Program No. 1
Booting Process of Linux

Press the power button on your system, and after few moments you see the Linux login prompt. From the time you press the power button until the Linux login prompt appears, the following sequence occurs. The following are the 6 high level stages of a typical Linux boot process.

BIOS	Basic input / output system executes MBR
MBR	Master Boot Record executes GRUB
GRUB	Grand Unified Bootloader executes Kernal
Kernel	Kernel executes the /sbin/init program
Init	Init executes Runlevel programs
Runlevel	Runlevel programs are executes from /etc/rc.d/rc*.d/

Step-1. BIOS

- BIOS stands for Basic Input/Output System.
- Performs some system integrity checks.
- Searches, loads, and executes the boot loader program.
- It looks for boot loader in floppy, CD-ROMs, or hard drive. You can press a key (typically F12 or F2, but it depends on your system) during the BIOS startup to change the boot sequence.
- Once the boot loader program is detected and loaded into the memory, BIOS gives the control to it.
- So, in simple terms BIOS loads and executes the MBR boot loader.

Step-2. MBR

- MBR stands for Master Boot Record.
- It is located in the 1st sector of the bootable disk. Typically /dev/hda, or /dev/sda.
- MBR is less than 512 bytes in size. This has three components 1) primary boot loader info in 1st 446 bytes 2) partition table info in next 64 bytes 3) mbr validation check in last 2 bytes.
- It contains information about GRUB (or LILO in old systems).
- So, in simple terms MBR loads and executes the GRUB boot loader.

Step-3. GRUB

- GRUB stands for Grand Unified Bootloader.
- If you have multiple kernel images installed on your system, you can choose which one to be executed.

- GRUB displays a splash screen, waits for few seconds, if you don't enter anything, it loads the default kernel image as specified in the grub configuration file.
- GRUB has the knowledge of the filesystem (the older Linux loader LILO didn't understand filesystem).
- Grub configuration file is /boot/grub/grub.conf (/etc/grub.conf is a link to this). The following is sample grub.conf of CentOS.

```
#boot=/dev/sda
default=0
timeout=5
splashimage=(hd0,0)/boot/grub/splash.xpm.gz hiddenmenu
title CentOS(2.6.18-194.el5PAE)
root(hd0,0)
kernel/boot/vmlinuz-2.6.18-194.el5PAE ro root=LABEL=/
initrd /boot/initrd-2.6.18-194.el5PAE.img
```

- As you notice from the above info, it contains kernel and initrd image.
- So, in simple terms GRUB just loads and executes Kernel and initrdimages.

Step-4. Kernel

- Mounts the root file system as specified in the "root=" in grub.conf
- Kernel executes the /sbin/init program
- Since init was the 1st program to be executed by Linux Kernel, it has the process id (PID) of 1. Do a 'ps -ef | grep init' and check the pid.
- initrd stands for Initial RAM Disk.
- initrd is used by kernel as temporary root file system until kernel is booted and the real root file system is mounted. It also contains necessary drivers compiled inside, which helps it to access the hard drive partitions, and other hardware.

Step-5. Init

- Looks at the /etc/inittab file to decide the Linux run level.
- Following are the available run levels
  0 – halt
  1 – Single user mode
  2 – Multiuser, without NFS
  3 – Full multiuser mode
  4 – unused
  5 – X11
  6 – reboot
- Init identifies the default initlevel from /etc/inittab and uses that to load all appropriate program.

- Execute ‘grep initdefault /etc/inittab’ on your system to identify the default run level
- If you want to get into trouble, you can set the default run level to 0 or 6. Since you know what 0 and 6 means, probably you might not do that.
- Typically you would set the default run level to either 3 or 5.

Step-6. Runlevel programs

- When the Linux system is booting up, you might see various services getting started. For example, it might say “starting sendmail …. OK”. Those are the runlevel programs, executed from the run level directory as defined by your run level.
- Depending on your default init level setting, the system will execute the programs from one of the following directories.
  Run level 0 – /etc/rc.d/rc0.d/
  Run level 1 – /etc/rc.d/rc1.d/
  Run level 2 – /etc/rc.d/rc2.d/
  Run level 3 – /etc/rc.d/rc3.d/
  Run level 4 – /etc/rc.d/rc4.d/
  Run level 5 – /etc/rc.d/rc5.d/
  Run level 6 – /etc/rc.d/rc6.d/
- Please note that there are also symbolic links available for these directory under /etc directly. So, /etc/rc0.d is linked to /etc/rc.d/rc0.d.
- Under the /etc/rc.d/rc*.d/ directories, you would see programs that start with S and K.
- Programs starts with S are used during startup. S for startup.
- Programs starts with K are used during shutdown. K for kill.
- There are numbers right next to S and K in the program names. Those are the sequence number in which the programs should be started or killed.
- For example, S12syslog is to start the syslog deamon, which has the sequence number of 12. S80sendmail is to start the sendmail daemon, which has the sequence numberof
- 80. So, syslog program will be started before sendmail.

Login Process

i. Users enter their username and password
ii. The operating system confirms your name and password.
iii. A "shell" is created for you based on your entry in the "/etc/passwd" file
iv. You are "placed" in your "home"directory.
v. Start-up information is read from the file named "/etc/profile". This file is known as the system login file. When every user logs in, they read the information in this file.
vi. Additional information is read from the file named ".profile" that is located in your "home" directory. This file is known as your personal login file.

Result- The given program has been performed successfully.

Program No. 2
Basic Linux Commands

1. **Basics**
   i. echo SRM: to display the string SRM
   ii. clear: to clear the screen
   iii. date: to display the current date and time
   iv. cal 2022: to display the calendar for the year 2022
   v. cal 6 2022: to display the calendar for the June-2022
   vi. passwd: to change password

2. **Working with Files**
   i. ls: list files in the present working directory
   ii. ls –l: list files with detailed information (long list)
   iii. ls –a: list all files including the hidden files
   iv. cat > f1: to create a file (Press ^d to finish typing)
   v. cat f1: display the content of the file f1
   vi. wc f1: list no. of characters, words & lines of a file
   vii. f1 wc –c f1: list only no. of characters of file
   viii. f1 wc –w f1: list only no. of words of file f1
   ix. wc –l f1: list only no. of lines of file f1
   x. cp f1 f2: copy file f1 into f2
   xi. mv f1 f2: rename file f1 as f2
   xii. rm f1: remove the file f1
   xiii. head –5 f1: list first 5 lines of the file f1
   xiv. tail –5 f1: list last 5 lines of the file f1

3. **Working with Directories**
   i. mkdirelias: to create the directory elias
   ii. cd elias: to change the directory as elias
   iii. rmdirelias: to remove the directory elias
   iv. pwd: to display the path of the present working directory
   v. cd: to go to the home directory
   vi. cd ..: to go to the parent directory
   vii. cd -: to go to the previous working directory
   viii. cd /: to go to the root directory

4. **File name substitution**
   i. ls f?: list files start with ‘f’ and followed by any one character
   ii. ls *.c: list files with extension ‘c’
   iii. ls [gpy]et: list files whose first letter is any one of the character g, p or y and followed by the word et

iv. ls [a-d,l-m]ring: list files whose first letter is any one of the character from a to d and l to m and followed by the word ring.

5. I/O Redirection

Input redirection

wc –l < ex1:	To find the number of lines of the file 'ex1'

Output redirection

who > f2:	the output of 'who' will be redirected to file f2
cat >> f1:	to append more into the file f1

6. Piping

Syntax: Command1 | command2

Output of the command1 is transferred to the command2 as input. Finally output of the command2 will be displayed on the monitor.

ex. cat f1 | more: list the contents of file f1 screen by screen

head –6 f1 |tail –2: prints the 5th& 6th lines of the file f1.

7. Environment variables

echo $HOME	display the path of the home directory
echo $PS1	display the prompt string $
echo $PS2	display the second prompt string (> symbol by default)
echo $LOGNAME	login name
echo $PATH	list of pathname where the OS searches for an executable file

8. File Permission

-- chmod command is used to change the access permission of a file.

