EXPERIMENT 5

Aim: File system: Introduction to File system, File system Architecture, and File Types.

Soultion:

What are the different types of files in Linux?

In Linux there are basically three types of files:

- Ordinary/Regular files
- Special files
- Directories

Ordinary/Regular Files

These are files data contain text, data or program instructions and they are the most common type of files you can expect to find on a Linux system and they include:

- Readable files
- Binary files
- Image files
- Compressed files and so on.

Special Files

Special files include the following:

Block files : These are device files that provide buffered access to system hardware components. They provide a method of communication with device drivers through the file system.
One important aspect about block files is that they can transfer a large block of data and information at a given time.

Character files: These are also device files that provide unbuffered serial access to system hardware components. They work by providing a way of communication with devices by transferring data one character at a time.

Symbolic link files: A symbolic link is a reference to another file on the system. Therefore, symbolic link files are files that point to other files, and they can either be directories or regular files.

You can make symbolic links using the **ln** utility in Linux as in the example below.

```
# touch file1.txt
# ln -s file1.txt /home/tecmint/file1.txt  [create symbolic link]

# ls -l /home/tecmint/ | grep "^l"         [List symbolic links]
```

In the above example, I created a file called file1.txt in /tmp directory, then created the symbolic link, /home/tecmint/file1.txt to point to /tmp/file1.txt.

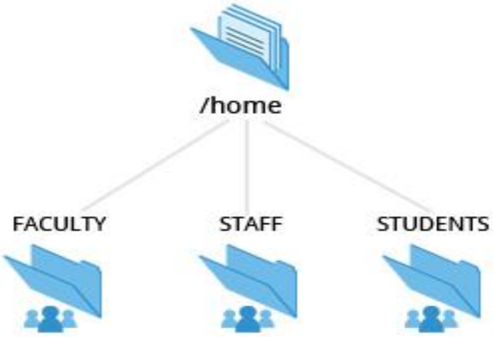
Pipes or Named pipes: These are files that allow inter-process communication by connecting the output of one process to the input of another.A named pipe is actually a file that is used by two processes to communicate with each and it acts as a Linux pipe.

Socket files: These are files that provide a means of inter-process communication, but they can transfer data and information between processes running on different environments.

This means that sockets provide data and information transfer between processes running on different machines on a network.

Directories

These are special files that store both ordinary and other special files and they are organized on the Linux file system in a hierarchy starting from the root (/) directory.In Linux (and all UNIX-like operating systems) it is often said “Everything is a file”, or at least it is treated as such. This means whether you are dealing with normal data files and documents, or with devices such as sound cards and printers, you interact with them through the same kind of Input/output (I/O) operations. This simplifies things: you open a “file” and perform normal operations like reading the file and writing on it.



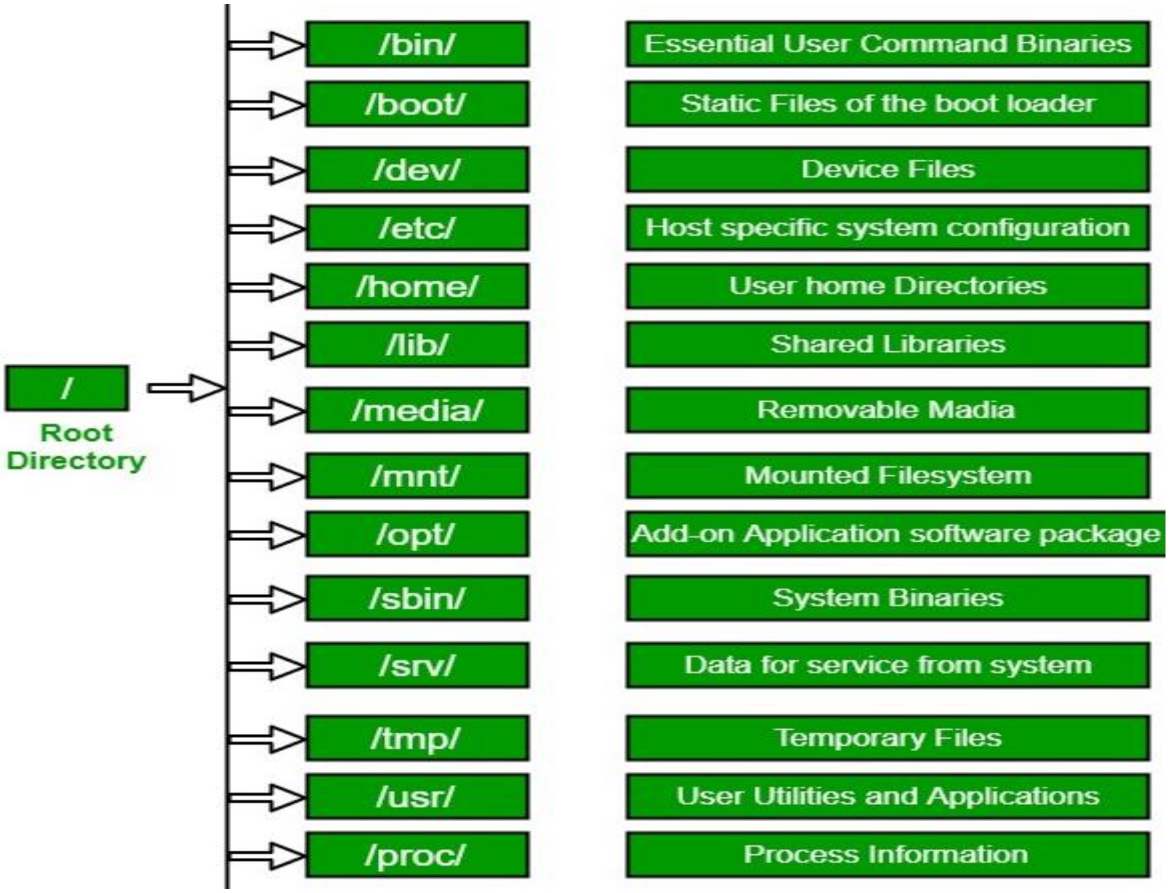
On many systems (including Linux), the **filesystem** is structured like a tree. The tree is usually portrayed as inverted, and starts at what is most often called the **root directory,** which marks the beginning of the hierarchical filesystem and is also some times referred to as the **trunk,** or simply denoted by **/**. The root directory is **not** the same as the root user. The hierarchical filesystem also contains other elements in the path (directory names) which are separated by forward slashes (/) as in /usr/bin/awk, where the last element is the actual file name.

