

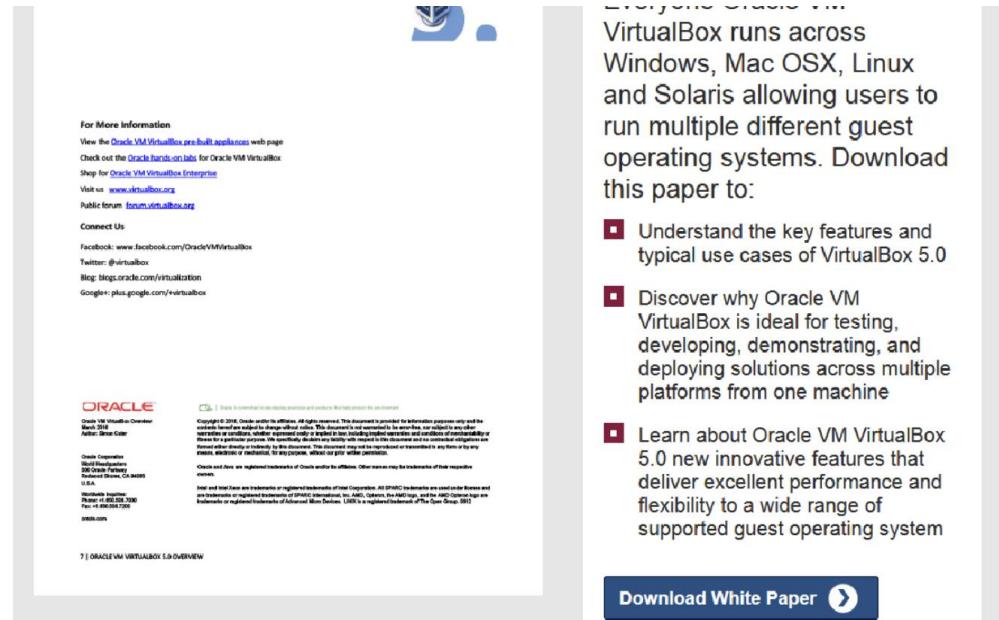
CS553 CLOUD COMPUTING: FALL 2022

HOMEWORK 1

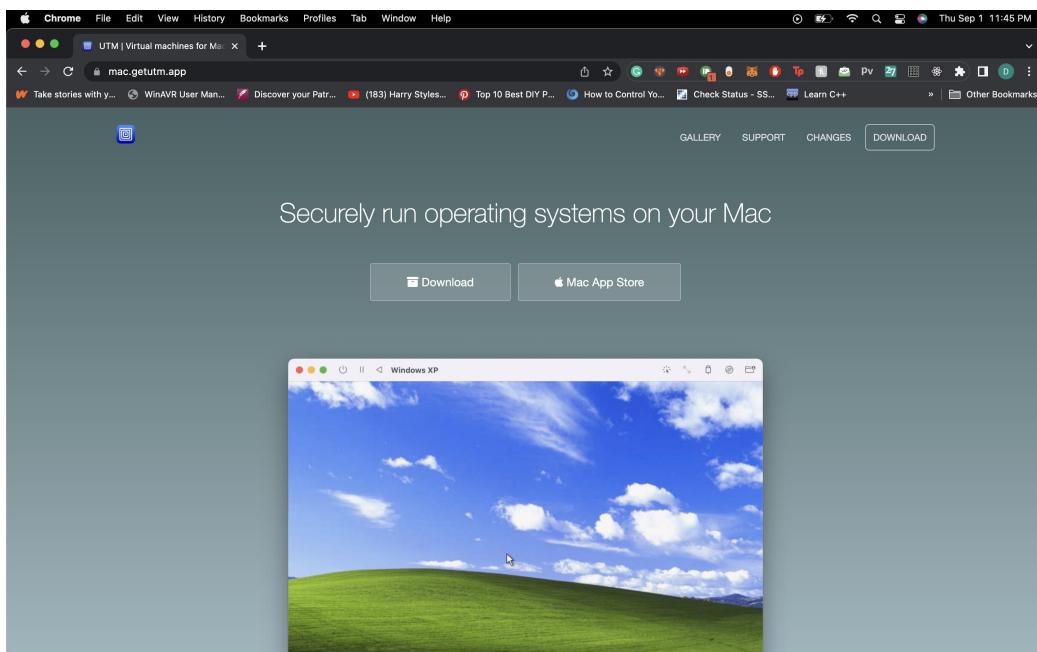
**Name: DEEKSHA PRABHAKAR
CWID: A20478791**

A1.

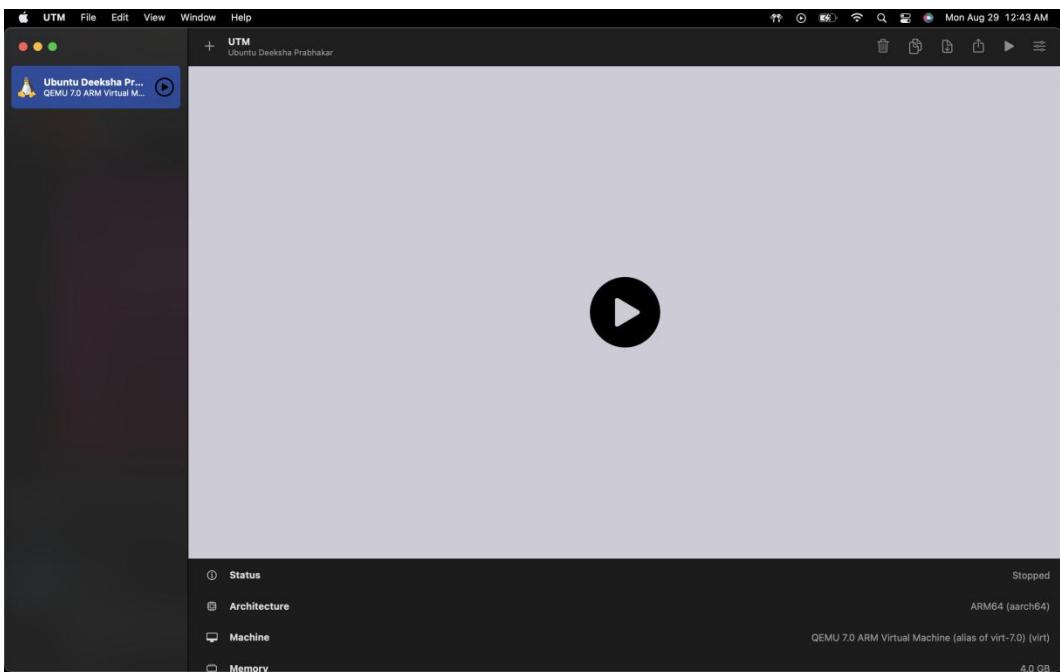
A.



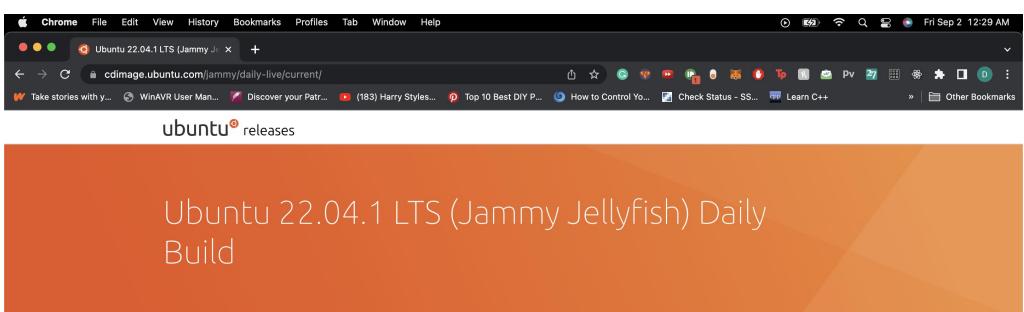
B. Since I am using mac m1, I have used UTM as suggested by Lan Nguyen.



C.



D.



Select an image

A screenshot of a "Select an image" dialog box. It contains two main sections: "Desktop image" and "64-bit ARM (ARMv8/AArch64) desktop image".

Desktop image

The desktop image allows you to try Ubuntu without changing your computer at all, and at your option to install it permanently later. This type of image is what most people will want to use. You will need at least 1024MiB of RAM to install from this image.

64-bit PC (AMD64) desktop image

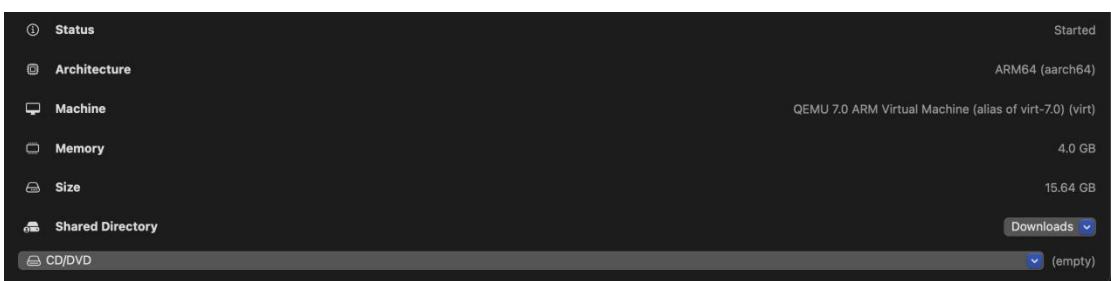
Choose this if you have a computer based on the AMD64 or EM64T architecture (e.g., Athlon64, Opteron, EM64T Xeon, Core 2). Choose this if you are at all unsure.

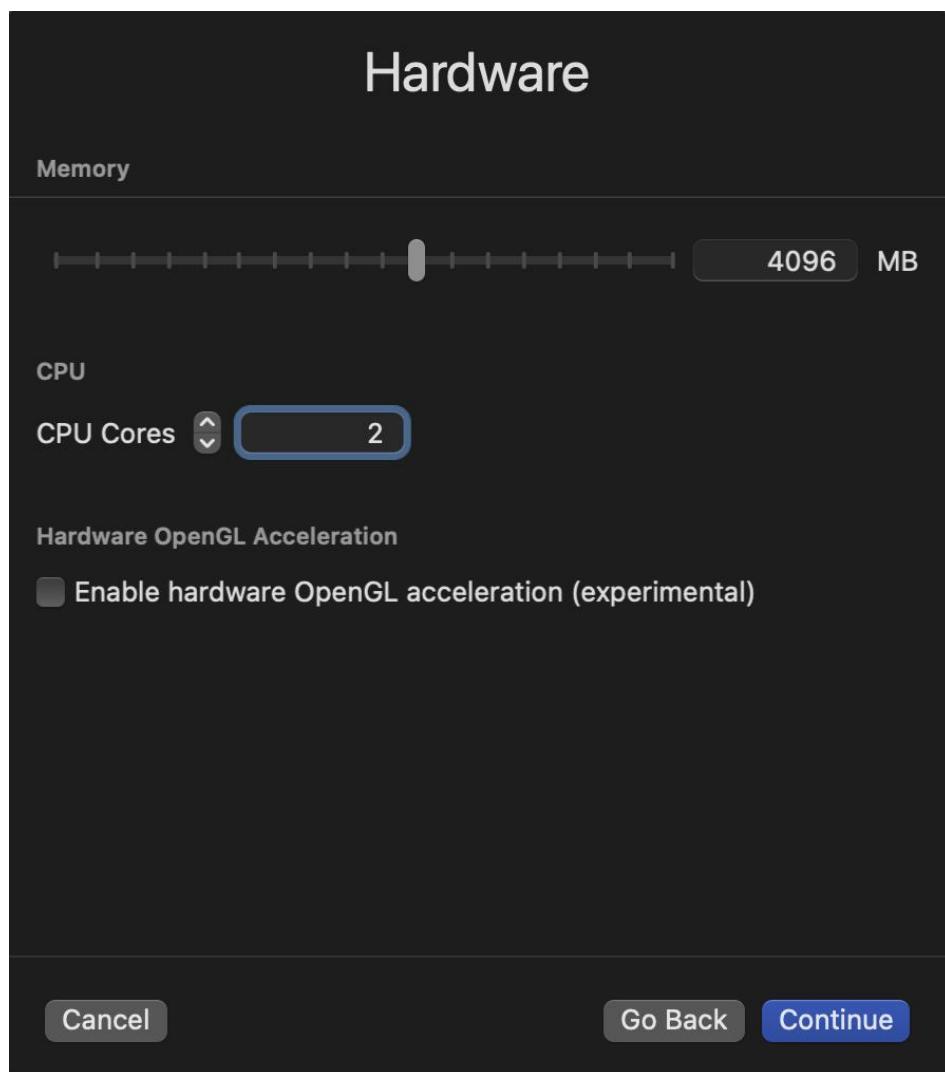
Warning: This image is oversized (which is a bug) and will not fit onto a standard 703MiB CD. However, you may still test it using a DVD, a USB drive, or a virtual machine.

