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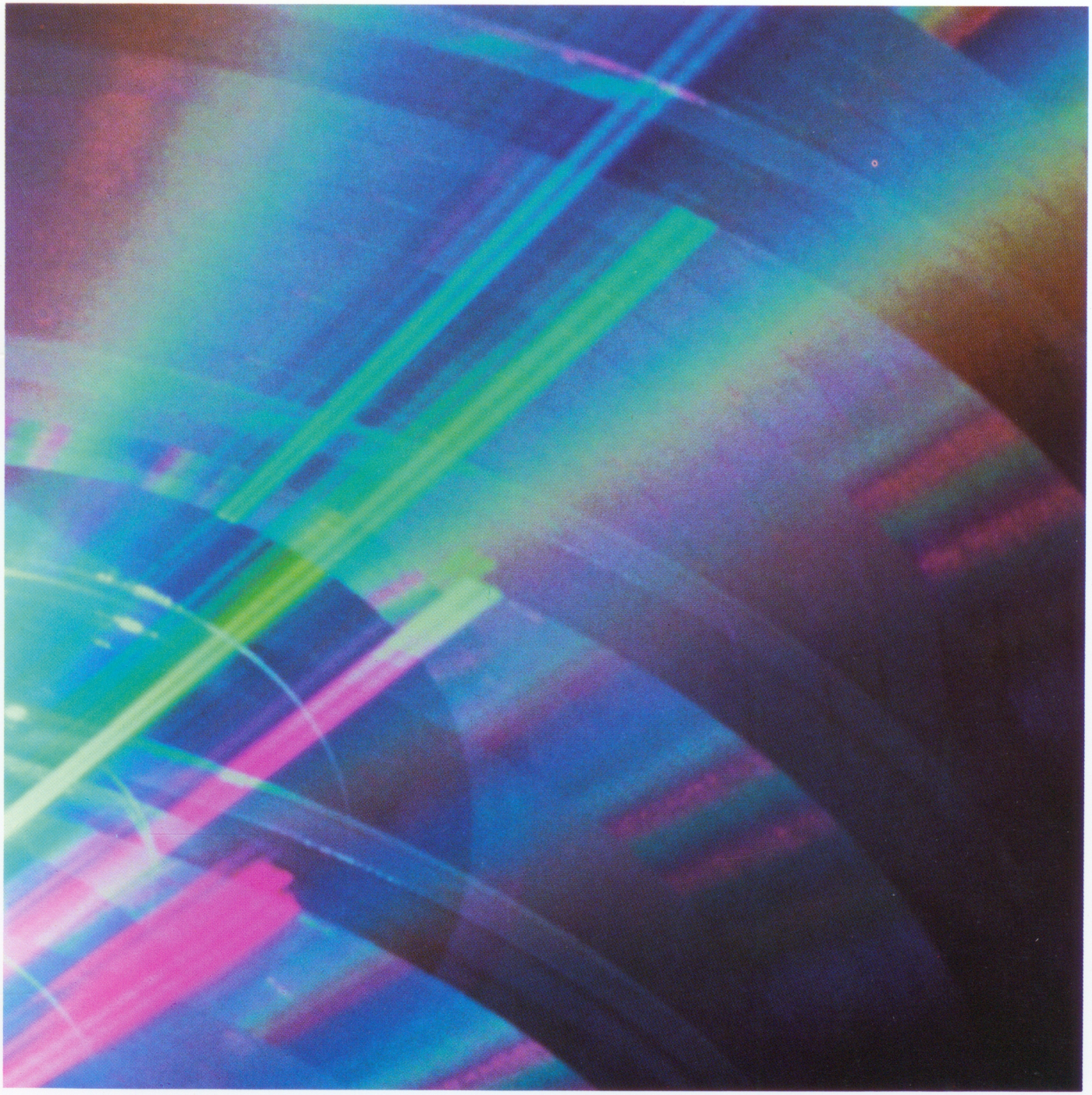
HP-UX User's Guide



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Manual Part Number 92453-90001 February 1988

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HP-UX User's Guide

Edition 2 E0288

92453-90001
Printed in U.S.A. 2/88

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First Edition . . . . . .November 1986

Second Edition. . . . . .January 1988 .... A.B2.00

Preface

This user's guide gives you an overview of the HP-UX operating system. It is intended as a starting point for general users and a review for more experienced users.

First-time HP-UX users should read this guide from start to finish. Throughout this guide you are directed to other HP-UX documentation where different topics of interest are discussed in more detail.

Chapter 1 focuses on defining HP-UX in terms of features, enhancements to the current industry standards, supported tools, and the physical structure of the operating system.

Chapter 2 presents the HP-UX file system, discussing files and directories.

Chapter 3 prepares you for the tutorial in Chapter 4, covering information you need to know before you use HP-UX.

Chapter 4 features a tutorial that presents some basic commands.

Chapter 5 focuses on additional information about files and a detailed discussion of subjects briefly mentioned in previous chapters.

Chapter 6 is the User's Tutorial covering some advanced tasks.

Chapter 7 summarizes some useful utilities.

Additional Documentation

These manuals provide additional information on the HP-UX operating system:

- HP-UX Reference Manual (09000-90009)
- HP-UX System Administrator Manual (92453-90004)
- HP-UX Real-Time Programming Manual (92453-90003)
- PORT/HP-UX Reference Manual (92561-90004)
- Starbase Reference Manual (98592-90060)
- Advanced Graphics Package Reference Manual (97085-90006)
- Device-Independent Graphics Library Programmer Reference Manual (97084-90010)
- ALLBASE/HP-UX HPIMAGE Reference Manual (36217-90002)
- HPtoday Developer Self-Paced Training Guide (92440-90003)
- HP-UX Concepts and Tutorials: Text Editors and Processors (97089-90022)
- HP-UX Concepts and Tutorials: Programming Environment (97089-90042)
- HP-UX Concepts and Tutorials: Shells and Miscellaneous Tools (97089-90062)
- HP-UX Concepts and Tutorials: Device I/O and User Interfacing (97089-90052)

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1

Introduction to HP-UX

HP-UX is an exceptionally powerful, standards-based operating system. It is an implementation of the UNIX* operating system with realtime enhancements.

HP-UX provides an interactive working environment that includes:

- A powerful command-line interpreter (the shell)
- A rich command language (the shell programming language)
- A convenient file system (the directory system)
- A powerful programming language (C)

Compatibility

HP-UX is completely compatible with the AT&T System V Interface Definition (SVID). HP-UX also includes many features of the University of California at Berkeley 4.2 BSD (Berkeley Software Distribution). These additional supported features extend the compatibility of HP-UX. Additionally, HP-UX includes many innovations that extend the capabilities of the system. These HP-UX features include:

- Realtime enhancements
- High performance file access
- Device input/output (I/O) libraries
- Native Language Support (NLS)

*UNIX is a registered trademark of AT&T in the U.S. and other countries.

Standard Features

Standard features of HP-UX include:

- Multitasking
- Multi-user or single-user capabilities
- Flexible environment support
- Communication among users, including electronic mail
- Library of tools for editing, compiling, and debugging
- User redirection of input/output
- Hierarchical file system capability
- Type-ahead capability

Multitasking allows you to perform more than one task at a time. For example, if you print a file, and, while that file is printing, you use the editor to modify another file, the system is performing multitasking operations. Multitasking enables you to use time efficiently by allowing you to do more than one task at once.

Multiuser capability permits several users to use the system simultaneously. For example, a credit-checking department may need several people to perform separate tasks concurrently (such as changing an address, and updating a balance) for a particular customer. This multiuser capability saves you time by allowing more than one person to work with one set of information at the same time.

A **flexible user environment** enables you to customize your system and applications. The **environment** is the set of conditions under which your commands run. You may sometimes need a specific environment to perform a specific task or run a specific application. Your system administrator initially sets up the environment and customizes it according to the needs of the installation. Environment customization is discussed in *HP-UX Concepts and Tutorials: Shells and Miscellaneous Tools*.

Input/output redirection allows you to send the standard input and/or output for a specified command to a file or device. The redirection may involve file input and/or file output. An extension of the I/O redirection feature called pipes is discussed in Chapter 5 of this guide. Pipes send command output to another command.

Type-ahead capability allows you to enter more commands while the system is executing a command. The entries are stored without interrupting the system. When the system is ready, it recognizes the keystrokes you have entered and proceeds accordingly. This allows you to give additional

commands, arguments, or variable values to a program before it finishes processing the last entry, and frees you from waiting for the system to prompt you for the next entry.

Realtime Enhancements

In addition to the standard features of the HP-UX operating system, realtime enhancements include:

- Realtime priorities
- Time-based scheduling
- Driver asynchronous I/O
- User control of buffering
- Software signals (interrupts and traps)
- Control of access to realtime privileges
- User control of file system buffering
- Interprocess communication
- Process locking
- File locking

For an explanation of these concepts and terms refer to the *HP-UX Real-Time Programming Manual*.

Supported Tools for HP-UX

A variety of HP-UX-based tools are available. The HP-UX operating system supports:

- Programming and migration tools
- Graphics libraries
- Database management
- Application development utilities
- Native language
- Networking applications.

The following paragraphs describe some of these applications.

Programming Tools

Programming tools include several compilers and a symbolic debugger.

Programming languages currently offered are:

- Assembly
- HP C
- HP FORTRAN 77
- HP Pascal

The HP Symbolic Debugger, XDB, is a powerful, flexible, interactive program designed to improve the productivity of software developers. The HP Symbolic Debugger debugs programs written in HP C, HP FORTRAN 77, and HP Pascal.

Migration Tools

PORT/HP-UX is a set of migration tools that allows HP 1000 users to modify programs so they will run on HP-UX systems. One major tool is RTE emulation software that reduces the requirement for manual conversion of system dependent calls. For more information on these migration tools, refer to the *Port/HP-UX Reference Manual.*

Graphics Libraries

Starbase and DGL/AGP are the graphics libraries currently available on HP-UX. The Starbase graphics library is a low-level two-dimensional and three-dimensional graphics library for HP-UX. The Device-Independent Graphics Library (DGL) and the Advanced Graphics Package (AGP) are supported. Existing DGL/AGP customers are supported through a DGL handler that calls the Starbase graphics library, allowing for support of new peripherals and porting of existing code. For more information on these graphics libraries refer to the *Starbase Reference Manual*, the *Device-Independent Graphics Library Programmer Reference Manual*, and the *Advanced Graphics Package Reference Manual.*

Database Management

ALLBASE is a database management system that lets you choose the appropriate data model on an application-by-application basis. ALLBASE offers a comprehensive set of features for both HPSQL, the relational model interface, or HPIMAGE, the network model interface. ALLBASE is built on a solid foundation of common internals

that are designed specifically to exploit the performance of HP Precision Architecture. For more information on this system refer to the *ALLBASE/HP-UX HPIMAGE Reference Manual*.