Method-1

Syntax : chmod [ugo] [+/-] [rwxa] filename

u : user, g : group, o : others

+ : Add permission - : Remove the permission r : read, w : write, x : execute, a : all permissions

ex. chmodug+rw f1

adding 'read & write' permissions of file f1 to both user and group members.

Method-2
Syntax : chmodoctnum file1

The 3 digit octal number is represented as follows

- first digit -- file permissions for the user
- second digit -- file permissions for the group
- third digit -- file permissions for others

Each digit is specified as the sum of following
4 – read permission, 2 – write permission, 1 – execute permission
ex. chmod 754 f1
it change the file permission for the file as follows

- read, write & execute permissions for the user ie; 4+2+1 = 7
- read, & execute permissions for the group members ie; 4+0+1 = 5
- only read permission for others ie; 4+0+0 = 4

Output-

```
$ echo SRMIST
SRMIST
$ date
Sat May  6 04:21:46 IST 2023
$ echo $HOME
echo $HOME

/home/webmaster
export "PS1=$ "

$ echo $PATH
echo $PATH

/opt/swift/bin:/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin
    :/sbin:/bin:.:/usr/local/mozart/bin:/usr/local/Pawn/bin:/usr
    /local/smlnj/bin:/usr/local/icon-v950/bin:
```

Result- The given program has been executed successfully.

Program No. 3
Linux File System

Linux File System

Linux File System or any file system generally is a layer which is under the operating system that handles the positioning of your data on the storage, without it; the system cannot knows which file starts from where and ends where.

Linux offers many file systems types like:

- Ext: an old one and no longer used due to limitations.
- Ext2: first Linux file system that allows 2 terabytes of data allowed.
- Ext3: came from Ext2, but with upgrades and backward compatibility.
- Ext4: faster and allow large files with significant speed.(Best Linux File System) It is a very good option for SSD disks and you notice when you try to install any Linux distro that this one is the default file system that Linux suggests.
- JFS: old file system made by IBM. It works very well with small and big files, but it failed and files corrupted after long time use, reports say.
- XFS: old file system and works slowly with small files.
- Btrfs: made by Oracle. It is not stable as Ext in some distros, but you can say that it is a replacement for it if you have to. It has a good performance.

File System Structure

The following table provides a short overview of the most important higher-level directories you find on a Linux system

Directory	Contents
/	Root directory—the starting point of the directory tree
/bin	Essential binary files. Binary Executable files
/boot	Static files of the boot loader.
/dev	Files needed to access host-specific devices.
/etc	Host-specific system configuration files.
/lib	Essential shared libraries and kernel modules.
/media	Mount points for removable media.
/mnt	Mount point for temporarily mounting a file system.
/opt	Add-on application software packages.
/root	Home directory for the superuser root.
/sbin	Essential system binaries.

/srv	Data for services provided by the system.
/tmp	Temporary files.
/usr	Secondary hierarchy with read-only data.
/var	Variable data such as log files

Result- The given program has been performed successfully.

Program No. 4
Editors and Filters

VI EDITOR

vi fname: to open the file fname

There are two types of mode in vi editor

Escape mode – used to give commands – to switch to escape mode, press <Esc> key

Command mode – used to edit the text – to switch to command mode, press any one the following inserting text command

1. Inserting Text

- i insert text before the cursor
- a append text after the cursor
- I insert text at the beginning of the line
- A append text to the end of the line
- r replace character under the cursor with the next character typed
- R Overwrite characters until the end of the line
- (small o) open new line after the current line to type text
- (capital O) open new line before the current line to type text

2. Cursor Movements

h	left
j	down
k	up
l	right

(The arrow keys usually work also)

^F	forward one screen
^B	back one screen
^D	down half screen
^U	up half screen

(^ indicates control key; case does not matter)

0	(zero) beginning of line
$	end of line

3. Deleting Text

Note: (n) indicates a number, and is optional

dd: deletes current line

(n) dd: deletes (n) line(s) ex. 5dd deletes 5 lines

(n)dw: deletes (n) word(s)

D: deletes from cursor to end of line
X: deletes current character
(n)x: deletes (n) character(s)
X: deletes previous character

4. **Saving Files**

:w- to save & resume editing (write & resume)
:wq- to save & exit (write & quit)
:q!- quit without save

5. **Cut, Copy and Paste**

Yy: copies current line
(n) yy: copies (n) lines from the current line. ex. 4yy copies 4 lines.
p: paste deleted or yanked (copied) lines after the cursor

FILTERS

1. **cut**

Used to cut characters or fields from a file/input
Syntax: cut -cchars filename
-ffieldnos filename
By default, tab is the field separator (delimiter). If the fields of the files are separated by any other character, we need to specify explicitly by –d option
cut -ddelimitchar
-ffiledsfilname

2. **paste**

Paste files vertically. That is n^{th} line of first file and n^{th} line of second file are pasted as the n^{th} line of result
Syntax: paste file1 file2
-ddcharoption is used to paste the lines using the delimiting character dchar
-s option is used paste the lines of the file in a single line

3. **tr**

Used to translate characters from standard input
Syntax: tr char1 char2 < filename
It translates char1 into char2 in file filename

Octal representation characters can also be used

Octal value	**Character**
'\7'	Bell
'\10'	Backspace
'\11'	Tab

'\12'	Newline
'\33'	Escape

Ex. tr : '\11' < f1 translates all : into tab of file f1

-s Option translate multiple occurrences of a character by single character.

-d Option is to delete a character

4. grep

Used to search one or more files for a particular pattern.

Syntax: grep pattern filename(s)

Lines that contain the pattern in the file(s) get displayed pattern can be any regular expressions

More than one file can be searched for a pattern

-v option displays the lines that do not contain the pattern

-l list only name of the files that contain the pattern

-n displays also the line number along with the lines that matches the pattern

5. sort

Used to sort the file in order

Syntax : sort filename

Sorts the data as text by default

Sorts by the first filed by default

-r	option sorts the file in descending order
-u	eliminates duplicate lines
-o filename	writes sorted data into the file fname
-tdchar	sorts the file in which fileds are separated by dchar
-n	sorts the data as number
+1n	skip first filed and sort the file by second filed numerically

6. Uniq

Displays unique lines of a sorted file

Syntax: uniq filename

-d option displays only the duplicate lines

-c displays unique lines with no. of occurrences.

7. cmp

Used to compare two files

Syntax: cmp f1 f2 compare two files f1 & f2 and prints the line of first difference

8. diff

Used to differentiate two files

Syntax: diff f1 f2 compare two files f1 & f2 and prints all the lines that are differed between f1 & f2

9. comm

Used to compare two sorted files

Syntax: comm file1 file2

Three columns of output will be displayed.

- First column displays the lines that are unique to file1
- Second column displays the lines that are unique to file2
- Third column displays the lines that are appears in both the files

-1	option suppress first column
-2	option suppress second column
-3	option suppress third column
-12	option display only third column
-13	option display only second column
-23	option display only first column

Result- The given program has been performed successfully.

Program No. 5
Compilation of C Program

Compilation of C Program

Step-1: Open the terminal and edit your program using vi editor/gedit editor and save with extension ".c"

Ex. vi test.c
(or) gedittext.c

Step-2: Compile your program using gcc compiler

Ex. gcctest.c Output file will be "a.out"
(or) gcc –o test text.c Output file will be "test"

Step-3: Correct the errors if any and run the program

Ex. ./a.out
or ./test

Optional Step: In order to avoid ./ prefix each time a program is to be executed, insert the following as the last line in the file .profile export PATH=.:$PATH
This Step needs only to be done once.

Debug C Programs using gdb debugger

Step-1: Compile C program with debugging option –g
Ex. gcc –g test.c
Step-2: Launch gdb. You will get gdb prompt
Ex. gdba.out
Step-3: Step break points inside C program
Ex. (gdb) b 10
Break points set up at line number 10. We can have any number of break points
Step-4: Run the program inside gdb
Ex. (gdb) r
Step-5: Print variable to get the intermediate values of the variables at break point
Ex. (gdb) p i Prints the value of the variable 'i'
Step-6: Continue or stepping over the program using the following gdb commands
c continue till the next break
n Execute the next line. Treats function as single statement
s Similar to 'n' but executes function statements line by line
l List the program statements
Step-7: Quit the debugger
(gdb) q

Result- The given program has been performed successfully.