64-bit ARM (ARMv8/AArch64) desktop image

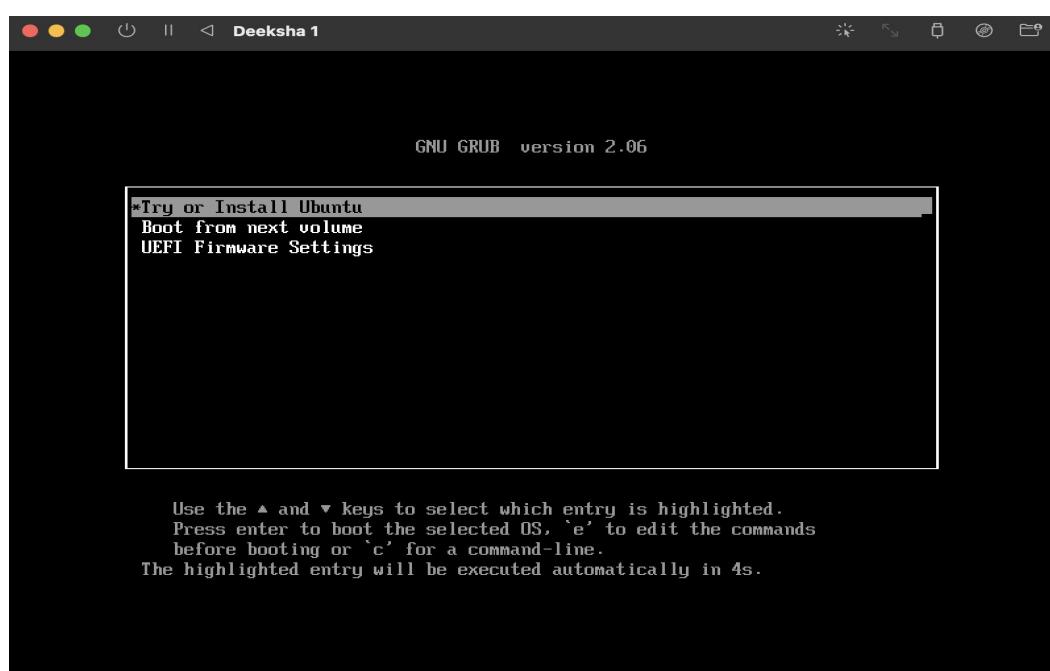
For 64-bit ARMv8 processors and above.

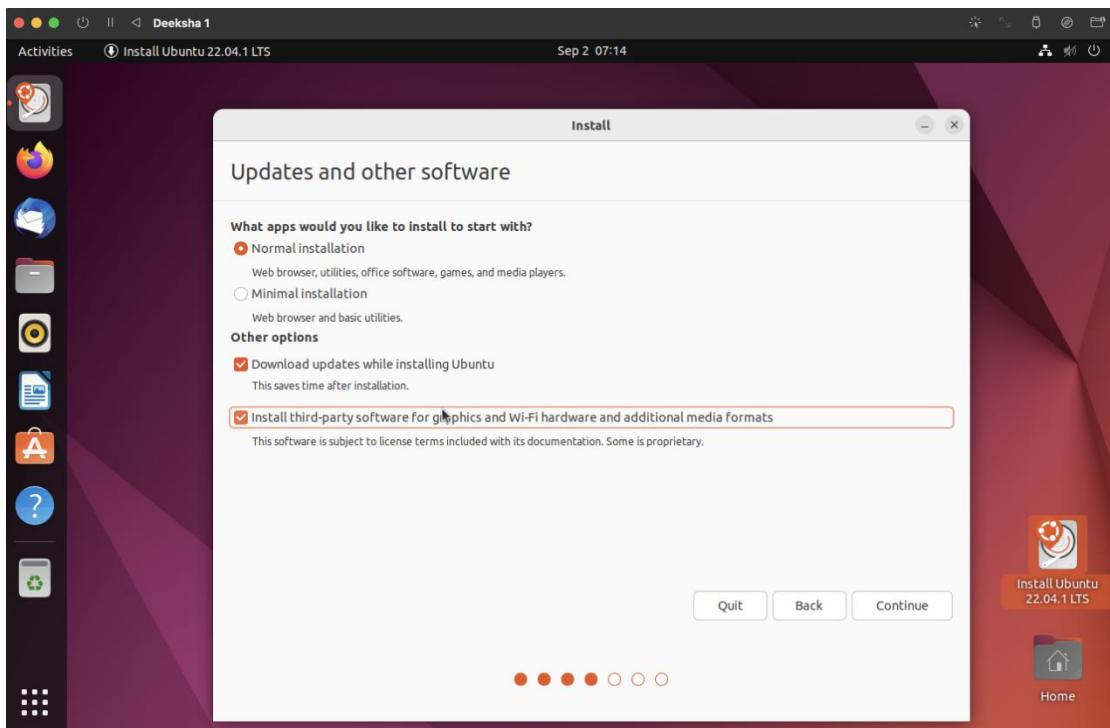
E.



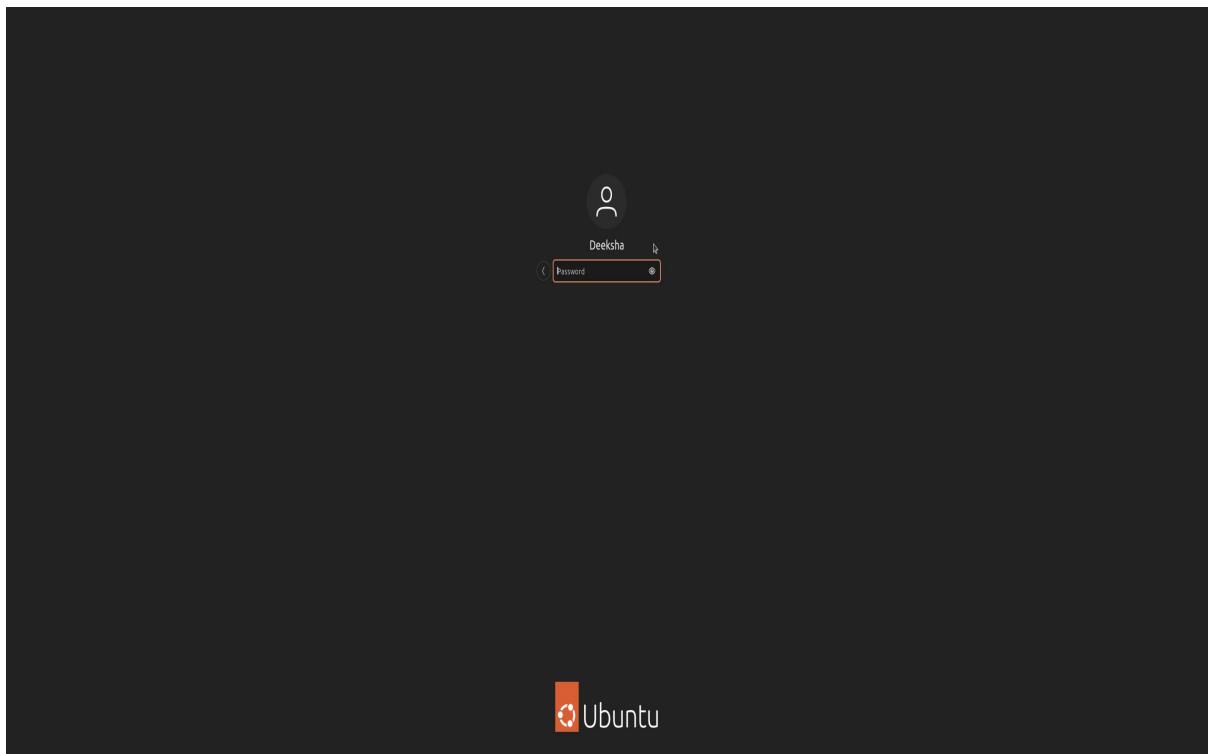


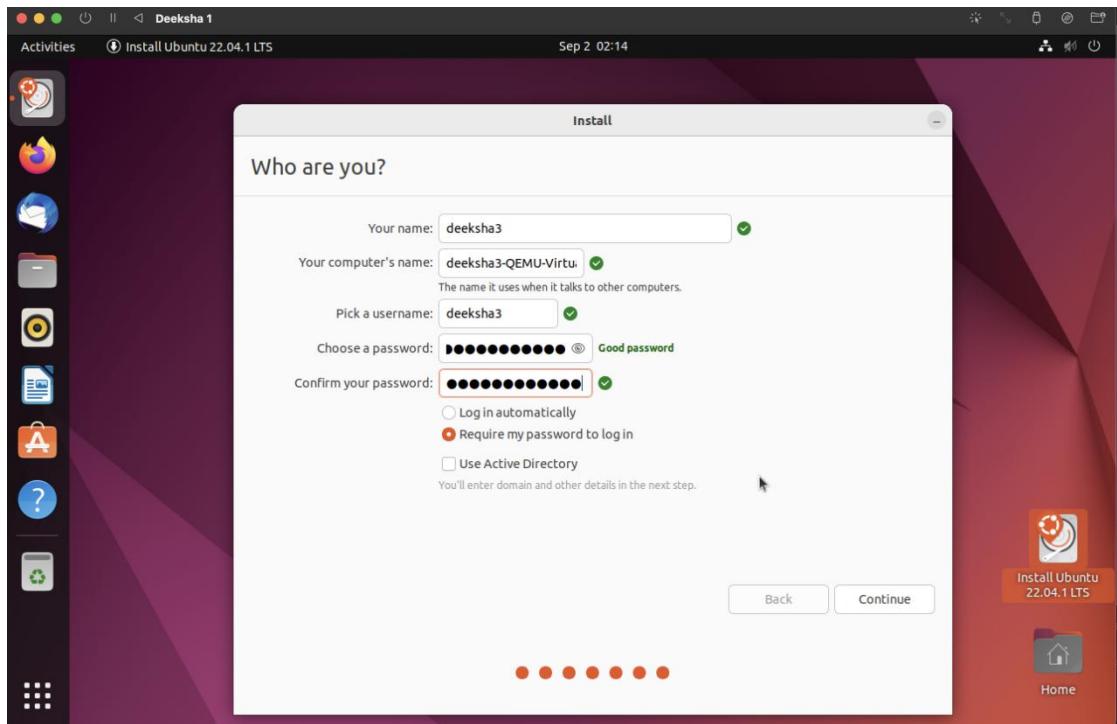
F.



