASIS** to force symbolic names to be processed exactly as they appear in the source program. This option is the same as using the **-YVAR_NAMES**, **-YCOM_NAMES**, and **-YEXT_NAMES** options, which may appear after the **-YALL_NAMES** option to control an individual symbolic name type.

Ignore CDEC$ directives (-YNO_CDEC)

The compiler recognizes CDEC$ directives that contain conditional compilation directives. Use this option disable them.

Pointers Equivalent to Integers (-YPEI={0|1})

This option controls whether or not the compiler will allow or accept a CRI style pointer to be equivalent to an integer argument. By default the Absoft Fortran 90/95 compiler allows this. Even with this relaxed error checking the compiler will correctly choose the right interface for the following example:

```
interface generic
  subroutine specific1(i)
      integer i
  end subroutine specific1
  subroutine specific2(p)
      integer i
      pointer (p,i)
  end subroutine specific2
end interface
call generic(i)
call generic(loc(i))
end
```

Regardless of the switch setting, this example will compile and the executable generated will be equivalent to:

```
call specific1(i)
call specific2(loc(i))
```

Literal constants in DATA statements (-YDATA_REAL_CONV)

Use this option to force the compiler to treat DATA statement constants in BOZ format (binary, octal, or hex) as literal constants. By default, the compiler will convert these constants as integers. The **–YDATA_REAL_CONV** will cause the compiler to assign them without conversion.

Don’t Mangle COMMON Block Name (-N110)

The **-N110** option prevents the compiler from mangling (changing) the global names for COMMON blocks. The default is to prepend the characters “_C” to the COMMON block name so that it does not conflict with other global names such as external procedure names. This option causes the compiler to emit the COMMON block name exactly as it appears in source.

Absoft Fortran 90/95 Compiler Directives

Compiler directives are lines inserted into source code that specify actions to be performed by the compiler. They are not Fortran 90/95 statements. If you specify a

compiler directive while running on a system that does not support that particular directive, the compiler ignores the directive and continues with compilation.

A *compiler directive line* begins with the characters `CDIR$` or `!DIR$`. How you specify compiler directives depends on the source form you are using.

If you are using fixed source form, indicate a compiler directive line by placing the characters `CDIR$` or `!DIR$` in columns 1 through 5. If the compiler encounters a nonblank character in column 6, the line is assumed to be a compiler directive continuation line. Columns 7 and beyond can contain one or more compiler directives. If you are using the default 72 column width, characters beyond column 72 are ignored. If you have specified 80 column lines, characters beyond column 80 are ignored.

If you are using free source form, indicate a compiler directive line by placing the characters `!DIR$` followed by a space, and then one or more compiler directives. If the position following the `!DIR$` contains a character other than a blank, tab, or newline character, the line is assumed to be a compiler directive continuation line.

If you want to specify more than one compiler directive on a line, separate each directive with a comma.

NAME Directive

The `NAME` directive allows you to specify a case-sensitive external name in a Fortran program. You can use this directive, for example, when writing calls to C routines. The case-sensitive external name is specified on the `NAME` directive, in the following format:

```
!DIR$ NAME (fortran="external" [,fortran="external"]...)
```

where: *fortran* is the name used for the object throughout the Fortran program whenever the external name is referenced.

external is the external name.

FREE[FORM] Directive

The `FREE` or `FREEFORM` directive specifies that the source code in the program unit is written in the free source form. The `FREE` directive may appear anywhere within your source code. The format of the `FREE` directive is:

```
!DIR$ FREE
```

You can change source form within an `INCLUDE` file. After the `INCLUDE` file has been processed, the source form reverts back to the source form that was being used prior to processing the `INCLUDE` file.

FIXED Directive

The FIXED directive specifies that the source code in the program unit is written in the fixed source form. The FIXED directive may appear anywhere within your source code. The format of the FIXED directive is:

```
!DIR$ FIXED
```

You can change source form within an INCLUDE file. After the INCLUDE file has been processed, the source form reverts back to the source form that was being used prior to processing the INCLUDE file.

NOFREEFROM Directive

The NOFREEFORM directive is the same as the FIXED directive (see above) and specifies that the source code in the program unit is written in the fixed source form.

FIXEDFORMLINESIZE Directive

The FIXEDFORMLINESIZE directive specifies the line length for fixed-form source code. The format of the FIXEDFORMLINESIZE directive is:

```
!DIR$ FIXEDFORMLINESIZE:{72|80|132}
```

ATTRIBUTES Directive

The ATTTRIBUTES directive can be used to apply special attributes to simplify passing variables between Fortran 90/95 and other languages. The format of the ATTTRIBUTES directive is:

```
!DIR$ ATTTRIBUTES attr-list::sym-list
```

where: *attr-list* is a comma separated list of attributes from the following set.

```
ALIAS
C
REFERENCE
STDCALL
VALUE
```

sym-list is a comma separated list of symbols.

The ALIAS attribute takes the form of

```
ALIAS:external
```

where: *external* is the is the external name of the procedure.

STACK Directive

The `STACK` directive causes the default storage allocation to be the stack in the program unit that contains the directive. This directive overrides the **`-s`** command line option in specific program units of a compilation unit. The format for this compiler directive is:

```
!DIR$ STACK
```

UNROLL Directive

The `UNROLL` directive is used to control loop unrolling by the compiler. Loop unrolling is automatically enabled with the `-O3` option. Use this directive to control loop unrolling independent of the `-O3` option. The format for this compiler directive is:

```
!DIR$ UNROLL N
```

where *N* is the count of the number of times to unroll the loop. If *N* is 0, the count is automatic. If *N* is 1, loop unrolling is disabled.

NOUNROLL Directive

The `NOUNROLL` directive is used to disable loop unrolling by the compiler. Loop unrolling is automatically enabled with the `-O3` option. Use this directive to disable loop unrolling in all circumstances. The format for this compiler directive is:

```
!DIR$ NOUNROLL
```

ABSOFT FORTRAN 77 OPTIONS

The compiler options detailed in this section are provided for compatibility with the Absoft legacy FORTRAN 77 compiler. This compiler is no longer supplied as all of its capabilities have been incorporated into the Fortran 95 compiler. These options are deprecated and will eventually no longer be supported. It is suggested that the equivalent Fortran 95 options be used instead.

Each option is listed with the corresponding option letter(s) and a short description. Options that take arguments (e.g. `-h 4` or `-o file`) must have a space to separate the option from the argument. The only exceptions are the `B` and `N` options; they do not have a space between the option and the argument (e.g. `-N33`).

Compiler control

These options control various aspects of the compilation process such warnings, verbosity, and definition of compiler directive variables. The generation of debugging information, for the symbolic source-level debugger, Fx3, is also controlled by compiler control options.

Show progress (-v)

Enabling the **-v** option will cause the `f77` compiler driver, described earlier in this chapter, to display the commands it is sending to the compiler, assembler, and linker.

Suppress warnings (-w)

Suppresses the listing of warning messages. For example, unreachable code and a missing label on a `FORMAT` statement generate warning messages. Compile time diagnostic messages are divided into two categories: errors and warnings. Error messages indicate that the compiler was unable to generate an output file. Warning messages indicate that some syntactic element was not appropriate, but the compiler was able to produce an output file.

Warn of non-ANSI usage (-N32)

Use of the **-N32** option will cause the compiler to issue a warning whenever the source code contains an extension to the ANSI FORTRAN 77 standard (American National Standard Programming Language FORTRAN, X3.9-1978). This option is useful for developing code that must be portable to other environments. The equivalent Fortran 95 option is **–en**.

Check Syntax Only (-dB)

The **–dB** option runs only the front end of the compiler. No object or executable files are created.

Append Underscore To Names (-N15)

Use of the **-N15** option will cause the compiler to define `SUBROUTINE` and `FUNCTION` names with a single trailing underscore. This option can be used to avoid name conflicts with the system libraries or to interface with other FORTRAN environments and libraries. See the **–B108** option below. The equivalent Fortran 95 option is **–YEXT_SFX=_**.

Append Underscore To Names (-B108)

Use of the **–B108** option directs the compiler to append an underscore to `SUBROUTINE` and `FUNCTION` definitions and references in a manner consistent with the g77 FORTRAN compiler. A single underscore is appended unless the name contains an underscore in which case two underscores are appended. This option can be used to avoid name conflicts with the system libraries or other FORTRAN environments. See the **–N15** option above.

Character Argument Parameters (-N90)

Use the **–N90** option to force the compiler to pass `CHARACTER` arguments in a manner that is compatible with `g77` and `f2c` protocols. The default is to pass `CHARACTER` arguments in a manner that is compatible with Absoft Compilers on other platforms.

Check array boundaries (-C)

When the **-C** compiler option is turned on, code will be generated to check that array indexes are within the bounds of an array. Exceptions: arrays whose last dimension is * and dummy arguments whose last dimension is 1 cannot be checked. In addition, file names and source code line numbers will be displayed with all run time error messages. The equivalent Fortran 95 option is **–Rb**.

Generate Debugging Information (-g)

Specifying the **–g** option will cause the compilers to include symbol and line information appropriate for debugging a compiled program with Fx3, the Absoft debugger, and other source level debugger which support Dwarf2 symbol information.

The Absoft Fortran 90/95 and FORTRAN 77 compilers have the capability to output special symbol information for use with the Fx3 debugger from Absoft. This information allows Fx3 to display the contents of adjustable arrays, arrays with more than four dimensions, arrays with lower bounds other than 1, and arrays with dimensions greater than 32767.

Generate Profiler Information (-P)

Specifying the **–P** option will place information for profiling execution into a compiled program. For information on using the Linux profiler, see the Linux manual page for *gprof*.

Conditional compilation (-x)

Statements containing an X or a D in column one are treated as comments by the compiler unless the **-x** compiler option is selected. This option allows a restricted form of conditional compilation designed primarily as a means for easily removing debugging code from the final program. When the **-x** option is selected, a blank character replaces any occurrence of an X or a D in column one. The only source formats for which conditional compilation is valid are standard FORTRAN 77, VAX Tab-Format, and wide format. The compiler also incorporates a complete set of statements for conditional compilation which are described in the **Conditional Compilation Statements** section of the **FORTRAN 77 Program** chapter in the *FORTRAN 77 Language Reference Manual*. The equivalent Fortran 95 option is **–YX**.

Max Internal Handle (-Tnn)

This option is used to change the number of handles used internally by the compiler. Under most conditions, the default value of 20000 handles is sufficient to compile even extremely large programs. However, under certain circumstances, this value may be exceeded and the compiler will issue a diagnostic indicating that the value should be increased.

Define Compiler Directive (-D*name*[=*value*])

The **-D** option is used to define conditional compilation variables from the command line. *value* can only be an integer constant. If *value* is not present, the variable is given the value of 1. Conditional compilation is described in the **Conditional Compilation Statements** section in the **FORTRAN 77 Program** chapter of the *FORTRAN 77 Language Reference Manual*.

Set Include Paths (-I)

Use this command to select additional directory paths to be searched for include and header files. The **-I** option is used to supply a comma separated list of directory paths which are prepended to file names used with the Fortran `INCLUDE` statement or the C/C++ `#include` directive.

```
-Ipath[,path…]
```

The paths are prepended in the order presented with the **-I** option when the include file is not first found in the local directory and when it is not itself an absolute path (a full file specification).

Optimizations

Absoft Fortran 77 is a globally optimizing compiler, so various optimizers can be turned on which affect single statements, groups of statements or entire programs. There are pros and cons when choosing optimizations; the application will execute much faster after compilation but the compilation speed itself will be slow. Some of the optimizations described below will benefit almost any FORTRAN code, while others should only be applied to specific situations.

You may want to ignore optimizations during program development or for compilations of FORTRAN source code ported to the Linux to save time. When a FORTRAN program is executing correctly and has been debugged, turn on optimizations for improved run-time performance. In general, all optimizations should be selected carefully.

Basic Optimizations (-O1)

The **–O1** option will cause most code to run faster and enables optimizations that do not rearrange your program. The optimizations include common subexpression elimination, constant propagation, and branch straightening. This option is generally usable with debugging options. **–cpu:host** is implied with this option.

Advanced Optimizations (-O2)

The **–O2** option enables advanced optimizers that can substantially rearrange the code generated for a program. The optimizations include strength reduction, loop invariant removal, code hoisting, and loop closure. This option is not usable with debugging options. **–cpu:host** is implied with this option.

Advanced Optimizations (-O3)

The **–O3** option enables advanced optimizers that can significantly rearrange and modify the code generated for a program. The optimizations include loop permutation (loop reordering), loop tiling (improved cache performance), loop skewing, loop reversal, unimodular transformations, forward substitution, and expression simplification. This option is not usable with debugging options. **–cpu:host** is implied with this option.

Advanced Optimizations (-Ofast)

The **–Ofast** option enables advanced optimizers that can significantly rearrange and modify the code generated for a program. The optimizations include the –O3 optimizations as well as turning on inter-procedural analysis.

Loop unrolling (-U and -h*nn* and -H*nn*)

The Absoft Fortran 77 compiler has the ability to automatically unroll some of the loops in your source code. Loops may be unrolled by any power of two. Generally it is beneficial to unroll loops that execute a large number of iterations, while the benefit is small for loops that iterate only a few times. Due to this, only innermost loops are considered for unrolling. The **-h***nn* option will cause the compiler to unroll your innermost loops *nn* times, where *nn* is any power of two. The **-H***nn* option will cause the compiler to consider loops containing *nn* or fewer operatings for unrolling. When the **–O3** option is used, the default is to only consider loops of a two lines and unroll them ten operatins. Using the **-U** option is equivalent to using **-h2 -H10**, causing innermost loops of ten or fewer operations to be unrolled twice. Loop unrolling will provide a speed increase in most cases, but will make your application larger and it will require more memory to compile. Consider the following example:

Original code:

```
SUBROUTINE SUB(A,N,X)
INTEGER A(100)

DO i=1,N
    A(i) = X*A(i)
END DO
RETURN
END
```

Becomes:

```
SUBROUTINE SUB(A,N,X)
INTEGER A(100)

DO i=1,MOD(N,4)
    A(i) = X*A(i)
END DO
DO i=MOD(N,4)+1,N,4
    A(i)   = X*A(i)
    A(i+1) = X*A(i+1)
    A(i+2) = X*A(i+2)
    A(i+3) = X*A(i+3)
END DO
RETURN
END
```

This is similar to the effect of loop unrolling. At least three comparisons and three branch instructions are saved each time the second loop is executed. Note that if your code contains extended range `DO` loops, unrolling loops will invalidate your program.

Compatibility

These options allow Absoft Fortran 77 to accept older or variant extensions of FORTRAN 77 source code from other computers such as mainframes. Many of these can be used for increased compatibility with FORTRAN 77 compilers on various mainframe computers.

Folding to lower case (-f)

The **-f** option will force all symbolic names to be folded to lower case. By default, the compiler considers upper and lowercase characters to be unique, an extension to FORTRAN 77. If you do not require case sensitivity for your compilations or specifically require that the compiler not distinguish between case use this option. This option should be used for compatibility with VAX and other FORTRAN environments. The following Fortran 95 options **-YEXT_NAMES=LCS**, **-YVAR_NAMES=UCS**, and **-YCOM_NAMES=LCS** are equivalent.

Folding to upper case (-N109)

By default, the compiler considers upper and lowercase characters to be unique, an extension to FORTRAN 77. If you do not require case sensitivity for your compilations or specifically require that the compiler not distinguish between case, as in FORTRAN 77, including the **-N109** option on the compiler invocation command line will force all symbolic names to be folded to upper case. The equivalent Fortran 95 option is **-ALL_NAMES=UCS**.

Static storage (-s)

In FORTRAN 66, all storage was static. If you called a subroutine, defined local variables, and returned, the variables would retain their values the next time you called the subroutine. FORTRAN 77 establishes both static and dynamic storage. Storage local to an external procedure is dynamic and will become undefined with the execution of a `RETURN` statement. The `SAVE` statement is normally used to prevent this, but the **-s** compiler option will force all program storage to be treated as static and initialized to zero. This option should be used for compatibility with VAX and other FORTRAN environments.

One-trip DO loops (-d)

FORTRAN 66 did not specify the execution path if the iteration count of a `DO` loop, as established from the `DO` parameter list, was zero. Many processors would execute this loop once, testing the iteration count at the bottom of the loop. FORTRAN 77 requires that such a `DO` loop not be executed. The **-d** option will cause all `DO` loops to be executed at least once, regardless of the initial value of the iteration count. The equivalent Fortran 95 option is **-ej**.

Integer Sizes (-i2 and -i8)

Without an explicit length declaration, `INTEGER` and `LOGICAL` data types default to thirty-two bits (four bytes). The **–i2** option can be used to change this default length to sixteen bits (two bytes) for both `INTEGER` and `LOGICAL`. The **–i8** option can be used to change the default `INTEGER` size to 64 bits (8 bytes). However, an explicit length specification in a type declaration statement always overrides the default data length.

Set Big-Endian (-N26)

Use this option to force the compiler to consider the byte ordering of all unformatted files to be big-endian by default . The `CONVERT` specifier in the `OPEN` statement may be used to override this setting for individual files.

Set Little-Endian (-N27)

Use this option to force the compiler to consider the byte ordering of all unformatted files to be little-endian by default . The `CONVERT` specifier in the `OPEN` statement may be used to override this setting for individual files.

Set COMMON block name (-N22)

The **-N22** option is used to change the scheme the compiler employs for generating global names for `COMMON` blocks. The default is to prepend the characters "`_C`" to the `COMMON` block name. This option cause the compiler to append a single underscore (_) instead. The equivalent Fortran 95 option is **-YCOM_PFX=_**.

Promote REAL and COMPLEX (-N113)

Without an explicit length declaration, single precision `REAL` and `COMPLEX` data types default to thirty-two bits (four bytes) and sixty-four bits (eight bytes), respectively. The **-N113** option is used to promote these to their double precision equivalents: `DOUBLE PRECISION` and `DOUBLE COMPLEX`. This option does not affect variables that appear in type statements with explicit sizes (such as `REAL*4` or `COMPLEX*8`).

