Tutorial:

Learning to Debug with edge

FORTRAN Edition

SiliconGraphics
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Learning to Debug with *edge*

FORTRAN Edition

Version 2.0

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Contents

To the Reader

This tutorial is designed for FORTRAN programmers with little or no experience using the Silicon Graphics, Inc. graphical debugger, *edge*. After only one or two hours with this tutorial you will be able to use *edge* to debug your programs more quickly and efficiently. You will learn:

- how to prepare a program for debugging under *edge*
- how to use the *edge* interface
- how to use both basic and advanced debugging commands to debug sample programs
- general rules to help you debug your own programs

To use this tutorial you need to have a very basic understanding of UNIX and the *vi* text editor. Read *Getting Started with the IRIS-4D Series Workstation* if you need to learn or review this information.

1. What is edge?

edge is a window-based, graphical interface to *dbx*, a standard UNIX debugger. You can use *dbx* to find bugs in your executable files, and if those executable files are compiled using the *-g* compiler option, *dbx* can relate the executable code to the source code. Specifically, *dbx* lets you:

- stop your program at specified points to check current values
- trace variables as they change throughout your program
- step through functions one line at a time

The *edge* interface to *dbx* consists of three independent windows: the Command Window, the Source Window, and the User Window. You can use the Command Window to issue *dbx* commands manually; you can use the Source Window to view the source code as it executes; and you can use the User Window to monitor the program input/output (standard in and standard out) and error messages (standard error).

Because *edge* runs under the Silicon Graphics, Inc. window manager, *4Sight*, it is not always necessary to type in *dbx* commands. The most common *dbx* commands are mapped to menus in the Command Window and the Source Window. The window manager also allows you to select command input (e.g., program variables) via the mouse.

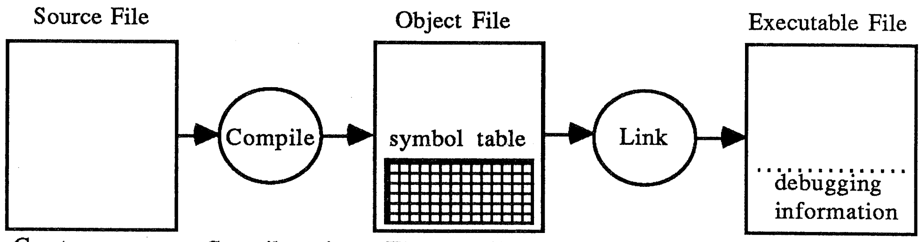
Another advantage of running *edge* under the *4Sight* window manager is that you can use *edge* to debug graphics programs that also run under the *4Sight* window manager. See Chapter 3 for more information about using *edge* with graphics programs.

Preparing a Program for Use under edge

You do not need to make any changes to your source code to run the code under *edge*. However, to take advantage of all the *edge* and *dbx* features, you should compile the program using the *-g* compiler option.

The *-g* compiler option ensures that the final executable file contains an expanded symbol table. Using this table, *edge* and *dbx* can relate lines of machine code to lines of source code and display that source code as it executes in the source window.

In addition, when preparing an executable for use under *edge*, you should not optimize the code. Optimized code can be submitted to *edge*, however, because optimization rearranges the machine code, following the execution of such a program can be very difficult.



Create your source code as usual.

Compile using the debugging flag (-g).

The compiler creates an expanded symbol table in your object file.

Your file is linked with the debugging flag.

Your executable file contains the information that the debugger needs.

Using Makefile to Set Up the edge Tutorial

You will be working on a sample program called *sort.f.* During this session you use six basic *edge* commands to eliminate two bugs. Your IRIS should be booted and displaying the `IRIS login:` prompt. Log in as *tutor*, and change directories so that your current working directory is */usr/tutor/edge/fortran/src*. Type:

```
cd  /usr/tutor/edge/fortran/src
```

To set up the *edge* tutorial environment, type:

```
make
```

When the system prompt appears again, list the contents of this directory. Type:

```
ls
```

You see six file names: *Makefile, names.in, scrub, sort.f, sort.h,* and *sort.m.* The program *sort.f* reads the input file *names.in*, sorts it, and puts the results into an output file. To briefly look over *sort.f*, type:

```
more  sort.f
```

Press <spacebar> to look at the next screenful; press <delete> to stop viewing the program and return to the system prompt.

Note: If you find any bugs, do not try to fix them!

When you feel comfortable with the structure of *sort.f*, return to the system prompt.

The *Makefile* in this directory helps you do the tutorial at your own pace, and lets you easily restore the directory so someone else can start fresh with the tutorial.

If you need to stop before you complete the tutorial, you can save your work and pick up where you left off later. To save your bug fixes, type:

```
make  save
```

When you want to resume the tutorial, return to the */usr/tutor/edge/fortran/src* directory and type:

```
make  restore
```

Finally, when you complete the tutorial, restore the directory so someone else can do the tutorial. Type:

```
make  done
```

Now you are ready to tackle the first bug.