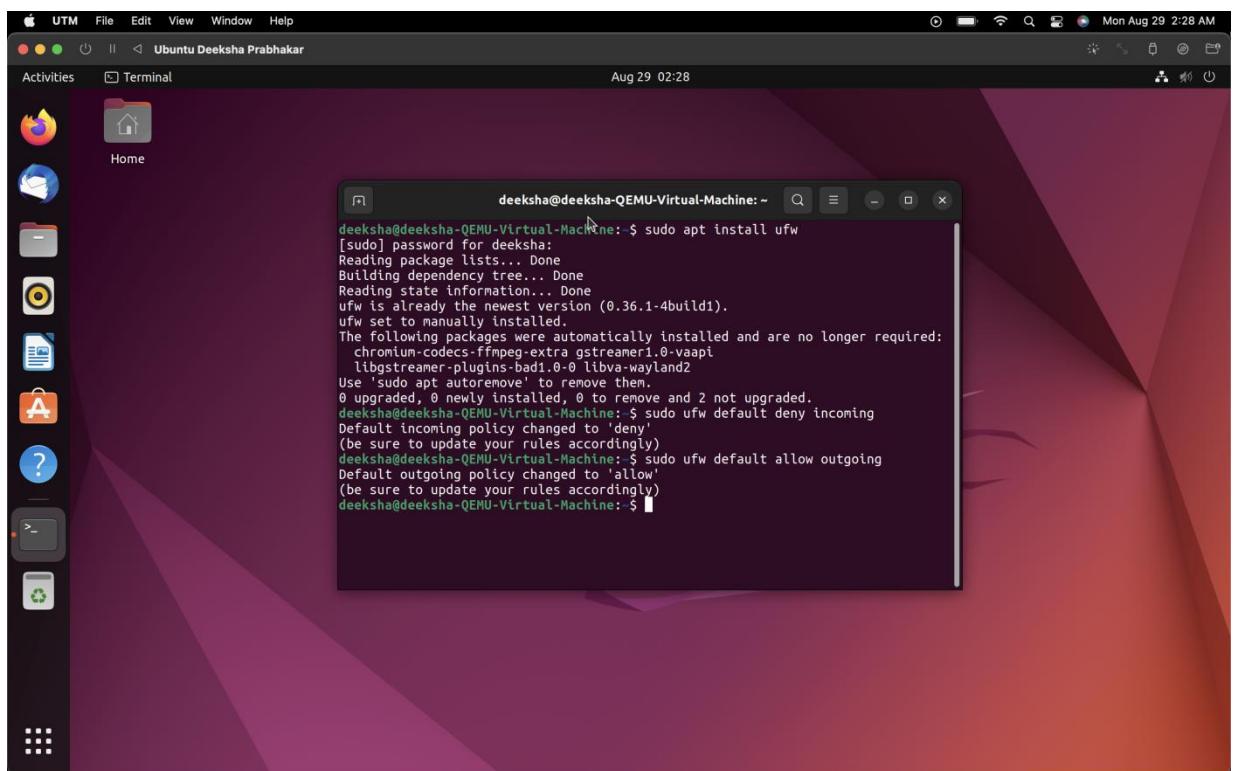


G.

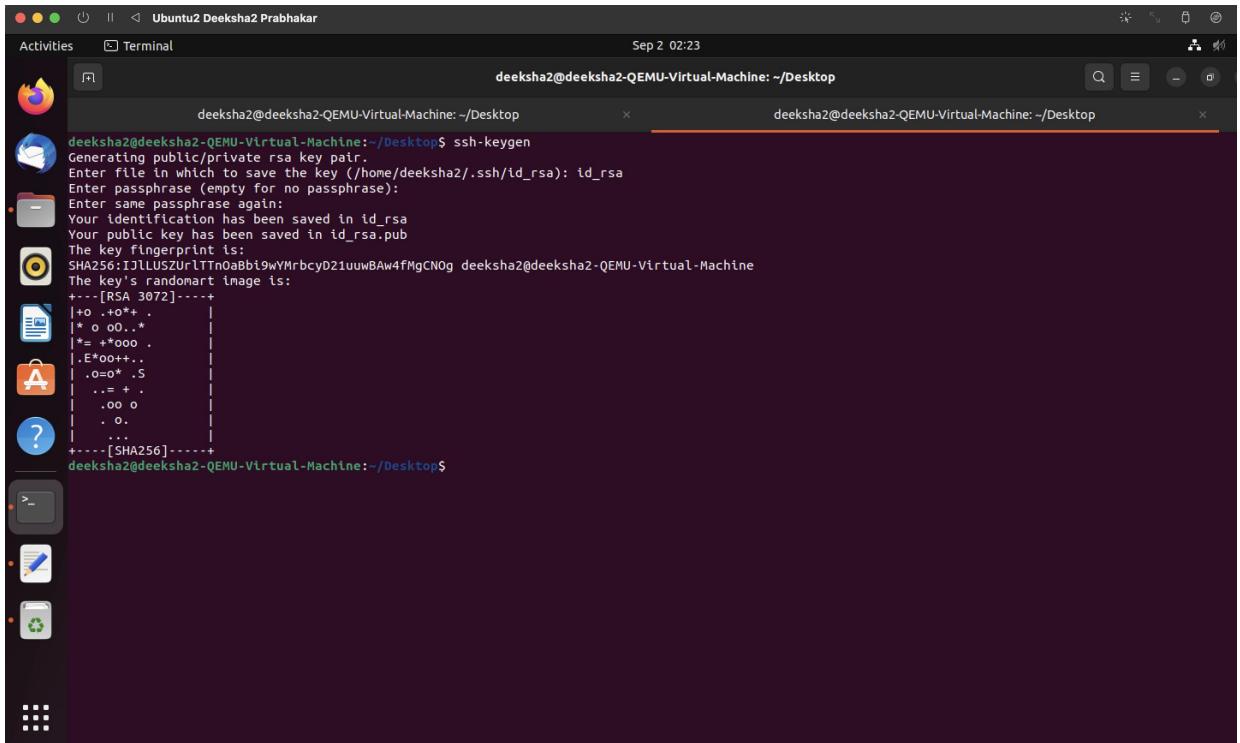




H.

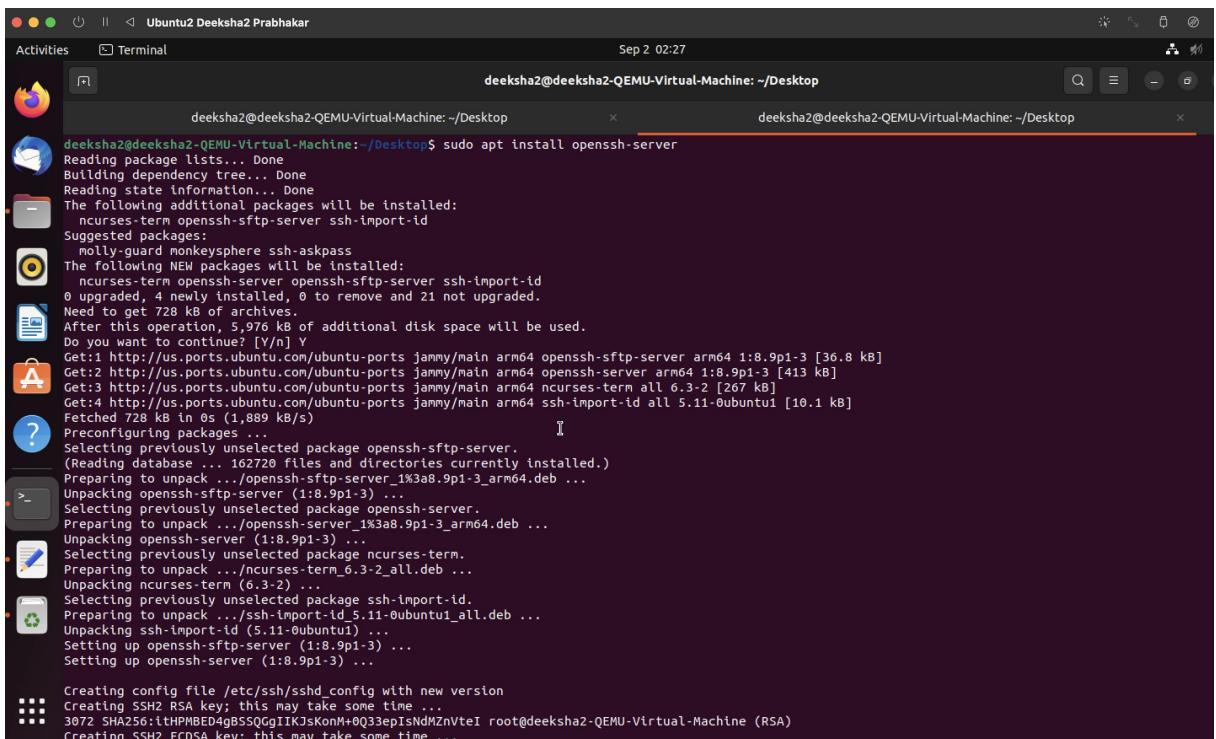


I.