Escape sequences in strings (-K)

If the **-K** option is turned on, the compiler will transform certain escape sequences marked with a '\' embedded in character constants. For example '`\n`' will be transformed into a newline character for your system. Refer to the **FORTRAN 77 Program** chapter *FORTRAN 77 Language Reference Manual* for more information on the escape sequences that are supported. The equivalent Fortran 95 option is **-YCSLASH=1**.

Align COMMON variables (-N34)

If a COMMON block is defined in a manner that causes a misaligned storage location, the **-N34** option can be used to insert space to eliminate the misalignment. This option may invalidate your code if the same `COMMON` block is defined differently in different program units.

Temporary string size (-t*nn*)

In certain cases the compiler is unable to determine the amount of temporary string space that string operations will require. This undetermined length occurs when the REPEAT function is used or when a `CHARACTER*(*)` variable is declared in a subroutine or function. In these cases, the compiler will assume that the operation in question will require 1024 bytes of temporary string space. This default value can be changed by specifying the **-t***nn*, where *nn* is a positive integer constant. When this option is specified, the default temporary string size will be *nn* bytes. The equivalent Fortran 95 option is **-YCLEN=*nn***.

Source Formats

For compatibility with other FORTRAN environments and to provide more flexibility, the compiler can be directed to accept source code that has been written in a variety of different formats. The default setting is to accept only ANSI standard FORTRAN source code format. See the **FORTRAN 77 Program** chapter of the *FORTRAN 77 Language Reference Manual* for more information on alternative source code formats.

Fortran 90/95 Free-Form (-8)

Use of the **-8** option instructs the compiler to accept source code written in the format for the FORTRAN 90/95 Free Source Form. The equivalent Fortran 95 option is **–f free**.

Wide format (-W)

Use of the **-W** option causes the compiler to accept statements that extend beyond column 72 up to column 132. The equivalent Fortran 95 option is **–W132**.

CHAPTER 6

Porting Code

This chapter describes issues involved in porting legacy FORTRAN 77 code from other platforms. One of the major design goals for Absoft Pro Fortran is to permit easy porting of source code from mainframe computers such as VAX and IBM, and from workstations such as Sun. The result is the rich set of statements and intrinsic functions accepted by the Absoft Fortran 77 compiler.

The Absoft Fortran 77 compiler is recommended for porting most legacy codes because of the number extensions and features it supports. Consequently, FORTRAN 77 options and language features will be described in this chapter. However, in most cases, the Fortran 90/95 compiler has equivalent options and can also be used. Refer to the **Using the Compilers** chapter for information on Fortran 90/95 compile time options.

The last section of this chapter describes Linux specific issues about porting code.

As a general rule when porting code, use the following compiler option:

-s Force all program storage to be treated as static and initialized to zero.

Ported programs that have incorrect runs or invalid results are usually caused by the differences between Linux and other environments such as floating point math precision or stack-size issues. See the section **Other Porting Issues** later in this chapter for special considerations when porting code to Linux. In addition, you may want to use this option:

-C Check array boundaries and generate better runtime errors. Using this option makes programs slightly larger and they will execute slower.

If you want to use the Absoft debugger, Fx3, add the **-g** option to generate debugging information.

PORTING CODE FROM VAX

Absoft Fortran 77 automatically supports most of the VAX FORTRAN language extensions. Below are a list of key VAX FORTRAN extensions that are supported and a list of those that are not supported. Using various options, the compiler can also accept VAX Tab-Format source lines and/or 132-column lines. Otherwise, only ANSI FORTRAN 77 fixed format lines are accepted.

Key Supported VAX FORTRAN Extensions

- NAMELIST—the NAMELIST terminator may be either "$" or "&"
- STRUCTURE, RECORD, UNION, MAP, %FILL statements
- DO WHILE loops
- INCLUDE statement
- ENCODE, DECODE, ACCEPT, TYPE, and most OPEN I/O specifiers
- Hollerith and hexadecimal constant formats
- "!" comments
- Variable Format Descriptors (I<w>.<d> where w and d are variables)

Key Unsupported VAX FORTRAN Extensions

- Absoft Pro Fortran uses IEEE floating point representation
- I/O statements DELETE, DEFINE FILE, and REWRITE
- Data dictionaries

Compile Time Options and Issues

Absoft Fortran 77 can be made even more compatible with VAX FORTRAN by using a group of compiler options collectively referred to as the "VAX compatibility options".

VAX-compatible time, date, and random number routines are available by linking with the library file libV77.a in the Absoft lib and lib64 directories. The routine names may be referenced as all upper case, all upper case with an underscore appended, or all lower case with an underscore appended. The routine names are:

DATE subroutine	returns current date as CHARACTER*9
IDATE subroutine	returns current date as 3 INTEGER*4
TIME subroutine	returns current time as CHARACTER*8
SECNDS subroutine	returns seconds since midnight
RAN function	returns random number

The following list of VAX FORTRAN "qualifiers" shows the equivalent Absoft Fortran 77 options or procedures:

/ANALYSIS_DATA	no equivalent
/CHECK BOUNDS	**-C** to check array boundaries
/CHECK NONE	do not use the **-C** option
/CHECK OVERFLOW	no equivalent
/CHECK UNDERFLOW	no equivalent
/CONTINUATIONS	no equivalent
/CROSS_REFERENCE	no equivalent
/DEBUG	**-g** to generate debugging information
/D_LINES	**-x** to compile lines with a "D" or "X" in column 1

/DIAGNOSTICS	append > filename to the f77 command line to create a file containing compiler warning and error messages.
/DML	no equivalent
/EXTEND_SOURCE	**-W** to permit source lines up to column 132 instead of 72
/F77	do not use the **-d** option
/NOF77	**-d** for FORTRAN 66 compatible DO loops
/G_FLOATING	see the section **Numeric Precision** later in this chapter
/I4	do not use the **-i** option
/NOI4	**-i** for interpreting INTEGER and LOGICAL as INTEGER*2 and LOGICAL*2
/LIBRARY	no equivalent
/LIST	a symbol table dump may be generated with the **-D** option
/MACHINE_CODE	**-S** to generate an assembly source file that *can* be assembled
/OBJECT	no equivalent—you can use the cp command to copy an object file to another name
/OPTIMIZE	**-O** to use basic optimizations
/PARALLEL	no equivalent
/SHOW	no equivalent
/STANDARD	**-N32** to generate warnings for non-ANSI FORTRAN 77 usage
/WARNINGS DECLARATIONS	the IMPLICIT NONE statement may be used to generate warnings for untyped data items
/WARNINGS NONE	**-w** to suppress compiler warnings

The tab size on Linux may be different than the VAX. You can set the tab size for the compiler with the environment variable TABSIZE. For more information about tab size, see the **Tab Character Size** section later in this chapter.

PORTING CODE FROM IBM VS FORTRAN

Absoft Fortran 77 automatically supports most of the IBM VS FORTRAN language extensions. Below is a list of key VS FORTRAN extensions that are supported and not supported. Using a compiler option, Absoft Fortran 77 can also accept VS FORTRAN Free-Form source lines which use 80 columns, otherwise, only ANSI FORTRAN 77 fixed format lines are accepted.

Key Supported VS FORTRAN Extensions

- "*" comments in column 1
- Can mix CHARACTER and non-CHARACTER data types in COMMON blocks
- The NAMELIST terminator may be an ampersand "&"
- Hollerith constants

Key Unsupported VS FORTRAN Extensions

- Absoft Fortran 77 uses IEEE floating point representation (more accurate)
- Debug statements
- I/O statements `DELETE`, `REWRITE`, and `WAIT`
- `INCLUDE` statement syntax is different

Compile-time Options and Issues

Absoft Fortran 77 can be made even more compatible with VS FORTRAN by using the compiler option:

-s Force all program storage to be treated as static and initialized to zero

PORTING CODE FROM MICROSOFT FORTRAN (PC VERSION)

Absoft Fortran 77 automatically supports many of the Microsoft FORTRAN language extensions. Below is a list of key Microsoft FORTRAN extensions that are supported and not supported. Absoft Fortran 77 does not have the code size restrictions found in the segmented Microsoft FORTRAN models.

Key Supported Microsoft FORTRAN Extensions

- The NAMELIST terminator may be an ampersand "`&`"
- The Free-Form Source Code is very similar to VS FORTRAN (**-V** option)
- `AUTOMATIC` statement
- `STRUCTURE`, `RECORD`, `UNION`, `MAP` statements
- `SELECT CASE` statements
- `DO WHILE` loops
- `INCLUDE` statement
- Conditional compilation statements

Key Unsupported Microsoft FORTRAN Extensions

- Metacommands
- MS-DOS specific intrinsic functions
- `INTERFACE TO` statement
- `OPEN` statement displays standard file dialog when using `FILE=""`

Compile-time Options and Issues

Absoft Fortran 77 can be made even more compatible with Microsoft FORTRAN by using the compiler option:

-s Force all program storage to be treated as static and initialized to zero

The following list of Microsoft FORTRAN metacommands shows the equivalent Absoft Fortran 77 options or procedures:

`$DEBUG`	**-C** to check array boundaries and other run-time checks
`$DECLARE`	the `IMPLICIT NONE` statement may be used to generate warnings for untyped data items
`$DO66`	**-d** for FORTRAN 66 compatible `DO` loops
`$FLOATCALLS`	all floating point is calculated inline or with a threaded math library in Absoft Fortran 77
`$FREEFORM`	**-V** for IBM VS FORTRAN Free-Form source code
`$INCLUDE`	use the `INCLUDE` statement
`$LARGE`	not necessary — Absoft Fortran 77 does not have the data size restrictions found in the segmented Microsoft FORTRAN models
`$LINESIZE`	not applicable
`$LIST`	no equivalent
`$LOOPOPT`	**-U** for loop unrolling optimization; **-R** for loop invariant removal
`$MESSAGE`	no equivalent
`$PAGE`	not applicable
`$PAGESIZE`	not applicable
`$STORAGE:2`	**-i** for interpreting `INTEGER` and `LOGICAL` as `INTEGER*2` and `LOGICAL*2`
`$STORAGE:4`	do not use the **-i** option
`$STRICT`	**-N32** to generate warnings for non-ANSI FORTRAN 77 usage
`$SUBTITLE`	not applicable
`$TITLE`	not applicable
`$TRUNCATE`	no equivalent

PORTING CODE FROM SUN WORKSTATIONS

Absoft Fortran 77 automatically supports most of the Sun FORTRAN language extensions. Below is a list of key Sun FORTRAN extensions that are supported and not supported. The Sun FORTRAN compiler appends an underscore to all external names to prevent collisions with the C library. Absoft Fortran 77, by default, does not append an underscore to maintain compatibility with Linux functions and other development languages.

Key Supported Sun FORTRAN Extensions

- `NAMELIST`; the `NAMELIST` terminator may be either "`$`" or "`&`"
- `STRUCTURE`, `RECORD`, `POINTER`, `UNION`, `MAP`, `%FILL` statements
- `DO WHILE` loops
- `INCLUDE` statement
- `ENCODE`, `DECODE`, `ACCEPT`, `TYPE`, and most `OPEN` I/O specifiers
- Hollerith and hexadecimal constant formats
- "`!`" comments in column 1

PORTING CODE FROM MACINTOSH SYSTEMS

Other Absoft Macintosh Compilers

Over the past 20 years, Absoft has offered several different compilers for a number of Macintosh environments. This section outlines some of the differences between these products.

MacFortran	This 68000 compiler supported ANSI FORTRAN 77 and compiled programs directly from the Finder without using MPW. Although it lacked optimizations and support for many of the extensions in Absoft Pro Fortran for Macintosh with PowerPC, it compiled very fast and was easy to use.
MacFortran/020	This 68000 compiler was the same as MacFortran but it could also produce faster code for 68020 and 68030 systems that incorporated a floating point unit.
MacFortran II	This 68000 compiler is very similar to Absoft Pro Fortran for Macintosh with PowerPC. It supports many of the same optimizations and extensions, but is designed for 68000 based Macintoshes.

DISTRIBUTION ISSUES

If you plan to distribute executable programs generated with Absoft Fortran 77, you must obtain a copy of the Absoft "Redistribution License Agreement", complete it, and return it to Absoft. There is no charge for this license or the redistribution of programs created with Absoft Pro Fortran. To obtain the Absoft "Redistribution License Agreement", visit the Absoft Corporation web site at http://www.absoft.com, or write to:

Absoft Corporation
2781 Bond Street
Rochester Hills, MI 48309

OTHER PORTING ISSUES

Not all porting and compatibility issues can be solved automatically by Absoft Pro Fortran or by using various option combinations. There are six issues that must be addressed on a program-by-program basis for the Linux computer:

Memory Management	Tab Character Size
Naming Conventions	Numeric Precision
File and Path Names	Floating Point Math Control

Memory Management

Local variables and temporary values are stored in the ESP stack frame. All other storage is allocated statically in the data and/or bss sections.

Dynamic Storage

Storage for variables local to a function or a subroutine is allocated in the stack frame. As a result, local variables are undefined when execution of a function or subroutine begins and become undefined again when execution terminates. This can cause difficulties in two areas.

First, problems may arise when porting Fortran applications from environments that statically allocate all memory; the application may except variables to retain their definition status across procedure references. However, it produces applications that make more effective use of memory and provides the ability to call functions and subroutines recursively. The next section describes how to declare static storage space.

Second, the Linux stack is limited to 8 MB and large arrays allocated in the stack frame may overflow the stack. You can increase the stack size with the `ulimit` command (`ulimit` is a bash command - the csh equivalent to `ulimit -s` is `limit stack`) to raise the stack size limit:

```
# ulimit –s
8192
# ulimit -s 32768
# ulimit -s
32768
```

The Linux stack limit is defined by the following around line 293 in `sched.h`:

```
#define _STK_LIM        (8*1024*1024)
```

Static Storage

There are three ways to define static storage in Fortran. The first two allow static variables to be defined selectively and are either placing them in `COMMON` blocks or using the `SAVE` statement. The third method, using the **`–s`** compiler option, forces *all* program storage to be treated as static. Static memory is allocated out of the data and/or bss

sections and remains defined for as long as the application runs. In addition, all static storage will be initialized to zero when the application begins execution.

Naming Conventions

Global names in Fortran include all procedure names and `COMMON` block names, both of which are significant to 31 characters. All global procedure names are folded to lower case and have a single underscore ("_") appended unless the compiler character case and symbol decoration options are used. All `COMMON` block names are folded to lower case and have the characters "_C" prepended unless the compiler character case and symbol decoration options are used. All other symbols are manipulated as addresses or offsets from local labels and are invisible to the linker.

Procedure Names

Names of functions and subroutines in Fortran programs will appear in the assembly language source output or object file records with their names folded to lower case and with a single underscore ("_") appended.

If a FORTRAN 77 subroutine is defined as:

```
SUBROUTINE SUB(…)
.
.
.
RETURN
END
```

It will be defined in assembly language as:

```
      .globl sub_
sub_:

      ret
```

COMMON Block Names

The convention in Absoft Pro Fortran is to use the name given in the COMMON statement folded to lower case and preceded with the characters "_C". `BLANK` common uses the name *_BLNK__*.

For example, the `COMMON` block declaration:

```
COMMON /the_block/ a, b, c
```

will produce the following assembler directive:

```
.comm _Cthe_block, 0x0000000c
```

File and Path Names

When the compiler encounters the Fortran `INCLUDE` statement, it takes the `CHARACTER` constant immediately following as a file name, searches for the file, and, if the file is found, copies its contents into the source file. If an absolute or relative path name is specified, the compiler will search only that path. If only a file name is given, the compiler will first look for the file in the current directory. It will then search any directory defined by the environment variable `F77INCLUDES`. Additional search paths may be specified with the –I compiler option.

Tab Character Size

The compiler assumes a standard tab size of eight spaces. This is the default for most editors. When the compiler encounters a tab character (ASCII 9) during compilation, it is replaced with the appropriate number of spaces for alignment to the next tab stop. By setting the environment variable `TABSIZE`, the tab size used by the compiler can be changed. The following command line for the Bourne shell will set the tab size for the compiler to four spaces:

```
TABSIZE=4
export TABSIZE
```

Runtime Environment

A number of the aspects of the runtime environment can be controlled with the `ABSOFT_RT_FLAGS` environment variable. This variable can be a combination of any of the following switches (the leading minus sign is required for each switch and multiple switches must be separated by one or more spaces):

-defaultcarriage

> Causes the units preconnected to standard output to interpret carriage control characters as if they had been connected with `ACTION='PRINT'`.

-fileprompt

> Causes the library to prompt the user for a filename when it implicitly opens a file as the result of I/O to an unconnected unit number. By default, the library creates a filename based on the unit number.

-vaxnames

> Causes the library to use 'vax style' names (FORnnn.DAT) when creating a filename as the result of I/O to an unconnected unit number.

-unixnames

Causes the library to use 'unix style' names (fort.nnn) when creating a filename as the result of I/O to an unconnected unit number.

-bigendian

Causes the library to interpret all unformatted files using big endian byte ordering.

-littleendian

Causes the library to interpret all unformatted files using little endian byte ordering.

-noleadzero

Causes the library to surpress the printing of leading zeroes when processing an Fw.d edit descriptor. This only affects the limited number of cases where the ANSI standard makes printing of a leading zero implementation defined.

-reclen32

Causes the library to interpret the value specified for `RECL=` in an `OPEN` statement as 32-bit words instead of bytes.

-f90nlexts

Allows f90 `namelist` reads to accept non-standard syntax for array elements. Without this flag, the following input results in a runtime error:

```
$ONE
A(1)=1,2,3,4
$END
```

When -f90nlexts is set, the values are assigned to the first four elements of A.

-nounit9

Causes UNIT 9 not to be preconnected to standard input and output.

-maceol

Formatted sequential files are in Classic Macintosh format where each record ends with a carriage return,

-doseol

Formatted sequential files are in Windows format where each record ends with a carriage return followed by a line feed.

-unixeol

Formatted sequential files are in Unix format where each record ends with a line feed.

-hex_uppercase

Data written with the Z edit descriptor will use upper case characters for A-F.