Application Development Utilities

HPtoday is a fourth generation language that consists of a Computer-Assisted Programming Package for development of data or transaction processing related applications. HPtoday gives you the tools to specify what an application is to do without concern for the detailed steps required to do it. With the HPtoday Developer Package, you fill in blanks on formatted screens instead of coding program instructions. While the computer and HPtoday do most of the work, you still retain full control over the development of your application. For more information on HPtoday refer to the *HPtoday Developer Self-paced Training Guide*.

Native Language Support

Native Language Support (NLS) is a set of tools provided to produce localized applications. NLS tools allow programs to be written with a language-independent interface. This interface can later be changed to a local language without modification of the executable program. Currently, HP-UX NLS includes character support, messages, and commands for 25 different languages. The localization procedure is discussed in *HP-UX Concepts and Tutorials: Device I/O and User Interfacing*.

Networking Applications

Network Services (NS), Local Area Network (LAN), Advanced Research Projects Agency and SNA Systems Network Architecture (ARPA) /9000 are high performance networking products for HP computers in the factory and engineering market segments. These tools allow you to easily transfer files between systems without worrying about all the technical details of error checking and message routing.

Structure of HP-UX

The HP-UX operating system comprises:

- Kernel
- Shell
- Utilities
- File system

Figure 1-1 shows the basic structure of the HP-UX system.

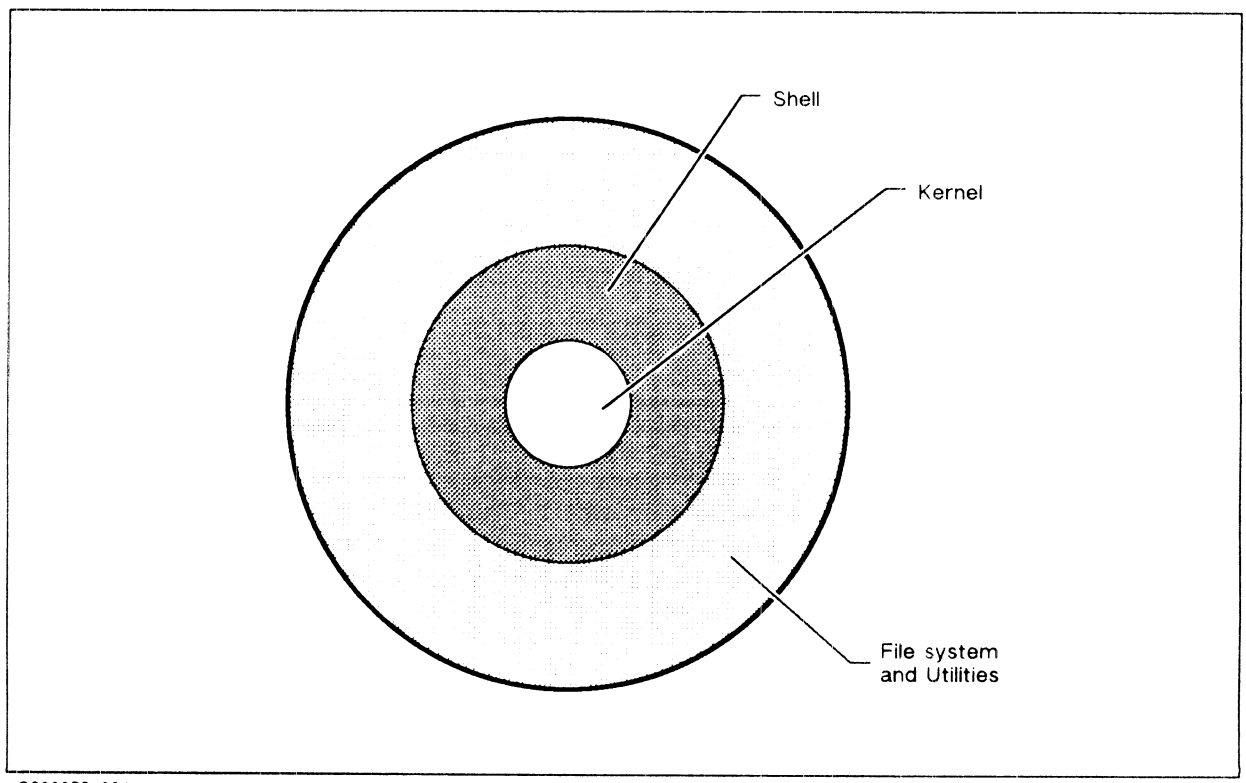


Figure 1-1. HP-UX Structure

The Kernel

The **kernel** controls the computer resources. It allows you to perform tasks on the computer without paying attention to hardware details. For example, to obtain a printed copy of a file, you need not worry about when the data is sent to the printer or how to control the printer operations. You do not have to wait for the copy to be printed to continue your work. You simply enter the command with the name of the file and the system takes care of the rest. You can immediately enter

another command to do the next task and pick up your printout later. The kernel performs the following functions:

- Manages system resources including physical devices such as terminals, printers, and disks to allow sharing of resources.
- Manages computer memory to maintain the most efficient use of memory.
- Executes programs through commands entered at terminals or programmatically.
- Controls multi-terminal operations to allow users at different terminals to perform concurrent tasks.
- Controls I/O devices to facilitate communication with different I/O devices.
- Manages the file system to provide convenient access to disc files.
- Responds to external interrupts to schedule and run special application programs.

The Shell

The **shell** is an interactive program that interprets commands you enter at the terminal and instructs the kernel to perform the requested task. The shell environment is where you do much of your work at the terminal. From the shell, you invoke other programs such as text editors. If an error occurs during the execution of a command, the shell displays a diagnostic error message followed by the shell prompt. At this point you may reenter the correct command for the successful completion of the task requested.

Three user interface programs are provided with HP-UX. When your account is set up, the system administrator chooses one of these programs for you. These are the Bourne shell (**sh**) and the C shell (**csh**), or the Korn shell (**ksh**). The C shell environment is much like that of the Bourne shell, but offers you a more powerful environment with more user-interactive features. The Korn shell incorporates the interactive features of the C shell and the portability of the Bourne shell.

NOTE

Throughout this guide when referring to the interactive use of the shell, the terms program and command are synonymous.

Standard shell features:

- Batch file programming language capability
- Choice of foreground or background execution
- I/O redirection
- Pipelines

The shell is not only an interpreter but also a **programming language**. It provides for conditional and branching constructs. For example, the statements **if, while, for,** and **case** are implemented in the shell. You may specify a series of shell commands in a file and execute them as a program. This capability is useful for repetitive tasks such as a customized sort routine. This file is referred to as a **shell script** and is explained further in Chapter 6 of this guide.

Foreground execution of a command makes you wait for the command to finish execution before you can request another task. HP-UX offers background execution as an alternative to foreground execution waiting time. **Background execution** allows you to execute a task and proceed to the next task without waiting for the completion of the first task. This capability is explained further in Chapter 5 of this guide.

The **shell I/O redirection** feature provides flexibility in manipulating program input and output. You may redirect the program input from or output to a file instead the terminal, which is the default destination. I/O redirection is discussed in Chapter 5 of this guide.

Pipes allow you to send the output of one program to the input of another, thus eliminating the need for specifying temporary files for consecutive task oriented commands. Think of the pipe (|) as a link in a chain of command oriented tasks. For example, you may wish to list the contents of a file, sort the listing alphabetically in reverse, and print the results. This can be done with one command line using the pipeline feature.

Pipes and filter programs are discussed in Chapter 5 of this guide.

The Bourne shell (sh), C shell (csh), Korn shell (ksh), and shell scripts are explained thoroughly in *HP-UX Concepts and Tutorials: Shells and Miscellaneous Tools*.

Utilities

Utilities form a large part of the standard HP-UX operating system. They are programs that perform a variety of specific functions. Many of these programs are tools designed to help you write your own applications.

You will find many tools in the HP-UX operating system. There are tools for text editing and formatting, program development, and system management and maintenance. Standard utilities include:

grep - a program for searching through text files
sort - a program for sorting text files
awk - a programming lanquage for manipulating data and text
make - a program for maintaining computer programs
lint - a program checker and verifier for C source code
ed - an interactive, line-oriented text editor
vi - an interactive, display-oriented text editor
sed - a non-interactive text editor
mailx - an electronic mail program
bc - an arithmetic program
dc - a desk top calculator
wc - a word, line, and character counter

The File System

The HP-UX file system is an organized hierarchical structure for storing information. These collections are called files and may contain programs, letters, memos, statistical data, or shell scripts. A directory file contains information about other files. The HP-UX file system is explained in Chapter 2 of this guide.

Chapter Review

- HP-UX software is an implementation of the UNIX System V operating system with realtime extensions.
- Standard HP-UX features include:
  - Multitasking capability
  - Multiuser capability
  - Flexible environment support
  - Communication among users and electronic mail
  - Collection of tools for editing, compiling, debugging
  - User redirection of I/O
- The HP-UX operating system supports programming and migration tools, graphics libraries, database management, application development utilities, native language software, and a series of networking applications.
- The major software components of the HP-UX operating system are the kernel, the shell, some commands, and the file system.
- The kernel is the software that controls the computer resources.
- The shell is an interactive program that controls the execution of commands, and provides the user interface (environment).
- The standard shell features include:
  - Choice of foreground or background execution
  - I/O redirection
  - Pipelines and filters
- Commands include tools for text editing and formatting, and for program development.

2

The HP-UX File System

The HP-UX file system provides a structure for data storage. It is made up of files and directories. This chapter describes files, directories, and their attributes.

Files

HP-UX files are the simplest components of the HP-UX file system. Files typically reside on a storage device, (usually a disk) and are accessed by filenames.

File Types

There are three types of files in the HP-UX file system:

1. Ordinary files
2. Directory files
3. Device files (also known as special files)

A directory file is a file that contains information about other files. The system uses device files so you can access peripheral devices (such as a tape drive). In this manual, only text files, directory files, and executable files are discussed. Device files and special files are discussed in the *HP-UX System Administrator Manual*.

Standard Files

A series of standard files typically appears in each user account. An account is established for you by the system administrator so you can access the system. Whether or not you may alter these files in your account is determined by the system administrator when your account is created. The following standard files could appear in your account:

File **.login** is a C shell start-up script file executed once when you log in. This file sets up your environment by executing

commands that you always want to execute at the beginning of each login session.

File **.cshrc** may be used to tailor your C shell environment at login or when **csh** is executed.

Refer to *HP-UX Concepts and Tutorials: Shells and Miscellaneous Tools*, C shell section, for further information on **.login** and **.cshrc** files.

File **.profile** in the Bourne shell tailors the Bourne shell environment, as the file **.cshrc** does in the C shell environment.

File **.mailrc** sets up your mail receiving variables. It tailors your mail-reading environment, controls the **mailx** command, and can provide shorter aliases for commonly used addresses.

