

User Interfaces

User interface means by which the user and a computer system interact. There are two different ways to work with the Linux operating system:

- Graphical user interface (GUI),
 - Famous two types are:
 - gnome → ex: ubuntu
 - Kool Desktop Environment (KDE) → ex: kubuntu
- Command line interface (CLI),

Graphical User Interface (GUI):

- It is a user interface, in which the user uses a mouse pointer to manipulate application windows.

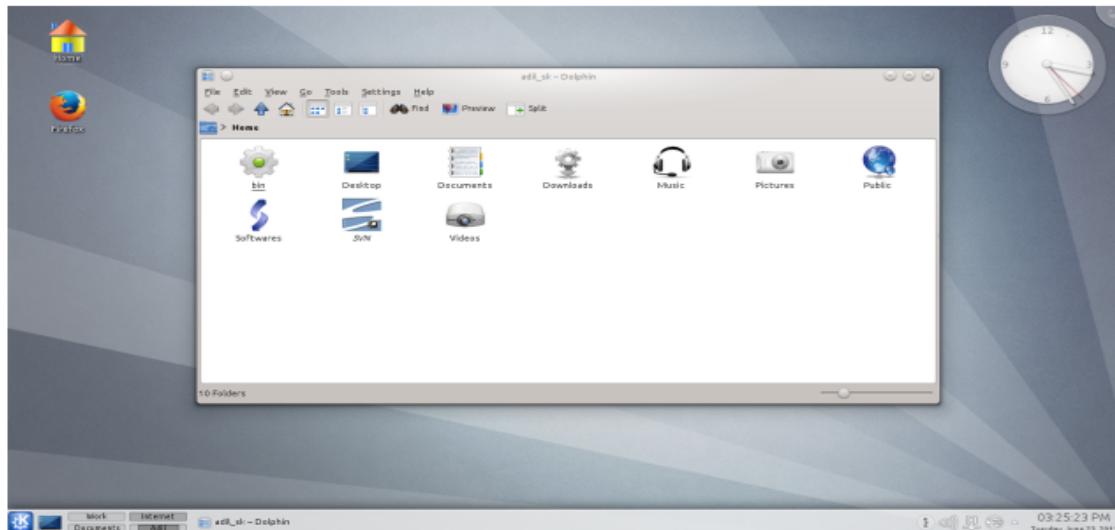


Figure 1 : GUI

Command Line Interface (CLI)

- Commands are instructions given to the system. CLI is a user interface, in which the user interacts with the system using commands at a prompt.
- Textual mode is used to execute the commands by invoking the shells.
- With a CLI, users have all the control over the file system and operating system, and the tasks become simple.

```
emertxe@ubuntu:~$ ls
22002  Dir1      Downloads  file.txt      Music      Public      TEST
Desktop  Documents  ECEP      MPLABXProjects  Pictures  Templates  Videos
emertxe@ubuntu:~$ pwd
/home/emertxe
emertxe@ubuntu:~$
```

Figure 2 : CLI

The Shell

- A shell is an application, works as a command interpreter that allows a user to interact with operating system services.
- Shell takes human-readable commands from the user and translates them into kernel-compatible commands.

- It's a command language interpreter that can read commands from keyboards or files and execute them. When a user logs in or launches a terminal, the shell is launched.
- It has been inherited from the UNIX operating system, which was the predecessor to Linux.
- A command-line interface can be used to access Shell. A specific tool called Terminal in Linux/macOS or Command Prompt in Windows OS is used to type in human-readable commands like "cat," "ls," and so on, and then the commands are executed. The result will be then displayed on the terminal.

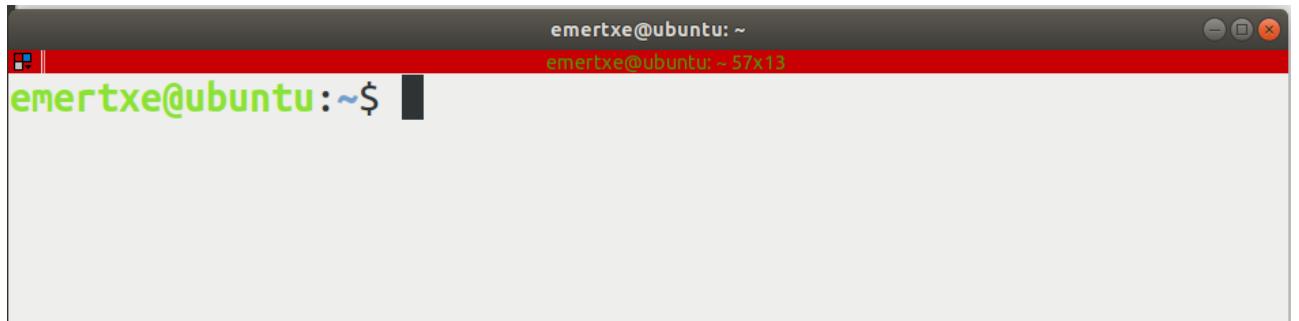


Figure 3 : The Shell

Types of Shell:

- Login shell
- Non - Login shell

Login Shell :

- This Shell can be accessed after a successful login
- A login shell is the first process that executes under your user ID when you log in for an interactive session.

Non - Login shell:

- A Non login shell is started by a program without a login
- When a shell runs a script or a command passed on its command line, it's a non-login shell. Such shells run all the time, it's very common that when a program calls another program, it really runs a tiny script in a shell to invoke that other program.

If you open a shell or terminal, and it asks you to log in (with username and password) before it gives you a prompt, it's a login shell.

If it doesn't ask you to log in, and lets you use it straight away, it's a non-login shell.

Examples for Shells:

- sh (Bourne shell) - It is the first UNIX shell. It is faster and more preferred. It lacks features for interactive use like the ability to recall previous commands.
- bash (GNU Bourne - Again Shell) - This shell was designed to be compatible with the Bourne shell. It incorporates useful features from different types of shells in Linux such as Korn shell and C shell. It allows us to automatically recall previously used commands and edit them with the help of arrow keys, unlike the Bourne shell.
- csh (C shell) - It incorporated features such as aliases and command history. It includes helpful programming features like built-in arithmetic and C-like expression syntax.
- ksh (Korn Shell) - It is a superset of the Bourne shell. So it supports everything in the Bourne shell. It has interactive features. It includes

features like built-in arithmetic and C-like arrays, functions, and string-manipulation facilities. It is faster than C shell.

Shell Invocation

- The main task of a shell is providing a user environment.

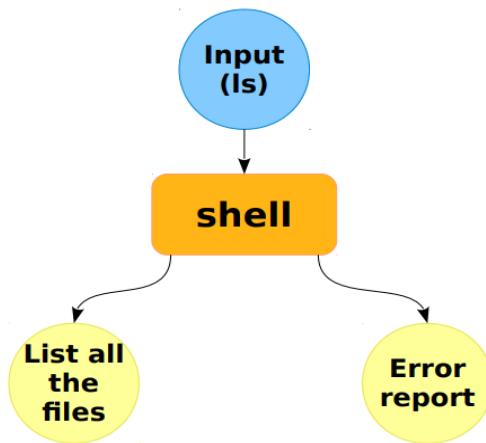


Figure 4 : Shell Invocation

When we invoke the shell, for example giving ls command as an input to the shell, if it is a command shell displays corresponding output, if not, it will throw an error.

- ls is a command used to list the contents of a directory.

The Bash shell

- Bash is the GNU Project's shell—the Bourne Again Shell. This is an sh-compatible shell that incorporates useful features from the Korn shell (ksh) and the C shell (csh).
- It has more features than sh in terms of programming and interactive use. Furthermore, most sh programmes can be run without modification by Bash.

Bash provides the following enhancements:

- Command line editing.
- Unlimited size command history.
- Job control
- Shell Functions and aliases
- Indexed arrays of unlimited size.
- Integer arithmetic in any base from two to sixty-four.

When you start a terminal running the Bash shell, you're greeted with a prompt. A prompt is a symbol, usually a dollar sign (\$), indicating that the shell is waiting for your input.

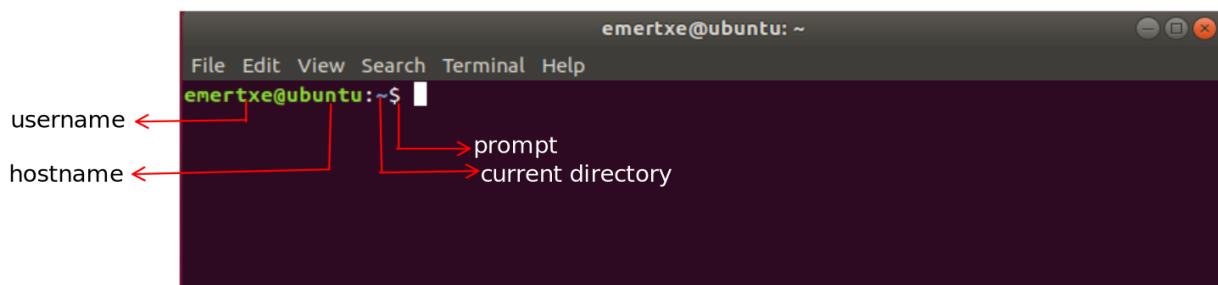


Figure 5 : The Shell

Shell Usage and Basic Commands:

In Linux CLI (Command Line Interface) , commands are the way in which a user interacts with the operating system. In simple words, a command is an instruction given by the user to do specific tasks on the system. So to do any basic or advanced tasks commands can be executed on the shell.

To execute a command on the system, start a terminal, you will get a command prompt, type the command relevant to the task which you want to perform and press the ENTER key. Pressing ENTER key executes the command you entered.

Anatomy of a command

A command may have multiple arguments. Arguments are the inputs to the command which we give along with the command in the command line. Arguments can be options, file path or the arguments itself.

Command_name [options] [arguments]

Options always start with - (hyphen) either single hyphen (-) or double hyphen (--). Single hyphen denotes short option which has single letter and Double hyphen denotes long option which has a word. Arguments are not always mandatory to the command . optional arguments are mentioned with [].There are some commands which do not take any arguments.
Example -pwd,clear

Types of commands

1.Shell-built in Commands-command binaries available in shell itself

Bash provides a number of commands internally called shell builtins. Those command binary files will be available in shell itself

2.Non-shell built-in commands -command binaries available in external location

Commands whose binary files available in external memory location

3.Aliased commands - User defined commands

Commands that you can define yourselves are aliased commands, built from other commands.

pwd - prints current working directory

As soon as we open a terminal, we are taken to the user home directory, which can be known with the command pwd .**pwd** command prints the name of the current/working directory. **pwd** does not take any options or arguments.



```
emertxe@ubuntu:~$ emertxe@ubuntu:~$ pwd /home/emertxe emertxe@ubuntu:~$
```

A screenshot of a terminal window. The title bar says "emertxe@ubuntu: ~ 57x13". The terminal shows a single line of text: "emertxe@ubuntu:~\$ emertxe@ubuntu:~\$ pwd /home/emertxe emertxe@ubuntu:~\$". The text is in black on a light gray background, with the command and its output clearly visible.