Bug #1

1. Compile and link *sort.f* using the *edge* flag, and name your executable file *sort.*

   ```
   f77  -g  sort.f  -o  sort
   ```

2. Run your program using the input file *names.in*, and put the sorted results into a new output file called *names.out.*

   ```
   sort  names.in  -o  names.out
   ```

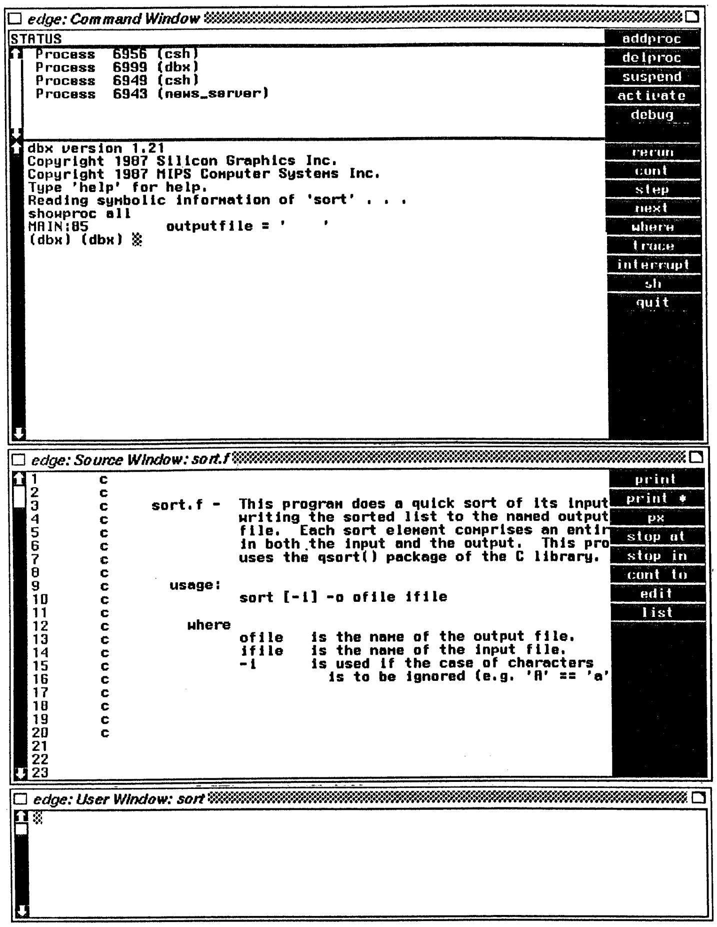
3. You see this message:

   ```
   sort: cant open input file named
   ```

   sort couldn't open *names.in*, and also couldn't report its name. You want to use *edge* to find the problem, so go into the *edge* environment.

   ```
   edge  sort
   ```

4. You see the three *edge* windows. They are described on the next page.



```
Process  6956 (csh)
Process  6999 (dbx)
Process  6949 (csh)
Process  6943 (news_server)
```

```
dbx version 1.21
Copyright 1987 Silicon Graphics Inc.
Copyright 1987 MIPS Computer Systems Inc.
Type 'help' for help.
Reading symbolic information of 'sort' . . .
showproc all
MAIN:85         outputfile = '    '
(dbx) (dbx)
```

```
c
c
c      sort.f -  This program does a quick sort of its input
c                writing the sorted list to the named output
c                file.  Each sort element comprises an entir
c                in both the input and the output.  This pro
c                uses the qsort() package of the C library.
c
c        usage:
c                sort [-i] -o ofile ifile
c
c          where
c                ofile   is the name of the output file.
c                ifile   is the name of the input file.
c                -i      is used if the case of characters
c                          is to be ignored (e.g. 'A' == 'a'
c
c
c
c
c
```

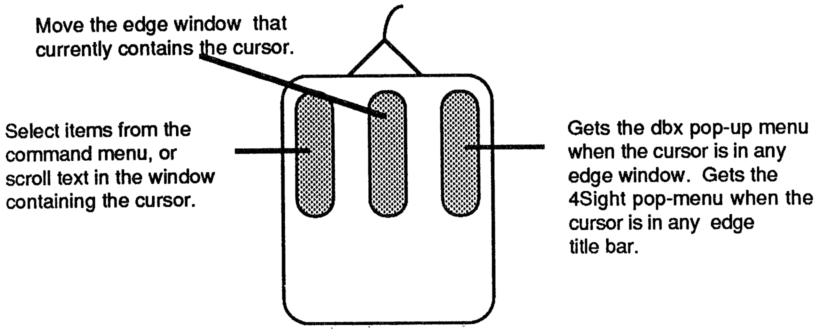
The top window, the Command Window, contains a command menu, a process list, and a *dbx* command processor. The top section of the Command Window, the process list, lists all the processes associated with your login. The lower section of the Command Window, the *dbx* command processor, receives typed commands to *edge*, and runs all of the standard *dbx* commands.