Floating Point Math Control

This section describes the basic information needed to control the floating-point unit (FPU) built into Intel. The FPU provides a hardware implementation of the IEEE Standard For Binary Floating Point Arithmetic (ANSI/IEEE Std 754-1985). As a result it allows a large degree of program control over operating modes. There are two aspects of FPU operation that can affect the performance of a FORTRAN program:

Rounding direction

Exception handling

A single subroutine is provided with the compiler that is used to retrieve the current state of the floating-point unit or establish new control conditions:

```
CALL fpcontrol(cmd,arg)
```

where: *cmd* is an `INTEGER` variable that is set to 0 to retrieve the state of the floating point unit and 1 to set it to a new state.

arg is an `INTEGER` variable that receives the current state of the floating point unit if *cmd* is 0 and contains the new state if *cmd* is 1.

Rounding Direction

The first aspect of FPU operation that may affect a FORTRAN program is rounding direction. This refers to the way floating-point values are rounded after completion of a floating-point operation such as addition or multiplication. The four possibilities as defined in the fenv.inc include file are:

`FE_TONEAREST`	round to nearest
`FE_TOWARDZERO`	round toward zero
`FE_UPWARD`	round toward +infinity
`FE_DOWNWARD`	round toward -infinity

Exception Handling

The second aspect of FPU operation that affects FORTRAN programs is the action taken when the FPU detects an error condition. These error conditions are called exceptions, and when one occurs the default action of the FPU is to supply an error value (either Infinity or NaN) and continue program execution. Alternatively, the FPU can be instructed to generate a floating point exception and a run time error when an exception takes place. This is known as *enabling the exception*. The five exceptions that can occur in a FORTRAN program are:

`FE_INEXACT`	inexact operation
`FE_DIVBYZERO`	divide-by-zero
`FE_UNDERFLOW`	underflow
`FE_OVERFLOW`	overflow
`FE_INVALID`	invalid argument

FSPLIT - SOURCE CODE SPLITTING UTILITY

When you need to manage large files, work on small portions of Fortran code, or port code from other environments, you may want to split large, cumbersome source files into one procedure per file. This can be done using the Fsplit tool. The command syntax for the tool is shown below.

```
fsplit [option…] [file…]
```

Fsplit splits FORTRAN source files into separate files with one procedure per file. The following command line will generate individual files for each procedure:

```
fsplit largefile.f
```

A procedure includes block data, function, main, program, and subroutine program declarations. The procedure, proc, is put into file *proc*`.f` with the following exceptions:

- An unnamed main program is placed in `MAIN.f`.
- An unnamed block data subprogram is placed in a file named `blockdataNNN.f`, where `NNN` is a unique integer value for that file. An existing block data file with the same name will not be overwritten.
- Newly created procedures (non-block data) will replace files of the same name.
- File names are truncated to 14 characters.

Output files are placed into the directory in which the `fsplit` command was executed. The tab size is pulled from the environment variable `TABSIZE` if it exists, otherwise, a tab size of 8 is used. Options for the command are:

-v Verbose progress of `fsplit` is displayed on standard diagnostic.

-V Source files are in VAX FORTRAN Tab-Format.

-I Source files are in IBM VS FORTRAN Free-Form.

-8 Source files are in Fortran 90/95 Free Source Form.

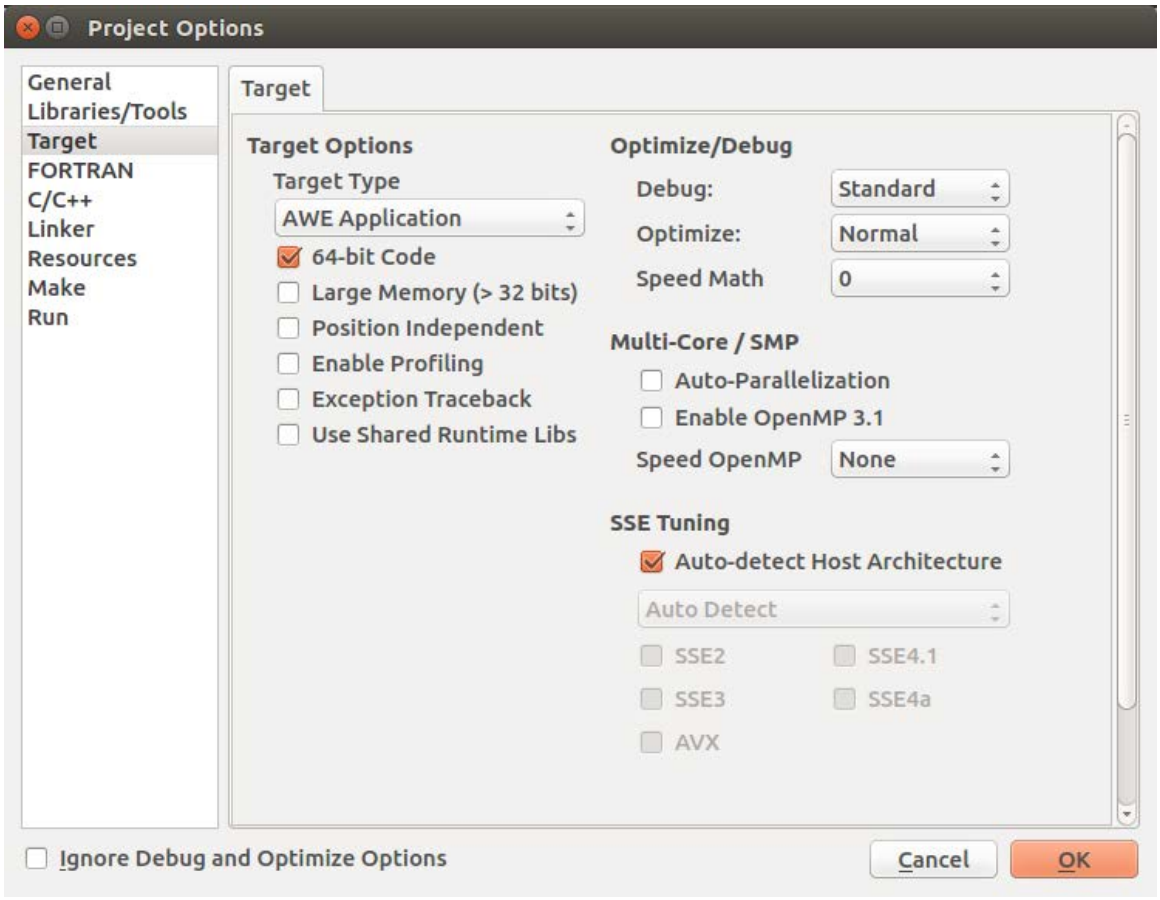
-W Source files are in wide format.

CHAPTER 7

Absoft Window Environment

This chapter describes AWE, the Absoft Window Environment. AWE provides an alternate executable format to a simple terminal application. AWE supplies a windowed application for program input and output with the ability to save and print the output. In addition, you can open new windows and communicate with them through normal Fortran `READ` and `WRITE` statements.

An Absoft Window Environment application is selected by choosing a **Target Type** of **AWE Application** from the **Target** pane of the Options dialog. An AWE application can also be selected from the command line with **–awe** option.



AWE PREFERENCES

When an AWE application is selected, AbsoftTools automatically adds the file `AWE_Prefences.f95` to the project. This file contains functions and subroutines that set the default settings for the behavior of the AWE application. You can alter the default behavior by simply editing this file. The procedures are:

```
Integer function AWE_getStackSize()
```

This routine specifies the stack size for an AWE application. The default stack size is 32 megabytes.

```
logical function AWE_getMdiMode()
```

This function controls whether windows opened in AWE will appear inside a single "frame" window or whether they open as individual windows. The default is to open windows inside the frame.

```
logical function AWE_getShowMaximized()
```

This function can be used to open the AWE window already maximized. The default is `.false.`.

```
logical function AWE_promptSaveOnExit()
```

This function controls whether AWE prompts to save the output window(s) at program exit. If this prompt is disabled, the contents of the window(s) will be lost if not explicitly saved. The default is to display a prompt to save the output.

```
integer function AWE_getMainWindowWidth()
```

This function controls the initial width of the window. The default is 1024.

```
integer function AWE_getMainWindowHeight()
```

This function controls the initial height of the window. The default is 768.

```
integer function AWE_getMdiTextWindowWidth()
```

When AWE is in MDI mode (see `getMdiMode` preference) this function controls the initial width of the initial Fortran I/O window and the default width for any windows created with the OPEN statement. The default is `AWE_getMainWindowWidth() * .75`

```
integer function AWE_getMdiTextWindowHeight()
```

When AWE is in MDI mode (see `getMdiMode` preference) this function controls the initial height of the initial Fortran I/O window and the default height for any windows created with the OPEN statement. The default is `AWE_getMainWindowHeight() * .75`

```
integer function AWE_defaultFontSize()
```

This function controls the height of the font use in the window. The default is 10.

```
subroutine AWE_defaultFontFamily(family)
```

This subroutine controls the family of the font use in the window. The default is `"Sans"`.

```
logical function AWE_autoSave()
```

This function controls whether the window text is automatically saved when the program exits. If this function returns `.true.`, the content of any windows will be automatically saved to files with the names of the windows. The default is `.false.`.

```
logical function AWE_showDefaultOutputWindow()
```

This function controls whether default AWE window is shown or not. If you only want to show a plot or a canvas without the default text window, set this to `.false.`. The default is `.true.`. Note that if this window is not shown, input/output to the system device is not available.

OPENING ADDITIONAL TEXT WINDOWS

Additional text windows can be created with the Fortran `OPEN` statement setting the `ACCESS=` specifier to:

```
"window [,height, width]"
```

The optional arguments, *`height`* and *`width`*, are integers which specify the dimensions of the window in pixels. The window title will be the argument of the `FILE=` specifier of the `OPEN` statement. For example:

```
OPEN(15, FILE="my window", ACCESS="window, 800, 400")
```

DETERMINING WHEN A WINDOW CLOSES

If your program needs to know when a window closes (perhaps by the user clicking in the close box for it), add a subroutine named `AWE_windowDidClose` to your program. It will be called when a window closes with the name of the window as a `CHARACTER` argument.

```
SUBROUTINE AWE_windowDidClose(WindowName), &
            BIND(C,NAME="_AWE_windowDidClose")
CHARACTER(LEN=*) WindowName
END SUBROUTINE AWE_windowDidClose
```

POSITIONING WINDOWS

After creating one or more windows, your program can change their position on the screen using the `AWE_moveWindow`.

```
interface
   subroutine AWE_moveWindow(unit,x_pos,y_pos)
   integer(kind=4) :: unit
   integer(kind=4):: x_pos
   integer(kind=4):: y_pos
   end subroutine AWE_moveWindow

   subroutine AWE_moveWindow(xyplot,x_pos,y_pos)
   type(AWE_XYPlot) :: xyplot
   integer(kind=4):: x_pos
   integer(kind=4):: y_pos
   end subroutine AWE_moveWindow

   subroutine AWE_moveWindow(piechart,x_pos,y_pos)
   type(AWE_PieChart) :: piechart
   integer(kind=4):: x_pos
   integer(kind=4):: y_pos
   end subroutine AWE_moveWindow

   subroutine AWE_moveWindow(barchart,x_pos,y_pos)
   type(AWE_BarChart) :: barchart
   integer(kind=4):: x_pos
   integer(kind=4):: y_pos
   end subroutine AWE_moveWindow

   subroutine AWE_moveWindow(canvas,x_pos,y_pos)
   type(AWE_Canvas) :: canvas
   integer(kind=4):: x_pos
   integer(kind=4):: y_pos
   end subroutine AWE_moveWindow

   subroutine AWE_moveWindow(contourplot,x_pos,y_pos)
   type(AWE_ContourPlot) :: contourplot
   integer(kind=4):: x_pos
   integer(kind=4):: y_pos
   end subroutine AWE_moveWindow

   subroutine AWE_moveWindow(polarplot,x_pos,y_pos)
   type(AWE_PolarPlot) :: polarplot
   integer(kind=4):: x_pos
   integer(kind=4):: y_pos
   end subroutine AWE_moveWindow
end interface
```

If you have specified .TRUE. for the getMidiMode preference to select the multiple document interface, you can also tile or stack program windows using the AWE_tileWindows and AWE_cascadeWindows subroutines. These routine are equivalent to the Tile and Cascade commands available under the program's Window menu.

```
interface
   subroutine AWE_tileWindows()
   end subroutine AWE_tileWindows

   subroutine AWE_cascadeWindows()
   end subroutine AWE_cascadeWindows
end interface
```

ACVTIVATING A WINDOW

You can bring a particular window to the front and give it input focus using the AWE_activateWindow subroutine.

```
interface
   subroutine AWE_avtivateWindow(unit)
   integer(kind=4) :: unit
   end subroutine AWE_avtivateWindow

   subroutine AWE_avtivateWindow(xyplot,x_pos,y_pos)
   type(AWE_XYPlot) :: xyplot
   end subroutine AWE_avtivateWindow

   subroutine AWE_avtivateWindow(piechart,x_pos,y_pos)
   type(AWE_PieChart) :: piechart
   end subroutine AWE_avtivateWindow

   subroutine AWE_avtivateWindow(barchart,x_pos,y_pos)
   type(AWE_BarChart) :: barchart
   end subroutine AWE_avtivateWindow

   subroutine AWE_avtivateWindow (canvas,x_pos,y_pos)
   type(AWE_Canvas) :: canvas
   end subroutine AWE_avtivateWindow

   subroutine AWE_avtivateWindow (contourplot,x_pos,y_pos)
   type(AWE_ContourPlot) :: contourplot
   end subroutine AWE_avtivateWindow

   subroutine AWE_avtivateWindow (polarplot,x_pos,y_pos)
   type(AWE_PolarPlot) :: polarplot
   end subroutine AWE_avtivateWindow
end interface
```

AWE MENUS

You can add your own menus and callback subroutines to an AWE application. After adding all of your menu commands and connecting them to callback subroutines, you exit your program normally. Then, when a menu command is chosen, your callback subroutine is entered. This section describes the functionality that is available. The interfaces indicate these are integer functions. They do not return any useful information and the result can be discarded.

```
interface
  subroutine AWE_addMenu (unit, title, text, callback, item_shortcut)
  integer(kind=any) :: unit
  character(len=*) :: title, text
  external :: callback
  character(len=*),optional :: item_shortcut

  end subroutine AWE_addMenu
end interface
```

`unit` is Fortran unit number used to open the window. The unit number of the default input/output window is -2. `title` is the name of the menu and `text` is the name of the menu command. `callback` is the name of a subroutine in your program that is called when the menu command is selected.

To add an accelerator to a menu use the ampersand character (&) before the letter in the menu command (the `text` variable) that will be the accelerator. For example:

```
CALL AWE_addMenu(MyUnit, "My Menu", "&A Command", MyCallbackA)
```

If an accelerator is used with the name of menu (the `title` argument), then all calls to `AWE_addMenu` must specify the accelerator. For example:

```
CALL AWE_addMenu(MyUnit, "&My Menu", "&A Command", MyCallbackA)
CALL AWE_addMenu(MyUnit, "&My Menu", "&B Command", MyCallbackB)
```

To add a keyboard shortcut to a menu item, pass the optional argument `item_shortcut`. This character argument takes the format “modifier key name + letter” where the modifier key name is taken from the following table and interpreted as indicated:

MODIFIER KEY NAME	WINDOWS	LINUX	OS X
“CTRL”	Ctrl key	Ctrl key	Command key
“META”	Windows key		Ctrl key
“ALT”	Alt key	Alt key	Option key

For example, the following call creates a menu item named “Lock Data” with the keyboard shortcut Ctrl-L:

```
CALL AWE_addMenu(MyUnit, "Data Menu", "Lock Data", LockCB, "CTRL+L")
```

```
interface
  subroutine AWE_setItemCheckable(unit, title, text, flag)
  integer(kind=any) :: unit
  character(len=*) :: title, text
  logical(kind=4) :: flag
  end subroutine AWE_setMenuItemCheckable
end interface
```

`unit` is Fortran unit number used to open the window. The unit number of the default input/output window is -2. `title` is the name of a previously added menu and `text` is the name of a previously added menu command. The menu command will be checkable if `flag` is `.true.`.

```
interface
  logical function AWE_isMenuItemChecked(unit, title, text)
  integer(kind=any) :: unit
  character(len=*) :: title, text
  end function AWE_ isMenuItemChecked
end interface
```

`unit` is Fortran unit number used to open the window. The unit number of the default input/output window is -2. `title` is the name of a previously added menu and `text` is the name of a previously added menu command. The functions returns `.true.` if the menu item is checked.

```
interface
  subroutine AWE_setItemChecked(unit, title, text, flag)
  integer(kind=any) :: unit
  character(len=*) :: title, text
  logical(kind=4) :: flag
  end subroutine AWE_setItemChecked
end interface
```

`unit` is Fortran unit number used to open the window. The unit number of the default input/output window is -2. `title` is the name of a previously added menu and `text` is the name of a previously added menu command. The menu command must also have been specified in a previous `AWE_setMenuItemCheckable` reference. The menu command will be checked if `flag` is `.true.`. The menu command will be unchecked if `flag` is `.false.`.

```
interface
  subroutine AWE_menuItemEnable(unit, title, text, flag)
  integer(kind=any) :: unit
  character(len=*) :: title, text
  logical(kind=4) :: flag
  end subroutine AWE_menuItemEnable
end interface
```

`unit` is Fortran unit number used to open the window. The unit number of the default input/output window is -2. `title` is the name of a previously added menu and `text` is the

name of a previously added menu command. The menu command will be enabled if `flag` is `.true.`. The menu command will be disabled if `flag` is `.false.`.