Figure 6: output of pwd command

ls -list

pwd command tells which directory you are into. To list the contents of the directory **ls** command is used. **ls** denotes list directory contents. **ls** command can be executed with and without any argument , Without any arguments **ls** command list the contents of the current working directory. **ls** command with options gives more desired output.

```
emertxe@ubuntu:~$ ls  
22002  Dir1  Documents  ECEP      MPLABXProjects  New_Folder  Public    Test     TEST2  Videos  
Desktop  DIR2  Downloads  file.txt  Music       Pictures    Templates  TEST1  TEST3  
emertxe@ubuntu:~$
```

Figure 7: Output of ls command

1.long listing of directory contents

When ls command is used without any arguments it displays the names of files in the current directory. To get detailed information about the files **-l long listing** option is used.

```
emertxe@ubuntu:~$ ls -l  
total 72  
drwxr-xr-x  3 emertxe emertxe 4096 Feb 25 15:36 22002  
drwxr-xr-x  2 emertxe emertxe 4096 May 17 2020 Desktop  
drwxr-xr-x 11 emertxe emertxe 4096 Feb  8 08:46 Dir1  
drwxrwxr-x  3 emertxe emertxe 4096 Mar  1 11:24 DIR2  
drwxr-xr-x  4 emertxe emertxe 4096 Oct 29 15:54 Documents  
drwxr-xr-x  5 emertxe emertxe 4096 Feb  8 16:35 Downloads  
drwxr-xr-x  5 emertxe emertxe 4096 Dec 28 17:54 ECEP  
-rw-rw-r--  1 emertxe emertxe   0 Mar  1 17:31 file.txt  
drwxr-xr-x  2 emertxe emertxe 4096 May 17 2020 MPLABXProjects  
drwxr-xr-x  2 emertxe emertxe 4096 May 17 2020 Music  
drwxrwxr-x  2 emertxe emertxe 4096 Mar  1 10:11 New_Folder  
drwxr-xr-x  2 emertxe emertxe 4096 Feb  8 14:46 Pictures  
drwxr-xr-x  2 emertxe emertxe 4096 May 17 2020 Public  
drwxr-xr-x  4 emertxe emertxe 4096 Oct 28 15:15 Templates  
drwxrwxr-x  6 emertxe emertxe 4096 Feb  4 18:41 Test  
drwxrwxr-x  2 emertxe emertxe 4096 Mar  1 10:12 TEST1  
drwxrwxr-x  2 emertxe emertxe 4096 Mar  1 10:12 TEST2  
drwxrwxr-x  2 emertxe emertxe 4096 Mar  1 10:12 TEST3  
drwxr-xr-x  2 emertxe emertxe 4096 May 17 2020 Videos  
emertxe@ubuntu:~$
```

Figure 8 . Output of ls -l command

Output description of the ls -l command:

Let's split the output into fields for better understanding.

drwxr-xr-x 2 emertxe emertxe 4096 May 17 2020 Desktop

↓↓ ↓↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓
1 2 3 4 5 6 7 8 9 10

- **Field 1 -type of file**

- for File, d for Directory, l for Link and so on(There are 7 types of file in Linux)

- **Field 2 ,3,4**

Those are permissions that means read, write and execute, and comes in three different fields that belongs to the permission the:

1. second: user permission
2. third: group permission
3. fourth: other users permission

- **Field 5:**

This field specifies the number of links or directories inside this directory.

- **Field 6:**

The user that owns the file, or directory

- **Field 7:**

The group that file belongs to, and any user in that group will have the permissions given in the third field over that file.

- **Field 8:**

The size in bytes

- **Field 9**

The date of last modification

- **Field 10**

The name of the file

2. View hidden files in Linux

To list all files including hidden files starting with . (dot).

```
emertxe@ubuntu:~$ ls -a
.
..          .dbus      .gnupg      MPLABXProjects  .ssh           .vboxclient-display.pid
22002       Desktop   .ICEauthority  Music        .sudo_as_admin_successful .vboxclient-draganddrop.pid
.bash_history  Dir1     .java        New_Folder   Templates      .vboxclient-seamless.pid
.bash_logout   Documents .local       .new.txt.swp  Test          Videos
.bashrc        Downloads .mchp_packs  Pictures     TEST1         .vim
.cache         ECEP      .mozilla    .pki          TEST2         .viminfo
.code.c.swp    file.txt  .mplabcomm .profile     TEST3         .vimrc
.config        .gnome   .mplab_ide  Public      .thunderbird .vboxclient-clipboard.pid
emertxe@ubuntu:~$
```

Figure 9 output of ls -a

3.List files with human readable format

To list the files with human readable format i.e size of each file with human understandable format -h option is used along with ls -l

```

emertxe@ubuntu:~$ ls -lh
total 72K
drwxr-xr-x 3 emertxe emertxe 4.0K Feb 25 15:36 22002
drwxr-xr-x 2 emertxe emertxe 4.0K May 17 2020 Desktop
drwxr-xr-x 11 emertxe emertxe 4.0K Feb 8 08:46 Dir1
drwxrwxr-x 3 emertxe emertxe 4.0K Mar 1 11:24 DIR2
drwxr-xr-x 4 emertxe emertxe 4.0K Oct 29 15:54 Documents
drwxr-xr-x 5 emertxe emertxe 4.0K Feb 8 16:35 Downloads
drwxr-xr-x 5 emertxe emertxe 4.0K Dec 28 17:54 ECEP
-rw-rw-r-- 1 emertxe emertxe 0 Mar 1 17:31 file.txt
drwxr-xr-x 2 emertxe emertxe 4.0K May 17 2020 MPLABXProjects
drwxr-xr-x 2 emertxe emertxe 4.0K May 17 2020 Music
drwxrwxr-x 2 emertxe emertxe 4.0K Mar 1 10:11 New_Folder
drwxr-xr-x 2 emertxe emertxe 4.0K Feb 8 14:46 Pictures
drwxr-xr-x 2 emertxe emertxe 4.0K May 17 2020 Public
drwxr-xr-x 4 emertxe emertxe 4.0K Oct 28 15:15 Templates
drwxrwxr-x 6 emertxe emertxe 4.0K Feb 4 18:41 Test
drwxrwxr-x 2 emertxe emertxe 4.0K Mar 1 10:12 TEST1
drwxrwxr-x 2 emertxe emertxe 4.0K Mar 1 10:12 TEST2
drwxrwxr-x 2 emertxe emertxe 4.0K Mar 1 10:12 TEST3
drwxr-xr-x 2 emertxe emertxe 4.0K May 17 2020 Videos
emertxe@ubuntu:~$
```

Figure 10.output of ls -l command

4.List files with classifying its type

Using -F option along with ls option classifies the file with adding character at the end of the file name

```

emertxe@ubuntu:~$ ls -F
22002/ Dir1/ Documents/ ECEP/ MPLABXProjects/ New_Folder/ Public/ Test/ TEST2/ Videos/
Desktop/ DIR2/ Downloads/ file.txt Music/ Pictures/ Templates/ TEST1/ TEST3/
emertxe@ubuntu:~$
```

Figure 11. Output of ls -F command

Where,

- / - Directory,
- @ - symbolic link,
- * - Executable program

| -pipe
and so on.

5.List contents in reverse order

ls -l displays the contents in dictionary order, using -r along with ls -l will display the contents in reverse order.

```
emertxe@ubuntu:~$ ls -lr
total 72
drwxr-xr-x  2 emertxe emertxe 4096 May 17 2020 Videos
drwxrwxr-x  2 emertxe emertxe 4096 Mar  1 10:12 TEST3
drwxrwxr-x  2 emertxe emertxe 4096 Mar  1 10:12 TEST2
drwxrwxr-x  2 emertxe emertxe 4096 Mar  1 10:12 TEST1
drwxrwxr-x  6 emertxe emertxe 4096 Feb  4 18:41 Test
drwxr-xr-x  4 emertxe emertxe 4096 Oct 28 15:15 Templates
drwxr-xr-x  2 emertxe emertxe 4096 May 17 2020 Public
drwxr-xr-x  2 emertxe emertxe 4096 Feb  8 14:46 Pictures
drwxrwxr-x  2 emertxe emertxe 4096 Mar  1 10:11 New_Folder
drwxr-xr-x  2 emertxe emertxe 4096 May 17 2020 Music
drwxr-xr-x  2 emertxe emertxe 4096 May 17 2020 MPLABXProjects
-rw-rw-r--  1 emertxe emertxe    0 Mar  1 17:31 file.txt
drwxr-xr-x  5 emertxe emertxe 4096 Dec 28 17:54 ECEP
drwxr-xr-x  5 emertxe emertxe 4096 Feb  8 16:35 Downloads
drwxr-xr-x  4 emertxe emertxe 4096 Oct 29 15:54 Documents
drwxrwxr-x  3 emertxe emertxe 4096 Mar  1 11:24 DIR2
drwxr-xr-x 11 emertxe emertxe 4096 Feb  8 08:46 Dir1
drwxr-xr-x  2 emertxe emertxe 4096 May 17 2020 Desktop
drwxr-xr-x  3 emertxe emertxe 4096 Feb 25 15:36 22002
emertxe@ubuntu:~$
```

Figure 12 Output of ls -lr command

6.Recursively List subdirectories in linux.

To recursively list the content of a sub directory in the current working directory, ls -R is used.(R denotes recursive)

```
emertxe@ubuntu:~$ cd Test/
emertxe@ubuntu:~/Test$ ls
Dir1 Dir2 Dir4 Dir5 file1 file2 file3 file4
emertxe@ubuntu:~/Test$ ls -R
.:
Dir1 Dir2 Dir4 Dir5 file1 file2 file3 file4

./Dir1:
file1 file2 file3 file4

./Dir2:
new1 new2 new3 new4

./Dir4:

./Dir5:
emertxe@ubuntu:~/Test$
```

Figure 13 Output of ls -R command

7.List directory information with ls command.

We can pass directory name along with ls command to list the content of a particular directory.Example **ls <dir_name>**

```
emertxe@ubuntu:~$ ls Test/
Dir1 Dir2 Dir4 Dir5 file1 file2 file3 file4
emertxe@ubuntu:~$ 
emertxe@ubuntu:~$ ls Dir12
ls: cannot access 'Dir12': No such file or directory
emertxe@ubuntu:~$
```

Figure 14 Output of ls <dir> command

In the above figure directory name is passed as an argument to ls command.

Note: The argument directory name should be existing. If not error “No such file or directory” message will be displayed on screen as shown in above figure.

man - manual page

To view the available options and arguments types of command manual page of the command can be referred. To get the manual page of a command , a man command is used.

```
man <command_name>
```

Example: man ls will show the manual page of ls command

type - prints type of command

Type command is used to know the type of the command whether it is shell built-in, aliased or non-shell built-in(hashed) command.

```
emertxe@ubuntu:~$ type ls
ls is aliased to `ls --color=auto'
emertxe@ubuntu:~$ type pwd
pwd is a shell builtin
emertxe@ubuntu:~$ type clear
clear is hashed (/usr/bin/clear)
emertxe@ubuntu:~$ █
```

Figure 15 . Output of type command

cd- change directory

To change the current working directory cd command is used. From the below example we change the directory to Documents folder.

```
emertxe@ubuntu:~$ ls  
22002 Dir1 Documents ECEP MPLABXProjects New_Folder Public Test TEST2 Videos  
Desktop DIR2 Downloads file.txt Music Pictures Templates TEST1 TEST3  
emertxe@ubuntu:~$ cd Documents/  
emertxe@ubuntu:~/Documents$ pwd  
/home/emertxe/Documents  
emertxe@ubuntu:~/Documents$ █
```

Figure 16 Usage of cd command

- cd .. - To move the previous working directory
- cd - To move to user's home directory
- cd - To move to previous working directory
- cd / To move to root directory

```
emertxe@ubuntu:~/Documents$ pwd  
/home/emertxe/Documents  
emertxe@ubuntu:~/Documents$ cd ..  
emertxe@ubuntu:~$ pwd  
/home/emertxe  
emertxe@ubuntu:~$ cd ../../..  
emertxe@ubuntu:/$ pwd  
/  
emertxe@ubuntu:/$
```

Figure 17 Illustration of cd command

```
emertxe@ubuntu:~/ECEP$ pwd  
/home/emertxe/ECEP  
emertxe@ubuntu:~/ECEP$ cd ~  
emertxe@ubuntu:~$  
emertxe@ubuntu:~$ pwd  
/home/emertxe  
emertxe@ubuntu:~$ cd -  
/home/emertxe/ECEP  
emertxe@ubuntu:~/ECEP$ █
```

Figure 18 Illustration of cd command

Directory Structure

In Linux Systems, all the files are well organized .All those files are categorized and arranged under top level directories. The top level directories are placed under one topmost directory i.e root (/) directory.

```
emertxe@ubuntu:~$ cd /
emertxe@ubuntu:/$ pwd
/
emertxe@ubuntu:/$ ls
bin  dev  home  initrd.img.old  lib64  media  opt  root  sbin  srv  sys  usr  VBox.log  vmlinuz.old
boot etc  initrd.img  lib  lost+found  mnt  proc  run  snap  swapfile  tmp  var  vmlinuz
emertxe@ubuntu:/$
```

