UNIX Bourne Shell Programming

Developed by:

User Liaison Section, D-7131

Denver Office

I. INTRODUCTION

A. Audience

This course is for individuals who have completed "UNIX for Beginning Users" (or equivalent experience) and want to write UNIX BourneShell script files. A script file contains a sequence of UNIX commands which can be executed by entering one command. It is assumed that the student already has a good understanding of the UNIX operating system, be able to use a UNIX editor, and be familiar with a computer terminal or typewriter keyboard.

B. Course Objectives

Upon successful completion of this course the student will be able to:

1. Write moderately complex BourneShell scripts.

2. Make a BourneShell script executable.

3. Demonstrate how to use the following BourneShell commands: shift, exit, expr, test, if then, if then else, if then elif, for, while, until, and case.

4. Use the following BourneShell constructs: tracing mechanisms (for debugging), user variables, BourneShell variables, read-only variables, positional parameters, reading input to a BourneShell script, command substitution, comments, and exporting variables. In addition, test on numeric values, test on file type, and test on character strings are covered.

6. Create a ".profile" script to customize the user environment.

7. Use advanced features of File Transfer Protocol (FTP)

8. Compile source code into object and executable modules.

9. Optional: KornShell programming. This is of primary interest to programmers.

10. Convert VMS DCL command files to UNIX Shell.

C. Course Handout Conventions

There are several conventions used in this handout for consistency and easier interpretation:

1. Samples of actual terminal sessions are single-lined boxed.

2. User entries are shown in bold print and are underlined.

   exit

3. All keyboard functions in the text will be bold.

(Ret)	Backspace
Tab	Ctrl-F6
Print (Shift-F7)	Go to DOS (1)

NOTE: (Ret) indicates the Return or Enter key located above the right Shift key.

4. Examples of user entries not showing the computer's response are in dotted-lined boxes.

5. Command formats are double-lined boxed.

6. Three dots either in vertical or horizontal alignment mean continuation or that data is missing from diagram.

NOTES

1. BOURNESHELL OVERVIEW

The BourneShell is both a command-line interpreter and a high-level programming language. When it is acting as a command-line interpreter, it processes commands as you enter them at the command prompt. When you use it as a programming language, it processes commands that are stored in files known as BourneShell scripts. This course will show you how to create and execute BourneShell scripts. We will explore BourneShell programming including such features as variables, control structures, processes, and executable files.

The BourneShell is one of three shells available on most UNIX systems. Bourne is the accepted standard for System V UNIX. The other shells are being used more and more. The other shells are the CShell and the KornShell. The CShell is BSD (Berkeley Software Distribution) UNIX. BSD was developed at the University of California at Berkeley, California. Most of the features found in the BourneShell are also found in the other shells; there are differences, however. The CShell and KornShell are not standard on UNIX System V but are generally available.

BourneShell scripts allow you to group command lines together and execute them by entering a single command at the command line. This allows complex functions to be completed by any user, and repetitive functions can be completed easily. Input and output can also be redirected from a BourneShell script.

1.1 What is the BourneShell?

BourneShell is a high level programming language and a command line interpreter.

The command to invoke the BourneShell is:

```
É͸
°  Command Format:  sh [-acefhiknrstuvx] [args]                  °
°                                                                 °
°  (See Appendix A for a complete list of options etc)            °
È͹
```

A Shell script is an executable plain file that contains UNIX and shell commands. To execute the shell script type the name of the script at the prompt. A simple shell script called shell_ex is shown in the following example. The output from the execution of the shell is also shown.

Sample Session:

```
Ú_____________________________________________________________¿
| $cat shell_ex                                               |
| echo "This is a very simple shell procedure "               |
| echo "created with the basic echo command "                 |
| echo "and three other very basic commands "                 |
| echo                                                        |
| ps                                                          |
| echo                                                        |
| who                                                         |
| echo                                                        |
| ls                                                          |
| $sh shell_ex                                                |
| This is a very simple shell procedure                       |
| created with the very basic echo command                    |
| and three other very basic commands                         |
|                                                             |
| PID    TTY     TIME    COMMAND                              |
| 10443 rt02120  0:01    sh                                   |
| 10427 rt02120  0:04    ksh                                  |
|                                                             |
```

```
| sgavlick  rt021e0   Sep 7   13:26                                  |
| teacher   rt021b0   Sep 7   14:39                                  |
|                                                                    |
| memo                                                               |
| class_notes                                                        |
| $                                                                  |
```

1.2 Making a Bourne Shell Script Executable

A BourneShell script is an ordinary file that contains commands which can be executed in sequence by entering one command at the BourneShell prompt. In order for a script to be executed, it must first be executable. This is done with the chmod command.

Sample Session:

```
| $cat shell_ex                                                      |
| echo "This is a very simple shell procedure "                      |
| echo "created with the basic echo command "                        |
| echo "and three other very basic commands "                        |
| echo                                                               |
| ps                                                                 |
| echo                                                               |
| who                                                                |
| echo                                                               |
| ls                                                                 |
| $                                                                  |
```

If the ls -l shell_ex command were entered, we would see the protections assigned to this file.

Sample Session:

```
| $ls -l shell_ex                                                    |
| -rw-r--r-- 1 teacher class  66 Sep 7 10:24 shell_ex                |
| $                                                                  |
```

The character in column one is the type of file.

- `-` = ordinary (plain) disk file
- `d` = directory
- `b` = block special file
- `c` = character special file
- `p` = fifo file ("named pipe") special file
- `l` = symbolic link

Notice that the script file in the previous sample session has the following file protections:

```
     User   - Read and Write
     Group  - Read
     Other  - Read
```

No execute permissions have been granted for user, group, or other. If we try to execute this script by typing its name, the following would result.

Sample Session:

```
$shell_ex
shell_ex: execute permission denied
$
```

This error message would indicate that execute permission was denied. The BourneShell script could not be executed. To change the permissions for the BourneShell script, use the chmod command.

Sample Session:

```
$chmod 755 shell_ex
$ls -l shell_ex
-rwxr-xr-x 1 teacher class  66 Sep 7  10:26 shell_ex
$
```

Now that the permissions have been changed to allow user, group, and others to execute the file, it will execute properly.
Sample Session:

```
$shell_ex
This is a very simple shell procedure
created with the basic echo command
and three other very basic commands

PID    TTY     TIME    COMMAND
10443 rt02120  0:01    sh
10427 rt02120  0:04    ksh

sgavlick  rt021e0   Sep 7   13:26
. teacher   rt021b0   Sep 7   14:39
.
.
```

The protections will work as you expect. Execute permission for the user will allow you (the owner) to run the BourneShell script.

Group permissions allow anyone in your group to execute the script, and other permission allows anyone on the system to execute the script.

1.3 Tracing Mechanisms

It is possible to have a trace made of the BourneShell script as it executes. This is invaluable for debugging purposes. All that is required is to give an option to the BourneShell. This is done by including an option on the call to "sh". The command to do this is:

```
Command Format: sh [-acefhiknrstuvx] [args]

See Appendix A for a complete list of options etc
```

The option to turn on tracing is -x. For an example, let's trace the execution of the simple script shell_ex.

Sample session:

```
$cat shell_ex
echo "This is a very simple shell procedure "
echo "created with the basic echo command "
echo "and three other very basic commands "
echo
ps
echo
who
echo
ls
$
```

Execute the BourneShell script using the -x option on the call to the shell. The following sample session shows how to do this and it shows the results of the trace.

Sample session:

```
$sh -x shell_ex
+ echo This is a very simple shell procedure
This is a very simple shell procedure
+ echo created with the basic echo command
created with the basic echo command
+ echo and three other very basic commands
and three other very basic commands
+ echo

+ ps
PID    TTY      TIME       COMMAND
10443 rt01120   0:01       sh
10427 rt02120   0:04       ksh
+ echo
```

```
|                                                                |
|     + who                                                      |
|     sgavlick  rt021e0   Sep 7  13:26                          |
|     teacher   rt02120   Sep 7  14:39                          |
|     + echo                                                     |
|                                                                |
|     + ls                                                       |
|     memo                                                       |
|     class_notes                                                |
|     $                                                          |
À________________________________________________________________Ù
```

The commands as read from the BourneShell script are indicated by the plus sign (+). The next line or lines are the results of the execution of the command. Using this tracing option allows you to se the execution of each command in the script and see the results of that execution.

NOTES

Workshop 1

This workshop will reinforce your understanding of the ideas presented in Chapter 1. Each student is to complete the entire workshop.

DESK EXERCISES

1. The BourneShell can act as a command line

   or a high level .

2. The BourneShell is one of three shells generally available. What are the other two?

3. One advantage of using a shell script is

   .

4. The command to call the BourneShell is:

   a. bourne
   b. ksh
   c. b
   d. sh

5. Why would you use tracing?

6. What UNIX command do you enter to make a BourneShell script executable?

That's all

NOTES

2. USER, SHELL, AND READ-ONLY SHELL VARIABLES

The BourneShell has no true numeric variables. It uses string variables to represent numbers, as well as text. String variables are able to take on the value of a string of characters. There are three types of variables in the BourneShell. They are user variables, BourneShell variables, and Read-only BourneShell variables.

You can declare, initialize, read, and modify user variables from a BourneShell script or from the command line. The BourneShell itself declares and initializes shell variables, but you can read and modify them. The BourneShell also initializes the read-only shell variables, and you can read but not modify them.

2.1 User Variables

It is legal to assign any sequence of non-blank characters as the name of a variable. The sample session below creates a variable called person and initializes it with the string Richard.

It is important to note that you must NOT precede or follow the equal sign with a space or TAB character.

Sample Session:

```
$person=Richard
```

This sample session indicates that person does not represent the string Richard. The string person is echoed as person. The BourneShell will only do the substitution of the value of the variable when the name of the variable is preceded with a dollar sign ($).

Sample Sesssion:

```
Ú_____________________________________________________________________¿
|  $echo person                                                        |
|  person                                                              |
|  $echo $person                                                       |
|  Richard                                                             |
|  $                                                                   |
À_____________________________________________________________________Ù
```

If you want to have imbedded spaces in a variable, it is necessary to quote the string.

Sample Session:

```
Ú_____________________________________________________________________¿
|  $person='Richard and Kathleen'                                      |
|  $echo $person                                                       |
|  Richard and Kathleen                                                |
|  $                                                                   |
À_____________________________________________________________________Ù
```

The echo utility copies its arguments to the standard output. The command echo $person displays the value of the variable person. It will not display $person because the BourneShell doesn't pass $person as an argument. The leading dollar sign ($) causes the BourneShell to substitute the value of the variable and then passes that value to the utility. The echo utility then displays the value of the variable, not its name, never knowing that you called it with a variable. The BourneShell passed the same command line as if you had typed in echo Richard and Kathleen. The BourneShell can be prevented from doing this substitution by entering one of the following:

Sample Sessions:

```
Ú_____________________________________________________________________¿
|  $echo $person                                                       |
|  Richard and Kathleen                                                |
|  $                                                                   |
À_____________________________________________________________________Ù
```

In this session the contents of the variable person are displayed. The BourneShell made the substitution because the variable name person is preceded by a dollar sign ($).

```
Ú_____________________________________________________________________¿
|  $echo \$person                                                      |
|  $person                                                             |
|  $                                                                   |
À_____________________________________________________________________Ù
```

In the above example the variable person is preceded by a dollar sign ($) but the dollar sign has a backslash (\) ahead of it. The backslash has the effect of cancelling the special meaning of the character following the backslash. In this case, the special meaning of the dollar sign is ignored and the substitution is not done.

```
Ú──────────────────────────────────────────────────────────────────────¿
|  $echo '$person'                                                     |
|  $person                                                             |
|  $                                                                   |
À──────────────────────────────────────────────────────────────────────Ù
```

The single quote marks (') causes the characters between the marks to be taken as literal. The shell makes no attempt to interpret the meanings of these characters. The shell passes these characters on with no substitution.

```
Ú──────────────────────────────────────────────────────────────────────¿
|  $echo "$person"                                                     |
|  Richard and Kathleen                                                |
|  $                                                                   |
À──────────────────────────────────────────────────────────────────────Ù
```

The double quote marks do not prevent the shell from making substitution; and the value of the variable will be displayed by the utility.

2.2 Shell Variables

The BourneShell declares and initializes variables that determine such things as your home directory, what directories the shell will look in when you give commands, how often to look for mail, your prompt, and many other things. We will look at several of these BourneShell variables and their functions. You can assign new values to these variables from the command line or from the execution of the .profile file in your home directory.

2.2.1 HOME

The first BourneShell variable that we will look at is the HOME variable. By default, the home directory is the current working directory after you login. The system administrator determines your home directory when you establish an account and places that information in the /etc/passwd file. When you login, the BourneShell gets that pathname and assigns it to the HOME variable.

When you enter a cd command with no argument, the utility takes the name of the directory from the HOME variable and makes it the current working directory. If you change the HOME variable to another directory pathname, the utility will make the new directory the current working directory.

Sample Session:

```
Ú──────────────────────────────────────────────────────────────────────¿
| $echo $HOME                                                          |
| /user0/rharding                                                      |
| $cd                                                                  |
```

```
| $pwd                                                                |
| /user0/rharding                                                     |
| $HOME=/user0/rharding/eng                                           |
| $cd                                                                 |
| $pwd                                                                |
| /user0/rharding/eng                                                 |
| $                                                                   |
À_____________________________________________________________________Ù
```

This example shows how the value of the HOME variable affects the cd utility. The cd command will use the value of the HOME variable as the pathname for the current working directory.

2.2.2 IFS

This is the internal-field separator BourneShell variable. You can always use a space or tab to separate characters on the command line. When you assign the IFS variable to another character, you can also use this character as the field separator.

Example:

```
.....................................................................
. $num_args a:b:c:d                                                  .
.....................................................................
```

This example shows only one argument, namely a:b:c:d.

```
.....................................................................
.  $IFS=:                                                            .
.  $num_args a:b:c:d                                                 .
.....................................................................
```

This example now shows four different arguments; each being separated by the new IFS, (:).

2.2.3 MAIL

The MAIL variable contains the name of the file that the mail (and mailx) utilities use to store your mail. Usually, the absolute pathname of this file is /usr/mail/name, where name is your login name.

Example:

```
.....................................................................
. $MAIL=/usr/mail/rharding                                           .
.....................................................................
```

2.2.4 MAILPATH

This variable contains a list of filenames separated by colons. If set, the BourneShell will inform you when any of these files are modified (i.e. when new mail arrives). Normally, this variable is not set.

2.2.5 MAILCHECK

This variable specifies how often, in seconds, the BourneShell will check for new mail. The default is 600 seconds. If set to 0, it will check for new mail each time before it gives you a prompt.

2.2.6 PATH

This BourneShell variable will describe the directories that will be searched looking for the program that you want to execute. The BourneShell looks in several directories for a file that has the same name as the command that you entered. The PATH variable controls this search path. Normally, the first directory searched is the current working directory. If the program is not found, the search continues in the /bin and then the /usr/bin directory. Generally, these directories contain executable programs. If the program is not found in one of these directories, the BourneShell reports that the program can't be found (or executed).

The PATH variable lists the pathnames in the order in which the search will proceed. The pathnames are separated by a colon (:). If nothing (null string) precedes the colon, that indicates to start the search at the current working directory.

Example:

```
. $PATH=:/user0/rharding/bin:/bin:/usr/bin                    .
. $                                                           .
```

This PATH variable indicates to start the search for the program at the current working directory, then look in the directory /user0/rharding/bin, then /bin, and finally /usr/bin.

If each user has a unique path specified, each user can execute a different program by giving the same command. The search for the program stops when it is satisfied; thus, you can use the same name for your own programs as the standard UNIX utilities. To do this, simply put your program in one of the first directories that the BourneShell searches.

2.2.7 PS1

This is the BourneShell prompt which lets you know that the shell is waiting for you to give it a command. The default BourneShell prompt is a dollar sign ($). The shell stores the prompt as a string variable in PS1. When you change the value of this variable, the appearance of the prompt will change. When you are working on several different machines, it might be useful to have the prompt be the name of the machine you are working on.

Sample Session:

```
| $pwd                                                        |
| /user0/rharding                                             |
| $PS1='domax0: '                                             |
| domax0:                                                     |
```

Notice that prompt is now domax0:

2.2.8 PS2

This variable is called the secondary prompt. If the command is not completed on one line and must be continued on the next line, the prompt for that continued line is PS2. The default is >. This prompt indicates that the BourneShell is expecting you to finish the previous command line.

Sample Session:

```
$echo 'demonstration of prompt string
>2'
demonstration of prompt string
2
$PS2='Continue? '
$echo 'demonstration of
Continue? prompt string 2'
demonstration of
prompt string 2
$
```

Notice how the secondary prompt was changed to "Continue? ".

2.3 Read-Only User Variables

The contents of the user variables and the shell variables can be modified by the user. It is possible to assign a new value to them. The new value can be assigned from the dollar ($) prompt or from inside a BourneShell script. Read-only variables are different. The value of read-only variables can not be changed.

The variable must be initialized to some value; and then, by entering the following command, it can be made read only.

```
Command format:    readonly variable_name

variable_name = name of the variable to be made read only
```

Sample Session:

```
$person=Kathleen
$readonly person
$echo $person
Kathleen
$person=Richard
person: is read only
$
```

The readonly command given without any arguments will display a list of all the read-only variables.

Sample Session:

```
Ú_____________________________________________________________________¿
| $person=Kathleen                                                     |
| $readonly person                                                     |
| $example=Richard                                                     |
| $readonly example                                                    |
| $readonly                                                            |
| readonly person                                                      |
| readonly example                                                     |
| $                                                                    |
À_____________________________________________________________________Ù
```

2.4 Read-Only Shell Variables

The read-only shell variables are similar to the read-only user variables; except the value of these variables is assigned by the shell, and the user CANNOT modify them.

2.4.1 Name of the Calling Program

The shell will store the name of the command you used to call a program in the variable named $0.

It has the number zero because it appears before the first argument on the command line.

Sample Session:

```
Ú_____________________________________________________________________¿
| $cat name_ex                                                         |
| echo 'The name of the command used'                                  |
| echo 'to execute this script was' $0                                 |
| $name_ex                                                             |
| The name of the command used                                         |
| to execute this script was name_ex                                   |
| $                                                                    |
À_____________________________________________________________________Ù
```

2.4.2 Arguments

The BourneShell will store the first nine command line arguments in the variables named $1, $2, ..., $9. These variables appear in this section because you cannot change them using the equal sign. It is possible to modify them using the set command.

Sample Session:

```
Ú_____________________________________________________________________¿
| $cat arg_ex                                                          |
| echo 'The first five command line'                                   |
| echo 'arguments are' $1 $2 $3 $4 $5                                  |
| $arg_ex Richard Kathleen Douglas                                     |
| The first five command line                                          |
| arguments are Richard Kathleen Douglas                               |
| $                                                                    |
À_____________________________________________________________________Ù
```

The script arg_ex will display the first five command-line

arguments. The variables representing $4 and $5 have a null value.

The BourneShell variable $* represents all of the command-line arguments as shown in the following example.

Sample Session:

```
$cat display_all
echo $*
$display_all Richard Kathleen Douglas
Richard Kathleen Douglas
$
```

The BourneShell variable $# contains the number of arguments on the command line. This is a string variable that represents a decimal number. You can use the expr utility to perform calculations with that number and test to perform logical tests on it.

Sample Session:

```
$cat num_args
echo 'This script was called with'
echo $# 'arguments'
$num_args Richard Kathleen Douglas
This script was called with
3 arguments
$
```

2.4.3 Shift

The shift command promotes each of the command-line arguments. The second argument, represented by $2, is now the first argument, represented by $1. The third becomes the second and so on until the last argument becomes the next to last. You can access only the first nine command-line arguments (as $1 through $9). The shift command gives you access to the tenth, and the first becomes unavailable. There is no "unshift" command that will return the arguments that are no longer available.

Sample Session:

```
$cat demo_shift
echo 'arg1='$1 '  arg2='$2 '   arg3='$3
shift
echo 'arg1='$1 '  arg2='$2 '   arg3='$3
shift
echo 'arg1='$1 '  arg2='$2 '   arg3='$3
shift
echo 'arg1='$1 '  arg2='$2 '   arg3='$3
shift
$demo_shift Richard Kathleen Douglas
arg1=Richard  arg2=Kathleen  arg3=Douglas
```

```
| arg1=Kathleen arg2=Douglas   arg3=                                  |
| arg1=Douglas  arg2=          arg3=                                  |
| demo_shift: cannot shift                                            |
| $                                                                   |
```

The BourneShell will display an error message when the script executes a shift command after it has run out of variables.

2.4.4 Set

The Set command will display a list of all the variables that are set when it has no arguments.

Sample Session:

```
| $set                                                                |
| HOME=/user0/teacher                                                 |
| IFS=                                                                |
|                                                                     |
| LOGNAME=richard                                                     |
| MAIL=/usr/mail/richard                                              |
| MAILCHECK=600                                                       |
| PATH=:/bin:/usr/bin                                                 |
| PS1=$                                                               |
| PS2=>                                                               |
| SHELL=/bin/sh                                                       |
| TERM=vt100                                                          |
| TZ=MST7MDT                                                          |
| $                                                                   |
```

When set is called with arguments, it sets the value of the command-line arguments ($1-$n) to the arguments. The example sets the first three arguments.

Sample Session:

```
| $cat set_ex                                                         |
| set who really cares                                                |
| echo $#: $*                                                         |
| $set_ex                                                             |
| 3: who really cares                                                 |
| $                                                                   |
```

2.4.5 expr

The expr command will perform arithmetic in the BourneShell.

```
°   Command format:  expr expression                                 °
°                                                                    °
°   See Appendix C for a complete list of expressions                °
```

The arguments are taken as an expression. After the evaluation has taken place, the result is written to standard output. The terms of the expression must be separated by blanks. Special characters to the shell must be escaped. Strings containing blanks or other special characters must be quoted.

Sample Session:

```
$expr 7 + 8 + 10
25
$expr 10 - 8
2
$expr 10 '*' 4
40
$expr 135 / 5
27
$
```

expr will also work with user defined variables as in the following example:

Sample Session:

```
$cat data
8
15
25
$cat express
count=0
tot=0
for a in `cat data`
do
tot=`expr $tot + $a`
count=`expr $count + 1`
done
avg=`expr $tot / $count`
echo "The average is $avg"
$
```

Let's execute the script "express" with tracing on so we can follow the execution.

Sample Session:

```
$sh -x express
count=0
tot=0
+ cat data
+ expr 0 + 8
tot=8
+ expr 0 + 1
count=1
+ expr 8 + 15
```

```
| tot=23                                                                |
| + expr 1 + 1                                                          |
| count=2                                                               |
| + expr 23 + 25                                                        |
| tot=48                                                                |
| + expr 2 + 1                                                          |
| count=3                                                               |
| + expr 48 / 3                                                         |
| avg=16                                                                |
| + echo The average is 16                                              |
| The average is 16                                                     |
| $                                                                     |
```

NOTES

NOTES

Workshop 2

This workshop will reinforce your understanding of the ideas presented in Chapter 2. Login to the Multimax using the username and password given to you by the instructor. Each student is to complete the entire workshop.

DESK EXERCISES

1. Any series of non-blank characters can be assigned to a user variable.

   True/False

2. How can you insert a space into a user variable?

3. What utility can be used to display the contents of a user variable to standard output?

4. The backslash (\) character is used to remove the special meaning of some characters.

   True/False

5. What other character can be used to prevent the shell from doing the substitution?

6. Double quote marks will prevent the shell from making the substitution.

True/False

Continue on the next page

7. What do the following shell variables do?

HOME

IFS

MAIL

MAILPATH

MAILCHECK

PATH

PS1

PS2

Continue on the next page

8. What is the command to create a read-only user variable?

9. What is the read-only shell variable that represents the calling program?

10. What do $1,$2,...,$9 represent?

11. What BourneShell variable represents all of the command line arguments?

12. What does the shift command do?

13. What is displayed when you enter set with no arguments?

Continue on the next page

COMPUTER EXERCISES

14. Login to the Multimax (domax1) using the username and password given to you by the instructor.

15. Create a subdirectory called sub_dir.

16. Modify your .profile to include the following:

    a) Change the home directory to sub_dir

    b) Set the internal-field separator to a comma

    c) Have mail messages saved into mail1.

    d) Set the PATH to look for programs in the following directories:

       $HOME/bin
       /bin
       /usr/bin

    e) Change the prompt to reflect the name of the system

    f) Change the secondary prompt to 'More?'

17. Execute the .profile
    Enter $. .profile

18. Verify that the changes are correct. If you have extra time go to the next page.

Extra Mile on the next page

Extra Mile

Change the .profile file so the date/time and a list of all users that are currently logged in will be displayed on your monitor screen automatically when you login.

NOTES

3. POSITIONAL PARAMETERS

A BourneShell script can also read in command-line arguments. The first argument is referred to as $1, the second is $2, and so on. Command-line arguments are referred to as positional parameters.

Let's look at an example BourneShell script to see how these are used.

Sample Session:

```
$cat neat_shell
echo $1 $2 $3
echo $0 is the name of the shell script
echo "There were $# arguments."
echo $*
$
```

Insure that the BourneShell script is executable by issuing this command:

Sample Session:

```
    $chmod a+x neat_shell
    $
```

Now, if we type the name of the BourneShell script with no arguments, we get the following results.

Sample Session:

```
$neat_shell

neat_shell is the name of the shell script
There were 0 arguments.

$
```

In this sample session, there were no arguments given so none were printed. $0 is the positional parameter that refers to the name of the script. Since there were no arguments given with this invocation of neat_shell, there were zero arguments listed.

3.1 Reading Input Into a Shell Variable

The BourneShell script can read user input from standard input. The read command will read one line from standard input and assign the line to one or more variables. The following example shows how this works.

Sample Session:

```
$cat read_script
echo "Please enter a string of your choice"
read a
echo $a
$
```

This simple script will read one line from standard input (keyboard) and assign it to the variable a.

Sample Session:

```
$read_script
Please enter a string of your choice
Here it is
Here it is
$
```

The line read from standard input can also be assigned to several variables as shown in the following example.

Sample Session:

```
$cat reads
echo "Please enter three strings"
read a b c
echo $a $b $c
echo $c
echo $b
echo $a
$
```

This time, we will turn on the trace mechanism and follow the execution of this BourneShell script.

Sample Session:

```
$sh -x reads
+ echo Please enter three strings
Please enter three strings
+ read a b c
this is more than three strings
```

```
| + echo this is more than three strings                          |
| this is more than three strings                                 |
| + echo more than three strings                                  |
| more than three strings                                         |
| + echo is                                                       |
| is                                                              |
| + echo this                                                     |
| this                                                            |
| $                                                               |
À_________________________________________________________________Ù
```

It is interesting to note that the spaces separate the values for the variables a,b, and c. For example, the variable a was assigned the string this, the variable b was assigned the string is, and the remainder of the line was assigned to c (including the spaces).

Sample Session:

```
Ú_________________________________________________________________¿
| $cat read_ex                                                    |
| echo  'Enter line: \c'                                          |
| read line                                                       |
| echo "The line was: $line"                                      |
| $                                                               |
À_________________________________________________________________Ù
```

In this example, the \c option will suppress the carriage return. The single quote marks protect the backslash from being interpreted by the shell. Also notice that the double quote marks have no effect on the substitution of the variable line.

Sample Session:

```
Ú_________________________________________________________________¿
| $read_ex                                                        |
| Enter line: All's well that ends well                           |
| The line was: All's well that ends well                         |
| $                                                               |
À_________________________________________________________________Ù
```

3.2 Command Substitution

You can execute a command by enclosing it within two grave accent marks [these are sometimes called backquotes (`)]. The BourneShell will replace the command and the grave marks with the output from the command.

Sample Session:

```
Ú_________________________________________________________________¿
| $cat dir                                                        |
| dir=`pwd`                                                       |
| echo 'You are using the' $dir 'directory'                       |
| $                                                               |
À_________________________________________________________________Ù
```

NOTE: The grave marks lean to the left, and the apostrophes lean to the right. The grave marks enclose the pwd

command.

Sample Session:

```
Ú_____________________________________________________________________¿
| $dir                                                                |
| You are using the /user0/rharding directory                         |
| $                                                                   |
À_____________________________________________________________________Ù
```

The important thing to notice here is that the pwd command was executed; and the output, /user0/rharding, was then assigned to the variable dir.

It is not necessary to assign the output of a command to a variable as shown in the previous example. The command substitution can occur directly as shown in the next example.

Sample Session:

```
Ú_____________________________________________________________________¿
| $cat dir2                                                           |
| echo 'You are using the' `pwd` 'directory'                          |
| $dir2                                                               |
| You are using the /user0/rharding directory                         |
| $                                                                   |
À_____________________________________________________________________Ù
```

One final example will show a practical use of command substitution. This BourneShell script will use the date command to provide the date in a useful format.

The normal output from the date command looks like the following.

Sample Session:

```
Ú_____________________________________________________________________¿
| $date                                                               |
| Wed Sep 12 18:02:05 MDT 1990                                        |
| $                                                                   |
À_____________________________________________________________________Ù
```

Here's a BourneShell script that rearranges the output into a more useable format.

Sample Session:

```
Ú_____________________________________________________________________¿
| $cat dateset                                                        |
| set `date`                                                          |
| echo $*                                                             |
| echo                                                                |
| echo 'Argument 1:' $1                                               |
| echo 'Argument 2:' $2                                               |
| echo 'Argument 3:' $3                                               |
| echo 'Argument 4:' $4                                               |
| echo                                                                |
| echo $2 $3, $6                                                      |
```

```
$dateset
Wed Sep 12 18:02:05 MDT 1990

Argument 1: Wed
Argument 2: Sep
Argument 3: 12
Argument 4: 18:02:05

Sep 12, 1990
$
```

The first command in the BourneShell script dateset uses the grave accent marks to set the command-line argument variables to the output of the date command. The next commands show the first four of these argument variables. The final command displays the arguments in a different order that could be useful in a report or a letter.

3.3 Comments in BourneShell Scripts

Comments can be inserted into the BourneShell script by beginning each comment line with the pound symbol (#) or a colon (:). All characters after the comment character will be ignored by the shell. The only exception to this rule is that the first character of the first line must not be a pound symbol; if the first character is a pound sign, the BourneShell tries to execute the script as if it was written in CShell syntax.

Sample Session:

```
$cat com_sub
  #   The first line sets your present working directory
#     to the variable 'directory'
directory=`pwd`
#     The second line sets the date to the variable 'when'
when=`date`
:     The third line will echo on the screen
echo "You are in $directory on $when"
:     You could have said echo :
:        "You are in `pwd` on `date`"
:     to have a one line program
$
```

3.4 BourneShell Environment - Exporting Variables

Within a process, you can declare, initialize, read, and modify variables. The variable is local to that process. When a process forks a child process, the parent process does not automatically pass the value of the variable to the child process.

Here is an example of the variables not being exported.

Sample Session:

```
$cat no_export
car=mercedes       # set the variable
echo $0 $car $$    # $0 = name of file executed
                   # $car =value of variable car
                   # $$ = PID number (process id)
inner              # execute another BourneShell script
echo $0 $car $$    # display same as above
$cat inner
echo $0 $car $$    # display variables for this process
$chmod a+x no_export
$chmod a+x inner
$no_export
no_export mercedes 4790
inner 4792
no_export mercedes 4790
$
```

When no_export was executed, it, of course, assigned a value of mercedes to the variable car and printed it out. The call to inner created a child process. Its PID is 4792, while the parent PID is 4790. Notice, when inner tried to print the value of car, it printed nothing. The reason is because the value of car was not passed by the parent.
Can the value be passed from parent to child process? Yes, by using the export command. Let's look at an example.

Sample Session:

```
$cat export_it
car=mercedes
export car
echo $0 $car $$
inner1
echo $0 $car $$
$cat inner1
echo $0 $car $$
car=chevy
echo $0 $car $$
$chmod a+x export_it
$chmod a+x inner1
$export_it
export_it mercedes 4798
inner1 mercedes 4800
inner1 chevy 4800
export_it mercedes 4798
$
```

In the export_it BourneShell script, the variable car was initialized to mercedes; and then it was exported. This means that the value of car is now available to a child process. When inner1 prints out the value of car it has the value of mercedes. This is as we expect because the value of car was exported from the parent. The next line of inner1 changes the value of car to chevy. This

is shown in the next line of the sample session. The last line of the session shows the return to the parent process and the value is still mercedes. How is this possible?

Exporting variables is only valid from the parent to the child process. The child process cannot change the parent's variable.

Workshop 3

This workshop will reinforce your understanding of the ideas presented in Chapter 3. Login to the Multimax using the username and password given to you by the instructor. Each student is to complete the entire workshop.

DESK EXERCISES

1. What is the positional parameter that represents the name of the command?

2. What positional parameter stands for the number of arguments on the command line?

3. What command will read one line from standard input and assign the value to a variable?

4. What character is used to indicate command substitution?

5. What are the two characters that indicate comments in BourneShell scripts?

Continue on the next page

6. Why is it bad practice to put a pound sign (#) in the first character position of the first line of a BourneShell script?