SPREAD SHEETS

You can create spread sheet windows in AWE to display rank 2 arrays. Subroutines are provided to open, close, read, write, and label spread sheets. Menu commands, described above, can be added to an AWE program to manipulate the data in the spread sheet.

```
interface
  subroutine AWE_CreateSpreadsheet(unit, title, rows, columns)
  integer(kind=4) :: unit
  character(len=*) :: title
  integer(kind=4) :: rows, columns
  end subroutine AWE_CreateSpreadsheet
end interface
```

This subroutine creates a spread sheet window. `unit` is the value used to identify the spread sheet in subsequent spread sheet write, read, and close subroutine references, described next. `title` is the title that will be displayed in the spread sheet window. `rows` and `columns` are the number of rows and columns respectively in the spread sheet.

```
interface
  subroutine AWE_setHorizontalHeaderLabels(unit, labels)
  integer(kind=4) :: unit
  character(len=*), dimension(:) :: array
  end subroutine AWE_setHorizontalHeaderLabels
end interface
```

This subroutine is used to set the horizontal labels of the spread sheet. `unit` is the value that was used to identify the spread sheet when it was opened. `labels` is a rank 1 `character` array used to label the columns.

```
interface
  subroutine AWE_setVerticalHeaderLabels(unit, labels)
  integer(kind=4) :: unit
  character(len=*), dimension(:) :: array
  end subroutine AWE_setVerticalHeaderLabels
end interface
```

This subroutine is used to set the vertical labels of the spread sheet. `unit` is the value that was used to identify the spread sheet when it was opened. `labels` is a rank 1 `character` array used to label the rows.

```
interface
  subroutine AWE_writeSpreadsheet(unit, array)
  integer(kind=4) :: unit
  any, dimension(:,:) :: array
  end subroutine AWE_writeSpreadsheet
end interface
```

This subroutine is used to transfer data from an array in your program to the spread sheet. `unit` is the value that was used to identify the spread sheet when it was opened. `array` can be any type or kind. Its shape must match the number of rows and columns specified when the spreadsheet was opened.

```
interface
  subroutine AWE_readSpreadsheet(unit, array)
  integer(kind=4) :: unit
  any, dimension(:,:) :: array
  end subroutine AWE_readSpreadsheet
end interface
```

This subroutine is used to read the spread sheet data into an array in your program. `unit` is the value that was used to identify the spread sheet when it was opened. `array` should be the same type and kind used in writes to the spread sheet. The shape of `array` must match the number of rows and columns specified when the spreadsheet was opened.

```
interface
  subroutine AWE_closeSpreadsheet(unit)
  integer(kind=4) :: unit
  end subroutine AWE_closeSpreadsheet
end interface
```

This subroutine closes the spread sheet window. `unit` is the value that was used to identify the spread sheet when it was opened.

ALERT BOXES

An alert box can be displayed with the following function:

```
interface
  subroutine AWE_alertBox(title, text)
  character(len=*) :: title, text
  end subroutine AWE_alertBox
end interface
```

`title` is used as the title of the alert box `text` is the text that will be displayed in it.

PLOTS

AWE can be used to create several different types of plots: XY plots, contour plots, polar charts, bar charts, and pie charts. The plots can be printed and saved to PNG (Portable Network Graphics) format files. Default values are supplied for all label and color parameters allowing you to quickly display your data. Each of these parameters is easily customized giving you the flexibility to produce professional looking plots.

AWE plots use RGB colors extensively. Although default values are always supplied, you can replace them with any RGB value you want. The Appendix, *AWE RGB Colors*, in this

manual lists a number of predefined values supplied in the AWE_Interfaces module that are available to you by simply using their symbolic names.

An example of using AWE to create each of the three types of plots in provided in the Absoft examples directory.

Pie Charts

Only three subroutine calls are needed to create, display and close pie charts. An AWE derived type called AWE_PieChart is used with each subroutine to specify the pie chart. It is defined as follows:

```
TYPE AWE_PieChart
  INTEGER, PRIVATE :: id
  CHARACTER*(128) :: title = "Pie Chart"
  INTEGER :: chartBackgroundColor = z'FFE8E8E8'
  INTEGER :: chartTextColor = AWE_black
  CHARACTER*(128), ALLOCATABLE :: legendNames(:)
  INTEGER, ALLOCATABLE :: legendColors(:)
END TYPE
```

id is the internal pie chart identifier. AWE will automatically assign a unique value when the pie chart is created.

title it the pie chart title. It is centered and displayed on top of the chart.

chartBackgroundColor is the RGB background color the chart is displayed on.

chartTextColor is the RGB color of the legend text.

legendNames is an array of the names used for legends. The legend is displayed vertically on the right side of the chart.

legendColors is an array of the RGB colors used for chart wedges.

To create a pie chart, declare an instance of AWE_PieChart, supply the parameters you want to customize and call the AWE_createPiechart subroutine with the AWE_PieChart variable as an argument:

```
USE AWE_Interfaces
TYPE(AWE_PieChart) :: piechart
CALL AWE_createPiechart(piechart)
```

To display the pie chart, call the AWE_writePiechart subroutine with the AWE_PieChart variable used to create the pie chart and a rank 1 array with your data. The rank 1 array can be either INTEGER(KIND=4), INTEGER(KIND=8), or REAL of any KIND.

```
REAL, DIMENSION(3) :: array=[3,4,5]
CALL AWE_writePiechart(piechart, array)
```

To close the pie chart, call the AWE_closePiechart subroutine with the AWE_PieChart variable used to create the pie chart:

```
CALL AWE_closePiechart(piechart)
```

To save a pie chart to a file, call the AWE_savePiechart subroutine the AWE_PieChart variable used to create the chart and the name of the file to save it to. The format will automatically be determined by the file name extension. The default is PNG. PNG and BMP are supported on all operating systems.

```
CALL AWE_savePiechart(piechart,”chart.png”)
```

Bar Charts

Only three subroutine calls are needed to create, display and close bar charts. An AWE derived type called AWE_BarChart is used with each subroutine to specify the bar chart. It is defined as follows:

```
TYPE AWE_BarChart
  INTEGER, PRIVATE :: id
  CHARACTER*(128) :: title = "Title"
  CHARACTER*(128) :: xAxisName = "xAxis"
  CHARACTER*(128) :: yAxisName = "yAxis"
  INTEGER :: chartBackgroundColor = z'FFE8E8E8'
  CHARACTER*(128), ALLOCATABLE :: legendNames(:)
  INTEGER, ALLOCATABLE :: legendColors(:)
END TYPE
```

id is the internal bar chart identifier. AWE will automatically assign a unique value when the bar chart is created.

title it the bar chart title. It is centered and displayed on top of the chart.

xAxisName is the name of the X axis. It is centered and displayed on bottom of the chart.

yAxisName is the name of the Y axis. It is centered and displayed on the left side of the chart.

chartBackgroundColor is the RGB background color the chart is displayed on.

legendNames is an array of the names used for legends. The legend is displayed vertically on the right side of the chart.

legendColors is an array of the RGB colors used for chart bars.

To create a bar chart, declare an instance of AWE_BarChart, supply the parameters you want to customize and call the AWE_createBarchart subroutine with the AWE_BarChart variable as an argument:

```
USE AWE_Interfaces
```

```
TYPE(AWE_BarChart) :: barchart
CALL AWE_createBarchart(barchart)
```

To display the bar chart, call the `AWE_writeBarchart` subroutine with the `AWE_BarChart` variable used to create the bar chart and a rank 2 array with your data. The rank 2 array can be either `INTEGER(KIND=4)`, `INTEGER(KIND=8)`, or `REAL` of any `KIND`. The first dimension is the number of bars per interval and second dimension is the intervals.

```
REAL, DIMENSION(3,3):: array
array = RESHAPE([4,2,8,4,3,6,1,8,2], [3,3])
CALL AWE_writeBarchart(barchart, array)
```

To close the bar chart, call the `AWE_closeBarchart` subroutine with the `AWE_BarChart` variable used to create the bar chart:

```
CALL AWE_closeBarchart(barchart)
```

To save a bar chart to a file, call the `AWE_saveBarchart` subroutine the `AWE_BarChart` variable used to create the chart and the name of the file to save it to. The format will automatically be determined by the file name extension. The default is PNG. PNG and BMP are supported on all operating systems.

```
CALL AWE_saveBarchart(barchart,"chart.png")
```

XY Plots

Only three subroutine calls are needed to create, display and close XY plots. Two AWE derived types are used are used to specify the appearance of XY plots. The first one is used for titles, and axis scaling. It is defined as follows:

```
TYPE AWE_XYPlot
  INTEGER, PRIVATE :: id
  CHARACTER*(128) :: title = "Title"
  CHARACTER*(128) :: xAxisName = "xAxis"
  CHARACTER*(128) :: yAxisName = "yAxis"
  INTEGER         :: chartBackgroundColor = z'FFE8E8E8'
  INTEGER         :: xAxisScaleType = AWE_ScaleType_Linear
  REAL(KIND=8)    :: xAxisScaleUB = undefined
  REAL(KIND=8)    :: xAxisScaleLB = undefined
  REAL(KIND=8)    :: xAxisScaleStep = undefined
  INTEGER         :: yAxisScaleType = AWE_ScaleType_Linear
  REAL(KIND=8)    :: yAxisScaleUB = undefined
  REAL(KIND=8)    :: yAxisScaleLB = undefined
  REAL(KIND=8)    :: yAxisScaleStep = undefined
  INTEGER         :: showHorizontalGridLines = .TRUE.
  INTEGER         :: showVerticalGridLines = .TRUE.
END TYPE
```

`id` is the internal XY plot identifier. AWE will automatically assign a unique value when the XY plot is created.

`title` is the XY plot title. It is centered and displayed on top of the chart.

`xAxisName` is the name of the X axis. It is centered and displayed on bottom of the plot.

`yAxisName` is the name of the Y axis. It is centered and displayed on the left side of the plot.

`chartBackgroundColor` is the RGB background color the plot is displayed on.

`xAxisScaleType` specifies the scale type of the X axis. The two possible values are `AWE_ScaleType_Linear` and `AWE_ScaleType_Logarithmic`.

`xAxisScaleUB` specifies the upper bound of the X axis. The default is the upper bound of the `x` data.

`xAxisScaleLB` specifies the lower bound of the X axis. The default is the lower bound of the `x` data.

`xAxisScaleStep` specifies the step increments of the X axis. The default is an increment appropriate to the range of the `x` data.

`yAxisScaleType` specifies the scale type of the Y axis. The two possible values are `AWE_ScaleType_Linear` and `AWE_ScaleType_Logarithmic`.

`yAxisScaleUB` specifies the upper bound of the Y axis. The default is the upper bound of the `y` data.

`yAxisScaleLB` specifies the lower bound of the Y axis. The default is the lower bound of the `y` data.

`yAxisScaleStep` specifies the step increments of the Y axis. The default is an increment appropriate to the range of the `y` data.

`showHorizontalGridLines` enables or disables horizontal grid lines. The default is `.TRUE.`.

`showVerticalGridLines` enables or disables vertical grid lines. The default is `.TRUE.`.

Multiple curves can plotted on a single XY plot. The color, style, and label for each curve is specified in a unique `AWE_XYPlot_Data` derived type:

```
TYPE AWE_XYPlot_Data
  CHARACTER*(128) :: curveLabel = "Label"
  INTEGER :: curveColor = AWE_steel_blue
  INTEGER :: curveWidth = 1
  INTEGER :: plotSymbolColor = AWE_crimson
  INTEGER :: plotSymbolSize = 6
```

```
  INTEGER :: plotSymbolStyle = AWE_PlotSymbol_NoSymbol
  INTEGER :: fittedCurve = AWE_InvertedCurve
END TYPE AWE_XYPlot_Data
```

`curveLabel` is the label used to identify the curve. It is listed on the right side of the plot.

`curveColor` is the RGB color used to draw the curve.

`curveWidth` is the size of the pen used to draw the curve.

`plotSymbolColor` is the RGB color used to draw the symbol at the data points of the plot. See `plotSymbolStyle` below.

`plotSymbolSize` is the size of the symbol drawn at the data points of the plot. See `plotSymbolStyle` below.

`plotSymbolStyle` is the style of the symbol drawn at the data points of the plot. It can be one of the following:

```
AWE_PlotSymbol_NoSymbol          AWE_PlotSymbol_Ellipse
AWE_PlotSymbol_Rect              AWE_PlotSymbol_Diamond
AWE_PlotSymbol_Triangle          AWE_PlotSymbol_DTriangle
AWE_PlotSymbol_UTriangle         AWE_PlotSymbol_LTriangle
AWE_PlotSymbol_RTriangle         AWE_PlotSymbol_Cross
AWE_PlotSymbol_XCross            AWE_PlotSymbol_HLine
AWE_PlotSymbol_VLine             AWE_PlotSymbol_Star1
AWE_PlotSymbol_Star2             AWE_PlotSymbol_Hexagon
```

`fittedCurve` can be either `AWE_InvertedCurve` or `AWE_FittedCurve`.

To create an XY plot, declare an instance of `AWE_XYPlot`, supply the parameters you want to customize and call the `AWE_createXYPlot` subroutine with the `AWE_XYPlot` variable as an argument:

```
USE AWE_Interfaces
TYPE(AWE_XYPlot) :: xyplot
CALL AWE_createXYPlot(xyPlot)
```

To plot an XY curve, call the `AWE_writeXYPlot` subroutine with the `AWE_XYPlot` variable used to create the plot, a rank 2, shape `(2,:)` array, and an instance of `AWE_XYPlot_Data` variable. The rank 2 array can be either `INTEGER(KIND=4)`, `INTEGER(KIND=8)`, or `REAL` of any `KIND`.

```
TYPE(AWE_XYPlot_Data) :: plotData
REAL, DIMENSION(2,5) :: array
array = RESHAPE([2,5,4,3,6,7,8,5,10,11], [2,5])
CALL AWE_writeXYPlot(xyplot, array, plotData)
```

To close the XY plot, call the `AWE_closeXYPlot` subroutine with the `AWE_XYPlot` variable used to create the plot:

```
CALL AWE_closeXYPlot(xyPlot)
```

To clear an XY plot, call the AWE_clearXYPlot subroutine with the AWE_XYPlot variable used to create the plot:

```
CALL AWE_clearXYPlot(xyPlot)
```

To save a plot to a file, call the AWE_saveXYPlot subroutine the AWE_XYPlot variable used to create the plot and the name of the file to save it to. The format will automatically be determined by the file name extension. The default is PNG. PNG and BMP are supported on all operating systems.

```
CALL AWE_saveXYPlot(xyplot,"plot.png")
```

Contour Plots

A contour plot is a two-dimensional representation of a three dimensional dat. Two AWE derived types are used are used to specify the appearance of contour plots. The first one is used for titling the plot. It is defined as follows:

```
TYPE AWE_ContourPlot
      INTEGER, PRIVATE id
      CHARACTER*(128) :: title = "Title"
      LOGICAL         :: showHorizontalGridLines = .FALSE.
      LOGICAL         :: showVerticalGridLines   = .FALSE.
      LOGICAL         :: showImageBlend          = .TRUE.
      LOGICAL         :: showContourLines        = .FALSE.
END TYPE
```

title is the contour plot title. It is centered and displayed on top of the plot.

showHorizontalGridLines enable or disable horizontal grid lines. The default is .FALSE.

showVerticalGridLines enable or disable vertical grid lines. The default is .FALSE.

showImageBlend enable or disable display of contour color map. The default is .TRUE.

showContourLines enable or disable display of contour lines for the contour levels. The default is .FALSE.

The second derived type supplies the color map, thresholds, and axis limits.

```
TYPE AWE_ContourPlot_Data
  CHARACTER*(128) :: rightAxisName = "Label"
  INTEGER, ALLOCATABLE :: mapColors(:)
  REAL(KIND=KIND(1.0d0)), ALLOCATABLE :: mapThresholds(:)
  REAL(KIND=KIND(1.0d0)), ALLOCATABLE :: contourLevels(:)
  REAL(KIND=KIND(1.0d0)) xmin, xmax, ymin, ymax, zmin, zmax
END TYPE AWE_ContourPlot_Data
```

rightAxisName is the name of the Z axis and is displayed on the right side of the plot.

mapColors is an array of colors used to define three dimensional depths.

mapThresholds is an array of z axis color thresholds. The thresholds must be a vector greater than 1 and range from 0.0 - 1.0. The z values are mapped into the thresholds to produce the color.

contourLevels is an array of values that determine the placement of contour lines when they are enabled.

xmin, xmax, ymin, ymax, zmin, and zmax are the axes limits.

To create a contour plot, declare an instance of AWE_ContourPlot, supply the parameters you want to customize and call the AWE_createContourPlot subroutine with the AWE_ContourPlot variable as an argument:

```
USE AWE_Interfaces
TYPE(AWE_ContourPlot) :: ContourPlot
CALL AWE_createContourPlot(ContourPlot)
```

To plot contour, call the AWE_writeContourPlot subroutine with the AWE_ContourPlot variable used to create the plot, a double precision function name to generate the z axis data, and an instance of AWE_ContourPlot_Data variable..

```
TYPE(AWE_ContourPlot_Data) :: plotData
REAL(KIND=KIND(1.0d0), EXTERNAL :: ContourCallback
CALL AWE_writeContourPlot(ContourPlot, ContourCallback, plotData)
```

ContourCallback is a pure, double precision function that takes two double precision arguments, x and y, and returns z as its result:

```
INTERFACE
  PURE REAL(KIND=KIND(1.0d0) FUNCTION ContourCallback (x,y)
    REAL(KIND=KIND(1.0d0), INTENT(IN) :: x,y
  END FUNCTION ContourCallback
END INTERFACE
```

NOTE: ContourCallback is called from a separate thread and cannot be used to reliably create and/or share data with other routines in your program as there is no way to ensure synchronization.

To close the contour plot, call the AWE_closeContourPlot subroutine with the AWE_ContourPlot variable used to create the plot:

```
CALL AWE_closeContourPlot(ContourPlot)
```

To clear a contour plot, call the AWE_clearContourPlot subroutine with the AWE_ContourPlot variable used to create the plot:

```
CALL AWE_clearContourPlot(ContourPlot)
```

To save a plot to a file, call the AWE_saveContourPlot subroutine the AWE_ContourPlot variable used to create the plot and the name of the file to save it to. The format will automatically be determined by the file name extension. The default is PNG. PNG and BMP are supported on all operating systems.

```
CALL AWE_saveContourPlot(ContourPlot,"plot.png")
```

Polar Plots

Only three subroutine calls are needed to create, display and close polar plots. Two AWE derived types are used are used to specify the appearance of polar plots. The first one is used for the plot title and background. It is defined as follows:

```
TYPE AWE_PolarPlot
  INTEGER, PRIVATE id
  CHARACTER*(128) :: title = "Title"
  INTEGER :: chartBackgroundColor = AWE_dark_blue
END TYPE PolarPlot
```

id is the internal polar plot identifier. AWE will automatically assign a unique value when the polar plot is created.

title it the polar plot title. It is centered and displayed on top of the chart.

chartBackgroundColor is background color of the polar axis.

