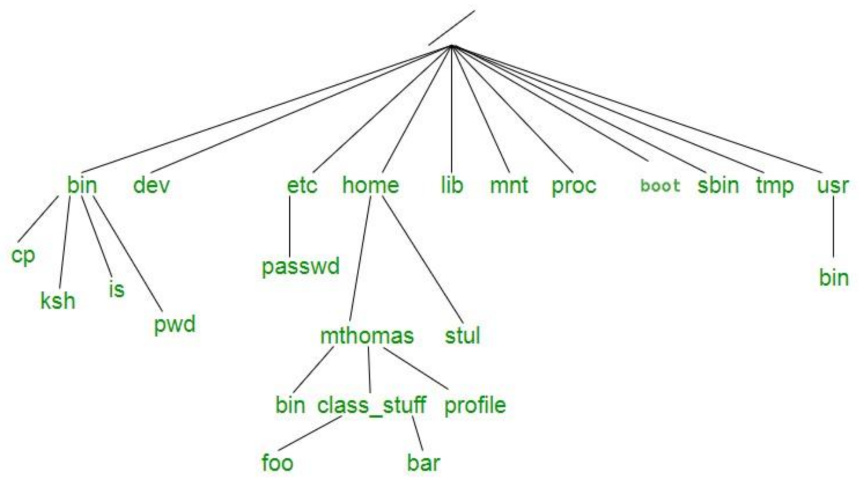
Module 2

UNIX file system

Unix file system is a logical method of organizing and storing large amounts of information in a way that makes it easy to manage. A file is a smallest unit in which the information is stored. Unix file system has several important features. 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 file system. Files in Unix System are organized into multi-level hierarchy structure known as a directory tree. At the very top of the file system is a directory called "root" which is represented by a "/". All other files are "descendants" of root.



Directories or Files and their description –

/ : The slash / character alone denotes the root of the filesystem tree.
/bin : Stands for "binaries" and contains certain fundamental utilities, such as ls or cp, which are generally needed by all users.
/boot : Contains all the files that are required for successful booting process.
/dev : Stands for "devices". Contains file representations of peripheral devices and pseudodevices.
/etc : Contains system-wide configuration files and system databases. Originally also contained "dangerous maintenance utilities" such as init,but these have typically been moved to /sbin or elsewhere.
/home : Contains the home directories for the users.
/lib : Contains system libraries, and some critical files such as kernel modules or device drivers.
/media : Default mount point for removable devices, such as USB sticks, media players, etc.
/mnt : Stands for "mount". Contains filesystem mount points. These are used, for example, if the system uses multiple hard disks or hard disk partitions. It is also often used for remote (network) filesystems, CD-ROM/DVD drives, and so on.
/proc : procfs virtual filesystem showing information about processes as files.

/root : The home directory for the superuser “root” – that is, the system administrator. This account’s home directory is usually on the initial filesystem, and hence not in /home (which may be a mount point for another filesystem) in case specific maintenance needs to be performed, during which other filesystems are not available. Such a case could occur, for example, if a hard disk drive suffers physical failures and cannot be properly mounted.

/tmp : A place for temporary files. Many systems clear this directory upon startup; it might have tmpfs mounted atop it, in which case its contents do not survive a reboot, or it might be explicitly cleared by a startup script at boot time.

/usr : Originally the directory holding user home directories,its use has changed. It now holds executables, libraries, and shared resources that are not system critical, like the X Window System, KDE, Perl, etc. However, on some Unix systems, some user accounts may still have a home directory that is a direct subdirectory of /usr, such as the default as in Minix. (on modern systems, these user accounts are often related to server or system use, and not directly used by a person).

/usr/bin : This directory stores all binary programs distributed with the operating system not residing in /bin, /sbin or (rarely) /etc.

/usr/include : Stores the development headers used throughout the system. Header files are mostly used by the #include directive in C/C++ programming language.

/usr/lib : Stores the required libraries and data files for programs stored within /usr or elsewhere.

/var : A short for “variable.” A place for files that may change often – especially in size, for example e-mail sent to users on the system, or process-ID lock files.

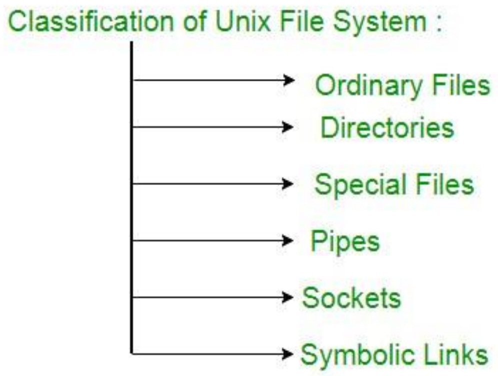
/var/log : Contains system log files.