Activities Terminal Sep 2 02:23

```
deeksha2@deeksha2-QEMU-Virtual-Machine: ~/Desktop
deeksha2@deeksha2-QEMU-Virtual-Machine:~/Desktop$ ssh-keygen
Generating public/private rsa key pair.
Enter file in which to save the key (/home/deeksha2/.ssh/id_rsa): id_rsa
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in id_rsa
Your public key has been saved in id_rsa.pub
The key fingerprint is:
SHA256:1JLLUSZUrLTInoAbBi9wYMrbcyD21uuwBAw4fMgCN0g deeksha2@deeksha2-QEMU-Virtual-Machine
The key's randomart image is:
+---[RSA 3072]---+
|+o .+o*+ .|
|* o oO .*|
|= +*000 .|
|.E*00++..|
|.o=0* .5|
...= + .|
..oo o|
... o.|
...
+---[SHA256]---+
deeksha2@deeksha2-QEMU-Virtual-Machine:~/Desktop$
```

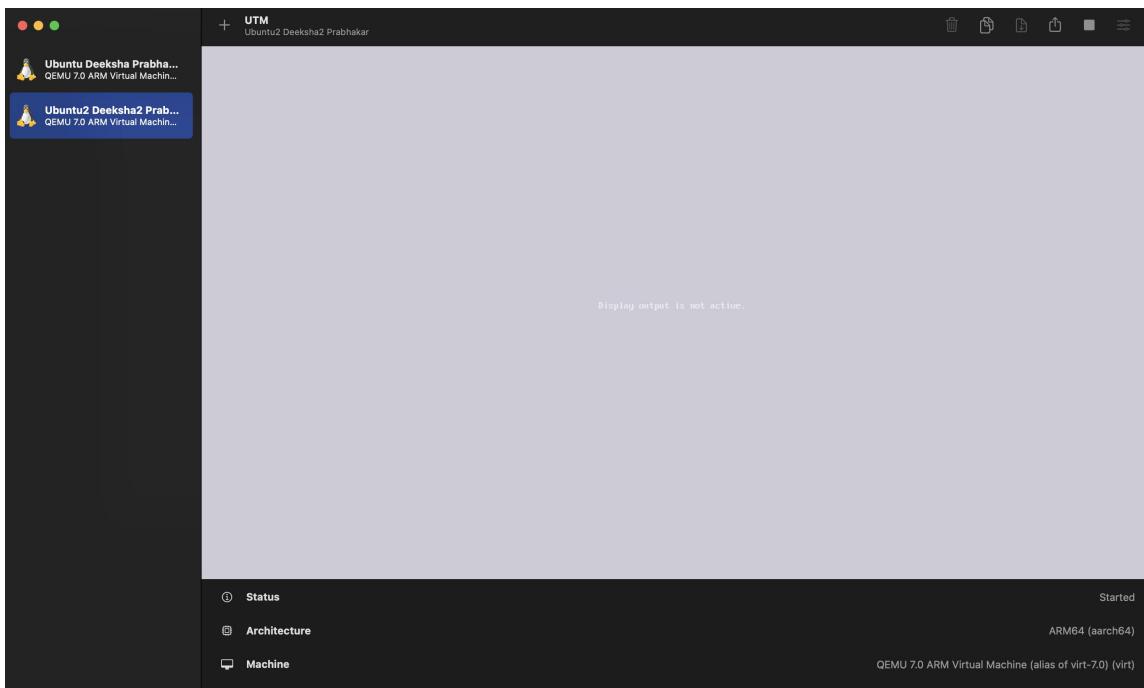


Activities Terminal Sep 2 02:27

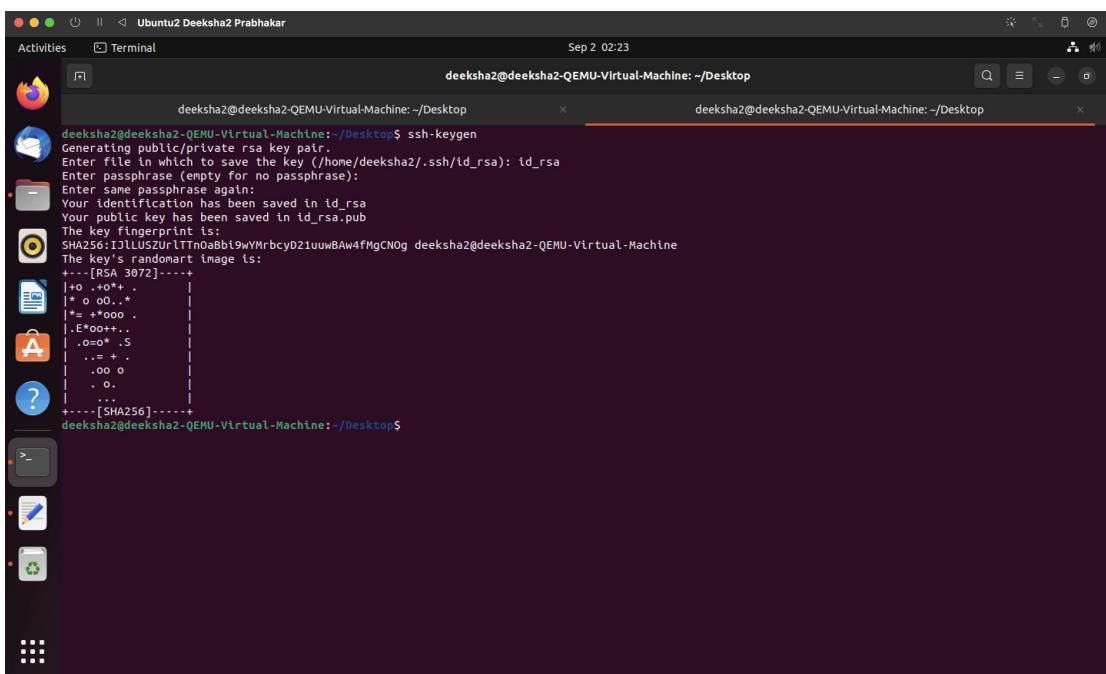
```
deeksha2@deeksha2-QEMU-Virtual-Machine: ~/Desktop
deeksha2@deeksha2-QEMU-Virtual-Machine:~/Desktop$ sudo apt install openssh-server
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  ncurses-term openssh-sftp-server ssh-import-id
Suggested packages:
  molly-guard monkeysphere ssh-askpass
The following NEW packages will be installed:
  ncurses-term openssh-server openssh-sftp-server ssh-import-id
0 upgraded, 4 newly installed, 0 to remove and 21 not upgraded.
Need to get 728 kB of archives.
After this operation, 5,976 kB of additional disk space will be used.
Do you want to continue? [Y/n] Y
Get:1 http://us.archive.ubuntu.com/ubuntu ports jammy/main arm64 openssh-sftp-server arm64 1:8.9p1-3 [36.8 kB]
Get:2 http://us.archive.ubuntu.com/ubuntu ports jammy/main arm64 openssh-server arm64 1:8.9p1-3 [413 kB]
Get:3 http://us.archive.ubuntu.com/ubuntu ports jammy/main arm64 ncurses-term all 6.3-2 [267 kB]
Get:4 http://us.archive.ubuntu.com/ubuntu ports jammy/main arm64 ssh-import-id all 5.11-0ubuntu1 [10.1 kB]
Fetched 728 kB in 0s (1,889 kB/s)
Preconfiguring packages ...
Selecting previously unselected package openssh-sftp-server.
(Reading database ... 162720 files and directories currently installed.)
Preparing to unpack .../openssh-sftp-server_1%3a8.9p1-3_arm64.deb ...
Unpacking openssh-sftp-server (1:8.9p1-3) ...
Selecting previously unselected package openssh-server.
Preparing to unpack .../openssh-server_1%3a8.9p1-3_arm64.deb ...
Unpacking openssh-server (1:8.9p1-3) ...
Selecting previously unselected package ncurses-term.
Preparing to unpack .../ncurses-term_6.3-2_all.deb ...
Unpacking ncurses-term (6.3-2) ...
Selecting previously unselected package ssh-import-id.
Preparing to unpack .../ssh-import-id_5.11-0ubuntu1_all.deb ...
Unpacking ssh-import-id (5.11-0ubuntu1) ...
Setting up openssh-sftp-server (1:8.9p1-3) ...
Setting up openSSH-server (1:8.9p1-3) ...

Creating config file /etc/ssh/sshd_config with new version
Creating SSH2 RSA key; this may take some time ...
3072 SHA256:iHMPMBED4gBSSQogIKJSkOnM+0Q33episNsdWZhVteI root@deeksha2-QEMU-Virtual-Machine (RSA)
Creating SSH2 ECDSA key; this may take some time ...
```

J.



K.



Ubuntu Deeksha Prabhakar

Activities Terminal Aug 31 01:28

```
deeksha@deeksha2-QEMU-Virutal-Machine: ~
```

Number of key(s) added: 1

Now try logging into the machine, with: "ssh 'deeksha@192.168.64.2'" and check to make sure that only the key(s) you wanted were added.

```
deeksha@deeksha2-QEMU-Virutal-Machine: $ ssh -i ~/.ssh/id_rsa deeksha@192.168.64.2
```

Welcome to Ubuntu 22.04.1 LTS (GNU/Linux 5.15.0-47-generic aarch64)

- * Documentation: <https://help.ubuntu.com>
- * Management: <https://landscape.canonical.com>
- * Support: <https://ubuntu.com/advantage>

3 updates can be applied immediately. To see these additional updates run: apt list --upgradable

```
A Last login: Wed Aug 31 01:14:46 2022 from 192.168.64.5
deeksha@deeksha2-QEMU-Virutal-Machine: $ scp ~/.ssh/id_rsa.pub deeksha@192.168.64.2:id_rsa.pub
Enter passphrase for key '/home/deeksha/.ssh/id_rsa':
id_rsa.pub          100% 590   1.8MB/s  00:00
deeksha@deeksha2-QEMU-Virutal-Machine: $ #
```

Ubuntu2 Deeksha2 Prabhakar

Activities Terminal Aug 31 01:27

```
deeksha@deeksha2-QEMU-Virutal-Machine: ~
```

```
inet6 fd78:a5bb:36f2:8495:de0:2a17:fa8e:64a1 prefixlen 64 scopeid 0x00<global>
inet6 fe80::a550:b69a:9054:659e prefixlen 64 scopeid 0x20<link>
inet6 fd78:a5bb:36f2:8495:50bd:37ee:96ac:532c prefixlen 64 scopeid 0x00<global>
ether 96:d6:df:d5:83:4d txqueuelen 1000 (Ethernet)
RX packets 820 bytes 154513 (154.5 KB)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 600 bytes 82749 (82.7 KB)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
inet 127.0.0.1 netmask 255.0.0.0
inet6 ::1 prefixlen 128 scopeid 0x10<host>
loop txqueuelen 1000 (Local Loopback)
RX packets 465 bytes 50144 (50.1 KB)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 465 bytes 50144 (50.1 KB)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

deeksha@deeksha2-QEMU-Virutal-Machine: $ touch ~/.ssh/authorized_keys
Help @deeksha2-QEMU-Virutal-Machine: $ chmod 644 ~/.ssh/authorized_keys
deeksha@deeksha2-QEMU-Virutal-Machine: $ cat id_rsa.pub > ~/.ssh/authorized_keys
s
deeksha@deeksha2-QEMU-Virutal-Machine: $
```

L.