File **.history** contains a history of the most recently entered C shell commands. This file is used as input to the history command. Chapter 6 of this guide explains how to use the **history** command.

There are two hidden files in each directory which contain the pathnames for the parent of the directory and the directory itself. These special pathnames are described in the following section. The file containing the pathname for the parent directory is "..". The file containing the pathname for the current directory is ".". Directories are discussed later in this chapter.

Filenames

HP-UX file names can be up to 255 characters. You may use any combination of letters a through z and A through Z, numbers 0 through 9 and characters such as underscore "_", comma ",", and minus "-" sign.) Filenames can also include valid 8-bit and 16-bit international characters.

NOTE

HP-UX distinguishes the difference between uppercase and lowercase letters.

You should not use characters that have special meaning. These characters are called metacharacters and they are described in Chapter 5 of this guide and in *HP-UX Concepts and Tutorials Shells and Miscellaneous Tools*.

The following is the list of characters you should avoid when naming files:

- slash (/)
- greater than (>)
- less than (<)
- pipe (vertical bar) (|)
- question mark (?)
- left square bracket ([)
- right square bracket (])
- asterisk (*)
- left brace ({)
- right brace (})
- space ( )
- tilde (~)
- single quotation mark (')
- double quotation mark (")
- backslash (\)
- grave (`)
- exclamation point (!)
- ampersand (&)
- dollar sign ($)
- left parentheses (()
- right parentheses ())
- semicolon (;)

The period (.) in a filename is conventionally used in two ways. First, filenames beginning with a period are normally hidden when you invoke the list directory (**ls**) command. Secondly, the period is generally used to precede a file extension. Some commands (or programs) expect certain conventions to be followed. For example, HP C source files usually end with .c, HP Pascal source files end with .p and libraries end with .a. You may want to give similar files the same extension. For example, if you had some files containing letters you could give them the extension .letter, or you could give temporary files the extension .temp. These are just examples. You can use whatever extensions you want when you name your files.

Sample Filenames (with and without extensions)

Here are some samples of legal filenames:

message	tmp2	pas.p
report	100884	memo.outl
letter	foo	Sharon3.Tmp
temp	a.out	test.007
joe	mag.c	test.102
tmp1	fnt.-f	file.name.Z
.profile	TEMP2	fowler@hplabs
emacs-help	lost+fnd	_exrc

Directories

A **directory** is a file that contains details about other files. These files are said to be contained in the directory. You can have one or more directories containing your files or other directories. A directory contains the names and **inode** identification of files contained within it. The inode for a file contains information such as the type, size and location of the file. A directory contained within another directory is called a **subdirectory**. This capability to nest directories gives the file system its hierarchical nature. If you think of files as folders of information, directories are the file drawers where related folders are stored. You may create and use directories to organize information. For example, you may have all memos in one directory, all information about a client in another directory, and all information about a conference in still another directory. Refer to the Getting Started Tutorial in Chapter 4 of this guide for details on the specific commands that are used to create and manipulate directories and files.

Directory Names

Directory names can be up to 255 characters, consisting of combinations of uppercase and/or lowercase letters, digits, and other characters in the HP character set. However, the same restrictions apply to directory names as to filenames. Refer to the "Filenames" section in this chapter for a list of specific character restrictions. The slash (/) has a special meaning for the file system and is not allowed as part of a directory name. Directory names can also include valid 8-bit and 16-bit international characters.

Pathnames

A pathname is the location of a file or directory within the file system. It presents a path through the hierarchical directory structure. The pathname is made up of a series of directory names separated by slashes (/) and ends with the name of the file or directory you are locating. For example, sample pathnames from Figure 2-1 are:

/dev
/dev/tty
/bin
/bin/sh
/usr/mnl
/usr/report/mkt/atu
/usr/report/sale/cal

The directory pathname can be specified two ways, absolute or relative. The way you use a pathname depends on where you are working at the time, what you want to do, and what files and directories you need to access.

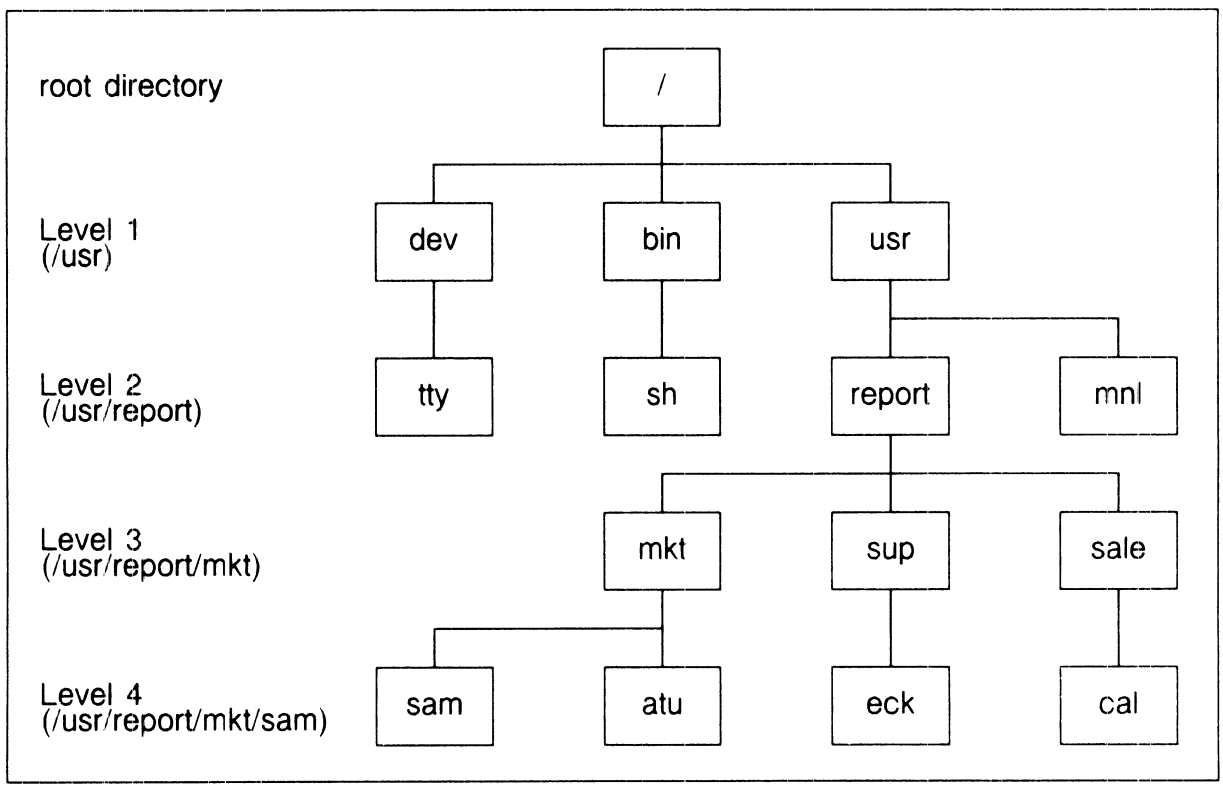


Figure 2-1. Sample Directory Structure

Absolute Pathname

The **absolute pathname** describes the location of a file or directory in relation to the root of the file system. Using an absolute pathname ensures that the system will locate the file or directory from anywhere. An absolute pathname begins with a slash (/) that signifies the root directory, the start of the entire file system. Then it lists all directories required to get to the file or directory. For example, the file called cal in directory sale is specified by the absolute pathname of /usr/report/sale/cal.

Relative Pathname

The **relative pathname** defines the location of a file or directory in relation to the working directory. The relative pathname starts with the name of a file or directory within your current directory. By leaving out the name of your current (also known as working) directory, the system uses that directory name by default. For example, sample relative pathnames from Figure 2-1 may be:

sale/cal	(from directory /usr/report)
report/sup/eck	(from directory /usr)
mkt/sam	(from directory /usr/report)
mkt/atu	(from directory /usr/report)

Special Directories

There are several special directories in the hierarchical file structure. The four special directories are the root directory, the home directory, the working directory and the parent directory.

The Root Directory

The root directory is the top of the file structure, and is designated by a slash (/) as the first character of a pathname. All absolute pathnames start at the root directory.

The Home Directory

Your home directory is the directory you are in at login. This directory is assigned to you by the system administrator when creating your account. It is your working directory until you change directories. Your home directory may be at any level of the file system structure.

The Working Directory

The working directory is the directory you are currently in. The working directory and your home directory are the same when

you logon. Changing your working directory is covered in the Getting Started Tutorial in Chapter 4 of this guide.

The Parent Directory

Every directory has a parent directory, including the root directory. The parent directory of the root is the root directory. For example, from Figure 2-1, / is the parent directory of dev, bin, and usr. Sup is the parent directory of eck.

Standard Directories

Following is a list of important directories used by the HP-UX operating system.

/	root directory required by all systems
/usr	contains user and system support directories
/bin	contains subdirectories for system use
/usr/bin	contains utilities and programs
/dev	contains device files
/etc	contains miscellaneous system administration files such as the passwd files and installation utilities
/tmp	contains temporary files
/lib	contains libraries (subroutines)
/usr/lib	contains more libraries
/mnt	often contains user home directories

Chapter Review

- The HP-UX file system is a hierarchical structure containing files and directories.
- HP-UX files are referenced by their filenames.
- A filename may be up to 255 characters.
- There are three types of files in the HP-UX file system: ordinary files (text and executable), directory files, and special files.
- Directories are files that contain information about other files such as their name and inode. These files are said to be in the directory.
- A directory name may be up to 255 characters.
- A pathname specifies the location of a file or directory.
- An absolute pathname describes the location of a file or directory relative to the root file system.
- A relative pathname describes the location of a file or directory relative to the working directory.
- There are four special directories:
  - Root directory
  - Home directory
  - Working directory
  - Parent directory

3

Before You Begin

This chapter presents some information you will need before beginning the tutorial in the next chapter. The following topics are covered.

- Conventions used in this guide
- System administrator
- Uppercase and lowercase entries
- Frequently used keys
- Correcting typing errors
- Standard HP-UX command format
- Successfully completed tasks
- Online documentation feature

It is assumed that you are familiar with the display terminal you will be using to access the HP-UX system and that it is a supported terminal for HP-UX.

Manual Conventions

Throughout the remainder of this manual, user input in examples is shaded to separate them from system messages, displays, and comments. Variables in user input are shown in angled brackets, for example, <filename> indicates the name of a file of your choice. The frequently used carriage return is indicated in sample display dialogs as [RETURN] when needed. In sample screen displays, comments are enclosed in parentheses following the terminal entry. The system prompt is shown as $, although your system may display a different prompt.