The color, style, and label for each plot is specified in a unique AWE_PolarPlot_Data derived type:

```
TYPE AWE_PolarPlot_Data
  CHARACTER*(128) :: curveLabel = "Label"
  INTEGER :: curveColor      = AWE_yellow
  INTEGER :: curveWidth      = 1
  INTEGER :: plotSymbolColor = AWE_red
  INTEGER :: plotSymbolSize  = 3
  INTEGER :: plotSymbolStyle = AWE_PlotSymbol_NoSymbol
END TYPE AWE_PolarPlot_Data
```

curveLabel is the label used to identify the curve. It is listed on the bottom of the plot.

curveColor is RGB color used to draw the curve.

curveWidth is the size of the pen used to draw the curve.

plotSymbolColor is the RGB color used to draw the symbol at the data points of the plot. See plotSymbolStyle below.

plotSymbolSize is the size of the symbol drawn at the data points of the plot. See plotSymbolStyle below.

plotSymbolStyle is the style of the symbol drawn at the data points of the plot. It can be one of the following:

```
AWE_PlotSymbol_NoSymbol          AWE_PlotSymbol_Ellipse
AWE_PlotSymbol_Rect              AWE_PlotSymbol_Diamond
AWE_PlotSymbol_Triangle          AWE_PlotSymbol_DTriangle
AWE_PlotSymbol_UTriangle         AWE_PlotSymbol_LTriangle
AWE_PlotSymbol_RTriangle         AWE_PlotSymbol_Cross
AWE_PlotSymbol_XCross            AWE_PlotSymbol_HLine
AWE_PlotSymbol_VLine             AWE_PlotSymbol_Star1
AWE_PlotSymbol_Star2             AWE_PlotSymbol_Hexagon
```

To create a polar plot, declare an instance of AWE_PolarPlot, supply the parameters you want to customize and call the AWE_createPolarPlot subroutine with the AWE_PolarPlot variable as an argument:

```
USE AWE_Interfaces
TYPE(AWE_PolarPlot) :: plot
CALL AWE_createPolarPlot(plot)
```

To plot an polar plot, call the AWE_writePolarPlot subroutine with the AWE_PolarPlot variable used to create the plot, a rank 2, shape (2,:) array, and an instance of AWE_PolarPlot_Data variable. The rank 2 array can be either INTEGER(KIND=4), INTEGER(KIND=8), or REAL of any KIND.

```
TYPE(AWE_PolarPlot_Data) :: plotData
REAL, DIMENSION(2,600) :: array
CALL AWE_writePolarPlot(plot, array, plotData)
```

To close the polar plot, call the AWE_closePolarPlot subroutine with the AWE_PolarPlot variable used to create the plot:

```
CALL AWE_closePolarPlot(plot)
```

To clear a polar plot, call the AWE_clearPolarPlot subroutine with the AWE_PolarPlot variable used to create the plot:

```
CALL AWE_clearPolarPlot(plot)
```

To save a plot to a file, call the AWE_savePolarPlot subroutine the AWE_PolarPlot variable used to create the plot and the name of the file to save it to. The format will automatically be determined by the file name extension. The default is PNG. PNG and BMP are supported on all operating systems.

```
CALL AWE_savePolarPlot(plot,"plot.png")
```

CANVASES

A canvass provides a drawing surface and graphics primitives that can be used to create a free form drawing. Among the many primitives provided are line, rectangle, arc, are

polygon, and commands. A number of derived types are used with canvases. They will be described first.

Canvas Derived Types

The AWE_Canvas type is used to specify the canvas for creation and all subsequent calls.

```
TYPE AWE_Canvas
  INTEGER, PRIVATE :: id
  CHARACTER(LEN=128) :: title = ""
  INTEGER :: width  = 500
  INTEGER :: height = 500
  INTEGER :: backgroundColor = AWE_white
END TYPE AWE_Canvas
```

`id` is the internal canvas identifier. AWE will automatically assign a unique value when the canvas is created.

`title` is the canvas window title.

`Width` and `height` are the dimensions of the canvas. The defaults are 500 x 500.

`backgroundColor` is the color of the drawing background.

An `AWE_CanvasPen` defines the style of the pen used with various other drawing commands.

```
TYPE AWE_CanvasPen
  REAL    :: penWidth  = 0.0
  INTEGER :: penStyle  = CanvasPenStyle_SolidLine
  INTEGER :: capStyle  = CanvasPenCapStyle_SquareCap
  INTEGER :: joinStyle = CanvasPenJoinStyle_BevelJoin
  INTEGER :: penColor  = AWE_black
END TYPE AWE_CanvasPen
```

`penWidth` is the width of the pen.

`penStyle` is the style of the pen. The following styles are available:

```
CanvasPenStyle_NoPen             CanvasPenStyle_SolidLine
CanvasPenStyle_DashLine          CanvasPenStyle_DotLine
CanvasPenStyle_DashDotLine       CanvasPenStyle_DashDotDotLine
```

`capStyle` defines the shape of the end cap of line segment drawn with the pen. The following styles are available:

```
CanvasPenCapStyle_SquareCap      CanvasPenCapStyle_FlatCap
CanvasPenCapStyle_RoundCap
```

joinStyle defines the shape of joint between two line segments drawn with the pen. The following styles are available:

```
CanvasPenJoinStyle_BevelJoin     CanvasPenJoinStyle_MiterJoin = 1
CanvasPenJoinStyle_RoundJoin
```

penColor defines the color of the pen.

An AWE_CanvasBrush defines the style of the brush used with various other drawing commands.

```
TYPE AWE_CanvasBrush
  INTEGER :: brushColor = AWE_black
END TYPE AWE_CanvasBrush
```

brushColor defines the color of the brush.

An AWE_Point defines a point on the canvas.

```
TYPE AWE_Point
  REAL x,y
END TYPE AWE_Point
```

x and y are the coordinates of the point.

An AWE_Size defines two dimensional space.

```
TYPE AWE_Size
  REAL width,height
END TYPE AWE_Size
```

width and height are the dimensions.

An AWE_Line defines a line on the canvas.

```
TYPE AWE_Line
 TYPE(AWE_Point) :: start, end
END TYPE AWE_Line
```

start and end are the end points of the line. They are given as instances of an AWE_Point type.

An AWE_Rect defines a rectangle on the canvas.

```
TYPE AWE_Rect
  TYPE(AWE_Point) :: origin
  TYPE(AWE_Size) :: size
END TYPE AWE_Rect
```

origin is given an AWE_Point and is the origin of the rectangle.

size is given an AWE_Size and is the width and height of the rectangle.

An AWE_Font defines a font for use with text drawing routines on the canvas.

```
TYPE AWE_Font
  CHARACTER(LEN=64) :: familyName = "Sans"
  INTEGER :: pointSize = 12
  INTEGER :: weight    = AWE_FontWeight_Normal
  LOGICAL :: italic    = .false.
END TYPE AWE_Font
```

familyName defines the font family of the font.

pointSize defines the size of the font.

weight defines the weight of the font. The following weights are available:

```
AWE_FontWeight_Light             AWE_FontWeight_Normal
AWE_FontWeight_DemiBold          AWE_FontWeight_Bold
AWE_FontWeight_Black
```

italic specified if the font is be in *italics*. The default is .false..

Canvas Routines

The following routines are used to create, close, and draw on the canvas.

To create a canvas, declare an instance of AWE_Canvas, supply the parameters you want to customize and call the AWE_createCanvas subroutine with the AWE_Canvas variable as an argument:

```
USE AWE_Interfaces
TYPE(AWE_Canvas) :: canvas
CALL AWE_createCanvas(canvas)
```

To draw lines on a canvas, use the AWE_canvasDrawLines subroutine.

```
USE AWE_Interfaces
TYPE(AWE_Canvas) :: canvas
TYPE(AWE_Line) :: lines(:)
TYPE(AWE_CanvasPen), OPTIONAL :: pen
CALL AWE_canvasDrawLines(canvas, lines, pen)
```

Note that lines is an array of AWE_Line types. If the optional pen argument is omitted, the last pen used will be supplied.

To draw an arc on a canvas, use the AWE_canvasDrawArc subroutine.

```
USE AWE_Interfaces
TYPE(AWE_Canvas) :: canvas
TYPE(AWE_Rect) :: rect
REAL startAngle, spanAngle
TYPE(AWE_CanvasPen), OPTIONAL :: pen
CALL AWE_canvasDrawArc(canvas, rect, startAngle, spanAngle, pen)
```

rect defines the bounding rectangle. startAngle specifies the beginning of the arc in degrees. spanAngle defines the arc in degrees. If the optional pen argument is omitted, the last pen used will be supplied.

To draw rectangles on a canvas, use the AWE_canvasDrawRects subroutine.

```
USE AWE_Interfaces
TYPE(AWE_Canvas) :: canvas
TYPE(AWE_Rect) :: rects(:)
TYPE(AWE_CanvasPen), OPTIONAL :: pen
TYPE(AWE_CanvasBrush), OPTIONAL :: brush
CALL AWE_canvasDrawRects(canvas, rects, pen, brush)
```

Note that rects is an array of AWE_Rect types. If the optional pen and/or brush arguments are omitted, the last pen and/or brush used will be supplied.

To draw rounded rectangles on a canvas, use the AWE_canvasDrawRoundedRects subroutine.

```
USE AWE_Interfaces
TYPE(AWE_Canvas) :: canvas
TYPE(AWE_Rect) :: rects(:)
REAL :: xradius, yradius
TYPE(AWE_CanvasPen), OPTIONAL :: pen
TYPE(AWE_CanvasBrush), OPTIONAL :: brush
CALL AWE_canvasDrawRoundedRects(canvas, rects, xradius,&
                                yradius, pen, brush)
```

Note that rects is an array of AWE_Rect types. xradius and yradius control the rounded corners. If the optional pen and/or brush arguments are omitted, the last pen and/or brush used will be supplied.

To draw a polygon on a canvas, use the AWE_canvasDrawPolygon subroutine.

```
USE AWE_Interfaces
TYPE(AWE_Canvas) :: canvas
TYPE(AWE_Point) :: points(:)
TYPE(AWE_CanvasPen), OPTIONAL :: pen
TYPE(AWE_CanvasBrush), OPTIONAL :: brush
CALL AWE_canvasDrawPolygon(canvas, points, pen, brush)
```

If the optional pen and/or brush arguments are omitted, the last pen and/or brush used will be supplied.

To draw a chord on a canvas, use the AWE_canvasDrawChord subroutine.

```
USE AWE_Interfaces
TYPE(AWE_Canvas) :: canvas
TYPE(AWE_Rect) :: rect
REAL startAngle, spanAngle
TYPE(AWE_CanvasPen), OPTIONAL :: pen
TYPE(AWE_CanvasBrush), OPTIONAL :: brush
CALL AWE_canvasDrawChord(canvas, rect, startAngle, spanAngle, &
                         pen, brush)
```

rect defines the bounding rectangle. startAngle specifies the beginning of the arc in degrees. spanAngle defines the arc in degrees. If the optional pen and/or brush arguments are omitted, the last pen and/or brush used will be supplied.

To draw a pie segment on a canvas, use the AWE_canvasDrawPie subroutine.

```
USE AWE_Interfaces
TYPE(AWE_Canvas) :: canvas
TYPE(AWE_Rect) :: rect
real startAngle, spanAngle
TYPE(AWE_CanvasPen), OPTIONAL :: pen
TYPE(AWE_CanvasBrush), OPTIONAL :: brush
CALL AWE_canvasDrawPie(canvas, rect, startAngle, spanAngle, &
                       pen, brush)
```

rect defines the bounding rectangle. startAngle specifies the beginning of the arc in degrees. spanAngle defines the arc in degrees. If the optional pen and/or brush arguments are omitted, the last pen and/or brush used will be supplied.

To draw an ellipse on a canvas, use the AWE_canvasDrawEllipse subroutine.

```
USE AWE_Interfaces
TYPE(AWE_Canvas) :: canvas
TYPE(AWE_Rect) :: rect
TYPE(AWE_CanvasPen), OPTIONAL :: pen
TYPE(AWE_CanvasBrush), OPTIONAL :: brush
CALL AWE_canvasDrawEllipse(canvas, rect, pen, brush)
```

rect defines the bounding rectangle. The ellipse will be sized to fit the rectangle. If the optional pen and/or brush arguments are omitted, the last pen and/or brush used will be supplied.

To draw text on a canvas, use the AWE_canvasDrawText subroutine.

```
USE AWE_Interfaces
TYPE(AWE_Canvas) :: canvas
TYPE(AWE_Rect) :: rect
CHARACTER(LEN=*) text
INTEGER, optional :: flags
TYPE(AWE_Font) :: font
INTEGER, OPTIONAL:: textColor = AWE_black
CALL AWE_canvasDrawText(canvas, rect, text, flags, font, &
                        textColor)
```

rect defines the bounding rectangle. The ellipse will be sized to fit the rectangle. If the optional textColor argument is omitted, it defaults to AWE_black. The flag arguments can be a combination of:

```
AWE_TextFlag_None                AWE_TextFlag_AlignLeft
AWE_TextFlag_AlignRight          AWE_TextFlag_AlignHCenter
AWE_TextFlag_AlignJustify        AWE_TextFlag_AlignTop
AWE_TextFlag_AlignBottom         AWE_TextFlag_AlignVCenter
AWE_TextFlag_AlignCenter         AWE_TextFlag_TextDontClip
AWE_TextFlag_TextSingleLine      AWE_TextFlag_TextExpandTabs
AWE_TextFlag_TextShowMnemonic    AWE_TextFlag_TextWordWrap
AWE_TextFlag_TextIncludeTrailingSpaces
```

To display a picture on a canvas, use the AWE_canvasDrawPicture subroutine.

```
USE AWE_Interfaces
TYPE(AWE_Canvas) :: canvas
TYPE(AWE_Rect) :: rect
CHARACTER(LEN=*) filename
CALL AWE_canvasDrawPicture(canvas, rect, filename)
```

rect defines the bounding rectangle.

To close the canvas, call the AWE_closeCanvas subroutine with the AWE_Canvas variable used to create the canvas:

```
CALL AWE_closeCanvas(canvas)
```

To clear a canvas, call the AWE_clearCanvas subroutine with the AWE_Canvas variable used to create the canvas:

```
CALL AWE_clearCanvas(canvas)
```

To save a canvas to a file, call the AWE_saveCanvas subroutine the AWE_ContourPlot variable used to create the canvas and the name of the file to save it to. The format will automatically be determined by the file name extension. The default is PNG. PNG and BMP are supported on all operating systems.

```
CALL AWE_saveCanvas(canvas,"canvas.png")
```

DIALOGS

Modal dialogs can be easily created and displayed using AWE. A modal dialog requires the user to interact with it before returning to the main program flow. A typical use of an AWE dialog is to establish initial program parameters; however, they can be displayed at any point in the program where you need them.

There are three steps to working with AWE dialogs: create the dialog, add items to the dialog, and display the dialog. Dialog items automatically arranged vertically in the dialog box in the order they are added.

Creating an AWE dialog

Before you can add items to a dialog you must create it. This done with the `AWE_createDialog` subroutine call:

```
USE AWE_Interfaces
TYPE(AWE_FormDialog) :: dialog
CALL AWE_createDialog(dialog)
```

The derived type `AWE_FormDialog` is defined as follows:

```
TYPE AWE_FormDialog
  INTEGER, PRIVATE :: dialogID
  CHARACTER(LEN=128) title
END TYPE
```

`dialogID` is the internal dialog identifier. AWE will automatically assign a unique value when the dialog is created.

`title` is the text that will be displayed in the dialog title bar.

Adding Items to an AWE dialog

Dialog items are displayed in a dialog in the order they are added. Items are added to a dialog with the `AWE_addToDialog` subroutine call:

```
CALL AWE_addToDialog(item, dialog)
```

`item` is the dialog item to add (see below).

`dialog` is the instance of the `AWE_FormDialog` derived type used to create the dialog.

The following sections describe the items and how to add them to a dialog.

Dialog Labels

Static text is added to a dialog with an `AWE_FormLabel` derived type:

```
TYPE AWE_FormLabel
  INTEGER, PRIVATE :: id
  CHARACTER(LEN=128) :: text = ""
END TYPE
```

`id` is the internal dialog item identifier. AWE will automatically assign a unique value when the item is added to the dialog.

`text` is the text that will be displayed in the dialog box.

```
USE AWE_Interfaces
TYPE(AWE_FormDialog) :: dialog
TYPE(AWE_FormLabel) :: label
```

```
dialog%title = "title"
Label%text = "label"
CALL AWE_createDialog(dialog)
CALL AWE_AddToDialog(label, dialog)
```

Dialog Combo Box

A combo box is a type of drop down menu with a title and selections. It is added to a dialog with an `AWE_FormComboBox` derived type:

```
TYPE AWE_FormComboBox
  INTEGER, PRIVATE :: id
  CHARACTER (LEN=128) :: title = ""
  CHARACTER (LEN=128), ALLOCATABLE, DIMENSION(:) :: items
  INTEGER selected = 1
END TYPE
```

`id` is the internal dialog item identifier. AWE will automatically assign a unique value when the item is added to the dialog.

`title` is the text that will be displayed to the left of the combo box.

`items` is the array of items text that will be displayed in the combo box menu.

