UNIX

computer Operating System

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About the Tutorial

Unix is a computer Operating System which is capable of handling activities from multiple users at the same time. The development of Unix started around 1969 at AT&T Bell Labs by Ken Thompson and Dennis Ritchie. This tutorial gives a very good understanding on Unix.

Audience

This tutorial has been prepared for the beginners to help them understand the basics to advanced concepts covering Unix commands, Unix shell scripting and various utilities.

Prerequisites

We assume you have adequate exposure to Operating Systems and their functionalities. A basic understanding on various computer concepts will also help you in understanding the various exercises given in this tutorial.

Execute Unix Shell Programs

If you are willing to learn the Unix/Linux basic commands and Shell script but you do not have a setup for the same, then do not worry — The CodingGround is available on a high-end dedicated server giving you real programming experience with the comfort of single-click execution. Yes! It is absolutely free and online.

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Unix for Beginners

1. Unix — Getting Started

What is Unix?

The Unix operating system is a set of programs that act as a link between the computer and the user.

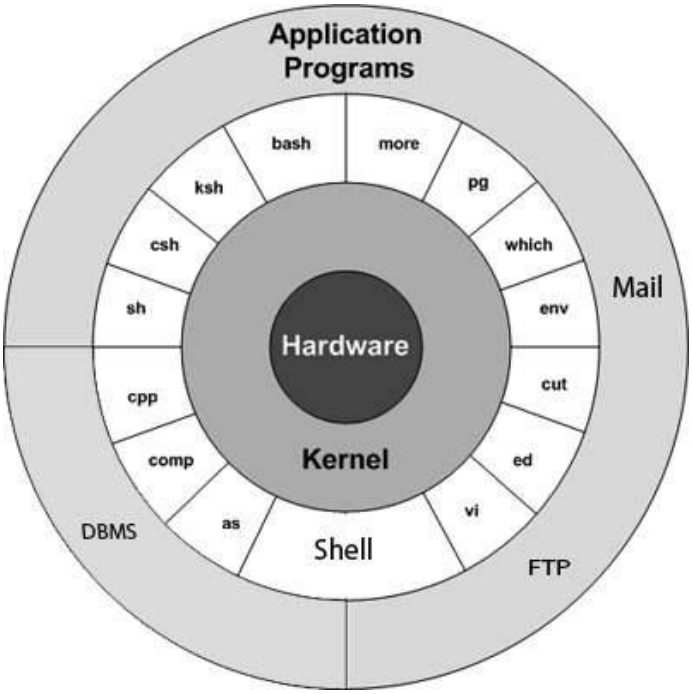
The computer programs that allocate the system resources and coordinate all the details of the computer's internals is called the **operating system** or the **kernel**.

Users communicate with the kernel through a program known as the **shell**. The shell is a command line interpreter; it translates commands entered by the user and converts them into a language that is understood by the kernel.

- Unix was originally developed in 1969 by a group of AT&T employees Ken Thompson, Dennis Ritchie, Douglas McIlroy, and Joe Ossanna at Bell Labs.
- There are various Unix variants available in the market. Solaris Unix, AIX, HP Unix and BSD are a few examples. Linux is also a flavor of Unix which is freely available.
- Several people can use a Unix computer at the same time; hence Unix is called a multiuser system.
- A user can also run multiple programs at the same time; hence Unix is a multitasking environment.

Unix Architecture

Here is a basic block diagram of a Unix system –



The main concept that unites all the versions of Unix is the following four basics –

- **Kernel:** The kernel is the heart of the operating system. It interacts with the hardware and most of the tasks like memory management, task scheduling and file management.
- **Shell:** The shell is the utility that processes your requests. When you type in a command at your terminal, the shell interprets the command and calls the program that you want. The shell uses standard syntax for all commands. C Shell, Bourne Shell and Korn Shell are the most famous shells which are available with most of the Unix variants.
- **Commands and Utilities:** There are various commands and utilities which you can make use of in your day to day activities. **cp, mv, cat** and **grep,** etc. are few examples of commands and utilities. There are over 250 standard commands plus numerous others provided through 3rd party software. All the commands come along with various options.
- **Files and Directories:** All the data of Unix is organized into files. All files are then organized into directories. These directories are further organized into a tree-like structure called the **filesystem**.

System Bootup

If you have a computer which has the Unix operating system installed in it, then you simply need to turn on the system to make it live.

As soon as you turn on the system, it starts booting up and finally it prompts you to log into the system, which is an activity to log into the system and use it for your day-to-day activities.

Login Unix

When you first connect to a Unix system, you usually see a prompt such as the following:

```
login:
```

To log in

- Have your userid (user identification) and password ready. Contact your system administrator if you don't have these yet.
- Type your userid at the login prompt, then press **ENTER**. Your userid is **case-sensitive**, so be sure you type it exactly as your system administrator has instructed.
- Type your password at the password prompt, then press **ENTER**. Your password is also case-sensitive.
- If you provide the correct userid and password, then you will be allowed to enter into the system. Read the information and messages that comes up on the screen, which is as follows.

```
login : amrood
amrood's password:
Last login: Sun Jun 14 09:32:32 2009 from 62.61.164.73
$
```

You will be provided with a command prompt (sometime called the **$** prompt) where you type all your commands. For example, to check calendar, you need to type the **cal** command as follows –

```
$ cal
     June 2009
Su Mo Tu We Th Fr Sa
    1  2  3  4  5  6
 7  8  9 10 11 12 13
14 15 16 17 18 19 20
21 22 23 24 25 26 27
```

```
28 29 30


$
```

Change Password

All Unix systems require passwords to help ensure that your files and data remain your own and that the system itself is secure from hackers and crackers. Following are the steps to change your password –

Step 1: To start, type password at the command prompt as shown below.

Step 2: Enter your old password, the one you're currently using.

Step 3: Type in your new password. Always keep your password complex enough so that nobody can guess it. But make sure, you remember it.

Step 4: You must verify the password by typing it again.

```
$ passwd
Changing password for amrood
(current) Unix password:******
New Unix password:*******
Retype new Unix password:*******
passwd: all authentication tokens updated successfully
$
```

Note – We have added asterisk (*) here just to show the location where you need to enter the current and new passwords otherwise at your system. It does not show you any character when you type.

Listing Directories and Files

All data in Unix is organized into files. All files are organized into directories. These directories are organized into a tree-like structure called the filesystem.

You can use the **ls** command to list out all the files or directories available in a directory. Following is the example of using **ls** command with **-l** option.

```
$ ls -l
total 19621
drwxrwxr-x  2 amrood amrood      4096 Dec 25 09:59 uml
```

```
-rw-rw-r--  1 amrood amrood      5341 Dec 25 08:38 uml.jpg
drwxr-xr-x  2 amrood amrood      4096 Feb 15  2006 univ
drwxr-xr-x  2 root   root        4096 Dec  9  2007 urlspedia
-rw-r--r--  1 root   root      276480 Dec  9  2007 urlspedia.tar
drwxr-xr-x  8 root   root        4096 Nov 25  2007 usr
-rwxr-xr-x  1 root   root        3192 Nov 25  2007 webthumb.php
-rw-rw-r--  1 amrood amrood     20480 Nov 25  2007 webthumb.tar
-rw-rw-r--  1 amrood amrood      5654 Aug  9  2007 yourfile.mid
-rw-rw-r--  1 amrood amrood    166255 Aug  9  2007 yourfile.swf

$
```

Here entries starting with **d.....** represent directories. For example, uml, univ and urlspedia are directories and rest of the entries are files.

Who Are You?