An example that showed you how to enter the **ls** command would look like this:

```
$ ls [RETURN]
```

The System Administrator

You should have an administrator for your system. If there is none, appoint a person who can log in as a superuser and who is thoroughly knowledgeable about the HP-UX operating system. The system administrator is responsible for maintaining the system and can perform tasks not available to the general user. The following is a list of some of the responsibilities of a system administrator:

- Creating accounts for all users
- Creating and setting each user environment
- Creating and deleting passwords
- Establishing login and logout messages
- Creating the shell prompt
- Categorizing the file system into a logically organized directory structure.

Before you can access the system, an account must be created for you. The system administrator may or may not assign a password to your account when it is created. If one is assigned, you may change your password at any time after logging in. Changing your password is discussed in the Getting Started Tutorial section of this guide.

Uppercase and Lowercase Entries

Uppercase and lowercase entries are not interchangeable. The HP-UX operating system recognizes the difference between uppercase and lowercase entries. Wherever an uppercase letter is shown in text or examples, using a lowercase letter results in an error message or an unpredictable response from the system. This includes the login name and password entries.

Frequently Used Keys

There are three keys on your terminal keyboard that are frequently used. These keys are described below.

Key	Purpose
[RETURN]	The carriage return and line feed for the cursor is referred to as the [RETURN] key. In communicating with the system, you must end your entries by pressing the [RETURN] key. This key indicates the completion of your entry. The system will not perform an entered command until you press [RETURN].
[CONTROL]	The [CONTROL] key must be used simultaneously with another key. This combination of the [CONTROL] key and another key is called a control sequence. A control sequence is often denoted in this guide as [CONTROL-D], [CONTROL-H], [CONTROL-U], etc. In screen displays, it is shown as ^U, ^H, etc. Note: As soon as the control sequence is completed, the specified action occurs immediately; it is not necessary to use the [RETURN] key. Although the letter keys are shown in uppercase, lowercase works just as well. This is an exception to the description given under the Uppercase and Lowercase Entries section.
[BACKSPACE]	The [BACKSPACE] key moves the terminal cursor back one space. When you backspace over a command that you have typed, the command will not disappear, but when you press [RETURN] the command will not be executed.

Correcting Typing Errors

When you are entering a command, typing errors can be corrected before you press the [RETURN] key. You can correct one character or a whole line at a time.

The typing correction keys are normally shown in your login system message. They are typically the [BACKSPACE], [CONTROL-H],

and [CONTROL-U] keys. Your terminal (stty) settings must be correct for these keys to work in this manner.

Use the [BACKSPACE] key to move backward one character at a time. Each time you press the [BACKSPACE] key one character is nullified. For example, press this key three times to move backward three characters, then you can type the correct character(s).

[CONTROL-H] functions the same as the [BACKSPACE] key.

To erase an entire command, use [CONTROL-U]. Each time you enter [CONTROL-U], whatever you have typed on the command line is deleted. The system prompt will disappear as well. Press [RETURN] and the system prompt will reappear and you can retype your command.

Standard HP-UX Command Format

The commands used for various file system tasks have the following standard format:

command [options] [argument] [argument]

where:

command is the name recognized by the system. It is usually a mnemonic representative of the task the command performs. For example, to list directory contents, the command is **ls** (list directory contents).

options are the directives associated with the command. The directives specify modifications to the behavior of the command. They consist of a string of characters preceded by a minus sign. Multiple directives may be specified as such: **ls -lr** (directing the output of the listing in **l**ong form and in **r**everse.)

argument is a field containing information for a particular command to perform a task. Some commands require directory or filenames such as **diff** that must have two files specified to compare. Some commands use the argument as a descriptive term as in the "search criteria" for the **find** command. When multiple arguments are specified they are separated by a space. Options and arguments are sometimes referred to as parameters.

Successfully Completed Tasks

When you successfully complete a task, the system responds by displaying the shell prompt. The default prompt is $ for the Bourne shell and the Korn shell, and % for the C shell. If an error occurs, a message is displayed. For example, if you want to list the directory contents, and you type **lt** instead of **ls**, the following message is displayed.

```
lt: not found.
```

(Assuming the **lt** command does not exist.)

Online Documentation

The HP-UX system offers online documentation for the hundreds of commands available. Descriptions of commands are intended only as a reference or a refresher. The screen display for each command is the information taken directly from the Commands section of the *HP-UX Reference* manual.

The **man** (manual) command is used to display online manual pages (manpages) that contain information about a particular command. The only parameter needed for the **man** command is the command name known to the system. A list of all the command names can be found in the permuted index of the *HP-UX Reference* manual.

$ **man ls** RETURN	(request for information on ls command)

The **man** command uses the **more** displaying utility. The instructions on how to use this utility are discussed in Chapter 4 under "Listing Contents of a File".

Chapter Review

- In this manual, angled brackets < > represent a user-specified variable such as the name of a file, $ is the system prompt, and [RETURN] is the carriage return. User input is shaded.
- The system administrator has many responsibilities such as:
  - Creating accounts for all users
  - Creating and setting each user environment
  - Establishing login messages
  - Creating a logically structured directory system
  - Establishing logout messages
- Uppercase and lowercase entries are distinguishable by the system and are therefore not the same.
- Pressing [RETURN] is required to complete a system request.
- [CONTROL]-<key> means press the [CONTROL] and another key at the same time to perform an action.
- Pressing [BACKSPACE] or [CONTROL-H] can be used to backspace over a single character.
- [CONTROL-U] erases an entire command.
- The standard HP-UX command format is:

  command [options] [argument] [argument]

- Successfully completed tasks are indicated by the shell prompt display.
- Online documentation is available via the **man** command which displays information from the *HP-UX Reference* manual.

4

Getting Started Tutorial

HP-UX is a large operating system with many capabilities. The best way to learn HP-UX is through actually using the system. This chapter provides a tutorial to get you started with HP-UX. The tutorial covers tasks that first-time users will find helpful, and is designed so that you may stop and restart at any point you wish.

Tutorial Task Summary

The following tasks are described in this chapter:

- Logging in
- Logging out
- Creating a password
- Changing a password
- Displaying the time and date
- Displaying all users on the system
- Displaying the working directory pathname
- Listing contents of a directory
- Listing contents of a file
- Creating a file using the ed editor
- Creating a file using the vi editor
- Removing a file
- Creating a directory
- Displaying contents of a directory
- Changing the working directory
- Removing a directory
- Copying a file
- Renaming or moving a file
- Printing a file

Logging In

To get the attention of the system, press RETURN key to display a login prompt. The login prompt is:

```
login:
```

This prompt indicates that the system is ready to accept a login name.

Sample login without password:

```
login:  kurt  RETURN
Welcome to the HP-UX system.
Fri Nov 20 1987 13:59:47 PM
$                (you are now logged in)
```

Sample login with password:

```
login:  kurt  RETURN
password:  <enter password>RETURN
(password is not displayed)
Welcome to the HP-UX system.
Fri Nov 20 1987  13:59:47 PM
$                (you are now logged in)
```

NOTE

Login messages vary from system to system, therefore sample system messages may not be exact.

When the $ prompt is displayed, you may access the C shell by using the **csh** command and the Korn shell by using the **ksh** command. The default prompt for the C shell is %, while the default prompt for the Korn shell is $, the same as the Bourne shell. Also, you can ask your system administrator to change your account so you log directly into the C shell or Korn shell rather than the Bourne shell.

Setting Up the Tutorial

Now that you are logged into the system, you need to set up a sample file structure. This will make it easier for you to follow the tutorials since the filenames and directory names will be the same. Follow the commands shown in the examples exactly. For now, try not to worry about what you are doing.

All of the commands will be explained in the lessons that follow.

```
$ who > tutorial.1 [RETURN]
$ man ls > tutorial.2 [RETURN]
$ ls > tutorial.3 [RETURN]
$ mkdir tutorial [RETURN]
$ cp tutorial.1 tutorial [RETURN]
$ cp tutorial.3 tutorial [RETURN]
```

The contents of the files created may be a little different from the displays listed in the tutorials. However, don't let this confuse you. For the purposes of this tutorial the content is not as important as the commands.

Logging Out

After completing your tasks, you may leave the system by logging out. To log out, you must have the system prompt displayed. Enter [CONTROL-D] or the system logout command (usually **exit**).

```
$ [CONTROL-D]
or
$ exit [RETURN]
(logout message)
```

No further action is required. The system may or may not display any exiting information depending on how your system is set up by the system administrator.

Creating a Password

To create a passwordfor your account, use the **passwd** command. The system will prompt you for a password of your choice. The password should be at least six characters but no more than 14 characters. In addition, there must be at least two alphabetic characters and at least one numeric or special (nonletter) character.

```
$ passwd [RETURN]
New password: <enter password> [RETURN] (entry not shown)
Reenter new password: (repeat above) [RETURN]
$
```

Having a password on your account keeps people from logging into your account and accessing your files with your access permissions. Access permissions are explained in Chapter 5.

Changing a Password

Changing a password is also done with the **passwd** (password) command. The system will prompt you for three entries. After the sequence is finished, your new password will be in effect. If you make an error in one of your entries, the system will display an appropriate error message and prompt you for the next entry or instruct you to start over.

```
$ passwd [RETURN]
changing password for (login name displayed)
Old password: <enter password> [RETURN]
New password: <enter new password> [RETURN]
Re-enter new password: <repeat above entry>
[RETURN]
$                    (New password in effect)
```

Displaying the Time and Date

The current time and date can be displayed on your screen by the **date** command. For example:

```
$ date [RETURN]
Fri Nov  20  09:31 07 PDT 1987
$
```

If the time and date are not correct, see your system administrator.

Displaying Users Currently Logged In

To display users currently logged into the system, enter the **who** command. This command shows the login names of users, the system name for each user's terminal, and the login date and time of each user.

```
$ who [RETURN]
kristin      ttya2     Apr 1    07:31
sameer       ttya3     Apr 1    08:23
suzanne      ttya4     Apr 1    10:44
nigel        ttya7     Apr 1    10:57
linda        ttya9     Apr 1    12:10
$
```

Use this command before trying to communicate with another user on the system. Communication among users is established based on user names and a user's system name is sometimes different from their actual name.

Displaying the Working Directory Pathname

The **pwd** (print working directory) command displays the path from the root directory to your current working directory.

```
$ pwd RETURN
/homedir
```
(your home directory pathname)

This command is very helpful for determining your current position in the directory structure if you have changed your working directory several times. If you have not changed directories since you logged on, **pwd** will display your home directory pathname.

NOTE

You will see /homedir often in this tutorial. This refers to your home directory pathname. Pathnames will vary from system to system and user to user. You will not actually see "/homedir" displayed as the name of your home directory.