Program No. 6
Process Creation

Syntax for process creation
int fork();

Returns 0 in child process and child process ID in parent process.

Other Related Functions
intgetpid() returns the current process ID
intgetppid() returns the parent process ID
wait() makes a process wait for other process to complete

Virtual fork
vfork() function is similar to fork but both processes shares the same address space.

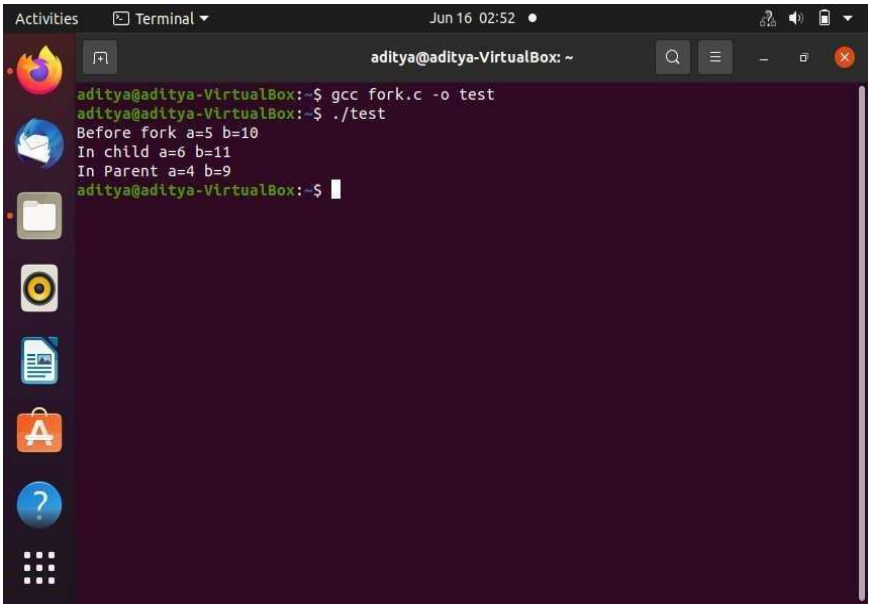
Q1. Find the output of the following program

```
#include <stdio.h>
#include<unistd.h>

int main()
{
int a=5,b=10,pid;
printf("Before fork a=%d b=%d \n",a,b); pid=fork();

if(pid==0)
{
a=a+1; b=b+1;
printf("In child a=%d b=%d \n",a,b);
}
else
{
sleep(1); a=a-1; b=b-1;
printf("In Parent a=%d b=%d \n",a,b);
}
return 0;
}
```

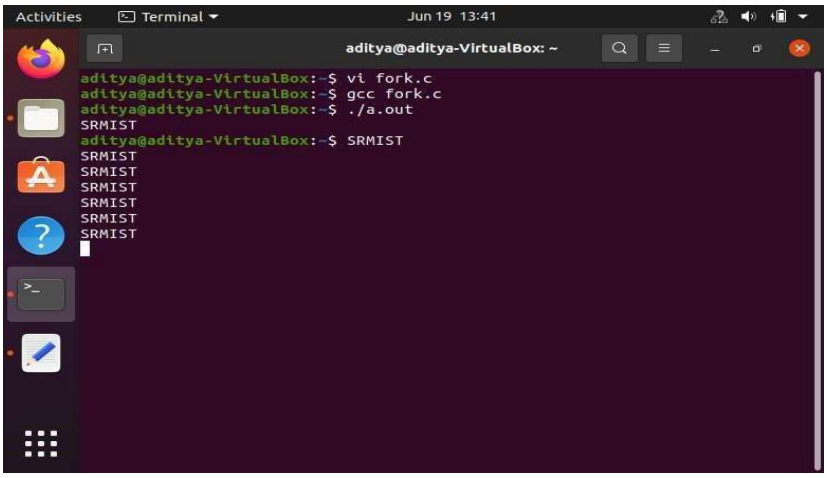
Output:



Q2. Calculate the number of times the text “SRMIST” is printed.

```
#include
<stdio.h> #include<unistd.h>
int main()
{
fork();          fork();
fork();
printf(“SRMIST\n”);
return 0;
}
```

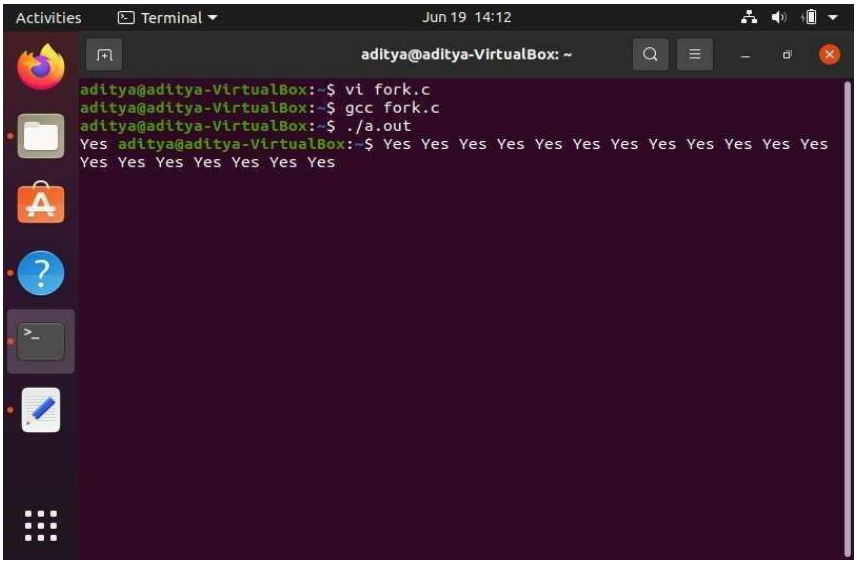
Output:



Q3. How many child processes are created for the following code?

```
#include <stdio.h>
#include<unistd.h>
intmain()
{ fork();
fork()&&fork()||fork();
fork();
printf("Yes ");  return 0;
}
```

Output:



Result- The given programs have been executed successfully.