While you're logged into the system, you might be willing to know : **Who am I**?

The easiest way to find out "who you are" is to enter the **whoami** command –

```
$ whoami
 amrood

$
```

Try it on your system. This command lists the account name associated with the current login. You can try **who am i** command as well to get information about yourself.

Who is Logged in?

Sometime you might be interested to know who is logged in to the computer at the same time.

There are three commands available to get you this information, based on how much you wish to know about the other users: **users, who,** and **w**.

```
$ users
 amrood bablu qadir

```

```
$ who
amrood ttyp0 Oct 8 14:10 (limbo)
bablu  ttyp2 Oct 4 09:08 (calliope)
qadir  ttyp4 Oct 8 12:09 (dent)

$
```

Try the **w** command on your system to check the output. This lists down information associated with the users logged in the system.

Logging Out

When you finish your session, you need to log out of the system. This is to ensure that nobody else accesses your files.

To log out

- Just type the **logout** command at the command prompt, and the system will clean up everything and break the connection.

System Shutdown

The most consistent way to shut down a Unix system properly via the command line is to use one of the following commands –

Command	Description
halt	Brings the system down immediately
init 0	Powers off the system using predefined scripts to synchronize and clean up the system prior to shutting down
init 6	Reboots the system by shutting it down completely and then restarting it
poweroff	Shuts down the system by powering off
reboot	Reboots the system

shutdown	Shuts down the system

You typically need to be the super user or root (the most privileged account on a Unix system) to shut down the system. However, on some standalone or personally-owned Unix boxes, an administrative user and sometimes regular users can do so.

2. Unix — File Management

In this chapter, we will discuss in detail about file management in Unix. All data in Unix is organized into files. All files are organized into directories. These directories are organized into a tree-like structure called the filesystem.

When you work with Unix, one way or another, you spend most of your time working with files. This tutorial will help you understand how to create and remove files, copy and rename them, create links to them, etc.

In Unix, there are three basic types of files –

- **Ordinary Files** – An ordinary file is a file on the system that contains data, text, or program instructions. In this tutorial, you look at working with ordinary files.
- **Directories** – Directories store both special and ordinary files. For users familiar with Windows or Mac OS, Unix directories are equivalent to folders.
- **Special Files** – Some special files provide access to hardware such as hard drives, CD-ROM drives, modems, and Ethernet adapters. Other special files are similar to aliases or shortcuts and enable you to access a single file using different names.

Listing Files

To list the files and directories stored in the current directory, use the following command:

```
$ls
```

Here is the sample output of the above command –

```
$ls

bin         hosts   lib     res.03
ch07        hw1     pub     test_results
ch07.bak    hw2     res.01  users
docs        hw3     res.02  work
```

The command **ls** supports the **-l** option which would help you to get more information about the listed files –

```
$ls -l
```

```
total 1962188

drwxrwxr-x  2 amrood amrood      4096 Dec 25 09:59 uml
-rw-rw-r--  1 amrood amrood      5341 Dec 25 08:38 uml.jpg
drwxr-xr-x  2 amrood amrood      4096 Feb 15  2006 univ
drwxr-xr-x  2 root   root        4096 Dec  9  2007 urlspedia
-rw-r--r--  1 root   root      276480 Dec  9  2007 urlspedia.tar
drwxr-xr-x  8 root   root        4096 Nov 25  2007 usr
drwxr-xr-x  2    200    300      4096 Nov 25  2007 webthumb-1.01
-rwxr-xr-x  1 root   root        3192 Nov 25  2007 webthumb.php
-rw-rw-r--  1 amrood amrood     20480 Nov 25  2007 webthumb.tar
-rw-rw-r--  1 amrood amrood      5654 Aug  9  2007 yourfile.mid
-rw-rw-r--  1 amrood amrood    166255 Aug  9  2007 yourfile.swf
drwxr-xr-x 11 amrood amrood      4096 May 29  2007 zlib-1.2.3
$
```

Here is the information about all the listed columns –

- **First Column**: Represents the file type and the permission given on the file. Below is the description of all type of files.
- **Second Column**: Represents the number of memory blocks taken by the file or directory.
- **Third Column**: Represents the owner of the file. This is the Unix user who created this file.
- **Fourth Column**: Represents the group of the owner. Every Unix user will have an associated group.
- **Fifth Column**: Represents the file size in bytes.
- **Sixth Column**: Represents the date and the time when this file was created or modified for the last time.
- **Seventh Column**: Represents the file or the directory name.

In the **ls -l** listing example, every file line begins with a **d**, **-**, or **l**. These characters indicate the type of the file that's listed.

Prefix	Description

-	Regular file, such as an ASCII text file, binary executable, or hard link
b	Block special file. Block input/output device file such as a physical hard drive
c	Character special file. Raw input/output device file such as a physical hard drive
d	Directory file that contains a listing of other files and directories
l	Symbolic link file. Links on any regular file
p	Named pipe. A mechanism for interprocess communications
s	Socket used for interprocess communication

Metacharacters

Metacharacters have a special meaning in Unix. For example, ***** and **?** are metacharacters. We use ***** to match 0 or more characters, a question mark (**?**) matches with a single character.

For Example –

```
$ls ch*.doc
```

Displays all the files, the names of which start with **ch** and end with **.doc** –

```
ch01-1.doc   ch010.doc  ch02.doc    ch03-2.doc
ch04-1.doc   ch040.doc  ch05.doc    ch06-2.doc
ch01-2.doc ch02-1.doc c
```

Here, ***** works as meta character which matches with any character. If you want to display all the files ending with just **.doc**, then you can use the following command –

```
$ls *.doc
```

Hidden Files

An invisible file is one, the first character of which is the dot or the period character (.). Unix programs (including the shell) use most of these files to store configuration information.

Some common examples of the hidden files include the files –

- **.profile** – The Bourne shell (sh) initialization script
- **.kshrc** – The Korn shell (ksh) initialization script
- **.cshrc** – The C shell (csh) initialization script
- **.rhosts** – The remote shell configuration file

To list the invisible files, specify the **-a** option to **ls** –

```
$ ls -a

.          .profile       docs      lib      test_results
..         .rhosts        hosts     pub      users
.emacs     bin            hw1       res.01   work
.exrc      ch07           hw2       res.02
.kshrc     ch07.bak       hw3       res.03
$
```

- Single dot (**.**) – This represents the current directory.
- Double dot (**..**) – This represents the parent directory.

Creating Files

You can use the **vi** editor to create ordinary files on any Unix system. You simply need to give the following command –

```
$ vi filename
```

The above command will open a file with the given filename. Now, press the key **i** to come into the edit mode. Once you are in the edit mode, you can start writing your content in the file as in the following program –

```
This is unix file....I created it for the first time.....
```

```
I'm going to save this content in this file.
```

Once you are done with the program, follow these steps –

- Press the key **esc** to come out of the edit mode.
- Press two keys **Shift + Z** together to come out of the file completely.

You will now have a file created with **filename** in the current directory.

```
$ vi filename
$
```

Editing Files

You can edit an existing file using the **vi** editor. We will discuss in short how to open an existing file –

```
$ vi filename
```

Once the file is opened, you can come in the edit mode by pressing the key **i** and then you can proceed by editing the file. If you want to move here and there inside a file, then first you need to come out of the edit mode by pressing the key **Esc.** After this, you can use the following keys to move inside a file –

- **l** key to move to the right side.
- **h** key to move to the left side.
- **k** key to move upside in the file.
- **j** key to move downside in the file.