Listing Contents of a Directory

The **ls** command lists the contents of a directory. The command may be used with or without specifying a directory pathname. The default is a listing of your current working directory, but you may list any directory (that you have the correct permissions for) in the structure by specifying its pathname. The format of the displayed listing is determined by the option(s) given with the command. A thorough discussion of the options is given in the *HP-UX Reference* manual, or you can use the **man** command to view online manual pages.

```
$ ls RETURN                          (default working directory)
tutorial   tutorial.1   tutorial.2   tutorial.3

$ ls tutorial RETURN                 (directory pathname given)
tutorial.1   tutorial.3
$
```

You may try the **root** directory or the /usr directory.

```
$ ls / RETURN   (display contents of the root directory)
bin             lib          tmp
dev             lost+found   users
etc             system       usr
hp-ux           sysbckup
$
```

Note that directories (as well as files) are included in the display.

Viewing Contents of a File

The HP-UX system provides several ways to examine the contents of a text file. The simplest way is to use the **more** command. This command displays a screenful of text at a time to allow you to read at your own pace. For example, to display the file tutorial.2, type the following command.

```
$ more tutorial.2  RETURN
```

Remember that anytime you want to exit a large file without displaying the contents of the entire file, enter CONTROL-C. This will return you to the system prompt.

```
LS(1)                    HP-UX 2.0          LS(1)
NAME
     ls, l, ll, lsf, lsr, lsx - list contents of directories
SYNOPSIS
     ls [ -abcdfgilmnoqrstux1ACFR ] [ names ]
     l [ls options] [ names ]
     ll [ls options] [ names ]
     lsf [ls options] [ names ]
     lsr [ls options] [ names ]
     lsx [ls options] [ names ]

HP-UX COMPATIBILITY
     Level: HP-UX/NUCLEUS

     Origin: System V and UCB
---More--(6%)
```

Notice that one screen of text is displayed and the percentage of text displayed thus far is indicated next to the character string "--More--". At this point you may do any of the following:

More Command Summary

- Display commands for **more**, enter: h (for help)
- Display another screenful, enter: SPACE
- Display one more line, enter: RETURN
- Terminate the listing, enter: q (for quit) or CONTROL-C.

Creating a File Using the ed Editor

Ed is a line editor that manipulates text on a line-by-line basis; you display, change, delete, move, and copy text a line at a time. To create a file called tutorial.4 with **ed** enter:

```
$ ed tutorial.4 RETURN                    (invoke ed command)
?tutorial.4
a RETURN                                  (invoke append mode)
Now is the time RETURN                    (enter text)
for all good citizens RETURN
to come to the aid RETURN
of their country. RETURN
. RETURN                                  (text termination character)
w                                         (save file)
75                                        (number of characters in file)
q                                         (quit, to leave ed)
$
```

If you make a typing mistake in the append mode, use your backspace key to position the cursor and correct the error. Once RETURN has been pressed, the previous line cannot be altered within the append mode by moving the cursor.

Ed Command Summary

1,4**p**	display lines 1 to 4 on screen
1,4**np**	display lines 1 to 4 on screen with line numbers
2**c**	change (replace) line 2 and continue to insert lines until a terminating "." is entered.
2	display line 2
RETURN	display next line
-	display previous line
+4	skip ahead 4 lines
.=	display current line number

$=	display total number of lines in file
a	append text after current line until terminating "." entered.
5,10**d**	delete lines 5 to 10
6**d**	delete line 6
d	delete current line
w	save file
q	quit editing session
CONTROL-d	quit editing session without saving changes

Creating a File Using the vi Editor

Vi (pronounced vee-eye) is a (visual) screen editor. The screen editor **vi** and the line editor **ex** are actually the same program. This program may act as either a visual or a line editor depending on the name (**vi** or **ex**) used to invoke it.

To create a file:

1. Run **vi** with the name of the file to be created. For example, enter:

```
$ vi tutorial.5 RETURN
<(cursor positioned here)
~
~
~
~
~
~                    (blank lines with leading tilde)
~
~
~
~
~
~
~
~
~
"tutorial.5" [New file]
```

2. Enter the append command "a" and type in any text. The cursor will drop to the first line. Correct text on the same line with the BACKSPACE key. Use the RETURN key for new lines.

3. Exit append mode by pressing the ESCAPE key. Most vi commands are terminated by pressing the ESCAPE key. Verify that you are out of the append mode by pressing the ESCAPE key again; **vi** responds with a beep to indicate that it is expecting another command.

Vi Command Summary

These are command mode commands and take effect as soon as the keys are pressed.

h	moves cursor to the left one character
j	moves cursor to the next line
k	moves cursor to the previous line
l	moves cursor to the right one character
CONTROL-f	moves to the next screen
CONTROL-b	moves to the previous screen
dw	deletes characters from cursor to next word, including punctuation
dd	deletes line at cursor position
r	replaces character at cursor position
ZZ	saves file and exits **vi** (**ZZ** must be in capital letters)
x	deletes character at cursor position
u	undoes previous command

These are append mode commands and require the ESCAPE key to be pressed after you finish editing or adding text.

a	append text after the cursor position
i	inserts text before the cursor position
o	adds a new line below the cursor position
O	adds a new line above the cursor position
R	replaces text starting at cursor position
cw	changes one word starting at cursor position

Take a few minutes and try the various command mode and append mode commands.

To save any changes you have made, press the ESCAPE key to exit append mode, and type (in uppercase) ZZ. The RETURN key is not needed. After your file is written to disk, the shell prompt is displayed.

You may also save the file under another filename and then exit **vi**. Type a colon:

```
:        (RETURN is not needed)
```

The cursor will move to the bottom of your screen next to a : prompt.

Type:

:**w <filename>** RETURN (saves the file)

The cursor will return to the top of the screen. You may now exit **vi** by typing:

:**q**
$

If you attempt to exit a file (using **q**) that you have edited you will receive the message:

```
No write since last change (:quit! overrides)
```

To exit a file without saving your changes, type a colon:

: (RETURN is not needed)

And then type:

:**q!** (Exit vi without saving changes)
$

NOTE

Further information on text editors edit, ex, vi, and ed is provided in *HP-UX Concepts and Tutorials: Text Editors and Processors*.

Removing a File

The **rm** (remove) command deletes files from their directory. It is a good idea to get into the habit of using the -i option so that the system will prompt you to make sure you want to delete the file.

CAUTION

Once a file is removed, you cannot recover it. However, an earlier version may have been put on a backup tape by your system administrator. This version will not reflect any changes you have made since the last backup was done, but it is often helpful. See your system administrator for details on how to recover backup files.

```
$ rm -i tutorial.5 [RETURN]          (remove file tutorial.5)
tutorial.5: ? y [RETURN]             (are you sure ?)
```

Creating a Directory

The **mkdir** (make directory) command is used to create a new directory. With this command you can create a directory within your working directory or you can specify a full directory pathname that terminates with the name of the directory you wish to create. The name of a new directory must be unique within a directory.

```
$ mkdir tutorial2 [RETURN]           (create tutorial2)
$ ls [RETURN]                        (verify it got created)
tutorial  tutorial.1  tutorial.2  tutorial.3
tutorial.4  tutorial2
$ mkdir /homedir/tutorial/tutorial3 [RETURN]
```

Changing the Working Directory

The **cd** (change directory) command allows you to move around in the file system by changing the working (current) directory.

```
$ pwd [RETURN]  (verify working directory)
/homedir
$ cd tutorial [RETURN]  (change working directory)
$ pwd [RETURN]  (verify change of working directory)
/homedir/tutorial (new working directory)
```

Changing to the Parent Directory

If you are in a directory and wish to go to your parent directory specify ".." as the directory pathname.

```
$ pwd [RETURN]
/homedir/tutorial
$ cd .. [RETURN]  (change working directory to parent)
$ pwd [RETURN]  (verify change)
/homedir/ (your home directory)
```

Changing to the Home Directory

After changing your working directory several times, you may wish to return to your home directory. Use the **cd** command without arguments to move to your home directory.

```
$ cd tutorial [RETURN]               (change out of home directory)
$ pwd [RETURN]                       (display working directory)
```

```
/homedir/tutorial
$ cd [RETURN]                    (change to home directory)
$ pwd [RETURN]                   (verify home directory)
/homedir
```

Removing a Directory

Use the command **rmdir** (remove directory) to purge unwanted directories. To delete a directory you must first purge any files and other directories it contains. The **rmdir** command should be issued from a directory other than the one you wish to purge from your account.

```
$ pwd [RETURN]                   (verify not in directory
/homedir                         tutorial2)

$ ls tutorial2 [RETURN]          (verify directory is empty)
$ rmdir tutorial2 [RETURN]             (remove directory)
$ ls [RETURN]                          (verify the removal)
tutorial   tutorial.1   tutorial.2   tutorial.3
tutorial.4
$
```

Copying a File

The **cp** (copy) command is used to copy files. It can be used to copy a file, creating a duplicate file under a different name within the same directory, or a duplicate file with the same or different name in another directory. The **cp** command requires a source filename and a destination filename. These filenames may or may not have a directory pathname specified with them. You can also list just a directory pathname for the destination. In this case the source filename is concatenated with the pathname to form the destination file.

```
$ cp tutorial.1 tutorial.5 [RETURN] (create duplicate
                                     file within working directory)
$ ls [RETURN]                        (verify file was copied)
tutorial   tutorial.1   tutorial.2   tutorial.3
tutorial.4   tutorial.5
$ cp tutorial.5 tutorial [RETURN]          (copy file to another
                                           directory)
$ ls tutorial [RETURN]               (verify file was copied)
tutorial.1   tutorial.3   tutorial.5   tutorial3
$
```

CAUTION

The copy command will overwrite an existing file having the same name as the destination file. Exercise care so that you do not destroy any existing files that you wish to keep.

Renaming or Moving a File

The **mv** command is used to move a file to a different directory or rename a file. Like the **cp** command it requires a source and destination file and it overwrites the destination file if it already exists. The difference between **cp** and **mv** is that **cp** results in two identical files and **mv** results in one file with a new name and the contents unchanged.

```
$ ls RETURN                          (check directory for filenames)
tutorial   tutorial.1   tutorial.2   tutorial.3
tutorial.4   tutorial.5
$ mv tutorial.5 tutorial.6 RETURN    (rename tutorial.5
                                      to tutorial.6)
$ ls RETURN                          (verify that file was renamed)
tutorial   tutorial.1   tutorial.2   tutorial.3
tutorial.4   tutorial.6
$ mv tutorial.4 tutorial RETURN      (move tutorial.4 to
                                      tutorial/tutorial.4)
$ ls RETURN                          (verify file moved)
tutorial   tutorial.1   tutorial.2   tutorial.3
tutorial.6

$ ls tutorial RETURN                 (verify move into records)
tutorial.1   tutorial.3   tutorial.4
tutorial.5   tutorial3
```

Printing a File

The **lp** (line printer) command is used to print files. This command copies your file to the printer queue and frees your terminal for further use. The printer queue then allocates the time for your file to be printed. You may specify several files at one time to be printed.

```
$ lp tutorial.1 tutorial.2 RETURN (print files)
```

You will receive a message giving you the identification number of your printing request and telling you how many files were sent. Printing options are discussed in the *HP-UX Reference* manual.