7. Variables set by the parent process are automatically known to the child process.

   True/False

8. What command will allow the value of a variable to be passed to a child process?

9. Can a child process change the value of the parents' variable? Why?

COMPUTER EXERCISES

10. Write a BourneShell script called "reverse_it" that has three strings as parameters and then display the strings in opposite order. Be sure to include appropriate comments.

    Hint: positional parameters

11. Write a BourneShell script called "read_it" that does the same as question 10 but prompts the user to enter each string separately. How would you trace the execution of this script. Do it!

Continue on the next page.

12. Write a BourneShell script that uses the output of the "date" command and changes it

    from:

Wed Sep 12 18:02:05 MDT 1990

to:

Sep 12, 1990 18:02:05
NOTES

4. CONTROL CONSTRUCTS:

The BourneShell control constructs can alter the flow of control within the script. The BourneShell provides simple two-way branch if statements and multiple-branch case statements, plus for, while, and until statements.

In discussing these control structures, the BourneShell keywords will be in bold type and the normal type are the user supplied items to cause the desired effect in command format boxes.

4.1 Types of Tests Used with Control Constructs:

The test utility evaluates expressions and returns a condition indicating whether or not the expression is true (equal to zero) or false (not equal to zero). There are no options with this utility. The format for this utility is as follows:

```
Command Format:  test expression

expression - composed of constants, variables, and
             operators
```

Expressions will be looked at in greater detail later with some examples. There are a few items that need to be mentioned that apply to expressions. Expressions can contain one or more evaluation criteria that test will evaluate. A -a that separates two criteria is a logical AND operator. In this case, both criteria must evaluate to true in order for test to return a value of true. The -o is the logical OR operator. When this operator separates two criteria, one or the other (or both) must be true for test to return a true condition.

You can negate any criterion by preceding it with an exclamation mark (!). Parentheses can be used to group criteria. If there are no parentheses, the -a (logical AND operator) takes precedence over the -o (logical OR operator). The test utility will evaluate operators of equal precedence from left to right.

Within the expression itself, you must put special characters, such as parentheses, in quote marks so the BourneShell will not evaluate them but will pass them to test.

Since each element (evaluation criterion, string, or variable) in

an expression is a separate argument, each must be separated by a space.

The test utility will work from the command line but it is more often used in a script to test input or verify access to a file.

Another way to do the test evaluation is to surround the expression with left and right brackets. A space character must appear after the left bracket and before the right bracket.

```
  test expression    =    [ expression ]
```

4.2 Test on Numeric Values

Test expressions can be in many different forms. The expressions can appear as a set of evaluation criteria. The general form for testing numeric values is:

```
É͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸»
°          int1 op int2                                                  °
È͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸¼
```

This criterion is true if the integer int1 has the specified algebraic relationship to integer int2.

The valid operators (op) are:

-eq	equal
-ne	not equal
-gt	greater than
-lt	less than
-ge	greater than or equal
-le	less than or equal

4.3 Test on Character Strings

The evaluation criterion for character strings is similar to numeric comparisons. The general form is:

```
string1 op string2
```

The operators (op) are:

string1 = string2	true if string1 and string 2 are equal
string1 != string2	true if string1 and string2 are not equal

string1	true if string1 is not the null string

Sample Session:

```
$ cat test_string
number=1
numero=0001
if test $number = $numero
then echo "String vals for $number and $numero are ="
else echo "String vals for $number and $numero not ="
fi
if test $number -eq $numero
then echo "Numeric vals for $number and $numero are ="
else echo "Numeric vals for $number and $numero not ="
fi
$chmod 755 test_string
$sh -x test_string
number=1
numero=0001
+ test 1 = 0001
+ echo String vals for 1 and 0001 not =
String vals for 1 and 0001 not =
+ test 1 -eq 0001
+ echo Numeric vals for 1 and 0001 are =
Numeric  vals for 1 and 0001 are =
$test_string
String vals for 1 and 0001 not =
Numeric vals for 1 and 0001 are =
$
```

4.4 Test on File Types

The test utility can be used to determine information about file types. All of the criterion can be found in Appendix B. A few of them are listed here:

-r filename	true if filename exists and is readable
-w filename	true if filename exists and is writable
-x filename	true if filename exists and is executable
-f filename	true if filename exists and it is a plain file
-d filename	true if filename exists and it is a directory.
-s filename	true if filename exits and it contains information (has a size greater than 0 bytes)

Example:

.....

```
. $test -d new_dir                                                    .
.....................................................................
```

If new_dir is a directory, this criterion will evaluate to true. If it does not exist, then it will be false.

4.5 if then

The format for this construct is:

```
É͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸»
°  Command Format:  if expression                                     °
°                        then  commands                               °
°                   fi                                                °
È͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸¼
```

The if statement evaluates the expression and then returns control based on this status. The fi statement marks the end of the if, notice that fi is if spelled backward.

The if statement executes the statements immediately following it if the expression returns a true status. If the return status is false, control will transfer to the statement following the fi.

Sample Session:

```
Ú_____________________________________________________________________¿
| $cat check_args                                                     |
| if (test $# = 0)                                                    |
|      then echo 'Please supply at least 1 argument'                  |
|      exit                                                           |
| fi                                                                  |
| echo 'Program is running'                                           |
| $                                                                   |
À_____________________________________________________________________Ù
```

This little script will check to insure that you are giving at least one argument. If none are given it will display the error message and exit. If one or more arguments are given it will display "Program is running" and run the rest of the script, if any.

Sample Session:

```
Ú_____________________________________________________________________¿
| $check_args                                                         |
| Please supply at least 1 argument                                   |
| $check_args xyz                                                     |
| Program is running                                                  |
| $                                                                   |
À_____________________________________________________________________Ù
```

4.6 if then else

The format for this construct is:

```
É͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸»
°  Command Format:  if expression                                     °
°                        then commands                                °
```

```
°                          else commands                                 °
°                      fi                                                °
ÈÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ¼
```

The else part of this structure makes the single-branch if statement into a two-way branch. If the expression returns a true status, the commands between the then and the else statement will be executed. After these have been executed, control will start again at the statement after the fi.

If the expression returns false, the commands following the else statement will be executed.
Sample Session:

```
Ú_____________________________________________________________________¿
| $cat test_string                                                     |
| number=1                                                             |
| numero=0001                                                          |
| if test $number = $numero                                            |
| then echo "String values of $number and $numero are equal"           |
| else echo "String values of $number and $numero not equal"           |
| fi                                                                   |
| if test $number -eq $numero                                          |
| then echo "Numeric values of $number and $numero are equal"          |
| else echo "Numeric values of $number and $numero not equal"          |
| fi                                                                   |
À_____________________________________________________________________Ù
```

Let's follow the execution of this script with tracing.

Sample Session:

```
Ú_____________________________________________________________________¿
| $sh -x test_string                                                   |
| number=1                                                             |
| numero=0001                                                          |
| + test 1 = 0001                                                      |
| + echo String values of 1 and 0001 are not equal                     |
| String values of 1 and 0001 are not equal                            |
| + test 1 -eq 0001                                                    |
| + echo Numeric values of 1 and 0001 are equal                        |
| Numeric values of 1 and 0001 are equal                               |
| $chmod a+x test_string                                               |
| $test_string                                                         |
| String values of 1 and 0001 are not equal                            |
| Numeric values of 1 and 0001 are equal                               |
| $                                                                    |
À_____________________________________________________________________Ù
```

4.7 if then elif

The format for this construct is:

```
É»
°  Command Format:  if expression                                       °
°                        then commands                                  °
```

```
°                      elif expression                                  °
°                             then commands                             °
°                             else commands                             °
°                    fi                                                 °
ÈÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ¼
```

The elif construct combines the else and if statements and allows you to construct a nested set of if then else structures.

4.8 for

The format for this construct is:

```
ÉÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ»
°  Command Format:  for loop-index in argument-list                    °
°                        do                                           °
°                        commands                                     °
°                        done                                         °
ÈÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ¼
```

This structure will assign the value of the first item in the argument list to the loop index and executes the commands between the do and done statements. The do and done statements indicate the beginning and end of the for loop.

After the structure passes control to the done statement, it assigns the value of the second item in the argument list to the loop index and repeats the commands. The structure will repeat the commands between the do and done statements once for each argument in the argument list. When the argument list has been exhausted, control passes to the statement following the done.

Sample Session:

```
Ú_____________________________________________________________________¿
| $cat find_henry1                                                     |
| for x in project1 project2 project3                                  |
| do                                                                   |
| grep henry $x                                                        |
| done                                                                 |
À_____________________________________________________________________Ù
```

Sample Session:

```
Ú_____________________________________________________________________¿
| $head project?                                                       |
| ==> project1 <==                                                     |
| henry                                                                |
| joe                                                                  |
| mike                                                                 |
| sue                                                                  |
|                                                                      |
| ==> project2 <==                                                     |
| joe                                                                  |
| mike                                                                 |
| sue                                                                  |
|                                                                      |
| ==> project3 <==                                                     |
```

```
| joe                                                                  |
| mike                                                                 |
| sue                                                                  |
| henry                                                                |
|                                                                      |
| ==> project4 <==                                                     |
| joe                                                                  |
| mike                                                                 |
|                                                                      |
| $find_henry                                                          |
| henry                                                                |
| henry                                                                |
| $                                                                    |
À______________________________________________________________________Ù
```

Each file in the argument list was searched for the string, henry. When a match was found, the string was printed.

4.9 while

The format for this construct is:

```
É͸
°  Command Format:  while expression                                  °
°                        do                                          °
°                        commands                                    °
°                        done                                        °
È͹
```

As long as the expression returns a true exit status, the structure continues to execute the commands between the do and the done statement. Before each loop through the commands, the structure executes the expression. When the exit status of the expression is false (non-zero), control is passed to the statement following the done statement.

The commands to be executed must change the expression test or an infinite loop can result.

4.10 until

The format for this construct is:

```
É͸
°  Command Format:  until expression                                  °
°                        do                                          °
°                        commands                                    °
°                        done                                        °
È͹
```

The until and while structures are very similar. The only difference is that the test is at the top of the loop. The until structure will continue to loop until the expression returns true or a nonerror condition. The while loop will continue as long as a true or nonerror condition is returned.

The commands to be executed must change the expression test or an

infinite loop can result.
Sample Session:

```
$cat until_ex
secretname='jenny'
name='noname'
echo 'Try to guess the secret name!'
echo
until (test "$name" = "$secretname")
    do
    echo 'Your guess:  \c'
    read name
    done
echo 'You did it!'
$
```

The until loop will continue until name is equal to the secret name.

Sample Session:

```
$chmod a+x until_ex
$until_ex
Try to guess the secret name!

Your guess: gaylan
Your guess: art
Your guess: richard
Your guess: jenny
You did it!
$
```

4.11 case

The format for this construct is:

```
Command Format:  case test-string in
                      pattern-1 ) commands-1 ;;
                      pattern-2 ) commands-2 ;;
                      pattern-3 ) commands-3 ;;
                      .
                      .
                      .
                      *)          commands   ;;
                 esac
```

The case structure allows a multiple-branch decision mechanism. The path that is taken depends on a match between the test-string and one of the patterns.
Sample Session:

```
$cat case_ex
echo 'Enter A, B, or C: \c'
read letter
case $letter in
   A) echo 'You entered A' ;;
   B) echo 'You entered B' ;;
   C) echo 'You entered C' ;;
   *) echo 'You did not enter A, B, or C' ;;
esac
$chmod a+x case_ex
$case_ex
Enter A, B, or C: B
You entered B
$case_ex
Enter A, B, or C: b
You did not enter A, B, or C
$
```

This example uses the value of a character that the user entered as the test string. The value is represented by the variable letter. If letter has the value of A, the structure will execute the command following A. If letter has a value of B or C, then the appropriate commands will be executed. The asterisk indicates any string of characters; and it, therefore, functions as a catchall for a no-match condition. The lowercase b in the second sample session is an example of a no match condition.

NOTES

NOTES

Workshop 4

This workshop will reinforce your understanding of the ideas presented in Chapter 4. Login to the Multimax using the username and password given to you by the instructor. Each student is to complete the entire workshop.

DESK EXERCISES

1. Which utility will evaluate an expression and then return a condition indicating whether or not the expression is true (equal to zero) or false (not equal to zero)?

2. What are the operators for character string comparisons?

Continue on the next page

COMPUTER EXERCISES

3. Use the "if then" construct to write a BourneShell script that will check for at least two parameters being present on the command line. Output an appropriate error message.

4. Write a BourneShell script using the "if then else" construct that will check for equality of two strings that are supplied as parameters to the script. Output a message stating if the strings are equal or not equal.

5. Write a BourneShell script using the "if then elif" construct that will check two numbers, input as parameters, and tell if the first parameter is greater than, equal to, or less than the second number. Output appropriate error messages.

6. Write a BourneShell script using the "for" construct that has a loop index called "fruit" and an argument list as follows: apples oranges bananas pears. Echo the name of each argument to the monitor screen and when the last argument is listed output an appropriate message.

Continue on the next page

7. Write a BourneShell script using the "while" construct that will add all the numbers between 0 and 9 and display the result. The sum of the digits 0 through 9 is 45.

8. Write a BourneShell script using the "until" construct similar to the example in the manual except compare numbers instead of strings.

9. Write a BourneShell script using the "case" statement that will ask you to enter the day of the week and then echo that day to the monitor screen. Be sure to include an appropriate message if you enter in a string other than a valid day of the week.

EXTRA MILE

10. Write a BourneShell script called "dir_num" that will test all of the files in the current directory and print all the files that prove to be a directory.

NOTES

ÜÜÜ

5. COMPILING PROGRAMS IN UNIX

This chapter will examine compiling source code programs in three high level languages "C", FORTRAN, and COBOL. The second part of the chapter will look at the archive and library maintainer. The archive allows you to create a library of object modules. These files are used by the link editor.

5.1 "C": Sample Program with a Main and Two Functions in One File

Based on the command line options, cc compiles, assembles, and load

C language source code programs. It can also assemble and load assembly language source programs or merely load object programs.

```
ÉÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ»
°  Command Format:  cc [options] file-list                         °
°                                                                  °
°  (See Appendix E for a complete list of options)                 °
ÈÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ¼
```

When using the cc utility, the following conventions are observed:

1. A filename with the extension of .c indicates a C language source program.

2. A filename with an extension of .s indicates an assembly language source program.

3. A filename with an extension of .o indicates an object program.

The cc utility will take its input from the file or files you specify on the command line. Unless you use the -o option, it will store the executable program in a file called a.out.
Sample C Language Source Code Program:

```
Ú________________________________________________________________¿
| $cat hello.c                                                   |
| main ()                                                        |
| {                                                              |
|      printf ("Hello from main!\n\n");                          |
|      printf ("Calling function1!\n\n");                        |
|      funct1();                                                 |
|      printf ("\t Back from function1!\n\n");                   |
|      printf ("Calling function2!\n\n");                        |
|      funct2();                                                 |
|      printf ("\t Back from funct2!\n\n");                      |
|      printf ("That's all!\n\n");                               |
| }                                                              |
| funct1()                                                       |
| {                                                              |
|      printf ("\t\t Hello from function1!\n\n);                 |
| }                                                              |
| funct2()                                                       |
| {                                                              |
|      printf ("\t\t Hello from function2!\n\n);                 |
| }                                                              |
À________________________________________________________________Ù
```

5.2 "C": Compiling a Program

To compile the previous example program into an executable module, enter the following command at the command line.

Sample Session:

```
$cc hello.c
$
```

Without any options, cc accepts C source code and assembly language programs that follow the conventions outlined above. It will compile, assemble, and load these programs to produce an executable called a.out. The cc utility puts the object code in files with the same base filename (everything before the period) as the source but with a filename extension of .o . The a.out stands for assembly output. This is the default.

Sample Session:

```
$cc hello.c
$a.out
Hello from main!

Calling function1!

                Hello from function1!

           Back from function1!

Calling function2!

                Hello from function2!

           Back from function2!

That's all!
$
```

NOTE: The a.out file that was created by the cc utility has the following permissions:

user - read, write, and execute
group - read and execute
other - read and execute

It is not necessary for you to change the permissions using the chmod command because the cc utility set the execute permissions for you.

5.3 "C": Renaming the Executable Module

You can rename the executable module using the mv command. The file permissions will be the same as before the file is renamed.

Sample Session:

```
$mv a.out hello
```

```
| $hello                                                          |
| Hello from main!                                                |
|                                                                 |
| Calling function1!                                              |
|                                                                 |
|                Hello from function1!                            |
|                                                                 |
|           Back from function1!                                  |
|                                                                 |
| Calling function2!                                              |
|                                                                 |
|                Hello from function2!                            |
|                                                                 |
|           Back from function2!                                  |
|                                                                 |
| That's all!                                                     |
| $                                                               |
À_________________________________________________________________Ù
```

5.4 "C": Giving a Name to the Output File

It is possible to have the output sent to a file you specify instead of a.out by using the following command:

```
É͸
°  Command Format:  cc -o output source                          °
°                                                                 °
°  output - the name of the executable file                       °
°                                                                 °
°  source - the name of the C source code file                    °
È͹
```

The -o option tells cc to tell the link editor to use the specified name for the output instead of the default a.out.

NOTE: It is not necessary for the -o option to appear after the cc command. The filename that appears after the -o is the name of the output file. For example, cc source -o output is the same as cc -o output source.

Sample Session:

```
Ú_________________________________________________________________¿
| $cc -o hello hello.c                                            |
| $hello                                                          |
| Hello from main!                                                |
| Calling function1!                                              |
|                                                                 |
|                Hello from function1!                            |
|                                                                 |
|           Back from function1!                                  |
|                                                                 |
| Calling function2!                                              |
|                                                                 |
|                Hello from function2!                            |
|                                                                 |
|           Back from function2!                                  |
```

```
|                                                                |
| That's all!                                                    |
| $                                                              |
À________________________________________________________________Ù
```

5.5 "C": Producing an Assembly Listing

This option causes cc to compile C programs and leave the corresponding assembly language source programs in a file with filename extensions of .s.

```
É»
°  Command Format:  cc -S hello.c                              °
°                                                               °
°  -S = Compile only                                           °
È¼
```

Sample Session:

```
Ú_____________________________________________________________¿
| $cc -S  hello.c                                              |
| $ls -C                                                       |
| example.f    hello     hex.c     octal.c                     |
| hello.c      hello.s   multiply.c                           |
| $                                                            |
À_____________________________________________________________Ù
```

5.6 "C": Main and Two Functions in Three Separate Source Files

This is the same C program that we have seen before, except it is now in three files rather than one as before. The three files are main.c, funct1.c, and funct2.c.

```
Ú_____________________________________________________________¿
| $cat main.c                                                  |
| main ()                                                      |
| {                                                            |
|      printf ("Hello from main!\n\n");                        |
|      printf ("Calling function1!\n\n");                      |
|      funct1();                                               |
|      printf ("\t Back from function1!\n\n");                 |
|      printf ("Calling function2!\n\n");                      |
|      funct2();                                               |
|      printf ("\t Back from funct2!\n\n");                    |
|      printf ("That's all!\n\n");                             |
| }                                                            |
| $cat funct1.c                                                |
| funct1()                                                     |
| {                                                            |
|      printf ("\t\t Hello from function1!\n\n);               |
| }                                                            |
| $cat funct2.c                                                |
| funct2()                                                     |
| {                                                            |
|      printf ("\t\t Hello from function2!\n\n);               |
| }                                                            |
```

5.7 "C": Compiling but Not Producing an Executable Module

Using the previous program, the following command will compile but not produce an executable module.

```
Command Format:     cc -c main.c funct1.c funct2.c

-c = Compile, but do not load object files.  This option
     causes cc to compile and/or assemble source code
     programs and leave the corresponding object programs
     in files with filename extensions of .o.
```

Sample Session:

```
$cc -c main.c funct1.c funct2.c
main.c:
funct1.c:
funct2.c:
$ls a.out
a.out not found
$ls -C *.o
funct1.o           funct2.o          main.o
$
```

The -c options causes the compilation system to suppress the link edit phase. This produces an object file or files, in this example (main.o funct1.o funct2.o), that can be link edited at a later time with the cc command with no options.

5.8 FORTRAN: Sample Program a Main and Two Subroutines

There are several conventions for use with the FORTRAN compiler. They are:

1. The name of the file containing the FORTRAN source code must end with .f.

2. The compiler is invoked with f77.

3. Several options are available with the compiler. (-c, -o, -p, -S)

4. Preconnections are made for stdin (unit5) and stdout (unit6).

This is the FORTRAN source code example to be used in the following discussions of the FORTRAN compiler.

Sample Session:

```
$cat hello.f
      program calling
      write(6,100)
100   format (' Hello from main!',/)
      write(6,110)
110   format(' Calling subroutine1!',/)
      call sub1
      write(6,120)
120   format(t15' Back from subroutine1!',/)
      write(6,130)
130   format(' Calling subroutine2!',/)
      call sub2
      write(6,140)
140   format(t15' Back from subroutine2!',/)
      write(6,150)
150   format(' That's all, folks!')
      end
      subroutine sub1
      write(6,200)
200   format(t20,' Hello from subroutine1!',/)
      end
      subroutine sub2
      write(6,210)
210   format(t20,' Hello from subroutine2!',/)
      end
```

5.9 FORTRAN: Compiling a Program

The FORTRAN compiler is invoked with the following command:

```
°  Command Format:  f77                                                  °
```

To compile the above program into an executable program, use the following command at the command line.

Sample Session:

```
$f77 hello.f
$
```

Without any options, f77 accepts FORTRAN source code and assembly language programs that follow the conventions outlined above. It will compile, assemble, and load these programs to produce an executable called a.out. The f77 utility outputs the object code into files with the same base filename (everything before the period) as the source but with a filename extension of .o.
The a.out stands for assembly output. This is the default.

Sample Session:

```
$f77 hello.f
$a.out
```

```
| Hello from main!                                                    |
|                                                                     |
| Calling function1!                                                  |
|                                                                     |
|              Hello from function1!                                  |
|                                                                     |
|         Back from function1!                                        |
|                                                                     |
| Calling function2!                                                  |
|                                                                     |
|              Hello from function2!                                  |
|                                                                     |
|         Back from function2!                                        |
|                                                                     |
| That's all!                                                         |
| $                                                                   |
À_____________________________________________________________________Ù
```

NOTE: The a.out file that was created by the f77 utility has the following permissions:

user - read, write, and execute
group - read and execute
other - read and execute

It is not necessary for you to change the permissions using the chmod command because the f77 utility set the execute permissions for you.

5.10 FORTRAN: Renaming the Executable Module

You can rename the executable module using the mv command. The file permissions will be the same as before the file is renamed.

Sample Session:

```
Ú_____________________________________________________________________¿
| $mv a.out hello                                                     |
| $hello                                                              |
| Hello from main!                                                    |
|                                                                     |
| Calling function1!                                                  |
|                                                                     |
|              Hello from function1!                                  |
|                                                                     |
|         Back from function1!                                        |
|                                                                     |
| Calling function2!                                                  |
|                                                                     |
|              Hello from function2!                                  |
|                                                                     |
|         Back from function2!                                        |
|                                                                     |
| That's all!                                                         |
| $                                                                   |
```

5.11 FORTRAN: Giving a Name to the Output File

It is possible to have the output sent to a file you specify instead of the default, a.out, by using the following command:

```
Command Format:  f77 -o output source

output - the name of the executable file

source - the name of the Fortran source code file
```

The -o option tells the f77 utility to tell the link editor to use the specified name for the output instead of the default a.out.

NOTE: It is not necessary for the -o option to appear after the f77 command. The filename that appears after the -o is the name of the output file. For example, f77 source -o output is the same as f77 -o output source.

Sample Session:

```
$f77 -o hello hello.f
$hello
Hello from main!
Calling function1!

             Hello from function1!

         Back from function1!

Calling function2!

             Hello from function2!

         Back from function2!

That's all!
$
```

5.12 FORTRAN: Producing an Assembly Listing

This option causes f77 to compile Fortran programs and leave the corresponding assembly language source programs in a file with filename extensions of .s.

```
Command Format:  f77 -S hello.f

-S = Compile only
```

Sample Session:

```
$f77 -S  hello.f
$ls -C
example.f         hello     hex.c     octal.c
hello.c           hello.s   multiply.c
$
```

The file hello.s contains the assembly listing.

5.13 FORTRAN: Main and Two Subroutines in Three Separate Source Files

Sample Session:

```
$cat main.f
      program calling
      write(6,100)
 100  format (' Hello from main!',/)
      write(6,110)
 110  format(' Calling subroutine1!',/)
      call sub1
      write(6,120)
 120  format(t15' Back from subroutine1!',/)
      write(6,130)
 130  format(' Calling subroutine2!',/)
      call sub2
      write(6,140)
 140  format(t15' Back from subroutine2!',/)
      write(6,150)
 150  format(' That's all, folks!')
      end
$cat sub1.f
      subroutine sub1
      write(6,200)
 200  format(t20,' Hello from subroutine1!',/)
      end
$cat sub2.f
      subroutine sub2
      write(6,210)
 210  format(t20,' Hello from subroutine2!',/)
      end
```

5.14 FORTRAN: Compiling But Not Producing an Executable Module

Using the above program, the following command will compile but not produce an executable module.

```
  Command Format:  f77 -c main.f sub1.f sub2.f

  -c = Compile, but do not load object files.  This option
       causes f77 to compile and/or assemble source code
       programs and leave the corresponding object programs
       in files with filename extensions of .o.
```

Sample Session:

```
$f77 -c main.f sub1.f sub2.f
main.f:
     MAIN: calling:
sub1.f:
     sub1:
sub2.f:
     sub2:
$ls a.out *.o
a.out not found
funct1.o
funct2.o
hello.o
main.o
sub1.o
sub2.o
$
```

The -c options causes the compilation system to suppress the link edit phase. This produces an object file or files, in this example (main.o sub1.o sub2.o), that can be link edited at a later time with the f77 command with no options.

5.15 FORTRAN: Compiling Object Files to Produce an Executable Module

The command to produce an executable nodule from several object files is done in the following manner:

```
Command Format:  f77 obj_1 obj_2 obj_3

obj_1 through obj_n - the object files
```

Sample Session:

```
$f77 main.o sub1.o sub2.o
$ls -C
funct1.o funct2.o hello.o main.o sub1.o sub2.o a.out
$
```

5.16 COBOL: Sample Program with a Main and Two Subroutines

Sample Session:

```
$cat teacher.cob
identification division.
program-id. teacher.
environment division.
configuration section.
```

```
| data division.                                                    |
| working-storage section.                                          |
| procedure division.                                               |
| begin section.                                                    |
| begin-it.                                                         |
|      display " Hello from main!".                                 |
|      display "  Calling subroutine1!".                            |
|      perform subroutine1.                                         |
|      display "               Back from subroutine1!".             |
|      display "  Calling subroutine2!".                            |
|      perform subroutine2.                                         |
|      display "               Back from subroutine2!".             |
|      display "  That's all, folks!".                              |
|      stop run.                                                    |
| subroutine1 section.                                              |
| sub1.                                                             |
|      display "               Hello from subroutine1!".            |
| subroutine2 section.                                              |
| sub2.                                                             |
|      display "               Hello from subroutine2!".            |
```

5.17 COBOL: Compiling a Program

```
° Command Format:  cobol source_filename                          °
```

Three files are created by the compiler. They are identified by the same filename as the source code but with a different extension. They have the extensions .IDY, .INT, and .LST.

NOTE: The extensions are uppercase characters. UNIX is case sensitive.

Sample Session:

```
| $cobol teacher.cob                                                |
| $ls teacher*                                                      |
| teacher.IDY                                                       |
| teacher.INT                                                       |
| teacher.LST                                                       |
| teacher.cob                                                       |
| $                                                                 |
```

5.18 COBOL: Running a Program

```
| $cbrun teacher.INT                                                |
| Hello from Main!                                                  |
|   Calling subroutine1!                                            |
|               Hello from subroutine1!                             |
|              Back from subroutine1!                               |
|   Calling subroutine2!                                            |
```

```
|               Hello from subroutine2!                          |
|              Back from subroutine2!                            |
| That's all, folks!                                             |
| $                                                              |
À________________________________________________________________Ù
```

NOTES

Workshop 5

This workshop will reinforce your understanding of the ideas presented in Chapter 5. Login to the Multimax using the username and password given to you by the instructor. Each student is to complete the entire workshop.

DESK EXERCISES

1. "C": What is the command to compile, assemble, and load source code programs?

2. "C": What is the filename extension that indicates a source code program? An assembly language program? An object code file?

3. "C": What is the default filename assigned to the executable file?

4. "C": What command can be used to rename the executable file produced by the cc compiler? What are the file protections associated with the executable?

5. "C": What option will produce an assembly listing? What is the filename extension of this file?

Continue on the next page

6. "C": What command will compile the source code program but will not load object files but will keep the object files in files with extensions of .o?

7. FORTRAN: What is the command to invoke the compiler?

8. FORTRAN: What is the filename extension for source code programs?

9. FORTRAN: What is the name of the default executable file?

10. FORTRAN: How can you change the permissions on the executable module so anyone can execute it?

11. FORTRAN: What option on the call to the compiler will allow you to specify the name of the executable file?

Continue on the next page

12. FORTRAN: What option on the call to the compiler will produce an assembly listing? What is the filename extension of this file?

13. FORTRAN: What option will produce object modules but not produce an executable module?

14. FORTRAN: What command will produce an executable module from several object modules?

15. COBOL: What is the command to call the compiler?

16. COBOL: What are the three files created by the compiler? What are the filename extensions?

17. COBOL: Which of the three files that have been created are used to run the program?

Continue on the next page

COMPUTER EXERCISES

18. Copy the following files from /user0/teacher:

    main.c funct1.c funct2.c

Are these programs "C", FORTRAN, or COBOL? Compile these three files creating an executable file called main1.exe and then execute it. What are the file protections? Why?

19. Now append the three files into one file. Use output redirection.

Compile the file creating the executable file called main2.exe . Execute main2.exe.

20. Copy the following files from /user0/teacher:

main.f sub1.f sub2.f

Compile these three files creating an executable file called main1.exe . Execute main1.exe

21. Now append the three files into one file.

Compile the file creating the executable file called main2.exe . Execute main2.exe.

22. COBOL: Copy teacher.cob from /user0/teacher.

Compile and run it.

NOTES

NOTES

6. UNIX TOOLS

6.1 Processes

A process is the execution of a command by UNIX. Processes can also be executed by the operating system itself. Like the file structure, the process structure is hierarchical. It contains parents, children, and even a root. A parent can fork (or spawn) a child process. That child can, in turn, fork other processes. The first thing the operating system does to begin execution is to create a single process, PID number 1. PID stands for Process IDentification. This process will hold the same position as the root directory in the file structure. This process is the ancestor to all processes that each user works with. It forks a process for each terminal. Each one of these processes becomes a Shell process when the user logs on.

6.2 Executing a Command

When you give a command to the Shell, it will fork a process to execute the command. While the child process is executing the command, the parent will go to sleep. Sleeping means that the process will not use any CPU time. It remains inactive until it is awakened. When the child process has finished executing the command, it dies. The parent process, which is running the Shell, wakes up and prompts you for another command.

When you request a process to run in the background (by ending the command line with an &), the Shell forks a child process that is allowed to run to completion. The parent process will report the PID of the child process and them prompts you for another command. The child and parent are now independent processes.

6.3 Process Identification

The Unix operating system assigns a unique process identification number (PID) to each process. It will keep the same PID as long as the process is in existence. During one session, the same process is always executing the login Shell. When you execute another command a new process is forked and a new PID is assigned to that process. When that child process is finished you are returned to the login process, which is running the Shell, and that parent process has the same PID as when you logged on.
The Shell stores the PID in Shell variable called $$. The PID can also be shown with the process status (ps) command. The format for ps is as follows:

```
É͸
°    Command Format:  ps [options]                                  °
°                                                                   °
°    See on-line manual for options                                 °
È͹
```

With no options given the ps command will give you certain information about processes associated with the controlling terminal. The output consists of a short listing containing the process id, terminal id, cumulative execution time, and the command name. Otherwise, options will control the display.

Sample session:

```
Ú_____________________________________________________________________
______¿
| $echo $$
|
| 8347
|
| $ps
|
|    PID TTY      TIME COMMAND
|
|   8347 rt021a0  0:03 ksh
|
```

```
|   8376 rt021a0  0:06 ps
|
| $
|
À_______________________________________________________________________
______Ù
```

The PID numbers of the Shell are the same in the sample session
because the shell will substitute its own PID number for $$.
The Shell makes the substitution before it forks a new process to
execute the echo command. Therefore, echo will display the PID
number of the process that called it, not the PID of the process
that is executing it.
The -l option will display more information about the processes.