So using the above keys, you can position your cursor wherever you want to edit. Once you are positioned, then you can use the **i** key to come in the edit mode. Once you are done with the editing in your file, press **Esc** and finally two keys **Shift + ZZ** together to come out of the file completely.

Display Content of a File

You can use the **cat** command to see the content of a file. Following is a simple example to see the content of the above created file –

```
$ cat filename
This is unix file....I created it for the first time.....
I'm going to save this content in this file.
```

```
$
```

You can display the line numbers by using the **-b** option along with the **cat** command as follows –

```
$ cat -b filename
1   This is unix file....I created it for the first time.....
2   I'm going to save this content in this file.
$
```

Counting Words in a File

You can use the **wc** command to get a count of the total number of lines, words, and characters contained in a file. Following is a simple example to see the information about the file created above –

```
$ wc filename
2  19 103 filename
$
```

Here is the detail of all the four columns –

- **First Column**: Represents the total number of lines in the file.
- **Second Column**: Represents the total number of words in the file.
- **Third Column**: Represents the total number of bytes in the file. This is the actual size of the file.
- **Fourth Column**: Represents the file name.

You can give multiple files and get information about those files at a time. Following is simple syntax –

```
$ wc filename1 filename2 filename3
```

Copying Files

To make a copy of a file use the **cp** command. The basic syntax of the command is –

```
$ cp source_file destination_file
```

Following is the example to create a copy of the existing file **filename**.

```
$ cp filename copyfile
$
```

You will now find one more file **copyfile** in your current directory. This file will exactly be the same as the original file **filename**.

Renaming Files

To change the name of a file, use the **mv** command. Following is the basic syntax −

```
$ mv old_file new_file
```

The following program will rename the existing file **filename** to **newfile.**

```
$ mv filename newfile
$
```

The **mv** command will move the existing file completely into the new file. In this case, you will find only **newfile** in your current directory.

Deleting Files

To delete an existing file, use the **rm** command. Following is the basic syntax −

```
$ rm filename
```

Caution: A file may contain useful information. It is always recommended to be careful while using this **Delete** command. It is better to use the **-i** option along with **rm** command.

Following is the example which shows how to completely remove the existing file **filename**.

```
$ rm filename
$
```

You can remove multiple files at a time with the command given below −

```
$ rm filename1 filename2 filename3
$
```

Standard Unix Streams

Under normal circumstances, every Unix program has three streams (files) opened for it when it starts up –

- **stdin** – This is referred to as the *standard input* and the associated file descriptor is 0. This is also represented as STDIN. The Unix program will read the default input from STDIN.
- **stdout** – This is referred to as the *standard output* and the associated file descriptor is 1. This is also represented as STDOUT. The Unix program will write the default output at STDOUT
- **stderr** – This is referred to as the *standard error* and the associated file descriptor is 2. This is also represented as STDERR. The Unix program will write all the error messages at STDERR.

3. Unix — Directory Management

In this chapter, we will discuss in detail about directory management in Unix.

A directory is a file the solo job of which is to store the file names and the related information. All the files, whether ordinary, special, or directory, are contained in directories.

Unix uses a hierarchical structure for organizing files and directories. This structure is often referred to as a directory tree. The tree has a single root node, the slash character (**/**), and all other directories are contained below it.

Home Directory

The directory in which you find yourself when you first login is called your home directory.

You will be doing much of your work in your home directory and subdirectories that you'll be creating to organize your files.

You can go in your home directory anytime using the following command –

```
$cd ~
$
```

Here **~** indicates the home directory. Suppose you have to go in any other user's home directory, use the following command –

```
$cd ~username
$
```

To go in your last directory, you can use the following command –

```
$cd -
$
```

Absolute/Relative Pathnames

Directories are arranged in a hierarchy with root **(/)** at the top. The position of any file within the hierarchy is described by its pathname.

Elements of a pathname are separated by a **/**. A pathname is absolute, if it is described in relation to root, thus absolute pathnames always begin with a **/**.

Following are some examples of absolute filenames.

```
/etc/passwd
/users/sjones/chem/notes
/dev/rdsk/Os3
```

A pathname can also be relative to your current working directory. Relative pathnames never begin with **/**. Relative to user amrood's home directory, some pathnames might look like this –

```
chem/notes
personal/res
```

To determine where you are within the filesystem hierarchy at any time, enter the command **pwd** to print the current working directory –

```
$pwd
/user0/home/amrood

$
```

Listing Directories

To list the files in a directory, you can use the following syntax –

```
$ls dirname
```

Following is the example to list all the files contained in **/usr/local** directory –

```
$ls /usr/local

X11       bin          gimp       jikes       sbin
ace       doc          include    lib         share
atalk     etc          info       man         ami
```

Creating Directories

We will now understand how to create directories. Directories are created by the following command –

```
$mkdir dirname
```

Here, directory is the absolute or relative pathname of the directory you want to create. For example, the command –

```
$mkdir mydir
$
```

Creates the directory **mydir** in the current directory. Here is another example –

```
$mkdir /tmp/test-dir
$
```

This command creates the directory **test-dir** in the **/tmp** directory. The **mkdir** command produces no output if it successfully creates the requested directory.

If you give more than one directory on the command line, **mkdir** creates each of the directories. For example, –

```
$mkdir docs pub
$
```

Creates the directories docs and pub under the current directory.

Creating Parent Directories

We will now understand how to create parent directories. Sometimes when you want to create a directory, its parent directory or directories might not exist. In this case, **mkdir** issues an error message as follows –

```
$mkdir /tmp/amrood/test
mkdir: Failed to make directory "/tmp/amrood/test";
No such file or directory
$
```

In such cases, you can specify the **-p** option to the **mkdir** command. It creates all the necessary directories for you. For example –

```
$mkdir -p /tmp/amrood/test
$
```

The above command creates all the required parent directories.

Removing Directories

Directories can be deleted using the **rmdir** command as follows –

```
$rmdir dirname
$
```

Note – To remove a directory, make sure it is empty which means there should not be any file or sub-directory inside this directory.

You can remove multiple directories at a time as follows –

```
$rmdir dirname1 dirname2 dirname3
$
```

The above command removes the directories dirname1, dirname2, and dirname3, if they are empty. The **rmdir** command produces no output if it is successful.

Changing Directories

You can use the **cd** command to do more than just change to a home directory. You can use it to change to any directory by specifying a valid absolute or relative path. The syntax is as given below –

```
$cd dirname
$
```

Here, **dirname** is the name of the directory that you want to change to. For example, the command –

```
$cd /usr/local/bin
$
```

Changes to the directory **/usr/local/bin**. From this directory, you can **cd** to the directory **/usr/home/amrood** using the following relative path –

```
$cd ../../home/amrood
$
```

Renaming Directories

The **mv (move)** command can also be used to rename a directory. The syntax is as follows:

```
$mv olddir newdir
$
```

You can rename a directory **mydir** to **yourdir** as follows –

```
$mv mydir yourdir
$
```

The directories . (dot) and .. (dot dot)

The **filename .** (dot) represents the current working directory; and the **filename ..** (dot dot) represents the directory one level above the current working directory, often referred to as the parent directory.

If we enter the command to show a listing of the current working directories/files and use the **-a option** to list all the files and the **-l option** to provide the long listing, we will receive the following result.

```
$ls -la
drwxrwxr-x    4    teacher   class   2048  Jul 16 17.56 .
drwxr-xr-x    60   root              1536  Jul 13 14:18 ..
----------    1    teacher   class   4210  May 1 08:27 .profile
-rwxr-xr-x    1    teacher   class   1948  May 12 13:42 memo
$
```

4. Unix — File Permission / Access Modes

In this chapter, we will discuss in detail about file permission and access modes in Unix. File ownership is an important component of Unix that provides a secure method for storing files. Every file in Unix has the following attributes –

- **Owner permissions** – The owner's permissions determine what actions the owner of the file can perform on the file.
- **Group permissions** – The group's permissions determine what actions a user, who is a member of the group that a file belongs to, can perform on the file.
- **Other (world) permissions** – The permissions for others indicate what action all other users can perform on the file.