The middle window (the Source Window) lists the source code that you are currently debugging. You can scroll through the source code by placing your cursor over the "up" or "down" arrows of the scroll bar and clicking the left mouse button.

You can also scroll text by placing the cursor on the elevator block of the scroll bar, pressing and holding the left mouse button, and dragging the cursor up or down. The Source Window also continues the command menu started in the Command Window.

The bottom window (the User Window) displays the results you get when you run the program (standard in, standard out, and standard error).

To use the commands on a command menu, position the cursor over the menu item and press the left mouse button. If the command requires an object, you must highlight that object before you select the command. To highlight an object (e.g., a variable in the source code or a process listed in the top of the Command Window), position the cursor over the start of object, press and hold the left mouse button, drag the cursor to the end of the object, and release the left mouse button.


Move the edge window that currently contains the cursor.
Select items from the command menu, or scroll text in the window containing the cursor.
Gets the dbx pop-up menu when the cursor is in any edge window. Gets the 4Sight pop-menu when the cursor is in any edge title bar.

5. Look for the section of code where the input file is assigned. Scroll to line 122.

6. Set a breakpoint at line 122 to make the program stop and display this line when it reaches it. To set a breakpoint at a line of code, highlight the line of code, then select 'stop at' from the command menu.

7. Now run *sort* in *edge*. Type:

```
run  names.in  -o  names.out
```

In the Command Window you see this message:

```
Process 7995 (sort) started
[2] Process  7995 (sort) stopped at [MAIN:122 ,0x4003bc]
        inputfile = curarg
```

Whenever a line of code that causes a program fault contains a variable, you should check its value.

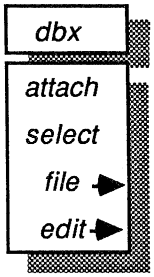
8. Check the value of *curarg* (current argument). Use the *print* command.

   To use print, first highlight the variable that you want to print, then select 'print' from the command menu. Highlight *curarg* by positioning your cursor at the beginning of the word, pressing and holding the left mouse button, then dragging the cursor over the rest of the word. When the entire word is highlighted, release the left button. Now use the left button to select 'print' from the command menu.

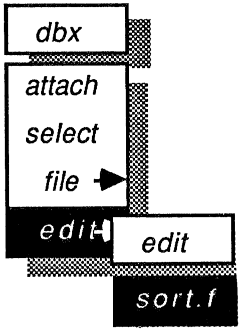
   The value of *curarg* is '''', a null string. Although it is possible that *curarg* is supposed to be empty, it is also possible that is was never initialized. Therefore, you should check to see whether it was initialized.

9. Scroll back to where *curarg* should have been initialized, between lines 89 and 92. As you can see, *curarg* has not been initialized.

10. Edit the source file. To edit your file, position your cursor in any *edge* window, and press and hold the right mouse button. You see the following menu:



Move down the menu so that 'edit' is highlighted, then carefully slide your cursor to the right. You see a sub-menu that contains only one choice — 'sort.f'. Make sure it is highlighted (your cursor should be on top of it), then release the mouse button.



You see a red outline, and the shape of your cursor has changed. Move the cursor down to the lower left-hand corner of your screen, and press and release the right mouse button. You have just created a new UNIX shell that is running the *vi* text editor on your source file, *sort.f.* (When your program consists of several source files, the 'edit' sub-menu contains all of them so you can access them easily.)

11. Tell *vi* to display line numbers. Move the cursor to *vi* window and type:

```
:set number
```

This step is very important for maintaining the integrity of this tutorial. You must add temporary line numbers to your file so that you can edit it exactly as this tutorial does. This way, the references to line numbers throughout the tutorial will remain accurate.

12. Edit the code so that lines 87-95 look like this:

```
87              argc = iargc()
88
89              do 100 i=1, argc
90
91   c          get the current argument
92              call getarg(i, curarg)
93
94
95   c          is it a switch?
```

13. Save your edits and exit from *vi* as usual. Type:

```
:wq
```

14. When you exit *vi*, the new shell disappears.

15. Exit from *edge* by selecting 'quit' from the command menu.

You have successfully eliminated the first bug.

Bug #2

1. Recompile your program using the *edge* flag, then run it.

```
f77  -g  sort.f  -o  sort
sort  -o  names.out  names.in
```

2. You see this message:

```
sorting . . .
7 records sorted from input file names.in
     onto output file -o
```

It seems that the file was sorted, but the output file was named *-o* rather than *names.out*. Go into the *edge* environment.

```
edge  sort
```

3. It's likely that there is a problem where the output file is assigned. Look for this code in the Source Window by scrolling through the text using the middle mouse button.

4. Set a breakpoint at the line in which the name of the output file is assigned. Highlight the line of code (line 112) using the left mouse button, then select 'stop' from the command menu.

5. Use the *run* command to run *sort* in *edge.*

```
run  -o  names.out  names.in
```

6. You see that line 112 contains the variable *curarg*. Check *curarg*'s value by highlighting it using the left mouse button, then selecting 'print' from the command menu.