Ubuntu Deeksha Prabhakar

Activities Terminal Aug 31 01:29

```
deeksha@deeksha2-QEMU-Virutal-Machine: ~
```

- * Management: <https://landscape.canonical.com>
- * Support: <https://ubuntu.com/advantage>

3 updates can be applied immediately. To see these additional updates run: apt list --upgradable

```
Last login: Wed Aug 31 01:14:46 2022 from 192.168.64.5
deeksha@deeksha2-QEMU-Virutal-Machine: $ scp ~/.ssh/id_rsa.pub deeksha@192.168.64.2:id_rsa.pub
Enter passphrase for key '/home/deeksha/.ssh/id_rsa':
id_rsa.pub          100% 590   1.8MB/s  00:00
deeksha@deeksha2-QEMU-Virutal-Machine: $ ssh deeksha@192.168.64.2
Enter passphrase for key '/home/deeksha/.ssh/id_rsa':
Welcome to Ubuntu 22.04.1 LTS (GNU/Linux 5.15.0-47-generic aarch64)

* Documentation: https://help.ubuntu.com
* Management: https://landscape.canonical.com
* Support: https://ubuntu.com/advantage

3 updates can be applied immediately. To see these additional updates run: apt list --upgradable

Last login: Wed Aug 31 01:28:28 2022 from 192.168.64.2
deeksha@deeksha2-QEMU-Virutal-Machine: $
```

Ubuntu2 Deeksha2 Prabhakar

Activities Terminal Aug 31 01:29

```
deeksha@deeksha2-QEMU-Virutal-Machine: ~
```

```
inet 127.0.0.1 netmask 255.0.0.0
inet6 ::1 prefixlen 128 scopeid 0x10<host>
loop txqueuelen 1000 (Local Loopback)
RX packets 465 bytes 50144 (50.1 KB)
RX errors 0 dropped 0 overruns 0 frame 0
TX packets 465 bytes 50144 (50.1 KB)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

deeksha@deeksha2-QEMU-Virutal-Machine: $ touch ~/.ssh/authorized_keys
deeksha@deeksha2-QEMU-Virutal-Machine: $ chmod 644 ~/.ssh/authorized_keys
deeksha@deeksha2-QEMU-Virutal-Machine: $ cat id_rsa.pub > ~/.ssh/authorized_keys
s
deeksha@deeksha2-QEMU-Virutal-Machine: $ ssh deeksha@192.168.64.2
Enter passphrase for key '/home/deeksha/.ssh/id_rsa':
Welcome to Ubuntu 22.04.1 LTS (GNU/Linux 5.15.0-47-generic aarch64)

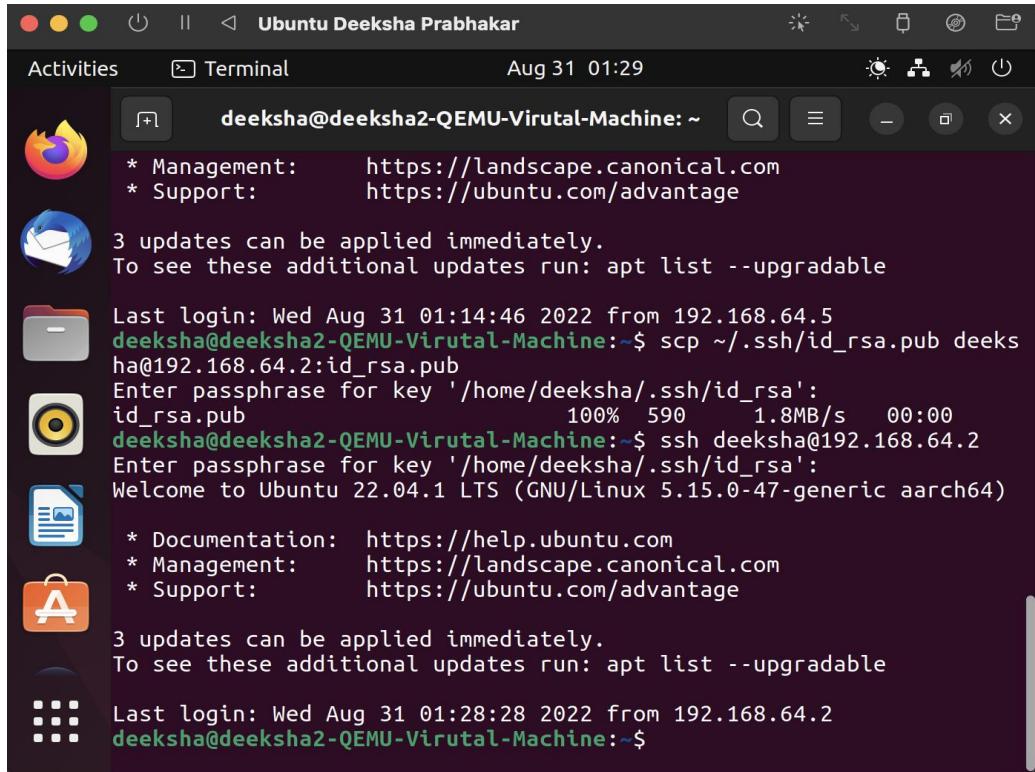
* Documentation: https://help.ubuntu.com
* Management: https://landscape.canonical.com
* Support: https://ubuntu.com/advantage

3 updates can be applied immediately. To see these additional updates run: apt list --upgradable

Last login: Wed Aug 31 01:25:29 2022 from 192.168.64.2
deeksha@deeksha2-QEMU-Virutal-Machine: $
```

A2.

1.ssh- It is used to access local Bash scripts from a local or remote server.



```
deeksha@deeksha2-QEMU-Virutal-Machine: ~
* Management: https://landscape.canonical.com
* Support: https://ubuntu.com/advantage

3 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

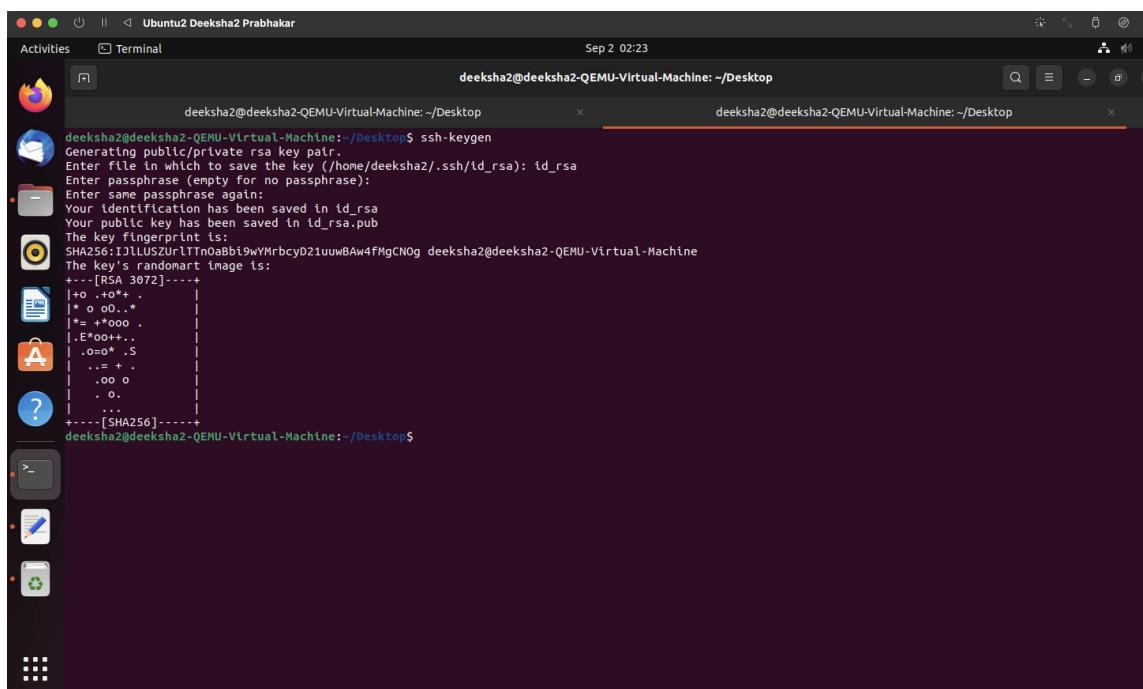
Last login: Wed Aug 31 01:14:46 2022 from 192.168.64.5
deeksha@deeksha2-QEMU-Virutal-Machine:~$ scp ~/ssh/id_rsa.pub deeks
ha@192.168.64.2:id_rsa.pub
Enter passphrase for key '/home/deeksha/.ssh/id_rsa':
id_rsa.pub                                100%   590     1.8MB/s   00:00
deeksha@deeksha2-QEMU-Virutal-Machine:~$ ssh deeksha@192.168.64.2
Enter passphrase for key '/home/deeksha/.ssh/id_rsa':
Welcome to Ubuntu 22.04.1 LTS (GNU/Linux 5.15.0-47-generic aarch64)

 * Documentation: https://help.ubuntu.com
 * Management: https://landscape.canonical.com
 * Support: https://ubuntu.com/advantage

3 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

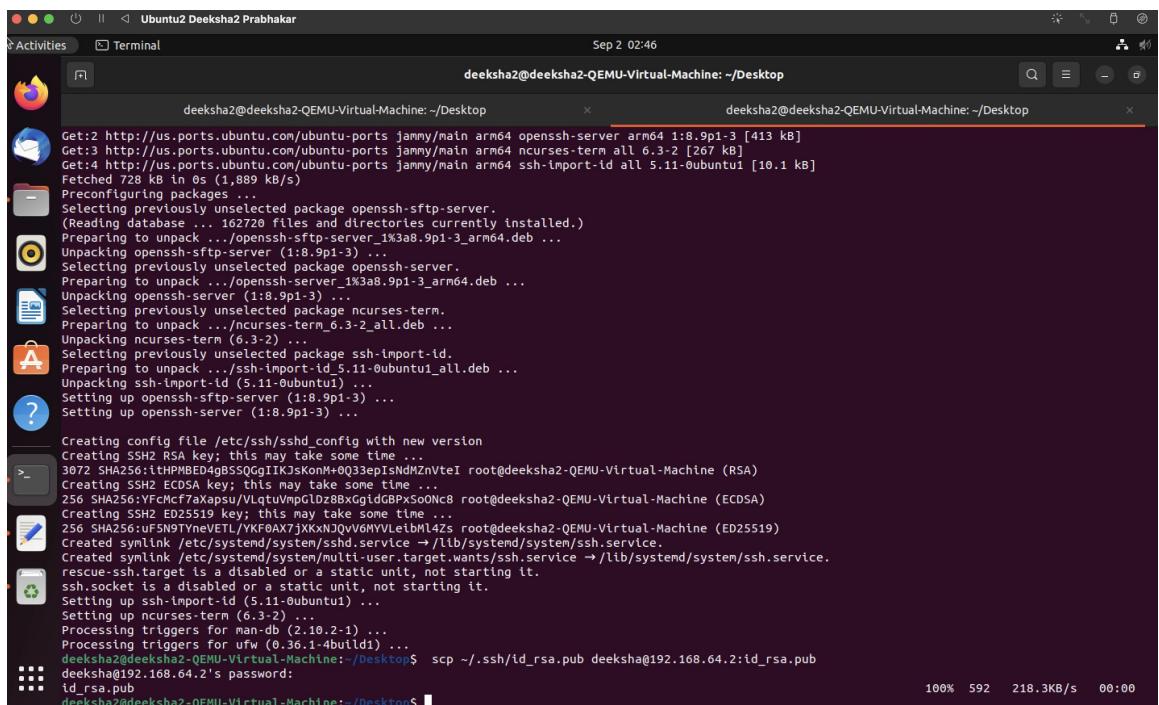
Last login: Wed Aug 31 01:28:28 2022 from 192.168.64.2
deeksha@deeksha2-QEMU-Virutal-Machine:~$
```

2. ssh-keygen- This is used to create keys to connect and authenticate between the client and server.



```
deeksha2@deeksha2-QEMU-Virtual-Machine: ~/Desktop
Generating public/private rsa key pair.
Enter file in which to save the key (/home/deeksha2/.ssh/id_rsa): id_rsa
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in id_rsa
Your public key has been saved in id_rsa.pub
The key fingerprint is:
SHA256:IJLUSZUrLTn0abt9wYMrbcyD2iuuwB4w4FmgCN0g deeksha2@deeksha2-QEMU-Virtual-Machine
The key's randomart image is:
+---[RSA 3072]---+
|+o .o+* .
|* o o...*
|= +*oo .
|.E*o+*+..
| .o=o* .S
| ... + .
| ..oo o
| . o.
| ...
+---[SHA256]---+
deeksha2@deeksha2-QEMU-Virtual-Machine:~/Desktop$
```