The Permission Indicators

While using **ls -l** command, it displays various information related to file permission as follows –

```
$ls -l /home/amrood
-rwxr-xr--  1 amrood   users 1024  Nov 2 00:10  myfile
drwxr-xr--- 1 amrood   users 1024  Nov 2 00:10  mydir
```

Here, the first column represents different access modes, i.e., the permission associated with a file or a directory.

The permissions are broken into groups of threes, and each position in the group denotes a specific permission, in this order: read (r), write (w), execute (x) –

- The first three characters (2-4) represent the permissions for the file's owner. For example, **-rwxr-xr--** represents that the owner has read (r), write (w) and execute (x) permission.
- The second group of three characters (5-7) consists of the permissions for the group to which the file belongs. For example, -**rwxr-xr--** represents that the group has read (r) and execute (x) permission, but no write permission.
- The last group of three characters (8-10) represents the permissions for everyone else. For example, **-rwxr-xr--** represents that there is **read (r)** only permission.

File Access Modes

The permissions of a file are the first line of defense in the security of a Unix system. The basic building blocks of Unix permissions are the **read**, **write**, and **execute** permissions, which have been described below –

Read

Grants the capability to read, i.e., view the contents of the file.

Write

Grants the capability to modify, or remove the content of the file.

Execute

User with execute permissions can run a file as a program.

Directory Access Modes

Directory access modes are listed and organized in the same manner as any other file. There are a few differences that need to be mentioned:

Read

Access to a directory means that the user can read the contents. The user can look at the **filenames** inside the directory.

Write

Access means that the user can add or delete files from the directory.

Execute

Executing a directory doesn't really make sense, so think of this as a traverse permission.

A user must have **execute** access to the **bin** directory in order to execute the **ls** or the **cd** command.

Changing Permissions

To change the file or the directory permissions, you use the **chmod** (change mode) command. There are two ways to use chmod — the symbolic mode and the absolute mode.

Using chmod in Symbolic Mode

The easiest way for a beginner to modify file or directory permissions is to use the symbolic mode. With symbolic permissions you can add, delete, or specify the permission set you want by using the operators in the following table.

chmod Operator	Description
+	Adds the designated permission(s) to a file or directory.
-	Removes the designated permission(s) from a file or directory.
=	Sets the designated permission(s).

Here's an example using **testfile**. Running **ls -1** on the testfile shows that the file's permissions are as follows –

```
$ls -l testfile
-rwxrwxr--  1 amrood   users 1024  Nov 2 00:10  testfile
```

Then each example **chmod** command from the preceding table is run on the testfile, followed by **ls –l**, so you can see the permission changes –

```
$chmod o+wx testfile
$ls -l testfile
-rwxrwxrwx  1 amrood   users 1024  Nov 2 00:10  testfile
$chmod u-x testfile
$ls -l testfile
-rw-rwxrwx  1 amrood   users 1024  Nov 2 00:10  testfile
$chmod g=rx testfile
$ls -l testfile
-rw-r-xrwx  1 amrood   users 1024  Nov 2 00:10  testfile
```

Here's how you can combine these commands on a single line:

```
$chmod o+wx,u-x,g=rx testfile
$ls -l testfile
-rw-r-xrwx  1 amrood   users 1024  Nov 2 00:10  testfile
```

Using chmod with Absolute Permissions

The second way to modify permissions with the chmod command is to use a number to specify each set of permissions for the file.

Each permission is assigned a value, as the following table shows, and the total of each set of permissions provides a number for that set.

Number	Octal Permission Representation	Ref
0	No permission	---
1	Execute permission	--x
2	Write permission	-w-
3	Execute and write permission: 1 (execute) + 2 (write) = 3	-wx
4	Read permission	r--
5	Read and execute permission: 4 (read) + 1 (execute) = 5	r-x
6	Read and write permission: 4 (read) + 2 (write) = 6	rw-
7	All permissions: 4 (read) + 2 (write) + 1 (execute) = 7	rwx

Here's an example using the testfile. Running **ls -1** on the testfile shows that the file's permissions are as follows –

```
$ls -l testfile
-rwxrwxr--  1 amrood   users 1024  Nov 2 00:10  testfile
```

Then each example **chmod** command from the preceding table is run on the testfile, followed by **ls –l**, so you can see the permission changes –

```
$ chmod 755 testfile
$ls -l testfile
-rwxr-xr-x  1 amrood   users 1024  Nov 2 00:10  testfile
$chmod 743 testfile
```

```
$ls -l testfile
-rwxr---wx  1 amrood   users 1024  Nov 2 00:10  testfile
$chmod 043 testfile
$ls -l testfile
----r---wx  1 amrood   users 1024  Nov 2 00:10  testfile
```

Changing Owners and Groups

While creating an account on Unix, it assigns a **owner ID** and a **group ID** to each user. All the permissions mentioned above are also assigned based on the Owner and the Groups.

Two commands are available to change the owner and the group of files −

- **chown** − The **chown** command stands for **"change owner"** and is used to change the owner of a file.
- **chgrp** − The **chgrp** command stands for **"change group"** and is used to change the group of a file.

Changing Ownership

The **chown** command changes the ownership of a file. The basic syntax is as follows −

```
$ chown user filelist
```

The value of the user can be either the **name of a user** on the system or the **user id (uid)** of a user on the system.

The following example will help you understand the concept −

```
$ chown amrood testfile
$
```

Changes the owner of the given file to the user **amrood**.

NOTE: The super user, root, has the unrestricted capability to change the ownership of any file but normal users can change the ownership of only those files that they own.

Changing Group Ownership

The **chgrp** command changes the group ownership of a file. The basic syntax is as follows:

```
$ chgrp group filelist
```

The value of group can be the **name of a group** on the system or **the group ID (GID)** of a group on the system.

Following example helps you understand the concept:

```
$ chgrp special testfile
$
```

Changes the group of the given file to **special** group.

SUID and SGID File Permission

Often when a command is executed, it will have to be executed with special privileges in order to accomplish its task.

As an example, when you change your password with the **passwd** command, your new password is stored in the file **/etc/shadow**.

As a regular user, you do not have **read** or **write** access to this file for security reasons, but when you change your password, you need to have the write permission to this file. This means that the **passwd** program has to give you additional permissions so that you can write to the file **/etc/shadow**.

Additional permissions are given to programs via a mechanism known as the **Set User ID (SUID)** and **Set Group ID (SGID)** bits.

When you execute a program that has the SUID bit enabled, you inherit the permissions of that program's owner. Programs that do not have the SUID bit set are run with the permissions of the user who started the program.

This is the case with SGID as well. Normally, programs execute with your group permissions, but instead your group will be changed just for this program to the group owner of the program.

The SUID and SGID bits will appear as the letter **"s"** if the permission is available. The SUID **"s"** bit will be located in the permission bits where the owners' **execute** permission normally resides.

For example, the command -

```
$ ls -l /usr/bin/passwd
-r-sr-xr-x  1   root   bin  19031 Feb 7 13:47  /usr/bin/passwd*
$
```

Shows that the SUID bit is set and that the command is owned by the root. A capital letter **S** in the execute position instead of a lowercase **s** indicates that the execute bit is not set.