Chapter Review

- Use **cd** to change your working directory.
- Use **cp** to copy a file.
- Use **date** to display the date and time on your screen.
- Use **ed** to edit files line by line.
- Use **lp** to send files to the line printer.
- Use **ls** to list the contents of a directory.
- Use **mkdir** to create a new directory.
- Use **more** to display contents of files.
- Use **mv** to move or rename a file.
- Use **passwd** to change or create your password.
- Use **pwd** to display the current directory path.
- Use **rm** to remove one or more files.
- Use **rmdir** to remove an empty directory.
- Use **vi** to edit files in screen mode.
- Use **who** to display all users on the system.

5

More About HP-UX

Chapters 1 through 4 have given you an introduction to HP-UX. This chapter focuses on expanding your knowledge of the operating system by presenting details not covered in previous chapters. This chapter presents more details about the HP-UX file system, expands on a few of the system commands, and provides examples of some features that can be used with most commands.

More on Files

The following sections present some advanced features of the file system. Some of the topics covered are access permissions, file ownership, and file links.

File Access Permissions

File access permissions allow you to control access to your files. The three access permissions are read, write, and execute. These access permissions have separate meanings for files and directories.

access permission	ordinary file	directory file
read	Allows examination of file contents.	Allows listing of files within directory.
write	Allows changing contents of file.	Allows creating new files and removing old ones.
execute	Allows executing file as command.	Allows searching directory.

There are also three groups to which each file permits access:

- The file's owner
- The file owner's group
- Other system users

You may also change your default access permissions by using the **umask** command. See the *HP-UX Reference* manual.

Displaying Access Permissions of a File

In order to see the access permissions of the files in your directory, use the -l (letter l) option for the ls command. For example:

```
$ls -l RETURN
drwxr-xr-x   1  sam lab 1135  Apr  04  10:22 tutorial
-rwxr-xr-x   1  sam lab 2005  May  10   8:22 tutorial.1
-rwxr-xr-x   1  sam lab   25  Jun  14  17:22 tutorial.2
-rwxr-xr-x   1  sam lab   10  Jun  14  17:23 tutorial.3
```

The meaning of each field of information is explained below.

-rwxr-xr-x This is the permission (protection or security) field. The first column indicates the file type.

- **-** an ordinary file
- **d** a directory
- **b** a special (block) file
- **c** a special (character) file
- **p** a named pipe
- **n** a special (network) file

The remainder of the field shows permissions for the owner (first three columns), the group (next three columns), and others (the last three columns).

rwx The three columns of permission shown in order: read, write, and execute. A dash in any column indicates permission denied.

The execute permission for a file means that the file can be executed as an HP-UX operating system command.

The execute permission for a directory allows you to view the directory. Without the **x** permission to a directory, other permissions are ignored.

Examples:

drwxr-xr-x

allows owner read, write, and execute permission;

drwxr-xr-x

allows members of the same group read and execute permission

drwxr-xr-x

allows others read and execute permission

The next field shows the number of links, referring to the physical file.

The third field shows the login name of the person who created the file (or directory).

The fourth field shows the group to which that login belongs.

The fifth field shows the size of the file in number of characters. Next is the date and time when the file was last modified.

The last field is the name of the file (or directory).

Changing Access Permission

The **chmod** command is used to change the access permission of files. Because directories are also files, you can change the permissions for directories with the **chmod** command. You must be the owner of a file or a directory to be able to change the permissions. Otherwise, the message "Permission denied" is displayed after you enter the **chmod** command.

Permission is designated for each of the three groups, the owner, the group to which the owner belongs, and users other than the owner. The three levels, read, write, and execute, are specified in octal with the following values:

r w x

1 1 1 = permission allowed (rwx in ls output)

0 0 0 = permission denied (--- in ls output)

The following example shows the various combinations of permission and the corresponding octal values. You will need to specify these values when using **chmod** to change file permissions.

---	--x	r--	r-x	rw-	rwx
0 0 0	0 0 1	1 0 0	1 0 1	1 1 0	1 1 1
0	1	4	5	6	7

For example:

```
$ chmod 640 tutorial.1 RETURN
```

This would change the access permissions of tutorial.1 to allow you to read and write to the file, allow members of your group to read the file, and deny any access to other users.

File Ownership

The HP-UX system recognizes you as the owner of a file when you create it. Being the owner grants you the capability to change the access permissions. You may change the ownership of a file to another user on the system. The owner and the system administrator are the only users that can change the ownership of a file to another user.

NOTE

Once you (the owner) change the ownership of a file to another user, you cannot change the ownership back to yourself. At this point, your access permission to the changed file is the same as other general users. If the file denies general users all access to that file, you may not access that file in any way.

Changing Ownership of a File

For example, if you want to change the ownership of the file tutorial.1 to george. The command would be:

```
$ chown george tutorial.1 [RETURN]
$                    (ownership change complete)
```

George is now the owner of tutorial.1. The access permissions remain the same.

File Links

File links are connections between the filename and the physical file location on the external storage device. The link is a pointer from the directory containing the filename to the physical location of the file. The first link is established when a file is created.

Multiple links are allowed in the HP-UX file system. A physical file may be referenced by several path names. For example, "/dev/prog/newfile" may be linked to "/bin/util/newfile" and "/usr/mne/newfile". The three filenames all point to one physical file location.

Therefore, if any of these logical files are modified, the modifications are reflected in all the files linked to the physical file.

File links are established by the use of the **ln** (link) command. This command is discussed in the *HP-UX Reference* manual.

I/O Redirection

The shell handles all input and output from the standard I/O devices recognized by the system. When you log into the system from your terminal, the standard input device is your keyboard and the standard output device is your display screen. Some system programs may use other peripheral devices as the standard output device, for example **lp** uses the line printer as its standard output device and a graphics program may use a plotter as its standard output device.

Since the shell handles the input and output of all programs, it is possible to divert the program input and/or output. In most cases this involves changing from the standard device to an input or output file. The shell commands for redirection are:

> redirects output to a specified file. The use of this redirection character in a command line creates a new file if the file does not exist. If the file exists it will be overwritten.

>> redirects output to a specified file. The use of this redirection character in a command **appends** the output to the file specified.

< redirects input from a specified file

For example, if you wished to redirect the input and output of the **cat** command, you could use the following command string:

```
$ cat <newinput >newoutput
```

In this example "newinput" was processed through the **cat** command to create "newoutput". The command line could have been **cat >newoutput <newinput** to achieve the same result. Input and output redirectives can appear in any order.

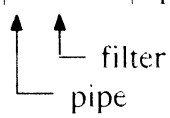
CAUTION

Do not specify the same filename for both the source and destination files. If you do, the shell will delete the contents of the source file before its contents are processed by the command.

Pipes and Filters

A pipe is an I/O channel used for process-to-process data transfer. The vertical bar or pipe (|) character is used in a command line to specify a pipe, and creates a link between two programs. In the example below, the pipeline is used to list the contents of a file, sort the listing alphabetically in reverse, and print the results specified.

```
$ ls /dev | sort -r | lp
```



The command **sort** in the sample pipeline is considered a filter. Filters are programs in a pipeline that transform the data as it passes from input to output.

NOTE

Spaces around the pipes are not delimiters and are used in this case for readability. You may use spaces to make your command line more readable.

The equivalent results of the above example without the use of the pipeline feature would be used like this:

```
$ ls /dev >tempfile          (creates file with directory list)
$ sort -r tempfile > sortedfile (sort and create
                                 new file)
$ lp sortedfile              (send sorted file to the printer)
```

Multiple Commands

You may enter two or more **shell** commands or pipelines on the same command line for sequential execution. The system will execute these commands in order from left to right. The first command is executed and upon its completion, the next command is executed.

The semicolon (;) serves as a command separator. For example:

```
$ date; pwd                  (display the date and then the
                              working directory)

$ date; pwd;ls /dev | sort -r | lp
```

Spaces separate options and arguments and are ignored between commands. The second example illustrates the capability to intermix system commands and pipelines on the same command line.

If you reach the end of the command line, the "\" is used as a continuation character so you can press return and continue typing on the command line.

Background Execution

The shell allows you to run programs in the background. This means that you can enter another command without waiting or the previous command you entered to complete execution. This feature will save you time when you have many tasks you want to complete.

CAUTION

Redirect the output from any command that outputs to your display screen. Failure to do so will cause unexpected results when running programs in background.

The ampersand (&) causes background execution of each command or pipeline specified. The ampersand is specified after the last argument for that command. For example.

```
$ sort -r largefile & sort file1 & diff file2 file3>file4 &
14143                (display of process
14144                identification numbers)
14145
```

This command line sorts two files and executes a **diff** command as background processes. Each of these commands are given a process identification number (PID) that is displayed to the screen. These numbers are not normally important to the interactive system user, but for background processes PID numbers can be used in determining the status of the processes or terminating processes.

NOTE

Sequential execution works well with commands that have short execution times, and background processing works well with commands that have long execution times.

Checking the Status of a Background Process

If you need to find out the status of a background process, the **ps** command can be used. Enter **ps** without any arguments to list the active processes associated with your terminal. For example:

```
$ ps RETURN
PID       TTY       TIME      COMMAND
4507      tty2p5     0:02     csh
6211      tty2p5     0:00     ps
$
```

The column headings in the above example are:

PID	Process ID number
TTY	Number of your terminal
TIME	Cumulative CPU time.
COMMAND	Command that initiated the process.

Killing a Background Process

If for any reason you want to terminate a background process, the **kill** command with the "-1" option can be used. For example:

```
$ kill -1 4507          (kill process ID number 4507)
$
```

Conditional Execution

There are two conditional execution constructs available for command line entries. The double ampersand (&&) and the double vertical bar (||).

The Double Ampersand

The double ampersand (&&) causes the next command or pipeline in the sequence to be executed only if the previous command or pipeline executes successfully. For example:

```
$ cd /users/kb/tools && cp tempfile tempfile2
```

In the previous example, the **cd** command tries to change the working directory to **/users/kb/tools**. If it is successful, the **cp** command will copy tempfile to tempfile2. If the command is unsuccessfully executed then no further action is taken.

Double Vertical Bar

The double vertical bar (||) causes the next command or pipeline in the sequence to be executed only if the previous command or pipeline was unsuccessful. For example:

```
$ cd /users/kb/tools || mkdir /users/kd/tools
```

In this example, as in the previous one, the **cd** command tries to change the working directory. If the directory does not exist (meaning **cd** was unsuccessful), the directory is created. If the directory did exist, no further action is taken.

Mixing Conditional Execution Symbols

The double ampersand and the double vertical bar can be intermixed on a command line. For example:

```
$ cd /usr/temp && cp temp1 temp2 || echo "no such
directory"
```

This command line states that if the change of working directory is successful then temp1 is to be copied to temp2 and if the change of a working directory is not successful, then a message is to be displayed to the terminal.