   The value is *-o*. This is the argument that appears on the command line one position before the desired output file, *names.out*. This means that the dummy counter *i* has not been incremented properly. If you scroll through this loop of code, see that you need to increment *i* past the *-o* switch.

7. Edit *sort.f* by placing the cursor in any *edge* window, pressing the right mouse button, and selecting 'sort.f' from the rollover menu that is beneath the 'edit' choice.

8. Tell *vi* to display line numbers.

   ```
   :set number
   ```

9. Change your code so that lines 106-112 look like this:

   ```
   106              elseif (curarg(2:2) .eq. 'o') then
   107  c             the output file name follows
   108
   109  c    increment past the switch
   110       call bump(i)
   111
   112  c    get the output file name
   ```

10. Save your changes and exit from *vi*:

    ```
    :wq
    ```

11. Exit from *edge* by selecting 'quit' from the command menu.

12. Recompile *sort.f*, and run it outside of the *edge* environment. Move the cursor to the console window and type:

    ```
    f77  -g  sort.f  -o  sort
    sort  -o  names.out  names.in
    ```

You have successfully debugged your program. Remember, if you want to take a break at this point, you can save your work on the code by typing:

```
make  save
```

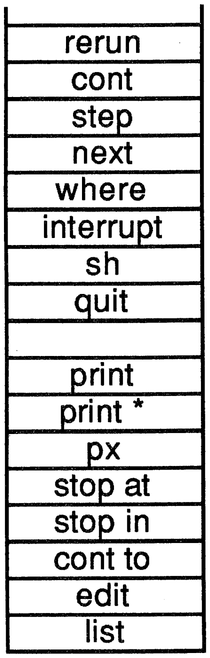
Summary of Basic Commands

To give commands to *edge* you can type them at the prompt in the Command Window, select them from the command menu, or select them from the *edge* pop-up menu.

You learned two commands that you type. Square brackets ([]) surrounding an argument mean the argument is optional; angle brackets (<>) surrounding an argument mean it is mandatory.

- **edge** <*executable filename*>: Go into the *edge* environment.
- **run** [*arguments*]: Run the executable file with which you are currently working.

You learned three commands that you select from the command menu.

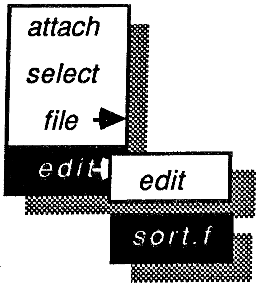


Exit from edge.

Display the value of the highlighted variable.

Set breakpoint at highlighted line.

You learned one command that you select from the pop-up menu.



Start up a UNIX shell that is running *vi* on this file.

You will use these commands extensively in the next chapter, along with several advanced commands, to help you track down more complex bugs.

2. More Elusive Bugs

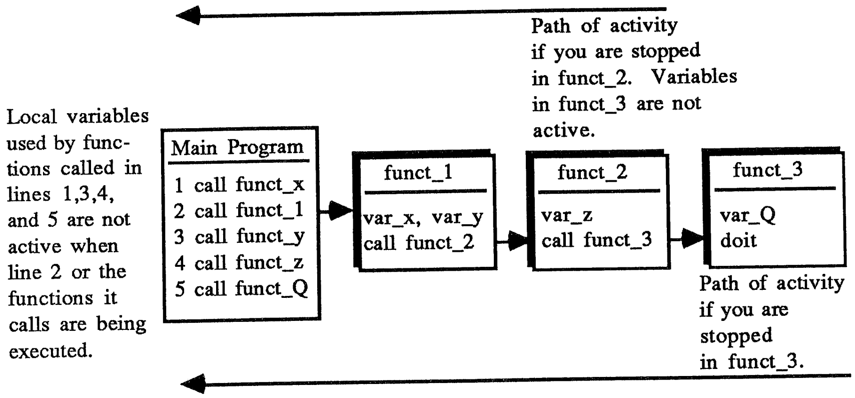
As you saw in Chapter 1, the basic commands are very useful and versatile. However, at times your programs will demand more sophisticated debugging tools. This chapter describes the advanced commands, and leads you through a more complex debugging situation.

Understanding Some Advanced Commands

You use 14 new commands in this chapter. As in Chapter 1, most of the commands are explained during the debugging session when you reach a point where you need to use them. However, some of the commands require more detailed explanations, so you will learn what they do now, and how to use them during the session.

The *trace* command lets you track the value of a variable as it changes. When you use *trace*, you must remember three important rules:

- You can trace only *active* variables. At any point during the execution of a program, the program has access to a certain set of variables; these variables are active at this point. Global variables are always active. Local variables are active only when their routine either is being executed, or is calling a routine that also has active variables. Such a series of routines calling other routines is called a *path of activity*. When you set a breakpoint using *edge*, the program stops at a certain point in its execution where there is a set path of activity. This path starts at the routine in which you have stopped, and extends back through the intermediate routines to the line of the main program from which it all originated. Any variable along this path is active, and therefore you can trace it. (See the figure on the following page.)