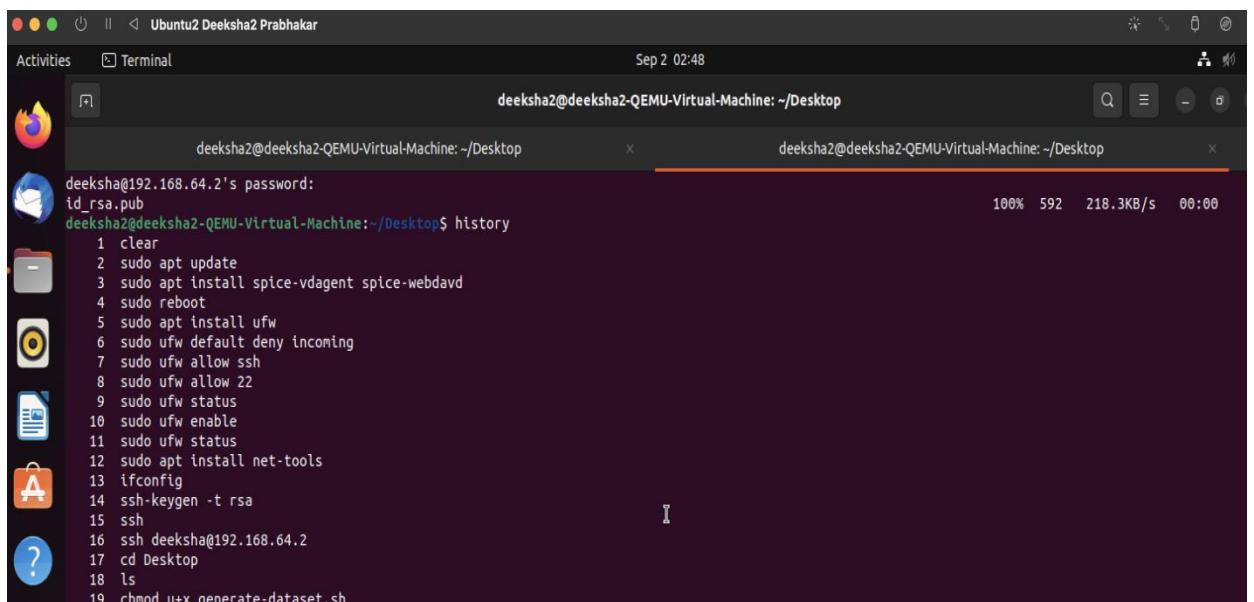
3. scp- It is used to copy files between servers in a secure way.



```
Get:2 http://us.ports.ubuntu.com/ubuntu-ports jammy/main arm64 openssh-server arm64 1:8.9p1-3 [413 kB]
Get:3 http://us.ports.ubuntu.com/ubuntu-ports jammy/main arm64 ncurses-term all 6.3-2 [267 kB]
Get:4 http://us.ports.ubuntu.com/ubuntu-ports jammy/main arm64 ssh-import-id all 5.11-0ubuntu1 [10.1 kB]
Fetched 728 kB in 0s (1,889 kB/s)
Preconfiguring packages ...
Selecting previously unselected package openssh-sftp-server.
(Reading database ... 167720 files and directories currently installed.)
Preparing to unpack .../openssh-sftp-server_1%3a8.9p1-3_arm64.deb ...
Unpacking openssh-sftp-server (1:8.9p1-3) ...
Selecting previously unselected package openssh-server.
Preparing to unpack .../openssh-server_1%3a8.9p1-3_arm64.deb ...
Unpacking openssh-server (1:8.9p1-3) ...
Selecting previously unselected package ncurses-term.
Preparing to unpack .../ncurses-term_6.3-2_all.deb ...
Unpacking ncurses-term (6.3-2) ...
Selecting previously unselected package ssh-import-id.
Preparing to unpack .../ssh-import-id_5.11-0ubuntu1_all.deb ...
Unpacking ssh-import-id (5.11-0ubuntu1) ...
Setting up openssh-sftp-server (1:8.9p1-3) ...
Setting up openssh-server (1:8.9p1-3) ...

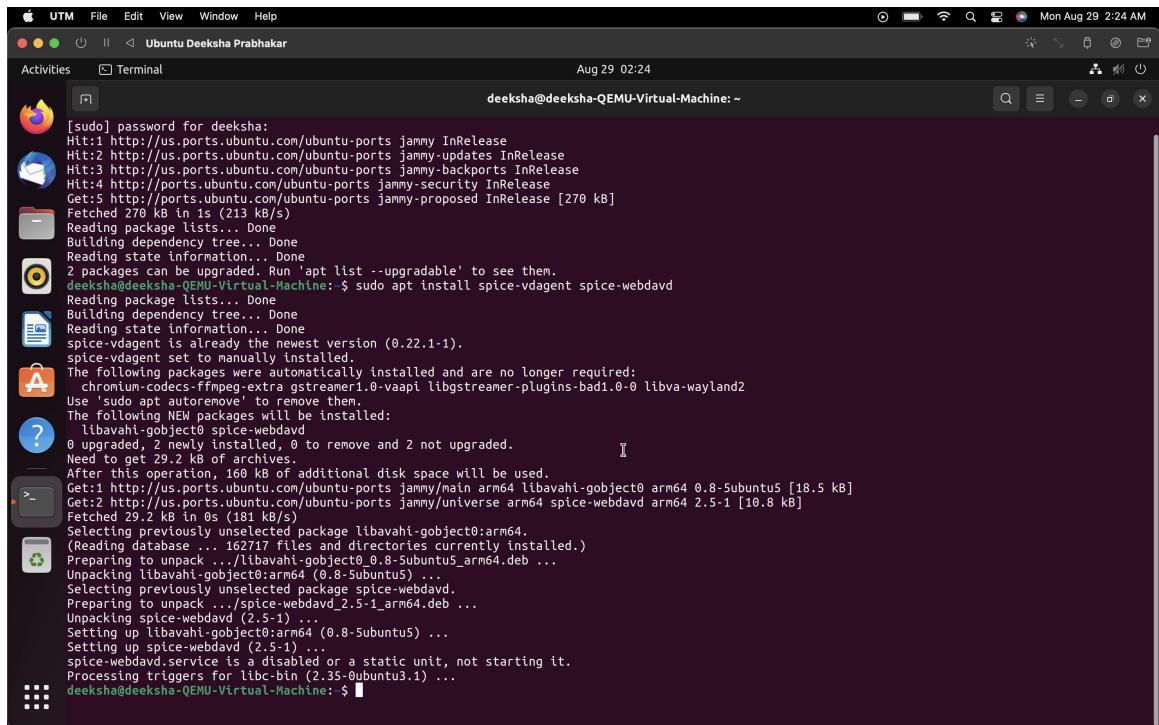
Creating config file /etc/ssh/sshd_config with new version
Creating SSH2 RSA key; this may take some time ...
3072 SHA256:iTHPMBED4gSSQGgIIKjSkonnM+0Q33epIsNDMzNvteI root@deeksha2-QEMU-Virtual-Machine (RSA)
Creating SSH2 ECDSA key; this may take some time ...
256 SHA256:YFcMcfcf7Xapsu/VlqtuVmglDzBxGgidGPxSoONc8 root@deeksha2-QEMU-Virtual-Machine (ECDSA)
Creating SSH2 ED25519 key; this may take some time ...
256 SHA256:uf5N97YneVETL/YKFOAX7JXKnJQv6MYVLiebml4zs root@deeksha2-QEMU-Virtual-Machine (ED25519)
Created symlink /etc/systemd/system/multi-user.target.wants/ssh.service → /lib/systemd/system/ssh.service.
Created symlink /etc/systemd/system/ssh.service → /lib/systemd/system/ssh.service.
rescue-ssh.target is a disabled or a static unit, not starting it.
ssh.socket is a disabled or a static unit, not starting it.
Setting up ssh-import-id (5.11-0ubuntu1) ...
Setting up ncurses-term (6.3-2) ...
Processing triggers for man-db (2.10.2-1) ...
Processing triggers for ufw (0.36.1-4build1) ...
deeksha2@deeksha2-QEMU-Virtual-Machine:~/Desktop$ scp ./ssh/id_rsa.pub deeksha@192.168.64.2:id_rsa.pub
deeksha@192.168.64.2's password:
id_rsa.pub
deeksha@deeksha2-QEMU-Virtual-Machine:~/Desktop$
```

4. history- it is used to view the commands that were run previously i.e command history.



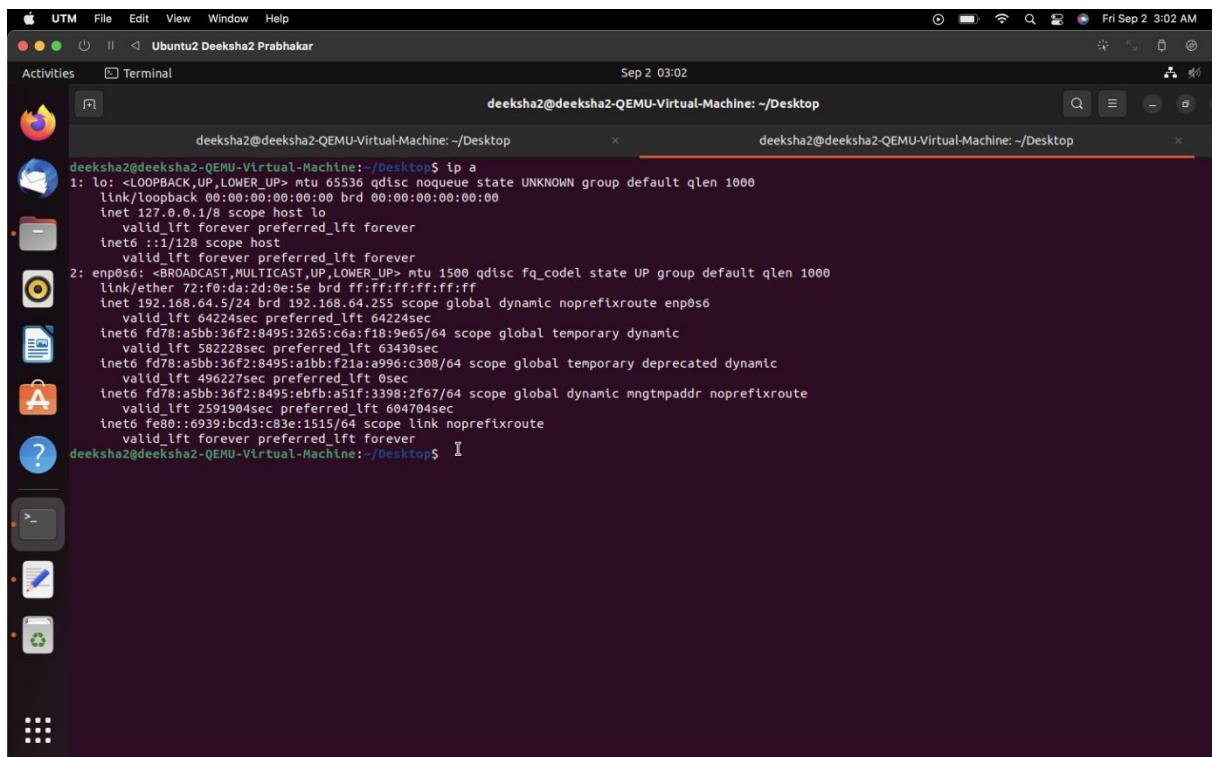
```
deeksha@192.168.64.2's password:
deeksha@deeksha2-QEMU-Virtual-Machine:~/Desktop$ history
 1  clear
 2  sudo apt update
 3  sudo apt install spice-vdagent spice-webdavd
 4  sudo reboot
 5  sudo apt install ufw
 6  sudo ufw default deny incoming
 7  sudo ufw allow ssh
 8  sudo ufw allow 22
 9  sudo ufw status
10  sudo ufw enable
11  sudo ufw status
12  sudo apt install net-tools
13  ifconfig
14  ssh-keygen -t rsa
15  ssh
16  ssh deeksha@192.168.64.2
17  cd Desktop
18  ls
19  chmod u+x generate-dataset.sh
```