Figure 19. Directory structure

bin - User command binary files

Executable command binary files that can be executed by any user in the system.Binary files are executable files which are in machine readable format.

```
emertxe@ubuntu:~$ ls bin/
bash  cpio  gunzip  mkdir  ping6  su  uncompress
bunzip2  dash  gzip  mknod  Plymouth  sync  unicode_start
busybox  date  hostname  more  ps  systemctl
bzcat  dd  ip  mount  rbash  systemd-ask-password
bzcmp  df  journalctl  mountpoint  readlink  systemd-escape
bzdiff  dir  kbd_mode  nt  red  systemd-hwdb
bzegrep  dmesg  kill  mt-gnu  rm  systemd-inhibit
bzexe  dnsdomainname  kmod  mv  rmdir  systemd-machine-id-setup
bzfgrep  domainname  less  nano  rnano  systemd-notify
bzgrep  dumpkeys  lessecho  nc  run-parts  systemd-sysusers
bzip2  echo  lessfile  nc.openbsd  sed  systemd-tmpfiles
bzip2recover  ed  lesskey  netcat  setfacl  systemd-tty-ask-password-agent
bzless  egrep  lesspipe  netstat  setfont  tar
bzmore  false  ln  networkctl  setupcon  tempfile
cat  fgconsole  loadkeys  nisdomainname  sh  touch
chacl  fgrep  login  open  sh.distrib  true
chgrp  findmnt  logind  openvt  sleep  udevadm
chmod  fuser  ls  pidof  ss  unlockmgr_server
chown  fusermount  lsblk  ping  static-sh  umount
chvt  getfacl  lsmod  ping4  stty  uname
cp  grep
emertxe@ubuntu:/$
```

Figure 20 contents of /bin

sbin - superuser command binary files

Executable super user command binary files that can be executed only by superuser. These command binaries are binary files of important commands that are related to the system and security. If a normal user wants to execute these commands ,the user should have superuser permission.

emertxe@ubuntu:~\$ ls /sbin	acpi_available	dhclient-script	fsck.msdos	ip6tables-restore	lsmod	nameif	route	tipc
	agetty	dmsetup	fsck.vfat	ip6tables-save	lspcmcia	on_ac_power	rtacct	tune2fs
	alsa	dmstats	fsfreeze	ipmaddr	mi-tool	pam_extrousers_chkpwd	rtmon	u-d-c-print-p
	ci-ids							
	apm_available	dofsck	fstab-decode	iptables	mkdosfs	pam_extrousers_update	runlevel	udevadm
	apparmor_parser	dosfslabel	fstrim	iptables-restore	mke2fs	pam_tally	runuser	umount.udisks
2								
	badblocks	dumpe2fs	gdisk	iptables-save	mkfs	pam_tally2	setcap	unix_chkpwd
	blkdeactivate	e2fsck	getcap	iptunnel	mkfs.bfs	parted	setvtrgb	unix_update
	blkdiscard	e2image	getpcaps	isosize	mkfs.cramfs	partprobe	sfdisk	ureadahead
	blkid	e2label	getty	iw	mkfs.ext2	pccardctl	sgdisk	wipefs
	blockdev	e2undo	halt	iwconfig	mkfs.ext3	pivot_root	shadowconfig	wpa_action
	bridge	fatlabel	hdparm	iwevent	mkfs.ext4	plipconfig	shutdown	wpa_cli
	capsh	fdisk	hwclock	iwgetid	mkfs.fat	plymouthd	slattach	wpa_supplicant
t								
	cfdisk	findfs	ifconfig	iwlist	mkfs.minix	poweroff	start-stop-daemon	xtables-multi
	cgdisk	fixparts	ifdown	ippriv	mkfs.msdos	rarp	sudo	zramctl
	chcpu	fsck	ifquery	iwspy	mkfs.vfat	raw		
	crda	fsck.cramfs	ifup	kbdrate	mkhomedir_helper	rcvboxadd	swlogin	
	ctrlaltdel	fsck.ext2	init	killall5	mkswap	rcvboxadd-service	swapslabel	
	debugfs	fsck.ext3	insmod	ldconfig	modinfo	reboot	swapoff	
	depmod	fsck.ext4	installkernel	ldconfig.real	modprobe	regdump	swapon	
	devlink	fsck.fat	ip	logsave	mount.fuse	resize2fs	switch_root	
	dhclient	fsck.minix	ip6tables	losetup	mount.vboxsf	rmmount	sysctl	
							tc	
							telinit	
emertxe@ubuntu:~\$								

Figure 21 . contents of /sbin

For Example:

Commands like reboot,poweroff,shutdown affects working of the system.

boot - bootable files

It contains all the boot-related information files and folders such as conf, grub and bootable images etc.

```
emertxe@ubuntu:~$ ls /boot
config-4.15.0-99-generic           memtest86+.elf
grub                                memtest86+_multiboot.bin
initrd.img-4.15.0-99-generic        System.map-4.15.0-99-generic
initrd.img-4.15.0-99-generic.old-dkms vmlinuz-4.15.0-99-generic
memtest86+.bin
emertxe@ubuntu:~$
```

Figure 22 . Contents of /boot

dev- device files

Each device is a file in linux. /dev directory has all files required for device communication.