Path of activity if you are stopped in funct_2. Variables in funct_3 are not active.
Local variables used by functions called in lines 1,3,4, and 5 are not active when line 2 or the functions it calls are being executed.
Main Program
1 call funct_x
2 call funct_1
3 call funct_y
4 call funct_z
5 call funct_Q
funct_1
var_x, var_y
call funct_2
funct_2
var_z
call funct_3
funct_3
var_Q
doit
Path of activity if you are stopped in funct_3.

- The syntax you use to give the *trace* command depends on your location within the path of activity. If you are stopped in the routine *rout_3* and want to trace the variable *var_x* which is in *rout_1*, you must type `trace rout_1.var_x`. If you are already in *rout_1*, just type `trace var_x`.
- Always set a trace in the first executable line of code after the line that assigns the new value to the variable. This is necessary because *edge* displays the value of the variable before it executes the line at which you set the trace.

The *step* and *next* commands let you execute and view each line individually, effectively letting you step through your whole program.

step lets you go through your program in its logical order, one line at a time. When you get to a line that calls a routine, the next line you will see is the first line of that routine. When the routine ends, you return to the line of code that called it.

next also lets you go through your program line by line, but it treats each line, even a line that calls a routine, as a single event. So, when you reach a line that calls a routine, the program executes it, but you don't step through the routine code and watch it happen. Rather, you see the next line of code in the current routine and you can check the values that the other routine returns.

Both *step* and *next* display the line of code before it is executed. To check the value of a variable that is in the current line, execute *step* or *next* one more time, and then *print* the variable.

Using the Advanced Commands

If you used the *make save* command to take a break from the tutorial, you can now pick up where you left off. You need to restore the files that you edited earlier, and then recompile *sort*. Return to the */usr/tutor/edge/fortran/src* directory and type:

```
make  restore
f77  -g  sort.f  -o  sort
```

Bug #3

1. Up to this point you have been working in the *src* directory. Since *sort* is working, make a copy of *sort*, place this copy in the *fortran* directory, and try it out there. Copy *sort* into *fortran*, and change directories so that *fortran* is your current directory.

   ```
   cp  sort  ..
   cd  ..
   ```

2. Sort the file *names.in*, and put the result into the file *names.out*. This time try using the *-i* flag so *sort* will ignore letter case.

   ```
   sort  -i  names.in  -o  names.out
   ```

   You see this message:

   ```
   sort:  cant open input file named
   ```

3. It seems that using *-i* caused a problem, so go into the *edge* environment.

   ```
   edge  sort
   ```

   You notice that the Source Window did not appear. This is because *edge* can't find your source code. *edge* assumes that source code and libraries for your program are in the current working directory unless you tell it otherwise. *sort.f* is still in the directory *src* while you are now in *fortran.*

4. Tell *edge* which directories contain files that it needs to use.

   ```
   use  src
   ```

5. Now that you can see your source code, search for the error message that you saw when you ran *sort. edge* supports the *vi* string search commands slash (/) and question mark (?). / searches forward through your file; ? searches backwards. Search forward for the first occurrence of *cant open.*

   ```
   /cant  open
   ```

6. The error message receives a variable called *inputfile.* Use / to find the line of code in which *inputfile* is initialized.

   ```
   /inputfile
   /
   /
   ```

7. You find that *inputfile* is initialized in line 128. Set a breakpoint here by highlighting line 128, then selecting 'stop at' from the command menu.

8. Run the program in *edge* using the same flags as before.

   ```
   run  -i  names.in  -o  names.out
   ```

9. In the User Window you see this message:

```
sort:  cant open input file named
```

This shows you that something else is wrong. *sort* executed completely, but didn't stop at line 128. This means that it never looked at 128. Look for the loop of code that processes the command line arguments by using the middle mouse button to scroll through your source code.

You find that the variable *curarg* keeps track of the value of the current argument (either a flag or a file name). Trace *curarg* as it changes values. Be sure to set the trace at the first executable line after *curarg* is assigned a new value, since *trace* displays the value of a line before it executes the line. At the `(dbx)` prompt, type:

```
trace  curarg  at  96
```

10. Run the program again. When you have already run a program in *edge*, you can easily run it again with the same arguments by using the *rerun* command. Select 'rerun' from the command menu. The cursor changes shape so it now looks like the corner of a window. *edge* displays the tracing information in a special window that you create (sweep out).

11. To sweep out the Variable Display Window, position the cursor above all of the *edge* windows, press and hold the right mouse button to set the corner of the new window, drag the cursor diagonally to where you want the opposite corner to appear, then release the button.

    This is the Variable Display Window. You can scroll through this window just as you can scroll through the Source Window. In the Variable Display Window, you see this message:

    ```
    [2] curarg changed before [MAIN: line 5]:

            new value = "-i
    [2] curarg changed before [MAIN: line 96]:
            old value = "-i
            new value = "-o
    ```

    curarg received some values, but didn't receive the value of the input file name. Check out the dummy counter *i* which determines the value that *curarg* receives. Before you do this, find out which *edge* commands you have already set by using the *status* command.