5. sudo- it allows users to run programs with the security allowances of super user.



```
[sudo] password for deeksha:
Hit:1 http://usports.ubuntu.com/ubuntu-ports jammy InRelease
Hit:2 http://usports.ubuntu.com/ubuntu-ports jammy-updates InRelease
Hit:3 http://usports.ubuntu.com/ubuntu-ports jammy-backports InRelease
Hit:4 http://ports.ubuntu.com/ubuntu-ports jammy-security InRelease
Get:5 http://ports.ubuntu.com/ubuntu-ports jammy-proposed InRelease [270 kB]
Fetched 270 kB in 1s (213 kB/s)
Reading package lists... Done
Building dependency tree... Done
Building state information... Done
2 packages can be upgraded. Run 'apt list --upgradable' to see them.
deeksha@deeksha-QEMU-Virtual-Machine: $ sudo apt install spice-vdagent spice-webdavd
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
spice-vdagent is already the newest version (0.22.1-1).
spice-vdagent set to manually installed.
The following packages were automatically installed and are no longer required:
  chromium-codecs-ffmpeg-extra gstreamer1.0-vaapi libgstreamer-plugins-bad1.0-0 libvba-wayland2
Use 'sudo apt autoremove' to remove them.
The following NEW packages will be installed:
  libavahi-gobject0 spice-webdavd
0 upgraded, 2 newly installed, 0 to remove and 2 not upgraded.
Need to get 29.2 kB of archives.
After this operation, 160 kB of additional disk space will be used.
Get:1 http://usports.ubuntu.com/ubuntu-ports jammy/main arm64 libavahi-gobject0 arm64 0.8-5ubuntu5 [18.5 kB]
Get:2 http://usports.ubuntu.com/ubuntu-ports jammy/universe arm64 spice-webdavd arm64 2.5-1 [10.8 kB]
Fetched 29.2 kB in 0s (181 kB/s)
Selecting previously unselected package libavahi-gobject0:arm64.
(Reading database ... 162717 files and directories currently installed.)
Preparing to unpack .../libavahi-gobject0_0.8-5ubuntu5_arm64.deb ...
Unpacking libavahi-gobject0:arm64 (0.8-Subuntu5) ...
Selecting previously unselected package spice-webdavd.
Preparing to unpack .../spice-webdavd_2.5-1_arm64.deb ...
Unpacking spice-webdavd (2.5-1) ...
Setting up libavahi-gobject0:arm64 (0.8-Subuntu5) ...
Setting up spice-webdavd (2.5-1) ...
spice-webdavd.service is a disabled or a static unit, not starting it.
Processing triggers for libc-bin (2.35-Subuntu3.1) ...
deeksha@deeksha-QEMU-Virtual-Machine: $
```

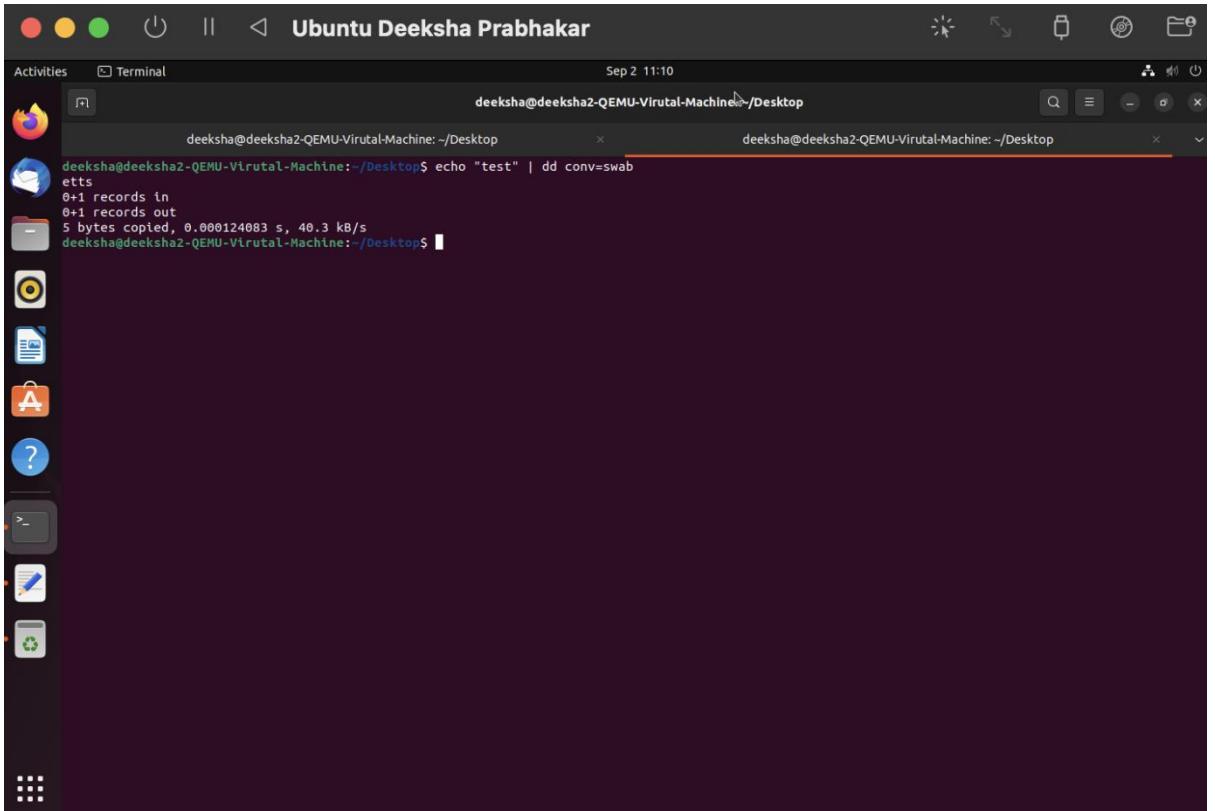
6. ip- it tells us about the ip addresses of the user.



```
deeksha2@deeksha2-QEMU-Virtual-Machine: ~/Desktop
deeksha2@deeksha2-QEMU-Virtual-Machine: ~/Desktop$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
    inet6 ::1/128 scope host
        valid_lft forever preferred_lft forever
2: enp0s6: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    link/ether 72:f0:da:2d:0e:5e brd ff:ff:ff:ff:ff:ff
    inet 192.168.64.5/24 brd 192.168.64.255 scope global dynamic noprefixroute enp0s6
        valid_lft 64224sec preferred_lft 64224sec
    inet6 fd78:a5bb:36f2:8495:3265:c6a:f18:9e65/64 scope global temporary dynamic
        valid_lft 582228sec preferred_lft 63430sec
    inet6 fd78:a5bb:36f2:8495:a1bb:f21a:a996:c308/64 scope global temporary deprecated dynamic
        valid_lft 496227sec preferred_lft 0sec
    inet6 fe80::6939:bc03:c83e:1515/64 scope link noprefixroute
        valid_lft forever preferred_lft forever
deeksha2@deeksha2-QEMU-Virtual-Machine: ~/Desktop$
```

7. dd- it reads the input, processes it and then writes it into an input block.

Here, I have used dd to swap the bytes of input



A screenshot of an Ubuntu desktop environment. The title bar says "Ubuntu Deeksha Prabhakar". The desktop has a dark theme with a vertical dock on the left containing icons for Dash, Home, Applications, and Help. A terminal window is open in the center, showing the command:

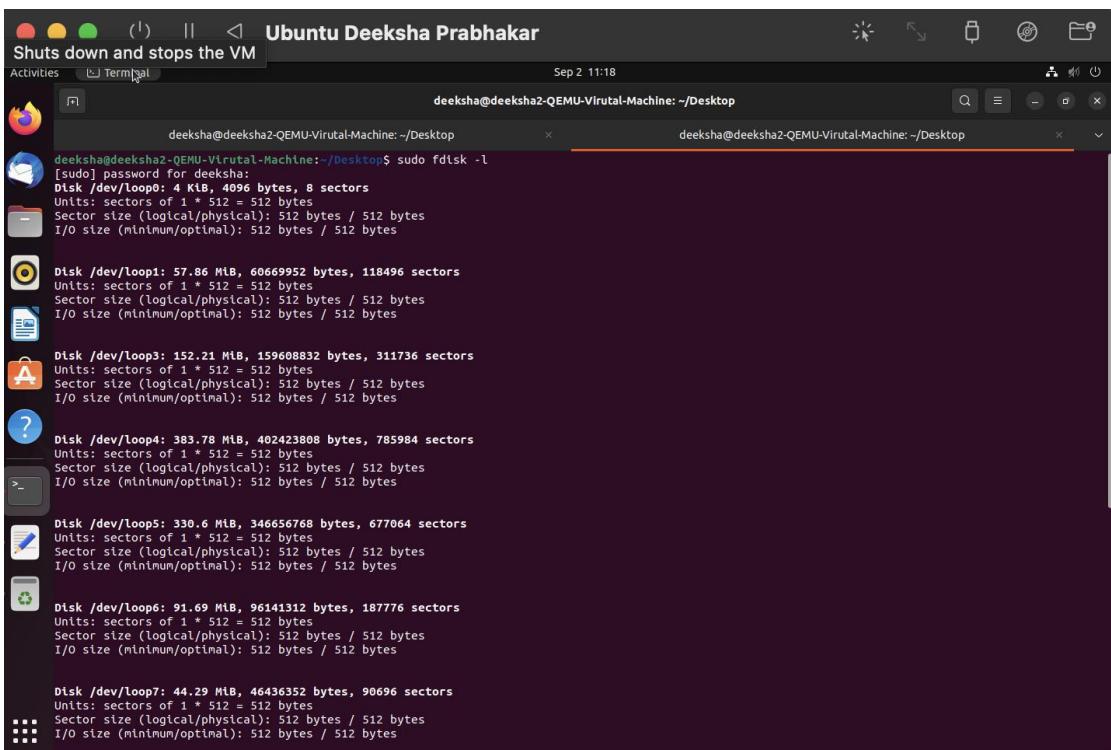
```
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$ echo "test" | dd conv=swab
```

The output shows:

```
ette
0+1 records in
0+1 records out
5 bytes copied, 0.000124083 s, 40.3 kB/s
```

The terminal window title is "Terminal". The status bar at the bottom of the screen shows "Sep 2 11:10".

8. fdisk- It is used to create and manipulate disk partition and get disk partition information.