Below are the device files present in /dev directory .stdout is responsible for writing output on standard output device i.e screen.stdin is responsible for reading input from the standard input stream i.e keyboard,stderr is responsible for printing error on standard error stream.

```
emertxe@ubuntu:~$ ls /dev
autofs          input          ptmx         tty      tty30    tty53    ttyS17  urandom
block           kmsg          pts          tty0    tty31    tty54    ttyS18  userio
bsg             lightnvm     random       tty1    tty32    tty55    ttyS19  vboxguest
btrfs-control   log          rfkill      tty10   tty33    tty56    ttyS20  vboxuser
bus              loop0        rtc          tty11   tty34    tty57    ttyS21  vcs
cdrom           loop1        rtc0         tty12   tty35    tty58    ttyS22  vcs1
char             loop2        sda          tty13   tty36    tty59    ttyS23  vcs2
console          loop3        sda1         tty14   tty37    tty6     ttyS24  vcs3
core             loop4        sg0          tty15   tty38    tty60    ttyS25  vcs4
cpu_dma_latency  loop5        sg1          tty16   tty39    tty61    ttyS26  vcs5
cuse             loop6        shm          tty17   tty40    tty62    ttyS27  vcs6
disk             loop7        snapshot    tty18   tty41    tty63    ttyS28  vcsa
dri              loop-control  snd          tty19   tty42    tty7     ttyS29  vcsa1
dvd               mapper      sr0          tty2    tty43    tty8     ttyS30  vcsa2
ecryptfs         mcelog      stderr       tty20   tty44    tty9     ttyS31  vcsa3
fb0              mem         stdn         tty21   tty45    tty10    ttyS32  vcsa4
fd               memory_bandwidth  stdout      tty22   tty46    tty11    ttyS33  vcsa5
full             mqueue      stderr       tty23   tty47    tty12    ttyS34  vcsa6
fuse             net          stdin        tty24   tty48    tty13    ttyS35  vfio
hidraw0          network_latency  tnt0        tty25   tty49    tty14    ttyS36  vga_arbiter
hpet             network_throughput  tnt1        tty26   tty50    tty15    ttyS37  vhci
hugepages        null         tnt2        tty27   tty51    tty16    ttyS38  vhost-net
hwrng            port         tnt3        tty28   tty52    tty17    ttyS39  vhost-vsock
i2c-0            ppp          tnt4        tty29   tty53    tty18    zero
initctl          osaux       tnt5        tty30   tty54    tty19
                           tnt6        tty31   tty55    tty1a
                           tnt7        tty32   tty56    tty1b
                           tnt8        tty33   tty57    tty1c
                           tnt9        tty34   tty58    tty1d
                           tnta        tty35   tty59    tty1e
                           tntb        tty36   tty60    tty1f
                           tntc        tty37   tty61    tty1g
                           tntd        tty38   tty62    tty1h
                           tnte        tty39   tty63    tty1i
                           tntf        tty40   tty64    tty1j
                           tntg        tty41   tty65    tty1k
                           tnth        tty42   tty66    tty1l
                           tnti        tty43   tty67    tty1m
                           tntj        tty44   tty68    tty1n
                           tntk        tty45   tty69    tty1o
                           tntl        tty46   tty70    tty1p
                           tntm        tty47   tty71    tty1q
                           tntn        tty48   tty72    tty1r
                           tnto        tty49   tty73    tty1s
                           tntp        tty50   tty74    tty1t
                           tntq        tty51   tty75    tty1u
                           tnts        tty52   tty76    tty1v
                           tntr        tty53   tty77    tty1w
                           tntu        tty54   tty78    tty1x
                           tntv        tty55   tty79    tty1y
                           tntw        tty56   tty7a    tty1z
                           tntx        tty57   tty7b    tty1A
                           tnty        tty58   tty7c    tty1B
                           tntz        tty59   tty7d    tty1C
                           tnt1        tty60   tty7e    tty1D
                           tnt2        tty61   tty7f    tty1E
                           tnt3        tty62   tty7g    tty1F
                           tnt4        tty63   tty7h    tty1G
                           tnt5        tty64   tty7i    tty1H
                           tnt6        tty65   tty7j    tty1I
                           tnt7        tty66   tty7k    tty1J
                           tnt8        tty67   tty7l    tty1K
                           tnt9        tty68   tty7m    tty1L
                           tnta        tty69   tty7n    tty1M
                           tntb        tty70   tty7o    tty1N
                           tntc        tty71   tty7p    tty1O
                           tntd        tty72   tty7q    tty1P
                           tnte        tty73   tty7r    tty1Q
                           tntf        tty74   tty7s    tty1R
                           tntg        tty75   tty7t    tty1S
                           tnth        tty76   tty7u    tty1T
                           tnti        tty77   tty7v    tty1U
                           tntj        tty78   tty7w    tty1V
                           tntk        tty79   tty7x    tty1W
                           tntl        tty7a   tty7y    tty1X
                           tntm        tty7b   tty7z    tty1Y
                           tntn        tty7c   tty71   tty1Z
                           tnto        tty7d   tty72   tty1A
                           tntp        tty7e   tty73   tty1B
                           tntq        tty7f   tty74   tty1C
                           tnts        tty75   tty76   tty1D
                           tntr        tty77   tty78   tty1E
                           tntu        tty79   tty79   tty1F
                           tntv        tty7a   tty7b   tty1G
                           tntw        tty7c   tty7d   tty1H
                           tntx        tty7e   tty7f   tty1I
                           tnty        tty7g   tty7h   tty1J
                           tntz        tty7i   tty7j   tty1K
                           tnt1        tty7k   tty7l   tty1L
                           tnt2        tty7m   tty7n   tty1M
                           tnt3        tty7o   tty7p   tty1N
                           tnt4        tty7q   tty7r   tty1O
                           tnt5        tty7s   tty7t   tty1P
                           tnt6        tty7u   tty7v   tty1Q
                           tnt7        tty7w   tty7x   tty1R
                           tnt8        tty7y   tty7z   tty1S
                           tnt9        tty71   tty72   tty1T
                           tnta        tty73   tty74   tty1U
                           tntb        tty75   tty76   tty1V
                           tntc        tty77   tty78   tty1W
                           tntd        tty79   tty79   tty1X
                           tnte        tty7a   tty7b   tty1Y
                           tntf        tty7c   tty7d   tty1Z
                           tntg        tty7e   tty7e   tty1A
                           tnth        tty7f   tty7f   tty1B
                           tnti        tty7g   tty7g   tty1C
                           tntj        tty7h   tty7h   tty1D
                           tntk        tty7i   tty7i   tty1E
                           tntl        tty7j   tty7j   tty1F
                           tntm        tty7k   tty7k   tty1G
                           tntn        tty7l   tty7l   tty1H
                           tnto        tty7m   tty7m   tty1I
                           tntp        tty7n   tty7n   tty1J
                           tntq        tty7o   tty7o   tty1K
                           tnts        tty7p   tty7p   tty1L
                           tntr        tty7q   tty7q   tty1M
                           tntu        tty7r   tty7r   tty1N
                           tntv        tty7s   tty7s   tty1O
                           tntw        tty7t   tty7t   tty1P
                           tntx        tty7u   tty7u   tty1Q
                           tnty        tty7v   tty7v   tty1R
                           tntz        tty7w   tty7w   tty1S
                           tnt1        tty7x   tty7x   tty1T
                           tnt2        tty7y   tty7y   tty1U
                           tnt3        tty7z   tty7z   tty1V
                           tnt4        tty71   tty71   tty1W
                           tnt5        tty72   tty72   tty1X
                           tnt6        tty73   tty73   tty1Y
                           tnt7        tty74   tty74   tty1Z
                           tnt8        tty75   tty75   tty1A
                           tnt9        tty76   tty76   tty1B
                           tnta        tty77   tty77   tty1C
                           tntb        tty78   tty78   tty1D
                           tntc        tty79   tty79   tty1E
                           tntd        tty7a   tty7a   tty1F
                           tnte        tty7b   tty7b   tty1G
                           tntf        tty7c   tty7c   tty1H
                           tntg        tty7d   tty7d   tty1I
                           tnth        tty7e   tty7e   tty1J
                           tnti        tty7f   tty7f   tty1K
                           tntj        tty7g   tty7g   tty1L
                           tntk        tty7h   tty7h   tty1M
                           tntl        tty7i   tty7i   tty1N
                           tntm        tty7j   tty7j   tty1O
                           tntn        tty7k   tty7k   tty1P
                           tnto        tty7l   tty7l   tty1Q
                           tntp        tty7m   tty7m   tty1R
                           tntq        tty7n   tty7n   tty1S
                           tnts        tty7o   tty7o   tty1T
                           tntr        tty7p   tty7p   tty1U
                           tntu        tty7q   tty7q   tty1V
                           tntv        tty7r   tty7r   tty1W
                           tntw        tty7s   tty7s   tty1X
                           tntx        tty7t   tty7t   tty1Y
                           tnty        tty7u   tty7u   tty1Z
                           tntz        tty7v   tty7v   tty1A
                           tnt1        tty7w   tty7w   tty1B
                           tnt2        tty7x   tty7x   tty1C
                           tnt3        tty7y   tty7y   tty1D
                           tnt4        tty7z   tty7z   tty1E
                           tnt5        tty71   tty71   tty1F
                           tnt6        tty72   tty72   tty1G
                           tnt7        tty73   tty73   tty1H
                           tnt8        tty74   tty74   tty1I
                           tnt9        tty75   tty75   tty1J
                           tnta        tty76   tty76   tty1K
                           tntb        tty77   tty77   tty1L
                           tntc        tty78   tty78   tty1M
                           tntd        tty79   tty79   tty1N
                           tnte        tty7a   tty7a   tty1O
                           tntf        tty7b   tty7b   tty1P
                           tntg        tty7c   tty7c   tty1Q
                           tnth        tty7d   tty7d   tty1R
                           tnti        tty7e   tty7e   tty1S
                           tntj        tty7f   tty7f   tty1T
                           tntk        tty7g   tty7g   tty1U
                           tntl        tty7h   tty7h   tty1V
                           tntm        tty7i   tty7i   tty1W
                           tntn        tty7j   tty7j   tty1X
                           tnto        tty7k   tty7k   tty1Y
                           tntp        tty7l   tty7l   tty1Z
                           tntq        tty7m   tty7m   tty1A
                           tnts        tty7n   tty7n   tty1B
                           tntr        tty7o   tty7o   tty1C
                           tntu        tty7p   tty7p   tty1D
                           tntv        tty7q   tty7q   tty1E
                           tntw        tty7r   tty7r   tty1F
                           tntx        tty7s   tty7s   tty1G
                           tnty        tty7t   tty7t   tty1H
                           tntz        tty7u   tty7u   tty1I
                           tnt1        tty7v   tty7v   tty1J
                           tnt2        tty7w   tty7w   tty1K
                           tnt3        tty7x   tty7x   tty1L
                           tnt4        tty7y   tty7y   tty1M
                           tnt5        tty7z   tty7z   tty1N
                           tnt6        tty71   tty71   tty1O
                           tnt7        tty72   tty72   tty1P
                           tnt8        tty73   tty73   tty1Q
                           tnt9        tty74   tty74   tty1R
                           tnta        tty75   tty75   tty1S
                           tntb        tty76   tty76   tty1T
                           tntc        tty77   tty77   tty1U
                           tntd        tty78   tty78   tty1V
                           tnte        tty79   tty79   tty1W
                           tntf        tty7a   tty7a   tty1X
                           tntg        tty7b   tty7b   tty1Y
                           tnth        tty7c   tty7c   tty1Z
                           tnti        tty7d   tty7d   tty1A
                           tntj        tty7e   tty7e   tty1B
                           tntk        tty7f   tty7f   tty1C
                           tntl        tty7g   tty7g   tty1D
                           tntm        tty7h   tty7h   tty1E
                           tntn        tty7i   tty7i   tty1F
                           tnto        tty7j   tty7j   tty1G
                           tntp        tty7k   tty7k   tty1H
                           tntq        tty7l   tty7l   tty1I
                           tnts        tty7m   tty7m   tty1J
                           tntr        tty7n   tty7n   tty1K
                           tntu        tty7o   tty7o   tty1L
                           tntv        tty7p   tty7p   tty1M
                           tntw        tty7q   tty7q   tty1N
                           tntx        tty7r   tty7r   tty1O
                           tnty        tty7s   tty7s   tty1P
                           tntz        tty7t   tty7t   tty1Q
                           tnt1        tty7u   tty7u   tty1R
                           tnt2        tty7v   tty7v   tty1S
                           tnt3        tty7w   tty7w   tty1T
                           tnt4        tty7x   tty7x   tty1U
                           tnt5        tty7y   tty7y   tty1V
                           tnt6        tty7z   tty7z   tty1W
                           tnt7        tty71   tty71   tty1X
                           tnt8        tty72   tty72   tty1Y
                           tnt9        tty73   tty73   tty1Z
                           tnta        tty74   tty74   tty1A
                           tntb        tty75   tty75   tty1B
                           tntc        tty76   tty76   tty1C
                           tntd        tty77   tty77   tty1D
                           tnte        tty78   tty78   tty1E
                           tntf        tty79   tty79   tty1F
                           tntg        tty7a   tty7a   tty1G
                           tnth        tty7b   tty7b   tty1H
                           tnti        tty7c   tty7c   tty1I
                           tntj        tty7d   tty7d   tty1J
                           tntk        tty7e   tty7e   tty1K
                           tntl        tty7f   tty7f   tty1L
                           tntm        tty7g   tty7g   tty1M
                           tntn        tty7h   tty7h   tty1N
                           tnto        tty7i   tty7i   tty1O
                           tntp        tty7j   tty7j   tty1P
                           tntq        tty7k   tty7k   tty1Q
                           tnts        tty7l   tty7l   tty1R
                           tntr        tty7m   tty7m   tty1S
                           tntu        tty7n   tty7n   tty1T
                           tntv        tty7o   tty7o   tty1U
                           tntw        tty7p   tty7p   tty1V
                           tntx        tty7q   tty7q   tty1W
                           tnty        tty7r   tty7r   tty1X
                           tntz        tty7s   tty7s   tty1Y
                           tnt1        tty7t   tty7t   tty1Z
                           tnt2        tty7u   tty7u   tty1A
                           tnt3        tty7v   tty7v   tty1B
                           tnt4        tty7w   tty7w   tty1C
                           tnt5        tty7x   tty7x   tty1D
                           tnt6        tty7y   tty7y   tty1E
                           tnt7        tty7z   tty7z   tty1F
                           tnt8        tty71   tty71   tty1G
                           tnt9        tty72   tty72   tty1H
                           tnta        tty73   tty73   tty1I
                           tntb        tty74   tty74   tty1J
                           tntc        tty75   tty75   tty1K
                           tntd        tty76   tty76   tty1L
                           tnte        tty77   tty77   tty1M
                           tntf        tty78   tty78   tty1N
                           tntg        tty79   tty79   tty1O
                           tnth        tty7a   tty7a   tty1P
                           tnti        tty7b   tty7b   tty1Q
                           tntj        tty7c   tty7c   tty1R
                           tntk        tty7d   tty7d   tty1S
                           tntl        tty7e   tty7e   tty1T
                           tntm        tty7f   tty7f   tty1U
                           tntn        tty7g   tty7g   tty1V
                           tnto        tty7h   tty7h   tty1W
                           tntp        tty7i   tty7i   tty1X
                           tntq        tty7j   tty7j   tty1Y
                           tnts        tty7k   tty7k   tty1Z
                           tntr        tty7l   tty7l   tty1A
                           tntu        tty7m   tty7m   tty1B
                           tntv        tty7n   tty7n   tty1C
                           tntw        tty7o   tty7o   tty1D
                           tntx        tty7p   tty7p   tty1E
                           tnty        tty7q   tty7q   tty1F
                           tntz        tty7r   tty7r   tty1G
                           tnt1        tty7s   tty7s   tty1H
                           tnt2        tty7t   tty7t   tty1I
                           tnt3        tty7u   tty7u   tty1J
                           tnt4        tty7v   tty7v   tty1K
                           tnt5        tty7w   tty7w   tty1L
                           tnt6        tty7x   tty7x   tty1M
                           tnt7        tty7y   tty7y   tty1N
                           tnt8        tty7z   tty7z   tty1O
                           tnt9        tty71   tty71   tty1P
                           tnta        tty72   tty72   tty1Q
                           tntb        tty73   tty73   tty1R
                           tntc        tty74   tty74   tty1S
                           tntd        tty75   tty75   tty1T
                           tnte        tty76   tty76   tty1U
                           tntf        tty77   tty77   tty1V