Sample Session:

```
Ú_______________________________________________________________________
____________________¿
| $ps -l
|
|     F S   UID   PID  PPID  C PRI NI     ADDR     SZ    WCHAN TTY
TIME COMD           |
| f0000 S   115  8347   309  2  30 20  1009000    140    94014 rt021a0
0:03 ksh            |
| f0000 O   115  8386  8347 16  68 20  1308000     72          rt021a0
0:01 ps             |
| $ps -l
|
|     F S   UID   PID  PPID  C PRI NI     ADDR     SZ    WCHAN TTY
TIME COMD           |
| f0000 S   115  8347   309  1  30 20  1009000    140    94014 rt021a0
0:03 ksh            |
| f0000 O   115  8387  8347 26  73 20  1146000     72          rt021a0
0:01 ps             |
| $
|
À_______________________________________________________________________
____________________Ù
```

6.4 grep: A Pattern Matching Filter

The grep utility can search through a file to see if it contains
a specified string of characters. The utility will not change the
file it searches but displays each line that contains the string.
The format for the string is:

```
ÉÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ
ÍÍÍÍÍÍ»
º  Command Format:  grep [options] limited_regular-expression [file]
º
º
º
```

```
°    Use the man command for a complete list of options
°
°
°
ÈÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ
ÍÍÍÍÍÍ¼
```

The grep utility searches files for a pattern and displays all lines that contain the pattern. It uses limited-regular-expressions (these are expressions that have string values that use a subset of all the possible alphanumeric and special characters) like those used with ed to match the patterns.

Be careful using the characters $, *, [, ^, |, (,), and \ in the regular expression because they will be evaluated by the shell. It is good practice to enclose the regular expression in single quotes. This will prevent the shell from evaluating these special characters.

The grep utility will assume standard input if no files are given. Normally, each line found in the file will be displayed to standard output.

Sample session:

```
.................................................................
.    $grep 'disc' memo                                          .
.................................................................
```

This command will search the file "memo" for the string "disc". It will include words like discover and indiscreet because they contain the characters "disc". The single quote marks are not necessary and for this example they wouldn't have made any difference. They do allow you to include spaces in the search pattern.

6.4.1 More on Regular Expressions

The grep command can be best understood by a discussion of regular expressions. Let's create a database of phone numbers called phone.lis and then use regular expressions to search through the database. Here is as listing of the contents of phone.lis

Sample session:

```
Ú_______________________________________________________________¿
|    $cat phone.lis                                             |
|    Smith, Joan              7-7989                            |
|    Adams, Fran              2-3876                            |
|    StClair, Fred            4-6122                            |
|    Jones, Ted               1-3745                            |
|    Stair, Rich              5-5972                            |
|    Benson, Sam              4-5587                            |
|    $                                                          |
À_______________________________________________________________Ù
```

The format for the records in this database is:

```
     Last name, First name <tab>   #-####
```

Using the database (phone.lis) above. What grep command would we use to search through the database and get all the records that had a person whose name contains an "S".

An alphabetic character represents itself.

Sample session:

```
$grep S phone.lis
Smith, Joan             7-7989
StClair, Fred           4-6122
Stair, Rich             5-5972
Benson, Sam             4-5587
$
```

This grep command searched for the string "S" and then listed all the lines in phone.lis that matched.
A single . (dot) is used to represent any single character.

Sample session:

```
$grep .S phone.lis
Benson, Sam         4-5587
$
```

A $ represents the end of the line.

Sample session:

```
$grep 5$ phone.lis
Jones, Ted         1-3745
$
```

A ^ represents the beginning of the line

Sample session:

```
$grep ^S phone.lis
Smith, Joan         7-7989
StClair, Fred       4-6122
Stair, Rich         5-5972
$
```

Regular expressions must get to grep in order for them to be evaluated properly. Let's say we want to get the records of employees that have a phone number that begins with a "4".

What does the following expression do?

Sample session:

```
Ú_____________________________________________________________________¿
|    $grep <tab>4 phone.lis                                            |
|    StClair, Fred        4-6122                                       |
|    Jones, Ted           1-3745                                       |
|    Benson, Sam          4-5587                                       |
|    $                                                                 |
À_____________________________________________________________________Ù
```

Why did we get the record of Ted Jones? The tab character was evaluated by the shell and so the search was actually made looking for a "4". This is the same as if we had entered $grep 4 phone.lis. We must prevent the shell from evaluating these characters, this is done with the \ (backslash) character as shown in the next example.

Sample session:

```
Ú_____________________________________________________________________¿
|    $grep \<tab>4 phone.lis                                           |
|    StClair, Fred                4-6122                               |
|    Benson, Sam                  4-5587                               |
|    $                                                                 |
À_____________________________________________________________________Ù
```

Now it worked properly. It searched for a <tab> character followed by the number 4. The [] (left and right brackets) are used to identify a range of characters.

Sample session:

```
Ú_____________________________________________________________________¿
|    $grep \[AF] phone.lis                                             |
|    Adams, Fran              2-3876                                   |
|    StClair, Fred            4-6122                                   |
|    $                                                                 |
À_____________________________________________________________________Ù
```

Why do [] need to be quoted? In the previous example the search makes a match on "A" or "F" .

A - (dash) can indicate inclusion. For example, we want to make a match on a phone number that has a 1, 2, 3, or 4. How can this be done? Here's an example:

Sample Session:

```
Ú_____________________________________________________________________¿
|    $grep \[1-4] phone.lis                                            |
|    Adams, Fran                2-3876                                 |
|    StClair, Fred              4-6122                                 |
|    Jones, Ted                 1-3745                                 |
|    Stair, Rich                5-5972                                 |
|    Benson, Sam                4-5587                                 |
```

```
|    $                                                                  |
À_____________________________________________________________________Ù
```

A ^ character looks for all characters NOT inside the [] brackets.

For example,

[^0-9] matches all non-digits

[^a-zA-Z] matches all non-alphabetic characters

Note: \, *, and $ lose their meta-character meanings inside the []. Also the ^ character is special only if it appears first.

What is the following command searching for?

Sample Session:

```
Ú_____________________________________________________________________¿
|    $grep '[^789]$' phone.lis                                          |
|    Adams, Fran                 2-3876                                 |
|    StClair, Fred               4-6122                                 |
|    Jones, Ted                  1-3745                                 |
|    Stair, Rich                 5-5972                                 |
|    $                                                                  |
À_____________________________________________________________________Ù
```

6.4.2 Closure

The * (asterisk) represents zero or more of the characters preceding the asterisk.

A* represents 0 or more As.

AA* represents 1 or more As.

[0-9]*$ 0 or more digits at the end of a line
(last four digits in a phone number)

.* represents 0 or more of any character.

How would you write a grep command using regular expressions to find the last name starting with an "S" and the first name with an "F"?

^S Begins with an "S"

.*,F Any number of characters before ,F

Sample session:

```
Ú_____________________________________________________________________¿
|    $grep ^S.\*,F phone.lis                                            |
|    StClair, Fred     4-6122                                           |
|    $                                                                  |
```

```
À_____________________________________________________________________Ù
```

Note: The * (asterisk) was quoted so the shell didn't try to evaluate it.

It is very desireable to quote the entire string to keep the shell from doing an expansion or substitution. It also increases readability of the regular expression as in the following example:

Sample session:

```
Ú_____________________________________________________________________¿
|    $grep '^S.*, F' phone.lis                                         |
|    StClair, Fred     4-6122                                          |
|    $                                                                 |
À_____________________________________________________________________Ù
```

6.4.3 Some Nice grep Options

The grep provides several options that modify how the search is performed.

-c Report count of matching lines only

-v Print those lines that don't match the pattern.

What will these lines print?

Sample session:

```
Ú_____________________________________________________________________¿
|     $grep -c '[J-Z]' phone.lis                                       |
|     5                                                                |
|     $                                                                |
À_____________________________________________________________________Ù
```

Why did we get this result? Let's analyze the command. In English, this command could be interpreted to mean "Tell me how many records in the file "phone.lis" contain a letter from the set J through and including Z." Look at the phone.lis file and see that five records fit this restriction.
So the answer is 5.

Now look at another example and see what this one does.

Sample session:

```
Ú_____________________________________________________________________¿
|    $grep -v '[J-Z]' phone.lis                                        |
|    Adams,Fran        2-3876                                          |
|    $                                                                 |
À_____________________________________________________________________Ù
```

Why is this the only record that was found? The -v option says to select records that don't match the pattern. This is the same pattern as the previous example and therefore it selects records that don't match the pattern. The "Adams" record is the only one

that doesn't make a match. It doesn't have a character from the set J through and Z.

6.4.4 Summary of Regular Expression Characters

^	Beginning of the line
$	End of the line
*	0 or more preceding characters
.	Any single character
[...]	A range of characters
[^...]	Exclusion range of characters

6.5 sed: Edit a File to Standard Output

UNIX provides a method of editing streams of data. It is the sed utility. The name of this utility is derived from Stream EDitor. This is not the same as the vi editor. The vi editor edits text in a file. The sed utility edits text in a stream. In order to edit a character stream two things are required. First, the line to edit must be identified (regular expressions) and second, how to edit the line.

The formal form for the sed utility is as follows:

```
É͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸»
°                                                                              °
°    Command Format: sed [-n] [-e script] [-f sfile] [files]                   °
°                                                                              °
°    Details in on-line man pages                                              °
°                                                                              °
È͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸¼
```

The sed utility copies the named files (standard input default) to the standard output, edited according to a set (script) of commands. The -f options cause the script to be taken from file "sfile".

The general form is:

```
$sed /address/instruction
```

Note: If no address is specified, all lines are chosen to edit.

'sed' addresses can be line numbers or regular expressions.

Example:

```
line numbers        2,4
                    2,$  ($ represents the last line)
```

```
     textual address     /regular-expression/
```

Note: Forward slashes enclose textual addresses

The sed instructions indicate what editing function to perform. Here some useful sed instructions:

```
     s         substitute

     d         delete
```

Note: Most sed command lines contain spaces or metacharacters and they should be quoted to protect them from the shell. There are many more editing commands provided by sed. Here is a sample sed command to edit the records in the database file that we are already familiar with, namely, phone.lis:

Sample session:

```
$sed /s/Smith/Smythe/ phone.lis
Smythe, Joan        7-7989
Adams, Fran         2-3876
StClair, Fred       4-6122
Jones, Ted          1-3745
Stair, Rich         5-5972
Benson, Sam         4-5587
$
```

sed is an editor . It simply copies the standard input to the standard output, editing the lines that match the indicated address. The original file is not changed.

Here's another example of a sed command.

Sample session:

```
$sed '2,4 s/2$/3/' phone.lis
Smith, Joan         7-7989
Adams, Fran         2-3876
StClair, Fred       4-6123
Jones, Ted          1-3745
Stair, Rich         5-5972
Benson, Sam         4-5587
$
```

What does this sed command do? If you read command in English it reads like this: On lines 2 through 4 substitute the 2 at the end of the line with a 3. Notice that the phone number for StClair,Fred changed from 4-6122 to 4-6123. The number for Stair,Rich didn't change because it was outside the range.

The sed utility can also be use to delete parts of a line of data. This is done by substituting nothing for the parts you want to delete. It looks like this:

Sample session:

```
$sed 's/^.*, //' phone.lis
Joan              7-7989
Fran              2-3876
Fred              4-6122
Ted               1-3745
Rich              5-5972
Sam               4-5587
$
```

Reading this command it means:

Substitute from the beginning of the line followed by any number of characters followed by a comma with the null string (nothing). This has the effect of removing the text.

Here's a delete command and how it's used.

Sample session:

```
$sed d phone.lis
$
```

Why is there no output? Well, it read standard input and did the editing function on all the selected lines. Since no lines were specified all lines were selected to be edited. The editing was to delete the line.

Question: Has the original file been destroyed?

Multiple commands are allowed in sed. Each instruction is applied to each input line.

Sample session:

```
$sed '/Stair/d
>/Adams/d' phone.lis
Smith, Joan         7-7989
StClair, Fred       4-6122
Jones, Ted          2-1136
Benson, Sam         4-5587
$
```

The records for Adams and Stair have both been removed from the database.

Note: The > character is the BourneShell secondary prompt.

6.6 awk: A Pattern Matching Programming Language

Suppose you wanted to change the format of the database phone.lis to be the first name followed by the last name. There is no easy way to do this with sed. Fortunately, UNIX not only provides a stream editor (sed) but it also has a formatting tool. The formatting tool in UNIX is called awk. This tool is named after authors who wrote it Alfred V. Aho, Peter J. Weinberger, and Brian W. Kerninghan so it really doesn't have any meaning.

The awk utility is a pattern scanning and processing language. It will search one or more files for a specified pattern and then performs an action, such as writing to standard output or incrementing a counter when it finds a match. You can use awk to generate reports or filter text. It works equally well with numbers or text. The authors designed it to be easy to use and sacrificed execution speed toward this end.

While the sed utility allows us to change the text in a stream, awk allows us to rearrange, add, or delete text in a stream, easily.

The awk takes advantage of many constructs from the C programming language. It has the following features:

- flexible format
- conditional execution
- looping statements
- numeric variables
- string variables
- regular expressions
- C's printf

The awk will take it's input from the files you specify on the command line or from standard input. The following is the format for awk:

```
É͸»
º                                                                  º
º    Command format: awk [-Fc] [prog] [files]                      º
º                                                                  º
È͸¼
```

The awk will scan each line of file for lines that match a set of patterns specified by prog. With each pattern in prog there can be an associated action to be performed when the line is found. The set of patterns may appear literally as prog, or in a file specified as -f file. The prog string should be enclosed in single quotes to protect it from the Shell.

Files are read in order and if there are none specified the standard input is read. Each line is matched against the pattern

portion of every pattern-action statement. The associated action is performed for each matched pattern. An input line is made up fields separated by white space. $1, $2.. define the fields. $0 refers to the whole line.

A pattern-action statement has the form:

```
pattern {action}
```

A missing action means print the line; a missing pattern always makes a match. a statement can be one of the following:

```
if (conditional) statement [else statement]
while (conditional) statement
for (expression;conditional;expression) statement
break
continue
{[statement]...}
variable=expression
print [expression-list] [>expression]
printf format [,expression-list][>expression]
next # skip remaining pattern on this input line
exit # skip the rest of the input
```

Statements are terminated by semi-colons, new-lines (CR), or right braces.

Let's look at the syntax for awk in a little simpler manner.

```
awk 'commands' [filename]
```

An awk program (commands) consists of a optional pattern to match and an action to perform if a match is found on the current line. This syntax looks like this:

```
awk '/pattern/{action}' [filename]
```

The pattern used is a regular expression enclosed in forward slashes. If no pattern is listed, the action will be performed for every line. An action can contain several commands. There can be multiple patterns and actions.

```
awk '/pattern1/{action1}
 /pattern2/{action2}' [filename}
```

One of awks commands is print. It puts the current line on standard output.

Sample session:

```
$awk '{print}' phone.lis
Smith, Joan         7-7989
Adams, Fran         2-3876
StClair, Fred       4-6122
Jones, Ted          1-3745
Stair, Rich         5-5972
Benson, Sam         4-5587
$
```

The awk splits every input line at whitespace and keeps track of the number of fields on each line and counts the number of lines read. Each field is identified by its field number and a $.

$1 Identifies the first field

$2 Identifies the second field

.

$0 Identifies the entire line

NF Identifies the number of fields on the line

NR Identifies the number of lines that have been read

Sample session:

```
$awk '{print NR,$1}' phone.lis
1 Smith,
2 Adams,
3 StClair,
4 Jones,
5 Stair,
6 Benson,
$
```

To change the order of the names in phone.lis use awk. The comma in the print command tells awk to separate each field with a space. Without the comma, the output would have no spacing.

Sample session:

```
$awk '{print $2, $1 "<tab>"$3}' phone.lis
Joan Smith,         7-7989
Fran Adams,         2-3876
Fred StClair,       4-6122
Ted Jones,          1-3745
Rich Stair,         5-5972
Sam Benson,         4-5587
$
```

6.7 sort: Sort a File

The sort utility sorts line of all the named files together and writes the result to standard output. The standard input is used if - is used as a file name or no input files are specified.

Comparisons are based one or more sort keys extracted from each line of input. There is only one key by default, that's the entire line, and ordering is lexicographic by bytes in machine collating sequence.

```
Command format: sort [-cmu][-ooutput][-ykmem][-zrecsz]
                     [-dfiMnr][-btx][+pos][-pos2][files]

 See on-line manual for options etc.
```

The easiest way to use sort is to add it at the end af a pipeline. What does the following command line accomplish:

Sample session:

```
$grep '<tab>[45]' phone.lis | sed 's/<tab>/<tab>73/' | sort
Benson, Sam         734-5587
StClair, Fred       734-6122
Stair, Rich         735-5972
$
```

The grep command will select only those records that have a 4 of a 5 in the phone number, those records are then sent to sed which will add "73" just after the tab character, then the records are sent to sort and put in alphabetical order. Notice that there is a problem here, should StClair come before Stair in an alphabetical listing? The answer is NO. Why did this happen? It occurred because of the collating sequence for the default sort.

This can be fixed by specifying some options on the call to the sort utility. Here are some options for sort. Let's see if we can determine how to remedy the problem discovered in the default sort.

Sort options:

- `-f` Fold lower case into upper case
- `-r` Reverse the sort from highest to lowest
- `-b` Ignore leading blank spaces
- `-d` Dictionary sort - ignore non alphanumeric characters
- `-m` Merge two sorted files together
- `-n` Sort the list as numbers not digit characters

Notice the -f options folds lower case into upper case. This option will make the sort for our problem work correctly. Here's the sample.

Sample session:

```
$grep '<tab>[45]' phone.lis|sed 's/<tab>/<tab>73/'|sort -f
Benson, Sam         734-5587
Stair, Rich         735-5972
StClair, Fred       734-6122
$
```

The sort can also be directed to use only a portion of the line as a sorting key versus the entire line. The utility will automatically break each line into fields at whitespace delimiters. You can use a character other than whitespace by using the -t option. The fields are set up like this:

```
   0     1        2
  /----|/---|/-------------|
 Adams, Fran         2-3876
```

In order to sort by the second field here is the sort command to enter.

Sample session:

```
$sort +1 phone.lis
Adams, Fran         2-3876
StClair, Fred       4-6122
Smith, Joan         7-7989
Stair, Rich         5-5972
Benson, Sam         4-5587
Jones, Ted          1-3745
$
```

Here's a sample of a sort on the 3rd field.

Sample session:

```
 $sort +2 phone.lis
 Jones, Ted         1-3745
 Adams, Fran        2-3876
 Benson, Sam        4-5587
 StClair, Fred      4-6122
 Stair, Rich        5-5972
 Smith, Joan        7-7989
 $
```

A sort can also be performed by a character position within a field. Here's the sample.

Sample session:

```
$sort +2.4 phone.lis
StClair, Fred           4-6122
Benson, Sam             4-5587
Jones, Ted              1-3745
Adams, Fran             2-3876
Stair, Rich             5-5972
Smith, Joan             7-7989
$
```

Note: The first character of a field is the delimiter for that field

6.8 What Other Useful UNIX Tools are Available

As stated from the beginning, one of the maxims used to develop UNIX was that tools would continue to be developed. Here is a list of tools that might be of interest to you.

UNIX Tool	Description
comm	Compares two sorted file and reports differences
cut	Select columns or fields from lines in a field (System V only)
diff	Report the differences between two files
join	Join lines in two files that contain a common field
pg	Show files (or standard input) on a terminal a screen at a time
od	Print the numeric equivalent of a file's content
tail	List end of files (or standard input) on standard output
tee	Sends standard input to two different places
tr	Transforms all occurrences of one character into another
wc	Count the characters, words, and lines in a file

6.9 Archiver and Library Maintainer

This command will maintain groups of files combined into a single archive file. The main use of ar is to create and update library files as used by the link editor. It can also be used for any other similar purpose. The file header consists of printable ASCII characters. If the archive consists of printable characters, then the entire archive is also printable.

The format for the ar command is as follows:

```
É͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸»
° Command Format:  ar key [posname] afile [name]...                    °
°                                                                       °
° Unlike command options, the command key is required.  The key,       °
° usually a - sign, is formed with one of the following letters        °
° drqtpmx.  Arguments to the key are made from one or more of          °
° the following set, vuaibcis.  See Appendix I for a complete          °
° list of command keys.                                                °
°                                                                       °
° posname is an archive member name used as a reference for            °
° positioning other files in the archive.                              °
°                                                                       °
° afile is the name of the archive.                                    °
°                                                                       °
° name[s] are the constituent files in the archive.                    °
È͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸¼
```

To illustrate how to create and use an archive file, we will use the "C" program called main.c and the two functions, funct1.c and funct2.c. First, create the object files that we intend to put into the archive file.

Sample Session:

```
Ú_____________________________________________________________________¿
| $cc -c main.c funct1.c funct2.c                                      |
| main.c:                                                              |
| funct1.c:                                                            |
| funct2.c:                                                            |
| $ls -C *.o                                                           |
| funct1.o funct2.o main.o                                             |
| $                                                                    |
À_____________________________________________________________________Ù
```

Remember the -c option will not produce an executable module, but it does create the object modules. These object modules are file files that we will place into an archive.

6.9.1 ar: Creating an Archive File with Object Modules

In this call to ar, we will use the r command key which will replace the named files in the archive. The v option will give a verbose file-by-file description of the making of the new archive file.

Sample Session:

```
$ar rv functs.a funct1.o funct2.o
a - funct1.o
a - funct2.o
ar: creating functs.a
$
```

The name of the new archive file is functs.a. The files that have been added to that archive are funct1.o and funct2.o. The file protections for the new archive file are rw-r--r--.

6.9.2 ar: Verifying the Contents of the Archive File

The key command to list the table of contents is t. The t command will print a table of contents of the archive file. When the v option is used with the t command it will give a long listing of all information about the files.

Sample Session:

```
$ar tv functs.a
rw-r--r--    115/    200 448 Sep 27 09:56 1990 funct1.o
rw-r--r--    115/    200 448 Sep 27 09:56 1990 funct2.o
$
```

This output shows that there are two members in this archive file, namely, funct1.o and funct2.o.

The protections of these files is:

owner - read and write
group - read
other - read

The fields are, left to right, the file protections, owner, group, size (in bytes), creation date and time, and finally the name of the constituent.

6.9.3 ar: Removing Duplicate Object Files

Once the archive has been created and verified, the object files in your directory can be deleted. This can be accomplished with the rm command.

Sample Session:

```
$rm funct?.o
$
```

The question mark (?) is a wildcard that stands for any single character. The files funct1.o and funct2.o no longer exist in your subdirectory.

6.9.4 ar: Compiling Main and Archive Files

Now that the object files, funct1.o and funct2.o, are in the archive file functs.a you, can link them with main.o in the following manner.

Sample Session:

```
$cc -o new_hello main.o functs.a
$ls -la new_hello
-rwxr-xr-x  1 teacher class  17570  Sep 27 12:58 new_hello
$
```

Workshop 6

This workshop will reinforce your understanding of the ideas presented in Chapter 6. Login to the Multimax using the username and password given to you by the instructor. Each student is to complete the entire workshop.

DESK EXERCISES

1. What is a UNIX process?

2. When a command is given to the Shell it will fork a child process to execute the command.

   True/False

3. What is a process identification number (PID)?

4. What is the name of the Shell variable that contains the current PID?

5. What is the UNIX command to find the PIDs associated with the controlling terminal? What option is needed to get detailed information?

6. What does the UNIX command grep do?

Continue on the next page

7. What do the following regular expressions represent?

   ^Ba

   .*

   BB*

   J*

   [0-9]*$

8. What does the UNIX command sed do?

9. What does the UNIX command awk do?

10. What does the UNIX command sort do?

11. What is the main use for the UNIX command ar?

Continue on the next page

COMPUTER EXERCISES

Use the phone.lis database file to answer the following questions.

12. "I want to find all the phone numbers that begin with a 4 and end with a 2"

13. "I can't remember the name but I believe the last name starts with an S and the first name with an F"

14. Find all the people with 3 character first names.

15. Write a grep command that finds all the phone numbers that don't begin with a 4, 5, or 6.

16. Write a grep command that finds all entries beginning with J-Z and ending with a 2 or 5.

17. Put a 23 in front of every phone number. (Hint:sed)

18. Replace the first name with the person's first initial and a period.

Continue on the next page

19. Task: A new phone system has been installed and people with phone extensions beginning with 4 or 5 now have a new prefix: 73. Create a file of only the people with the new phone numbers.

20. Print out the phone list showing last name and first name in the following format and sorted by last name.

First name <tab> Last name

That's enough, don't you think?

7. VAX DCL TO UNIX SHELL SCRIPT CONVERSION

This chapter will describe the steps necessary to convert DCL command files into Shell scripts. It is not a one to one conversion and many features found in one operating system are not found in the other. This requires you to write shell scripts that emulate features of the other. This is especially true of VAX and UNIX. The best way to accomplish this is to know exactly what it is that the command file does in VMS and then write the equivalent function in a shell script. There are few features that are the similar and those will be examined.

There is really no "best" way to approach this subject. VMS and UNIX are both unique operating systems. Much of the material covered in this course up to this point will be used in the conversion process. We will start with a list of standard UNIX tools and their VMS equivalents. This will give a you a flavor of the kinds of tools each operating system has to offer.

Major Tool	VMS	UNIX
Editors	EDT	ed
	TECO	ex
	TPU	vi

Communications	MAIL	mail
	REPLY	write
	PHONE	talk
	DECnet	ftp
		telnet
Compilers	FORTRAN	f77
		cc
Text Processing	RUNOFF	troff
		nroff
		awk
		lex
		sed
	SORT	sort
	MERGE	merge
Program Development Tools	LINK	link
	DEBUG	adb/dbx
	LIBRARIAN	ar/ranlib
	DEC MMS	make
		yacc
	DEC CMS	scs
Miscellaneous	DECalc	bc/dc
	DECspell	spell

As you can see from the above lists, both systems offer editors capable of screen or line editing capabilities. Both have interactive communications, electronic mail, networking, file transfer, remote command execution, and remote logins. These utilities and tools are standard to UNIX but require a license to run under VMS. The Digital Command Language (DCL) and the UNIX Shell (Bourne,C, or Korn) are command interpreters. That is, they are both programs that parse the command line and then pass control to other programs that are the kernel of the operating system.

7.1 Processes

When you login to either system the operating system will create a unique process. This process is given access to memory and CPU resources. The differences between the two operating systems with respect to multi-tasking needs explanation. Multi-tasking is concurrent processes initiated by a single user. When the user starts a terminal session the system initiates a single process called the PARENT process. It is possible to start multiple processes from the parent process. This is called spawning in VMS and forking in UNIX. The new process is called a sub-process in VMS and a child process in UNIX. This idea of "forking" a child process occurs frequently in UNIX.

When UNIX creates a child process or VMS creates a subprocess different things occur. First, let's look at VMS. When the

subprocess is spawned the parent goes to "sleep" until the user logs off from the subprocess. When the logoff occurs control returns to the parent. The VMS ATTACH command gives control back to the parent process and the subprocess goes to sleep. The point is that only one process is active at a time. The exception is the VMS RUN/PROCESS=name which will run a user-defined process at the same time commands can be issued at the parent process.

In UNIX, you can run parent and children processes at the same time. A child process can fork another process and thus a process can be both a parent and child. Child processes are not restricted to user-defined images but can be any valid UNIX operation. UNIX processes that are running or stopped but not getting input from a terminal are said to be in background. When you begin a UNIX session the kernel gives you a copy of the shell. When you enter a command the Shell forks a child. That child then processes the command you entered.

Note: some commands are executed by the Shell itself and no child is forked.

This is a different concept from VMS, in which all commands are executed by the parent process. Once a subprocess is created the parent remains dormant until the subprocess completes.

All the above parent and child processes use the standard default for input and output devices, the terminal. Input and output streams in UNIX are called standard input (stdin) and standard output (stdout). Standard error (stderr) also uses the terminal as it's default output. In order to redirect these streams from a terminal in VMS it is requires the assignment of the logical names SYS$OUTPUT, SYS$INPUT, and SYS$ERROR to a file or device. UNIX has a much nicer means of redirecting the input or output.

7.2 Pipes

A vertical bar (|) is used to redirect the output of a command to the input of another command. This is the power of UNIX. For example, we want to get a list of all currently active users, sorted in alphabetical order, and sent to the printer, how could that be done in VMS? Here's one solution:

VMS Sample Session:

```
$SHOW USERS/OUTPUT=A.TEMP
$SORT/KEY=POSITION:40,SIZE:6)-
  A.TEMP SYS$PRINT
```

Notice the need for an intermediate file called A.TEMP.

Now how would this same requirement be met using UNIX. There is a command that will list the users that are currently logged on to the system. The command is who. Pipes allow the output of one command to be the input into another command. The output of who can be put into another UNIX command sort by a pipe. In a similar

manner, the output of sort can be redirected to another command called lp. Thus the same problem can be solved using UNIX Shell in this way:

UNIX Bourne Shell Sample Session:

```
$who | sort | lp -dmtlzr
```

Notice that there is not a one-to-one command conversion that is taking place here. The idea is to convert the process more than individual commands from VMS DCL to UNIX Shell.

7.3 Input, Output, and Error Redirection

Just as the VMS logicals SYS$INPUT, SYS$OUTPUT, SYS$COMMAND, and SYS$ERROR point at the terminal by default, so do the UNIX equivalents stdin, stdout, and stderr. The equivalent of the SYS$COMMAND in UNIX is the "Here is" document. UNIX uses a much more simplified method of redirecting input and output to or from a file. UNIX does not require the effect of an ASSIGN statement ahead of the redirection. UNIX uses a metacharacter that is included as part of the command line. Here is an example of both VMS and UNIX.

VMS Sample Session:

```
$ASSIGN/USER A.LIS SYS$OUTPUT
$ASSIGN/USER INPUT.DAT FOR005
$RUN MYPROG
```

The equivalent function can be written in UNIX Shell like this:

UNIX Bourne Shell Sample:

```
$myprog < input.dat > a.lis
```

The point here is to see that the metacharacters < and > act as the input and output redirection symbols. Please don't get the idea that UNIX is much simpler than VMS DCL. That is not the case. They each have strong points and weak points, they are not the same. This is comparing apples and oranges.

Here is a partial list of the metacharacters used by the UNIX Shells and their meanings. These can be useful when you try to redirect input and output.

Character	Meaning
>	Redirect standard output (stdout)
>>	Redirect and append standard output (stdout)

>&	Redirect standard output (stdout) and standard error (stderr)
>>&	Redirect and append standard output (stdout) and standard error (stderr)
<	Redirect standard input (stdin)
||	Redirect standard output (stdout) to another command

These are the most commonly used redirection metacharacters.

Notes:

UNIX redirection only affects the command line on which the redirection character occurs.

Error messages are not redirected and will appear on the terminal.

If a file already exists, VMS will create a new version of the file with a higher version number. By default, UNIX will overwrite the existing file.

7.4 Command Structure and File Naming Conventions

VMS is not case-sensitive in its interpretation of commands. It doesn't distinguish between upper and lower case characters. This is not true in UNIX, however. Commands must be entered in lower case characters only. The Shell will not understand characters that are in uppercase.

Filenames are also case sensitive in UNIX. The file named MYFILE.DAT and the file myfile.dat refer to different files. One advantage of this is that you can have a much larger variety of filenames with fewer characters. Especially good if you don't like to type.

This also has advantage over the filename conventions used by VMS. Directories and subdirectories are pointer files in both operating systems. When a subdirectory is created in VMS it is given the extension name .DIR automatically. UNIX files on the other hand do not distinguish between ordinary files and directories. Many VMS users have adopted a practice of naming new subdirectories in UNIX with all capital letters or the first letter being capitalized. This is not, however, standard UNIX practice.

VMS Sample Session:

```
$CREATE/DIRECTORY [.TEST]
$DIRECTORY
```

UNIX Shell Sample Session:

```
.................................................................
.  $mkdir Test                                                  .
.  $ls Test                                                     .
.................................................................
```

It is possible in UNIX to maintain the same filename conventions that you used in VMS. The period (.) is a legal character in a UNIX filename. Some VMS users like to continue the practice of naming files using the same . extensions from VMS. Problems occur when default extensions are different between the two systems. For example, object files use the extension .OBJ in VMS but .o in UNIX. Another example is FORTRAN source code in UNIX the extension is .f and VMS uses .FOR. Note that .o and .f are UNIX conventions to facilitate file recognition and that UNIX commands do not assume file extensions as VMS does.
Here is a list of commonly used extensions for both operating systems.