If the sticky bit is enabled on the directory, files can only be removed if you are one of the following users –

- The owner of the sticky directory
- The owner of the file being removed
- The super user, root

To set the SUID and SGID bits for any directory try the following command –

```
$ chmod ug+s dirname
$ ls -l
drwsr-sr-x 2 root root  4096 Jun 19 06:45 dirname
$
```

5. Unix — Environment

In this chapter, we will discuss in detail about the Unix environment. An important Unix concept is the **environment**, which is defined by environment variables. Some are set by the system, others by you, yet others by the shell, or any program that loads another program.

A variable is a character string to which we assign a value. The value assigned could be a number, text, filename, device, or any other type of data.

For example, first we set a variable TEST and then we access its value using the **echo** command:

```
$TEST="Unix Programming"
$echo $TEST
Unix Programming
```

Note that the environment variables are set without using the **$** sign but while accessing them we use the $ sign as prefix. These variables retain their values until we come out of the shell.

When you log in to the system, the shell undergoes a phase called **initialization** to set up the environment. This is usually a two-step process that involves the shell reading the following files –

- /etc/profile
- profile

The process is as follows –

- The shell checks to see whether the file **/etc/profile** exists.
- If it exists, the shell reads it. Otherwise, this file is skipped. No error message is displayed.
- The shell checks to see whether the file **.profile** exists in your home directory. Your home directory is the directory that you start out in after you log in.
- If it exists, the shell reads it; otherwise, the shell skips it. No error message is displayed.

As soon as both of these files have been read, the shell displays a prompt –

```
$
```

This is the prompt where you can enter commands in order to have them executed.

Note – The shell initialization process detailed here applies to all **Bourne** type shells, but some additional files are used by **bash** and **ksh**.

The .profile File

The file **/etc/profile** is maintained by the system administrator of your Unix machine and contains shell initialization information required by all users on a system.

The file **.profile** is under your control. You can add as much shell customization information as you want to this file. The minimum set of information that you need to configure includes -

- The type of terminal you are using
- A list of directories in which to locate the commands
- A list of variables affecting the look and feel of your terminal

You can check your **.profile** available in your home directory. Open it using the **vi** editor and check all the variables set for your environment.

Setting the Terminal Type

Usually, the type of terminal you are using is automatically configured by either the **login** or **getty** programs. Sometimes, the auto configuration process guesses your terminal incorrectly.

If your terminal is set incorrectly, the output of the commands might look strange, or you might not be able to interact with the shell properly.

To make sure that this is not the case, most users set their terminal to the lowest common denominator in the following way –

```
$TERM=vt100
$
```

Setting the PATH

When you type any command on the command prompt, the shell has to locate the command before it can be executed.

The PATH variable specifies the locations in which the shell should look for commands. Usually the Path variable is set as follows –

```
$PATH=/bin:/usr/bin
$
```

Here, each of the individual entries separated by the colon character **(:)** are directories. If you request the shell to execute a command and it cannot find it in any of the directories given in the PATH variable, a message similar to the following appears –

```
$hello

hello: not found

$
```

There are variables like PS1 and PS2 which are discussed in the next section.

PS1 and PS2 Variables

The characters that the shell displays as your command prompt are stored in the variable PS1. You can change this variable to be anything you want. As soon as you change it, it'll be used by the shell from that point on.

For example, if you issued the command –

```
$PS1='=>'

=>

=>

=>
```

Your prompt will become **=>**. To set the value of **PS1** so that it shows the working directory, issue the command –

```
=>PS1="[\u@\h \w]\$"

[root@ip-72-167-112-17 /var/www/tutorialspoint/unix]$

[root@ip-72-167-112-17 /var/www/tutorialspoint/unix]$
```

The result of this command is that the prompt displays the user's username, the machine's name (hostname), and the working directory.

There are quite a few **escape sequences** that can be used as value arguments for PS1; try to limit yourself to the most critical so that the prompt does not overwhelm you with information.

Escape Sequence	Description
\t	Current time, expressed as HH:MM:SS
\d	Current date, expressed as Weekday Month Date
\n	Newline
\s	Current shell environment
\W	Working directory
\w	Full path of the working directory
\u	Current user's username
\h	Hostname of the current machine
\#	Command number of the current command. Increases when a new command is entered
\$	If the effective UID is 0 (that is, if you are logged in as root), end the prompt with the # character; otherwise, use the $ sign

You can make the change yourself every time you log in, or you can have the change made automatically in PS1 by adding it to your **.profile** file.

When you issue a command that is incomplete, the shell will display a secondary prompt and wait for you to complete the command and hit **Enter** again.

The default secondary prompt is **>** (the greater than sign), but can be changed by re-defining the **PS2** shell variable –

Following is the example which uses the default secondary prompt –

```
$ echo "this is a
> test"
this is a
```

```
test
$
```

The example given below re-defines PS2 with a customized prompt –

```
$ PS2="secondary prompt->"
$ echo "this is a
secondary prompt->test"
this is a
test
$
```

Environment Variables

Following is the partial list of important environment variables. These variables are set and accessed as mentioned below –

Variable	Description
DISPLAY	Contains the identifier for the display that **X11** programs should use by default.
HOME	Indicates the home directory of the current user: the default argument for the cd **built-in** command.
IFS	Indicates the **Internal Field Separator** that is used by the parser for word splitting after expansion.
LANG	LANG expands to the default system locale; LC_ALL can be used to override this. For example, if its value is **pt_BR**, then the language is set to (Brazilian) Portuguese and the locale to Brazil.
LD_LIBRARY_PATH	A Unix system with a dynamic linker, contains a colon-separated list of directories that the dynamic linker should search for shared objects when building a process image after exec, before searching in any other directories.

PATH	Indicates the search path for commands. It is a colon-separated list of directories in which the shell looks for commands.
PWD	Indicates the current working directory as set by the cd command.
RANDOM	Generates a random integer between 0 and 32,767 each time it is referenced.
SHLVL	Increments by one each time an instance of bash is started. This variable is useful for determining whether the built-in exit command ends the current session.
TERM	Refers to the display type.
TZ	Refers to Time zone. It can take values like GMT, AST, etc.
UID	Expands to the numeric user ID of the current user, initialized at the shell startup.

Following is the sample example showing few environment variables –

```
$ echo $HOME
/root
]$ echo $DISPLAY

$ echo $TERM
xterm
$ echo $PATH
/usr/local/bin:/bin:/usr/bin:/home/amrood/bin:/usr/local/bin
$
```

6. Unix — Basic Utilities

In this chapter, we will discuss in detail about Printing and Email as the basic utilities of Unix. So far, we have tried to understand the Unix OS and the nature of its basic commands. In this chapter, we will learn some important Unix utilities that can be used in our day-to-day life.

Printing Files

Before you print a file on a Unix system, you may want to reformat it to adjust the margins, highlight some words, and so on. Most files can also be printed without reformatting, but the raw printout may not be that appealing.

Many versions of Unix include two powerful text formatters, **nroff** and **troff**.

The pr Command

The **pr** command does minor formatting of files on the terminal screen or for a printer. For example, if you have a long list of names in a file, you can format it onscreen into two or more columns.