                           tntg        tty78   tty78   tty1W
                           tnth        tty79   tty79   tty1X
                           tnti        tty7a   tty7a   tty1Y
                           tntj        tty7b   tty7b   tty1Z
                           tntk        tty7c   tty7c   tty1A
                           tntl        tty7d   tty7d   tty1B
                           tntm        tty7e   tty7e   tty1C
                           tntn        tty7f   tty7f   tty1D
                           tnto        tty7g   tty7g   tty1E
                           tntp        tty7h   tty7h   tty1F
                           tntq        tty7i   tty7i   tty1G
                           tnts        tty7j   tty7j   tty1H
                           tntr        tty7k   tty7k   tty1I
                           tntu        tty7l   tty7l   tty1J
                           tntv        tty7m   tty7m   tty1K
                           tntw        tty7n   tty7n   tty1L
                           tntx        tty7o   tty7o   tty1M
                           tnty        tty7p   tty7p   tty1N
                           tntz        tty7q   tty7q   tty1O
                           tnt1        tty7r   tty7r   tty1P
                           tnt2        tty7s   tty7s   tty1Q
                           tnt3        tty7t   tty7t   tty1R
                           tnt4        tty7u   tty7u   tty1S
                           tnt5        tty7v   tty7v   tty1T
                           tnt6        tty7w   tty7w   tty1U
                           tnt7        tty7x   tty7x   tty1V
                           tnt8        tty7y   tty7y   tty1W
                           tnt9        tty7z   tty7z   tty1X
                           tnta        tty71   tty71   tty1Y
                           tntb        tty72   tty72   tty1Z
                           tntc        tty73   tty73   tty1A
                           tntd        tty74   tty74   tty1B
                           tnte        tty75   tty75   tty1C
                           tntf        tty76   tty76   tty1D
                           tntg        tty77   tty77   tty1E
                           tnth        tty78   tty78   tty1F
                           tnti        tty79   tty79   tty1G
                           tntj        tty7a   tty7a   tty1H
                           tntk        tty7b   tty7b   tty1I
                           tntl        tty7c   tty7c   tty1J
                           tntm        tty7d   tty7d   tty1K
                           tntn        tty7e   tty7e   tty1L
                           tnto        tty7f   tty7f   tty1M
                           tntp        tty7g   tty7g   tty1N
                           tntq        tty7h   tty7h   tty1O
                           tnts        tty7i   tty7i   tty1P
                           tntr        tty7j   tty7j   tty1Q
                           tntu        tty7k   tty7k   tty1R
                           tntv        tty7l   tty7l   tty1S
                           tntw        tty7m   tty7m   tty1T
                           tntx        tty7n   tty7n   tty1U
                           tnty        tty7o   tty7o   tty1V
                           tntz        tty7p   tty7p   tty1W
                           tnt1        tty7q   tty7q   tty1X
                           tnt2        tty7r   tty7r   tty1Y
                           tnt3        tty7s   tty7s   tty1Z
                           tnt4        tty7t   tty7t   tty1A
                           tnt5        tty7u   tty7u   tty1B
                           tnt6        tty7v   tty7v   tty1C
                           tnt7        tty7w   tty7w   tty1D
                           tnt8        tty7x   tty7x   tty1E
                           tnt9        tty7y   tty7y   tty1F
                           tnta        tty7z   tty7z   tty1G
                           tntb        tty71   tty71   tty1H
                           tntc        tty72   tty72   tty1I
                           tntd        tty73   tty73   tty1J
                           tnte        tty74   tty74   tty1K
                           tntf        tty75   tty75   tty1L
                           tntg        tty76   tty76   tty1M
                           tnth        tty77   tty77   tty1N
                           tnti        tty78   tty78   tty1O
                           tntj        tty79   tty79   tty1P
                           tntk        tty7a   tty7a   tty1Q
                           tntl        tty7b   tty7b   tty1R
                           tntm        tty7c   tty7c   tty1S
                           tntn        tty7d   tty7d   tty1T
                           tnto        tty7e   tty7e   tty1U
                           tntp        tty7f   tty7f   tty1V
                           tntq        tty7g   tty7g   tty1W
                           tnts        tty7h   tty7h   tty1X
                           tntr        tty7i   tty7i   tty1Y
                           tntu        tty7j   tty7j   tty1Z
                           tntv        tty7k   tty7k   tty1A
                           tntw        tty7l   tty7l   tty1B
                           tntx        tty7m   tty7m   tty1C
                           tnty        tty7n   tty7n   tty1D
                           tntz        tty7o   tty7o   tty1E
                           tnt1        tty7p   tty7p   tty1F
                           tnt2        tty7q   tty7q   tty1G
                           tnt3        tty7r   tty7r   tty1H
                           tnt4        tty7s   tty7s   tty1I
                           tnt5        tty7t   tty7t   tty1J
                           tnt6        tty7u   tty7u   tty1K
                           tnt7        tty7v   tty7v   tty1L
                           tnt8        tty7w   tty7w   tty1M
                           tnt9        tty7x   tty7x   tty1N
                           tnta        tty7y   tty7y   tty1O
                           tntb        tty7z   tty7z   tty1P
                           tntc        tty71   tty71   tty1Q
                           tntd        tty72   tty72   tty1R
                           tnte        tty73   tty73   tty1S
                           tntf        tty74   tty74   tty1T
                           tntg        tty75   tty75   tty1U
                           tnth        tty76   tty76   tty1V
                           tnti        tty77   tty77   tty1W
                           tntj        tty78   tty78   tty1X
                           tntk        tty79   tty79   tty1Y
                           tntl        tty7a   tty7a   tty1Z
                           tntm        tty7b   tty7b   tty1A
                           tntn        tty7c   tty7c   tty1B
                           tnto        tty7d   tty7d   tty1C
                           tntp        tty7e   tty7e   tty1D
                           tntq        tty7f   tty7f   tty1E
                           tnts        tty7g   tty7g   tty1F
                           tntr        tty7h   tty7h   tty1G
                           tntu        tty7i   tty7i   tty1H
                           tntv        tty7j   tty7j   tty1I
                           tntw        tty7k   tty7k   tty1J
                           tntx        tty7l   tty7l   tty1K
                           tnty        tty7m   tty7m   tty1L
                           tntz        tty7n   tty7n   tty1M
                           tnt1        tty7o   tty7o   tty1N
                           tnt2        tty7p   tty7p   tty1O
                           tnt3        tty7q   tty7q   tty1P
                           tnt4        tty7r   tty7r   tty1Q
                           tnt5        tty7s   tty7s   tty1R
                           tnt6        tty7t   tty7t   tty1S
                           tnt7        tty7u   tty7u   tty1T
                           tnt8        tty7v   tty7v   tty1U
                           tnt9        tty7w   tty7w   tty1V
                           tnta        tty7x   tty7x   tty1W
                           tntb        tty7y   tty7y   tty1X
                           tntc        tty7z   tty7z   tty1Y
                           tntd        tty71   tty71   tty1Z
                           tnte        tty72   tty72   tty1A
                           tntf        tty73   tty73   tty1B
                           tntg        tty74   tty74   tty1C
                           tnth        tty75   tty75   tty1D
                           tnti        tty76   tty76   tty1E
                           tntj        tty77   tty77   tty1F
                           tntk        tty78   tty78   tty1G
                           tntl        tty79   tty79   tty1H
                           tntm        tty7a   tty7a   tty1I
                           tntn        tty7b   tty7b   tty1J
                           tnto        tty7c   tty7c   tty1K
                           tntp        tty7d   tty7d   tty1L
                           tntq        tty7e   tty7e   tty1M
                           tnts        tty7f   tty7f   tty1N
                           tntr        tty7g   tty7g   tty1O
                           tntu        tty7h   tty7h   tty1P
                           tntv        tty7i   tty7i   tty1Q
                           tntw        tty7j   tty7j   tty1R
                           tntx        tty7k   tty7k   tty1S
                           tnty        tty7l   tty7l   tty1T
                           tntz        tty7m   tty7m   tty1U
                           tnt1        tty7n   tty7n   tty1V
                           tnt2        tty7o   tty7o   tty1W
                           tnt3        tty7p   tty7p   tty1X
                           tnt4        tty7q   tty7q   tty1Y
                           tnt5        tty7r   tty7r   tty1Z
                           tnt6        tty7s   tty7s   tty1A
                           tnt7        tty7t   tty7t   tty1B
                           tnt8        tty7u   tty7u   tty1C
                           tnt9        tty7v   tty7v   tty1D
                           tnta        tty7w   tty7w   tty1E
                           tntb        tty7x   tty7x   tty1F
                           tntc        tty7y   tty7y   tty1G
                           tntd        tty7z   tty7z   tty1H
                           tnte        tty71   tty71   tty1I
                           tntf        tty72   tty72   tty1J
                           tntg        tty73   tty73   tty1K
                           tnth        tty74   tty74   tty1L
                           tnti        tty75   tty75   tty1M
                           tntj        tty76   tty76   tty1N
                           tntk        tty77   tty77   tty1O
                           tntl        tty78   tty78   tty1P
                           tntm        tty79   tty79   tty1Q
                           tntn        tty7a   tty7a   tty1R
                           tnto        tty7b   tty7b   tty1S
                           tntp        tty7c   tty7c   tty1T
                           tntq        tty7d   tty7d   tty1U
                           tnts        tty7e   tty7e   tty1V
                           tntr        tty7f   tty7f   tty1W
                           tntu        tty7g   tty7g   tty1X
                           tntv        tty7h   tty7h   tty1Y
                           tntw        tty7i   tty7i   tty1Z
                           tntx        tty7j   tty7j   tty1A
                           tnty        tty7k   tty7k   tty1B
                           tntz        tty7l   tty7l   tty1C
                           tnt1        tty7m   tty7m   tty1D
                           tnt2        tty7n   tty7n   tty1E
                           tnt3        tty7o   tty7o   tty1F
                           tnt4        tty7p   tty7p   tty1G
                           tnt5        tty7q   tty7q   tty1H
                           tnt6        tty7r   tty7r   tty1I
                           tnt7        tty7s   tty7s   tty1J
                           tnt8        tty7t   tty7t   tty1K
                           tnt9        tty7u   tty7u   tty1L
                           tnta        tty7v   tty7v   tty1M
                           tntb        tty7w   tty7w   tty1N
                           tntc        tty7x   tty7x   tty1O
                           tntd        tty7y   tty7y   tty1P
                           tnte        tty7z   tty7z   tty1Q
                           tntf        tty71   tty71   tty1R
                           tntg        tty72   tty72   tty1S
                           tnth        tty73   tty73   tty1T
                           tnti        tty74   tty74   tty1U
                           tntj        tty75   tty75   tty1V
                           tntk        tty76   tty76   tty1W
                           tntl        tty77   tty77   tty1X
                           tntm        tty78   tty78   tty1Y
                           tntn        tty79   tty79   tty1Z
                           tnto        tty7a   tty7a   tty1A
                           tntp        tty7b   tty7b   tty1B
                           tntq        tty7c   tty7c   tty1C
                           tnts        tty7d   tty7d   tty1D
                           tntr        tty7e   tty7e   tty1E
                           tntu        tty7f   tty7f   tty1F
                           tntv        tty7g   tty7g   tty1G
                           tntw        tty7h   tty7h   tty1H
                           tntx        tty7i   tty7i   tty1I
                           tnty        tty7j   tty7j   tty1J
                           tntz        tty7k   tty7k   tty1K
                           tnt1        tty7l   tty7l   tty1L
                           tnt2        tty7m   tty7m   tty1M
                           tnt3        tty7n   tty7n   tty1N
                           tnt4        tty7o   tty7o   tty1O
                           tnt5        tty7p   tty7p   tty1P
                           tnt6        tty7q   tty7q   tty1Q
                           tnt7        tty7r   tty7r   tty1R
                           tnt8        tty7s   tty7s   tty1S
                           tnt9        tty7t   tty7t   tty1T
                           tnta        tty7u   tty7u   tty1U
                           tntb        tty7v   tty7v   tty1V
                           tntc        tty7w   tty7w   tty1W
                           tntd        tty7x   tty7x   tty1X
                           tnte        tty7y   tty7y   tty1Y
                           tntf        tty7z   tty7z   tty1Z
                           tntg        tty71   tty71   tty1A
                           tnth        tty72   tty72   tty1B
                           tnti        tty73   tty73   tty1C
                           tntj        tty74   tty74   tty1D
                           tntk        tty75   tty75   tty1E
                           tntl        tty76   tty76   tty1F
                           tntm        tty77   tty77   tty1G
                           tntn        tty78   tty78   tty1H
                           tnto        tty79   tty79   tty1I
                           tntp        tty7a   tty7a   tty1J
                           tntq        tty7b   tty7b   tty1K
                           tnts        tty7c   tty7c   tty1L
                           tntr        tty7d   tty7d   tty1M
                           tntu        tty7e   tty7e   tty1N
                           tntv        tty7f   tty7f   tty1O
                           tntw        tty7g   tty7g   tty1P
                           tntx        tty7h   tty7h   tty1Q
                           tnty        tty7i   tty7i   tty1R
                           tntz        tty7j   tty7j   tty1S
                           tnt1        tty7k   tty7k   tty1T
                           tnt2        tty7l   tty7l   tty1U
                           tnt3        tty7m   tty7m   tty1V
                           tnt4        tty7n   tty7n   tty1W
                           tnt5        tty7o   tty7o   tty1X
                           tnt6        tty7p   tty7p   tty1Y
                           tnt7        tty7q   tty7q   tty1Z
                           tnt8        tty7r   tty7r   tty1A
                           tnt9        tty7s   tty7s   tty1B
                           tnta        tty7t   tty7t   tty1C
                           tntb        tty7u   tty7u   tty1D
                           tntc        tty7v   tty7v   tty1E
                           tntd        tty7w   tty7w   tty1F
                           tnte        tty7x   tty7x   tty1G
                           tntf        tty7y   tty7y   tty1H
                           tntg        tty7z   tty7z   tty1I
                           tnth        tty71   tty71   tty1J
                           tnti        tty72   tty72   tty1K
                           tntj        tty73   tty73   tty1L
                           tntk        tty74   tty74   tty1M
                           tntl        tty75   tty75   tty1N
                           tntm        tty76   tty76   tty1O
                           tntn        tty77   tty77   tty1P
                           tnto        tty78   tty78   tty1Q
                           tntp        tty79   tty79   tty1R
                           tntq        tty7a   tty7a   tty1S
                           tnts        tty7b   tty7b   tty1T
                           tntr        tty7c   tty7c   tty1U
                           tntu        tty7d   tty7d   tty1V
                           tntv        tty7e   tty7e   tty1W
                           tntw        tty7f   tty7f   tty1X
                           tntx        tty7g   tty7g   tty1Y
                           tnty        tty7h   tty7h   tty1Z
                           tntz        tty7i   tty7i   tty1A
                           tnt1        tty7j   tty7j   tty1B
                           tnt2        tty7k   tty7k   tty1C
                           tnt3        tty7l   tty7l   tty1D
                           tnt4        tty7m   tty7m   tty1E
                           tnt5        tty7n   tty7n   tty1F
                           tnt6        tty7o   tty7o   tty1G
                           tnt7        tty7p   tty7p   tty1H
                           tnt8        tty7q   tty7q   tty1I
                           tnt9        tty7r   tty7r   tty1J
                           tnta        tty7s   tty7s   tty1K
                           tntb        tty7t   tty7t   tty1L
                           tntc        tty7u   tty7u   tty1M
                           tntd        tty7v   tty7v   tty1N
                           tnte        tty7w   tty7w   tty1O
                           tntf        tty7x   tty7x   tty1P
                           tntg        tty7y   tty7y   tty1Q
                           tnth        tty7z   tty7z   tty1R
                           tnti        tty71   tty71   tty1S
                           tntj        tty72   tty72   tty1T
                           tntk        tty73   tty73   tty1U
                           tntl        tty74   tty74   tty1V
                           tntm        tty75   tty75   tty1W
                           tntn        tty76   tty76   tty1X
                           tnto        tty77   tty77   tty1Y
                           tntp        tty78   tty78   tty1Z
                           tntq        tty79   tty79   tty1A
                           tnts        tty7a   tty7a   tty1B
                           tntr        tty7b   tty7b   tty1C
                           tntu        tty7c   tty7c   tty1D
                           tntv        tty7d   tty7d   tty1E
                           tntw
```