    ```
    status
    ```

12. You see this list:

    ```
    [2]  stop at "sort.f": 128
    [3]  { ; trace curarg; }  at "sort.f" 96
    ```

    You should delete the *curarg* trace so it doesn't clutter the *i* trace. When you use the *delete* command, refer to the *edge* breakpoints and traces by using their status numbers.

    ```
    delete 3
    ```

13. Now trace the dummy counter *i*.

```
trace  i  at  96
```

14. Run the program by selecting 'rerun' from the command menu.

15. In the Variable Display Window, you see this message:

```
[3] sort.MAIN.i changed before [MAIN: line 96]:
        new value = 1;
[3] sort.MAIN.i changed before [MAIN: line 96]:
        old value = 1;
        new value = 3;
```

Notice that *i* skipped from 1 to 3. It seems that *i* is not being incremented properly. Since *sort* didn't work correctly when you used the *-i* flag, scroll to the code that passes the dummy counter through the *-i* case.

You see that *i* is incremented once at the beginning of the loop, and again at the end of the loop. Usually you increment a dummy counter in the *do* statement at the beginning of the loop. Edit *sort.f* by placing the cursor in any *edge* window, pressing the right mouse button, and selecting 'src/sort.f' from the rollover menu that is beneath the 'edit' choice.

16. Tell *vi* to add line numbers.

```
:set number
```

17. Delete only these three lines.

```
c       bump the counter
        call bump(i)

```

Your code should now look like this:

```
c       if (curarg(2:2) .eq. 'i') then
            ignorecase = 1

        elseif (curarg(2:2) .eq. 'o') then
c          the output name follows
```

18. Save your changes and exit from *vi.*

```
:wq
```

19. Exit from *edge* by selecting 'quit' from the command menu.

Bug #4

1. Return to the *src* directory and recompile and run your program.

```
cd  src
f77  -g  sort.f  -o  sort
sort  -i  names.in  -o  names.out
```

2. The program seems to be working. Just to be positive, take a look at the output file.

```
more  names.out
```

3. The comparison doesn't seem to work properly. *sort* is not ignoring the case of the records. Use *edge* to find the problem.

```
edge  sort
```

4. Look over the file *names.in* to make sure nothing has happened to it. To view the contents of a file other than the one you are debugging, use the *file* command.

```
file  names.in
```

5. It seems to be intact, so return your source file to the Source Window. To use *file* to view a source file in the Source Window, place the cursor in any *edge* window, press the right mouse button, and select the source file from the rollover menu that is beneath the 'file' choice. The 'file' choice lists all of the source files that are part of your program. In this case, select 'sort.f'.

6. The routine *bsort* actually does the sorting, so find this routine.

```
/bsort
/
```

7. You find that *bsort* uses the results of the routine *cmprec*. Find this routine.

```
/cmprec
/
/
/
/
```

8. Set a breakpoint in *cmprec* using the *stop in* command. When you use *stop in* with a routine, it sets a breakpoint at the first executable line of the routine.

```
stop  in  cmprec
```

9. Run the program in *edge*.

```
run  -i  names.in  -o  names.out
```

10. You see this message:

```
Process 8350 (sort) started
[2]Process 8350 (sort) stopped at [sort.cmprec:231 ,0x40080c]
       if(ignorecase .ne. 0) then
```

Go through *cmprec* one step at a time. Select ‘step’ from the command menu.

11. You see this message:

```
Process 8350 (sort) stopped at [sort.cmprec:235 ,0x400820]
        tempbuf0 = lower(rec(index0))
```

If you take another *step*, you will enter the subroutine *lower*. Rather than stepping through it, use *next* to skip the explicit tracing of *lower*. Select ‘next’ from the command menu.

12. Check to see if *tempbuf0* contains the right value, that is, the first record of the file *names.in*. Highlight *tempbuf0* then select 'print' from the command menu.

13. This doesn't look correct. Check the first element of the array *rec* to see what the record should have been. To do this you must be in the routine *lower*, so rerun *sort* and *step* through *cmprec* into *lower*. Select 'rerun' from the command menu, then select 'step' twice from the command menu.

14. Now check the value of *rec(index0)*. Normally you could highlight this variable then select 'print' from the command menu. However, *dbx* doesn't recognize parentheses, so you need to use square brackets instead. Type:

```
print rec[index0]
```

15. If you compare this to the contents of *tempbuf0*, it looks like lower is lowercasing only the first letter and putting it into the buffer. You see in the Source Window that the variable *c* moves each letter of a record from the buffer *bufinput* into the buffer *result*. *islower* checks the case of each letter, and *tolower* lowercases any upper case letters that *islower* finds. Trace *c*'s progress by checking its value at the end of the loop.

```
trace  c  at  279
```

16. Now check the contents of the buffer *bufinput* to see which record is about to be put into *tempbuf*. Highlight *bufinput* in line 266 and select 'print' from the command menu.