VMS	UNIX	Definition
.OLB	.a	Library
.BAS	.bas	BASIC Source Code
.C	.c	C Source Code
.FOR	.f	FORTRAN Source Code
	.h	C header files
	.l	lex program
.OBJ	.o	Object Code
.PAS	.p	PASCAL Source Code
	.s	Symbolic Assembly Code
	.y	yacc program
.EXE	a.out	Executable Image
.ADA		ADA Source Code
.B32		BLISS-32 Source Code
.CLD		Command description file
.COB		Cobol Source Code
.COM		Commands for the language interpreter
.DAT		Data file
.DIS		Distribution list file for MAIL
.DIR		Directory file
.EDT		Startup command file for EDT editor
.DOC		Documentation
.HLP		Input source files for HELP Library
.JOU		Journal file created by EDT
.LIS		Listing of text
.LOG		Batch job output file
.MAI		MAIL message file

.MAR	VAX Macro source code	
.SYS	System Image	
.TMP	Temporary file	

7.5 File Management Commands

This is a table of the more commonly used file management commands. Some of these commands have been covered elsewhere in this manual. The on-line manual command (man) can be used to get detailed information about any UNIX command.

UNIX Command	VMS equivalent	Purpose
ar	LIBRARY	Archive files
awk	TPU	Pattern matching utility
cat	TYPE/APPEND	Catenates and prints to terminal
cd	SET DEFAULT	Change working directory
chgrp	SET FILE	Change group ownership
chmod	SET PROTECTION	Changes protection
cmp	DIFFERENCE	Compares two files and reports first difference found
cp	COPY	Create a new copy
find	DIRECTORY	Locates within a directory structure
ftp	COPY	Transfer to/from remote node
grep	SEARCH	Finds a string
ln	ASSIGN	Create a symbolic link
ls	DIRECTORY	List contents of a directory
merge	MERGE	Merge files
mkdir	CREATE/DIR	Make a directory
mv	RENAME	Moves or renames files
od	DUMP	Octal, decimal, hex, ASCII dump
pr	PRINT/HEAD	Prints files
pwd	SHOW DEFAULT	Working directory name
rm	DELETE	Removes or deletes files

rmdir	DELETE	Removes a directory file
sort	SORT	Sorts by a key
tail	EDIT/READ	Outputs last part of file
tar	BACKUP	Tape archive
touch	CREATE	Updates file characteristics or creates null file
tr	EDIT	Translates characters

7.6 Metacharacters

Characters that have special meanings to the Shell are known as metacharacters. Users should avoid using these characters in filenames as results might be unpredictable. We have already seen several metacharacters, for example, vertical bar (|), or the greater than (>) or less than (<). The function of metacharacters can be different depending on whether the Shell or a UNIX tool interprets the character. The following is a list of UNIX special characters and their VMS equivalent.

UNIX Char	Function	VMS equivalent
&	Perform command in Background	
=	Assignment operator	=
;	Command separator	
\	Continuation of command line	-
\m	Literal translation of metacharacter m	"m
'	Turn off special meaning	"
`	Process immediately	@ & run
"	Group characters into a single argument	"
#	Comment follows	!
*	Wildcard filename substitution	*
?	Wildcard filename substitution single character	%
$	Argument substitution follows	'
$#	Argument count	
$$	Process id	F$GETJPI("PID")
$?	Exit status	$STATUS
$<	Read one line from standard input	INQUIRE, READ
.	Current directory	[]
[]	Selective filename substitution	

Note: Metacharacters unique to the C-Shell have not been included in this list to reduce confusion. Check C-Shell documentation for a complete list.

7.7 Wildcards: Are They Really Wild?

UNIX wildcards extend the features found with wildcards in VMS. The following table shows how UNIX expands wildcard definitions:

Ú_____¿

UNIX example	Meaning
*	# All files in the current directory and one level below
.	# Files in the current directory
.	# All files that contain a period in the filename
*.com	# All files in the current directory that end in .com
?.com	# All files in the current directory that end in .com and have one character preceding the period
name[xyz]	# All files in the current directory, namex, namey, or namez
name[a-z]	# All files in the current directory namea through namez
name[a-z4]	# All files in the current directory, namea through namez and name4

There are no absolute rules concerning the use of wildcards. The output produced by the wildcard expansion process is command dependent. For instance, the ls * command will list files in the current directory and the files in the directory in the next lower level as well. The wc * (word count) command will produce output for the files in the current directory only. Thus as you can see commands vary in how wildcards are expanded.

Users and programmers can use wildcards in a similar way to the method of using wildcards on the VAX. UNIX will interpret *.com to mean any file in the current directory that ends in .com even though the extension has no meaning in UNIX.

7.8 Summary

The VMS and UNIX operating systems are similar in some respects. The VMS user must recognize that there are some fundamental differences.

UNIX allows multiple processes and the user must learn to manage these processes. VMS usually manages a single process which processes commands in sequence.

UNIX has a different command syntax. UNIX commands are already short and cannot be abbreviated like VMS commands. UNIX commands do not lend themselves easily to describe their function. For example, TYPE seems to describe the function better than cat in UNIX. Single letter options modify UNIX commands in a manner

similar to VMS command qualifiers.

UNIX has a different file and directory structure. You can address any file irrespective of the physical device using the absolute or relative pathname.

UNIX has metacharacters which have special functions when interpreted by the Shell.

NOTES

Workshop 7

This workshop will reinforce your understanding of the ideas presented in all the previous chapters. Login to the Multimax using the username and password given to you by the instructor. Each student is to complete the entire workshop.

DESK EXERCISES

1. Convert the DCL command file found on the next page to BourneShell and run it.

Helpful?? Hints:

What does the VMS DCL command file do?

Does UNIX Shell have a similar function?

What does the UNIX command cut do?

What does the UNIX command date do?

Can this script be converted one line at a time?

Continue on the next page

```
$ Today = F$cvtime("today",,"weekday")
$ if today .eqs. "Monday" then goto monday
$ if today .eqs. "Tuesday" then goto tuesday
$ if today .eqs. "Wednesday" then goto wednesday
$ if today .eqs. "Thursday" then goto thursday
```

```
$ if today .eqs. "Friday" then goto friday
$ go to weekend
$ Monday:
$    Write sys$output " "
$    Write sys$output "Today is ''today' and there are 5 days
 until this weekend"
$    Write sys$output " "
$    exit
$ Tuesday:
$    Write sys$output " "
$    Write sys$output "Today is ''today' and there are 4 days
 until this weekend"
$    Write sys$output " "
$    exit
$ Wednesday:
$    Write sys$output " "
$    Write sys$output "Today is ''today' and there are 3 days
 until this weekend"
$    Write sys$output " "
$    exit
$ Thursday:
$    Write sys$output " "
$    Write sys$output "Today is ''today' and there are 2 days
 until this weekend"
$    Write sys$output " "
$    exit
$ Friday:
$    Write sys$output " "
$    Write sys$output "Today is ''today' and there is 1 day
 until this weekend"
$    Write sys$output " "
$    exit
$ Weekend:
$    Write sys$output " "
$    Write sys$output "Today is ''today' and why are you working
 on a weekend"
$    Write sys$output " "
$    exit
```

Continue on the next page

2. Not all functions, especially calls to library functions, that exist in VMS have an equivalent call in UNIX Shell. An example of this is F$ELEMENT in VMS. Write a BourneShell script that will do the same job as F$ELEMENT and test it.

If time remains and you want a further challenge:

3. Write a user interface to add and delete records to the phone.lis database. Query the user in a user friendly manner and check to see if the name is already in the database prior to adding it.

That's all for this workshop. If you didn't finish because of time, that's OK, as long as you understand the process needed to do conversions.

NOTES

ÜÜÜ

8. ADVANCED FEATURES OF FTP

This chapter will discuss some advanced features of the FTP server as implemented on the Multimax. The introduction of FTP in UNIX for Beginning Users gave an elementary introduction to some of the features. If you are not familiar with the basics, please refer to that manual. It is not the purpose to review those basics here.

The FTP (Internet file transfer program) is the user interface to the DARPA File Transfer Protocol. This utility program will transfer files to and from a remote computer. In order for files to be transferred from the local computer to a remote computer, a connection must be established. This can be done from the FTP command line. The connection to the remote computer will remain active until it is terminated by the user.

The remote computer with whom the connection is to be made can be specified on the FTP command. In this case, FTP will immediately try to establish a connection. If the remote computer is not specified, FTP will enter its command interpreter mode and wait for instructions; a prompt will be displayed.

FTP does have a help feature, and all 58 commands can be listed. It will also give a terse description of each command. In addition, there are on-line manual pages which can be accessed by using the man command in UMAX.

8.1 Initializing FTP on UMAX

The term, "local computer," will refer to the Multimax. The

"remote computer" will refer to the other computer with which you are trying to send/receive files. For purposes of this course, we will be referring to the VAX minicomputer as the remote computer. Please be aware that these procedures will work for any computer connected to Ethernet and having an FTP server.

FTP can be invoked on the local computer using the following syntax:

```
ÉÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ»
°  Command Format:  ftp [-v] [-d] [-i] [-n] [-g] [host]         °
°                                                               °
°         -v = verbose on, forces ftp to show all responses     °
°              from the remote server                           °
°                                                               °
°         -d = enables debugging                                °
°                                                               °
°         -i = turn off interactive prompting during            °
°              multiple file transfers.                         °
°                                                               °
°         -n = disables the "auto-login" feature                °
°                                                               °
°         -g = disable filename globbing                        °
°                                                               °
°         host = the name of the remote computer                °
ÈÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ¼
```

NOTE: UMAX (UNIX) is case sensitive. The commands and options must be entered as shown.

8.2 Multiple File Transfers

The syntax for the multiple get command is:

```
ÉÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ»
°  Command Format:  mget remote-files                           °
°                                                               °
°  remote-files = remote computer wildcard specification        °
°                      or                                       °
°                  file1 file2 ... filen                        °
ÈÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ¼
```

The remote computer wildcard specification is expanded in a process called globbing. Once the globbing is complete, a get is performed on each filename; and it is transferred to the local computer. The filename is the same on both computers. You can specify the filenames to be transferred separating them with spaces.

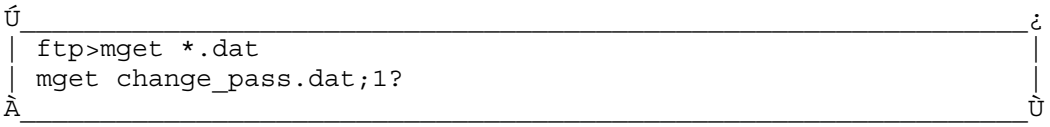
Example:

```
.................................................................
. ftp>mget *.dat;*                                              .
.................................................................
```

This command will transfer all versions of the remote-files that have the filename extension of .dat. If the option -i was specified on the call to FTP, then the files will be transferred

automatically. If the option was not specified, FTP will prompt you before transferring each file.

Sample Session:



The default is 'yes', pressing (Ret) will cause the file to be sent to the local directory. If you don't want this file transferred, enter n(Ret); you will then be prompted for the next file, if one exists.

8.3 Auto Login Feature

It is possible to have the login procedure occur automatically. To do this requires a file in your home directory called .netrc. The .netrc file contains login and initialization information to be used by the auto-login process. The following variables are used and can be separated by spaces, tabs, or new lines.

machine name

This is the name of the remote computer. The auto-login process will search the .netrc file for a machine variable that matches the name of the remote computer on the ftp command or as an open command argument. Once a match is found, the next variables are also processed until the end of file or another machine variable is encountered.

login name

This is the username on the remote system. If this variable is present, the auto-login process will login to the remote computer with the given username.

password string

This is the password to be used when logging in to the remote system.

NOTE: If this variable is present in the .netrc file, ftp will abort the auto-login process if the .netrc file is readable by anyone but the user.

account string

This supplies an additional account password. If present, the auto-login process will supply the string as an additional password if required by the remote server.

macdef name

This defines a macro. This variable will function like the ftp macdef command. A macro is defined with the specified name, its contents begin with the next .netrc line and continue until a null line (2 new line characters). If a macro named init is defined, it will be executed as the last step of the auto-login process.
Sample Session:

```
$cat .netrc
machine erc830
login teacher
password secret1
machine erc780
login rharding
password secret2
$
```

To invoke the auto-login feature, type the ftp command and enter the name of the remote computer as an argument.

Sample Session:

```
$ftp erc830
Connected to erc830.
220 erc830 Wollongong FTP Server (Ver 5.0) at Tue Oct 23
331 Password required for rharding.
230 User logged in, default directory D_1131:[RHARDING]
ftp>
```

If the .netrc file is readable by anyone other than the user, the following error message will appear; and the connection will not be made to the remote computer.

Sample Session:

```
$ls -l .netrc
$ftp erc830
Connected to erc830.
220 erc830 Wollongong FTP Server (Ver 5.0) at Tue Oct 23
Error - .netrc file not correct mode.
Remove password or correct code.
221 Goodbye.
ftp>
```

To correct this error, change the mode of the .netrc file so it is not readable by other users or remove the password from the file. This is to prevent your password from being read by an unauthorized user.

8.4 Macros

Macros are a single instruction that a program replaces by several, usually, more complex instructions. The ftp command to create a macro definition is:

```
É͸»
°  Command Format:  macdef macro-name                                  °
°                                                                      °
°  macro-name - the name of the macro                                  °
È͸¼
```

After the macdef command is given, all subsequent lines are stored as a macro with the name macro_def. Consecutive newline characters or carriage returns terminate the input mode into the macro. There is a limit of 16 defined macros and a limit of 4096 characters in all defined macros.

Sample Session:

```
Ú_____________________________________________________________¿
| ftp>macdef get_files                                        |
| open erc780                                                 |
| get file_1                                                  |
| put result_2                                                |
| close                                                       |
| ftp>                                                        |
À_____________________________________________________________Ù
```

In this example, the four lines of the macro can be executed simply be entering get_files at the ftp prompt. The macro will only exist until the current ftp session is closed.

8.5 Filename Translation

Filename conventions differ from one computer to another, and FTP will allow you to translate the name as it is transferred. One way is to specify the name of the file as it is to exist on the local computer. This is done by the argument on the put or get command.

```
É͸»
°  Command Format:  put local-file [remote-file]                     °
°                                                                    °
°                   get remote-file [local-file]                     °
È͸¼
```

If you don't specify the remote-file (for the put command) or the local-file (for the get command), the name will be the same on both the local and remote computer. This can cause a problem if you are not aware of it. There is an FTP command that will allow the name to be translated automatically.

```
É͸»
°  Command Format:  nmap [inpattern outpattern]                      °
```

```
ÈÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ¼
```

If no arguments are supplied, it will set or unset the filename mapping mechanism. If arguments are specified, remote filenames are mapped during mput (multiple file puts) and put (single file) commands that are issued without a specified remote filename.

If arguments are specified, local filenames are mapped during mget (multiple file gets) and get (single file) commands that are issued without a specified local filename.

The mapping follows the pattern set by inpattern and outpattern. Variable templating is done by including the sequences "$1", "$2",...."$9 "in inpattern. All other characters are treated literally and are used to determine the nmap inpattern variable values.

For example, say the inpattern was $1.$2 and the remote filename is mydata.data, $1 would have the value mydata and $2 would have the value data. The outpattern determines the resulting mapped filename. The sequences "$1", "$2",..."$9", are replaced by the value resulting from the inpattern template. "$0" is replaced by the original filename.

8.6 Aborting Transfers

Press the terminal interrupt key (usually Ctrl-C) to abort a file transfer. The sending transfer will stop immediately. Receiving transfers will be halted by FTP sending an ABOR command to the remote server and discarding any further data that is received.

If the remote server doesn't support the ABOR protocol command the ftp> prompt will not appear until the requested file has been sent.

8.7 More Remote Computer Commands

These commands can be useful when working with the directories on the remote computer.

```
ÉÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ»
º  Command Format:  cdup                                         º
ÈÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ¼
```

This FTP command will change the remote machine current working directory to the parent of the current working directory.

```
ÉÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ»
º  Command Format:  delete remote-file                           º
º                                                                º
º  remote-file  name of the file to delete                       º
ÈÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ¼
```

This FTP command will delete the specified file.

```
É͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸»
°  Command Format:  mdelete [remote-files]                                  °
°                                                                           °
°  remote-files  names of the files to delete                               °
È͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸¼
```

This FTP command acts as a multiple delete. It will delete all the specified files.

```
É͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸»
°  Command Format:  mkdir directory-name                                    °
°                                                                           °
°  directory-name  the name of the directory to be created                  °
°                  on the remote computer.                                  °
È͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸¼
```

This FTP command will create a directory on the remote computer.

```
É͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸»
°  Command Format:  rmdir directory-name                                    °
°                                                                           °
°  directory-name  the name of the directory on the remote                  °
°                  computer that will be removed.                           °
È͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸͸¼
```

This FTP command will remove the specified directory.

NOTE: This command will not work with some remote servers.

NOTES

Workshop 8

This workshop will reinforce your understanding of the ideas presented in Chapter 9. Login to the Multimax using the username and password given to you by the instructor. Each student is to complete the entire workshop.

DESK EXERCISES (10 minutes)

1. What FTP command is used to transfer more than one file at a time? What FTP command will give a prompt to you before each file is retrieved? Suggestion: there are two ways

2. What is the name of the file where the auto-login variables are found? Extra credit: Why does this file begin with a dot (.)?

3. How can the file in question the auto-login file be protected from unauthorized reading?

4. What do the following FTP commands do?

cdup

delete (tough question)

mdelete (ditto)

mkdir

rmdir

Continue on the next page

COMPUTER EXERCISES (30 minutes)

5. Transfer all the files from on the VAX (erc830) to the domax1. Use only one command and use wildcards. The username and password for the VAX will be given to you by the instructor.

6. Transfer the files from the VAX and this time translate the names of the files as they are transferred.

7. Create an auto-login file for the erc830 and then do an auto-login to the VAX.

8. Logout.

9. OPTIONAL CHAPTER - KORNSHELL PROGRAMMING

The KornShell is a command-programming language that executes commands read from a terminal or file. The KornShell is close to being upward compatible with the standard BourneShell. For example, scripts written for the BourneShell (sh) will also work in the KornShell (ksh). The major enhancements are command-line reentry, in-line command editing, and aliasing.

This chapter will deal with some, not all, of the features that differentiate it from the BourneShell. For your information, here is a list of features that have been enhanced from Bourne. Improvements have been made as a command language, including command-line editing, a command history mechanism, command-name aliasing, job control, new capabilities for cd, and tilde expansion.

Improvements as a Programming Language include a more general I/O mechanism, Menu selection primitive, Built-in integer arithmetic, Substring operators, Array variables and attributes, More-general function facility, Co-process facility, Easier to debug, Better performance, and Better security.

The KornShell is a high level programming language and a command line interpreter.

```
É͸
°  Command Format: ksh [acefhikmnorstuvx] [ -o option]...[args] °
°                                                               °
°      See the appendix for a complete list of options          °
°                                                               °
È;¼
```

9.1 KornShell Variables

The KornShell has variables that are initialized for you on login such as:

PATH — Determine which directories are searched, sequentially for shell commands.

CDPATH — The directories that are searched for arguments to the "cd" command.

SHELL — The current interactive shell.

PWD — The present working directory.

IFS — Valid inter-field separators used to separate commands from arguments, arguments from each other and commands from each other.

EDITOR — Command line edit mode.

FCEDIT — Editor entered when using fc

TERM — Defines terminal capabilities

PS1 Primary shell prompt

PS2 Secondary shell prompt

PS3 Select command prompt

HOME Home directory

ENV File(s) to execute when entering this shell

LOGNAME Login name of the user

The command line argument variables are also available:
$$, $?, $*, $#, and the positionals ($0, $1, $2...etc)

9.2 User Defined Variables

These variables are similar to the BourneShell. The general form is VARIABLE=value.

No spaces are allowed around the =. You can enclose them in double quotes "=" or single quotes '=' for clarity. No spaces are allowed in "value". These can also be enclosed in double or single quotes. "value" can be a string or an expression. The value of a variable can be accessed by preceding the name of the variable with a dollar sign ($).

Examples:

```
. $MyString'='"This is a string"                    .
. $MyStatic=47                                      .
. $readonly Mystatic                                .
```

The readonly command makes MyStatic read only (can't change the contents).

Example:

```
. $typeset -i BIGINT=1492                           .
```

This will make the variable integer for faster arithmetics:

```
. $typeset -i8 OCTINT=9                             .
```

The output of OCTINT will be an octal integer; the assignment is decimal.

Sample Session:

```
$echo $OCTINT
8#11
$
```

9.3 Values of Variables Between Child and Parent Processes

Values in one shell are local only to that shell. If a child process or a subshell needs to have access to a value established in its parent, the value must be exported from the parent.

```
$typeset -i8 -x OCTINT=19
```

The -x option exports the variable OCTINT; subshells can read it, but can't change the value in the parent.

```
$MyString='Hi there'
```

At this point, the variable MyString is local to the current process. It is not available to a child process.

```
$export MyString
```

Now the variable MyString is available to subshells.

To allow a subshell to change the content of an exported variable and have that change be know to the parent, execute the child with ". program_name"

Sample Session:

```
$cat my.vars
echo Variable coming into script: $PARENT
PARENT='child value'
echo Variable coming out of the script: $PARENT
$PARENT='parent value'
$echo $PARENT
parent value
$my.vars
Variable coming into script:
Variable coming out of the script: child value
$echo $PARENT
parent value
$
```

Sample session:

```
$PARENT='parent value'
$echo $PARENT
```

```
| parent value                                                        |
| $. my.vars                                                          |
| Variable coming into the script: parent value                       |
| Variable coming out of the script: child value                      |
| $echo $PARENT                                                       |
| child value                                                         |
| $                                                                   |
À_____________________________________________________________________Ù
```

9.4 ksh: Aliases

The first word of each command can be replaced by the text of an alias if an alias for this word has been defined. The first character of an alias name can be any printable character, but the remaining characters must be the same as any valid identifier. Aliases can be created, listed, and exported with the alias command. They can be removed with the unalias command.

Aliasing is performed when scripts are read but not while they are executed. Therefore, for an alias to take effect the alias command has to be executed before the command which references the alias is read.

The format for the alias command is as shown below.

```
É»
°  Command Format:  alias [-tx] [name=value]                         °
°                                                                     °
°  -t = to set and list tracked aliases                               °
°  -x = to set or display exported aliases                            °
°                                                                     °
°  name = if specified, it must be a valid alias name                 °
°                                                                     °
°  value = value to equate with name                                  °
È¼
```

Example:

```
.....................................................................
. $alias                                                             .
.....................................................................
```

The command alone will display all aliases.

Sample Session:

```
Ú_____________________________________________________________________¿
| $alias                                                              |
| cd=c                                                                |
| echo=print -                                                        |
| false=let 0                                                         |
| functions=typeset -f                                                |
| hash=alias -t                                                       |
| history=fc -l                                                       |
| integer=typeset -i                                                  |
| monitor=/usr/lbin/top                                               |
| nohup=nohup                                                         |
| pwd=print - $PWD                                                    |
```

```
| r=fc -e -                                                    |
| true=:                                                       |
| type=whence -v                                               |
| $                                                            |
À______________________________________________________________Ù
```

Suppose, instead of typing in the ls -la command to get a full, long listing of the contents of the current directory, we want to shorten the command to list. Enter the following command to set the alias.

Example:

```
.............................................................
. $alias list='ls -la'                                       .
.............................................................
```

Now when you type in the command list, the alias will substitute the command ls -la for list; and the long listing will be displayed.

Sample Session:

```
Ú______________________________________________________________¿
| $list                                                        |
| total 54   0                                                 |
| drwx------  4 teacher  class   2590  May 1 09:39  .          |
| drwxr-xr-x 63 teacher  class   1536  Sep 9 13:11  ..         |
| -rw-r--r--  1 teacher  class     64  Jul 4 10:33  .assistrc  |
.                                                              .
.                                                              .
```

9.5 ksh: Command Line Editing

There are two forms of command-line editing in the KornShell. Both use the command history in the file indicated by the KornShell variable HISTFILE (default is HISTFILE=$HOME/.history).

Editing commands in the history file is accomplished with fc (fix command). To get a list of commands in the .history file, you enter the fc -l command at the dollar ($).

By default, the alias history may also be used.

Editing a command in the .history file with the fc command is controlled by the KornShell variable FCEDIT. FCEDIT determines the editor that the fc command will use.

Example:

```
.............................................................
.  $FCEDIT=/usr/bin/vi                                       .
.  $fc                                                       .
.............................................................
```

The KornShell variable causes the fc command to use the vi editor. The fc command, by itself, will take you into the vi editor with the most recent command. In this example, upon exiting the vi editor, the edited command will be executed.

Example:

```
. $ct .profile                                                  .
. .profile: No such file or directory                           .
. $fc -e - ct=cat c                                             .
```

The first line is a deliberate mistake; notice the error message. The fc command executes the most recent command that starts with a "c" and changes the first occurrence of "ct" to "cat"; it doesn't enter the editor.

Example:

```
. $ls /                                                         .
. $fc -e - ls=cd                                                .
```

The first command will list the contents of the root directory. The fc command changes that command from "ls" to "cd"; the "-" indicates that the line is to be edited instead of taken into the editor before execution.

9.6 ksh: Interactive Command Line Editing

In this method of command-line editing, the EDITOR KornShell variable controls the editing.

Example:

```
. $EDITOR=/usr/bin/vi                                           .
```

This command will put the KornShell in the vi editing mode.

To enter the edit history press Esc.

NOTE: This example is for the vi edit mode only; emacs or gmacs edit modes use different key stokes.

To move though the .history file use following keys:

<k>	Select the previous command
<j>	Select the next command
<h>	Next letter to the left
<l>	Next letter to the right

When the command line that you desire to change is displayed on the screen, you can use the following commands to make changes:

<i> insert chars Esc	Insert characters before the cursor
<A> append chars Esc	Append characters at the end of the line
<r> replacement char Esc	Change single character
<cw> replacement word Esc	Change single word
<x>	Delete single character

NOTE: A number can precede the command as a count, for example, "3x" deletes 3 characters.

<dw>	Delete single word

NOTE: A number can precede the command as a count, for example, "2dw" deletes 2 words.

(Ret)	Execute the altered command

When the (Ret) key is pressed, the edited command line will be executed. History is not changed, but the new command is entered into the .history file at the end.

These are not the only commands available with the interactive command line editing. You will find that the arrow keys will not work while editing the command line. Most of the editor features will be available for you to use, depending upon which editor was selected by the EDITOR shell variable.

9.7 ksh: Functions

Functions are similar to aliases, they run in the current KornShell process and define a set of actions. Positional parameters can be referenced; other previously defined functions can be referenced; nested function definitions are allowed with full visibility to all definitions.

The function keyword is used to define KornShell functions. The functions are read in and stored internally. Any alias names are resolved when the function is read. Functions are executed like commands with arguments passed as positional parameters.

Functions execute in the same process as the caller and share all files, traps, and present working directory with the caller.

The format for functions is:

```
É͸»
°  Command Format:                                                  °
°                                                                   °
°  function  identifier                                             °
°  {                                                                °
°        compound list                                              °
```

```
°  }                                                                    °
°                                                                       °
°  identifier - name by which the function is called                    °
°                                                                       °
°  compound list - The body of the function.                            °
ÈÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ¼
```

The left bracket { and the right bracket } are considered to be reserved words. The body of the function must exist between the two brackets.

Sample Session:

```
Ú_____________________________________________________________________¿
| $function k                                                         |
| {                                                                   |
| cd /; ls -C;                                                        |
| }                                                                   |
| $                                                                   |
À_____________________________________________________________________Ù
```

To execute the function, simply type the name of the function on the command line.

Sample Session:

```
Ú_____________________________________________________________________¿
| $k                                                                  |
| bck          lib       tmp       user12         user5             |
| bin          lost      tmp.ja    user13         user6             |
| bsd          nbox      unix      user14         user7             |
.                                                                     .
.                                                                     .
.                                                                     .
```

9.8 ksh: The Select Construct

The "select" construct is unique to the KornShell. It allows the user to determine the action based on input from either the command line (without an in list) or from an automatically prompted input. PS3 controls the "select" prompt.

The command format is as follows:

```
ÉÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ»
°  Command Format:  select identifier [in list]                       °
°                   do                                                °
°                        commands                                     °
°                   done                                              °
°                                                                     °
ÈÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ¼
```

In the select command:

ksh will display the items in one or more columns on standard error, each preceded by a number. The PS3 prompt follows. The number of columns is determined by the values of COLUMNS and LINES.

ksh will then read a selection line from standard input. If the line is the number of one of the displayed items, ksh sets the value of "identifier" to the item corresponding to this number. If the line is empty, ksh again displays the list of items; and the prompt is redisplayed. The "commands" are not executed.

ksh saves the contents of the selection line read from standard input in the KornShell variable REPLY.

ksh runs "commands" for each selection until ksh encounters a break, return, or exit command in the "commands" list.
Sample Session:

```
$cat select.ksh
stty erase
select myselection in fred wilma pebbles barney betty
do
case $myselection in
   fred)
        echo Fred was the selection
        ;;
   wilma)
        echo Wilma was the selection
        ;;
   pebbles)
        echo Pebbles was the selection
        ;;
   barney)
        echo Barney was the selection
        ;;
   betty)
        echo Betty was the selection
        ;;
esac
done
$chmod 755 select.ksh
$select.ksh
1) fred
2) wilma
3) pebbles
4) barney
5) betty
#? 3
Pebbles was the selection
#? 5
Betty was the selection
#? 6
#? 4
Barney was the selection
# Ctrl-C
$
```

A KornShell script that is not executable can be run implicitly with the ksh command. Tracing can be accomplished using the -v or the -x option.

Sample Session:

```
$ls -l select.ksh
-rw-r--r-- 1 teacher class 390 Oct 16 09:21 select.ksh
$ksh -x select.ksh
+ stty erase
1) fred
2) wilma
3) pebbles
4) barney
5) betty
#? 3
+ print - Pebbles was the selection
Pebbles was the selection
#? 5
+ print - Betty was the selection
Betty was the selection
#? 6
#? 4
+ print - Barney was the selection
Barney was the selection
#? Ctrl-C
$
```

The -n option will trace execution of the script without execution.

Workshop 9

This workshop will reinforce your understanding of the ideas presented in Chapter 10. Login to the Multimax using the username and password given to you by the instructor. Each student is to complete the entire workshop.

DESK EXERCISES

1. What command will invoke the KornShell?

2. What option will trace execution of a KornShell script?

Continue on the next page

3. What do the following shell variables indicate:

PATH

CDPATH

SHELL

PWD

IFS

EDITOR

FCEDIT

TERM

PS1

PS2

PS3

HOME

ENV

LOGNAME

Continue on the next page

4. What is an alias?

COMPUTER EXERCISES (30 minutes)

5. Define a function k that will:

   Display the present working directory, display a message that a listing will follow, sleep for three seconds, and then list the contents.

6. Set up an alias to do the ls -C function. Use a name of your own choice.

7. Write a KornShell script using the select command to display the following choices:

   Apples
   Bananas
   Pears
   Jack Daniels

   After a choice has been made print the following:

   "Thanks, your choice was" (display the choice)

8. Logout

Continue on the next page
Complete the Summary Workshop

and

Course Evaluation
NOTES

APPENDIX A - sh

NAME

sh, rsh - shell, the standard/restricted command programming language

SYNOPSIS

```
sh [ -acefhiknrstuvx ] [ args ]
rsh [ -acefhiknrstuvx ] [ args ]
```

DESCRIPTION

sh is a command programming language that executes commands read from a terminal or a file. rsh is a restricted version of the standard command interpreter sh; it is used to set up login names and execution environments whose capabilities are more controlled than those of the standard shell. See Invocation below for the meaning of arguments to the shell.

Definitions

A blank is a tab or a space. A name is a sequence of letters, digits, or underscores beginning with a letter or underscore. A parameter is a name, a digit, or any of the characters *, @, #, ?, -, $, and !.

Commands

A simple-command is a sequence of non-blank words separated by blanks. The first word specifies the name of the command to be executed. Except as specified below, the remaining words are passed as arguments to the invoked command. The command name is passed as argument 0 (see exec(2)). The value of a simple-command is its exit status if it terminates normally, or (octal) 200+status if it terminates abnormally (see signal(2) for a list of status values).

A pipeline is a sequence of one or more commands separated by |. The standard output of each command but the last is connected by a pipe(2) to the standard input of the next command. Each command is run as a separate process; the shell waits for the last command to terminate. The exit status of a pipeline is the exit status of the last command.

A list is a sequence of one or more pipelines separated by ;, &, &&, or ||, and optionally terminated by ; or &. Of these four symbols, ; and & have equal precedence, which is lower than that of && and ||. The symbols && and || also have equal precedence. A semicolon (;) causes sequential execution of the preceding pipeline; an ampersand (&) causes asynchronous execution of the preceding pipeline (i.e., the shell does not wait for that pipeline to finish). The symbol && (||) causes the list following it to be executed only if the preceding pipeline returns a zero (non-zero) exit status. An arbitrary number of new-lines may appear in a list, instead of semicolons, to delimit commands.