File system architecture

Linux File Hierarchy Structure

The Linux File Hierarchy Structure or the Filesystem Hierarchy Standard (FHS) defines the directory structure and directory contents in Unix-like operating systems.It is maintained by the Linux Foundation.

- In the FHS, all files and directories appear under the root directory /, even if they are stored on different physical or virtual devices.
- Some of these directories only exist on a particular system if certain subsystems, such as the X Window System, are installed.
- Most of these directories exist in all UNIX operating systems and are generally used in much the same way; however, the descriptions here are those used specifically for the FHS, and are not considered authoritative for platforms other than Linux.



Overview of Home Directories

Now that you know about the basics of filesystems, let's learn about the filesystem architecture and directory structure in Linux.

Each user has a **home directory**, usually placed under /home. The/root (slash-root) directory on modern Linux systems is no more than the root user's home directory.

The /home directory is often mounted as a separate filesystem on its own partition, or even exported (shared) remotely on a network through NFS.

Sometimes you may group users based on their department or function. You can then create subdirectories under the /home directory for each of these groups. For example, a school may organize /home with something like the following:

/home/faculty/

/home/staff/

/home/students/

In this section, you will learn to identify and differentiate between the different directories available in Linux.

/ (Root): Primary hierarchy root and root directory of the entire file system hierarchy.

- Every single file and directory starts from the root directory
- Only root user has the right to write under this directory
- /root is root user’s home directory, which is not same as /

The /bin and /sbin Directories

The /bin directory contains executable binaries, essential commands used in single-user mode, and essential commands required by all system users, such as:

Command	**Usage**
ps	Produces a list of processes along with status information for the system.
ls	Produces a listing of the contents of a directory.
cp	Used to copy files.

To view a list of programs in the /bin directory, type: ls /bin

Commands that are not essential for the system in single-user mode are placed in the /usr/bindirectory, while the /sbin directory is used for essential binaries related to system administration, such as **ifconfig** and **shutdown.** There is also a /usr/sbin directory for less essential system administration programs.

Sometimes /usr is a separate filesystem that may not be available/mounted in single-user mode. This was why essential commands were separated from non-essential commands. However, in some of the most modern Linux systems this distinction is considered obsolete, and /usr/binand /bin are actually just linked together as are /usr/sbin and /sbin.

The /dev Directory

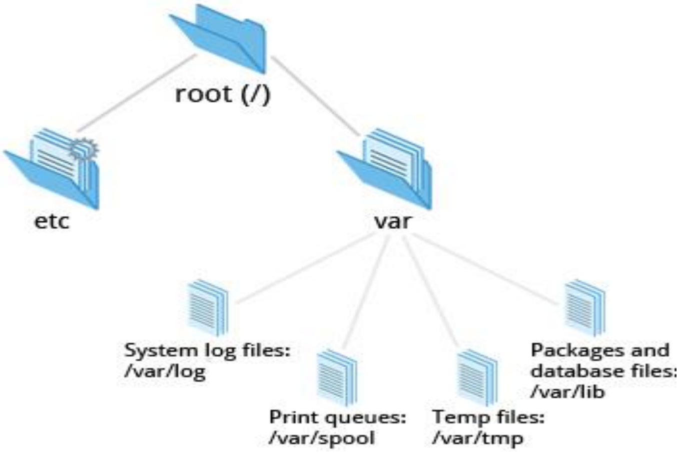
The /dev directory contains device nodes, a type of pseudo-file used by most hardware and software devices, except for network devices. This directory is:

- Empty on the disk partition when it is not mounted
- Contains entries which are created by the udev system, which creates and manages device nodes on Linux, creating them dynamically when devices are found. The /dev directory contains items such as:
- /dev/sda1 (first partition on the first hard disk)
- /dev/lp1 (second printer)
- /dev/dvd1 (first DVD drive)

The /var and /etc Directories

The /var directory contains files that are expected to change in size and content as the system is running (varstands for variable) such as the entries in the following directories:

- System log files: /var/log
- Packages and database files: /var/lib
- Print queues: /var/spool
- Temp files: /var/tmp



The /var directory may be put in its own filesystem so that growth of the files can be accommodated and the file sizes do not fatally affect the system. Network services directories such as /var/ftp (the FTP service) and /var/www (the HTTP web service) are also found under /var.