`selected` contains the array index of the selected combo box item when the dialog is dismissed. The default is 1, but can be preset to any of the menu items by setting `selected` to the desired value before the item is added to the dialog.

```
USE AWE_Interfaces
TYPE(AWE_FormDialog) :: dialog
TYPE(AWE_FormComboBox) :: comboBox
dialog%title = "title"
ALLOCATE(comboBox%items(3))
comboBox%title = "label"
comboBox%items(1) = "Item1"
comboBox%items(2) = "Item2"
comboBox%items(3) = "Item3"
CALL AWE_createDialog(dialog)
CALL AWE_AddToDialog(comboBox, dialog)
```

Dialog Check Box

A check box is a dialog item with a title and a checkable box. It is added to a dialog with an `AWE_FormCheckBox` derived type:

```
TYPE AWE_FormCheckBox
  INTEGER, PRIVATE :: id
  CHARACTER (LEN=128) :: title = ""
  LOGICAL checked = .false.
END TYPE
```

`id` is the internal dialog item identifier. AWE will automatically assign a unique value when the item is added to the dialog.

`title` is the text that will be displayed to the left of the check box.

`checked` indicates the state of the check box item when the dialog is dismissed. A value of `.true.` means the box is checked and a value of `.false.` means it is unchecked. The default is unchecked. To preset the state to checked, set `checked=.true.` before adding the item to the dialog.

```
USE AWE_Interfaces
TYPE(AWE_FormDialog) :: dialog
TYPE(AWE_FormCheckBox) :: checkBox
dialog%title = "title"
checkBox%title = "label"
CALL AWE_createDialog(dialog)
CALL AWE_AddToDialog(checkBox, dialog)
```

Dialog Text Edit Box

A text edit box is a dialog item with a title and a box where text can be entered. It is added to a dialog with an `AWE_FormLineEdit` derived type:

```
TYPE AWE_FormLineEdit
  INTEGER, PRIVATE :: id
  CHARACTER (LEN=128) :: title = ""
  CHARACTER (LEN=128) :: text = ""
  CHARACTER (LEN=128) :: placeholder = ""
END TYPE
```

`id` is the internal dialog item identifier. AWE will automatically assign a unique value when the item is added to the dialog.

`title` is the text that will be displayed to the left of the box.

`text` is the variable that any text entered by the user will be returned in. If this variable is initialized before adding the item to the dialog, it will be displayed in the dialog as the default value.

`placeholder` is text that will be displayed, grayed out, in the box. As soon as the cursor is placed in the text box, `placeholder` disappears. It is often useful as a prompt. If `text` is initialized, `placeholder` is ignored.

```
USE AWE_Interfaces
TYPE(AWE_FormDialog) :: dialog
TYPE(AWE_FormLineEdit) :: lineEdit
dialog%title = "title"
LineEdit%title = "label"
CALL AWE_createDialog(dialog)
CALL AWE_AddToDialog(LineEdit, dialog)
```

Dialog Radio Buttons

Radio buttons are a dialog item with a title and an array of buttons representing a single choice that may be made. They are added to a dialog with an `AWE_FormRadioButtons` derived type:

```
TYPE AWE_FormRadioButtons
  INTEGER, PRIVATE :: id
  CHARACTER (LEN=128) :: title = ""
  CHARACTER (LEN=128), ALLOCATABLE, DIMENSION(:) :: items
  INTEGER :: selected = 1
END TYPE
```

`id` is the internal dialog item identifier. AWE will automatically assign a unique value when the item is added to the dialog.

`title` is the text that will be displayed above the buttons.

`items` is an array of character variables containing the text for the buttons. There will be as many buttons as there are array elements.

`selected` returns the index of the selected button when the dialog is dismissed. It may be initialized to any value between `1` and the dimension extent of `items`. The default initialization is `1`, the first radio button.

```
USE AWE_Interfaces
TYPE(AWE_FormDialog) :: dialog
TYPE(AWE_FormRadioButtons) :: radioButtons
dialog%title = "title"
radioButtons%title = "Model"
allocate (radioButtons%items(3))
radioButtons%items(1) = "Small"
radioButtons%items(2) = "Medium"
radioButtons%items(3) = "Large"
CALL AWE_createDialog(dialog)
CALL AWE_AddToDialog(radioButtons, dialog)
```

Dialog File Selection Box

A file selection box item in a dialog consists of a title, a text box, and a file selection browse button. It is used to select files or directories. A file name can be entered directly in the text box. If the browse button is used, then the selection from the file selection dialog will be entered in the box automatically. A file selection box item is added to a dialog with an `AWE_FormFileDialog` derived type:

```
TYPE AWE_FormFileDialog
  INTEGER, PRIVATE :: id
  CHARACTER (LEN=128) :: title = ""
  CHARACTER (LEN=128) :: defaultDirectory = ""
  CHARACTER (LEN=128) :: placeholder = ""
  CHARACTER (LEN=128) :: text = ""
  INTEGER :: chooseMode = AWE_FormFileDialog_chooseExistingFile
END TYPE
```

`id` is the internal dialog item identifier. AWE will automatically assign a unique value when the item is added to the dialog.

`title` is the text that will be displayed to the left of the box.

`defaultDirectory` is used to set a default directory for the file selection dialog that is shown when the browse button is used.

`text` is the variable that any text entered by the user will be returned in. If this variable is initialized before adding the item to the dialog, it will be displayed in the dialog as the default value.

`placeholder` is text that will be displayed, grayed out, in the box. As soon as the cursor is placed in the text box, `placeholder` disappears. It is often useful as a prompt. If `text` is initialized, `placeholder` is ignored.

`chooseMode` determines the type of file selection dialog that is shown when the browse button is used. Three types are available:

```
AWE_FormFileDialog_chooseExistingFile
AWE_FormFileDialog_chooseDirectory
AWE_FormFileDialog_chooseNewFiles
```

Add a file selection box item to a dialog:

```
USE AWE_Interfaces
TYPE(AWE_FormDialog) :: dialog
TYPE(AWE_ FormFileDialog) :: fileDialog
dialog%title = "title"
fileDialog%title = "label"
CALL AWE_createDialog(dialog)
CALL AWE_AddToDialog(fileDialog, dialog)
```

Display an AWE Dialog

To display an AWE dialog, use the `AWE_showDialog` function:

```
INTEGER :: result
result = AWE_showDialog(dialog)
```

If `result==0`, the **Cancel** button was clicked. If `result==1`, the **OK** button was clicked.

TIMERS

A timer schedules a subroutine in your program to be executed at specified intervals. A derived type is used to define the timer interval and if the timer is to fire only once or be rescheduled after it goes off.

```
TYPE AWE_Timer
  INTEGER, PRIVATE :: id
  INTEGER :: interval = 100
  LOGICAL :: singleShot = .false.
END TYPE AWE_Timer
```

`id` is the internal timer item identifier. AWE will automatically assign a unique value when the timer is scheduled.

`interval` is the timer interval in milliseconds.

`singleShot` is used to indicate if the timer is be rescheduled after it goes off. The default is `.false.`.

To create a timer, declare an instance of `AWE_Timer`, supply the parameters you want to customize and call the `AWE_createTimer` subroutine with the `AWE_Timer` variable and the name of the subroutine to be called as arguments:

```
USE AWE_Interfaces
TYPE(AWE_Timer) :: timer
EXTERNAL callBack
CALL AWE_createTimer(timer, callBack)
```

If the main program has exited, the timer is started immediately. Otherwise, the timer is queued and will start as soon as the main program exits or a `STOP` statement is executed.

To cancel a timer, call the `AWE_destroyTimer` subroutine with the `AWE_Timer` variable used to create the timer:

```
SUBROUTINE AWE_destroyTimer(timer)
  TYPE(AWE_Timer) :: timer
END SUBROUTINE
```

CHAPTER 8

Interfacing With Other Languages

This chapter discusses interfacing Absoft Pro Fortran with the C Programming Language and assembly language, debugging programs, and profiling executables. Although Fortran programs can call C functions easily with just a `CALL` statement, the sections below should be read carefully to understand the differences between argument and data types.

INTERFACING WITH C

Absoft Pro Fortran is designed to be fully compatible with the implementation of the standard C Programming Language provided on Linux. The linker can be used to freely link C modules with Fortran main programs and vice versa. However, some precautions must be taken to ensure proper interfacing. Data types in arguments and results must be equivalent. The case of global symbols C is significant. The symbolic names of external procedure must match in case.

Fortran Data Types in C

Declarations for Fortran data types and the equivalent declarations in C are as follows:

Fortran	C
`LOGICAL*1 l`	`unsigned char l;`
`LOGICAL*2 m`	`unsigned short m;`
`LOGICAL*4 n`	`unsigned long n;`
`CHARACTER*n c`	`char c[n];`
`INTEGER*1 i` or `BYTE i`	`char i;`
`INTEGER*2 j`	`short j;`
`INTEGER*4 k`	`int k;` `long k`[1]`;`
`INTEGER*8 l`	`long long l;`
`REAL*4 a`	`float a;`
`REAL*8 d`	`double d;`

`COMPLEX*8 c`	`struct complx {`
	`  float x;`
	`  float y;`
	`};`
	`struct complx c;`

`COMPLEX*16 d`	`struct dcomp {`
	`  double x;`
	`  double y;`
	`};`
	`struct dcomp d;`

1. On 64-bit systems, `long` is equivalent to `INTEGER*8`.

The storage allocated by the C language declarations will be identical to the storage allocated by the corresponding Fortran declaration.

There are additional precautions when passing Fortran strings to C routines. See the section **Passing Strings to C** later in this chapter for more information.

Required Compiler Options

FORTRAN 77 code should be compiled with the following options:

-f	fold symbols to lower case
-s	use static storage
-N90	use g77 `CHARACTER` argument protocols

Fortran 90 code should be compiled with the following options:

-s	use static storage
-YCFRL=1	use g77 `CHARACTER` argument protocols

C code does not have to be compiled with any special options for the C compiler.

Rules for Linking

By default, Fortran external names are emitted with all lowercase letters and a single trailing underscore.

When linking Fortran and C programs, the `f77` or `f90` compiler driver should be used so that the appropriate Fortran and C libraries are included in the final application. The following command will compile the file `f1.f` with the FORTRAN 77 compiler and the file `c1.c` with the C compiler. It will then link the two resulting object files along with `o1.o` and the appropriate libraries to generate an executable application named exec:

```
f77 –o exec f1.f c1.c o1.o
```

If object files or libraries that have been built with `g77` are used, the `g77` runtime library should be specified as either: `-lf2c` or `–lg2c` depending on your version of Linux. Further, current information can be obtained in the technical support section at the Absoft web site: www.absoft.com.

Passing Parameters Between C and Fortran

The Absoft Pro Fortran compilers use the same calling conventions as the C programming language. Therefore, a Fortran routine may be called from C without being declared in the C program and vice versa, if the routine returns all results in parameters. Otherwise, the function must be typed compatibly in both program units. In addition, care must be taken to pass compatible parameter types between the languages. Refer to the table earlier in this chapter.

Reference parameters

By default, all Fortran arguments to routines are passed by reference, which means pointers to the data are passed, not the actual data. Therefore, when calling a Fortran procedure from C, pointers to arguments must be passed rather than values. Both integer and floating point values may be passed by reference. Consider the following example:

```
SUBROUTINE SUB(a_dummy,i_dummy)
REAL*4 a_dummy
INTEGER*4 i_dummy

WRITE (*,*) 'The arguments are ',a_dummy, ' and ', i_dummy
RETURN
END
```

The above subroutine is called from Fortran using the CALL statement:

```
a_actual = 3.3
i_actual = 9
CALL SUB(a_actual, i_actual)
END
```

However, to call the subroutine from C, the function reference must explicitly pass pointers to the actual parameters as follows:

```
int main()
{
      float a_actual;
      int i_actual;
      void sub_();

      a_actual = 3.3;
      i_actual = 9;
      sub_(&a_actual,&i_actual);
      return 0;
}
```

Note that the values of the actual parameters may then be changed in the Fortran subroutine with an assignment statement or an I/O statement.

When calling a C function from Fortran with a reference parameter, the C parameters are declared as pointers to the data type and the Fortran parameters are passed normally:

```
PROGRAM convert_to_radians
WRITE (*,*) 'Enter degrees:'
READ (*,*) c
CALL C_RAD(c)
WRITE (*,*) 'Equal to ',c,' radians'
END
```

```
void c_rad_(c)
float *c;
{
      float deg_to_rad = 3.14159/180.0;
      *c = *c * deg_to_rad;
}
```

Value parameters

Absoft Pro Fortran provides the intrinsic function %VAL() for passing value parameters. Function interfaces may also be used to specify which arguments to pass by value. Although it is generally pointless to pass a value directly to a Fortran procedure, these functions may be used to pass a value to a C function. The following is an example of passing a 4-byte integer:

```
WRITE (*,*) 'Enter an integer:'
READ (*,*) i
CALL C_FUN(VAL(i))
END
```

```
void c_fun_(i)
int i;
{
      printf ("%d is ",i);
      if (i % 2 == 0)
        printf ("even.\n");
      else
        printf ("odd.\n");
}
```

The value of i will be passed directly to C_FUN, and will be left unaltered upon return. Value parameters can be passed from C to Fortran with use of the VALUE statement. The arguments that are passed by value are simply declared as VALUE.

```
void c_fun()
{
void fortran_sub_();
int i;

      fortran_sub_(i);
}
```

```
SUBROUTINE FORTRAN_SUB(i)
VALUE i
...
END
```

Note that C will pass all floating-point data as double precision by default, and that the only Fortran data type that cannot be passed by value is CHARACTER.

Array Parameters

One-dimensional arrays can be passed freely back and forth as both language implementations pass arrays by reference. However, since C and Fortran use different row/column ordering, multi-dimensional arrays cannot be easily passed and indexed between the languages.

```
INTEGER ia(10)

CALL C_FUN(ia)
WRITE (*,*) ia

END
```

```
void c_fun_(i)
int i[];
{
int j;
      for(i=0; j<10; j++)
            i[j]=j;
}
```

Function Results

In order to obtain function results in Fortran from C language functions and vice versa, the functions must be typed equivalently in both languages: either `INTEGER`, `REAL`, or `DOUBLE PRECSION`. All other data types must be returned in reference parameters. The following are examples of the passing of function results between Fortran and C. The names are case-sensitive, so trying to call `cmax`, for example, will result in an error at link time.

A call to C from Fortran

```
PROGRAM callc
INTEGER*4 CMAX, A, B

WRITE (*,*) 'Enter two numbers:'
READ (*,*) A, B
WRITE (*,*) 'The largest of', A, ' and', B, ' is ', CMAX(A,B)
END
```

```
int cmax_(x,y)
int *x,*y;
{
     return( (*x >= *y) ? *x : *y );
}
```

A call to Fortran from C

```
main()
{
float qt_to_liters_(), qt;

      printf ("Enter number of quarts:\n");
      scanf ("%f",&qt);
      printf("%f quarts = %f liters.\n", qt, qt_to_liters_(&qt));
}
```

```
REAL*4 FUNCTION QT_TO_LITERS(q)
REAL*4 q;

QT_TO_LITERS = q * 0.9461;
END
```

Passing Strings to C

Fortran strings are a sequence of characters padded with blanks out to their full fixed length, while strings in C are a sequence of characters terminated by a null character. Therefore, when passing Fortran strings to C routines, you should terminate them with a null character. The following Fortran expression will properly pass the Fortran string `string` to the C routine `CPRINT`:

```
PROGRAM cstringcall
character*255 string
string = 'Moscow on the Hudson'
CALL CPRINT(TRIM(string)//CHAR(0))
END
```

```
void cprint_(anystring)
char *anystring;
{
      printf ("%s\n",anystring);
}
```

This example will neatly output "`Moscow on the Hudson`". If the `TRIM` function were not used, the same string would be printed, but followed by 235 blanks. If the `CHAR(0)` function was omitted, C would print characters until a null character was encountered, whenever that might be.

You can also take advantage of the string length arguments that Fortran passes. After the end of the formal argument list, Fortran passes (and expects) the length of each CHARACTER argument as a 32-bit integer value parameter. For example:

```
SUBROUTINE FPRINT(string)
character*(*) string
print *, string
END
```

```
#include <string.h>

int main()
{
char string[] = {"Moscow on the Hudson"};
void fprint_(char *, int);

      fprint_(string, strlen(string));
      return 0;
}
```

Naming Conventions

Global names in Fortran include all procedure names and COMMON block names, both of which are significant to 31 characters. All global procedure names are folded to lower case and have a single underscore ("_") appended unless the compiler character case and symbol decoration options are used. All COMMON block names are folded to lower case and have the characters "_C" prepended unless the compiler character case and symbol decoration options are used. All other symbols are manipulated as addresses or offsets from local labels and are invisible to the linker.

Procedure Names

Names of functions and subroutines in Fortran programs will appear in the assembly language source output or object file records with their names folded to lower case and with a single underscore ("_") appended. Symbolic names in the C language are case sensitive, distinguishing between upper and lower case characters. To make FORTRAN code compatible with C, use the –YEXT_NAMES=ASIS and –YEXT_SFX="" options, the !DIR$ NAME directive, or the BIND attribute.

Accessing COMMON blocks from C

COMMON block names are global symbols formed in Absoft Pro Fortran folding the name of the common block to lower case and then prepending the characters "_C" to the name of the COMMON block. The elements of the COMMON block can be accessed from C by declaring an external structure using this name. For example, the COMMON block

```
COMMON /comm/ a,b,c
```

can be accessed with the C declaration:

```
extern struct {
     float a;
     float b;
     float c;
} _Ccomm;
```

Declaring C Structures in Absoft Pro Fortran

If there are equivalent data types in FORTRAN for all elements of a C structure, a RECORD can be declared in FORTRAN to match the structure in C:

C	FORTRAN
`struct str {`	`STRUCTURE /str/`
`char c;`	`  CHARACTER c`
`long l;`	`  INTEGER*4 l`
`float f;`	`  REAL*4 f`
`double d;`	`  REAL*8 d`
`};`	`END STRUCTURE`
`struct str my_struct;`	`RECORD /str/ my_struct`

By default, the alignment of the C structure should be identical to the FORTRAN RECORD. Refer to the **Specification and DATA Statements** chapter of the *FORTRAN 77 Language Reference Manual* for more information on the FORTRAN RECORD type.