Mixing Sequential, Background, and Conditional Execution

All four command separators (;,&,&&,||) can be intermixed on one command line. However, if a command line sequence requires all of the separators to perform the task, you should probably use other constructs in the shell programming language that provide the same function and are easier to read. For further information about the shell programming constructs available, refer to the *HP-UX Concepts and Tutorials: Shells and Miscellaneous Tools*.

Metacharacters

Metacharacters are characters that have special meaning to the shell program. There are special characters used for masking or expanding filenames, for I/O redirection and pipelines, and for quoting. The following is a summary of the more common characters with special meanings.

Filename Expansion

?	match any single character
*	match any character string
[ ]	match any one of characters within brackets
-	indicate a character range when used within brackets

```
$ ls file?        (directory list of files of the form
                  file then one other character)

$ ls file*        (directory list of files of the form
                  file then a string of 0 or more characters)

$ ls file[ab]     (directory list of filea or fileb)

$ ls file[a-z]    (directory list of filea through filez)
```

I/O Redirection

>	redirect output to a file
>>	appending output to a file
<	redirect input from a file; redirect output of one process to input of another process
|	redirect output of one process to input of another process

Examples of I/O redirection are shown earlier in this chapter.

Quoting

\	quoting character except at end of command line
'	used in pairs, quoting all characters within each pair
"	used in pairs, quoting all characters within each pair except $,', and \.

Examples of quoting are presented following the next section of this chapter.

Others

&	specify background processing
&&	conditional command line execution
||	conditional command line execution
\	command line continuation when used at end of line
;	command separator
$	value of a variable
`	used in pairs, output of a command
#	erase one character (depending on your terminal setting)
@	erase one line (depending on your terminal setting)

Quoting Metacharacters

There are four characters used to tell the system to ignore the special meaning of metacharacters. These characters are the backslash (\ ), the single quote ('), the double quote ("), and the grave accent (`).

The Backslash

The special meaning of a character can be stripped away by preceding that character with a backslash. Whenever a character is preceded by a backslash, the character is said to be quoted, and it is interpreted literally. For example,

```
echo prog*.c \*list\* lib\?.3?
```

The first argument tells **echo** to print all files in the current directory whose names begin with "prog", followed by any number of characters, followed by ".c". The second argument tells **echo** to print "*list*", since both asterisks are quoted, and are thus interpreted literally. The third argument tells **echo** to print all files in the current directory whose names are "lib?.3" followed by any single character. The first question mark is literal; the second stands for any single character.

The backslash is the most powerful quoting character because it can quote all special characters, including itself. However, it can quote only one character at a time. The following list shows all the characters that are special to the shell, all of which are quotable with a backslash:

```
? * [ ] \ $ ' " ` | & ; ( ) { } new-line
```

NOTE

If a newline is quoted by a backslash, the newline is ignored. When in doubt about whether or not a character needs quoting, it is safe to precede the character with a backslash; if the character has no special meaning, the backslash is ignored.

NOTE

The shells (sh, csh, and ksh) each have slightly different sets of special characters. See *HP-UX Concepts and Tutorials: Shell and Miscellaneous Tools* for more information.

The Single Quote

The single quote can be used in pairs to quote a string of characters. It can be used to quote all the special characters except the single quote itself. For example, the following entry

```
echo 'prog*.c *list* lib\? 3?'
```

prints the exact characters listed between the single quotes. Even the backslash is treated literally. This means that a string such as

```
echo 'Can\'t find file'
```

does not work as expected, because the backslash loses its quoting ability when enclosed between single quotes.

Thus, there is no way to put a single quote between single quotes without confusing the shell.

The Double Quote

The double quote quotes all special characters except \, $, ", and `. Since the backslash is not quoted within double quotes, it may be used to quote these four characters. In the following example,d

```
echo "The computer responds \"Not found\" and exits "
```

the backslash is used to quote the double quote character. Thus, a double quote may be included in a string enclosed in double quotes. The backslash itself must also be quoted to be interpreted literally within double quotes.

The example given in the last section can be executed successfully using double quotes:

```
echo "Can't find file."
```

This time, all characters show up as expected on your screen.

Since $ and ` are not quoted, parameter and command substitution are permitted. For example,

```
echo "$dirname processed at `date` "
```

prints out the name of the directory currently being processed, and the date and time at which it was processed. Braces are not required around dirname, since it is separated from the next word by a space. The backslash can be used to quote $

and ' to prevent parameter and command substitution from occurring.

To assign the string "print date and time" to the parameter "descr", type:

```
$ descr="print date and time"  RETURN
```

Use double quotes around the four words to force the shell to interpret the four words as a single string. Use echo to see the value that the shell has assigned to "descr":

```
$ echo $descr  RETURN
print date and time
$
```

Now assign the value "date" to the parameter "cmd":

```
$ cmd=date  RETURN
```

Since "date" has no spaces between the characters, the shell interprets "date" as a string, and you don't have to enclose it in double quotes. To see the value of "cmd", type:

```
$ echo $cmd  RETURN
date
$
```

Finally, you can combine the values of "descr" and "cmd" under one parameter:

```
$ cmddescr="cmd - $descr"  RETURN
```

To see the value of "cmddescr", type:

```
$ echo $cmddescr  RETURN
date - print date and time
$
```

The parameter "cmddescr" now contains a string similar to the line of text under the NAME heading of the description of the date command in the *HP-UX Reference* manual.

Chapter Review

- Access permissions control access to files.
- The **chmod** command changes the access permissions for a file.
- The **chown** command changes the ownership of a file.
- You can redirect command standard output by using the metacharacters >>, >, and <.
- A pipe (|) is an I/O channel used for process-to-process data transfer.
- You can enter two or more commands on one line by using a semicolon (;) between commands.
- Background execution allows you to run programs without having to wait for their completion to perform the next task. The ampersand (&) at the end of a command line specifies background execution.
- You can specify conditional execution of commands.
- Metacharacters are selected characters that have special meaning to the shell program

6

User's Tutorial

This chapter presents tutorials for some of the more advanced features of HP-UX. The format is similar to the Getting Started Tutorial in Chapter 4. The tutorials are designed to allow you to start and stop at any point you wish. Since the tasks are somewhat unrelated, you don't need to follow the exact order shown. You may find it more convenient to go through the tutorials as you need to do the tasks covered. The tasks covered are:

- Creating shell scripts
- Concatenating files
- Sorting files
- Comparing files
- Searching for a file
- Receiving and sending mail
- Using the history command in the C shell

NOTE

This tutorial refers to the file structure set up in the Getting Started Tutorial. If you don't have this on your system, please go back and read the instructions under Setting Up the Tutorial in Chapter 4.

Creating Shell Scripts

Shell scripts are command files that may contain some of the constructs of high level programming languages. The example that follows, however, presents a simple shell script that does not contain these constructs. Shell scripts save you typing and allow you to perform complex sets of commands that are awkward to type in sequentially

Create a file using ed or vi (see Chapter 4) with the contents shown below. Name this file **shellscript**.

```
pwd
ls -l
sleep 10
who
man ls
echo done
```

Now type in the following commands to execute your shell script.

```
$ chmod 777 shellscript [RETURN]        (Change the mode
                                         to executable)
$ shellscript [RETURN]                  (execute the shell script)
/homedir
(directory listing)
(no action for 10 seconds)
(names of people on the system)
(the man page of ls)
done
```

You can see that the process is very easy. A thorough discussion of shell scripts can be found in *HP-UX Concepts and Tutorials: Shells and Miscellaneous Tools*.

Concatenating Files

The **cat** (concatenate) command appends files and sequentially displays them on the screen. The output of this command can be redirected to an output file with the use of the I/O redirection features ">" and ">>". The ">" creates the output file if it does not exist. If the file exists, it will be overwritten, or if you have a special "noclobber" setting, an error message will be displayed. The ">>" is used to append the concatenated files to an existing file.

```
$ ls [RETURN]                           (display contents of
directory)                                      tutorial
tutorial.1   tutorial.2   tutorial.3

$ cat tutorial.1 tutorial.2 [RETURN]    (concatenate and
                                         display files)
(display of file tutorial.1)
(display of file tutorial.2)

$ cat tutorial.1 tutorial.2 >tutorial.4 [RETURN]
                    (concatenate files and create tutorial.4)

$ ls [RETURN]                           (verify tutorial.4 was created)
tutorial  tutorial.1  tutorial.2  tutorial.3
tutorial.4
```

Sorting Contents of a File

The **sort** command is used to sort the contents of one or more files. When used without any options, it sorts line by line in ASCII order. In general, the order is numbers, uppercase letters, then lowercase letters. Special characters such as commas and periods are intermixed. The man page called **ascii** provides the full set of ASCII characters in order. Several options can be used with the sort command. They are explained in the *HP-UX Reference* manual.

```
$ sort tutorial.1 RETURN
(display of sorted file)
```

Comparing File Contents

The **diff** (difference) command displays the difference between two specified files and can optionally produce the **ed** commands to bring them into agreement. The following two files are slightly different.

```
file "myfile"          | file "myfile1"       line #
                       |
Now is the time        | Now is the time        1
for all good citizens  | for all good citizens  2
to come to the aid     | to come to the aid     3
of their country.      | for their country      4
This is the last line  |                        5
```

Lines 4 and 5 are different in both files. Create these files in any way you wish. To display the differences the **diff** command requires the two file names to compare as parameters.

```
$ diff myfile myfile1 RETURN    (display the differences)
4,5c4
< of their country.
< This is the last line.
---
> for their country
$
```

The line containing "4,5c4" is the command for the **ed** editor to change the lines in "myfile" to match "myfile1". If you were to run diff with the -e option and then to pipe this output to a file and add two lines, it could be used as a command file input to the **ed** editor. The command file would then create another file identical to "myfile1" using "myfile". The following sequence of commands makes use of the option of

the **diff** command to create "myfile2", which will be identical to "myfile1", and run the command file with **ed**.

```
$ diff -e myfile myfile1>command.file  RETURN
$ ed command.file  RETURN                (edit command.file)
51                                       (number of characters read in)
$  RETURN                                (go to last line of text)
.                                        (display of last line of text)
a  RETURN                                (invoke append mode)
w myfile2  RETURN                        (create third file, myfile2)
q  RETURN                                (quit)
.  RETURN                                (end append mode)
w  RETURN                                (save new command.file)
63                                       (new number of characters)
q  RETURN                                (end edit session)

$ ed myfile<command.file  RETURN         (edit myfile using
                                         the newly created command.file)
99                                       (total characters in myfile)
75                                       (total characters in myfile2)
$ ls  RETURN                             (verify myfile2 was created)

(display of directory contents, should include myfile2)

$ diff myfile1 myfile2  RETURN           (test the difference)
$                        (no messages so the files are the same)
```

This command is useful for creating identical copies of files without editing the file line by line and displaying minor changes in files.