Program No. 7
System Admin Commands

INSTALLING SOFTWARE

To Update the package repositories

sudo apt-get update

To update installed software

sudo apt-get upgrade

To install a package/software

sudo apt-get install <package-name>

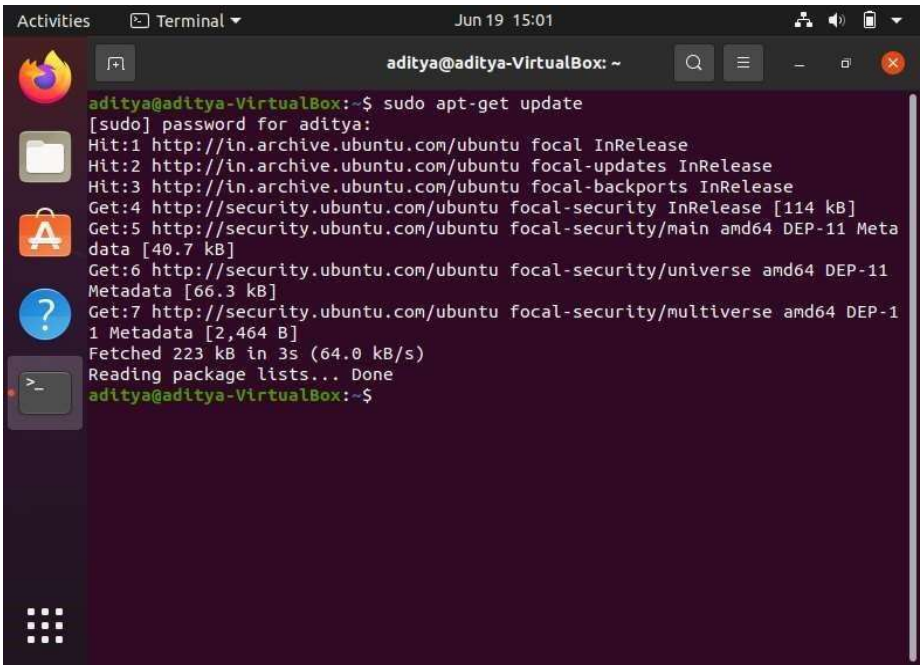
To remove a package from the system

sudo apt-get remove <package-name>

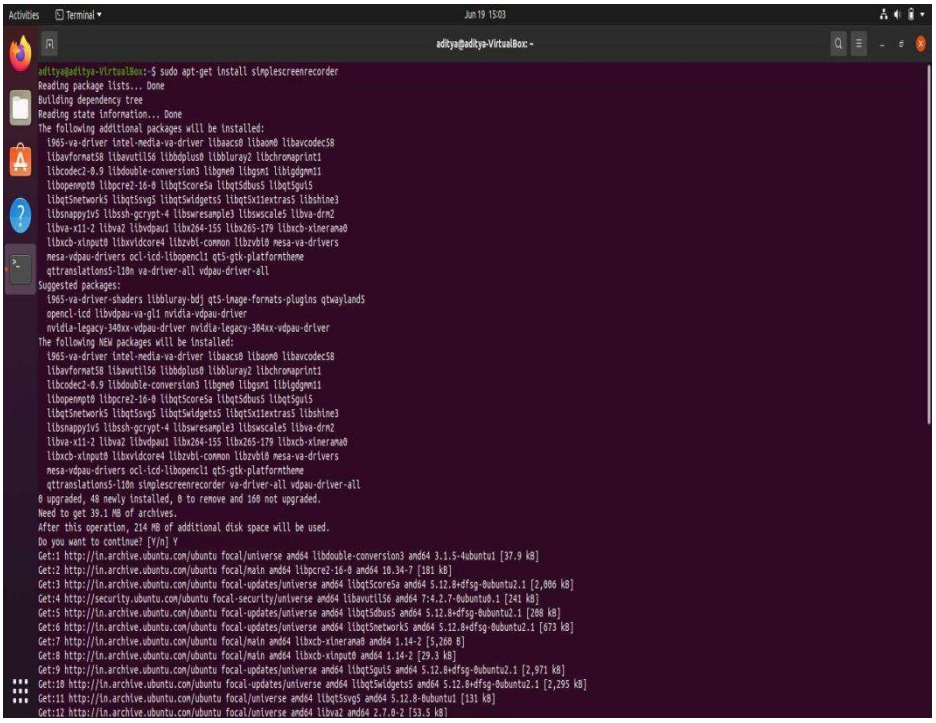
To reinstall a package

sudo apt-get install <package-name> --reinstall

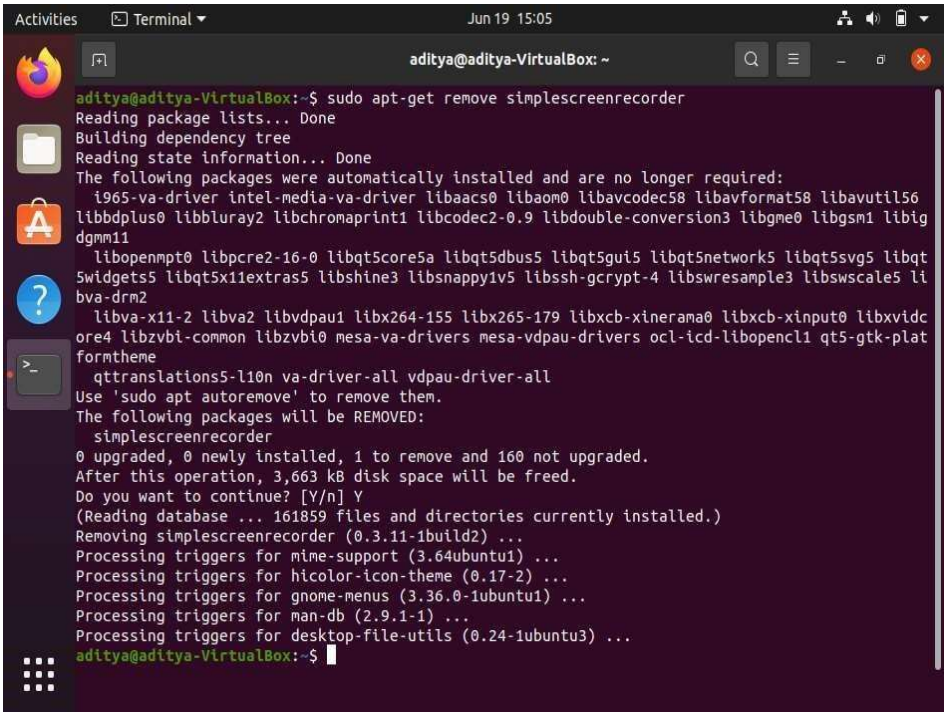
Q1. Update the package repositories



Q2. Install the package “simplescreenrecorder”



Q3. Remove the package “simplescreenrecorder”



MANAGING USERS

- Managing users is a critical aspect of server management.
- In Ubuntu, the root user is disabled for safety.
- Root access can be completed by using the sudo command by a user who is in the “admin” group.
- When you create a user during installation, that user is added automatically to the admin group.

To add a user:

sudoadduser username

To disable a user:

sudopasswd -l username

To enable a user:

sudopasswd -u username

To delete a user:

sudouserdel –r username

To create a group:

sudoaddgroupgroupname

To delete a group:

sudodelgroupgroupname

To create a user with group:

sudoadduser username groupname

To see the password expiry value for a user,

sudochage -l username

To make changes:

sudochage username

GUI Tool for User Management

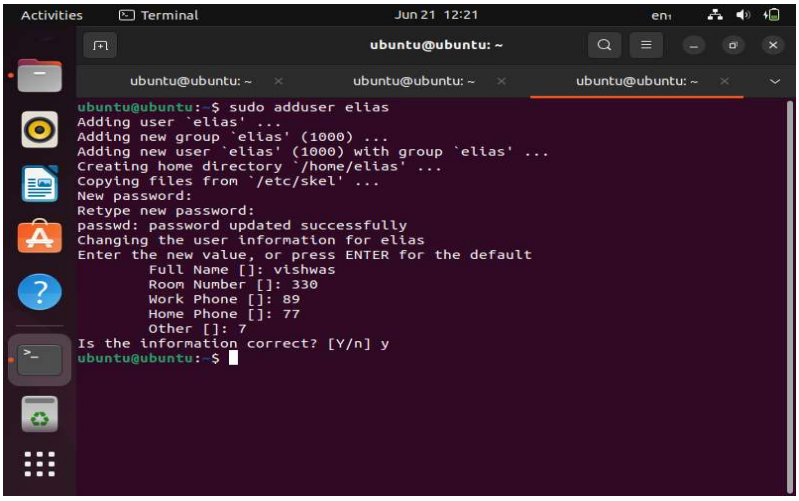
If you do not want to run the commands in terminal to manage users and groups, then you can install a GUI add-on.