INTERFACING WITH ASSEMBLY LANGUAGE

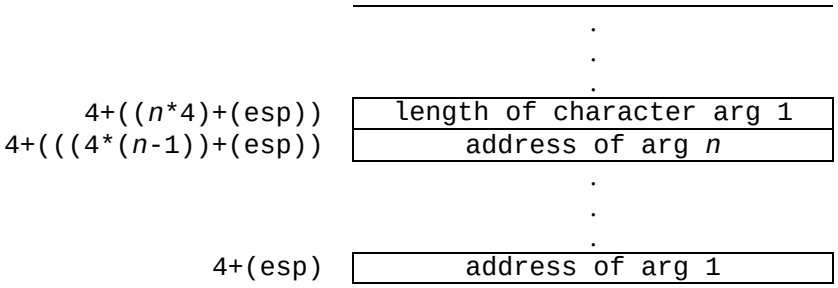
This section discusses how arguments and results are passed on the stack and in registers.

The Fortran Stack Frame

The addresses of arguments to a Fortran procedure are passed in a right to left order on the ESP the stack. The lengths of character arguments are passed as 32 bit integers above these addresses. On entry to a Fortran procedure, the stack frame is defined as follows:

Subroutine declaration: `SUBROUTINE sub(arg 1, ... ,arg n)`

`4+((n*4)+(4*(n-1))+(esp))`	length of character arg *n*



argument position = `4 + ((m-1) * 4)`
length position = `4 + (n * 4 + 4 + (m-1) * 4)`

where: *m* = argument number
n = total arguments

The Fortran Stack Frame

Value arguments for all data types are passed in the stack frame beginning at the argument position described above and extending as far as they need to. Value arguments that are less than four bytes in length are extended to four bytes before they are passed. The stack is always aligned to a sixteen byte boundary.

Space for CHARACTER and derived type function results is passed as if it were an extra argument at the beginning of the argument list. For example, the following two calls are equivalent in respect to how arguments are passed to the external function or subroutine:

```
CHARACTER*10 funct, arg, result
EXTERNAL sub

result = funct(argument)
CALL sub(result,argument)
```

Function Results

Absoft Pro Fortran returns all numeric and logical function registers. Floating point results are returned in `st(0)` or `st(0)` and `st(1)`. Integer and logical results are returned in EAX. POINTER results are also returned in EAX.

CHARACTER and derived type results cannot be returned in registers. Since space for the result is passed in as the first argument, no result need be returned. RECORD results are returned in the same fashion except that EAX is set to point the returned structure.

DEBUGGING

Debugging a Fortran program is accomplished with the Absoft source-level debugger, Fx3™. This is a multi-language, windowed debugger designed especially for Linux based computers. The operation of the debugger is detailed in the document, **Fx3 Debugger**

User Guide. The following paragraphs describe the compiler options and resources necessary to prepare a program for debugging.

Compiler Options

The **-g** compiler option directs the compiler to add symbol and line number information to the object file. This option should be enabled for each source file that you will want to have source code displayed while debugging. It is not required for files that you are not interested in.

It is recommended that all optimization options be disabled while debugging. This is because the optimizers can greatly distort the appearance and order of execution of the individual statements in your program. Code can be removed or added (for loop unrolling), variables may be removed or allocated to registers (making it impossible to examine or modify them), and statements may be executed out of order.

PROFILING

The Linux operating system includes the libraries and tools necessary to obtain procedure level profiles of your application. You simply create an instrumented version of your application (see **Compiler Options** below) and then execute it. The file `gmon.out` will automatically be created. Use *gprof* to display and analyze the results.

Compiler Options

The **-P** compiler option directs the compiler to add the symbol information to the object file necessary to profile an application. Enabling this option will allow the application to report the number of times a particular subroutine is called or a function is referenced.

All other options that you would normally use should be enabled, including optimization.

Appendix A

Absoft Compiler Option Guide

This appendix summarizes general options for Absoft Fortran compilers and specific options for the Absoft Fortran 90/95 and FORTRAN 77 compilers. Refer to the chapter, **Using the Compilers** for detailed descriptions of the options

ABSOFT FORTRAN COMPILER OPTIONS

Option	***Effect***
-###	Show what would be done, but do not actually execute anything.
-c	suppresses creation of an executable file — leaves compiled files in object code format.
-cpp	always run C pre-processor regardless of file extension
-no-cpp	never run C pre-processor
-g	generates symbol information for Fx3™.
-L*path*	library file search path specification.
-l*name*	library file specification.
-O	basic optimization. equivalent of –O2.
-o *name*	directs the compiler to produce an executable file called *name* where *name* is a file name.
-fPIC	generate position independent code.
-P	instrument executable for profiling.
-S	generates an assembly language output file.
-s	allocate local variables statically.
-u	undefine a symbol to the linker.
-V	causes the `f77` compiler to display its version number.
--version	causes the `f77` compiler to display its version number.
-v	directs the compiler to print status information as the compilation process proceeds.
-w	suppresses listing of all compile-time warning messages.
-X*option*	linker option.
-static	disable dynamic linking of executable

FPU CONTROL OPTIONS

-OPT:roundoff=# Set the level of acceptable rounding (# can be 0,1,2, or 3)

0 - Turn off optimizations that may be harmful to floating point calculations.
1 - Allow simple optimization that may affect floating point accuracy.
2 - Allow more extensive optimization that may affect floating point accuracy.
3 - Allow all optimizations affecting floating point accuracy.

-TENV:simd_... Controls floating point exception traps. Valid options are:

simd_imask – Invalid operation exception.
simd_dmask – Denormalized operand exception.
simd_zmask – Divide by zero exception.
simd_omask – Overflow exception.
simd_umask – Underflow exception.
simd_pmask - Precision exception.

PROCESSOR SPECIFIC OPTIONS

-cpu:*type* **This option is deprecated, please use –march, -mtune or -mcpu instead.**

-march=*type*
-mtune=*type*
-mcpu=*type* Processor specific optimization. Valid values for type are:

anyx86 – Intel Pentium, Pentium II, or Pentium III
athlon – AMD Athlon or Duron
athlon64 – AMD Athlon 64
pentium4 – Intel Pentium 4
xeon – Intel Xeon
em64t – Intel Pentium 4 with EM64T
opteron, athlon64fx – AMD Opteron or Athlon 64 Fx
core – Intel Core and Core 2
barcelona - AMD Opteron and Phenon with K10 arch
wolfdale – Intel Core i7 technology
zen – AMD RyZen technology
host - automatically establishes type based on the processor in the machine that the program is compiled with. If host cannot be determined anyx86 is used.

AMD AND INTEL 64-BIT PROCESSOR SPECIFIC OPTIONS

-mcmodel=*type* code generation memory size model. Valid types are small or medium

-m32	generate 32-bit code.
-m64	generate 64-bit code.

FORTRAN 90/95 CONTROL OPTIONS

-OPT:*alias=…*	Specify pointer aliasing model to be used. Valid arguments are: typed – Assumes that pointers of different types cannot point to the same memory location. restrict – Distinct pointers are assumed to point to non-overlapping memory locations. disjoint – Assume that any two pointer expressions point to disctint, non-overlapping objects.
-B108	append trailing underscores to procedure names.
-dq	Allow more than 100 error diagnostics.
-ea	Causes the `f95` compiler to abort the compilation process on the first error that it encounters.
-en	Causes the compiler to issue a warning whenever the source code contains an extension to the Fortran 90/95 standard.
-eR	Default recursion
-g	Generates symbol information for Fx™.
-M*nn*	Suppresses messages by message number.
-m*nn*	Suppresses messages by message level.
-P	Instrument executable for profiling.
-V	Causes the `f95` compiler to display its version number.
--version	Causes the `f95` compiler to display its version number.
-v	Directs the compiler to print status information as the compilation process proceeds
-w	Suppresses listing of all compile-time warning messages.
-msse2	Enable SSE2 extension.
-msse3	Enable SSE3 extension.
-mx87-precision=	Specify the precision of x87 floating-point calculations. Value can be 32,64 or 80.

FORTRAN OPTIMIZATION OPTIONS

-H*nn*	set loop unrolling limit.
-h*nn*	set loop unrolling factor.
-U	enable default loop optimization.
-ipa	turn on inter-procedural analysis (IPA).
-f[no-]fast-math	turn on fast math.

-O1	enables basic optimization.
-O2	enables block level optimization.
-O3	enables advanced optimization.
-Ofast	enables advanced optimization and IPA linking.
-speed_math=#	enables math optimizations which may improve performance at the expense of accuracy. valid arguments are 0-11.

FORTRAN 90/95 SOURCE FORMAT OPTIONS

-f*form*	sets the form of the source file to **free**, **fixed**, or **alt_fixed**.
-W*n*	sets the line length of source statements accepted by the compiler in Fixed-Form source format.

FORTRAN 90/95 COMPATIBILITY OPTIONS

-dp	causes variables declared in a `DOUBLE PRECISION` statement and constants specified with the `D` exponent to be converted to the default real kind.
-ej	causes all `DO` loops to be executed at least once, regardless of the initial value of the iteration count.
-i*n*	set default integer size to ***n*** (2 or 8) bytes.
-N113	set default real size to 8 bytes (`KIND=8`).
-p*path*	specify module search path
-s	allocate local variables statically
-Rb	generate code to check array boundaries.
-Rc	generate code to validate substring indexes.
-Rp	generate code to check for null pointers.
-Rs	generate code check array conformance.
-t*n*	this option increases the default temporary string size to 1024×10^n bytes.
-x*directive*	disable compiler directive in the source file.
-YCFRL	forces the compiler to pass `g77`/`f2c` compatible `CHARACTER` arguments.
-YCOM_NAMES	specify `COMMON` block names externally in upper or lower case.
-YCOM_PFX	specify `COMMON` block external name prefix.
-YCOM_SFX	specify `COMMON` block external name suffix.
-YCSLASH	directs the compiler to transform certain escape sequences marked with a '\' embedded in character constants.
-YEXT_NAMES	Specify procedure names externally in upper, lower, or mixed case.
-YEXT_PFX	Specify procedure external name prefix.
-YEXT_SFX	Specify procedure external name suffix.
-YMS7D	Recognize Microsoft style compiler directives beginning with a '$' in column 1.
-YNDFP	disallow the use of a '.' as a structure field separator.

-YPEI pointers are Equivalent to Integers allows a Cray-style pointer to be manipulated as an integer.
-trapuv trap uninitialized variables.
-zerouv set uninitialized variables to zero.

FORTRAN 77 CONTROL OPTIONS

-OPT:*alias=…* Specify pointer aliasing model to be used. Valid arguments are:

typed – Assumes that pointers of different types cannot point to the same memory location.
restrict – Distinct pointers are assumed to point to non-overlapping memory locations.
disjoint – Assume that any two pointer expressions point to disctint, non-overlapping objects.

-B108 add one trailing underscore to symbol names without an underscore and two trailing underscores to symbol names that already contain an underscore.

-C generates code to check that array indexes are within array bounds - file names and source code line numbers will be displayed with all run time error messages
-D used to define conditional compilation variables from the command line **(-D *name*[=value])** — if *value* is not present, the variable is assigned the value of 1
-g generates symbol information for Fx™.
-I*path* specify path to search for `INCLUDE` files.
-N32 directs the compiler to issue a warning whenever the source code contains an extension to the ANSI FORTRAN 77 standard
-dB check syntax only.

-N90 forces the compiler to pass `g77/f2c` compatible `CHARACTER` arguments.
-P instrument executable for profiling.
-T*nn* used to change the number of handles used internally by the compiler.

-t*nn* modifies the default temporary string size to *nn* bytes from the default of 1024 bytes

-v directs the compiler to print status information as the compilation process proceeds
-w suppresses listing of all compile-time warning messages
-x replaces any occurrence of `X` or `D` in column one with a blank character: allows a restricted form of conditional compilation

FORTRAN 77 SOURCE FORMAT OPTIONS

-8	directs the compiler to accept source code written in Fortran 90/95 Free Source Form
-W	directs the compiler to accept statements which extend beyond column 72 up to column 132

FORTRAN 77 COMPATIBILITY OPTIONS

-B108	add one trailing underscore to symbol names without an underscore and two trailing underscores to symbol names that already contain an underscore.
-cpp	always run C pre-processor regardless of file extension
-no-cpp	never run C pre-processor
-d	causes all `DO` loops to be executed at least once, regardless of the initial value of the iteration count (FORTRAN 66 convention)
-f	folds all symbolic names to lower case
-i*n*	changes the default storage length of `INTEGER` from 4 bytes to ***n*** (2 or 8).
-K	directs the compiler to transform certain escape sequences marked with a '\' embedded in character constants
-N22	don't mangle `COMMON` block names with leading "_c"
-N26	force the compiler to consider the byte ordering of all unformatted files to be big-endian by default
-N27	force the compiler to consider the byte ordering of all unformatted files to be little-endian by default
-N109	folds all symbolic names to UPPER CASE
-N113	changes `REAL` and `COMPLEX` data types without explicit length declara-tion to `DOUBLE PRECISION` and `DOUBLE COMPLEX`
-s	forces all program storage to be treated as static: see **-N1** also

Appendix B

ASCII Table

ASCII codes 0 through 31 are control codes that may or may not have meaning on Linux. They are listed for historical reasons and may aid when porting code from other systems. Codes 128 through 255 are extensions to the 7-bit ASCII standard and the symbol displayed depends on the font being used; the symbols shown below are from the Times New Roman font. The Dec, Oct, and Hex columns refer to the decimal, octal, and hexadecimal numerical representations.

Character	Dec	Oct	Hex	Description
NULL	0	000	00	null
SOH	1	001	01	start of heading
STX	2	002	02	start of text
ETX	3	003	03	end of text
ECT	4	004	04	end of trans
ENQ	5	005	05	enquiry
ACK	6	006	06	acknowledge
BEL	7	007	07	bell code
BS	8	010	08	back space
HT	9	011	09	horizontal tab
LF	10	012	0A	line feed
VT	11	013	0B	vertical tab
FF	12	014	0C	form feed
CR	13	015	0D	carriage return
SO	14	016	0E	shift out
SI	15	017	0F	shift in
DLE	16	020	10	data link escape
DC1	17	021	11	device control 1
DC2	18	022	12	device control 2
DC3	19	023	13	device control 3
DC4	20	024	14	device control 4
NAK	21	025	15	negative ack
SYN	22	026	16	synch idle
ETB	23	027	17	end of trans blk
CAN	24	030	18	cancel
EM	25	031	19	end of medium
SS	26	032	1A	special sequence
ESC	27	033	1B	escape
FS	28	034	1C	file separator
GS	29	035	1D	group separator
RS	30	036	1E	record separator
US	31	037	1F	unit separator

Character	Dec	Oct	Hex	Description
	32	040	20	space
!	33	041	21	exclamation
"	34	042	22	quotation mark
#	35	043	23	number sign
$	36	044	24	dollar sign
%	37	045	25	percent sign
&	38	046	26	ampersand
'	39	047	27	apostrophe
(	40	050	28	opening paren
)	41	051	29	closing paren
*	42	052	2A	asterisk
+	43	053	2B	plus
,	44	054	2C	comma
-	45	055	2D	minus
.	46	056	2E	period
/	47	057	2F	slash
0	48	060	30	zero
1	49	061	31	one
2	50	062	32	two
3	51	063	33	three
4	52	064	34	four
5	53	065	35	five
6	54	066	36	six
7	55	067	37	seven
8	56	070	38	eight
9	57	071	39	nine
:	58	072	3A	colon
;	59	073	3B	semicolon
<	60	074	3C	less than
=	61	075	3D	equal
>	62	076	3E	greater than
?	63	077	3F	question mark

Character	Dec	Oct	Hex	Description
@	64	100	40	commercial at
A	65	101	41	upper case letter
B	66	102	42	upper case letter
C	67	103	43	upper case letter
D	68	104	44	upper case letter
E	69	105	45	upper case letter
F	70	106	46	upper case letter
G	71	107	47	upper case letter
H	72	110	48	upper case letter
I	73	111	49	upper case letter
J	74	112	4A	upper case letter
K	75	113	4B	upper case letter
L	76	114	4C	upper case letter
M	77	115	4D	upper case letter
N	78	116	4E	upper case letter
O	79	117	4F	upper case letter
P	80	120	50	upper case letter
Q	81	121	51	upper case letter
R	82	122	52	upper case letter
S	83	123	53	upper case letter
T	84	124	54	upper case letter
U	85	125	55	upper case letter
V	86	126	56	upper case letter
W	87	127	57	upper case letter
X	88	130	58	upper case letter
Y	89	131	59	upper case letter
Z	90	132	5A	upper case letter
[	91	133	5B	opening bracket
\	92	134	5C	back slash
]	93	135	5D	closing bracket
^	94	136	5E	circumflex
_	95	137	5F	underscore
`	96	140	60	grave accent
a	97	141	61	lower case letter
b	98	142	62	lower case letter
c	99	143	63	lower case letter
d	100	144	64	lower case letter
e	101	145	65	lower case letter
f	102	146	66	lower case letter
g	103	147	67	lower case letter
h	104	140	68	lower case letter
i	105	151	69	lower case letter
j	106	152	6A	lower case letter
k	107	153	6B	lower case letter
l	108	154	6C	lower case letter
m	109	155	6D	lower case letter
n	110	156	6E	lower case letter
o	111	157	6F	lower case letter
p	112	160	70	lower case letter
q	113	161	71	lower case letter
r	114	162	72	lower case letter
s	115	163	73	lower case letter
t	116	164	74	lower case letter
u	117	165	75	lower case letter
v	118	166	76	lower case letter
w	119	167	77	lower case letter
x	120	170	78	lower case letter
y	121	171	79	lower case letter
z	122	172	7A	lower case letter
{	123	173	7B	opening brace
|	124	174	7C	vertical bar
}	125	175	7D	closing brace