etc- user, system and application configuration files

etc directory has all user specific , system specific and application specific configuration files .

emertxe@ubuntu:/\$ ls /etc	dkms	kernel	newt	selinux
acpi	dpkg	kernel-img.conf	nsswitch.conf	sensors3.conf
adduser.conf	emacs	kerneloops.conf	openal	sensors.d
alternatives	environment	ldap	opt	services
anacrontab	firefox	ld.so.cache	os-release	shadow
apg.conf	fonts	ld.so.conf	PackageKit	shadow-
apm	foomatic	ld.so.conf.d	pam.conf	shells
apparmor	fstab	legal	pam.d	skel
apparmor.d	fuse.conf	libao.conf	papersize	speech-dispatcher
apport	fwupd	libaudit.conf	passwd	ssh
appstream.conf	gai.conf	libblockdev	passwd-	ssl
apt	gconf	libnl-3	pcmcia	subgid
avahi	gdb	libpaper.d	perl	subgid-
bash.bashrc	gdm3	libreoffice	pki	subuid
bash_completion	geoclue	lintianrc	pm	subuid-
bash_completion.d	ghostscript	locale.alias	pnm2ppa.conf	sudoers
bindresvport.blacklist	gvnd	locale.gen	polkit-1	sudoers.d
binfmt.d	gnome	localtime	popularity-contest.conf	sysctl.conf
bluetooth	groff	logcheck	ppp	sysctl.d
brlapi.key	group	login.defs	profile	systemd
brltty	group-	logrotate.conf	profile.d	terminfo
brltty.conf	grub.d	logrotate.d	protocols	thunderbird
ca-certificates	gshadow	lsb-release	pulse	timezone

Figure 24 Contents of /etc

For example:

/etc/passwd file has all user related information.

/etc/shadow file is a passwd file

/etc/bluetooth file has all bluetooth configuration

/home - user's home directory

Each user has their own home directory in /home, wherein the user can have their own files and directories.

```
emertxe@ubuntu:/$ ls /home
emertxe  guhapriya  linux_user  user1  user3
emertxe@ubuntu:/$
```

Figure 25 /home directory

/lib and /lib64 - shared library files for all executables

The /lib directory contains shared library images (the C programming code library) needed to boot the system and run the commands in the root filesystem, ie. by binaries in /bin and /sbin. Libraries are readily identifiable through their filename extension of *.so. .so files are shared object files .Windows equivalent to a shared library would be a DLL (dynamically linked library) file. They are essential for basic system functionality.

```
emertxe@ubuntu:/$ ls /lib
apparmor    firmware      init          lsb          recovery-mode   ufw
console-setup hdparm       klibc-wBFLvVtxy4xJqEadIBJMa78iJz8.so  modprobe.d   systemd
cpp          i386-linux-gnu ld-linux.so.2        modules      terminfo      x86_64-linux-gnu
crda        ifupdown      linux-sound-base  netplan     udev
emertxe@ubuntu:/$ _
```

Figure 26 Contents of /lib

/media - mount point for removable devices

The /media directory contains subdirectories where removable media devices inserted into the computer are mounted. For example, when you

insert a CD into your Linux system, a directory will automatically be created inside the /media directory. You can access the contents of the CD inside this directory.

/mnt - mount point for non-removable storage devices

This is a generic mount point under which you mount your file systems or devices. Mounting is the process by which you make a filesystem available to the system. After mounting your files will be accessible under the mount-point.

/opt - optional add-ons software package

This directory is reserved for all the software and add-on packages that are not part of the default installation.

```
emertxe@ubuntu:/$ ls /opt
google microchip VBoxGuestAdditions-6.1.2
emertxe@ubuntu:/$ █
```

Figure 27 /opt directory

/proc - process related information

Information about all the running process in the system

```

emertxe@ubuntu:/$ ls /proc
1    1178 1277 1342 15   18   27   4   78   852 931 98
10   1179 1282 1346 1501 19   278 401 783 859 936 995
1023 1185 1286 1353 1510 1978 28   402 784 869 937  acpi
1032 1186 13   1355 1524 2    29   403 79   872 939  asound
1036 1199 1301 1357 155   20   30   405 8    877 941  buddyinfo
1037 12   1304 1358 156   2084 32   406 80   879 942  bus
1050 1201 1308 1361 157   2086 331 432 800 882 943  cgroups
1054 1206 1312 1365 1572 209 34   434 81   884 947  cmdline
1056 1209 1317 1366 1574 21   35   450 812 89   949  consoles
1059 1227 1321 1368 16   2116 356 482 82   896 951  cpuinfo
1063 1233 1326 1386 1694 2123 36   542 821 899 953  crypto
11   1238 1328 14   17   22   361 543 83   9    954  devices
115  1249 1329 1423 1747 23   363 6    830 902 956  diskstats
1162 1259 1330 1426 1772 24   364 637 831 906 961  dma
1163 1263 1331 1457 178   241 370 646 842 913 963  driver
1171 1265 1334 1480 1784 25   397 648 844 924 967  execdomains
1172 1268 1337 1490 179   26   398 7    846 928 972  fb
                                         filesystems meminfo sysrq-trigger
                                         fs        misc_ sysvipc
                                         interrupts modules thread-self
                                         iomem     mounts timer_list
                                         iports    mtrr   tty
                                         irq      net    uptime
                                         kallsyms pagetypeinfo version
                                         kcore    partitions version_signature
                                         keys     sched_debug vmallocinfo
                                         key-users schedstat vmstat
                                         kmsq    scsi    zoneinfo
                                         kpagemgroup self
                                         kpagemcount slabinfo
                                         kpagemflags softirqs
                                         loadavg  stat
                                         locks    swaps
                                         mdstat   sys
emertxe@ubuntu:$

```

Figure 28 /proc directory

All the numbers in the above figures are nothing but the process id of running process in the system

/tmp - temp files

/tmp has all temp files created at the time of running any application system. In other words, this can be used by any application to store all temporary data.

/root - root's home directory

The /root directory is the home directory of the root account. It is also referred to as *the root user's home directory*. /root contains configuration files for the root account, just as each ordinary user's home directory contains configuration and other files for that user.

/var - variable files

Contains variable data ,record of all logins and logouts by the users ,all the system processes.like system logging files, mail and temporary files are available as log files /var directory

/usr - multi-user utilities and applications

The */usr* directory consists of several subdirectories that contain additional user utilities and application files.

The */usr/bin* directory contains binary files of more commands.

The */usr/include* directory contains header files for compiling C programs.

The */usr/lib* directory contains more libraries and data files used by various commands.

The */usr/tmp* directory contains more temporary files.

```
emertxe@ubuntu:~$ ls /usr
bin  games  include  lib  libexec  local  sbin  share  src
emertxe@ubuntu:~$
```

Figure 29 . /usr directory

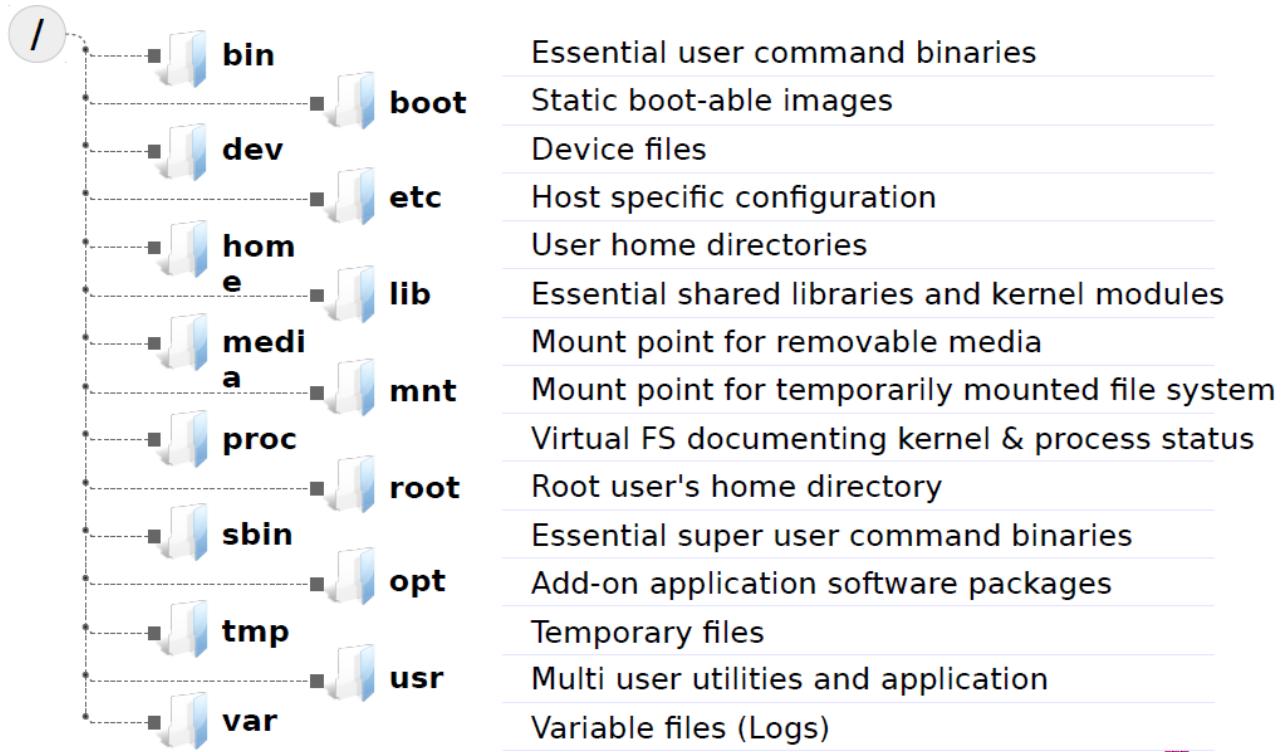


Figure 30 . Directory structure

which -locate a command

```

emertxe@ubuntu:~$ which pwd
/bin/pwd
emertxe@ubuntu:~$ which ls
/bin/ls
emertxe@ubuntu:~$
```

Figure 31 .Which command to locate command binary

whereis - locate the binary ,source and manual page of a command

```
emertxe@ubuntu:~$ whereis pwd  
pwd: /bin/pwd /usr/include/pwd.h /usr/share/man/man1/pwd.1.gz  
emertxe@ubuntu:~$ whereis ls  
ls: /bin/ls /usr/share/man/man1/ls.1.gz  
emertxe@ubuntu:~$
```

Figure 32 Whereis command to locate binary source and manual page of a command

Path

Path is the location where a particular file is located in a file system. Path of a file depends upon reference from where you take it. Depending upon the reference path can be classified as

1. Absolute path
2. Relative path

1. Absolute path

Specifies the location from the root directory(/). Absolute path always starts with / .