sudo apt install gnome-system-tools

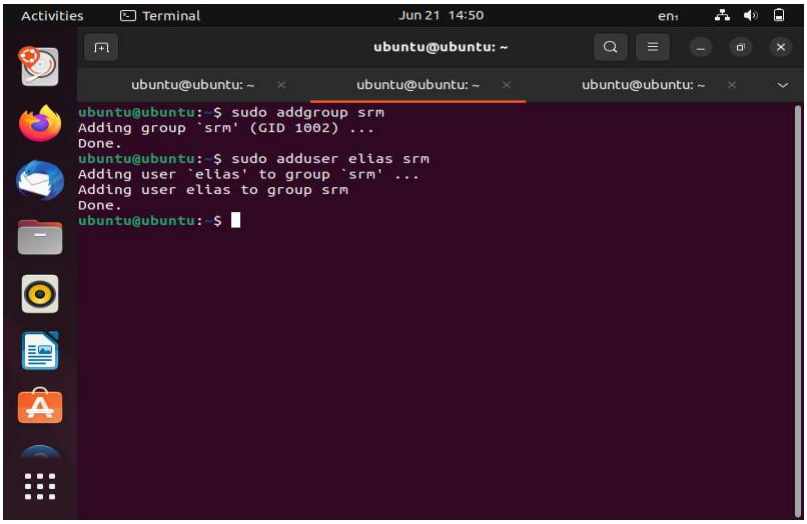
Once done, type

users-admin

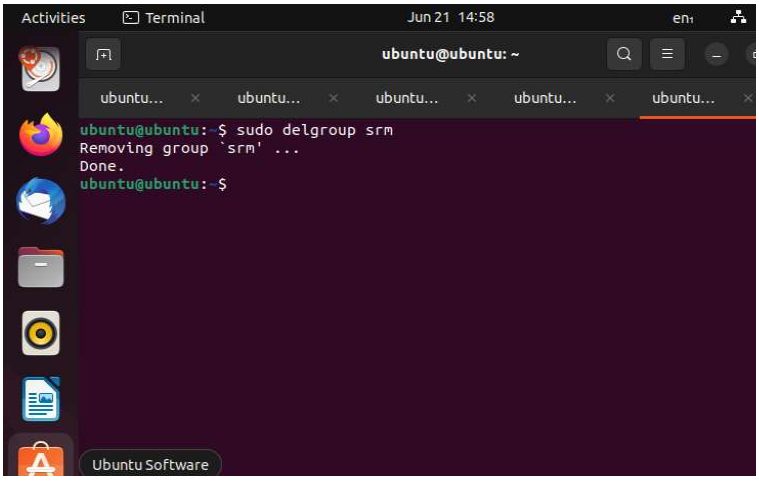
Q4. Create a user ‘elias’. Login to the newly created user and exit.



Q5. Create a group ‘cse’ and add the user ‘elias’ in that group .



Q6. Delete the user ‘elias’ and then delete the group ‘cse’.



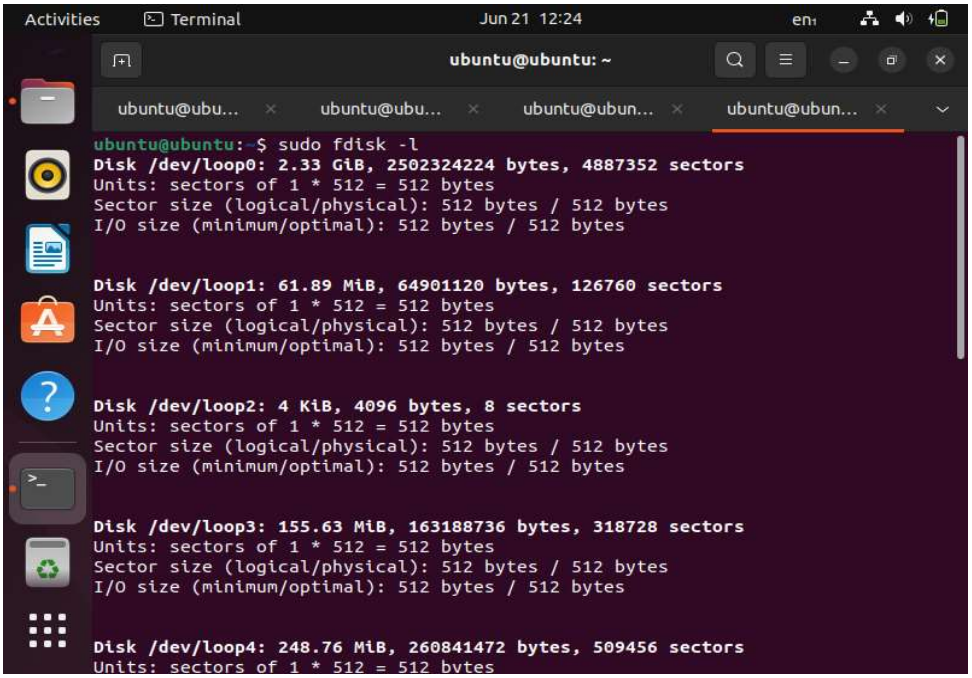
FILE SYSTEM

A file system is a permanent storage for containing data. Any non-volatile storage device like hard disk, usbetc has a file system in place, on top of which data is stored. While installing Linux, you may opt for either EXT4 or EXT3 file system.

EXT3: A journaling filesystem: logs changes in a journal to increase reliability in case of power failure or system crash.
EXT4: It is an advanced file syste. This file system supports 64-bit storage limits, columns up to 1 exabytes and you may store files up to 16 terabytes

Disk Partitions can be viewed by the command sudofdisk -l File system information are available in the file /etc/fstab

Q.7. List the partitions available in your system



NETWORKING

Most networking is configured by editing two files:

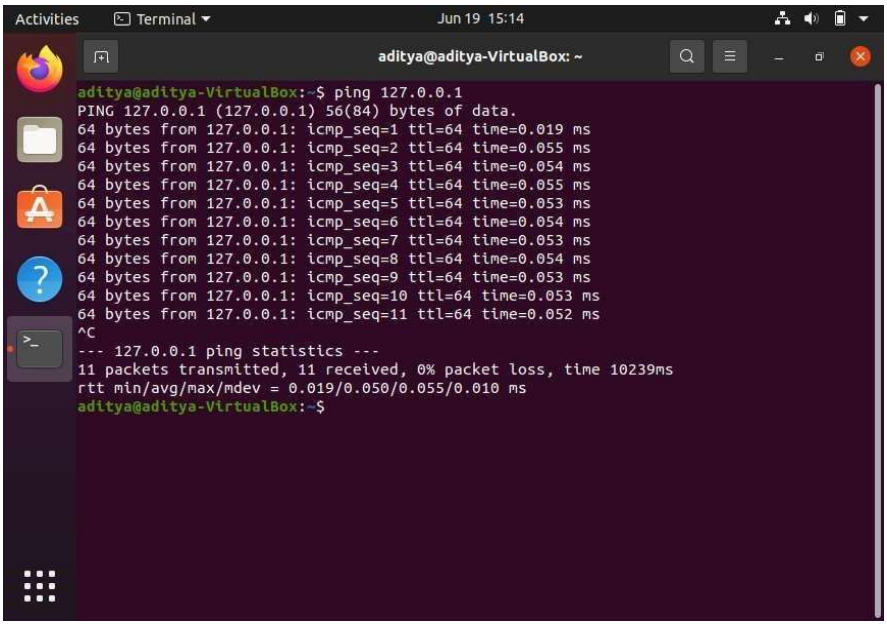
- /etc/network/interfaces
  Ethernet, TCP/IP, bridging
- /etc/resolv.confo DNS
  Other networking files:
- /etc/hosts
- /etc/dhcp3/dhcpd.conf

To test any host's connectivity
ping <ip-address>

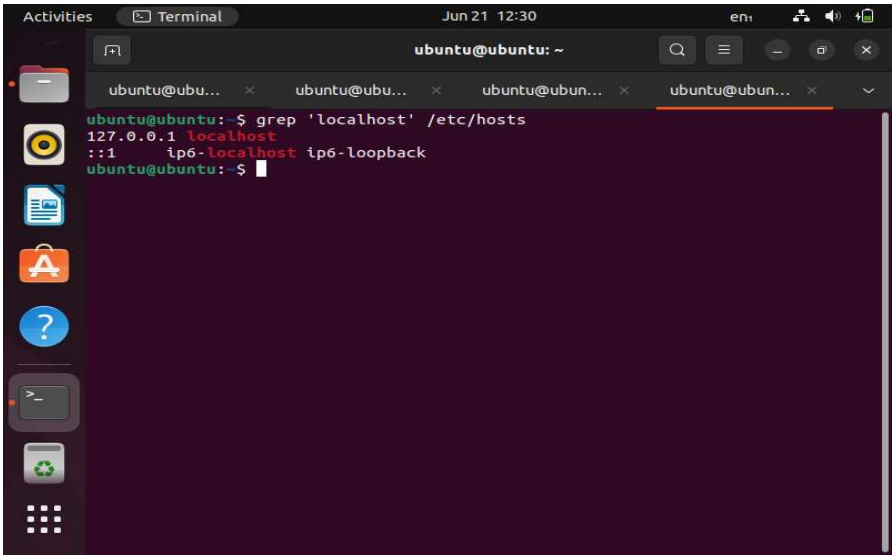
To start/stop/restart/reload networking services
sudo /etc/init.d/mnetworking<function>