Character	Dec	Oct	Hex	
~	126	176	7E	tilde
	127	177	7F	delete
□	128	200	80	
□	129	201	81	
‚	130	202	82	
ƒ	131	203	83	
„	132	204	84	
…	133	205	85	
†	134	206	86	
‡	135	207	87	
ˆ	136	210	88	
‰	137	211	89	
Š	138	212	8A	
‹	139	213	8B	
Œ	140	214	8C	
□	141	215	8D	
□	142	216	8E	
□	143	217	8F	
□	144	220	90	
‘	145	221	91	
’	146	222	92	
“	147	223	93	
”	148	224	94	
•	149	225	95	
–	150	226	96	
—	151	227	97	
˜	152	230	98	
™	153	231	99	
š	154	232	9A	
›	155	233	9B	
œ	156	234	9C	
□	157	235	9D	
□	158	236	9E	
Ÿ	159	237	9F	
	160	240	A0	
¡	161	241	A1	
¢	162	242	A2	
£	163	243	A3	
¤	164	244	A4	
¥	165	245	A5	
¦	166	246	A6	
§	167	247	A7	
¨	168	250	A8	
©	169	251	A9	
ª	170	252	AA	
«	171	253	AB	
¬	172	254	AC	
-	173	255	AD	
®	174	256	AE	
¯	175	257	AF	
°	176	260	B0	
±	177	261	B1	
²	178	262	B2	
³	179	263	B3	
´	180	264	B4	
µ	181	265	B5	
¶	182	266	B6	
·	183	267	B7	
¸	184	270	B8	
¹	185	271	B9	
º	186	272	BA	
»	187	273	BB	

Character	Dec	Oct	Hex
¼	188	274	BC
½	189	275	BD
¾	190	276	BE
¿	191	277	BF
À	192	300	C0
Á	193	301	C1
Â	194	302	C2
Ã	195	303	C3
Ä	196	304	C4
Å	197	305	C5
Æ	198	306	C6
Ç	199	307	C7
È	200	310	C8
É	201	311	C9
Ê	202	312	CA
Ë	203	313	CB
Ì	204	314	CC
Í	205	315	CD
Î	206	316	CE
Ï	207	317	CF
Ð	208	320	D0
Ñ	209	321	D1
Ò	210	322	D2
Ó	211	323	D3
Ô	212	324	D4
Õ	213	325	D5
Ö	214	326	D6
×	215	327	D7
Ø	216	330	D8
Ù	217	331	D9
Ú	218	332	DA
Û	219	333	DB
Ü	220	334	DC
Ý	221	335	DD

Character	Dec	Oct	Hex
Þ	222	336	DE
ß	223	337	DF
à	224	340	E0
á	225	341	E1
â	226	342	E2
ã	227	343	E3
ä	228	344	E4
å	229	345	E5
æ	230	346	E6
ç	231	347	E7
è	232	350	E8
é	233	351	E9
ê	234	352	EA
ë	235	353	EB
ì	236	354	EC
í	237	355	ED
î	238	356	EE
ï	239	357	EF
ð	240	360	F0
ñ	241	361	F1
ò	242	362	F2
ó	243	363	F3
ô	244	364	F4
õ	245	365	F5
ö	246	366	F6
÷	247	367	F7
ø	248	370	F8
ù	249	371	F9
ú	250	372	FA
û	251	373	FB
ü	252	374	FC
ý	253	375	FD
þ	254	376	FE
ÿ	255	377	FF

Appendix C

Bibliography

FORTRAN 90/95

These books and manuals are useful references for the Fortran 90/95 programming language and the floating point math format used by Absoft Pro Fortran on Linux.

Michael Metcalf and John Reid, *FORTRAN 90/95 explained*, Oxford University Press (1996)

Walter S. Brainerd, Charles H. Goldberg, and Jeanne C. Adams, *Programmer's Guide to Fortran90*, Unicomp, Inc (1994)

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These books and manuals are useful references for the FORTRAN language and the floating point math format used by Absoft Pro Fortran on Linux.

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James S. Coan, *Basic FORTRAN*, Hayden Book Company (1980)

American National Standard Programming Language FORTRAN, X3.9-1978, ANSI, 1430 Broadway, New York, N.Y. 10018

COMPUTER, *A Proposed Standard for Binary Floating-Point Arithmetic*, Draft 8.0 of IEEE Task P754, 10662 Los Vaqueros Circle, Los Alamitos, CA 90720 (1981)

M. Abramowitz and I.E. Stegun, *Handbook of Mathematical Functions*, U.S. Department of Commerce, National Bureau of Standards (1972)

Appendix D

AWE RGB Colors

AWE plots use RGB colors extensively. Although default values are always supplied, you can replace them with any RGB value you want. This appendix lists a number of predefined values supplied in the `AWE_Interfaces` module that are available to you by simply using their symbolic names.

```
INTEGER, PARAMETER :: AWE_maroon = z'800000'
INTEGER, PARAMETER :: AWE_dark_red = z'8B0000'
INTEGER, PARAMETER :: AWE_brown = z'A52A2A'
INTEGER, PARAMETER :: AWE_firebrick = z'B22222'
INTEGER, PARAMETER :: AWE_crimson = z'DC143C'
INTEGER, PARAMETER :: AWE_red = z'FF0000'
INTEGER, PARAMETER :: AWE_tomato = z'FF6347'
INTEGER, PARAMETER :: AWE_coral = z'FF7F50'
INTEGER, PARAMETER :: AWE_indian_red = z'CD5C5C'
INTEGER, PARAMETER :: AWE_light_coral = z'F08080'
INTEGER, PARAMETER :: AWE_dark_salmon = z'E9967A'
INTEGER, PARAMETER :: AWE_salmon = z'FA8072'
INTEGER, PARAMETER :: AWE_light_salmon = z'FFA07A'
INTEGER, PARAMETER :: AWE_orange_red = z'FF4500'
INTEGER, PARAMETER :: AWE_dark_orange = z'FF8C00'
INTEGER, PARAMETER :: AWE_orange = z'FFA500'
INTEGER, PARAMETER :: AWE_gold = z'FFD700'
INTEGER, PARAMETER :: AWE_dark_golden_rod = z'B8860B'
INTEGER, PARAMETER :: AWE_golden_rod = z'DAA520'
INTEGER, PARAMETER :: AWE_pale_golden_rod = z'EEE8AA'
INTEGER, PARAMETER :: AWE_dark_khaki = z'BDB76B'
INTEGER, PARAMETER :: AWE_khaki = z'F0E68C'
INTEGER, PARAMETER :: AWE_olive = z'808000'
INTEGER, PARAMETER :: AWE_yellow = z'FFFF00'
INTEGER, PARAMETER :: AWE_yellow_green = z'9ACD32'
INTEGER, PARAMETER :: AWE_dark_olive_green = z'556B2F'
INTEGER, PARAMETER :: AWE_olive_drab = z'6B8E23'
INTEGER, PARAMETER :: AWE_lawn_green = z'7CFC00'
INTEGER, PARAMETER :: AWE_chartreuse = z'7FFF00'
INTEGER, PARAMETER :: AWE_green_yellow = z'ADFF2F'
INTEGER, PARAMETER :: AWE_dark_green = z'006400'
INTEGER, PARAMETER :: AWE_green = z'008000'
INTEGER, PARAMETER :: AWE_forest_green = z'228B22'
INTEGER, PARAMETER :: AWE_lime = z'00FF00'
INTEGER, PARAMETER :: AWE_lime_green = z'32CD32'
INTEGER, PARAMETER :: AWE_light_green = z'90EE90'
INTEGER, PARAMETER :: AWE_pale_green = z'98FB98'
INTEGER, PARAMETER :: AWE_dark_sea_green = z'8FBC8F'
INTEGER, PARAMETER :: AWE_medium_spring_green = z'00FA9A'
INTEGER, PARAMETER :: AWE_spring_green = z'00FF7F'
INTEGER, PARAMETER :: AWE_sea_green = z'2E8B57'
INTEGER, PARAMETER :: AWE_medium_aqua_marine = z'66CDAA'
INTEGER, PARAMETER :: AWE_medium_sea_green = z'3CB371'
INTEGER, PARAMETER :: AWE_light_sea_green = z'20B2AA'
INTEGER, PARAMETER :: AWE_dark_slate_gray = z'2F4F4F'
INTEGER, PARAMETER :: AWE_teal = z'008080'
```

```
INTEGER, PARAMETER :: AWE_dark_cyan = z'008B8B'
INTEGER, PARAMETER :: AWE_aqua = z'00FFFF'
INTEGER, PARAMETER :: AWE_cyan = z'00FFFF'
INTEGER, PARAMETER :: AWE_light_cyan = z'E0FFFF'
INTEGER, PARAMETER :: AWE_dark_turquoise = z'00CED1'
INTEGER, PARAMETER :: AWE_turquoise = z'FF40E0D0'
INTEGER, PARAMETER :: AWE_medium_turquoise = z'48D1CC'
INTEGER, PARAMETER :: AWE_pale_turquoise = z'AFEEEE'
INTEGER, PARAMETER :: AWE_aqua_marine = z'7FFFD4'
INTEGER, PARAMETER :: AWE_powder_blue = z'B0E0E6'
INTEGER, PARAMETER :: AWE_cadet_blue = z'5F9EA0'
INTEGER, PARAMETER :: AWE_steel_blue = z'4682B4'
INTEGER, PARAMETER :: AWE_corn_flower_blue = z'6495ED'
INTEGER, PARAMETER :: AWE_deep_sky_blue = z'00BFFF'
INTEGER, PARAMETER :: AWE_dodger_blue = z'1E90FF'
INTEGER, PARAMETER :: AWE_light_blue = z'ADD8E6'
INTEGER, PARAMETER :: AWE_sky_blue = z'87CEEB'
INTEGER, PARAMETER :: AWE_light_sky_blue = z'87CEFA'
INTEGER, PARAMETER :: AWE_midnight_blue = z'191970'
INTEGER, PARAMETER :: AWE_navy = z'000080'
INTEGER, PARAMETER :: AWE_dark_blue = z'00008B'
INTEGER, PARAMETER :: AWE_medium_blue = z'0000CD'
INTEGER, PARAMETER :: AWE_blue = z'0000FF'
INTEGER, PARAMETER :: AWE_royal_blue = z'4169E1'
INTEGER, PARAMETER :: AWE_blue_violet = z'8A2BE2'
INTEGER, PARAMETER :: AWE_indigo = z'4B0082'
INTEGER, PARAMETER :: AWE_dark_slate_blue = z'483D8B'
INTEGER, PARAMETER :: AWE_slate_blue = z'6A5ACD'
INTEGER, PARAMETER :: AWE_medium_slate_blue = z'7B68EE'
INTEGER, PARAMETER :: AWE_medium_purple = z'9370DB'
INTEGER, PARAMETER :: AWE_dark_magenta = z'8B008B'
INTEGER, PARAMETER :: AWE_dark_violet = z'9400D3'
INTEGER, PARAMETER :: AWE_dark_orchid = z'9932CC'
INTEGER, PARAMETER :: AWE_medium_orchid = z'BA55D3'
INTEGER, PARAMETER :: AWE_purple = z'800080'
INTEGER, PARAMETER :: AWE_thistle = z'D8BFD8'
INTEGER, PARAMETER :: AWE_plum = z'DDA0DD'
INTEGER, PARAMETER :: AWE_violet = z'EE82EE'
INTEGER, PARAMETER :: AWE_magenta = z'FF00FF'
INTEGER, PARAMETER :: AWE_orchid = z'DA70D6'
INTEGER, PARAMETER :: AWE_medium_violet_red = z'C71585'
INTEGER, PARAMETER :: AWE_pale_violet_red = z'DB7093'
INTEGER, PARAMETER :: AWE_deep_pink = z'FF1493'
INTEGER, PARAMETER :: AWE_hot_pink = z'FF69B4'
INTEGER, PARAMETER :: AWE_light_pink = z'FFB6C1'
INTEGER, PARAMETER :: AWE_pink = z'FFC0CB'
INTEGER, PARAMETER :: AWE_antique_white = z'FAEBD7'
INTEGER, PARAMETER :: AWE_beige = z'F5F5DC'
INTEGER, PARAMETER :: AWE_bisque = z'FFE4C4'
INTEGER, PARAMETER :: AWE_blanched_almond = z'FFEBCD'
INTEGER, PARAMETER :: AWE_wheat = z'F5DEB3'
INTEGER, PARAMETER :: AWE_corn_silk = z'FFF8DC'
INTEGER, PARAMETER :: AWE_lemon_chiffon = z'FFFACD'
INTEGER, PARAMETER :: AWE_light_golden_rod_yellow = z'FAFAD2'
INTEGER, PARAMETER :: AWE_light_yellow = z'FFFFE0'
INTEGER, PARAMETER :: AWE_saddle_brown = z'8B4513'
INTEGER, PARAMETER :: AWE_sienna = z'A0522D'
INTEGER, PARAMETER :: AWE_chocolate = z'D2691E'
INTEGER, PARAMETER :: AWE_peru = z'CD853F'
INTEGER, PARAMETER :: AWE_sandy_brown = z'F4A460'
INTEGER, PARAMETER :: AWE_burly_wood = z'DEB887'
```

```
INTEGER, PARAMETER :: AWE_tan = z'D2B48C'
INTEGER, PARAMETER :: AWE_rosy_brown = z'BC8F8F'
INTEGER, PARAMETER :: AWE_moccasin = z'FFE4B5'
INTEGER, PARAMETER :: AWE_navajo_white = z'FFDEAD'
INTEGER, PARAMETER :: AWE_peach_puff = z'FFDAB9'
INTEGER, PARAMETER :: AWE_misty_rose = z'FFE4E1'
INTEGER, PARAMETER :: AWE_lavender_blush = z'FFF0F5'
INTEGER, PARAMETER :: AWE_linen = z'FAF0E6'
INTEGER, PARAMETER :: AWE_old_lace = z'FDF5E6'
INTEGER, PARAMETER :: AWE_papaya_whip = z'FFEFD5'
INTEGER, PARAMETER :: AWE_sea_shell = z'FFF5EE'
INTEGER, PARAMETER :: AWE_mint_cream = z'F5FFFA'
INTEGER, PARAMETER :: AWE_slate_gray = z'708090'
INTEGER, PARAMETER :: AWE_light_slate_gray = z'778899'
INTEGER, PARAMETER :: AWE_light_steel_blue = z'B0C4DE'
INTEGER, PARAMETER :: AWE_lavender = z'E6E6FA'
INTEGER, PARAMETER :: AWE_floral_white = z'FFFAF0'
INTEGER, PARAMETER :: AWE_alice_blue = z'F0F8FF'
INTEGER, PARAMETER :: AWE_ghost_white = z'F8F8FF'
INTEGER, PARAMETER :: AWE_honeydew = z'F0FFF0'
INTEGER, PARAMETER :: AWE_ivory = z'FFFFF0'
INTEGER, PARAMETER :: AWE_azure = z'F0FFFF'
INTEGER, PARAMETER :: AWE_snow = z'FFFAFA'
INTEGER, PARAMETER :: AWE_black = z'000000'
INTEGER, PARAMETER :: AWE_dim_gray = z'696969'
INTEGER, PARAMETER :: AWE_gray = z'808080'
INTEGER, PARAMETER :: AWE_dark_gray = z'A9A9A9'
INTEGER, PARAMETER :: AWE_silver = z'C0C0C0'
INTEGER, PARAMETER :: AWE_light_gray = z'D3D3D3'
INTEGER, PARAMETER :: AWE_gainsboro = z'DCDCDC'
INTEGER, PARAMETER :: AWE_white_smoke = z'F5F5F5'
INTEGER, PARAMETER :: AWE_white = z'FFFFFF'
```

Appendix E

speed_math option

The **-speed_math=*n*** option enables aggressive math optimizations that may improve performance at the expense of accuracy. Valid arguments for ***n*** are 0-11. The following table describes the effect of each level:

n	effect
0	enable wrap around optimization
1	allow relational operator folding; may cause signed integer overflow
2	enable partial redundancy elimination for loads and stores
3	enable memory optimization for functions without aliased arrays
4	inline NINT and related intrinsics with limited-domain algorithm use fast_powf in libm instead of powf
5	use multiplication and square root for exp() where faster
6	allow optimizations that reassociate floating point operators
7	*see notes below*
8	allow use of reciprocal instruction; convert a/b to a*(1/b)
9	use fast algorithms with limited domains for complex norm and divide use x*rsqrt(x) for sqrt(x) on machines where faster dead casgn function elimination
10	use AMD ACML library if applicable
11	allow relational operator folding; may cause unsigned integer overflow use IEEE rounding instead of Fortran rounding for NINT intrinsics use IEEE rounding instead of Fortran rounding for ANINT intrinsics

NOTES:

A. Departure from strict rounding is applied at 3 levels: level 1 is applied at ***n=5***, level 2 is applied at ***n=7***, and level 3 is applied at ***n=10***.
B. Conformance to IEEE-754 arithmetic rules is relaxed at 2 levels: level 1 is applied at ***n=6***, level 2 is applied at ***n=10***
C. At ***n=10***, the loop unrolling constraints are modified: loop size is increased to 7000, limit is increased to 9, minimum iteration is decreased to 200.

Appendix F

Technical Support

The Absoft Technical Support Group will provide technical assistance to all registered users of current products. They will *not* answer general questions about operating systems, operating system interfaces, graphical user interfaces, or teach programming. For further help on these subjects, please consult this manual and any of the books and manuals listed in the bibliography.

Before contacting Technical Support, please study this manual and the language reference manuals to be sure your problem is not covered here. Specifically, refer to the chapter **Using the Compilers** in this manual. To help Technical Support provide a quick and accurate solution to your problem, please include the following information in any correspondence or have it available when calling.

Product Information:

Name of product, version number, and serial number
Version number of the operating system

System Configuration:

Hardware configuration (processor, memory, etc.)
System software release (i.e. 4.0, 3.5, etc)
Any software or hardware modifications to your system

Problem Description:

What happens?
When does it occur?
Provide a small (20 line) step-by-step example if possible.

Contacting Technical Support:

Address: Absoft Corporation
Attn: Technical Support
2111 Cass Lake Road, Suite 102
Keego Harbor, MI 48320

telephone:	(248) 220-1191	9am - 3pm EST
FAX	(248) 220-1194	24 Hours
email	support@absoft.com	24 Hours
World Wide Web	http://www.absoft.com	

Index