A command is either a simple-command or one of the following. Unless otherwise stated, the value returned by a command is that of the last simple-command executed in the command.

for name [in word ...] do list done

Each time a for command is executed, name is set to the next word taken from the in word list. If in word ... is omitted, then the for command executes the do list

once for each positional parameter that is set (see Parameter Substitution below). Execution ends when there are no more words in the list.

case word in [pattern [| pattern] ...) list ;;] ... esac
A case command executes the list associated with the first pattern that matches word. The form of the patterns is the same as that used for file-name generation (see File Name Generation) except that a slash, a leading dot, or a dot immediately following a slash need not be matched explicitly.

if list then list [elif list then list] ... [else list] fi
The list following if is executed and, if it returns a zero exit status, the list following the first then is executed. Otherwise, the list following elif is executed and, if its value is zero, the list following the next then is executed. Failing that, the else lis is executed. If no else list or then list is executed then the if command returns a zero exit status.

while list do list done
A while command repeatedly executes the while list and if the exit status of the last command in the list is zero, executes the do list; otherwise the loop terminates. If no commands in the do list are executed, then the while command returns a zero exit status; until may be used in place of while to negate the loop termination test.

(list)
Execute list in a sub-shell.

{ list; }
list is executed in the current (that is, parent) shell.

name () { list; }
Define a function which is referenced by name. The body of the function is the list of commands between { and }. Execution of functions is described below (see Execution).

The following words are only recognized as the first word of a command and when not quoted:

if then else elif fi case esac for while until do done {}

Comments

A word beginning with # causes that word and all the following characters up to a new-line to be ignored.

Command Substitution

The shell reads commands from the string between two grave accents (``) and the standard output from these commands may be used as all or part of a word. Trailing new-lines from the standard output are removed.

No interpretation is done on the string before the string is read, except to remove backslashes (\) used to escape other characters. Backslashes may be used to escape a grave accent (`) or another backslash (\) and are removed before

the command string is read. Escaping grave accents allows nested command substitution. If the command substitution lies within a pair of double quotes (" ...` ...` ... "), a backslash used to escape a double quote (\") will be removed; otherwise, it will be left intact.

If a backslash is used to escape a new-line character (\new-line), both the backslash and the new-line are removed (see the later section on Quoting). In addition, backslashes used to escape dollar signs (\$) are removed. Since no interpretation is done on the command string before it is read, inserting a backslash to escape a dollar sign has no effect. Backslashes that precede characters other than \, `, ", new-line, and $ are left intact when the command string is read.

Parameter Substitution

The character $ is used to introduce substitutable parameters. There are two types of parameters, positional and keyword. If parameter is a digit, it is a positional parameter. Positional parameters may be assigned values by set. Keyword parameters (also known as variables) may be assigned values by writing:

```
name=value [ name=value ] ...
```

Pattern-matching is not performed on value. There cannot be a function and a variable with the same name.

${parameter}
: The value, if any, of the parameter is substituted. The braces are required only when parameter is followed by a letter, digit, or underscore that is not to be interpreted as part of its name. If parameter is * or @, all the positional parameters, starting with $1, are substituted (separated by spaces). Parameter $0 is set from argument zero when the shell is invoked.

${parameter:-word}
: If parameter is set and is non-null, substitute its value; otherwise substitute word.

${parameter:=word}
: If parameter is not set or is null set it to word; the value of the parameter is substituted. Positional parameters may not be assigned to in this way.

${parameter:?word}
: If parameter is set and is non-null, substitute its value; otherwise, print word and exit from the shell. If word is omitted, the message "parameter null or not set" is printed.

${parameter:+word}
: If parameter is set and is non-null, substitute word; otherwise substitute nothing.

In the above, word is not evaluated unless it is to be used as the substituted string, so that, in the following example, pwd is executed only if d is not set or is null:

```
     echo ${d:-`pwd`}
```

If the colon (:) is omitted from the above expressions, the shell only checks whether parameter is set or not.

The following parameters are automatically set by the shell:

- `#` The number of positional parameters in decimal.
- `-` Flags supplied to the shell on invocation or by the set command.
- `?` The decimal value returned by the last synchronously executed command.
- `$` The process number of this shell.
- `!` The process number of the last background command invoked.

The following parameters are used by the shell:

- `HOME` The default argument (home directory) for the cd command.
- `PATH` The search path for commands (see Execution below). The user may not change PATH if executing under rsh.
- `CDPATH` The search path for the cd command.
- `MAIL` If this parameter is set to the name of a mail file and the MAILPATH parameter is not set, the shell informs the user of the arrival of mail in the specified file.
- `MAILCHECK` This parameter specifies how often (in seconds) the shell will check for the arrival of mail in the files specified by the MAILPATH or MAIL parameters. The default value is 600 seconds (10 minutes). If set to 0, the shell will check before each prompt.
- `MAILPATH` A colon (:) separated list of file names. If this parameter is set, the shell informs the user of the arrival of mail in any of the specified files. Each file name can be followed by % and a message that will be printed when the modification time changes. The default message is you have mail.
- `PS1` Primary prompt string, by default "$ ".
- `PS2` Secondary prompt string, by default "> ".
- `IFS` Internal field separators, normally space, tab, and new-line.
- `SHACCT` If this parameter is set to the name of a file writable by the user, the shell will write an accounting record in the file for each shell procedure executed. Accounting routines such as acctcom(1) and acctcms(1M) can be used to analyze the data collected.
- `SHELL` When the shell is invoked, it scans the environment (see Environment below) for this name. If it is found and 'rsh' is the file name part of its value, the shell becomes a restricted

shell.

The shell gives default values to PATH, PS1, PS2, MAILCHECK and IFS. HOME and MAIL are set by login(1).

Blank Interpretation

After parameter and command substitution, the results of substitution are scanned for internal field separator characters (those found in IFS) and split into distinct arguments where such characters are found. Explicit null arguments ("" or '') are retained. Implicit null arguments (those resulting from parameters that have no values) are removed.

Input/Output

A command's input and output may be redirected using a special notation interpreted by the shell. The following may appear anywhere in a simple-command or may precede or follow a command and are not passed on to the invoked command; substitution occurs before word or digit is used:

<word — Use file word as standard input (file descriptor 0).

>word — Use file word as standard output (file descriptor 1). If the file does not exist it is created; otherwise, it is truncated to zero length.

>>word — Use file word as standard output. If the file exists output is appended to it (by first seeking to the end-of-file); otherwise, the file is created.

<<[-]word — After parameter and command substitution are done on word, the shell input is read up to the first line that literally matches the resulting word, or to an end-of-file. If, however, - is appended to <<:

1) leading tabs are stripped from word before the shell input is read (but after parameter and command substitution is done on word),
2) leading tabs are stripped from the shell input as it is read and before each line is compared with word, and
3) shell input is read up to the first line that literally matches the resulting word, or to an end-of-file.

If any character of word is quoted (see Quoting, later), no additional processing is done to the shell input. If no characters of word are quoted:

1) parameter and command substitution occurs,
2) (escaped) \newline is ignored, and
3) \ must be used to quote the characters \, $, and `.

The resulting document becomes the standard input.

<&digit — Use the file associated with file descriptor

digit as standard input. Similarly for the standard output using >&digit.

<&- The standard input is closed. Similarly for the standard output using >&--.

If any of the above is preceded by a digit, the file descriptor which will be associated with the file is that specified by the digit (instead of the default 0 or 1). For example:

```
... 2>&1
```

associates file descriptor 2 with the file currently associated with file descriptor 1.

The order in which redirections are specified is significant. The shell evaluates redirections left-to-right. For example:

```
... 1>xxx  2>&1
```

first associates file descriptor 1 with file xxx. It associates file descriptor 2 with the file associated with file descriptor 1 (i.e. xxx). It directs both standard output and standard error output (stdout, stderr) to xxx. If the order of redirections were reversed, file descriptor 2 would be associated with the terminal (assuming file descriptor 1 had been) and file descriptor 1 would be associated with file xxx.

Using the terminology introduced on the first page, under Commands, if a command is composed of several simple commands, redirection will be evaluated for the entire command before it is evaluated for each simple command. That is, the shell evaluates redirection for the entire list, then each pipeline within the list, the each command within each pipeline, then each list within each command.

If a command is followed by & the default standard input for the command is the empty file /dev/null. Otherwise, the environment for the execution of a command contains the file descriptors of the invoking shell as modified by input/output specifications.

Redirection of output is not allowed in the restricted shell.

File Name Generation

Before a command is executed, each command word is scanned for the characters *, ?, and [. If one of these characters appears, the word is regarded as a pattern. The word is replaced with alphabetically sorted file names that match the pattern. If no file name is found that matches the pattern, the word is left unchanged. The character . at the start of a file name or immediately following a /, as well as the character / itself, must be matched explicitly.

*	Matches any string, including the null string.
?	Matches any single character.
[...]	Matches any one of the enclosed characters. A pair of characters separated by - matches any character lexically between the pair, inclusive. If the first character following the opening "[" is a "!" any character not enclosed is matched.

Quoting

The following characters have a special meaning to the shell and cause termination of a word unless quoted:

; & ( ) | ^ < > new-line space tab

A character may be quoted (i.e., made to stand for itself) by preceding it with a backslash (\) or inserting it between a pair of quote marks ('' or ""). During processing, the shell may quote certain characters to prevent them from taking on a special meaning. Backslashes used to quote a single character are removed from the word before the command is executed. The pair \newline is removed from a word before command and parameter substitution.

All characters enclosed between a pair of single quote marks (''), except a single quote, are quoted by the shell. Backslash has no special meaning inside a pair of single quotes. A single quote may be quoted inside a pair of double quote marks (for example, "'").

Inside a pair of double quote marks (""), parameter and command substitution occurs and the shell quotes the results to avoid blank interpretation and file name generation. If $* is within a pair of double quotes, the positional parameters are substituted and quoted, separated by quoted spaces ("$1 $2 ..."); however, if $@ is within a pair of double quotes, the positional parameters are substituted and quoted, separated by unquoted spaces ("$1" "$2" ...). \ quotes the characters \, `, ", and $. The pair \newline is removed before parameter and command substitution. If a backslash precedes characters other than \, `, ", $, and new-line, the backslash itself is quoted by the shell.

Prompting

When used interactively, the shell prompts with the value of PS1 before reading a command. If at any time a new-line is typed and further input is needed to complete a command, the secondary prompt (i.e., the value of PS2) is issued.

Environment

The environment (see environ(5)) is a list of name-value pairs that is passed to an executed program in the same way as a normal argument list. The shell interacts with the environment in several ways. On invocation, the shell scans the environment and creates a parameter for each name found, giving it the corresponding value. If the user modifies the value of any of these parameters or creates new parameters,

none of these affects the environment unless the export command is used to bind the shell's parameter to the environment (see also set -a). A parameter may be removed from the environment with the unset command. The environment seen by any executed command is thus composed of any unmodified name-value pairs originally inherited by the shell, minus any pairs removed by unset, plus any modifications or additions, all of which must be noted in export commands.

The environment for any simple-command may be augmented by prefixing it with one or more assignments to parameters. Thus:

```
TERM=450 cmd
```

and

```
(export TERM; TERM=450; cmd)
```

are equivalent (as far as the execution of cmd is concerned).

If the -k flag is set, all keyword arguments are placed in the environment, even if they occur after the command name. The following first prints a=b c and c:

```
echo a=b c
set -k
echo a=b c
```

Signals

The INTERRUPT and QUIT signals for an invoked command are ignored if the command is followed by &; otherwise signals have the values inherited by the shell from its parent, with the exception of signal 11 (SIGSEGV) (but see also the trap command below). See nohup(1) for more signal handling.

Execution

Each time a command is executed, the above substitutions are carried out. If the command name matches one of the Special Commands listed below, it is executed in the shell process. If the command name does not match a Special Command, but matches the name of a defined function, the function is executed in the shell process (note how this differs from the execution of shell procedures). The positional parameters $1, $2, ... are set to the arguments of the function. If the command name matches neither a Special Command nor the name of a defined function, a new process is created and an attempt is made to execute the command via exec(2).

The shell parameter PATH defines the search path for the directory containing the command. Alternative directory names are separated by a colon (:). The default path is :/bin:/usr/bin (specifying the current directory, /bin, and /usr/bin, in that order). Note that the current directory is specified by a null path name, which can appear immediately after the equal sign or between the colon

delimiters anywhere else in the path list. If the command name contains a / the search path is not used; such commands will not be executed by the restricted shell. Otherwise, each directory in the path is searched for an executable file. If the file has execute permission but is not an a.out file, it is assumed to be a file containing shell commands. A sub-shell is spawned to read it. A parenthesized command is also executed in a sub-shell.

The location in the search path where a command was found is remembered by the shell (to help avoid unnecessary execs later). If the command was found in a relative directory, its location must be re-determined whenever the current directory changes. The shell forgets all remembered locations whenever the PATH variable is changed or the hash -r command is executed (see below).

Special Commands

Input/output redirection is now permitted for these commands. File descriptor 1 is the default output location.

:
: No effect; the command does nothing. A zero exit code is returned.

. file
: Read and execute commands from file and return. The search path specified by PATH is used to find the directory containing file.

break [n]
: Exit from the enclosing for or while loop, if any. If n is specified break n levels.

continue [n]
: Resume the next iteration of the enclosing for or while loop. If n is specified resume at the nth enclosing loop.

cd [arg]
: Change the current directory to arg. The shell parameter HOME is the default arg. The shell parameter CDPATH defines the search path for the directory containing arg. Alternative directory names are separated by a colon (:). The default path is <null> (specifying the current directory). Note that the current directory is specified by a null path name, which can appear immediately after the equal sign or between the colon delimiters anywhere else in the path list. If arg begins with a / the search path is not used. Otherwise, each directory in the path is searched for arg. The cd command may not be executed by rsh.

echo [arg ...]
: Echo arguments. See echo(1) for usage and description.

eval [arg ...]
: The arguments are read as input to the shell and the resulting command(s) executed.

exec [arg ...]
: The command specified by the arguments is executed in place of this shell without creating a new process.

Input/output arguments may appear and, if no other arguments are given, cause the shell input/output to be modified.

exit [n]
Causes a shell to exit with the exit status specified by n. If n is omitted the exit status is that of the last command executed (an end-of-file will also cause the shell to exit.)

export [name ...]
The given names are marked for automatic export to the environment of subsequently-executed commands. If no arguments are given, a list of all names that are exported in this shell is printed. (Variable names exported from a parent shell are listed only if they have been exported again during the current shell's execution.) Function names may not be exported.

getopts
Use in shell script to support command syntax standards (see intro(1)); it parses positional parameters and checks for legal options. See getopts(1) for usage and description.

hash [-r] [name ...]
For each name, the location in the search path of the command specified by name is determined and remembered by the shell. The -r option causes the shell to forget all remembered locations. If no arguments are given, information about remembered commands is presented. hits is the number of times a command has been invoked by the shell process. cost is a measure of the work required to locate a command in the search path. If a command is found in a "relative" directory in the search path, after changing to that directory, the stored location of that command is recalculated. Commands for which this will be done are indicated by an asterisk (*) adjacent to the hits information. cost will be incremented when the recalculation is done.

newgrp [arg ...]
Equivalent to exec newgrp arg .... See newgrp(1M) for usage and description.

pwd
Print the current working directory. See pwd(1) for usage and description.

read [name ...]
One line is read from the standard input and, using the internal field separator, IFS (normally space or tab), to delimit word boundaries, the first word is assigned to the first name, the second word to the second name, etc., with leftover words assigned to the last name. Lines can be continued using \new-line. Characters other than new-line can be quoted by preceding them with a backslash. These backslashes are removed before words are assigned to names, and no interpretation is done on the character that follows the backslash. The return code is 0 unless an end-of-file is encountered.

readonly [name ...]
The given names are marked readonly and the values of these names may not be changed by subsequent

assignment. If no arguments are given, a list of all readonly names is printed.

`return [ n ]`
: Causes a function to exit with the return value specified by n. If n is omitted, the return status is that of the last command executed.

`set [ --aefhkntuvx [ arg ... ] ]`
: `-a` Mark variables which are modified or created for export.
`-e` Exit immediately if a command exits with a non-zero exit status.
`-f` Disable file name generation.
`-h` Locate and remember function commands as functions are defined (function commands are normally located when the function is executed).
`-k` All keyword arguments are placed in the environment for a command, not just those that precede the command name.
`-n` Read commands but do not execute them.
`-t` Exit after reading and executing one command.
`-u` Treat unset variables as an error when substituting.
`-v` Print shell input lines as they are read.
`-x` Print commands and their arguments as they are executed.
`--` Do not change any of the flags; useful in setting $1 to -.

Using + rather than - causes these flags to be turned off. These flags can also be used upon invocation of the shell. The current set of flags may be found in $-. The remaining arguments are positional parameters and are assigned, in order, to $1, $2, ... If no arguments are given the values of all names are printed.

`shift [ n ]`
: The positional parameters from $n+1 ... are renamed $1 .... If n is not given, it is assumed to be 1.

`test`
: Evaluate conditional expressions. See test(1) for usage and description.

`times`
: Print the accumulated user and system times for processes run from the shell.

`trap [ arg ] [ n ] ...`
: The command arg is to be read and executed when the shell receives signal(s) n. (Note that arg is scanned once when the trap is set and once when the trap is taken.) Trap commands are executed in order of signal number. Any attempt to set a trap on a signal that was ignored on entry to the current shell is ineffective. An attempt to trap on signal 11 (memory fault) produces an error. If arg is absent all trap(s) n are reset to their original values. If arg is the null string this signal is ignored by the shell and by the commands it invokes. If n is 0 the command arg is executed on exit from the shell. The trap command with no arguments

prints a list of commands associated with each signal number.

type [name ...]
For each name, indicate how it would be interpreted if used as a command name.

ulimit [n]
Impose a size limit of n blocks on files written by the shell and its child processes (files of any size may be read). If n is omitted, the current limit is printed. Each user may lower the ulimit, but only a super-user (see su(1M)) can raise a ulimit.

umask [nnn]
The user file-creation mask is set to nnn (see umask(1)). If nnn is omitted, the current value of the mask is printed.

unset [name ...]
For each name, remove the corresponding variable or function. The variables PATH, PS1, PS2, MAILCHECK and IFS cannot be unset.

wait [n]
Wait for a background process whose process ID is n and report its termination status. If n is omitted, all the shell's currently active background processes are waited for and the return code will be zero.

Invocation

If the shell is invoked through exec(2) and the first character of argument zero is -, commands are initially read from /etc/profile and from $HOME/.profile, if such files exist. Thereafter, commands are read as described below, which is also the case when the shell is invoked as /bin/sh. The flags below are interpreted by the shell on invocation only. Note that unless the -c or -s flag is specified, the first argument is assumed to be the name of a file containing commands, and the remaining arguments are passed as positional parameters to that command file:

-c string If the -c flag is present commands are read from string.

-s If the -s flag is present or if no arguments remain commands are read from the standard input. Any remaining arguments specify the positional parameters. Shell output (except for Special Commands) is written to file descriptor 2.

-i If the -i flag is present or if the shell input and output are attached to a terminal, this shell is interactive. In this case TERMINATE is ignored (so that kill 0 does not kill an interactive shell) and INTERRUPT is caught and ignored (so that wait is interruptible). In all cases, QUIT is ignored by the shell.

-r If the -r flag is present the shell is a restricted shell.

The remaining flags and arguments are described under the set command above.

rsh Only

rsh is used to set up login names and execution environments whose capabilities are more controlled than those of the standard shell. The actions of rsh are identical to those of sh, except that the following are disallowed:

```
changing directory (see cd(1)),
setting the value of $PATH,
specifying path or command names containing /,
redirecting output (> and >>).
```

The restrictions above are enforced after .profile is interpreted.

A restricted shell can be invoked in one of the following ways: (1) rsh is the file name part of the last entry in the /etc/passwd file (see passwd(4)); (2) the environment variable SHELL exists and rsh is the file name part of its value; (3) the shell is invoked and rsh is the file name part of argument 0; (4) the shell is invoked with the -r option.

When a command to be executed is found to be a shell procedure, rsh invokes sh to execute it. Thus, it is possible to provide to the end-user shell procedures that have access to the full power of the standard shell, while imposing a limited menu of commands; this scheme assumes that the end-user does not have write and execute permissions in the same directory.

The net effect of these rules is that the writer of the .profile has complete control over user actions, by performing guaranteed setup actions and leaving the user in an appropriate directory (probably not the login directory).

The system administrator often sets up a directory of commands (i.e., /usr/rbin) that can be safely invoked by rsh. Some systems also provide a restricted editor red.

EXIT STATUS

Errors detected by the shell, such as syntax errors, cause the shell to return a non-zero exit status. If the shell is being used non-interactively execution of the shell file is abandoned. Otherwise, the shell returns the exit status of the last command executed (see also the exit command above).

FILES

```
/etc/profile
$HOME/profile
/tmp/sh*
/dev/null
```

SEE ALSO

acctcom(1), cd(1), echo(1), env(1), ksh(1), login(1), pwd(1), test(1), umask(1).
acctcms(1M), newgrp(1M), su(1M) in the UMAX V Administrator's Reference Manual.

dup(2), exec(2), fork(2), pipe(2), signal(2), ulimit(2), wait(2), a.out(4), passwd(4), profile(4), environ(5) in the UMAX V Programmer's Reference Manual.

CAVEATS

Words used for filenames in input/output redirection are not interpreted for filename generation (see File Name Generation, above). For example, cat file1 > a* will create a file named a*.

Because commands in pipelines are run as separate processes, variables set in a pipeline have no effect on the parent shell.

If the error message cannot fork, too many processes is displayed, try using the wait(1) command to clean up the background processes. If this does not help, the system process table is probably full or there are too many active foreground processes. (There is a limit to the number of process IDs associated with a login and to the number of which the system can keep track.)

BUGS

If a command is executed, and a command with the same name is installed in a directory in the search path before the directory where the original command was found, the shell will continue to exec the original command. Use the hash command to correct this situation.

If the current directory or one above it is moved, pwd may not give the correct response. Use the cd command with a full path name to correct this situation.

Not all the processes of a 3- or more-stage pipeline are children of the shell, and thus cannot be waited for.

For wait n, if n is not an active process id, all the shell's currently active background processes are waited for and the return code will be zero.

NOTES

ÜÜ
ÜÜÜÜÜÜÜ

APPENDIX B - test

$man test

NAME

test - condition evaluation command

SYNOPSIS

test expr
[expr]

DESCRIPTION

test evaluates the expression expr and, if its value is true, returns a zero (true) exit status; otherwise, a non-

zero (false) exit status is returned; test also returns a non-zero exit status if there are no arguments. When permissions are tested, the effective user ID of the process is used.

All operators, flags, and brackets (brackets used as shown in the second SYNOPSIS line) must be separate arguments to the test command; normally these items are separated by spaces.

The following primitives are used to construct expr:

-r file true if file exists and is readable.

-w file true if file exists and is writable.

-x file true if file exists and is executable.

-f file true if file exists and is a regular file.

-d file true if file exists and is a directory.

-c file true if file exists and is a character special file.

-b file true if file exists and is a block special file.

-p file true if file exists and is a named pipe (fifo).

-u file true if file exists and its set-user-ID bit is set.

-g file true if file exists and its set-group-ID bit is set.

-k file true if file exists and its sticky bit is set.

-s file true if file exists and has a size greater than zero.

-t [fildes]
  true if the open file whose file descriptor number is fildes (1 by default) is associated with a terminal device.

-z s1 true if the length of string s1 is zero.

-n s1 true if the length of the string s1 is non-zero.

s1 = s2 true if strings s1 and s2 are identical.

s1 != s2 true if strings s1 and s2 are not identical.

s1 true if s1 is not the null string.

n1 -eq n2 true if the integers n1 and n2 are algebraically equal. Any of the comparisons -ne, -gt, -ge,

-lt, and -le may be used in place of -eq.

These primaries may be combined with the following operators:

! unary negation operator.

-a
binary and operator.

-o binary or operator (-a has higher precedence than -o).

(expr) parentheses for grouping. Notice that parentheses are meaningful to the shell and, therefore, must be escaped.

SEE ALSO
csh(1), find(1), ksh(1), sh(1).

WARNING
If a user tests a file (using -r, -w, or -x), but the permission tested does not have the owner bit set, a non-zero (false) exit status will be returned even though the file may have the group or other bit set for that permission. The correct exit status will be set if the user is super-user.

The = and != operators have a higher precedence than the -r through -n operators, and = and != always expect arguments; therefore, = and != cannot be used with the -r through -n operators.

If more than one argument follows the -r through -n operators, only the first argument is examined; the others are ignored, unless a -a or a -o is the second argument.

In the second form of the command (i.e., the one that uses [], rather than the word test), the square brackets must be delimited by blanks.

NOTES

APPENDIX C - expr

$man expr
NAME
expr - evaluate arguments as an expression

SYNOPSIS
expr arguments

DESCRIPTION
The arguments are taken as an expression. After evaluation, the result is written on the standard output. Terms of the

expression must be separated by blanks. Characters special to the shell must be escaped. Note that 0 is returned to indicate a zero value, rather than the null string. Strings containing blanks or other special characters should be quoted. Integer-valued arguments may be preceded by a unary minus sign. Internally, integers are treated as 32-bit, 2s complement numbers.

The operators and keywords are listed below. Characters that need to be escaped are preceded by \. The list is in order of increasing precedence, with equal precedence operators grouped within {} symbols.

expr \ | expr returns the first expr if it is neither null nor 0, otherwise returns the second expr.

expr \& expr returns the first expr if neither expr is null nor 0, otherwise returns 0.

expr { =, \>, \, \<, \, != } expr
returns the result of an integer comparison if both arguments are integers, otherwise returns the result of a lexical comparison.

expr { +, - } expr
addition or subtraction of integer-valued arguments.

expr { *, /, % } expr
multiplication, division, or remainder of the integer-valued arguments.

expr : expr The matching operator : compares the first argument with the second argument which must be a regular expression. Regular expression syntax is the same as that of ed(1), except matching operator returns the number of characters matched (0 on failure). Alternatively, the \(...\) pattern symbols can be used to return a portion of the first argument.

EXAMPLES

1. a=`expr $a + 1`
   adds 1 to the shell variable

2. # For $a equal to either "/usr/abc/file" or just "file"
   expr $a : '.*/\(.*\)' \| $a
   returns the last segment of a path name (i.e., file). Watch out for / alone as an argument: expr will take it as the division operator (see BUGS below).

3. # A better representation of the previous example.
   expr //$a : '.*/\(.*\)'
   The addition of the // characters eliminates any

ambiguity about the division operator and simplifies the whole expression.

4. expr $VAR : '.*'
returns the number of characters in $VAR.

SEE ALSO
ed(1), sh(1).

DIAGNOSTICS
As a side effect of expression evaluation, expr returns the following exit values:
0 if the expression is neither null nor 0
1 if the expression is null or 0
2 for invalid expressions.

syntax error
for operator/operand errors
non-numeric argument
if arithmetic is attempted on such a string

BUGS
After argument processing by the shell, expr cannot tell the difference between an operator and an operand except by the value. If $a is an =, the command: expr $a = '=' looks like: expr = = = as the arguments are passed to expr (and they will all be taken as the = operator). The following works: expr X$a = X=

APPENDIX D - ftp

$man ftp

NAME
ftp - Internet file transfer program

SYNOPSIS
ftp [-v] [-d] [-i] [-n] [-g] [host]

DESCRIPTION
ftp is the user interface to the DARPA File Transfer Protocol. The program transfers files to and from a remote network site.

The client host with which ftp is to communicate can be specified on the command line. In this case, ftp immediately attempts to establish a connection to an FTP server on that host; otherwise, ftp enters its command interpreter and waits for instruction, displaying the prompt ftp>.

ftp recognizes the following commands:

! [command [args]]
Invoke an interactive shell on the local machine. If there are arguments, the first is taken to be a command to execute directly, with the rest of the arguments as its arguments.

$ macro-name [args]
Execute the macro-name that was defined with the macdef command. Arguments are passed to the macro unglobbed.

account [passwd]
Supply a supplemental password required by a remote system for access to resources once a login has been successfully completed. If no argument is included, the user will be prompted for an account password in a non-echoing input mode.

append local-file [remote-file]
Append a local file to a file on the remote machine. If remote-file is left unspecified, the local file name is used to name the remote file after being altered by any ntrans or nmap setting. File transfer uses the current settings for type, format, mode, and structure.

ascii Set the file transfer type to network ASCII. This is the default type.

bell Sound a bell after each file transfer command is completed.

binary Set the file transfer type to support binary image transfer.

bye Terminate the FTP session with the remote server and exit ftp.

case Toggle remote computer file name case mapping during mget commands. When case is on (default is off), remote computer file names with all letters in upper case are written in the local directory with the letters mapped to lower case.

cd remote-directory
Change the working directory on the remote machine to remote-directory.

cdup Change the remote machine working directory to the parent of the current remote machine working directory.

close Terminate the FTP session with the remote server, and return to the command interpreter. Any defined macros are erased.

cr Toggle carriage return stripping during ASCII type file retrieval. Records are denoted by a carriage return/linefeed sequence during ASCII type file transfer. When cr is on (the default), carriage returns are stripped from this sequence to conform with the UNIX single linefeed record delimiter.