Following is the syntax for the **pr** command –

```
pr option(s) filename(s)
```

The **pr** changes the format of the file only on the screen or on the printed copy; it doesn't modify the original file. Following table lists some **pr** options –

Option	Description
-k	Produces **k** columns of output
-d	Double-spaces the output (not on all **pr** versions)
-h "header"	Takes the next item as a report header
-t	Eliminates the printing of header and the top/bottom margins

-l PAGE_LENGTH	Sets the page length to PAGE_LENGTH (66) lines. The default number of lines of text is 56
-o MARGIN	Offsets each line with MARGIN (zero) spaces
-w PAGE_WIDTH	Sets the page width to PAGE_WIDTH (72) characters for multiple text-column output only

Before using **pr**, here are the contents of a sample file named food.

```
$cat food
Sweet Tooth
Bangkok Wok
Mandalay
Afghani Cuisine
Isle of Java
Big Apple Deli
Sushi and Sashimi
Tio Pepe's Peppers
........
$
```

Let's use the **pr** command to make a two-column report with the header *Restaurants* –

```
$pr -2 -h "Restaurants" food
Nov  7  9:58 1997  Restaurants   Page 1


Sweet Tooth              Isle of Java
Bangkok Wok              Big Apple Deli
Mandalay                 Sushi and Sashimi
Afghani Cuisine          Tio Pepe's Peppers
........
$
```

The lp and lpr Commands

The command **lp** or **lpr** prints a file onto paper as opposed to the screen display. Once you are ready with formatting using the **pr** command, you can use any of these commands to print your file on the printer connected to your computer.

Your system administrator has probably set up a default printer at your site. To print a file named **food** on the default printer, use the **lp** or **lpr** command, as in the following example:

```
$lp food
request id is laserp-525  (1 file)
$
```

The **lp** command shows an ID that you can use to cancel the print job or check its status.

- If you are using the **lp** command, you can use the -n**Num** option to print Num number of copies. Along with the command **lpr**, you can use **-Num** for the same.
- If there are multiple printers connected with the shared network, then you can choose a printer using -d**printer** option along with lp command and for the same purpose you can use -P**printer** option along with lpr command. Here printer is the printer name.

The lpstat and lpq Commands

The **lpstat** command shows what's in the printer queue: request IDs, owners, file sizes, when the jobs were sent for printing, and the status of the requests.

Use **lpstat -o** if you want to see all output requests other than just your own. Requests are shown in the order they'll be printed –

```
$lpstat -o
laserp-573  john  128865  Nov 7  11:27  on laserp
laserp-574  grace  82744  Nov 7  11:28
laserp-575  john   23347  Nov 7  11:35
$
```

The **lpq** gives slightly different information than **lpstat -o** –

```
$lpq
laserp is ready and printing
```

```
Rank    Owner       Job  Files                  Total Size
active  john        573  report.ps              128865 bytes
1st     grace       574  ch03.ps ch04.ps        82744 bytes
2nd     john        575  standard input         23347 bytes
$
```

Here the first line displays the printer status. If the printer is disabled or running out of paper, you may see different messages on this first line.

The cancel and lprm Commands

The **cancel** command terminates a printing request from the **lp command**. The **lprm** command terminates all **lpr requests**. You can specify either the ID of the request (displayed by lp or lpq) or the name of the printer.

```
$cancel laserp-575
request "laserp-575" cancelled
$
```

To cancel whatever request is currently printing, regardless of its ID, simply enter **cancel** and the printer name –

```
$cancel laserp
request "laserp-573" cancelled
$
```

The **lprm** command will cancel the active job if it belongs to you. Otherwise, you can give job numbers as arguments, or use a **dash (-)** to remove all of your jobs –

```
$lprm 575
dfA575diamond dequeued
cfA575diamond dequeued
$
```

The **lprm** command tells you the actual filenames removed from the printer queue.

Sending Email

You use the Unix mail command to send and receive mail. Here is the syntax to send an email –

```
$mail [-s subject] [-c cc-addr] [-b bcc-addr] to-addr
```

Here are important options related to mail command:

Option	Description
-s	Specifies subject on the command line.
-c	Sends carbon copies to the list of users. List should be a comma-separated list of names.
-b	Sends blind carbon copies to list. List should be a comma-separated list of names.

Following is an example to send a test message to admin@yahoo.com.

```
$mail -s "Test Message" admin@yahoo.com
```

You are then expected to type in your message, followed by **"control-D"** at the beginning of a line. To stop, simply type **dot (.)** as follows –

```
Hi,


This is a test

.
Cc:
```

You can send a complete file using a **redirect < operator** as follows –

```
$mail -s "Report 05/06/07" admin@yahoo.com < demo.txt
```

To check incoming email at your Unix system, you simply type email as follows –

```
$mail
no email
```

7. Unix — Pipes and Filters

In this chapter, we will discuss in detail about pipes and filters in Unix. You can connect two commands together so that the output from one program becomes the input of the next program. Two or more commands connected in this way form a pipe.

To make a pipe, put a vertical bar (**|**) on the command line between two commands.

When a program takes its input from another program, it performs some operation on that input, and writes the result to the standard output. It is referred to as a ***filter***.

The grep Command

The grep command searches a file or files for lines that have a certain pattern. The syntax is –

```
$grep pattern file(s)
```

The name **"grep"** comes from the ed (a Unix line editor) command **g/re/p** which means "globally search for a regular expression and print all lines containing it".

A regular expression is either some plain text (a word, for example) and/or special characters used for pattern matching.

The simplest use of grep is to look for a pattern consisting of a single word. It can be used in a pipe so that only those lines of the input files containing a given string are sent to the standard output. If you don't give grep a filename to read, it reads its standard input; that's the way all filter programs work –

```
$ls -l | grep "Aug"
-rw-rw-rw-   1 john  doc     11008 Aug  6 14:10 ch02
-rw-rw-rw-   1 john  doc      8515 Aug  6 15:30 ch07
-rw-rw-r--   1 john  doc      2488 Aug 15 10:51 intro
-rw-rw-r--   1 carol doc      1605 Aug 23 07:35 macros
$
```

There are various options which you can use along with the **grep** command –

Option	Description
-v	Prints all lines that do not match pattern.
-n	Prints the matched line and its line number.
-l	Prints only the names of files with matching lines (letter "l")
-c	Prints only the count of matching lines.
-i	Matches either upper or lowercase.

Let us now use a regular expression that tells grep to find lines with **"carol"**, followed by zero or other characters abbreviated in a regular expression as ".*"), then followed by "Aug".

Here, we are using the ***-i*** option to have case insensitive search –

```
$ls -l | grep -i "carol.*aug"
-rw-rw-r--   1 carol doc      1605 Aug 23 07:35 macros
$
```

The Sort Command

The **sort** command arranges lines of text alphabetically or numerically. The following example sorts the lines in the food file –

```
$sort food
Afghani Cuisine
Bangkok Wok
Big Apple Deli
```

```
Isle of Java


Mandalay
Sushi and Sashimi
Sweet Tooth
Tio Pepe's Peppers
$
```

The **sort** command arranges lines of text alphabetically by default. There are many options that control the sorting –

Option	Description
-n	Sorts numerically (example: 10 will sort after 2), ignores blanks and tabs.
-r	Reverses the order of sort.
-f	Sorts upper and lowercase together.
+x	Ignores first **x** fields when sorting.

More than two commands may be linked up into a pipe. Taking a previous pipe example using **grep**, we can further sort the files modified in August by the order of size.

The following pipe consists of the commands **ls, grep,** and **sort** –

```
$ls -l | grep "Aug" | sort +4n
-rw-rw-r--  1 carol doc      1605 Aug 23 07:35 macros
-rw-rw-r--  1 john  doc      2488 Aug 15 10:51 intro
-rw-rw-rw-  1 john  doc      8515 Aug  6 15:30 ch07
-rw-rw-rw-  1 john  doc     11008 Aug  6 14:10 ch02
$
```

This pipe sorts all files in your directory modified in August by the order of size, and prints them on the terminal screen. The sort option +4n skips four fields (fields are separated by blanks) then sorts the lines in numeric order.