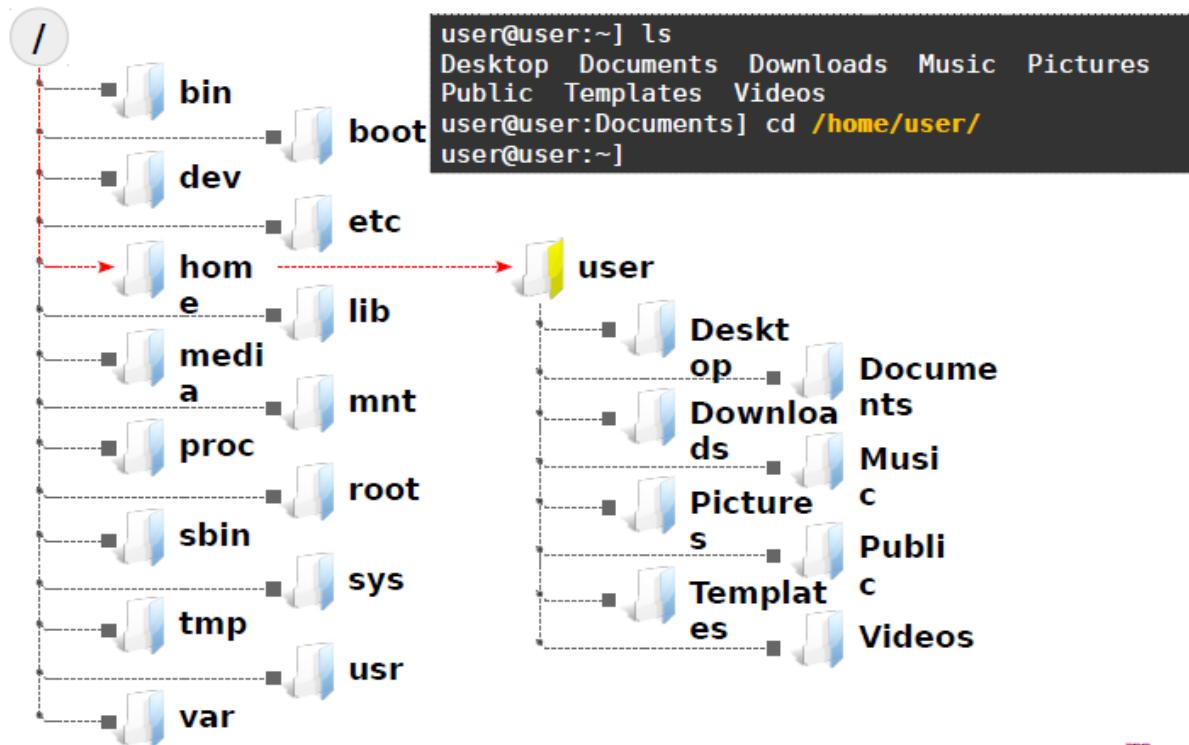


Figure 33.An example for Absolute path

2.Relative path

Specifies the location with respect to the current working directory. As the name suggests, the relative path varies with respect to the current working directory. Relative path starts either with directory name or with ..

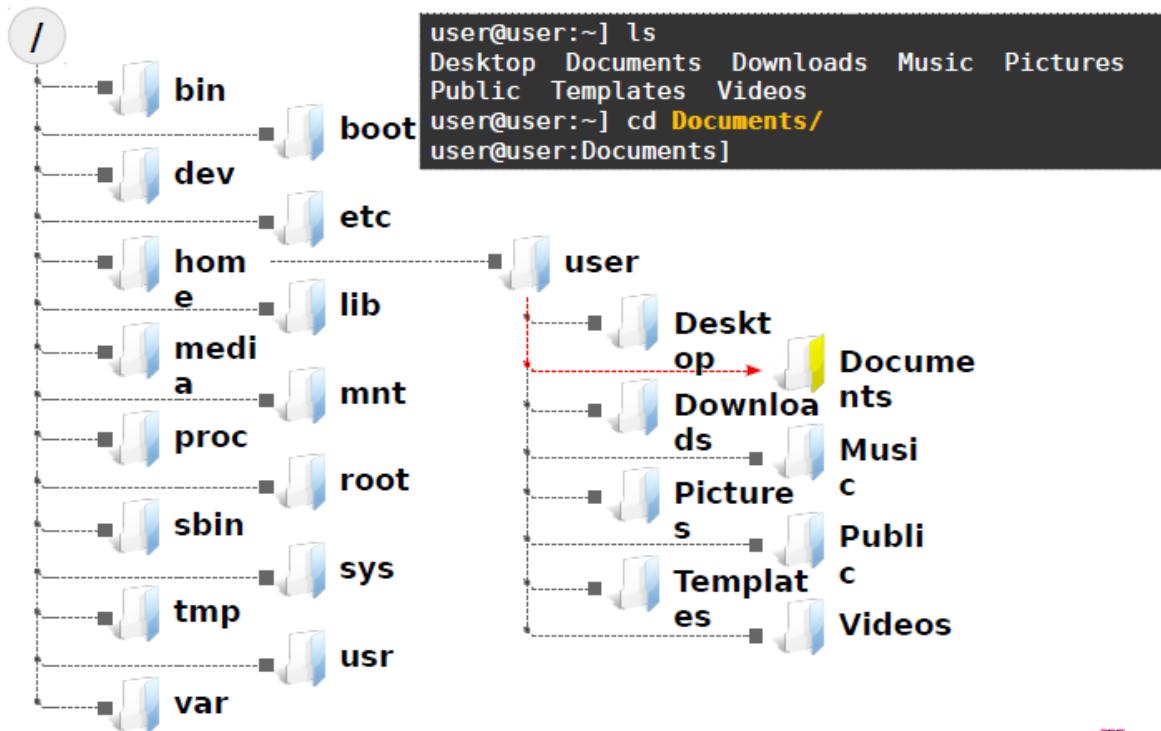


Figure 34 An example for Relative path

mkdir - make new directories

`mkdir` command is to create directories which do not already exist.

```

emertxe@ubuntu:~/ECEP$ ls
C DS LS
emertxe@ubuntu:~/ECEP$ mkdir Dir1 Dir2
emertxe@ubuntu:~/ECEP$ ls
C Dir1 Dir2 DS LS
emertxe@ubuntu:~/ECEP$ 

```

Figure 35 `mkdir` command to make multiple directories

We can create multiple directories in a single command by giving all directories names as arguments to the `mkdir` command separated by space.

`mkdir -p` is used to create a directory along with the parent directory as shown in the figure below.

```
emertxe@ubuntu:~/New$ ls
D1
emertxe@ubuntu:~/New$ mkdir D2/Test
mkdir: cannot create directory 'D2/Test': No such file or directory
emertxe@ubuntu:~/New$ mkdir -p D2/Test
emertxe@ubuntu:~/New$ emertxe@ubuntu:~/New$ ls -R
.:
D1  D2
./D1:
./D2:
Test
./D2/Test:
emertxe@ubuntu:~/New$
```

Figure 36 make directory along with parent directory

Touch - updates timestamps and creates new files

touch command generally updates the timestamp of existing files. If the file is not existing it creates empty files.

```
emertxe@ubuntu:~/New$ touch file1 file2 file3
emertxe@ubuntu:~/New$ ls
file1  file2  file3
```

Figure 37 touch command to create files

Let's look at the timestamp of created files by using `ls -l` command as shown in the figure below.

```
emertxe@ubuntu:~/New$ ls -l
total 0
-rw-rw-r-- 1 emertxe emertxe 0 Mar  2 12:21 file1
-rw-rw-r-- 1 emertxe emertxe 0 Mar  2 12:21 file2
-rw-rw-r-- 1 emertxe emertxe 0 Mar  2 12:21 file3
emertxe@ubuntu:~/New$
```

Figure 38Timestamp of Created files

```
emertxe@ubuntu:~/New$ touch file1 file2 file3
emertxe@ubuntu:~/New$
emertxe@ubuntu:~/New$ ls -l
total 0
-rw-rw-r-- 1 emertxe emertxe 0 Mar  2 12:23 file1
-rw-rw-r-- 1 emertxe emertxe 0 Mar  2 12:23 file2
-rw-rw-r-- 1 emertxe emertxe 0 Mar  2 12:23 file3
emertxe@ubuntu:~/New$
```

Figure 39 Timestamp of files after executing touch command

rmdir - remove directories

rmdir command removes empty directories.Lets create a new empty directory TBD as shown in below figure

```
emertxe@ubuntu:~$ ls
22002  Dir1      Downloads  file.txt      Music  Pictures  Templates  Videos
Desktop  Documents  ECEP      MPLABXProjects  New    Public    TEST
emertxe@ubuntu:~$ mkdir TBD #to be deleted
emertxe@ubuntu:~$ 
emertxe@ubuntu:~$ ls
22002  Dir1      Downloads  file.txt      Music  Pictures  TBD        TEST
Desktop  Documents  ECEP      MPLABXProjects  New    Public    Templates  Videos
emertxe@ubuntu:~$
```

Figure 40 Creates an empty directory

- represents the start of the comment ,anything written after # will be treated as a comment.

In the below empty directory TBD is deleted with rmdir command

```

emertxe@ubuntu:~$ ls
22002  Dir1      Downloads  file.txt      Music   Pictures   TBD      TEST
Desktop  Documents  ECEP      MPLABXProjects  New     Public     Templates  Videos
emertxe@ubuntu:~$ rmdir TBD
emertxe@ubuntu:~$ ls
22002  Dir1      Downloads  file.txt      Music   Pictures   Templates  Videos
Desktop  Documents  ECEP      MPLABXProjects  New     Public     TEST
emertxe@ubuntu:~$
```

Figure 41 rmdir command to remove empty directory

```

emertxe@ubuntu:~/New$ ls -R
.:
D1  D2

./D1:

./D2:
Test

./D2/Test:
emertxe@ubuntu:~/New$ rmdir -p D2/Test/
emertxe@ubuntu:~/New$ ls
D1
emertxe@ubuntu:~/New$
```

Figure 42 remove directory along with parent directory

If the directory is non-empty as in the below figure, the directory will not be removed.

```

emertxe@ubuntu:~$ mkdir TBD #to be deleted
emertxe@ubuntu:~$ 
emertxe@ubuntu:~$ cd TBD
emertxe@ubuntu:~/TBD$ mkdir Test
emertxe@ubuntu:~/TBD$ cd ..
emertxe@ubuntu:~$ ls TBD
Test
emertxe@ubuntu:~$ rmdir TBD
rmdir: failed to remove 'TBD': Directory not empty
emertxe@ubuntu:~$
```

Figure 43 Removing non-empty directory

rm - remove files or directory

Remove command removes files or directory. By default remove command removes files.

```
emertxe@ubuntu:~$ ls TBD  
Test  
emertxe@ubuntu:~$ rm TBD  
rm: cannot remove 'TBD': Is a directory  
emertxe@ubuntu:~$ █
```

Figure 44 when rm command used to delete directory

rm -r - to delete directories

To remove directories -r option is used. “r” denotes recursive. So using rm -r we can remove both empty and non-empty directories.

```
emertxe@ubuntu:~$ rm -r TBD  
emertxe@ubuntu:~$  
emertxe@ubuntu:~$ ls  
22002  Dir1      Downloads  file.txt      Music   Pictures  Templates  Videos  
Desktop  Documents  ECEP      MPLABXProjects  New     Public    TEST  
emertxe@ubuntu:~$
```

Figure 45 Usage of rm -r command

Using rm command deletes the files and directories permanently It's like shift + delete. There is no way to restore the deleted files and directories. So what if you delete the files or directories mistakenly. There is an option with rm command to avoid this. Using the rm -i option provides an interactive prompt before deletion.

rm -i - to get interactive prompt

```
emertxe@ubuntu:~$ ls
22002  Dir1      Downloads  file.txt      Music  Pictures  TBD      TEST
Desktop  Documents  ECEP      MPLABXProjects  New    Public    Templates  Videos
emertxe@ubuntu:~$
emertxe@ubuntu:~$ rm -ir TBD
rm: descend into directory 'TBD'? y
rm: remove directory 'TBD/Test'? y
rm: remove directory 'TBD'? y
emertxe@ubuntu:~$ ls
22002  Dir1      Downloads  file.txt      Music  Pictures  Templates  Videos
Desktop  Documents  ECEP      MPLABXProjects  New    Public    TEST
emertxe@ubuntu:~$
```

Figure 46 rm command with -i option

rm -i option provides interactivity. From the above figure you can observe , enter 'y' to delete the files or directories permanently. Pressing any key apart from y to abort the deletion.

cp - copy files and directories

cp command is to copy files and directories.copy command accepts two arguments i.e., source and destination.source is the path from where the file is to be copied and destination is the path to which the file is to be copied.