The /etc directory is the home for system configuration files. It contains no binary programs, although there are some executable scripts. For example, the file resolv.conf tells the system where to go on the network to obtain host name to IP address mappings (DNS). Files likepasswd,shadow and group for managing user accounts are found in the /etc directory. System run level scripts are found in subdirectories of /etc. For example, /etc/rc2.d contains links to scripts for entering and leaving run level 2. The rc directory historically stood for *Run Commands*. Some distros extend the contents of /etc. For example, Red Hat adds thesysconfig subdirectory that contains more configuration files.

The /boot Directory

The /boot directory contains the few essential files needed to boot the system. For every alternative kernel installed on the system there are four files:

1. vmlinuz: the compressed Linux kernel, required for booting
2. initramfs: the initial ram filesystem, required for booting, sometimes called initrd, not initramfs
3. config: the kernel configuration file, only used for debugging and bookkeeping
4. System.map: kernel symbol table, only used for debugging

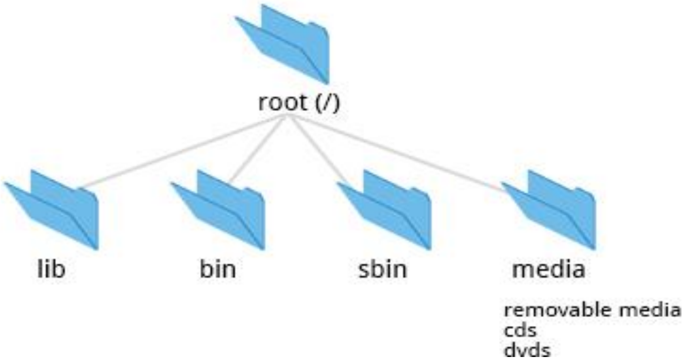
Each of these files has a kernel version appended to its name. The **Grand Unified Bootloader** (**GRUB**) files are also found under the /boot directory.

The /lib and /media Directories

/lib contains libraries (common code shared by applications and needed for them to run) for the essential programs in /bin and /sbin. These library filenames either start with ld or lib, for example, /lib/libncurses.so.5.7. Most of these are what are known as **dynamically loaded libraries** (also known as **shared libraries** or **Shared Objects** (**SO**)). On some Linux distributions there exists a /lib64 directory containing 64-bit libraries, while /lib contains 32-bit versions.

Kernel **modules** (kernel code, often device drivers, that can be loaded and unloaded without re-starting the system) are located in /lib/modules/<kernel-version-number>.

The /media directory is typically located where removable media, such as CDs, DVDs and USB drives are mounted. Unless configuration prohibits it, Linux automatically mounts the removable media in the /media directory when they are detected.



/srv – Service Data

- srv stands for service.
- Contains server specific services related data.
- For example, /srv/cvs contains CVS related data.

/media – Removable Media Devices

- Temporary mount directory for removable devices.
- For examples, /media/cdrom for CD-ROM; /media/floppy for floppy drives; /media/cdrecorder for CD writer

/mnt – Mount Directory

- Temporary mount directory where sysadmins can mount filesystems.

/opt – Optional add-on Applications

- opt stands for optional.
- Contains add-on applications from individual vendors.
- add-on applications should be installed under either /opt/ or /opt/ sub-directory.

/proc – Process Information

- Contains information about system process.
- This is a pseudo filesystem contains information about running process. For example: /proc/{pid} directory contains information about the process with that particular pid.
- This is a virtual filesystem with text information about system resources. For example: /proc/uptime

Using the 'file' utility

In Linux, a file's extension often does not categorize it the way it might in other operating systems. One cannot assume that a file named file.txt is a text file and not an executable program. In Linux a file name is generally more meaningful to the user of the system than the system itself; in fact most applications directly examine a file's contents to see what kind of object it is rather than relying on an extension. This is very different from the way **Windows** handles filenames, where a filename ending with .exe, for example, represents an executable binary file.

The real nature of a file can be ascertained by using the **file** utility. For the file names given as arguments, it examines the contents and certain characteristics to determine whether the files are plain text, shared libraries, executable programs, scripts, or something else.

Assignment:

1. Create a file by your section name having name of all the students of your section, create another file by your subsection name having name of 1-1 the students in your subsection. Compare the two files using all the comparison commands.

2. In Linux everything is considered as file. Explain?