Searching for a File

To search for a file, the **find** command can be used. This command searches for files from the search criteria provided and performs the action specified on the file(s) found. The form of this command is:

find pathname [search-criteria] [action]

The pathname specifies the directory or directories to begin the search. If no pathname is given, the working directory pathname is used. The search criteria specifies the type of search to be done. The action is the function to be performed when the files are found..

```
$ find -name tutorial.1 -print  RETURN
                    (finds tutorial.1 and displays its pathname)

$ find . -type d -print  RETURN (finds all directory files
                                and displays their pathname)
```

```
$ find . -type f -print [RETURN]   (finds all ordinary files
                                    and displays their pathnames)

$ find / -print [RETURN]           (finds and displays every
                                    file and directory you have
                                    permission to access)

$ find.-name d -print [RETURN]
                                    (finds and displays file whose names
                                    contain the letter d)
```

Receiving and Sending Mail

Use the **mailx** command to send mail. After entering the command followed by the usernames of the people you want to send the message to, you type the message. To end the message type a "." in the first column of the line. After you press [RETURN], your message will be sent.

Example:

```
$ who [RETURN]
<pick someone on the system to send the message to>

$ mailx <user> [RETURN]                (send message to user)
subject: mailx tutorial [RETURN]      (subject of message)
I am learning to use mailx. [RETURN]
This is a great way for me to communicate with [RETURN]
other users on the system. [RETURN]
. [RETURN]
EOT                  (end message)
$
```

To send the same message to a group of users, simply enter all the usernames after the mail command separated by spaces. For example,

```
$ mailx ed chuck kurt andrew newton kent audrey roy
(message)
.
EOT
$
```

The message will be sent to the users specified and a prompt such as

```
You have mail.
```

will be displayed on each user's screen either at login or when the next prompt is given to you by the system. The user does not need to be logged onto the system when you send the message.

To receive mail type:

```
$ mailx RETURN
```

You will see a list of the mail messages you have received. For the sake of this example, assume that your user name is "Zack". If you got mail from three of your coworkers, your list of messages might look like this:

```
mailx version 23.2 2/15/88.  Type ? for help.
 /usr/mail/zack : 3 messages  2 new 3 unread
  U 1 peter Mon Feb 1 13:03 10/127 Re:hello
> N 2 lee   Tue Feb 9  8:55 9/98   Re:meeting
  N 3 vivi  Thu Feb 11 9:23 10/111 Re:print
?
```

A **?** is displayed after the list of messages. This is the prompt for **mailx**. You can read your mail by typing the number of the message after the **?** prompt:

```
? 2
```

The contents of message 2 will be displayed:

```
From: lee Tue Feb 9 8:55
To: zack
Subject: meeting
Status: R

Don't forget the product team meeting on 2/22.
```

If you want to save a mail message in a file, type:

```
? s3 print
"print" [New file] 10/111
```

and message 3 will be saved in a file called "print".

If you want to delete a mail message, (for example message 1) type:

```
? d1
```

When you are done reading your mail, type a **q** at the **?** and you will be returned to the shell prompt.

```
? RETURN
(your mail message)
? q RETURN
$
```

To learn more about **mailx**, refer to *HP-UX Concepts and Tutorials: Shells and Miscellaneous Tools*.

Command History

You must enter the C shell to use command history commands. To enter the C shell, use this command:

```
$ csh (Puts you into the C shell)
```

When you are in the C shell, you will see some variation of the % prompt. The **csh** prompt can include an event number. For more details on customizing your prompt refer to *csh(1)* in the *HP-UX Reference Manual*. Some typical **csh** prompts are:

```
19%
jim11%
pubs03:
[23]%
```

The event number reflects the number of previous commands entered, whether or not any event was successfully executed. Each time you enter a command line, it is stored in a buffer and saved for subsequent examination or execution. The event number of this command line is the number shown on the prompt when the command was entered.

The number of commands to be stored in the buffer is set when the shell environment is established. However, you may change this number with the **set** command. The buffer is called the **history list**.

The commands are saved in the buffer in reverse order of entry, the first one recalled will be the last one entered. The complete list of commands in the buffer is listed with the oldest in the buffer at the top of the list.

The command history feature works on commands that are entered from the **csh** prompt, and provides the following:

- Lists the group of commands saved
- Selects a particular command and executes it
- Selects a command, modifies it, and executes it

Listing Command Buffer

To list the commands available for reexecution, use the **history** command. The size of the list is usually set by your system administrator. You can set the size of the list yourself by using the **set** command.

```
% set history=50 (keep the last 50 commands)
```

Or, use this variation of the **set** command:

```
% set savehist=50 (keep the last 50 commands and
                   restore them to your history list when
                   you log on again)
```

The actual size is determined by a **csh** variable called **history**. Sample history listings are shown below.

Example:

```
08% history RETURN
01    mail
02    ls -l
03    spell newfile
04    vi newfile.c
05    cc newfile.c
06    sort newfile.out | lp
07    cd ..
08    history
09%_
```

Example:

```
35% history RETURN
21    cat newfiled
22    spell report
23    vi newtext.c
24    cc newtext.c
25    sort newfile.out | lp
26    cd ..
27    history
28    history
29    oldscript model year cost yield
30    pwd
31    chmod 755 newscript
32    newscript model year cost yield
33    cd
34    ls -l > tmpfile
35    history
36%
```

In the last example, note that there are only 15 commands. This is the limit set by the **history** variable. As a new command is entered, the command at the top (oldest) is dropped from the list. All command lines typed are stored in the history list, even if they are duplicated.

Reexecuting a Command

To select a previous command for reexecution, use the ! character. You may select a previous command by several means:

```
!!     repeat the last command entered
!n     repeat the command with the event number n
```

Examples:

```
36% !! RETURN          (repeat the last command)

18% !8 RETURN          (repeat event 8 on the list)
```

Chapter Review

- Shell scripts can be used to simplify typing of commands.
- The **cat** command concatenates files.
- The **sort** command sorts text files in ASCII order.
- The **diff** command displays the difference between two files and optionally displays the **ed** commands to make them the same.
- The **find** command searches for a file given a search criteria, starting pathname, and an action to perform once it finds the file.
- Electronic mail can be sent to other users using the **mailx** command.
- The **history** command allows you to display previous commands if you are using the C shell. The ! command reexecutes a command in your history list.

7

Useful Utilities

Introduction

This chapter contains brief explanations of several useful HP-UX utilities. Following the explanation for each utility, references are made to other HP-UX manuals where further information or a tutorial may be found. These utilities described in this chapter are:

- sed — a non-interactive text editor
- awk — a programming language for manipulating data
- grep — a pattern search command
- lint — a C program checker
- bc — an arbitrary-precision desk calculator language
- dc — an interactive desk calculator
- wc — a counter for words, characters, or lines
- make — a program maintenance utility

Utilities

sed

The **sed** editor is non-interactive and helpful for editing large files. Since it is non-interactive it only has to keep a small amount of the large file in memory at one time. This eliminates the restrictions on file size that interactive editors have. The input to this editor can be complicated and redundant. Therefore, the ability to use command files as input saves typing, eliminates redundant entries, and reduces the probability of typographical errors. The **sed** editor is presented in *HP-UX Concepts and Tutorials: Text Editors and Processors*.

awk

The **awk** utility is a pattern scanning and processing language that searches input for patterns and performs actions on each line of input that satisfies the pattern. The following is a list of functions you can perform with **awk**. For more information refer to *HP-UX Concepts and Tutorials: Text Editors and Processors*.

- file generation from data files
- transform data within a file
- manipulation of columnar data
- search for specific file patterns

grep

The **grep** command searches text files for a specified string pattern. The text file can be any file you choose. You don't have to enter an editor to use **grep**. Also, you can specify more than one file. Several options are available that allow you to do such things as

- list only lines without the pattern
- list the number of lines that match the pattern
- list the names of files containing the pattern
- list the lines (with line numbers) that match the pattern

See the *HP-UX Reference* manual for a detailed discussion of **grep**.

lint

The **lint** utility checks program and verifies C source code, giving you warning messages pertaining to the style, efficiency, portability, and consistency of your program. Running **lint** is often useful even after you have successfully run the C compiler. Many times, there are defects in programs that are syntactically correct but which may affect the execution of the program. This utility will find some of these defects and tell you about potential problems. See *HP-UX Concepts and Tutorials: Programming Environment* for a detailed discussion of **lint**.

bc

The arithmetic language **bc** allows you to perform arithmetic on extremely large numbers. Memory is allocated dynamically, so the size of a number is limited only by the amount of memory available. You can use **bc** interactively like a hand calculator or write programs in **bc**'s pseudo-C language. Several built-in functions are included such as sin, cos, tan, and log. Arithmetic can be done in base ten or any other base. For further discussion of **bc**, see *HP-UX Concepts and Tutorials: Shells and Miscellaneous Tools*.

dc

Like **bc**, **dc** is an interactive desk top calculator, except that **dc** works like a stack calculator and uses reverse Polish notation. The normal operation mode is for integers, however, you can select options that allow arithmetic with alternate bases or the number of fractional digits to be maintained. With **dc** you can use input files to give commands. Also, **bc** accepts programs written in a high level language and compiles output that is interpreted by **dc**. Like **bc**, the size of a number that can be manipulated with **dc** is limited only by the amount of memory available. For a more thorough discussion of **dc**, refer to *HP-UX Concepts and Tutorials: Shells and Miscellaneous Tools*.

wc

The **wc** command outputs the number of lines, words and/or characters in one or more files. You can specify any one of these options or a combination of two or all three. If you don't specify a file, **wc** counts what is input in the standard input (usually the keyboard). This is especially useful when used in a pipe to report statistics for the pipeline data stream. Note that blank spaces, tabs and new line characters are included in the count. For more information, refer to the *HP-UX Reference* manual.

make

The **make** utility provides an easy and efficient way to create and maintain computer programs. If, for example, you are working on a project involving several source files, it is not always easy to remember which files you have altered and need to recompile. Whenever a change is made to a file, make knows to create the necessary object files.

With **make** you can:

- create a sequence of commands necessary for creating certain files
- create macros for substitution of long strings
- encapsulate commands in a single file for convenient administration

See the *HP-UX Concepts and Tutorials: Programming Environment* for a detailed discussion of **make**.

Chapter Summary

- **Sed** is a non-interactive editor that is useful for large text files.
- **Awk** is a pattern scanning and processing language.
- **Grep** is a pattern scanning utility that can be used outside of a text editor.
- **Lint** is a program checker for C programs that finds defects that the C compiler won't find.
- **Bc** is an arithmetic language that allows you to perform arithmetic on extremely large numbers.
- **Dc** is a desk top calculator that also can be used on large numbers.
- **Wc** is a word, character, and line counting utility.
- **Make** is a program for creation and maintenance utility that keeps track of which source files you have altered since the last compile.

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Manual Part No. 92453-90001
Printed in U.S.A. February 1988
E0288

HEWLETT PACKARD