17. Tell *edge* to continue tracing by selecting 'cont' from the command menu.

18. Use the right mouse button to sweep out the Variable Display Window. The new value is an empty string. It seems that one of the subroutines is returning unprintable characters. Check out the routine *tolower*. Rather than search for the string *tolower*, you can use the *list* command. When you use *list* with a routine name, *edge* takes you to the beginning of the routine.

```
list  tolower
```

19. If *tolower* is not defined, then maybe it isn't a routine after all. Use the *whatis* command to get some information about it.

```
whatis  tolower
```

20. Once again, it is not defined. Make sure *whatis* works by using it on *lower.*

```
whatis  lower
```

21. *whatis* can give you information about any variable, type, or routine that is in your program. The only kind of structure it can't describe is a preprocessor directive, such as a macro; so, *tolower* may be a macro. Find *tolower* and check it out.

```
/tolower
/
```

22. *tolower* is indeed a macro, and it looks correct. It expects a capital letter from *islower* and lowercases it. Perhaps *islower* is passing something other than only capital letters. Find *islower.*

```
/islower
/
```

23. You see that there is a mistake in the macro *islower*. The *z* should be a capital letter. Edit *sort.f* by placing the cursor in any *edge* window, pressing the right mouse button, and selecting 'sort.f' from the rollover menu that is beneath the 'edit' choice.

24. Add line numbers:

```
:set  number
```

25. Change line 25 so that it looks like this:

```
25   #define islower(c) ((ce .ge. 'A') .and. (c .le. 'Z'))
```

26. Save your edits and exit from *vi.*

```
:wq
```

27. Exit from *edge* by selecting 'quit' from the command menu.

28. Recompile your program, run it, and check the results. Move the cursor to the console window and type:

```
f77  -g  sort.f  -o  sort
sort  -i  names.in  -o  names.out
more  names.out
```

You have completely debugged your program, and you are through using this directory. Before you go on to the last chapter, restore the */usr/tutor/edge/fortran/src* directory to its original form so that other people can use it. To do this, type:

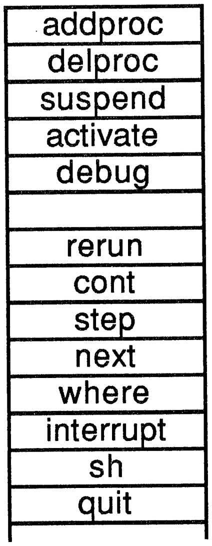
```
make  done
```

Summary of Advanced Commands

You learned seven commands that you type in the Command Window. Square brackets ([]) surrounding an argument mean the argument is optional; angle brackets (<>) surrounding an argument mean it is mandatory.

- **use** <*directory*> [*directory*] ... : Use these directories. They contain source code or the libraries that the program uses.
- **file** <*filename*>: Make this file the current file and display it in the Source Window. Type this command in the Command Window when the file you want to display is not a source file.
- **status**: Show a list of all of the *edge* breakpoints and traces that are currently set.
- **delete** <*status number*> [*status number*]: Delete this command.
- **trace** <*variable*> **at** <*line number*>: Print the value that this variable has when it reaches this line number.
- **stop in** <*function*>: Stop the program when it enters this function, and print the first executable line.
- **whatis** <*object*>: Display the definition of this object (function, type, or variable).

You learned four commands that you select from the command menu.



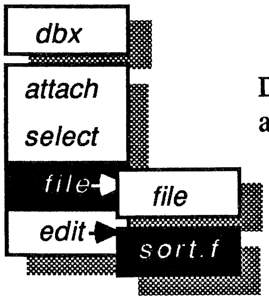
Rerun the last program using the same arguments.

Continue execution of a stopped program.

Execute next line of code. Step down into functions.

Execute next line of code. Do not step down into functions.

You learned one command that you select from the pop-up menu.



Display this file in the Source Window and make it the current file.

You also learned these *vi* search commands:

- /<*string*>: Search forward through the file for this string.
- ?<*string*>: Search backward through the file for this string.

This list and the list of basic commands on pages 13 and 14 cover most of the *edge* commands you need to debug your programs. A complete list of all *edge* commands that you learned in this tutorial appears in Chapter 3.

3. On Your Own

At this point you know enough about *edge* to use it to debug your own non-graphics programs. The first section of this chapter gives you some information on debugging graphics programs using *edge*. The rest of the chapter provides three useful references: a table that summarizes the debugging process, a list of all *edge* commands that you learned in this tutorial, and a list of sources that contain additional information about *edge*.

Using *edge* to Debug Graphics Programs

You can use all of the *edge* commands that you learned in this tutorial to debug graphics programs. The one difference is that you must run graphics programs in the foreground when you run them under *edge*. This section describes two ways you can do this.