Records on non-UNIX remote systems may contain single linefeeds; when an ASCII type transfer is made, these linefeeds may be distinguished from a record delimiter only when cr is off.

delete remote-file
Delete the file remote-file on the remote machine.

debug [debug-value]
Toggle debugging mode. If an optional debug-value is specified, it is used to set the debugging level. When debugging is on, ftp prints each command sent to the remote machine, preceded by the string --> .

dir [remote-directory] [local-file]
Print the contents of directory, remote-directory, and, optionally, place the output in local-file. If no directory is specified, the current working directory on the remote machine is used. If no local file is specified, or local-file is -, output comes to the terminal.

disconnect
A synonym for close.

form format
Set the file transfer form to format. The default format is file.

get remote-file [local-file]
Retrieve the remote-file and store it on the local machine. If the local file name is not specified, it is given the same name it has on the remote machine, subject to alteration by the current case, ntrans, and nmap settings. The current settings for type, form, mode, and structure are used while transferring the file.

glob Toggle filename expansion for mdelete, mget and mput. If globbing is turned off with glob, the file name arguments are taken literally and not expanded. Globbing for mput is done as in csh(1). For mdelete and mget, each remote file name is expanded separately on the remote machine and the lists are not merged. Expansion of a directory name is likely to be different from expansion of the name of an ordinary file: the exact result depends on the foreign operating system and FTP server, and can be previewed by doing "mls remote-files -". Note: mget and mput are not meant to transfer entire directory subtrees of files. That can be done by transferring a tar(1) archive of the subtree (in binary mode).

hash Toggle number-sign (#) printing for each data block transferred. The size of a data block i

1024 bytes.

help [command]
Print a description of command. With no argument, ftp prints a list of the known commands.

lcd [directory]
Change the working directory on the local machine. If no directory is specified, changes to the user's home directory.

ls [remote-directory] [local-file]
Print an abbreviated listing of the contents of a directory on the remote machine. If remote-directory is left unspecified, the current working directory is used. If no local file is specified, the output is sent to the terminal.

macdef macro-name
Define a macro. Subsequent lines are stored as the macro-name; a null line (consecutive newline characters in a file or carriage returns from the terminal) terminates macro input mode. There is a limit of 16 macros and 4096 total characters in all defined macros. Macros remain defined until a close command is executed. The macro processor interprets "$" and "\" as special characters. A "$" followed by a number (or numbers) is replaced by the corresponding argument on the macro invocation command line. A "$" followed by an "i" signals that macro processor that the executing macro is to be looped. On the first pass "$i" is replaced by the first argument on the macro invocation command line, on the second pass it is replaced by the second argument, and so on. A "\" followed by any character is replaced by that character. Use the "\" to prevent special treatment of the "$".

mdelete [remote-files]
Delete the specified files on the remote machine.

mdir remote-files local-file
Like dir, except multiple remote files may be specified. If interactive prompting is on, ftp will prompt the user to verify that the last argument is indeed the target local file for receiving mdir output.

mget remote-files
Expand the remote-files on the remote machine and do a get for each file name thus produced. See glob for details on the filename expansion. Resulting file names will then be processed according to case, ntrans, and nmap settings. Files are transferred into the local working directory, which can be changed with

"lcd directory"; new local directories can be created with "! mkdir directory".

mkdir directory-name
Make a directory on the remote machine.

mls remote-files local-file
Like ls, except multiple remote files may be specified. If interactive prompting is on, ftp will prompt the user to verify that the last argument is indeed the target local file for receiving mls output.

mode [mode-name]
Set the file transfer mode to mode-name. The default mode is stream.

mput local-files
Expand wild cards in the list of local files given as arguments and do a put for each file in the resulting list. See glob for details of filename expansion. Resulting file names will then be processed according to ntrans and nmap settings.

nmap [inpattern outpattern]
Set or unset the filename mapping mechanism. If no arguments are specified, the filename mapping mechanism is unset. If arguments are specified, remote filenames are mapped during mput commands and put commands issued without a specified remote target filename. If arguments are specified, local filenames are mapped during mget commands and get commands issued without a specified local target filename. This command is useful when connecting to a non-UNIX remote computer with different file naming conventions or practices. The mapping follows the pattern set by inpattern and outpattern. inpattern is a template for incoming filenames (which may have already been processed according to the ntrans and case settings). Variable templating is accomplished by including the sequences "$1", "$2", ..., "$9" in inpattern. Use "\" to prevent this special treatment of the "$" character. All other characters are treated literally, and are used to determine the nmap inpattern variable values. For example, given inpattern $1.$2 and the remote file name mydata.data, $1 would have the value mydata, and $2 would have the value data. The outpattern determines the resulting mapped filename. The sequences "$1", "$2", ..., "$9" are replaced by any value resulting from the inpattern template. The sequence "$0" is replaced by the original filename. Additionally, the sequence "[seq1,seq2]" is replaced by seq1 if seq1 is not a null string; otherwise it is replaced by seq2. For example, the command "nmap $1.$2.$3

[$1,$2].[$2,file]" would yield the output filename myfile.data for input filenames myfile.data and myfile.data.old, myfile.file for the input filename myfile, and myfile.myfile for the input filename .myfile. Spaces may be included in outpattern, as in the example:

```
nmap $1 | sed "s/  *$//" > $1
```

Use the "\" character to prevent special treatment of the "$", "[", "]", and "," characters.

ntrans [inchars [outchars]]
: Set or unset the filename character translation mechanism. If no arguments are specified, the filename character translation mechanism is unset. If arguments are specified, characters in remote filenames are translated during mput commands and put commands issued without a specified remote target filename. If arguments are specified, characters in local filenames are translated during mget commands and get commands issued without a specified local target filename. This command is useful when connecting to a non-UNIX remote computer with different file naming conventions or practices. Characters in a filename matching a character in inchars are replaced with the corresponding character in outchars. If the character's position in inchars is longer than the length of outchars, the character is deleted from the file name.

open host [port]
: Establish a connection to the specified host's FTP server. An optional port number can be supplied, in which case, ftp attempts to contact an FTP server at that port. If the auto-login option is on (default), ftp also attempts to automatically log the user in to the FTP server (see below).

prompt
: Toggle interactive prompting. Interactive prompting occurs during multiple file transfers to allow the user to selectively retrieve or store files. If prompting is turned off (default), any mget or mput transfers all files and mdelete will delete all files.

proxy ftp-command
: Execute an ftp command on a secondary control connection. This command allows simultaneous connection to two remote FTP servers for transferring files between the two servers. The first proxy command should be an open, to establish the secondary control connection. Enter the command "proxy ?" to see other ftp commands executable on the secondary connection. The following commands behave differently when

prefaced by proxy: open will not define new macros during the auto-login process, close will not erase existing macro definitions, get and mget transfer files from the host on the primary control connection to the host on the secondary control connection, and put, mput, and append transfer files from the host on the secondary control connection to the host on the primary control connection. Third party file transfers depend upon support of the FTP protocol PASV command by the server on the secondary control connection.

put local-file [remote-file]
Store a local file on the remote machine. If remote-file is left unspecified, the local file name is used in naming the remote file, after processing according to any ntrans or nmap settings. File transfer uses the current settings for type, format, mode, and structure.

pwd Print the name of the current working directory on the remote machine.

quit A synonym for bye.

quote arg1 arg2 ...
The arguments specified are sent, verbatim, to the remote FTP server.

recv remote-file [local-file]
A synonym for get.

remotehelp [command-name]
Request help from the remote FTP server. If a command-name is specified, it is supplied to the server as well.

rename [from] [to]
Rename, on the remote machine, the file from to the file to.

reset Clear reply queue. This command re-synchronizes command/reply sequencing with the remote FTP server. Resynchronization may be necessary following a violation of the FTP protocol by the remote server.

rmdir directory-name
Delete a directory on the remote machine.

runique Toggle storing of files on the local system with unique filenames. If a file already exists with a name equal to the target local filename for a get or mget command, a ".1" is appended to the name. If the resulting name matches another existing file, a ".2" is appended to the original name. If

this process continues up to ".99", an error message is printed, and the transfer does not take place. The generated unique filename will be reported. Note that runique will not affect local files generated from a shell command (see below). The default value is off.

send local-file [remote-file]
A synonym for put.

sendport Toggle the use of PORT commands. By default, ftp attempts to use a PORT command when establishing a connection for each data transfer. The use of PORT commands can prevent delays when performing multiple file transfers. If the PORT command fails, ftp uses the default data port. When the use of PORT commands is disabled, no attempt is made to use them for each data transfer. This is useful for certain FTP implementations that do ignore PORT commands but wrongly indicate they have been accepted.

status Show the current status of ftp.

struct [struct-name]
Set the file transfer structure to struct-name. The default structure is stream.

sunique Toggle storing of files on remote machine under unique file names. Remote FTP server must support the FTP protocol STOU command for successful completion. The remote server will report a unique name. Default value is off.

tenex Set the file transfer type to that needed to talk to TENEX machines.

trace Toggle packet tracing.

type [type-name]
Set the file transfer type to type-name. If no type-name is specified, the current type is printed. The default type is network ascii.

user user-name [password] [account]
The user identifies him/herself to the remote FTP server. If the password is not specified and the server requires it, ftp prompts the user for it (after disabling local echo). If an account field is not specified, and the FTP server requires it, the user is prompted for it. If an account field is specified, an account command will be relayed to the remote server after the login sequence is completed if the remote server did not require it for logging in. Unless ftp is invoked with "auto-login" disabled, this process is done automatically on initial connection to the FTP

server.

verbose Toggle verbose mode. In verbose mode, all responses from the FTP server are displayed to the user. In addition, if verbose is on, when a file transfer completes, statistics regarding the efficiency of the transfer are reported. By default, verbose is on.

? [command]
A synonym for help.

Command arguments that have embedded spaces can be quoted with double quote (") marks.

ABORTING A FILE TRANSFER

To abort a file transfer, use the terminal interrupt key (usually <ctrl>C). Sending transfers will be immediately halted. Receiving transfers will be halted by sending a FTP protocol ABOR command to the remote server, and discarding any further data received. The speed at which this is accomplished depends upon the remote server's support for ABOR processing. If the remote server does not support the ABOR command, an ftp> prompt will not appear until the remote server has completed sending the requested file.

The terminal interrupt key sequence will be ignored when ftp has completed any local processing and is awaiting a reply from the remote server. A long delay in this mode may result from the ABOR processing described above, or from unexpected behavior by the remote server, including violations of the FTP protocol. If the delay results from unexpected remote server behavior, the local ftp program must be killed by hand.

FILE NAMING CONVENTIONS

Files specified as arguments to ftp commands are processed according to the following rules.

1. If the file name is -, the standard input (for reading) or the standard output (for writing) is used.

2. If the first character of the file name is a bar |, the remainder of the argument is interpreted as a shell command. ftp then forks a shell, using popen(3S) with the argument supplied, and reads (writes) from the stdout (stdin). If the shell command includes spaces, the argument must be quoted; for example, "| ls -lt". A particularly useful example of this mechanism is "dir | more".

3. Failing the above checks, if globbing is enabled, local file names are expanded according to the rules used in the csh(1); see the glob command. If the ftp command expects a single local file (e.g., put), only the first filename generated by the globbing operation is used.

4. For mget commands and get commands with unspecified local file names, the local filename is the remote filename, which may be altered by a case, ntrans, or nmap setting. The resulting filename may then be altered if runique is on.

5. For mput commands and put commands with unspecified remote file names, the remote filename is the local filename, which may be altered by a ntrans or nmap setting. The resulting filename may then be altered by the remote server if sunique is on.

FILE TRANSFER PARAMETERS

The FTP specification identifies many parameters that can affect a file transfer. The type can be one of ascii, image (binary), ebcdic, and local byte size (for PDP-10's and PDP-20's mostly). ftp supports the ascii and image types of file transfer, plus local byte size 8 for tenex mode transfers.

ftp supports only the default values for the remaining file transfer parameters: mode, form, and struct.

OPTIONS

Options can be specified at the command line, or to the command interpreter.

The -v (verbose on) option forces ftp to show all responses from the remote server, as well as report on data transfer statistics.

The -n option restrains ftp from attempting "auto-login" upon initial connection. If auto-login is enabled, ftp checks the netrc file in the user's home directory for an entry describing an account on the remote machine. If no entry exists, ftp will prompt for the remote machine login name (default is the user identity on the local machine), and, if necessary, prompt for a password and an account with which to login.

The -i option turns off interactive prompting during multiple file transfers.

The -d option enables debugging.

The -g option disables file name globbing.

THE .netrc FILE

The .netrc file contains login and initialization information used by the "auto-login" process. It resides in the user's home directory. The following tokens are recognized; they may be separated by spaces, tabs, or new-lines:

machine name

Identify a remote machine name. The auto-login process searches the .netrc file for a machine token that

matches the remote machine specified on the ftp command line or as an open command argument. Once a match is made, the subsequent .netrc tokens are processed, stopping when the end of file is reached or another machine token is encountered.

login name
: Identify a user on the remote machine. If this token is present, the "auto-login" process will initiate a login using the specified name.

password string
: Supply a password. If this token is present, the "auto-login" process will supply the specified string if the remote server requires a password as part of the login process. Note that if this token is present in the .netrc file, ftp will abort the "auto-login" process if the .netrc is readable by anyone besides the user.

account string
: Supply an additional account password. If this token is present, the "auto-login" process will supply the specified string if the remote server requires an additional account password, or the "auto-login" process will initiate an ACCT command if it does not.

macdef name
: Define a macro. This token functions like the ftp macdef command functions. A macro is defined with the specified name; its contents begin with the next .netrc line and continue until a null line (consecutive new-line characters) is encountered. If a macro named init is defined, it is automatically executed as the last step in the "auto-login" process.

SEE ALSO

csh(1).
ftpd(1M) in the UMAX V Administrator's Reference Manual.

BUGS

Correct execution of many commands depends upon proper behavior by the remote server.

An error in the treatment of carriage returns in the 4.2BSD UNIX ASCII-mode transfer code has been corrected. This correction may result in incorrect transfers of binary files to and from 4.2BSD servers using the ascii type. Avoid this problem by using the binary image type.

NOTES

ÜÜ
ÜÜÜÜÜÜÜ

NOTES

ÜÜ
ÜÜÜÜÜÜ

APPENDIX E - cc

$man cc

NAME

cc - C compiler

SYNOPSIS

cc [option] ... file ...

DESCRIPTION

The cc command invokes the C language compiler. This C compiler is an advanced, optimizing compiler that accepts a complete implementation of the C programming language. For a more complete description of the compiler, see "C Language" and "Compiler and C Language" in the UMAX V Programmer's Guide.

Files with a .c suffix are taken to be C language source programs. The compiler processes every C language source file to produce a corresponding object file with the same file name and a .o suffix. Files with a .s suffix are taken to be assembly language source programs. These are assembled to produce a corresponding object file with the same file name and a .o suffix. Files with a suffix other than .c and .s are assumed to be object files (usually produced by an earlier compilation or assembly) or C-compatible libraries. These files, together with any object code produced by the compiler, are linked in the order they were specified to produce an executable program file named a.out.

If only one input file with a .c or .s suffix is supplied, the compiler automatically deletes the object file output produced from that input file after the executable program file a.out is created.

The cc options that modify the behavior described above are:

-A Cause ASCII assembler output to be generated and automatically piped to the assembler. The default is for direct generation of object code. The -A option is the same as the -q nodirect_code option.

-Bpath Run the compiler program contained in pathccom. If -B is specified with no path, then the default path is assumed to be /lib/o and the compiler program in /lib/occom is run. If no -B option is specified, then the compiler program in /lib/ccom is run.

-c Compile only. Produce object file output, even if there was only one source file.

-C Retain comments during the macro preprocessor pass.

-Dname=def
Define symbol name to be string def, as if by a #define statement. If =def is omitted, define name

to be 1.

-E Run only the macro preprocessor, process only input files with the .c suffix; send the result of this pass to the standard output.

-g Generate special symbol table data for sdb(1) or cdb(1) and pass the -g flag to the link editor.

-G Cause object code to be directly generated by the compiler, bypassing the intermediate steps of producing assembly code and assembling it to produce object code. This is the default. The -G option is the same as the -q direct_code option.

-Idir dir is a directory name. Search for #include files whose names do not begin with / first in the directory containing the source file, then in dir, and then in a list of standard defaults. Multiple -I options can establish a hierarchy of #include file directories.

-o output
Name the final, executable output file output instead of a.out. Note the space between the -o and the file name.

-O Perform optimizations which speed up the generated code. Also, perform any space optimizations which do not impact code speed. See also the -q option.

-p Prepare to generate an execution profile using prof(1). Include special profiling code that counts how many times each routine is called. If linking occurs, use a special startup routine that calls monitor(3C) and produces a mon.out file upon termination. Uses special profiling versions of standard libraries found in /usr/lib/libp/lib*.a.
NOTE: use of the MARK macro (see prof(5)) requires the -A option of cc.

-pg Prepare to generate an execution profile using gprof(1). Include special profiling code that counts how many times each function is called and how much time is spent in each. If linking occurs, use a special startup function that calls monstartup and produces a gmon.out file upon termination. Uses special profiling versions of standard libraries found in /usr/lib/libp/lib*.a. Note: Use of the MARK macro (see prof(5)) requires the -A option of cc.

-P Run all .c files through the preprocessing step, putting the result in the corresponding output file with a .i suffix.

-R Make initialized variables shared and read-only (by

passing the -r option to the assembler).

-S Generate only assembly language output, putting it in one or more files that have the source file name and an .s suffix.

-Uname Undefine symbol name to remove its default definition.

-v Report the names of all subprocesses invoked in the compiled program, and their arguments. This option shows any files that are linked automatically and the current compiler, assembler, and link editor options.

-w Suppress warning diagnostics.

-Wc,arg
-Wa,arg
-Wl,arg Pass option arg to the compiler (see "C Compiler Internal Options" in the "Compiler and C Language" chapter in the UMAX V Programmer's Guide), assembler (see as(1)), or linker (see ld(1)), respectively.

The following options are intended to provide more detailed control over the generated code and action of the compiler. In general, they should only be used for special situations.

-q qualifier
-q qualifier=arg
Modify the generated code of the compiler to reflect various special requirements of a program. Qualifiers include the following:

align_text, noalign_text
Enable alignment of text segments on boundaries that allows the burst mode of systems equipped with APCs (Advanced Dual Processor Cards, utilizing the NS32332 CPU chip) to be most effectively used. The default option is -q noalign_text, unless the -q optimize=time option is specified.

xpc, apc, dpc
Generate code optimized for a system equipped with XPCs (Extended Performance Dual Processor Cards, utilizing the NS32532 CPU chip), APCs (Advanced Dual Processor Cards, utilizing the NS32332 CPU chip), or DPCs (Dual Processor Cards, utilizing the NS32032 CPU chip). If the -q xpc option is specified, then the preprocessor symbol ns32532 is defined and code optimal for the NS32532 is generated. If the -q apc option is specified, then the preprocessor symbol ns32332 is defined and the -q align_text option is enabled. If the -q dpc

option is specified, then the preprocessor symbol ns32032 is defined and the -q noalign_text option is enabled. If neither -q xpc nor -q apc nor -q dpc is specified, then the default option is either -q xpc or -q apc or -q dpc , depending upon whether the system upon which the compiler is running is equipped with XPCs, APCs, or DPCs, respectively. Code generated with these options will work on all XPCs, APCs, and DPCs.

asmdir=prefix
crt0dir=prefix
lddir=prefix
: Overrides the defaults for the locations of as(1) (the assembler), the relevant startup routine (either crt0.o, mcrt0.o, or gcrt0.o), and ld(1) (the link editor). The default values for these are asmdir=/bin/, crt0dir=/lib/ (if the startup routine is crt0.o or mcrt0.o), crt0dir=/usr/lib/ (if the startup routine is gcrt0.o), and lddir=/bin/.

compiler_registers, nocompiler_registers
: Enable or disable compiler allocation of local variables to registers beyond those specified by register storage class specifications. The default option is -q compiler_registers. The -q nocompiler_registers option should only be used when code is written to depend on the existence of non-register class variables in memory.

direct_code, nodirect_code
: Enable or disable the direct generation of code by the compiler. When enabled, the compiler will directly generate object code, bypassing the intermediate steps of producing assembly code and assembling it to produce the object code. The -q nodirect_code option (same as the -A option) should only be needed if the source file contains asm statements. The -q direct_code option (same as the -G option) is enabled by default. The -q nodirect_code option is enabled if the -R option is specified.

enter_exits, noenter_exits
: Generate enter and exit instructions at subroutine start and end. Enter and exit instructions make stack tracing by debuggers possible. The -q noenter_exits option is enabled by default, unless the -g option is used.

extensions, noextensions
extensions=parallel

extensions=microtasking
    Specifies which language extensions will be recognized. The -q extensions=parallel option specifies that extensions which support parallel programming are recognized. This includes shared memory declarations and in-line code generation for spin lock routines. Consult the section "C Parallel Programming Extensions" in Chapter 18, Compiler and C Language in the UMAX V Programmer's Guide. The -q extension=microtasking option specifies that extensions which support microtasking are recognized. This includes the -q extension=parallel extensions, and also specifies that the microtasking library and an alternate version of crt0.o are to be used by the load step. The -q extensions option is equivalent to -q extension=microtasking. The default option is -q noextensions.

limitfregs, nolimitfregs
    Use or don't use the new NS32532 double precision floating point registers f1, f3, f5, f7. This flag is valid only in conjunction with the -q xpc flag. The default value for this flag is -q limitfregs (the new registers are not used). The double precision registers f1, f3, f5, f7 do not exist on APCs and DPCs, and code that uses these registers will not work on APCs and DPCs.

includes, noincludes
    Look or don't look for C language include files in the standard directory /usr/include. -q noincludes specifies there is no standard location for the include files. The default value is -q includes.

long_case, nolong_case
    Enable or disable the generation of case statements using a full four byte displacement. The -q nolong_case option is the default, allowing case statements to span 8 Kilobytes. The -q long_case option allows case statements to span 16 Megabytes. This should only be needed in unusual circumstances.

long_jump, nolong_jump
    Enable or disable the generation of jumps with four byte displacements when the assembler is unable to resolve them in 1 byte. This option only has effect when direct code generation is not enabled. The default option, -q nolong_jump, allows branches to span up to _8 Kilobytes. The -q long_jump option will allow branches to span up to _16 Megabytes.

loops, noloops
Enable or disable loop optimizations. These optimizations include loop-invariant hoisting and strength reduction. The default option is -q noloops.

optimize, nooptimize
optimize=none,optimize=standard,optimize=time,optimize=space
Specify the level of optimization. The -q optimize option is equivalent to the -q optimize=standard. The -q nooptimize option is equivalent to -q optimize=none. The -O option is equivalent to -q optimize=standard. The -q optimize=standard option enables a set of optimizations that do not take an excessive time to generate and do not overly favor space over time or vice versa. The -q optimize=time option enables optimizations which may take longer to recognize but should yield a program that takes minimal time. This option enables -q align_text, -q loops, and -q novolatile. If any of these options are inappropriate, they may be overridden by the appropriate -q noxxx option. The -q optimize=space option enables optimizations which may take longer to generate but should yield a program which takes minimal space. This option enables -q preload_constants and -q tail_merge. The default option is -q optimize=none.

preload_constants, nopreload_constants
Enable or disable the linking of constant values and addresses that are frequently referenced in the source code at the start of a program. This option saves space; it may save execution time if the constants and addresses are also referenced frequently during execution. The -q nopreload_constants option is the default; the -q preload_constants option is enabled by the -O option.

reg_params, noreg_params
Pass the first two parameters to a subroutine in registers rather than on the stack. The -q noreg_params option is the default. The standard libraries provided with the system assume -q noreg_params and will not work with object files built with the -q reg_params option.

sbfixed, nosbfixed
Enable or disable the use of the NS32000 sb register when generating immediate addresses. The -q sbfixed option is the default.

signed_bit_fields, nosigned_bit_fields
Enable or disable making bit fields in

structures of type int, short, and char to be signed. The default option, -q nosigned_bit_fields, is to make all fields unsigned.

small_enums, nosmall_enums
Enable or disable the allocation of each enum type as the smallest predefined type that can represent all of the values that are listed (that is values of type char, short, int, unsigned char, unsigned short, or unsigned that are used in the enum statement). The default option, -q nosmall_enums, allocates an enum type as an int.

standard_library, nostandard_library
Allows the compiler to replace calls to standard libc routines with equivalent in-line code. The default option is -q nostandard_library, unless the -q optimize=time option is specified.

tail_merge, notail_merge
Enable or disable branch-tail merging, an optimization which reduces code size by sharing common portions of then and else clauses or of case switches. The -q tail_merge option is enabled by default, and disabled when -O is specified.

volatile, novolatile
Disable or enable additional optimization on the assumption that memory never changes except as the result of explicit store operations. The default option, -q volatile, disables these optimizations. The -q novolatile option should be used when all variables that can be modified asynchronously (e.g., by signal handlers) have type volatile. Asynchronous modification could happen, for example, with signals, device drivers, and parallel processes accessing shared memory. The current default is -q novolatile. In the future, the goal is to have -q volatile the default value.

FILES

file.c	input file
file.o	object file
a.out	linked output
/lib/ccom	compiler
/lib/occom	backup compiler
/lib/crt0.o	runtime startoff
/lib/mcrt0.o	startoff for profiling
/lib/libc.a	standard library, see intro(3)
/usr/libp/lib*.a	profiling libraries, see intro(3)
/usr/include	standard directory for #include files
mon.out	file produced for analysis by prof(1)

SEE ALSO

adb(1), as(1), cdb(1), gprof(1), ld(1), prof(1), sdb(1), a.out(4), monitor(3C).
cflow(1) in the UMAX V User's Reference Manual.
"C Language" and "Compiler and C Language" in the UMAX V cflow(1) in the UMAX V User's Reference Manual.
"C Language" and "Compiler and C Language" in the UMAX V Programmer's Guide.
B. W. Kernighan and D. M. Ritchie, The C Programming Language. Prentice-Hall, 1978.

DIAGNOSTICS

The diagnostics produced by C itself are intended to be self-explanatory. Occasional messages may be produced by the assembler or link editor.

NOTES

NOTES

APPENDIX F - f77

$man f77

NAME

f77 - Fortran-77 compiler

SYNOPSIS

f77 [options] file [options] [files] ...

DESCRIPTION

The f77 compiler is an advanced, optimizing Fortran-77 compiler that accepts a complete implementation of the standard Fortran language defined by ANSI standard X3.9-1978. It also has extensions to support VAX Fortran functionality and parallel programming. The Fortran-77 compiler accepts any or none of the options described following, and one or more input file names. Files and options can be mixed in any order. Any differences between 4.2 and V are noted in the text.

Files that have an f or F extension are taken to be Fortran-77 language source programs. The compiler processes every Fortran-77 source file to produce a corresponding object file with the same file name and an o extension. Source files that have an F extension are passed through the C language macro preprocessor before being compiled by the f77 compiler. Files that have an e extension are assumed to be EFL (Extended Fortran Language) files, which are passed through the efl preprocessor before being compiled by the Fortran-77 compiler. Files that have an r extension are taken to be Ratfor files and passed through the ratfor preprocessor before being compiled. Files that have an s extension are assumed to be assembly language source programs. These are assembled to produce a corresponding

object file with the same file name and an o extension.

Files with extensions other than f, F, e, r, and s are assumed to be Fortran-compatible libraries, or object files such as those files produced by an earlier compilation or assembly. These files, together with any object code produced during the compilation, are loaded to produce an executable program file named aout.

If only one input file with an f, F, e, r, or s extension is supplied, the compiler automatically deletes the object file output produced from that input file after executable program file aout has been created.

All unrecognized options and all file names with extensions other than .f, .F, .e, .r, .c are passed to the loader. For assembler options, see as(1); for loader options, see ld(1). The f77 options are:

-Bprefix Run the compiler program contained in file prefixfcom. If prefix is not given, /usr/lib/ofcom is the default compiler used.

-c Compile only. Produce object file output (even if there was only one source file) and do not load the program after compiling it.

-Dname=def
Define symbol name to be string def, when running the C language preprocessor, as if by a #define statement. If =def is omitted, defines name to be 1 while running the C preprocessor.

-Estring Pass option(s) string to the efl preprocessor when processing input files that have the e extension.

-F Generate only Fortran language output from the ratfor or efl preprocessor, placing it in a file that has the source file name and the f extension, but do not run the Fortran-77 compiler.

-g Generate special symbol table data for the sdb(1) debugger (or the optional debugger), and pass the -lg flag to the loader.

-Ipath Include source files from the directory named path when running the C language preprocessor. When compiling source files named with the F extension, search for #include files (whose names do not begin with /) first in the directory containing the source file, then in the directory path, and then in a list of standard defaults. Multiple -I options can establish a hierarchy of #include file directories.

-i2 Make the default length of integer constants and variables, and all logical quantities, be short.

Complementary option -i4 is the default, which calls for long integer variables and constants.

-m Apply the M4 macro preprocessor to each EFL or Ratfor source file before passing it through the efl or ratfor preprocessor.

-O Perform optimizations that speed up the generated code; also perform any space optimizations that do not impact code speed. See also the -q qualifier options.

-o output Name the final, executable output file output rather than aout.

-onetrip Generate object code that executes the range of every do loop at least once, even if the initial value of the loop index exceeds the limit value.

-p Prepare to generate an execution profile using prof(1). Include special profiling code that counts how many times each routine is called. If loading occurs, use a special startup routine that calls monitor(3) and produces a monout file upon termination. Use a special profiling library instead of the standard C library.

-pg Generate an execution profile using gprof. Include special profiling code that counts how many times each routine is called. If loading occurs, use a special startup routine that calls monitor(3) and produces one or more gmon.pid upon termination. A profiling version of the standard library is used.

-R Make initialized variables shared and read-only (by passing the -r option to the assembler).

-Rstring Pass option(s) string to the ratfor preprocessor when processing input files that have an r extension.

-S Generate assembly language output for each source file, but do not assemble it. Assembler output for a source file with the extension f, F, e, r, or c is put in a file with the same name and a s extension.

-U Do not convert uppercase letters to lowercase letters. By default Fortran programs are converted to lowercase letters except within character string constants.

-u Disable automatic data typing and, instead, make the default type of a variable the undefined type.

-v Report the names of all subprocesses invoked by

the compiler and their arguments.

-w Suppress warning diagnostics.

-w66 Recognized only for compatibility with the Portable Fortran-77 Compiler, which used this option to suppress warnings about Fortran-66 features encountered during compilation. The Fortran-77 compiler does not flag language elements that are unique to Fortran-66.

-W[a c l], arg
Pass option arg to the assembler, compiler, or linker, as specified respectively by -Wa, arg, -Wc, arg, or -Wl, arg. The internal options for the f77 compiler include implementation options used to reconfigure the compiler for alien operating environments, and debugging options used for testing compiler software. These options should never be used in normal operation; they are described in the Fortran-77 Manual.

-q qualifier[=arg]
The qualifier options provide more detailed control over the generated code and action of the compiler. They modify the generated code of the compiler to reflect various special requirements of a program, and in general should only be used for special situations. The qualifier options deal with architecture, optimization selections, file configuration, and Fortran language extensions. In this listing they are grouped by category. Both the qualifiers and any arguments, which have compiler-defined values, can be abbreviated to their minimum number of unique characters. The qualifiers are:

portable
apc, apc01, apc02, dpc, xpc[,2arg], host_is_target,
These qualifiers select generation of code that is compatible with Multimax systems having APC DPC or XPC (National Semiconductor NS32xxx-based) processor boards. The default is to generate code appropriate for the machine on which the compiler is running. (Differences between generated APC and DPC code are primarily in alignment optimization.)

apc The apc qualifier selects APC01 code and the libm_apc.a math library.

apc01 The apc01 qualifier is the same as the apc qualifier. It is equivalent to the obsoleted switch combination, -q apc -q nofpa.

apc02 The apc02 qualifier selects APC02 code (with Cone instructions) and uses the libm_fpa.a math library. This is equivalent to the obsoleted switch combination, -q apc -q fpa.

dpc The dpc qualifier selects code optimized for a DPC system, and uses the libm_apc.a library.

xpc[,arg]
The xpc qualifier generates code optimized for XPC systems, using the libm_xpc.a math library. Since xpc permits access of 4 additional floating point (fp) registers and uses floating point instructions that do not exist for APC and DPC boards, code compiled using this option may not be portable to APC and DPC systems. xpc accepts the arguments limitfregs and nolimitfregs. -q xpc,limitfregs assures code compatibility with APC and DPC systems, selecting the libm_apc.a math library rather than libm_xpc.a and suppressing the usage of some double-precision floating point registers that are available to XPC systems; only 4 double-precision float registers are used.
-q xpc,nolimitfregs permits all floating point registers to be used, and uses the libm_xpc.a math library.

host_is_target
The host_is_target qualifier optimizes code for the system performing the compilation. No attempt is made to preserve portability. This is default behavior.

portable
The portable qualifier generates code that is portable across all Multimax APC, DPC, and XPC systems. A universal math library, libm_apc.a, is used. Only optimizations that are explicitly portable are used. Produced code is portable to APC and DPC systems even if compiled on an XPC system, since only 4 double-precision float registers are used.

align_text, noalign_text
Enable or disable alignment of text segments on boundaries to optimize burst mode on Multimax systems having APC s. The default

is noalign_text, unless optimize=time is enabled.

asmdir=prefix
: Use the assembler located in the prefixas file instead of the default assembler, /bin/as.

compiler_registers, nocompiler_registers
: Enable or disable compiler allocation of local variables to registers beyond those specified by register storage class specifications. The default is compiler_registers. nocompiler_registers should only be used when code is written to depend on the existence of non-register class variables in memory.

crt0dir=prefix
: Use the prefixcrt0.o startup file instead of the default startup file, /lib/crt0.o.

d_lines, nod_lines
: Enable or disable the recognition of any comment line, beginning with a D, as a code line. The default is nod_lines.

direct_code, nodirect_code
: Enable or disable the direct generation of code by the compiler. When enabled, the compiler directly generates object code, bypassing the intermediate steps of producing assembly code and assembling it to produce the object code. The nodirect_code qualifier should only be needed if the source file contains asm statements. direct_code is enabled by default. nodirect_code is enabled if the -R option is specified.

extensions[=arg], noextensions
: Enable or disable the specification of Fortran extensions. The default qualifier is noextensions. The available arguments are:

  berkeley_f77 — Supports the standard UNIX f77. This is equivalent to noextensions.

  extended_f77 — Supports an extension to f77 that allows Fortran programs written for VAX/VMS to be compiled on Multimax systems. This is the default when the -q extensions qualifier is given without an argument.

parallel — Recognizes the extensions that support parallel programming, including shared memory declarations and spinlocks in-line. This does not change the value of an earlier specified berkeley_f77 or extended_f77 selection.

lddir=prefix
: Use the link editor in prefixld instead of the default, /bin/ld.

long_case, nolong_case
: Enable or disable the generation of case statements using a full four-byte displacement. nolong_case is the default, allowing case statements to span 4 Kilobytes. long_case allows case statements to span 2 Megabytes. This should only be needed in unusual circumstances.

long_jump, nolong_jump
: Enable or disable the generation of jumps with four-byte displacements when the assembler is unable to resolve them in one byte. The default, nolong_jump, allows branches to span up to _8 Kilobytes. long_jump allows branches to span up to _16 Megabytes. Direct code generation selects one-, two-, or four-byte displacement as appropriate, regardless of the setting of this option.

loops, noloops
: Enable or disable loop optimizations. These optimizations include loop-invariant hoisting and strength reduction. The default is noloops.

optimize[=arg], nooptimize
: Enable or disable different levels of optimization. The default is optimize=none. The available arguments are:

  none — Enable no special optimizations. none is equivalent to nooptimize.

  space — Enable optimizations which may take longer to generate but which should produce a program that requires minimal space. This argument also enables preload_constants and tail_merge.

standard Enable a set of optimizations that do not take an excessive amount of time to generate and which do not favor space over time (or vice versa).

time Enable optimizations which may take longer to recognize but which should produce a program that requires minimal execution time. This argument also enables align_text, loops, and novolatile.

preload_constants, nopreload_constants
Enable or disable the loading of constant values and addresses that are frequently referenced in the source code at the start of a program. This option saves space; it may save execution time if the constants and addresses are also referenced frequently during execution. no_preload_constants is the default; preload_constants is enabled by the -O option.

single_lib, nosingle_lib
Enable or disable the use of single precision math routines for certain built-in functions when the functions are called with single precision arguments. The single precision versions offer significantly increased speed with almost no reduction in accuracy. single_lib is enabled by default.

tail_merge, notail_merge
Enable or disable branch-tail merging, an optimization that reduces code size by sharing common portions of then and else clauses or of case switches. tail_merge is disabled by default.

volatile, novolatile
Enable or disable additional optimization on the assumption that memory never changes except as the result of explicit store operations. The default is volatile, unless optimize=time is selected. novolatile, which enables the optimizations, is available only when optimize=time is selected. novolatile should only be used when it is clear that no variables can be modified asynchronously. Asynchronous modification could happen, for example, with signals, device drivers, or parallel processes accessing shared memory.