Note : <function> can be any one of stop or start or reload or restart

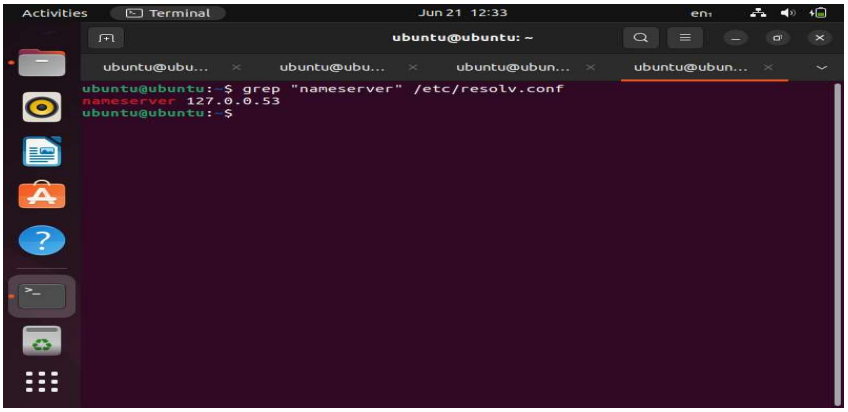
Q8. Check the connectivity of the host with IP address 127.0.0.1.



Q9. Find the IP address of the localhost.



Q10. Find the IP address of the DNS Server (name server)



INSTALLING INTERNET SERVICES

Installing Apache server

sudo apt-get install apache2

Configuration file for Apache server

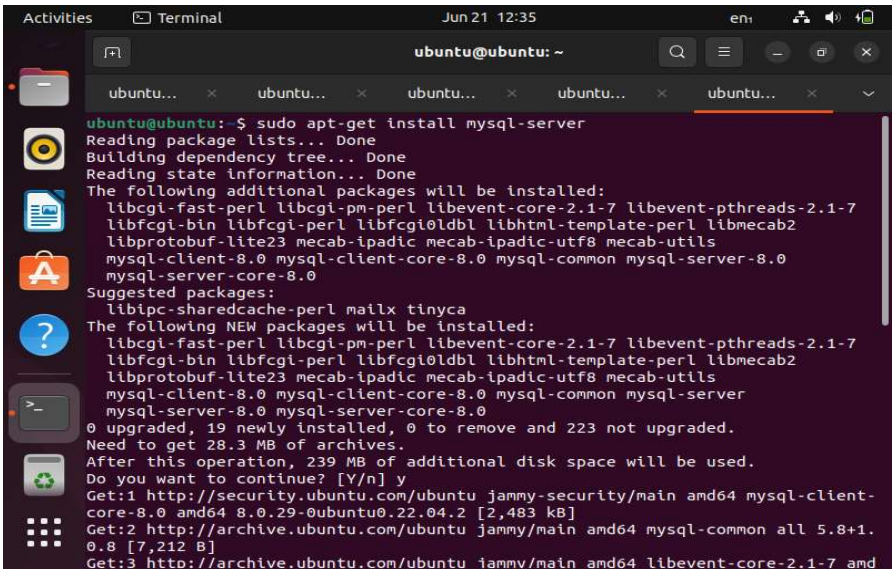
apache2.conf

Restart apache services after any configuration changes made

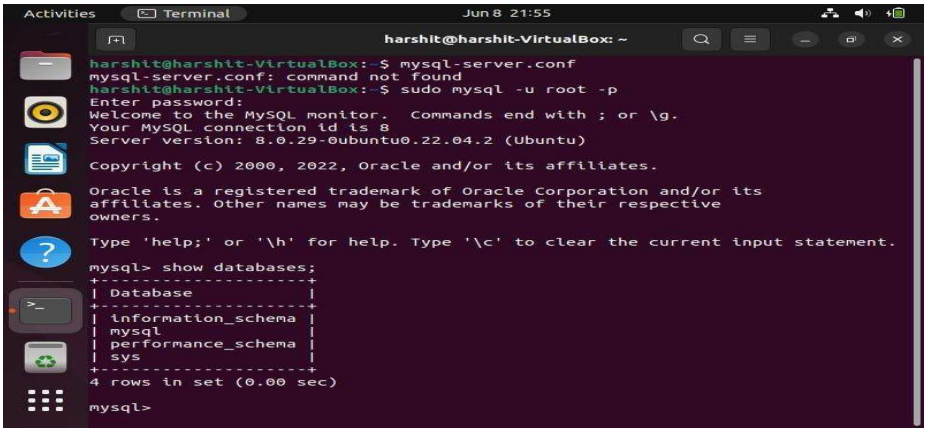
sudo /etc/init.d/mnetworking restart

Similarly all services can be installed, configured and restarted

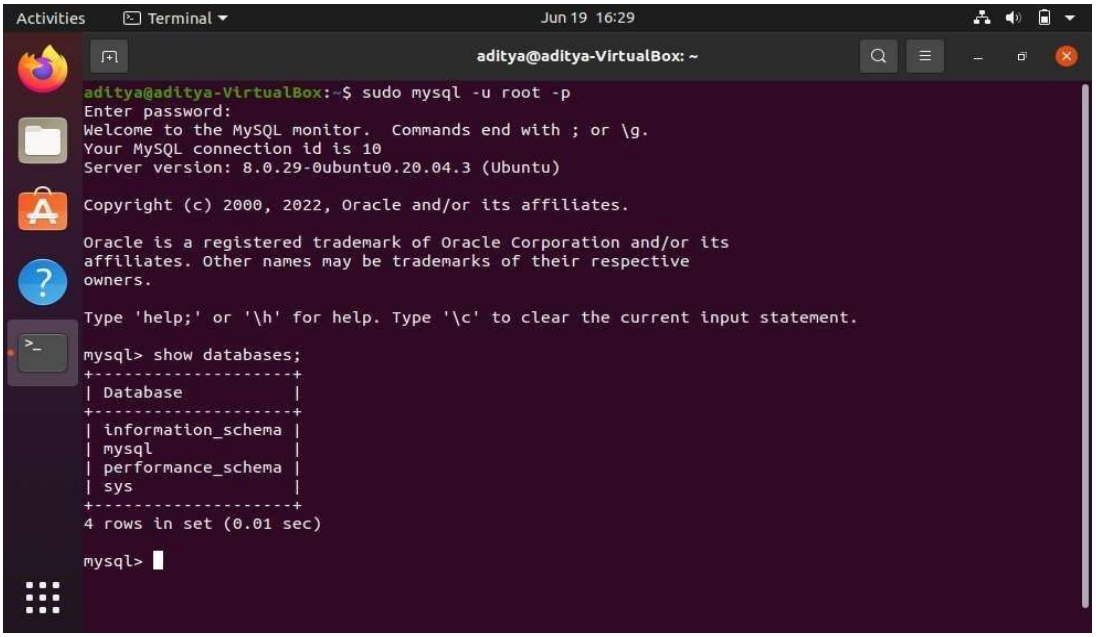
Q11. Install mysql server



Q12. Log on as root into mysql server



Q13. Create a new database for mysql server



Result- The given program has been performed successfully.

Program No. 8
Simple Task Automation

Linux Cron utility is an effective way to schedule a routine background job at a specific time and/or day on an on-going basis. You can use this to schedule activities, either as one- time events or as recurring tasks.