The pg and more Commands

A long output can normally be zipped by you on the screen, but if you run text through more or use the **pg** command as a filter; the display stops once the screen is full of text.

Let's assume that you have a long directory listing. To make it easier to read the sorted listing, pipe the output through **more** as follows −

```
$ls -l | grep "Aug" | sort +4n | more
-rw-rw-r--  1 carol doc      1605 Aug 23 07:35 macros
-rw-rw-r--  1 john  doc      2488 Aug 15 10:51 intro
-rw-rw-rw-  1 john  doc      8515 Aug  6 15:30 ch07
-rw-rw-r--  1 john  doc     14827 Aug  9 12:40 ch03
     .
     .
     .
-rw-rw-rw-  1 john  doc     16867 Aug  6 15:56 ch05
--More--(74%)
```

The screen will fill up once the screen is full of text consisting of lines sorted by the order of the file size. At the bottom of the screen is the **more** prompt, where you can type a command to move through the sorted text.

Once you're done with this screen, you can use any of the commands listed in the discussion of the more program.

8. Unix — Processes Management

In this chapter, we will discuss in detail about process management in Unix. When you execute a program on your Unix system, the system creates a special environment for that program. This environment contains everything needed for the system to run the program as if no other program were running on the system.

Whenever you issue a command in Unix, it creates, or starts, a new process. When you tried out the **ls** command to list the directory contents, you started a process. A process, in simple terms, is an instance of a running program.

The operating system tracks processes through a five-digit ID number known as the **pid** or the **process ID**. Each process in the system has a unique **pid**.

Pids eventually repeat because all the possible numbers are used up and the next pid rolls or starts over. At any point of time, no two processes with the same pid exist in the system because it is the pid that Unix uses to track each process.

Starting a Process

When you start a process (run a command), there are two ways you can run it –

- Foreground Processes
- Background Processes

Foreground Processes

By default, every process that you start runs in the foreground. It gets its input from the keyboard and sends its output to the screen.

You can see this happen with the **ls** command. If you wish to list all the files in your current directory, you can use the following command –

```
$ls ch*.doc
```

This would display all the files, the names of which start with **ch** and end with **.doc** –

```
ch01-1.doc    ch010.doc   ch02.doc     ch03-2.doc
ch04-1.doc    ch040.doc   ch05.doc     ch06-2.doc
ch01-2.doc    ch02-1.doc
```

The process runs in the foreground, the output is directed to my screen, and if the **ls** command wants any input (which it does not), it waits for it from the keyboard.

While a program is running in the foreground and is time-consuming, no other commands can be run (start any other processes) because the prompt would not be available until the program finishes processing and comes out.

Background Processes

A background process runs without being connected to your keyboard. If the background process requires any keyboard input, it waits.

The advantage of running a process in the background is that you can run other commands; you do not have to wait until it completes to start another!

The simplest way to start a background process is to add an ampersand (**&**) at the end of the command.

```
$ls ch*.doc &
```

This displays all those files the names of which start with **ch** and end with **.doc** –

```
ch01-1.doc    ch010.doc   ch02.doc     ch03-2.doc
ch04-1.doc    ch040.doc   ch05.doc     ch06-2.doc
ch01-2.doc    ch02-1.doc
```

Here, if the **ls** command wants any input (which it does not), it goes into a stop state until we move it into the foreground and give it the data from the keyboard.

That first line contains information about the background process - the job number and the process ID. You need to know the job number to manipulate it between the background and the foreground.

Press the Enter key and you will see the following –

```
[1]   +   Done                 ls ch*.doc &
$
```

The first line tells you that the **ls** command background process finishes successfully. The second is a prompt for another command.

Listing Running Processes

It is easy to see your own processes by running the **ps** (process status) command as follows –

```
$ps
PID       TTY      TIME        CMD
18358     ttyp3    00:00:00    sh
18361     ttyp3    00:01:31    abiword
18789     ttyp3    00:00:00    ps
```

One of the most commonly used flags for ps is the **-f** (f for full) option, which provides more information as shown in the following example –

```
$ps -f
UID      PID  PPID C STIME    TTY   TIME CMD
amrood   6738 3662 0 10:23:03 pts/6 0:00 first_one
amrood   6739 3662 0 10:22:54 pts/6 0:00 second_one
amrood   3662 3657 0 08:10:53 pts/6 0:00 -ksh
amrood   6892 3662 4 10:51:50 pts/6 0:00 ps -f
```

Here is the description of all the fields displayed by **ps -f** command –

Column	Description
UID	User ID that this process belongs to (the person running it)
PID	Process ID
PPID	Parent process ID (the ID of the process that started it)
C	CPU utilization of process
STIME	Process start time
TTY	Terminal type associated with the process
TIME	CPU time taken by the process

CMD	The command that started this process

There are other options which can be used along with **ps** command –

Option	Description
-a	Shows information about all users
-x	Shows information about processes without terminals
-u	Shows additional information like -f option
-e	Displays extended information

Stopping Processes

Ending a process can be done in several different ways. Often, from a console-based command, sending a CTRL + C keystroke (the default interrupt character) will exit the command. This works when the process is running in the foreground mode.

If a process is running in the background, you should get its Job ID using the **ps** command. After that, you can use the **kill** command to kill the process as follows –

```
$ps -f
UID      PID  PPID C STIME    TTY   TIME CMD
amrood   6738 3662 0 10:23:03 pts/6 0:00 first_one
amrood   6739 3662 0 10:22:54 pts/6 0:00 second_one
amrood   3662 3657 0 08:10:53 pts/6 0:00 -ksh
amrood   6892 3662 4 10:51:50 pts/6 0:00 ps -f
$kill 6738
Terminated
```

Here, the **kill** command terminates the **first_one** process. If a process ignores a regular kill command, you can use **kill -9** followed by the process ID as follows –

```
$kill -9 6738
Terminated
```

Parent and Child Processes

Each unix process has two ID numbers assigned to it: The Process ID (pid) and the Parent process ID (ppid). Each user process in the system has a parent process.

Most of the commands that you run have the shell as their parent. Check the **ps -f** example where this command listed both the process ID and the parent process ID.

Zombie and Orphan Processes

Normally, when a child process is killed, the parent process is updated via a **SIGCHLD** signal. Then the parent can do some other task or restart a new child as needed. However, sometimes the parent process is killed before its child is killed. In this case, the "parent of all processes," the **init** process, becomes the new PPID (parent process ID). In some cases, these processes are called orphan processes.

When a process is killed, a **ps** listing may still show the process with a **Z** state. This is a zombie or defunct process. The process is dead and not being used. These processes are different from the orphan processes. They have completed execution but still find an entry in the process table.

Daemon Processes

Daemons are system-related background processes that often run with the permissions of root and services requests from other processes.

A daemon has no controlling terminal. It cannot open **/dev/tty**. If you do a **"ps -ef"** and look at the **tty** field, all daemons will have a **?** for the **tty**.

To be precise, a daemon is a process that runs in the background, usually waiting for something to happen that it is capable of working with. For example, a printer daemon waiting for print commands.

If you have a program that calls for lengthy processing, then it’s worth to make it a daemon and run it in the background.

The top Command

The **top** command is a very useful tool for quickly showing processes sorted by various criteria.