/var/mail : The place where all the incoming mails are stored. Users (other than root) can access their own mail only. Often, this directory is a symbolic link to /var/spool/mail.

/var/spool : Spool directory. Contains print jobs, mail spools and other queued tasks.

/var/tmp : A place for temporary files which should be preserved between system reboots.

Types of Unix files – The UNIX files system contains several different types of files:



1) **Ordinary files** – An ordinary file is a file on the system that contains data, text, or program instructions.

Used to store your information, such as some text you have written or an image you have drawn. This is the type of file that you usually work with.
Always located within/under a directory file. Do not contain other files.
In long-format output of ls -l, this type of file is specified by the "-" symbol.

2) **Directories** – Directories store both special and ordinary files. For users familiar with Windows or Mac OS, UNIX directories are equivalent to folders. A directory file contains an entry for every file and subdirectory that it houses. If you have 10 files in a directory, there will be 10 entries in the directory. Each entry has two components. (1) The Filename (2) A unique identification number for the file or directory (called the inode number)

Branching points in the hierarchical tree.
Used to organize groups of files.
May contain ordinary files, special files or other directories.
Never contain "real" information which you would work with (such as text). Basically, just used for organizing files.
All files are descendants of the root directory, (named /) located at the top of the tree. In long-format output of ls –l , this type of file is specified by the "d" symbol.

3) **Special Files** – Used to represent a real physical device such as a printer, tape drive or terminal, used for Input/Output (I/O) operations. Device or special files are used for device Input/Output(I/O) on UNIX and Linux systems. They appear in a file system just like an ordinary file or a directory. On UNIX systems there are two flavors of special files for each device, character special files and block special files :

When a character special file is used for device Input/Output(I/O), data is transferred one character at a time. This type of access is called raw device access.

When a block special file is used for device Input/Output(I/O), data is transferred in large fixed-size blocks. This type of access is called block device access.
For terminal devices, it's one character at a time. For disk devices though, raw access means reading or writing in whole chunks of data – blocks, which are native to your disk.

In long-format output of ls -l, character special files are marked by the "c" symbol. In long-format output of ls -l, block special files are marked by the "b" symbol.

4) Pipes – UNIX allows you to link commands together using a pipe. The pipe acts a temporary file which only exists to hold data from one command until it is read by another.A Unix pipe provides a one-way flow of data.The output or result of the first command sequence is used as the input to the second command sequence. To make a pipe, put a vertical bar (|) on the command line between two commands.For example: who | wc -l In long-format output of ls –l , named pipes are marked by the "p" symbol.

5) Sockets – A Unix socket (or Inter-process communication socket) is a special file which allows for advanced inter-process communication. A Unix Socket is used in a client-server application framework. In essence, it is a stream of data, very similar to network stream (and network sockets), but all the transactions are local to the filesystem. In long-format output of ls -l, Unix sockets are marked by "s" symbol.

6) Symbolic Link – Symbolic link is used for referencing some other file of the file system.Symbolic link is also known as Soft link. It contains a text form of the path to the file it references. To an end user, symbolic link will appear to have its own name, but when you try reading or writing data to this file, it will instead reference these operations to the file it points to. If we delete the soft link itself , the data file would still be there.If we delete the source file or move it to a different location, symbolic file will not function properly. In longformat output of ls –l , Symbolic link are marked by the "l" symbol (that's a lower case L).

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.

Sr.No.	Prefix & Description
1	**-** Regular file, such as an ASCII text file, binary executable, or hard link.
2	**b** Block special file. Block input/output device file such as a physical hard drive.
3	**c** Character special file. Raw input/output device file such as a physical hard drive.
4	**d** Directory file that contains a listing of other files and directories.
5	**l** Symbolic link file. Links on any regular file.
6	**p** Named pipe. A mechanism for interprocess communications.
7	**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 + ZZ** 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.

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
$
```

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.

Sr.No.	Chmod operator & Description
1	+ Adds the designated permission(s) to a file or directory.
2	**-** Removes the designated permission(s) from a file or directory.
3	= 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
$
```

[File system, Types of file, File naming convention, Parent – Child relationship, HOME variable, inode number, Absolute pathname, Relative pathname, Significance of dot (.) and dotdot (..), Displaying pathname of the current directory (pwd), Changing the current directory (cd), Make directory (mkdir), Remove directories (rmdir), Listing contents of directory (ls), Very brief idea about important file systems of UNIX: /bin, /usr/bin, /sbin, /usr/sbin, /etc, /dev, /lib, /usr/lib, /usr/include, /usr/share/man, /temp, /var, /home]

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.