Crontab Syntax m h dom mon dow command

- m – The minute when the cron job will run (0-59)
- h - a numeric value determining the hour when the tasks will run (0-23)
- dom – Day of the Month when the cron job will run (1-31)
- mon - The month when the cron job will run (1-12)
- dow – Day Of the Week from 0-6 with Sunday being 0
- command- The linux command you wish to execute

Scheduling of Tasks (For Ubuntu)

Step-1: Open terminal and type the command
crontab -e
Step-2: Choose the editor. Better to select nano editor
Step-3: Edit the file based on the syntax given above
Step-4: Save and Exit the file
Step-5: Start cron daemon using the following command
systemctl start cron

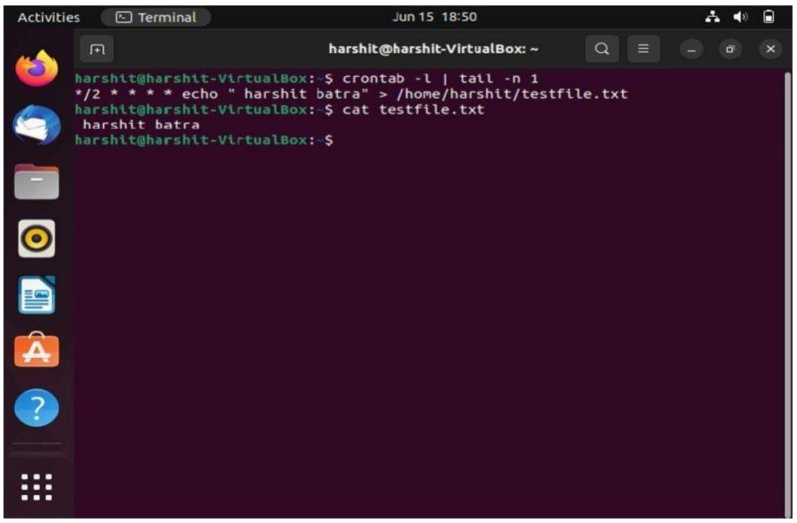
Example of crontab entry

0 8 * * 1 echo Have a Good Week >>tmpfile
Every Monday 8:00 am the message “Have a Good Week” transferred to the file ‘tmpfile’

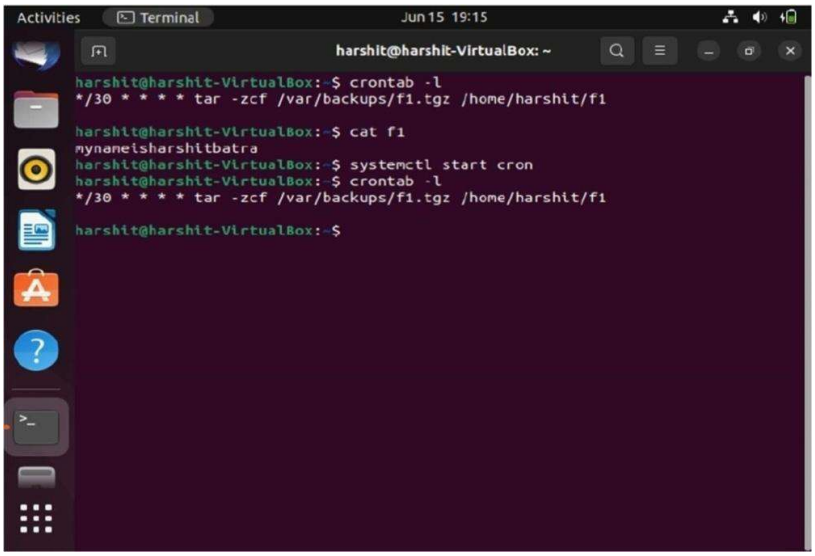
Special Crontab Characters

* represents all possible value
/ represents partial value. Ex. */10 in minute column specifies every 10 minutes
- represent range of values. Ex. 6-9 in hour column specifies 6am to 9 am
, (Comma) represent different set of values. Ex. 1,4 in month specifies Jan and Apr month

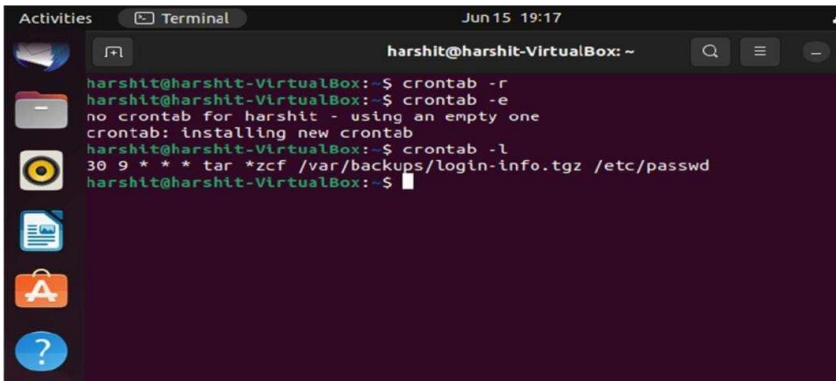
Q1. Schedule a task to display the following message on the monitor for every 2 minutes.



Q2. Schedule a task to take backup of your important file (say file f1) for every 30 minutes



Q3. Schedule a task to take backup of login information everyday 9:30am.



Result- The given program has been performed successfully.

Program No. 9
Shell Programs

How to run a Shell Script

- Edit and save your program using editor
- Add execute permission by chmod command
- Run your program using the name of your program
- ./program-name

Important Hints

- No space before and after the assignment operator Ex. sum=0
- Single quote ignores all special characters. Dollar sign, Back quote and Back slash are not ignored inside Double quote. Back quote is used as command substitution. Back slash is used to remove the special meaning of a character.
- Arithmetic expression can be written as follows : i=$((i+1) or i=$(expr $i + 1)
- Command line arguments are referred inside the programme as $1, $2, ..and so on
- $* represents all arguments, $# specifies the number of arguments
- read statement is used to get input from input device. Ex. read a b

Syntax for if statement

```
if [ condition ] then
...
elif [ condition ] then
        ... else
...
fi
```

Syntax for case structure

```
case value in pat1) ...statement;;
pat2) ... Statement;;
*)              ...
Statement;;
Esac
```

Syntax for for-loop

```
for var in list-of-values do
...
...
done
```

Syntax for While loop

while command,do

...

...

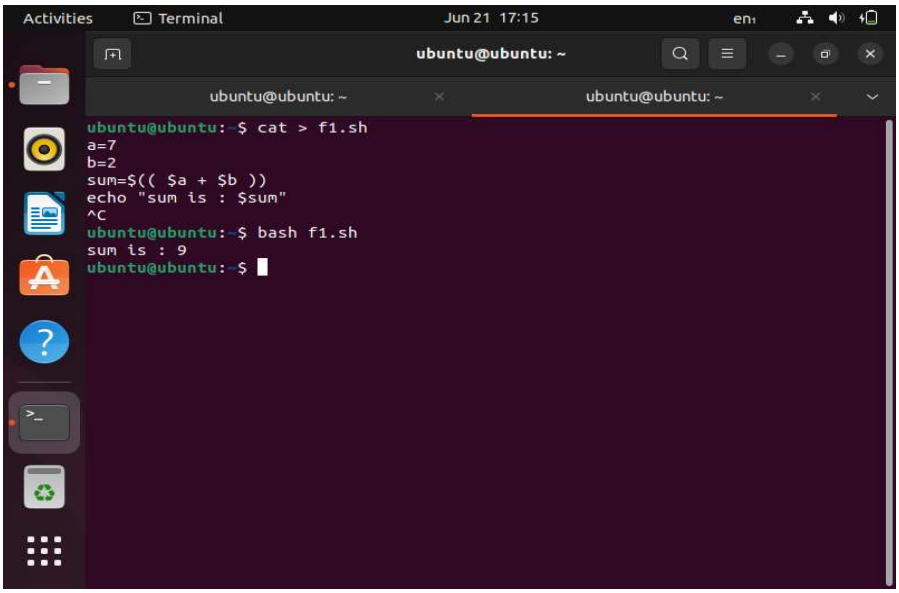
done

Syntax for printf statement

printf "string and format" arg1 arg2 … …

- Break and continue statements functions similar to C programming
- Relational operators are –lt, -le, -gt, -ge, -eq,-ne
- Ex. (i>= 10) is written as [$i -ge 10]
- Logical operators (and, or, not) are -o, -a, !
- Ex. (a>b) && (a>c) is written as [$a –gt $b –a $a –gt $c]
- Two strings can be compared using = operator

Q1. Write a program to perform sum of two numbers using shell.