It is an interactive diagnostic tool that updates frequently and shows information about physical and virtual memory, CPU usage, load averages, and your busy processes.

Here is the simple syntax to run top command and to see the statistics of CPU utilization by different processes –

```
$top
```

Job ID Versus Process ID

Background and suspended processes are usually manipulated via **job number (job ID)**. This number is different from the process ID and is used because it is shorter.

In addition, a job can consist of multiple processes running in a series or at the same time, in parallel. Using the job ID is easier than tracking individual processes.

9. Unix — Network Communication Utilities

In this chapter, we will discuss in detail about network communication utilities in Unix. When you work in a distributed environment, you need to communicate with remote users and you also need to access remote Unix machines.

There are several Unix utilities that help users compute in a networked, distributed environment. This chapter lists a few of them.

The ping Utility

The **ping** command sends an echo request to a host available on the network. Using this command, you can check if your remote host is responding well or not.

The ping command is useful for the following –

- Tracking and isolating hardware and software problems.
- Determining the status of the network and various foreign hosts.
- Testing, measuring, and managing networks.

Syntax

Following is the simple syntax to use the ping command –

```
$ping hostname or ip-address
```

The above command starts printing a response after every second. To come out of the command, you can terminate it by pressing **CNTRL + C** keys.

Example

Following is an example to check the availability of a host available on the network –

```
$ping google.com
PING google.com (74.125.67.100) 56(84) bytes of data.
64 bytes from 74.125.67.100: icmp_seq=1 ttl=54 time=39.4 ms
64 bytes from 74.125.67.100: icmp_seq=2 ttl=54 time=39.9 ms
64 bytes from 74.125.67.100: icmp_seq=3 ttl=54 time=39.3 ms
64 bytes from 74.125.67.100: icmp_seq=4 ttl=54 time=39.1 ms
64 bytes from 74.125.67.100: icmp_seq=5 ttl=54 time=38.8 ms
```

```
--- google.com ping statistics ---
22 packets transmitted, 22 received, 0% packet loss, time 21017ms
rtt min/avg/max/mdev = 38.867/39.334/39.900/0.396 ms
$
```

If a host does not exist, you will receive the following output –

```
$ping giiiiiigle.com
ping: unknown host giiiiigle.com
$
```

The ftp Utility

Here, **ftp** stands for **F**ile **T**ransfer **P**rotocol. This utility helps you upload and download your file from one computer to another computer.

The ftp utility has its own set of Unix-like commands. These commands help you perform tasks such as –

- Connect and login to a remote host.
- Navigate directories.
- List directory contents.
- Put and get files.
- Transfer files as **ascii**, **ebcdic** or **binary**.

Syntax

Following is the simple syntax to use the ping command –

```
$ftp hostname or ip-address
```

The above command would prompt you for the login ID and the password. Once you are authenticated, you can access the home directory of the login account and you would be able to perform various commands.

The following tables lists out a few important commands –

Command	Description

put filename	Uploads filename from the local machine to the remote machine.
get filename	Downloads filename from the remote machine to the local machine.
mput file list	Uploads more than one file from the local machine to the remote machine.
mget file list	Downloads more than one file from the remote machine to the local machine.
prompt off	Turns the prompt off. By default, you will receive a prompt to upload or download files using **mput** or **mget** commands.
prompt on	Turns the prompt on.
dir	Lists all the files available in the current directory of the remote machine.
cd dirname	Changes directory to dirname on the remote machine.
lcd dirname	Changes directory to dirname on the local machine.
quit	Helps logout from the current login.

It should be noted that all the files would be downloaded or uploaded to or from the current directories. If you want to upload your files in a particular directory, you need to first change to that directory and then upload the required files.

Example

Following is the example to show the working of a few commands –

```
$ftp amrood.com
Connected to amrood.com.
220 amrood.com FTP server (Ver 4.9 Thu Sep 2 20:35:07 CDT 2009)
Name (amrood.com:amrood): amrood
331 Password required for amrood.
```

```
Password:
230 User amrood logged in.
ftp> dir
200 PORT command successful.
150 Opening data connection for /bin/ls.
total 1464
drwxr-sr-x   3 amrood   group       1024 Mar 11 20:04 Mail
drwxr-sr-x   2 amrood   group       1536 Mar  3 18:07 Misc
drwxr-sr-x   5 amrood   group        512 Dec  7 10:59 OldStuff
drwxr-sr-x   2 amrood   group       1024 Mar 11 15:24 bin
drwxr-sr-x   5 amrood   group       3072 Mar 13 16:10 mpl
-rw-r--r--   1 amrood   group     209671 Mar 15 10:57 myfile.out
drwxr-sr-x   3 amrood   group        512 Jan  5 13:32 public
drwxr-sr-x   3 amrood   group        512 Feb 10 10:17 pvm3
226 Transfer complete.
ftp> cd mpl
250 CWD command successful.
ftp> dir
200 PORT command successful.
150 Opening data connection for /bin/ls.
total 7320
-rw-r--r--   1 amrood   group       1630 Aug  8 1994  dboard.f
-rw-r-----   1 amrood   group       4340 Jul 17 1994  vttest.c
-rwxr-xr-x   1 amrood   group     525574 Feb 15 11:52 wave_shift
-rw-r--r--   1 amrood   group       1648 Aug  5 1994  wide.list
-rwxr-xr-x   1 amrood   group       4019 Feb 14 16:26 fix.c
226 Transfer complete.
ftp> get wave_shift
200 PORT command successful.
150 Opening data connection for wave_shift (525574 bytes).
226 Transfer complete.
528454 bytes received in 1.296 seconds (398.1 Kbytes/s)
```


```
ftp> quit
221 Goodbye.
$
```

The telnet Utility

There are times when we are required to connect to a remote Unix machine and work on that machine remotely. **Telnet** is a utility that allows a computer user at one site to make a connection, login and then conduct work on a computer at another site.

Once you login using Telnet, you can perform all the activities on your remotely connected machine. The following is an example of Telnet session –

```
C:>telnet amrood.com
Trying...
Connected to amrood.com.
Escape character is '^]'.

login: amrood
amrood's Password:
**************************************************
*                                                *
*                                                *
*    WELCOME TO AMROOD.COM                       *
*                                                *
*                                                *
**************************************************

Last unsuccessful login: Fri Mar  3 12:01:09 IST 2009
Last login: Wed Mar  8 18:33:27 IST 2009 on pts/10

   {  do your work }

$ logout
Connection closed.
```

```
C:>
```

The finger Utility

The **finger** command displays information about users on a given host. The host can be either local or remote.

Finger may be disabled on other systems for security reasons.

Following is the simple syntax to use the finger command –

Check all the logged-in users on the local machine –

```
$ finger
Login     Name       Tty      Idle  Login Time   Office
amrood               pts/0          Jun 25 08:03 (62.61.164.115)
```

Get information about a specific user available on the local machine –

```
$ finger amrood
Login: amrood                           Name: (null)
Directory: /home/amrood                 Shell: /bin/bash
On since Thu Jun 25 08:03 (MST) on pts/0 from 62.61.164.115
No mail.
No Plan.
```

Check all the logged-in users on the remote machine –

```
$ finger @avtar.com
Login     Name       Tty      Idle  Login Time   Office
amrood               pts/0          Jun 25 08:03 (62.61.164.115)
```

Get the information about a specific user available on the remote machine –

```
$ finger amrood@avtar.com
Login: amrood                           Name: (null)
Directory: /home/amrood                 Shell: /bin/bash
On since Thu Jun 25 08:03 (MST) on pts/0 from 62.61.164.115
No mail.
```

```
No Plan.
```