If the destination file is non-existing ,a new file will be created and source file contents will be copied.If the destination file is already existing in the path ,the file will be overwritten with the source file contents.

```
emertxe@ubuntu:~$ cp <source> <destination>
```

Figure 47 usage of cp command

```
emertxe@ubuntu:~/TBD$ ls
file1 file2 file3
emertxe@ubuntu:~/TBD$ cp file1 file4
emertxe@ubuntu:~/TBD$ ls
file1 file2 file3 file4
emertxe@ubuntu:~/TBD$ cp file1 ..//file5
emertxe@ubuntu:~/TBD$ cd ..
emertxe@ubuntu:~$ ls
22002  Documents  file5          Music      Public    TEST
Desktop  Downloads  file.txt       New        TBD       Videos
Dir1    ECEP       MPLABXProjects Pictures  Templates
emertxe@ubuntu:~$
```

Figure 48 copy command to copy files

cp -r - to copy directories

To copy the directories -r option can be used. Multiple files can also be copied to a directory with cp command as shown in the below figure.

```
emertxe@ubuntu:~/TBD$ ls
file1 file2 file3 file4
emertxe@ubuntu:~/TBD$ mkdir Test
emertxe@ubuntu:~/TBD$ ls
file1 file2 file3 file4 Test
emertxe@ubuntu:~/TBD$ cp file1 file2 file3 Test
emertxe@ubuntu:~/TBD$ ls Test
file1 file2 file3
emertxe@ubuntu:~/TBD$ cp Test/ Test_copy
cp: -r not specified; omitting directory 'Test/'
emertxe@ubuntu:~/TBD$ cp -r Test/ Test_copy
emertxe@ubuntu:~/TBD$ ls
file1 file2 file3 file4 Test Test_copy
emertxe@ubuntu:~/TBD$
```

Figure 49 cp command to copy directories

mv - to move or rename files

mv command takes two arguments, source is the path from where the file to be moved and destination is the path to the file is moved.

```
emertxe@ubuntu:~/TBD$ mv <source> <destination>
```

Figure 50 usage of mv command

If the destination file is non-existing, the source file will be moved to the given destination path,. if destination file is already existing, source file content will be overwritten to the destination file and the source file will be removed as shown in below figure

```
emertxe@ubuntu:~/TBD$ ls ../
22002  Documents  file5      Music    Public    TEST
Desktop  Downloads  file.txt   New      TBD      Videos
Dir1    ECEP      MPLABXProjects Pictures  Templates
emertxe@ubuntu:~/TBD$ ls
file1  file2  file3  file4  Test  Test_copy
emertxe@ubuntu:~/TBD$
emertxe@ubuntu:~/TBD$ mv ..//file5 Test_copy
emertxe@ubuntu:~/TBD$
emertxe@ubuntu:~/TBD$ ls Test_copy/
file1  file2  file3  file5
emertxe@ubuntu:~/TBD$ ls ../
22002  Dir1    Downloads  file.txt   Music    Pictures  TBD    TEST
Desktop  Documents  ECEP      MPLABXProjects  New    Public    Templates  Videos
emertxe@ubuntu:~/TBD$
```

Figure 51 mv command to move files

If the destination and source are in the same directory, the source file will be renamed to give the destination file name if the destination file is not existing as shown in below figure.

```
emertxe@ubuntu:~/TBD$ ls  
file1 file2 file3 file4 Test Test_copy  
emertxe@ubuntu:~/TBD$ mv file1 file1.txt  
emertxe@ubuntu:~/TBD$ ls  
file1.txt file2 file3 file4 Test Test_copy  
emertxe@ubuntu:~/TBD$ █
```

Figure 52 renaming file using mv command

Vi editor - Visual editor

screen oriented text editor usually created for the unix operating system.
Improved version is called vim.

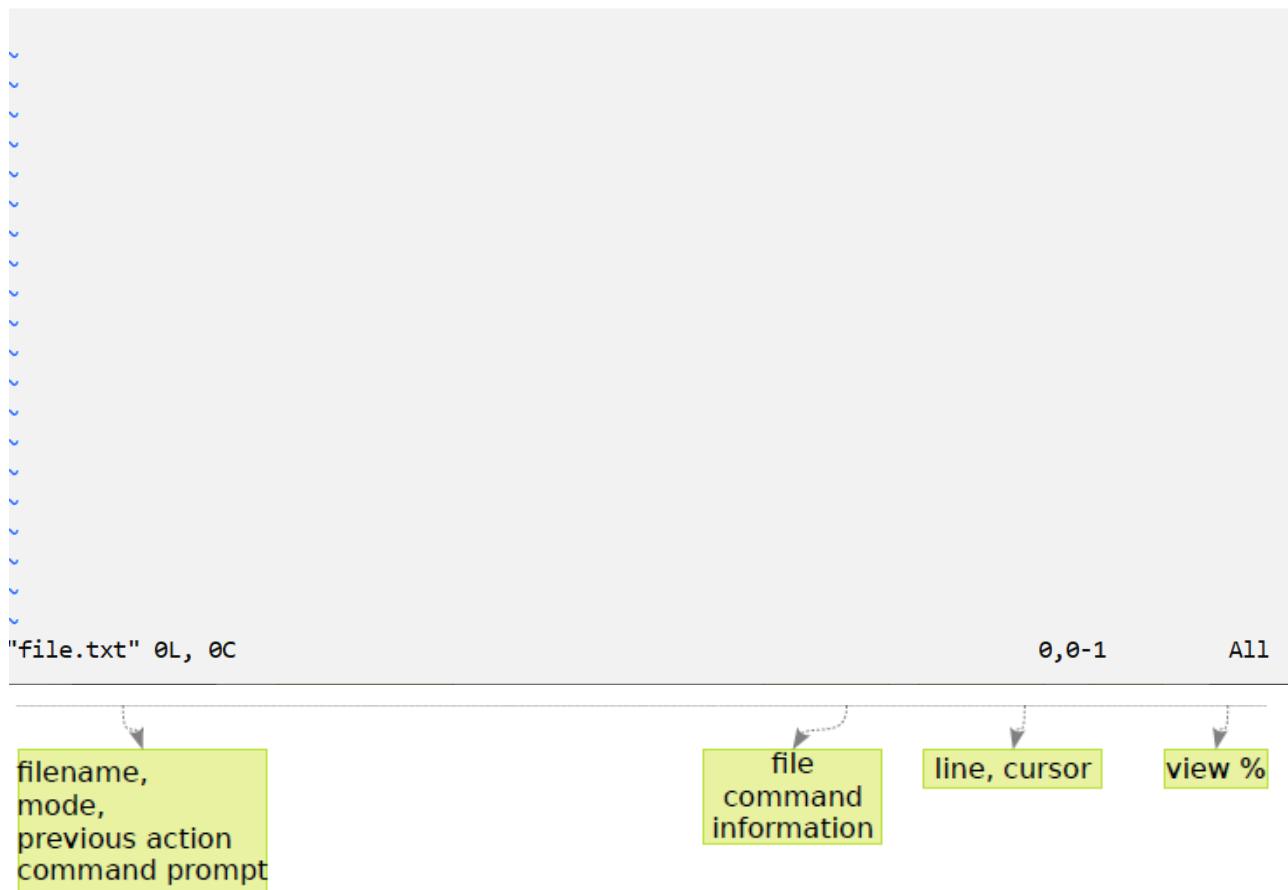


Figure 53 vi information

To open a file in vim editor

Command to open vi

- vi <file_name>
or

- vim <file_name>

To get basic grep on vi you may type vimtutor on the terminal. Read and follow the instructions given on the page

Installation of vi

Command to install vi

1. Sudo apt-get update
2. Sudo apt install vim

Modes of vi.

vi operates in three different modes

1. ESC and Command mode

This mode is default mode as soon as a file is opened. To enter into ESC mode ESC key can be pressed at any time .

To enter commands press ‘ : ’.

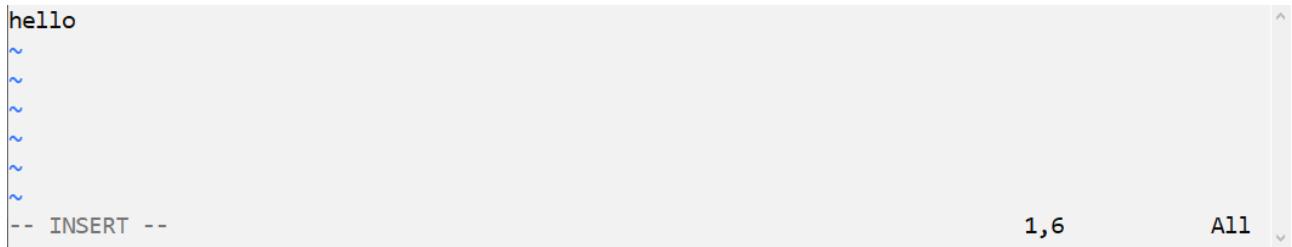
To type a command : <type your command>

:q	- quit/exit
:w	- write/save
:wq	- write and quit
:q!	- discard all the changes and quit

2. Edit mode

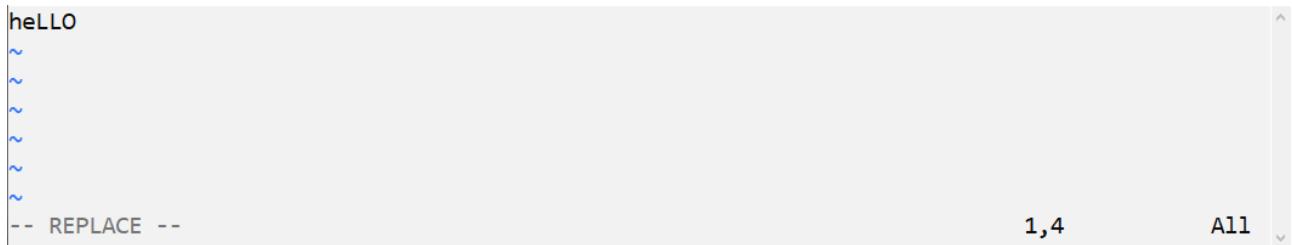
In edit mode we can enter or replace the text in the file

i/l - to insert text



```
hello
~
~
```

Figure 54 Vi editor in insert mode



```
heLLO
~
~
```

Figure 54 Vi editor in replace mode

r/R - to replace text

3. Visual mode

This mode helps us to select a part of the content. To enter into visual mode press `ESC` and press '`v`'. And use arrow keys to select a particular portion of the file content. The text with gray background is the selected text as shown in the below image.

```
hello world
Welcome all
^
^
^
^
^
^
-- VISUAL --
```

2 1,4 All

Figure 55 vi editor in visual mode

Vi shortcuts

All vi shortcuts should be given in ESC mode

1. yy - to copy
2. nyy - to copy n lines from cursor position
3. p-to paste below the cursor position
4. np-to paste n times
5. u-undo
6. Ctrl+ R -redo
7. o-to insert new line below the cursor
8. O- to insert new line above the cursor
9. dd -to delete a line
10. ndd -to delete n lines from cursor position
11. dw-to delete a word
12. d\$-to delete the text until end of the line
13. x- to delete char by char
14. D- to delete the text after the cursor position
15. d^ -to delete the text before the cursor position
16. gg-to go to 1st line
17. ngg -to go to nth line
18. G- to go to last line
19. A-to go to the last char of the line

20. a- to go to the 1st char of the line
21. cw -to change word from the cursor position
22. ncw -to change n words from cursor position
23. nb-to move backward n words

Most frequently executed commands in command mode

1. :set nu - to enable line numbers
2. :set no nu - to disable line numbers
3. :set hls - to enable highlight search
4. :set no hls - to disable highlight search
5. :e <filename> - to open another file without closing the existing file
(use ctrl+6 to switch between files)
6. :r <filename> - to reads file named filename at current cursor position