Result- The given program has been performed successfully.

Program No. 10
Pipes

Pipe is a communication medium between two or more processes. The system call for creating pipe is

int pipe(int p[2]);

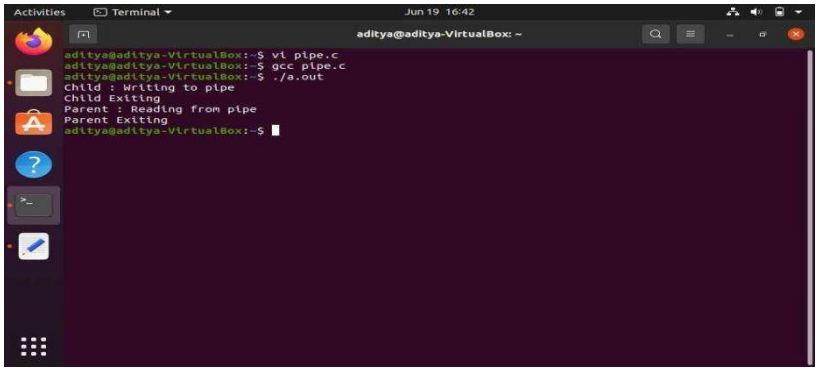
This system call would create a pipe for one-way communication i.e., it creates two descriptors, first one is connected to read from the pipe and other one is connected to write into the pipe. Descriptor p[0] is for reading and p[1] is for writing. Whatever is written into p[1] can be read from p[0].

Q1. Write the output of the following program

```
#include <stdio.h>
#include<unistd.h>
#include<sys/wait.h>
int main()
    { int p[2];
    char buff[25];
    if(fork()==0)
    { printf("Child : Writing to pipe \n");
    write(p[1],"Welcome",8); printf("Child Exiting\n");
    }
    else
    { wait(NULL);
    printf("Parent : Reading from pipe \n");
    read(p[1],buff,8); printf("Parent Exiting\n");
    }
    return 0;

}
```

Output:

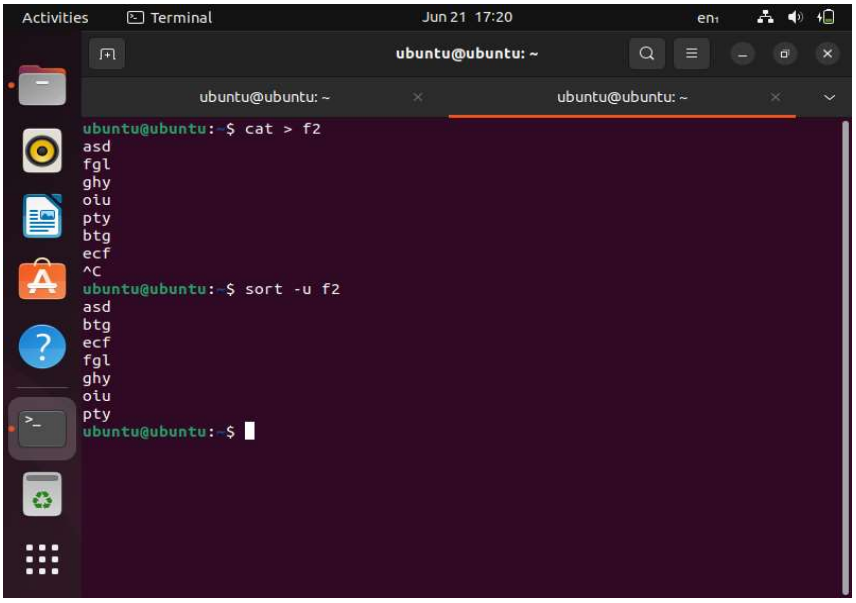


Implementing command line pipe using exec() family of functions00

Follow the steps to transfer the output of a process to pipe:

i. Close the standard output descriptor
ii. Use the following system calls, to take duplicate of output file descriptor of the pipe
    int dup(intfd);
    int dup2(intoldfd, intnewfd);
iii. Close the input file descriptor of the pipe
iv. Now execute the process

Q.2. Write a program to sort a file using pipes.



Result-The given programs have been performed successfully.

Program No. 11
First Come First Serve Scheduling

Q. Write a program to implement First Come First Serve scheduling in C language

```
#include <stdio.h>
int main()
{  int pid[15], bt[15], n;
   printf("Enter the number of processes: ");
   scanf("%d",&n);

   printf("Enter process id of all the processes: ");
   for(int i=0;i<n;i++)
   {     scanf("%d",&pid[i]);    }

   printf("Enter burst time of all the processes: ");
   for(int i=0;i<n;i++)
   {     scanf("%d",&bt[i]);    }

   int i, wt[n];  wt[0]=0;
   for(i=1; i<n; i++)
   {   wt[i]= bt[i-1]+ wt[i-1];    }

   printf("Process ID     Burst Time     Waiting Time     TurnAround Time\n");
   float twt=0.0;
   float tat= 0.0;
   for(i=0; i<n; i++)
   {  printf("%d\t\t", pid[i]);
      printf("%d\t\t", bt[i]);
      printf("%d\t\t", wt[i]);
      printf("%d\t\t", bt[i]+wt[i]);
      printf("\n");

      twt += wt[i];
      tat += (wt[i]+bt[i]);    }

   float att,awt;
   awt = twt/n;
   att = tat/n;
   printf("Avg. waiting time= %f\n",awt);
   printf("Avg. turnaround time= %f",att);
}
```

Output-

```
Enter the number of processes: 3
Enter process id of all the processes: 1 2 3
Enter burst time of all the processes: 5 11 11
Process ID     Burst Time     Waiting Time     TurnAround Time
1               5               0               5
2               11              5               16
3               11              16              27
Avg. waiting time= 7.000000
Avg. turnaround time= 16.000000
```

Result-The given program have been performed successfully.

Program No. 12
Shortest Job First Scheduling

Q. Write a program to implement Shortest Job First scheduling in C language

```
#include<stdio.h>
int main()
{
   int bt[20],p[20],wt[20],tat[20],i,j,n,total=0,totalT=0,pos,temp;
   float avg_wt,avg_tat;
   printf("Enter number of process:");
   scanf("%d",&n);

   printf("\nEnter Burst Time:\n");
   for(i=0;i<n;i++)
   {
      printf("p%d:",i+1);
      scanf("%d",&bt[i]);
      p[i]=i+1;
   }

   for(i=0;i<n;i++)
   {
      pos=i;
      for(j=i+1;j<n;j++)
      {  if(bt[j]<bt[pos])
            pos=j;
      }
      temp=bt[i];
      bt[i]=bt[pos];
      bt[pos]=temp;

      temp=p[i];
      p[i]=p[pos];
      p[pos]=temp;
   }

   wt[0]=0;
   for(i=1;i<n;i++)
   {
      wt[i]=0;
```

```
    for(j=0;j<i;j++)
        wt[i]+=bt[j];
     total+=wt[i];
  }

  avg_wt=(float)total/n;

  printf("\nProcess\t Burst Time \tWaiting Time\tTurnaround Time");
  for(i=0;i<n;i++)
  {
    tat[i]=bt[i]+wt[i];
    totalT+=tat[i];
    printf("\np%d\t\t %d\t\t %d\t\t\t%d",p[i],bt[i],wt[i],tat[i]);
  }

  avg_tat=(float)totalT/n;
  printf("\n\nAverage Waiting Time=%f",avg_wt);
  printf("\nAverage Turnaround Time=%f",avg_tat);
}
```

Output-

```
Enter number of process:4

Enter Burst Time:
p1:5
p2:4
p3:12
p4:7

Process      Burst Time     Waiting Time    Turnaround Time
p2               4              0                4
p1               5              4                9
p4               7              9                16
p3               12             16               28

Average Waiting Time=7.250000
Average Turnaround Time=14.250000
```

Result-The given programs have been performed successfully.