RESTRICTIONS

The -q flag and its qualifier options replace the following

options, which are no longer supported:

-A Replaced by -q nodirect_code.

-G Replaced by -q direct_code.

-H Replaced by -q notail_merge.

-J Replaced by -q long_jump.

-T Replaced by -q loops.

-V Replaced by -q novolatile.

FILES

./fort[pid].?	temporary fortran process files
a.out	loaded output file
file.[fFresc]	input file
file.o	object file
gmon.[pid]	file produced for analysis by monitor(3)
mon.out	file produced for analysis by prof(1)
/lib/cpp	C preprocessor
/lib/libc.a	C library
/lib/cpp	C preprocessor
/lib/libc.a	C library
/usr/lib/fcom	Fortran compiler
/usr/lib/libFBERK.a	combined libF77.a, libI77.a, and libU77.a library
/usr/lib/libFBERK_p.a	profiling combined Berkeley function library
/usr/lib/libFORT.a	combined libFBERK.a and libX77.a library
/usr/lib/libFORT_p.a	profiling combined extended Berkeley function
/usr/lib/libm_apc.a	standard NS32081 code math library
/usr/lib/libm_fpa.a	math library for APC02 systems with Cone processor
/usr/lib/libm_xpc.a	XPC system math library (8 float-register, NS32381)

SEE ALSO

as(1), cc(1), ld(1), m4(1), prof(1), sdb(1), cdb(1X), efl(1F), fpr(1F) fsplit(1F) ratfor(1F), struct(1F), intro(3F) epf(9F),
Fortran-77 Manual.

American National Standard Programming Language Fortran, ANSI X3.9-1978.

NOTES

NOTES

APPENDIX G - lint

$man lint

NAME

lint - a C program checker

SYNOPSIS

lint [option] ... file ...

DESCRIPTION

lint attempts to detect features of the C program files that are likely to be bugs, non-portable, or wasteful. It also checks type usage more strictly than the compilers. Among the things that are currently detected are unreachable statements, loops not entered at the top, automatic variables declared and not used, and logical expressions whose value is constant. Moreover, the usage of functions is checked to find functions that return values in some places and not in others, functions called with varying numbers or types of arguments, and functions whose values are not used or whose values are used but none returned.

Arguments whose names end with .c are taken to be C source files. Arguments whose names end with .ln are taken to be the result of an earlier invocation of lint with either the -c or the -o option used. The .ln files are analogous to .o (object) files that are produced by the cc(1) command when given a .c file as input. Files with other suffixes are warned about and ignored.

lint will take all the .c, .ln, and llib-lx.ln (specified by -lx) files and process them in their command line order. By default, lint appends the standard C lint library (llib-lc.ln) to the end of the list of files. However, if the -p option is used, the portable C lint library (llib-port.ln) is appended instead. When the -c option is not used, the second pass of lint checks this list of files for mutual compatibility. When the -c option is used, the .ln and the llib-lx.ln files are ignored.

Any number of lint options may be used, in any order, intermixed with file-name arguments. The following options are used to suppress certain kinds of complaints:

-a Suppress complaints about assignments of long values to variables that are not long.

-b Suppress complaints about break statements that cannot be reached. (Programs produced by lex(1) or yacc(1) will often result in many such complaints.)

-h Do not apply heuristic tests that attempt to intuit bugs, improve style, and reduce waste.

-u Suppress complaints about functions and external variables used and not defined, or defined and not used. (This option is suitable for running lint on a subset of files of a larger program).

-v Suppress complaints about unused arguments in functions.

-x Do not report variables referred to by external declarations but never used.

The following arguments alter lint's behavior:

-lx Include additional lint library llib-lx.ln. For example, a lint version of the Math Library llib-lm.ln can be included by inserting -lm on the command line. This argument does not suppress the default use of llib-lc.ln. These lint libraries must be in the assumed directory. This option can be used to reference local lint libraries and is useful in the development of multi-file projects.

-n Do not check compatibility against either the standard or the portable lint library.

-p Attempt to check portability to other dialects (IBM and GCOS) of C. Along with stricter checking, this option causes all non-external names to be truncated to eight characters and all external names to be truncated to six characters and one case.

-c Cause lint to produce a .ln file for every .c file on the command line. These .ln files are the product of lint's first pass only, and are not checked for inter-function compatibility.

-o lib
Cause lint to create a lint library with the name llib-llib.ln. The -c option nullifies any use of the -o option. The lint library produced is the input that is given to lint's second pass. The -o option simply causes this file to be saved in the named lint library. To produce a llib-llib.ln without extraneous messages, use of the -x option is suggested. The -v option is useful if the source file(s) for the lint library are just external interfaces (for example, the way the file llib-lc is written). These option settings are also available through the use of "lint comments" (see below).

The -D, -U, and -I options of cc(1) and cpp(1) and the -g and -O options of cc are also recognized as separate arguments. The -g and -O options are ignored, but, by recognizing these options, lint's behavior is closer to that of the cc command. Other options are warned about and ignored. The pre-processor symbol "lint" is defined to allow certain questionable code to be altered or removed for lint. Therefore, the symbol "lint" should be thought of as a reserved word for all code that is planned to be checked by lint.

Certain conventional comments in the C source will change

the behavior of lint:

/*NOTREACHED*/
: at appropriate points stops comments about unreachable code. (This comment is typically placed just after calls to functions like exit(2).)

/*VARARGSn*/
: suppresses the usual checking for variable numbers of arguments in the following function declaration. The data types of the first n arguments are checked; a missing n is taken to be 0.

/*ARGSUSED*/
: turns on the -v option for the next function.

/*LINTLIBRARY*/
: at the beginning of a file shuts off complaints about unused functions and function arguments in this file. This is equivalent to using the -v and -x options.

lint produces its first output on a per-source-file basis. Complaints regarding included files are collected and printed after all source files have been processed. Finally, if the -c option is not used, information gathered from all input files is collected and checked for consistency. At this point, if it is not clear whether a complaint stems from a given source file or from one of its included files, the source file name will be printed followed by a question mark.

The behavior of the -c and the -o options allows for incremental use of lint on a set of C source files. Generally, one invokes lint once for each source file with the -c option. Each of these invocations produces a .ln file which corresponds to the .c file, and prints all messages that are about just that source file. After all the source files have been separately run through lint, it is invoked once more (without the -c option), listing all the .ln files with the needed -lx options. This will print all the inter-file inconsistencies. This scheme works well with make(1); it allows make to be used to lint only the source files that have been modified since the last time the set of source files were linted.

FILES

/usr/lib/lint[12]	first and second passes
/usr/lib/llib-lc.ln	declarations for C Library functions (binary format; source is in /usr/lib/llib-lc)
/usr/lib/llib-port.ln	declarations for portable functions (binary format; source is in /usr/lib/llib-port)
/usr/lib/llib-lm.ln	declarations for Math Library functions (binary format; source is in /usr/lib/llib-lm.ln)
/usr/tmp/*lint*	temporaries

```
SEE ALSO
     cc(1), cpp(1), lex(1), make(1), yacc(1), tmpnam(3S).

BUGS
     exit(2), longjmp(3C), and other functions that do not return
     are not understood; this causes various lies.
APPENDIX H - cb

$man cb

NAME
     cb - C program beautifier

SYNOPSIS
     cb [ -s ] [ -j ] [ -l leng ] [ file ... ]

DESCRIPTION
     The cb comand reads C programs either from its arguments or
     from the standard input, and writes them on the standard
     output with spacing and indentation that display the
     structure of the code.  Under default options, cb preserves
     all user new-lines.

     cb accepts the following options.

     -s        Canonicalizes the code to the style of Kernighan
               and Ritchie in The C Programming Language.

     -j        Causes split lines to be put back together.

      -l leng  Causes cb to split lines that are longer than
               leng.

SEE ALSO
     cc(1).
     The C Programming Language.  Prentice-Hall, 1978.

BUGS
     Punctuation that is hidden in preprocessor statements will
     cause indentation errors.
                                           NOTES
ÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜ
ÜÜÜÜÜÜÜ
APPENDIX I - ar

$man ar

NAME
     ar - archive and library maintainer for portable archives

SYNOPSIS
     ar key [ posname ] afile [ name ] ...

DESCRIPTION
     The ar command maintains groups of files combined into a
     single archive file.  Its main use is to create and update
```

library files as used by the link editor. It can be used, though, for any similar purpose. The magic string and the file headers used by ar consist of printable ASCII characters. If an archive is composed of printable files, the entire archive is printable.

When ar creates an archive, it creates headers in a format that is portable across all machines. The portable archive format and structure is described in detail in ar(4). The archive symbol table (described in ar(4)) is used by the link editor (ld(1)) to effect multiple passes over libraries of object files in an efficient manner. An archive symbol table is only created and maintained by ar when there is at least one object file in the archive. The archive symbol table is in a specially named file which is always the first file in the archive. This file is never mentioned or accessible to the user. Whenever the ar command is used to create or update the contents of such an archive, the symbol table is rebuilt. The s option described below will force the symbol table to be rebuilt. The symbol table holds a maximum of 20,000 symbols.

Unlike command options, the command key is a required part of ar's command line. The key (which may begin with a -) is formed with one of the following letters: drqtpmx. Arguments to the key, alternatively, are made with one of more of the following set: vuaibcls. posname is an archive member name used as a reference point in positioning other files in the archive. afile is the archive file. The names are constituent files in the archive file. The meanings of the key characters are as follows:

d Delete the named files from the archive file.

r Replace the named files in the archive file. If the optional character u is used with r, then only those files with dates of modification later than the archive files are replaced. If an optional positioning character from the set aib is used, then the posname argument must be present and specifies that new files are to be placed after (a) or before (b or i) posname. Otherwise new files are placed at the end.

q Quickly append the named files to the end of the archive file. Optional positioning characters are invalid. The command does not check whether the added members are already in the archive. This option is useful to avoid quadratic behavior when creating a large archive piece-by-piece. Unchecked, the file may grow exponentially up to the second degree.

t Print a table of contents of the archive file. If no names are given, all files in the archive are tabled. If names are given, only those files are tabled.

p Print the named files in the archive.

m Move the named files to the end of the archive. If a positioning character is present, then the posname argument must be present and, as in r, specifies where the files are to be moved.

x Extract the named files. If no names are given, all files in the archive are extracted. In neither case does x alter the archive file.

The meanings of the key arguments are as follows:

v Give a verbose file-by-file description of the making of a new archive file from the old archive and the constituent files. When used with t, give a long listing of all information about the files. When used with x, precede each file with a name.

c Suppress the message that is produced by default when afile is created.

l Place temporary files in the local (current working) directory, rather than in the default temporary directory, /tmp.

s Force the regeneration of the archive symbol table even if ar is not invoked with a command which will modify the archive contents. This command is useful to restore the archive symbol table after the strip(1) command has been used on the archive.

SEE ALSO

ld(1), lorder(1), strip(1), tmpnam(3S), a.out(4), ar(4). "The Common Object File Format" in the UMAX V Programmer's Guide.

BUGS

If the same file is mentioned twice in an argument list, it may be put in the archive twice.

NAME

ar - common archive file format

DESCRIPTION

The archive command ar(1) combines several files into one. Archives are used mainly as libraries to be searched by the link editor ld(1).

Each archive begins with the archive magic string:

```
#define  ARMAG     "!<arch>\n"   /* magic string */
#define  SARMAG    8             /* length of magic string */
```

Each archive that contains common object files (see a.out(4)) includes an archive symbol table. The link editor

ld uses the symbol table to determine which archive members Each archive that contains common object files (see a.out(4)) includes an archive symbol table. The link editor ld uses the symbol table to determine which archive members must be loaded during the link edit process. The archive symbol table (if it exists) is always the first file in the archive (but is never listed) and is automatically created and updated by ar.

Following the archive magic string are the archive file members. Each file member is preceded by a file member header in the following format:

```
#define ARFMAG            "`\n"  /* header trailer string */
struct  ar_hdr {                 /* file member header */
        char ar_date[12];        /* file member date */
                                 member name */
        char ar_gid[6];          /* file member group
                                 identification */
        char ar_mode[8];         /* file member mode
                                 (octal) */
        char ar_size[10];        /* file member size */
        char ar_fmag[2];         /* header trailer string */
};
```

All information in the file member headers is in printable ASCII . The numeric information in the headers is stored as decimal numbers (except for ar_mode, which is in octal). Thus, if the archive contains printable files, the archive itself is printable.

The ar_name field is blank-padded and terminated with a slash (/). The ar_date field is the modification date of the file at the time it is inserted into the archive. Common format archives can be moved from system to system as long as the portable archive command ar is used.

Each archive file member begins on an even byte boundary; a newline is inserted between files if necessary. Nevertheless the size given reflects the actual size of the file exclusive of padding.

Notice there is no provision for empty areas in an archive file.

If the archive symbol table exists, the first file in the archive has a zero length name (that is, ar_name[0] == '/'). The contents of this file are:

The number of symbols. Length: 4 bytes.

The array of offsets into the archive file. Length: 4 bytes * "the number of symbols".

The name string table. Length: ar_size - (4 bytes * ("the number of symbols" + 1)).

The string table contains exactly as many null-terminated strings as there are elements in the offsets array. Each offset from the array is associated with the corresponding name from the string table (in order). The names in the string table are all the defined global symbols found in the common object files in the archive. Each offset is the location of the archive header for the associated symbol.

SEE ALSO

ar(1), ld(1), strip(1), ldahread(3X), ldfcn(4), a.out(4).

CAVEATS

strip removes all archive symbol entries from the header. The archive symbol entries must be restored with the ts option of ar command before the archive can be used with the link editor ld.

NOTES

ÜÜ
ÜÜÜÜÜÜÜ

NOTES

ÜÜ
ÜÜÜÜÜÜ

APPENDIX J - time

$man time

NAME

time - get time

SYNOPSIS

```
#include <sys/types.h>

time_t time (tloc)
time_t *tloc;
```

DESCRIPTION

time returns the value of time in seconds since 00:00:00 GMT, January 1, 1970.

If tloc is not a null pointer, the return value is also stored in the location to which tloc points.

time will fail if the following is true:

[EFAULT] points to an illegal address.

SEE ALSO

stime(2).

DIAGNOSTICS

Upon successful completion, time returns the value of time. Otherwise, a value of -1 is returned and errno is set to indicate the error.

NAME

time, ctime, ltime, gmtime - return system time

SYNOPSIS

integer function time() character*(*) function ctime (stime
integer stime subroutine ltime (stime, tarray)
integer stime, tarray(9) subroutine gmtime (stime, tarray)
integer stime, tarray(9)

DESCRIPTION

Time returns the time since 00:00:00 GMT, Jan 1, 1970, measured in seconds. This is the value of the system clock

Ctime converts a system time to a 24-character ASCII string The format is described under ctime(3). No newline or NULL is included.

Ltime and gmtime both disect a time field into month, day, etc., either for the local time zone or for GMT. The order and meaning of each element returned in tarray is described under ctime(3).

FILES

/usr/lib/libU77.a

SEE ALSO

ctime(3), itime(3F), idate(3F), fdate(3F)

NAME

time - time a command

SYNOPSIS

time command

DESCRIPTION

The command is executed; after it is complete, time prints the elapsed time during the command, the time spent in the system, and the time spent in execution of the command. Times are reported in seconds.

The times are printed on standard error.

SEE ALSO

timex(1).
times(2) in the UMAX V Programmer's Reference Manual.

APPENDIX K - ksh

$man ksh

NAME

ksh, rksh - korn shell, a command programming language

SYNOPSIS

ksh [-acefhikmnorstuvx] [-o option] ... [arg ...]
rksh [-acefhikmnorstuvx] [-o option] ... [arg ...]

DESCRIPTION

ksh is a command programming language that executes commands read from a terminal or a file. rksh is a restricted version of the standard command interpreter ksh; it is used to set up login names and execution environments whose capabilities are more controlled than those of the standard shell. See Invocation below for the meaning of arguments to the shell.

ksh is close to being upwards compatible with the standard Bourne shell (sh(1)). Its major enhancements include command re-entry, in-line command editing, and aliasing.

Definitions.

A metacharacter is one of the following characters:

; & ( ) | < > new-line space tab

A blank is a tab or a space. An identifier is a sequence of letters, digits, or underscores starting with a letter or underscore. Identifiers are used as names for aliases, functions, and named parameters. A word is a sequence of characters separated by one or more non-quoted metacharacters.

Commands.

A simple-command is a sequence of blank separated words which may be preceded by a parameter assignment list. (See Environment below). The first word specifies the name of the command to be executed. Except as specified below, the remaining words are passed as arguments to the invoked command. The command name is passed as argument 0 (see exec(2)). The value of a simple-command is its exit status if it terminates normally, or (octal) 200+status if it terminates abnormally (see signal(2) for a list of status values).

A pipeline is a sequence of one or more commands separated |. The standard output of each command but the last is connected by a pipe(2) to the standard input of the next command. Each command is run as a separate process; the shell waits for the last command to terminate. The exit status of a pipeline is the exit status of the last command. A list is a sequence of one or more pipelines separated by ;, &, &&, or ||, and optionally terminated by ;, &, or |&. Of these five symbols, ;, &, and |& have equal precedence, which is lower than that of && and ||. The symbols && and || also have equal precedence. A semicolon (;) causes sequential execution of the preceding pipeline; an ampersand (&) causes asynchronous execution of the preceding pipeline (i.e., the shell does not wait for that pipeline to finish). The symbol |& causes asynchronous execution of the preceding command or pipeline with a two-way pipe established to the parent shell. The standard input and output of the spawned command can be written to and read from by the parent shell using the -p option of the special commands read and print described later. Only one such command can be active at any given time. The symbol && (||) causes the list following it

to be executed only if the preceding pipeline returns a zero (non-zero) value. An arbitrary number of new-lines may appear in a list, instead of semicolons, to delimit commands.

A command is either a simple-command or one of the following. Unless otherwise stated, the value returned by a command is that of the last simple-command executed in the command.

for identifier [in word ...] do list done
: Each time a for command is executed, identifier is set to the next word taken from the in word list. If in word ... is omitted, then the for command executes the do list once for each positional parameter that is set (see Parameter Substitution below). Execution ends when there are no more words in the list.

select identifier [in word ...] do list done
: A select command prints on standard error (file descriptor 2), the set of words, each preceded by a number. If in word ... is omitted, then the positional parameters are used instead (see Parameter Substitution below). The PS3 prompt is printed and a line is read from the standard input. If this line consists of the number of one of the listed words, then the value of the parameter identifier is set to the word corresponding to this number. If this line is empty, the selection list is printed again. Otherwise the value of the parameter identifier is set to null. The contents of the line read from standard input is saved in the parameter REPLY. The list is executed for each selection until a break or end-of-file is encountered.

case word in [pattern [| pattern] ...) list ;;] ... esac
: A case command executes the list associated with the first pattern that matches word. The form of the patterns is the same as that used for file-name generation (see File Name Generation below).

if list then list [elif list then list] ... [else list] fi
: The list following if is executed and, if it returns a zero exit status, the list following the first then is executed. Otherwise, the list following elif is executed and, if its value is zero, the list following the next then is executed. Failing that, the else list is executed. If no else list or then list is executed, then the if command returns a zero exit status.

while list do list done
until list do list done
: A while command repeatedly executes the while list and, if the exit status of the last command in the list is zero, executes the do list; otherwise the loop terminates. If no commands in the do list are executed, then the while command returns a zero exit

status; until may be used in place of while to negate the loop termination test.

(list)
Execute list in a separate environment. Note, that if two adjacent open parentheses are needed for nesting, a space must be inserted to avoid arithmetic evaluation as described below.

{list;}
list is simply executed. Note that { is a keyword and requires a blank in order to be recognized.

function identifier { list ;}
identifier () { list ;}
Define a function which is referenced by identifier. The body of the function is the list of commands between { and }. (See Functions below).

time pipeline
The pipeline is executed and the elapsed time as well as the user and system time are printed on standard error.

The following keywords are only recognized as the first word of a command and when not quoted:

if then else elif fi case esac for while until do done { }
function select time

Comments.
A word beginning with # causes that word and all the following characters up to a new-line to be ignored.

Aliasing.
The first word of each command is replaced by the text of an alias if an alias for this word has been defined. The first character of an alias name can be any printable character, but the rest of the characters must be the same as for a valid identifier. The replacement string can contain any valid shell script including the metacharacters listed above. The first word of each command of the replaced text will not be tested for additional aliases. If the last character of the alias value is a blank then the word following the alias will also be checked for alias substitution. Aliases can be used to redefine special built-in commands but cannot be used to redefine the keywords listed above. Aliases can be created, listed, and exported with the alias command and can be removed with the unalias command. Exported aliases remain in effect for sub-shells but must be reinitialized for separate invocations of the shell (See Invocation below).

Aliasing is performed when scripts are read, not while they are executed. Therefore, for an alias to take effect the alias command has to be executed before the command which references the alias is read.

Aliases are frequently used as a short hand for full path names. An option to the aliasing facility allows the value of the alias to be automatically set to the full path name of the corresponding command. These aliases are called tracked aliases. The value of a tracked alias is defined the first time the identifier is read and undefined each time the PATH variable is reset. These aliases remain tracked so that the next subsequent reference will redefine the value. Several tracked aliases are compiled into the shell. The -h option of the set command makes each command name which is an identifier into a tracked alias.

The following exported aliases are compiled into the shell but can be unset or redefined:

```
echo='print -'
false='let 0'
functions='typeset -f'
history='fc -l'
integer='typeset -i'
nohup='nohup '
pwd='print - $PWD'
r='fc -e -'
true=':'
type='whence -v'
hash='alias -t'
```

Tilde Substitution.

After alias substitution is performed, each word is checked to see if it begins with an unquoted ~. If it does, then the word up to a / is checked to see if it matches a user name in the /etc/passwd file. If a match is found, the ~ and the matched login name is replaced by the login directory of the matched user. This is called a tilde substitution. If no match is found, the original text is left unchanged. A ~ by itself, or in front of a /, is replaced by the value of the HOME parameter. A ~ followed by a + or - is replaced by the value of the parameter PWD and OLDPWD respectively.

In addition, the value of each keyword parameter is checked to see if it begins with a ~ or if a ~ appears after a :. In either of these cases a tilde substitution is attempted.

Command Substitution.

The standard output from a command enclosed in a pair of grave accents (``) may be used as part or all of a word; trailing new-lines are removed. The command substitution `cat file` can be replaced by the equivalent but faster `<file>`. Command substitution of most special commands that do not perform input/output redirection are carried out without creating a separate process.

Parameter Substitution.

A parameter is an identifier, a digit, or any of the

characters *, @, #, ?, -, $, and !. A named parameter (a parameter denoted by an identifier) has a value and zero or more attributes. Named parameters can be assigned values and attributes by using the typeset special command. The attributes supported by the shell are described later with the typeset special command. Exported parameters pass values and attributes to sub-shells but only values to the environment.

The shell supports a limited one-dimensional array facility. An element of an array parameter is referenced by a subscript. A subscript is denoted by a [, followed by an arithmetic expression (see Arithmetic Evaluation below) followed by a]. The value of all subscripts must be in the range of 0 through 511. Arrays need not be declared. Any reference to a named parameter with a valid subscript is legal and an array will be created if necessary. Referencing an array without a subscript is equivalent to referencing the first element.

The value of a named parameter may also be assigned by writing:

```
name=value [ name=value ] ...
```

If the integer attribute, -i, is set for name the value is subject to arithmetic evaluation as described below. Positional parameters, parameters denoted by a number, may be assigned values with the set special command. Parameter $0 is set from argument zero when the shell is invoked. The character $ is used to introduce substitutable parameters.

${parameter}
: The value, if any, of the parameter is substituted. The braces are required when parameter is followed by a letter, digit, or underscore that is not to be interpreted as part of its name or when a named parameter is subscripted. If parameter is a digit then it is a positional parameter. If parameter is * or @, then all the positional parameters, starting with $1, are substituted (separated by spaces). If an array identifier with subscript * or @ is used, then the value for each of the elements is substituted (separated by spaces).

${#parameter}
: If parameter is not *, the length of the value of the parameter is substituted. Otherwise, the number of positional parameters is substituted.

${#identifier[*]}
: The number of elements in the array identifier is substituted.

${parameter:-word}
: If parameter is set and is non-null then substitute its value; otherwise substitute word.

${parameter:=word}
: If parameter is not set or is null then set it to word; the value of the parameter is then substituted.

Positional parameters may not be assigned to in this way.

${parameter:?word}
If parameter is set and is non-null then substitute its value; otherwise, print word and exit from the shell. If word is omitted then a standard message is printed.

${parameter:+word}
If parameter is set and is non-null then substitute word; otherwise substitute nothing.

${parameter#pattern}
${parameter##pattern}
If the shell pattern matches the beginning of the value of parameter, then the value of this substitution is the value of the parameter with the matched portion deleted; otherwise, the value of this parameter is substituted. In the first form the smallest matching pattern is deleted and in the latter form the largest matching pattern is deleted.

${parameter%pattern}
${parameter%%pattern}
If the shell pattern matches the end of the value of parameter, then the value of parameter with the matched part is deleted; otherwise substitute the value of parameter. In the first form the smallest matching pattern is deleted and in the latter form the largest matching pattern is deleted.

In the above, word is not evaluated unless it is to be used as the substituted string, so that, in the following example, pwd is executed only if d is not set or is null:

```
echo ${d:-`pwd`}
```

If the colon (:) is omitted from the above expressions, then the shell only checks whether parameter is set or not. If the shell pattern matches the end of the value of parameter, then the value of parameter with the matched part is deleted; otherwise substitute the value of parameter. In the first form the smallest matching pattern is deleted and in the latter form the largest matching pattern is deleted.

In the above, word is not evaluated unless it is to be used as the substituted string, so that, in the following example, pwd is executed only if d is not set or is null:

```
echo ${d:-`pwd`}
```

If the colon (:) is omitted from the above expressions, then the shell only checks whether parameter is set or not.

The following parameters are automatically set by the shell:

The number of positional parameters in decimal.

- Flags supplied to the shell on invocation or by the set command.

? The decimal value returned by the last executed

command.

$ The process number of this shell.

_ The last argument of the previous command. This parameter is not set for commands which are asynchronous.

! The process number of the last background command invoked.

PPID The process number of the parent of the shell.

PWD The present working directory set by the cd command.

OLDPWD
The previous working directory set by the cd command.

RANDOM
Each time this parameter is referenced, a random integer is generated. The sequence of random numbers can be initialized by assigning a numeric initialized by assigning a numeric value to

RANDOM.
Each time this parameter is referenced, a random integer is generated. The sequence of random numbers can be initialized by assigning a numeric to RANDOM.

REPLY
This parameter is set by the select statement and by the read special command when no arguments are supplied.

The following parameters are used by the shell:

CDPATH
The search path for the cd command.

COLUMNS
If this variable is set, the value is used to define the width of the edit window for the shell edit modes and for printing select lists.

EDITOR
If the value of this variable ends in emacs, gmacs, or vi and the VISUAL variable is not set, then the corresponding option (see Special Commands set below) will be turned on.

ENV If this parameter is set, then parameter substitution is performed on the value to generate the path name of the script that will be executed when the shell is invoked. (See Invocation below.) This file is typically used for alias and function definitions.

FCEDIT
The default editor name for the fc command.

IFS Internal field separators, normally space, tab, and new-line that is used to separate command words which result from command or parameter substitution and for separating words with the special command read.

HISTFILE
If this parameter is set when the shell is invoked, then the value is the path name of the file that will be used to store the command

history. (See Command Re-entry below.)

HISTSIZE
If this parameter is set when the shell is invoked, then the number of previously entered commands that are accessible by this shell will be greater than or equal to this number. The default is 128.

HOME The default argument (home directory) for the cd command.

MAIL If this parameter is set to the name of a mail file and the MAILPATH parameter is not set, then the shell informs the user of arrival of mail in the specified file.

MAILCHECK
This variable specifies how often (in seconds) the shell will check for changes in the modification time of any of the files specified by the MAILPATH or MAIL parameters. The default value is 600 seconds. If set to 0, the shell will check before each prompt.

MAILPATH
A colon (:) separated list of file names. If this parameter is set then the shell informs the user of any modifications to the specified files that have occurred within the last MAILCHECK seconds. Each file name can be followed by a ? and a message that will be printed. The message will undergo parameter and command substitution with the parameter, $_ defined as the name of the file that has changed. The default message is you have mail in $_.

PATH The search path for commands (see Execution below). The user may not change PATH if executing under rksh (except in .profile).

PS1 The value of this parameter is expanded for parameter substitution to define the primary prompt string which by default is "$ ". The character ! in the primary prompt string is replaced by the command number (see Command Re-entry below).

PS2 Secondary prompt string, by default "> ".

PS3 Selection prompt string used within a select loop, by default "#? ".

SHELL
The path name of the shell is kept in the environment. At invocation, if the value of this variable contains an r in the basename, then the shell becomes restricted.

TMOUT
If set to a value greater than zero, the shell will terminate if a command is not entered within the prescribed number of seconds. When the timer expires, a warning is printed and a 60 second grace period is provided.

VISUAL
If the value of this variable ends in emacs, gmacs, or vi then the corresponding option (see

Special Commands set below) will be turned on.

The shell gives default values to PS1, PS2, MAILCHECK, TMOUT, and IFS. HOME, MAIL, SHELL, PATH, and TZ are set by login(1). The remaining parameters are typically set in /etc/profile, .profile, or $(ENV) files.

After parameter and command substitution, the results of substitutions are scanned for the field separator characters (those found in IFS) and split into distinct arguments where such characters are found. Explicit null arguments "" or ' ' are retained. Implicit null arguments (those resulting from parameters that have no values) are removed.

Following substitution, each command word is scanned for the characters *, ?, and [unless the -f option has been set. If one of these characters appears then the word is regarded as a pattern. The word is replaced with alphabetically sorted file names that match the pattern. If no file name is found that matches the pattern, then the word is left unchanged. When a pattern is used for file name generation, the character . at the start of a file name or immediately following a /, as well as the character / itself, must be matched explicitly. In other instances of pattern matching the / and . are not treated specially.

`*` Matches any string, including the null string.

`?` Matches any single character.

`[...]`
Matches any one of the enclosed characters. A

pair of characters separated by - matches any character lexically between the pair, inclusive. If the first character following the opening [is a !, then any character not enclosed is matched. A - can be included in the character set by putting it as the first or last character.

Each of the metacharacters listed above (See Definitions above) has a special meaning to the shell and causes termination of a word unless quoted. A character may be quoted (i.e., made to stand for itself) by preceding it with a \. The pair \new-line is ignored. All characters enclosed between a pair of single quote marks (''), except a single quote, are quoted. Inside double quote marks (""), parameter and command substitution occurs and \ quotes the characters \, ', ", and $. $* is equivalent to "$1 $2 ...", whereas $@ is equivalent to $1 $2 ....

The special meaning of keywords can be removed by quoting any character of the keyword. The recognition of special command names listed below cannot be altered by quoting them.

An ability to perform integer arithmetic is provided with the special command let. Evaluations are performed using long arithmetic. Constants are of the form [base#]n where

base is a decimal number between two and thirty-six representing the arithmetic base and n is a number in that base. If the base is omitted them base 10 is used.

An internal integer representation of a named parameter can be specified with the -i option of the typeset special command. When this attribute is selected the first assignment to the parameter determines the arithmetic base to be used when parameter substitution occurs.

Since many of the arithmetic operators require quoting, an alternative form of the let command is provided. For any command which begins with a ((, all the characters until a matching)) are treated as a quoted expression. More precisely, ((...)) is equivalent to let " ...".

When used interactively, the shell prompts with the value of PS1 before reading a command. If at any time a new-line is typed and further input is needed to complete a command, then the secondary prompt (i.e., the value of PS2) is issued.

Before a command is executed, its input and output may be redirected using a special notation interpreted by the shell. The following may appear anywhere in a simple-command or may precede or follow a command and are not passed on to the invoked command. Command and parameter substitution occurs before word or digit is used except as noted below. File name generation occurs only if the pattern matches a single file and blank interpretation is not performed.

<word — Use file word as standard input (file descriptor 0).

>word — Use file word as standard output (file descriptor 1). If the file does not exist then it is created; otherwise, it is truncated to zero length.

>>word — Use file word as standard output. If the file exists then output is appended to it (by first seeking to the end-of-file); otherwise, the file is created.

<<[-]word — The shell input is read up to a line that is the same as word, or to an end-of-file. No parameter substitution, command substitution or file name generation is performed on word. The resulting document, called a here-document, becomes the standard input. If any character of word is quoted, no interpretation is placed upon the characters of the document; otherwise, parameter and command substitution occurs, \new-line is ignored, and \ must be used to quote the characters \, $, `, and the first character of word. If - is appended to

<<, all leading tabs are stripped from word and from the document.