To use the first method, you must call the `foreground` routine in your source code. At the beginning of the main routine, add this line:

```
CALL FOREGROUND()
```

To use the second method, you must add a conditional statement to your code so that when you use the *-D* flag when you compile, the compiler adds the `foreground` call to your code. This way the call happens only when you need it. At the beginning of your main routine, add this code:

```
# ifdef DEBUG
                CALL FOREGROUND()
# endif
```

If your program were called *graphic.f* and you wanted to debug it, you would compile it by typing:

```
f77  -g  -DDEBUG  graphic.f  -o  graphic  -Zg
```

The Debugging Process

This table illustrates a good, general purpose procedure for systematically debugging your own programs. Commands that you type at a prompt are printed here in `typewriter font.`

Procedure	*edge* Commands
1. Compile your program using the debugging flag.	`f77  -g`

2. Run your newly compiled program in the *edge* environment. Tell *edge* which directories to use.	`edge  <filename>`
	`use  <dir>  [dir]`
	`run  [arguments]`

3. If the program does not fault, go to step #4. If it does fault, find where the fault occurred.	select 'where'
4. Look over the code and set breakpoints at various lines and routines to check values.	highlight the code and select 'stop' `stop  in  <routine>`
5. Rerun your program with the same arguments.	select 'rerun'
6. When the program stops at each breakpoint, look at values, step through code if necessary, and continue running the program.	highlight a variable and select 'print' select 'step' select 'next' select 'cont'

7. If the value of a variable is not correct, trace it at the line after it is assigned its value. Remember to specify its module and routine if necessary.	`trace  [mod].[rout].<var>`
	`at <line number>`

8. Keep track of breakpoints and traces and delete those that you no longer need.	`status`
	`delete <status #>  [status #]`

9. When you find a bug, edit the code.	select a file from the 'edit' sub-menu
10. Exit from *edge* and go back to step #1.	select 'quit'

Summary of *edge* Commands

This section contains all of the *edge* commands that you can issue by typing in the Command Window, selecting from the command menu, or selecting from the pop-up menu.

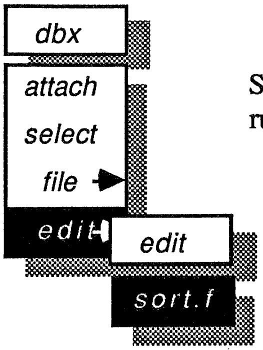
Textual Commands

- **delete** <*status number*> [*status number*]: Delete the commands that have these status numbers.
- **edge** <*executable filename*>: Go into the *edge* environment.
- **file** <*filename*>: Make this file the current file.
- **list** [*function*]: Display the code for this function.
- **run** [*arguments*]: Run the executable file with which you are working.
- **status**: Show a list of all the *edge* breakpoints and traces that are currently set.
- **stop in** <*function*>: Stop the program when it enters this function, and print the first executable line.
- **trace** <*variable*> **at** <*line number*>: Print the value that this variable has when it reaches this line number.
- **use** <*directory*> [*directory*] ... : Use these directories. They contain source code or libraries that the program uses.
- **whatis** <*object*>: Display the definition of this object (function, type, or variable).

Choices on the Command Menu

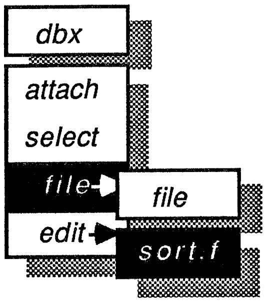
addproc	Add highlighted process to pool of processes controlled by edge.
delproc	Delete highlighted process from pool of edge-controlled processes.
suspend	Suspend execution of highlighted process.
activate	Select process from pool of processes controlled by debugger.
debug	Add selected process to process pool and stop process.
rerun	Rerun the last program using the same arguments.
cont	Continue execution of a stopped program.
step	Execute next line of code. Step down into functions.
next	Execute next line of code. Do not step down into functions.
where	Display details of the program fault.
interrupt	Stop edge from completing the current command.
sh	Start a new UNIX shell.
quit	Exit from edge.
print	Display the value of the highlighted variable.
print *	Display the value pointed to by the highlighted variable.
px	Display the hexedecimal value of the highlighted variable.
stop at	Set breakpoint at highlighted line.
stop in	Set break point at start of function containing highlight.
cont to	Continue execution of program until the highlighted line.
edit	Edit source for highlighted function.
list	List source for highlighted function.

Choices on the Pop-up Menu



Start up a UNIX shell that is running *vi* on this file.

Display this file in the Source Window and make it the current file.



vi Search Commands

- / *<string>*: Search forward through the file for this string.
- ? *<string>*: Search backward through the file for this string.

Where to Find Additional Information

The *IRIS-4D Programmer's Reference Manual*, section 1, contains two relevant manual pages: *edge*(1) describes all of the *edge* commands and command line options; *dbx*(1) describes all of the *dbx* commands and command line options. The same manual pages are on-line. To view them, type:

```
man  edge
```

or

```
man  dbx
```