<&digit The standard input is duplicated from file descriptor digit (see dup(2)). Similarly for the standard output using >& digit.

<&- The standard input is closed. Similarly for the standard output using >&-.

If one of the above is preceded by a digit, then the file descriptor number referred to is that specified by the digit (instead of the default 0 or 1). For example:

```
... 2>&1
```

means file descriptor 2 is to be opened for writing as a duplicate of file descriptor 1.

The order in which redirections are specified is significant. The shell evaluates each redirection in terms of the (file descriptor, file) association at the time of evaluation. For example:

```
... 1>fname 2>&1
```

first associates file descriptor 1 with file fname. It then associates file descriptor 2 with the file associated with file descriptor 1 (i.e. fname). If the order of redirections were reversed, file descriptor 2 would be associated with the terminal (assuming file descriptor 1 had been) and then file descriptor 1 would be associated with file fname.

If a command is followed by & and job control is not active, then the default standard input for the command is the empty file /dev/null. Otherwise, the environment for the execution of a command contains the file descriptors of the invoking shell as modified by input/output specifications.

The environment (see environ(5)) is a list of name-value pairs that is passed to an executed program in the same way as a normal argument list. The names must be identifiers and the values are character strings. The shell interacts with the environment in several ways. On invocation, the shell scans the environment and creates a parameter for each name found, giving it the corresponding value and marking it export. Executed commands inherit the environment. If the user modifies the values of these parameters or creates new ones, using the export or typeset -x commands they become part of the environment. The environment seen by any executed command is thus composed of any name-value pairs originally inherited by the shell, whose values may be modified by the current shell, plus any additions which must be noted in export or typeset -x commands.

The environment for any simple-command or function may be

augmented by prefixing it with one or more parameter assignments. A parameter assignment argument is a word of the form identifier=value. Thus:

```
TERM=450 cmd args                    and

(export TERM; TERM=450; cmd args)
```

are equivalent (as far as the above execution of cmd is concerned).

If the -k flag is set, all parameter assignment arguments are placed in the environment, even if they occur after the command name. The following first prints a=b c and then c:

```
echo a=b c
set -k
echo a=b c
```

Functions.

The function keyword, described in the Commands section above, is used to define shell functions. Shell functions are read in and stored internally. Alias names are resolved when the function is read. Functions are executed like commands with the arguments passed as positional parameters. (See Execution below).

Functions execute in the same process as the caller and share all files, traps (other than EXIT and ERR) and present working directory with the caller. A trap set on EXIT inside a function is executed after the function completes. Ordinarily, variables are shared between the calling program and the function. However, the typeset special command used within a function defines local variables whose scope includes the current function and all functions it calls.

The special command return is used to return from function calls. Errors within functions return control to the caller.

Function identifiers can be listed with the -f option of the typeset special command. The text of functions will also be listed. Function can be undefined with the -f option of the unset special command.

Ordinarily, functions are unset when the shell executes a shell script. The -xf option of the typeset command allows a function to be exported to scripts that are executed without a separate invocation of the shell. Functions that need to be defined across separate invocations of the shell should be placed in the ENV file.

Jobs.

If the monitor option of the set command is turned on, a terminating background job is so noted whenever ksh is writing a prompt. When a job is started asynchronously with &, the shell prints a line which looks like:

```
[1] 1234
```

indicating that the job started asynchronously was job number 1 and had one (top-level) process, whose process id was 1234. It keeps a table of current jobs, printed by the jobs command, and assigns them small integer numbers.

There are several ways to refer to jobs in the shell. The character % introduces a job name. When referring to job number 1, name it as %1. Jobs can also be named by prefixes of the string typed in to invoke them. Thus, 'kill %cc' would kill a background job whose name began with the string "cc" (if there were such a job).

The shell maintains a notion of the current and previous jobs. In output pertaining to jobs, the current job is marked with a + and the previous job with a -. The abbreviation %+ refers to the current job and %- refers to the previous job. %% is also a synonym for the current job.

This shell learns immediately whenever a process changes state. It normally informs the user whenever a job is finished executing, but only just before it prints a prompt. This is done so that it does not otherwise disturb other work.

When attempting to leave a login shell while jobs are running, be warning will be printed that 'You have running jobs'. Use the jobs command to see what they are. If immediately trying exit again, the shell will give a second warning, and the jobs will be terminated.

Job Control.

If a job is running, a ^Z <ctrl>Z can be typed which sends a STOP signal to the current job. The shell will then normally indicate that the job has been 'Stopped', and print another prompt. The state of this job can then be manipulated using the bg command, or running some other commands and then eventually bring the job back into the foreground with the foreground command fg. A ^Z takes effect immediately and is like an interrupt in that pending output and unread input are discarded when it is typed.

A job being run in the background will stop if it tries to read from the terminal. Background jobs are normally allowed to produce output, but this can be disabled by giving the command stty tostop. If this tty option is set, background jobs will stop when they try to produce output like they do when they try to read input.

Signals.

The INT and QUIT signals for an invoked command are ignored if the command is followed by & and job monitor option is not active. Otherwise, signals have the values inherited by the shell from its parent, with the exception of signal 11 (but see also the trap command below).

Execution.

Each time a command is executed, the above substitutions are carried out. If the command name matches one of the Special Commands listed below, it is executed within the current shell process. Next, the command name is checked to see if it matches one of the user defined functions. If it does, the positional parameters are saved and then reset to the arguments of the function call. When the function completes or issues a return, the positional parameter list is restored and any trap set on EXIT within the function is executed. The value of a function is the value of the last command executed. A function is also executed in the current shell process. If a command name is not a special command or a user defined function, a process is created and an attempt is made to execute the command via exec(2).

The shell parameter PATH defines the search path for the directory containing the command. Alternative directory names are separated by a colon (:). The default path is :/bin:/usr/bin (specifying the current directory, /bin, and /usr/bin, in that order). Note that the current directory is specified by a null path name, which can appear immediately after the equal sign, between colon delimiters, or at the end of the path list. If the command name contains a / then the search path is not used. Otherwise, each directory in the path is searched for an executable file. If the file has execute permission but is not a directory or an a.out file, it is assumed to be a file containing shell commands. A sub-shell is spawned to read it. All non-exported aliases, functions, and named parameters are removed in this case. A parenthesized command is also executed in a sub-shell.

Command Re-entry.

The text of the last HISTSIZE (default 128) commands entered from a terminal device is saved in a history file. The file $HOME/.history is used if the HISTFILE variable is not set or is not writable. A shell can access the commands of all interactive shells which use the same named HISTFILE. The special command fc is used to list or edit a portion this file. The portion of the file to be edited or listed can be selected by number or by giving the first character or characters of the command. A single command or range of commands can be specified. If an editor program is not specified as an argument to fc, the value of the parameter FCEDIT is used. If FCEDIT is not defined, /bin/ed is used. The edited command(s) is printed and re-executed upon leaving the editor. The editor name - is used to skip the editing phase and to re-execute the command. In this case a substitution parameter of the form old=new can be used to modify the command before execution. For example, if r is aliased to 'fc -e -' typing 'r bad=good c' will re-execute the most recent command which starts with the letter c, replacing the string bad with the string good.

In-line Editing Options

Normally, each command line entered from a terminal device

is simply typed followed by a new-line ('RETURN' or 'LINE FEED'). If either the emacs, or vi option is active, the user can edit the command line. To be in either of these edit modes set the corresponding option. An editing option is automatically selected each time the VISUAL or EDITOR variable is assigned a value ending in either of these option names.

The editing features require that the user's terminal accept 'RETURN' as carriage return without line feed and that a space ' ' must overwrite the current character on the screen. ADM terminal users should set the "space - advance" switch to 'space'. Hewlett-Packard series 2621 terminal users should set the straps to 'bcGHxZ etX'.

The editing modes implement a concept where the user is looking through a window at the current line. The window width is the value of COLUMNS if it is defined, otherwise 80. If the line is longer than the window width minus two, a mark is displayed at the end of the window to notify the user. As the cursor moves and reaches the window boundaries the window will be centered about the cursor. The mark is a > (<, *) if the line extends on the right (left, both) side(s) of the window.

Emacs Editing Mode

This mode is entered by enabling either the emacs or gmacs option. The only difference between these two modes is the way they handle ^T. To edit, the user moves the cursor to the point needing correction and then inserts or deletes characters or words as needed. All the editing commands are control characters or escape sequences. The notation for control characters is caret () followed by the character. For example, ^F is the notation for control F. This is entered by depressing 'f' while holding down the 'CTRL' (control) key. The 'SHIFT' key is not depressed. (The notation ^? indicates the DEL (delete) key.)

The notation for escape sequences is M- followed by a character. For example, M-f (pronounced Meta f) is entered by depressing ESC (ascii 033) followed by 'f'. (M-F would be the notation for ESC followed by 'SHIFT' (capital) 'F'.) All edit commands operate from any place on the line (not just at the beginning). Neither the "RETURN" nor the "LINE FEED" key is entered after edit commands except when noted.

^F	Move cursor forward (right) one character.
M-f	Move cursor forward one word. (The editor's idea of a word is a string of characters consisting of only letters, digits and underscores.)
^B	Move cursor backward (left) one character.
M-b	Move cursor backward one word.
^A	Move cursor to start of line.
^E	Move cursor to end of line.
^]char	Move cursor to character char on current line.
^X^X	Interchange the cursor and mark.
erase	(User defined erase character as defined by the

	stty command, usually ^H or #.) Delete previous character.
^D	Delete current character.
M-d	Delete current word.
M-^H	(Meta-backspace) Delete previous word.
M-h	Delete previous word.
M-^?	(Meta-DEL) Delete previous word (if the interrupt character is ^? (DEL, the default) then this command will not work).
^T	Transpose current character with next character in emacs mode. Transpose two previous characters in gmacs mode.
^C	Capitalize current character.
M-C	Capitalize current word.
^K	Kill from the cursor to the end of the line. If given a parameter of zero then kill from the start of line to the cursor.
^W	Kill from the cursor to the mark.
M-p	Push the region from the cursor to the mark on the stack.
kill	(User defined kill character as defined by the stty command, usually ^G or @.) Kill the entire current line. If two kill characters are entered in succession, all kill characters from then on cause a line feed (useful when using paper terminals).
^Y	Restore last item removed from line. (Yank item back to the line.)
^L	Line feed and print current line.
^@	(Null character) Set mark.
M-	(Meta space) Set mark.
^J	(New line) Execute the current line.
^M	(Return) Execute the current line.
eof	End-of-file character, normally ^D, will terminate the shell if the current line is null.
^P	Fetch previous command. Each time ^P is entered the previous command back in time is accessed.
M-<	Fetch the least recent (oldest) history line.
M->	Fetch the most recent (youngest) history line.
^N	Fetch next command. Each time ^N is entered the next command forward in time is accessed.
^Rstring	Reverse search history for a previous command line containing string. If a parameter of zero is given the search is forward. String is terminated by a "RETURN" or "NEW LINE".
^O	Operate - Execute the current line and fetch the next line relative to current line from the history file.
M-digits	(Escape) Define numeric parameter, the digits are taken as a parameter to the next command. The commands that accept a parameter are ^F, ^B, erase, ^D, ^K, ^R, ^P and ^N.
M-letter	Soft-key - The alias list is searched for an alias by the name _letter and if an alias of this name is defined, its value will be inserted on the line. The letter must not be one of the above meta-functions.

M-_	The last parameter of the previous command is inserted on the line.
M-.	The last parameter of the previous command is inserted on the line.
M-*	Attempt file name generation on the current word.
^U	Multiply parameter of next command by 4.
\	Escape next character. Editing characters, the user's erase, kill and interrupt (normally ^?) characters may be entered in a command line or in a search string if preceded by a \. The \ removes the next character's editing features (if any).
^V	Display version of the shell.

vi Editing Mode

There are two typing modes. Initially, when entering a command the user is in the input mode. To edit, the user enters control mode by typing ESC (033) and moves the cursor to the point needing correction and then inserts or deletes characters or words as needed. Most control commands accept an optional repeat count prior to the command.

When in vi mode on most systems, canonical processing is initially enabled and the command will be echoed again if the speed is 1200 baud or greater and it contains any control characters or less than one second has elapsed since the prompt was printed. The ESC character terminates canonical processing for the remainder of the command and the user can then modify the command line. This scheme has the advantages of canonical processing with the type-ahead echoing of raw mode.

If the option viraw is also set, the terminal will always have canonical processing disabled. This mode may be helpful for certain terminals.

Input Edit Commands

By default the editor is in input mode.

erase	(User defined erase character as defined by the stty command, usually ^H or #.) Delete previous character.
^W	Delete the previous blank separated word.
^D	Terminate the shell.
^V	Escape next character. Editing characters, the user's erase or kill characters may be entered in a command line or in a search string if preceded by a ^V. The ^V removes the next character's editing features (if any).
\	Escape the next erase or kill character.

Motion Edit Commands

These commands will move the cursor.

[count]l	Cursor forward (right) one character.
[count]w	Cursor forward one alpha-numeric word.

[count]W Cursor to the beginning of the next word that follows a blank.
[count]e Cursor to end of word.
[count]E Cursor to end of the current blank delimited word.
[count]h Cursor backward (left) one character.
[count]b Cursor backward one word.
[count]B Cursor to preceding blank separated word.
[count]fc Find the next character c in the current line.
[count]Fc Find the previous character c in the current line.
[count]tc Equivalent to f followed by h.
[count]Tc Equivalent to F followed by l.
;   Repeats the last single character find command, f, F, t, or T.
,   Reverses the last single character find command.
0   Cursor to start of line.
^   Cursor to first non-blank character in line.
$ Cursor to end of line.

Search Edit Commands

These commands access the command history.

[count]k Fetch previous command. Each time k is entered the previous command back in time is accessed.
[count]- Equivalent to k.
[count]j Fetch next command. Each time j is entered the next command forward in time is accessed.
[count]+ Equivalent to j.
[count]G The command number count is fetched. The default is the least recent history command.
/string   Search backward through history for a previous command containing string. String is terminated by a "RETURN" or "NEW LINE". If string is null the previous string will be used.
?string   Same as / except that search will be in the forward direction.
n   Search for next match of the last pattern to / or ? commands.
N   Search for next match of the last pattern to / or ?, but in reverse direction. Search history for the string entered by the previous / command.

Text Modification Edit Commands

These commands will modify the line.

a   Enter input mode and enter text after the current character.
A   Append text to the end of the line. Equivalent to $a.
[count]cmotion
c[count]motion
          Delete current character through the character motion moves the cursor to and enter input mode. If motion is c, the entire line will be deleted and input mode entered.
C   Delete the current character through the end of line and enter input mode. Equivalent to c$.
S   Equivalent to cc.

D Delete the current character through the end of line.

[count]dmotion

d[count]motion
Delete current character through the character motion moves the cursor to. Equivalent to d$. If motion is d , the entire line will be deleted.

i Enter input mode and insert text before the current character.

I Insert text before the beginning of the line. Equivalent to the two character sequence ^i.

[count]P Place the previous text modification before the cursor.

[count]p Place the previous text modification after the cursor.

R Enter input mode and replace characters on the screen with characters typed in overlay fashion.

rc Replace the current character with c.

[count]x Delete current character.

[count]X Delete preceding character.

[count]. Repeat the previous text modification command.

~ Invert the case of the current character and advance the cursor.

[count]_ Causes the count word of the previous command to be appended and input mode entered. The last word is used if count is omitted.

* Causes an * to be appended to the current word and file name generation attempted. If no match is found, it rings the bell. Otherwise, the word is replaced by the matching pattern and input mode is entered.

Other Edit Commands

Miscellaneous commands.

u Undo the last text modifying command.

U Undo all the text modifying commands performed on the line.

[count]v Returns the command fc -e ${VISUAL:-${EDITOR:-vi}} count in the input buffer. If count is omitted, then the current line is used.

^L Line feed and print current line. Has effect only in control mode.

^J (New line) Execute the current line, regardless of mode.

^M (Return) Execute the current line, regardless of mode.

Equivalent to I#<cr>. Useful for causing the current line to be inserted in the history without being executed.

Special Commands.

The following simple-commands are executed in the shell process. Input/Output redirection is permitted. File descriptor 1 is the default output location. Parameter assignment lists preceding the command do not remain in effect when the command completes unless noted.

: [arg ...]
     Parameter assignments remain in effect after the command completes. The command only expands parameters. A zero exit code is returned.

. file [arg ...]
     Parameter assignments remain in effect after the command completes. Read and execute commands from file and return. The commands are executed in the current shell environment. The search path specified by PATH is used to find the directory containing file. If any arguments arg are given, they become the positional parameters. Otherwise the positional parameters are unchanged.

alias [-tx] [name[=value] ...]

     Alias with no arguments prints the list of aliases in the form name=value on standard output. An alias is defined for each name whose value is given. A trailing space in value causes the next word to be checked for list tracked aliases. The value of a tracked alias is the full path name corresponding to the given name. The value becomes undefined when the value of PATH is reset but the aliases remained tracked. Without the -t flag, for each name in the argument list for which no value is given, the name and value of the alias is printed. The -x flag is used to set or print exported aliases. An exported alias is defined across sub-shell environments. Alias returns true unless a name is given for which no alias has been defined.

bg [%job]
     This command is only built-in on systems that support job control. Puts the specified job into the background. The current job is put in the background if job is not specified.

break [n]
     Exit from the enclosing for while until or select loop, if any. If n is specified then break n levels.

continue [n]
     Resume the next iteration of the enclosing for while until or select loop. If n is specified then resume at the n-th enclosing loop.
cd [arg]
cd old new
     This command can be in either of two forms. In the first form it changes the current directory to arg. If arg is - the directory is changed to the previous directory. The shell parameter HOME is the default arg. The parameter PWD is set to the current directory. The shell parameter CDPATH defines the search path for the directory containing arg.Alternativedirectorynamesare a colon (:). The

default path is <null> (specifying the current directory). Note that the current directory is specified by a null path name, which can appear immediately after the equal sign or between the colon delimiters anywhere else in the path list. If arg begins with a / then the search path is not used. Otherwise, each directory in the path is searched for arg.

The second form of cd substitutes the string new for the string old in the current directory name, PWD and tries to change to this new directory.

The cd command may not be executed by rksh.

eval [arg ...]
The arguments are read as input to the shell and the resulting command(s) executed.

exec [arg ...]
Parameter assignments remain in effect after the command completes. If arg is given, the command specified by the arguments is executed in place of this shell without creating a new process. Input/output arguments may appear and affect the current process. If no arguments are given, the effect of this command is to modify file descriptors as prescribed by the input/output redirection list. In this case, any file descriptor numbers greater than 2 that are opened with this mechanism are closed when invoking another program.

exit [n]
Causes the shell to exit with the exit status specified by n. If n is omitted then the exit status is that of the last command executed. An end-of-file will also cause the shell to exit except for a shell which has the ignoreeof option (see set below) turned on.

exit [name]
The given names are marked for automatic export to the environment of subsequently-executed commands.

fc [-e ename] [-nlr] [first] [last]
fc -e - [old=new] [command]
In the first form, a range of commands from first to last is selected from the last HISTSIZE commands that were typed at the terminal. The arguments first and last may be specified as a number or as a string. A string is used to locate the most recent command starting with the given string. A negative number is used as an offset to the current command number. If the flag -l, is selected, the commands are listed on standard output. Otherwise, the editor program ename

is invoked on a file containing these keyboard commands. If ename is not supplied, then the value of the parameter FCEDIT (default /bin/ed) is used as the editor. When editing is complete, the edited command(s) is executed. If last is not specified, it will be set to first. If first is not specified the default is the previous command for editing and -16 for listing. The flag -r reverses the order of the commands and the flag -n suppresses command numbers when listing. In the second form the most recent command in the history whose first letters match command is re-executed after the substitution old=new is performed.

fg [%job]
This command is only built-in on systems that support job control. If job is specified, it brings it to the foreground. Otherwise, the current job is brought into the foreground.

jobs [-l]
Lists the active jobs; given the -l option lists process id's in addition to the normal information.

kill [-sig] process ...
Sends either the TERM (terminate) signal or the specified signal to the specified jobs or processes. Signals are either given by number or by names (as given in <signal.h>, stripped of the prefix "SIG"). The signal names are listed by 'kill -l'. There is no default, saying just 'kill' does not send a signal to the current job. If the signal being sent is TERM (terminate) or HUP (hangup), then the job or process will be sent a CONT (continue) signal if it is stopped. The argument process can be either a process id or a job.

let arg ...
Each arg is an arithmetic expression to be evaluated. All calculations are done as long integers and no check for overflow is performed. Expressions consist of constants, named parameters, and operators. The following set of operators, listed in order of decreasing precedence, are implemented:

```
-          unary minus
!          logical negation
*  /  %    multiplication, division, remainder
+  -       addition, subtraction
<  >       comparison
==  !=     equality  inequality
=          arithmetic replacement
```

Sub-expressions in parentheses () are evaluated first and can be used to override the above precedence rules. The evaluation within a precedence group is from right to left for the = operator and from left to right for the others.

A parameter name must be a valid identifier. When a parameter is encountered, the value associated with the parameter name is substituted and expression evaluation resumes. Up to nine levels of recursion are permitted. The return code is 0 if the value of the last expression is non-zero, and 1 otherwise.

newgrp [arg ...]
Equivalent to exec newgrp arg ....

print [-Rnprsu[n]] [arg ...]
The shell output mechanism. With no flags or with flag -, the arguments are printed on standard output as described by echo(1). In raw mode, -R or -r, the escape conventions of echo are ignored. The -R option will print all subsequent arguments and options other than -n. The -p option causes the arguments to be written onto the pipe of the process spawned with |& instead of standard output. The -s option causes the arguments to be written onto the history file instead of standard output. The -u flag can be used to specify a one digit file descriptor unit number n on which the output will be placed. The default is 1. If the flag -n is used, no new-line is added to the output.

read [-prsu[n]] [name?prompt] [name ...]
The shell input mechanism. One line is read and is broken up into words using the characters in IFS as separators. In raw mode, -r, a \ at the end of a line does not signify line continuation. The first word is assigned to the first name, the second word to the second name, etc., with leftover words assigned to the last name. The -p option causes the input line to be taken from the input pipe of a process spawned by the shell using |&. If the -s flag is present, the input will be saved as a command in the history file. The flag -u can be used to specify a one digit file descriptor unit to read from. The file descriptor can be opened with the exec special command. The default value of n is 0. If name is omitted then REPLY is used as the default name. The return code is 0 unless an end-of-file is encountered. An end-of-file with the -p option causes cleanup for this process so that another can be spawned. If the first argument contains a ?, the remainder of this word is used as a prompt when the shell is interactive. If the given file descriptor is open for writing and is a terminal device then the prompt is placed on this unit. Otherwise the prompt is issued on file descriptor 2. The return code is 0 unless an end-of-file is encountered.

readonly [name ...]
The given names are marked readonly and these names cannot be changed by subsequent assignment.

return [n]
Causes a shell function to return to the invoking script with the return status specified by n. If n is omitted then the return status is that of the last command executed. If return is invoked while not in a function then it is the same as an exit.

set [-aefhkmnostuvx] [-o option ...] [arg ...]
The flags for this command have meaning as follows:

-a All subsequent parameters that are defined are automatically exported.

-e If the shell is non-interactive and if a command fails, execute the ERR trap, if set, and exit immediately. This mode is disabled while reading profiles.

-f Disables file name generation.

-h Each command whose name is an identifier becomes a tracked alias when first encountered.

-k All parameter assignment arguments are placed in the environment for a command, not just those that precede the command name.

-m Background jobs will run in a separate process group and a line will print upon completion. The exit status of background jobs is reported in a completion message. On systems with job control, this flag is turned on automatically for interactive shells.

-n Read commands but do not execute them.

-o The following argument can be one of the following option names:

allexport	Same as -a.
errexit	Same as -e.
emacs	Puts the user in an emacs style in-line editor for command entry.
gmacs	Puts the user in a gmacs style in-line editor for command entry.
ignoreeof	The shell will not exit on end-of-file. The command exit must be used.
keyword	Same as -k.
markdirs	All directory names resulting from file name generation have a trailing / appended.
monitor	Same as -m.
noexec	Same as -n.
noglob	Same as -f.
nounset	Same as -u.
verbose	Same as -v.
trackall	Same as -h.
vi	Puts the user in insert mode of a vi style in-line editor until hitting the escape character 033. This puts the user in move mode. A return sends the line.
viraw	Each character is processed as it is typed in vi mode.
xtrace	Same as -x.

If no option name is supplied then the current option settings are printed.

-s Sort the positional parameters.

-t Exit after reading and executing one command.

-u Treat unset parameters as an error when substituting.

-v Print shell input lines as they are read.

-x Print commands and their arguments as they are executed.

- Turns off -x and -v flags and stops examining arguments for flags.

-- Do not change any of the flags; useful in setting $1 to a value beginning with -. If no arguments follow this flag then the positional parameters are unset.

Using + rather than - causes these flags to be turned off. These flags can also be used upon invocation of the shell. The current set of flags may be found in $-. The remaining arguments are positional parameters and are assigned, in order, to $1, $2, ... If no arguments are given then the values of all names are printed on the standard output.

shift [n]

The positional parameters from $n+1 ... are renamed $1 ..., default n is 1. The parameter n can be any arithmetic expression that evaluates to a non-negative number less than or equal to $#.

test [expr]

Evaluate conditional expression expr. See test(1) for usage and description. The arithmetic comparison operators are not restricted to integers. They allow any arithmetic expression. Four additional primitive expressions are allowed:

-L file

True if file is a symbolic link.

file1 -nt file2

True if file1 is newer than file2.

file1 -ot file2

True if file1 is older than file2.

file1 -ef file2

True if file1 has the same device and i-node number as file2.

times

Print the accumulated user and system times for the shell and for processes run from the shell.

trap [arg] [sig] ...

arg is a command to be read and executed when the shell receives signal(s) sig. (Note that arg is scanned once when the trap is set and once when the trap is taken.) Each sig can be given as a number or as the name of the signal. Trap commands are executed in order of signal number. Any attempt to set a trap on a signal that was

ignored on entry to the current shell is ineffective. An attempt to trap on signal 11 (memory fault) produces an error. If arg is omitted or is -, then all trap(s) sig are reset to their original values. If arg is the null string then this signal is ignored by the shell and by the commands it invokes. If sig is ERR then arg will be executed whenever a command has a non-zero exit code. This trap is not inherited by functions. If sig is 0 or EXIT and the trap statement is executed inside the body of a function, then the command arg is executed after the function completes. If sig is 0 or EXIT for a trap set outside any function then the command arg is executed on exit from the shell. The trap command with no arguments prints a list of commands associated with each signal number.

typeset [-FLRZefilprtux[n] [name[=value]] ...]
Parameter assignments remain in effect after the command completes. When invoked inside a function, a new instance of the parameter name is created. The parameter value and type are restored when the function completes. The following list of attributes may be specified:

-F This flag provides UNIX to host-name file mapping on non-UNIX machines.

-L Left justify and remove leading blanks from value. If n is non-zero, it defines the width of the field, otherwise it is determined by the width of the value of first assignment. When the parameter is assigned, it is filled on the right with blanks or truncated, if necessary, to fit into the field. Leading zeros are removed if the -Z flag is also set. The -R flag is turned off.

-R Right justify and fill with leading blanks. If n is non-zero, it defines the width of the field, otherwise it is determined by the width of the value of first assignment. The field is left filled with blanks or truncated from the end if the parameter is reassigned. The L flag is turned off.

-Z Right justify and fill with leading zeros if the first non-blank character is a digit and the -L flag has not been set. If n is non-zero, it defines the width of the field, otherwise it is determined by the width of the value of first assignment.

-e Tag the parameter as having an error. This tag is currently unused by the shell and can be set or cleared by the user.

-f The names refer to function names rather than parameter names. No assignments can be made and the only other valid flag is -x.

-i Parameter is an integer. This makes arithmetic faster. If n is non-zero, it defines the output arithmetic base, otherwise the first assignment determines the output base.

-l All upper-case characters converted to lower-case.

The upper-case flag, -u is turned off.

-p The output of this command, if any, is written onto the two-way pipe.

-r The given names are marked readonly and these names cannot be changed by subsequent assignment.

-t Tags the named parameters. Tags are user definable and have no special meaning to the shell.

-u All lower-case characters are converted to upper-case characters. The lower-case flag, -l is turned off.

-x The given names are marked for automatic export to the environment of subsequently-executed commands.

Using + rather than - causes these flags to be turned off. If no name arguments are given but flags are specified, a list of names (and optionally the values) of the parameters which have these flags set is printed. (Using + rather than - keeps the values to be printed.) If no names and flags are given, the names and attributes of all parameters are printed.

ulimit [-cdfmpt] [n]

-c Imposes a size limit of n blocks on the size of core dumps (not on UMAX V).

-d Imposes a size limit of n blocks on the size of the data area (not on UMAX V).

-f Imposes a size limit of n blocks on files written by child processes (files of any size may be read).

-m Imposes a soft limit of n blocks on the size of physical memory (not on UMAX V).

-p Changes the pipe size to n (not on UMAX V).

-t Imposes a time limit of n seconds to be used by each process (not on UMAX V).

If no option is given, -f is assumed. If n is not given, the current limit is printed.

umask [nnn]

The user file-creation mask is set to nnn (see umask(2)). If nnn is omitted, the current value of the mask is printed.

unalias name ...

The parameters given by the list of names are removed from the alias list.

unset [-f] name ...

The parameters given by the list of names are unassigned, i.e., their values and attributes are erased. Readonly variables cannot be unset. If the flag, -f, is set, then the names refer to function names.

wait [n]

Wait for the specified process and report its

termination status. If n is not given then all currently active child processes are waited for. The return code from this command is that of the process waited for.

whence [-v] name ...
For each name, indicate how it would be interpreted if used as a command name.

The flag, -v, produces a more verbose report.

Invocation.
If the shell is invoked by exec(2), and the first character of argument zero ($0) is -, then the shell is assumed to be a login shell and commands are read from /etc/profile and then from either .profile in the current directory or $HOME/.profile, if either file exists. Next, commands are read from the file named by performing parameter substitution on the value of the environment parameter ENV (for instance, $HOME/.kshrc set in $HOME/.profile) if the file exists. Commands are then read as described below; the following flags are interpreted by the shell when it is invoked:

-c string If the -c flag is present then commands are read from string.

-s If the -s flag is present or if no arguments remain then commands are read from the standard input. shell output, except for the output of some of the Special Commands listed above, is written to file descriptor 2.

-i If the -i flag is present or if the shell input and output are attached to a terminal, this shell is interactive. In this case TERMINATE is ignored (so that kill 0 does not kill an interactive shell) and INTERRUPT is caught and ignored (so that wait is interruptible). In all cases, QUIT is ignored by the shell.

-r If the -r flag is present the shell is a restricted shell.

The remaining flags and arguments are described under the set command above.

rksh Only.
rksh is used to set up login names and execution environments whose capabilities are more controlled than those of the standard shell. The actions of rksh are identical to those of ksh, except that the following are disallowed:
changing directory (see cd(1)),
setting the value of SHELL or PATH,
specifying path or command names containing /,
redirecting output (> and >>).

The restrictions above are enforced after .profile and the

ENV files are interpreted.

When a command to be executed is found to be a shell procedure, rksh invokes ksh to execute it. Thus, it is possible to provide to the end-user shell procedures that have access to the full power of the standard shell, while imposing a limited menu of commands; this scheme assumes that the end-user does not have write and execute permissions in the same directory.

The net effect of these rules is that the writer of the .profile has complete control over user actions, by performing guaranteed setup actions and leaving the user in an appropriate directory (probably not the login directory).

The system administrator often sets up a directory of commands (i.e., /usr/rbin) that can be safely invoked by rksh. Some systems also provide a restricted editor /bin/red.

EXIT STATUS

Errors detected by the shell, such as syntax errors, cause the shell to return a non-zero exit status. If the shell is being used non-interactively then execution of the shell file is abandoned. Otherwise, the shell returns the exit status of the last command executed (see also the exit command above).

FILES

/etc/passwd
/etc/profile
$HOME/.profile
$HOME/.kshrc
/tmp/sh*
/dev/null

SEE ALSO

cat(1), cd(1), echo(1), emacs(1), env(1), gmacs(1), newgrp(1), shl(1), test(1), umask(1), vi(1).
dup(2), exec(2), fork(2), pipe(2), signal(2), umask(2), ulimit(2), wait(2), rand(3C), a.out(4), profile(4) in the UMAX V Programmer's Reference Manual.
environ(7) in the UMAX V Administrator's Reference Manual.

CAVEATS

If a command which is a tracked alias is executed, and then a command with the same name is installed in a directory in the search path before the directory where the original command was found, the shell will continue to exec the original command. Use the -t option of the alias command to correct this situation.

If moving the current directory or one above it, pwd may not give the correct response. Use the cd command with a full path name to correct this situation.

Some very old shell scripts contain a ^ as a synonym for the

pipe character |.

NOTES

NOTES

INDEX