A screenshot of an Ubuntu desktop environment. The title bar says "Ubuntu Deeksha Prabhakar". The desktop has a dark theme with a vertical dock on the left containing icons for Dash, Home, Applications, and Help. A terminal window is open in the center, showing the command:

```
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$ sudo fdisk -l
```

The output shows details for several disk partitions:

```
[sudo] password for deeksha:
Disk /dev/loop0: 4 KiB, 4096 bytes, 8 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes

Disk /dev/loop1: 57.86 MiB, 60669952 bytes, 118496 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes

Disk /dev/loop3: 152.21 MiB, 159608832 bytes, 311736 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes

Disk /dev/loop4: 383.78 MiB, 402423808 bytes, 785984 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes

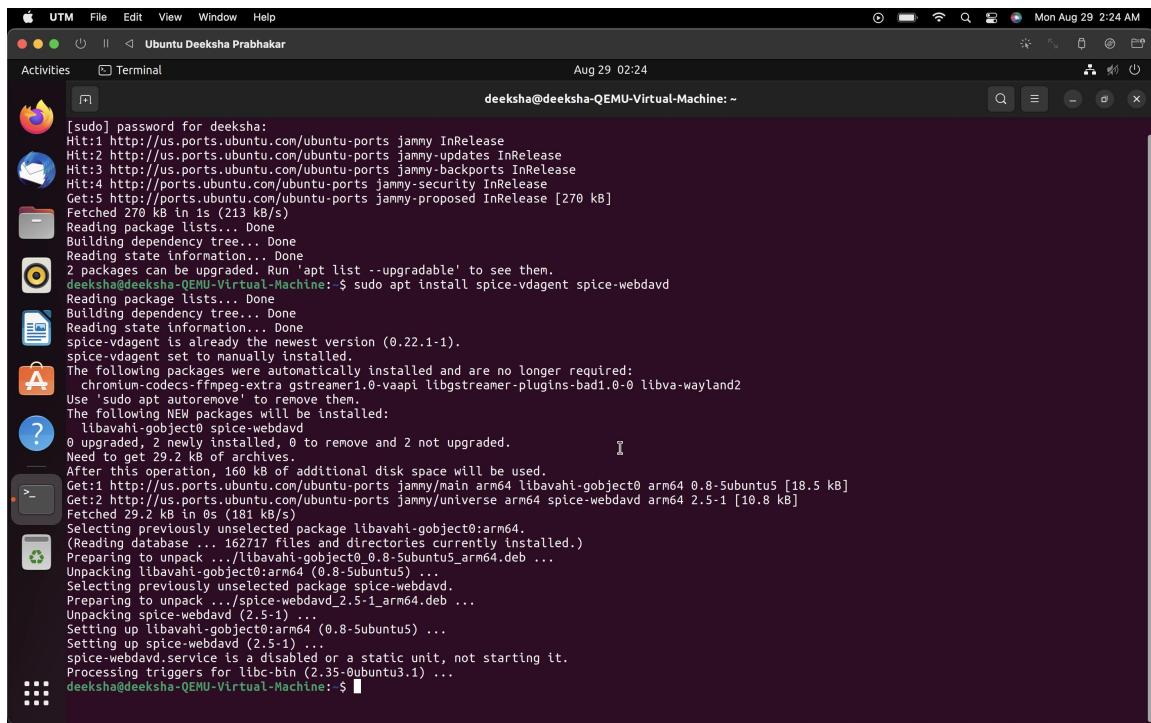
Disk /dev/loop5: 330.6 MiB, 346656768 bytes, 677064 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes

Disk /dev/loop6: 91.69 MiB, 96141312 bytes, 187776 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes

Disk /dev/loop7: 44.29 MiB, 46436352 bytes, 90696 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
```

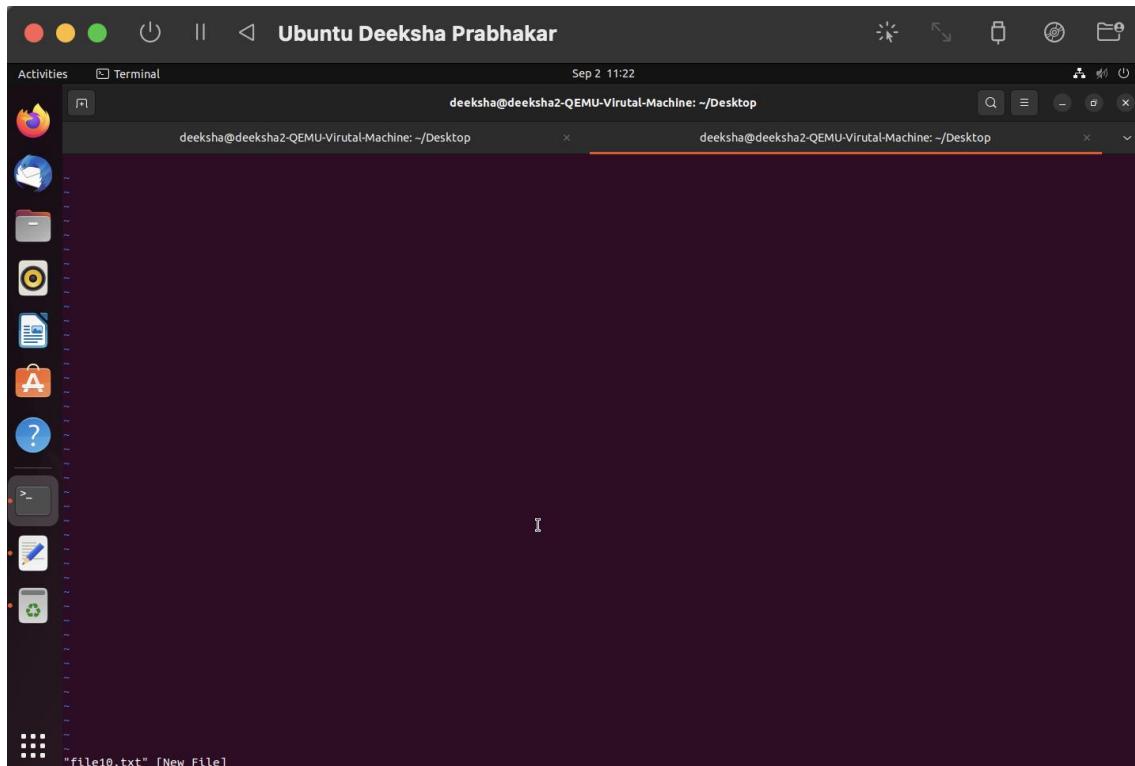
The terminal window title is "Terminal". The status bar at the bottom of the screen shows "Sep 2 11:18".

9. apt- It is used to install, update or manage packages.

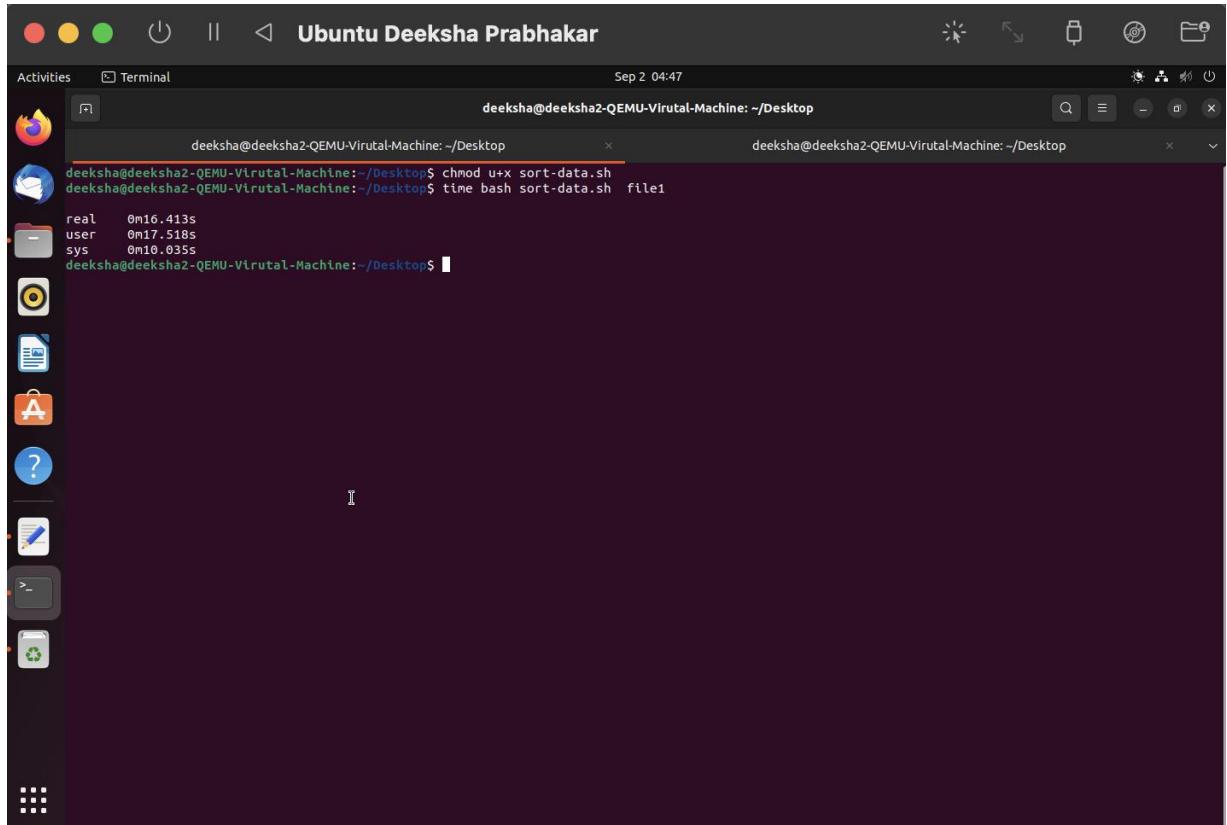


```
[sudo] password for deeksha:  
Hit:1 http://us.archive.ubuntu.com/ubuntu jammy InRelease  
Hit:2 http://us.archive.ubuntu.com/ubuntu jammy-updates InRelease  
Hit:3 http://us.archive.ubuntu.com/ubuntu jammy-backports InRelease  
Hit:4 http://ports.ubuntu.com/ubuntu-ports jammy-security InRelease  
Get:5 http://ports.ubuntu.com/ubuntu-ports jammy-proposed [270 kB]  
Fetched 270 kB in 1s (213 kB/s)  
Reading package lists... Done  
Building dependency tree... Done  
Reading state information... Done  
2 packages can be upgraded. Run 'apt list --upgradable' to see them.  
deeksha@deeksha-QEMU-Virtual-Machine:~$ sudo apt install spice-vdagent spice-webdavd  
Reading package lists... Done  
Building dependency tree... Done  
Reading state information... Done  
spice-vdagent is already the newest version (0.22.1-1).  
spice-vdagent set to manually installed.  
The following packages were automatically installed and are no longer required:  
  chromium-codecs-ffmpeg-extra gstreamer1.0-vaapi libgstreamer-plugins-bad1.0-0 libva-wayland2  
Use 'sudo apt autoremove' to remove them.  
The following NEW packages will be installed:  
  libavahi-gobject0 spice-webdavd  
0 upgraded, 2 newly installed, 0 to remove and 2 not upgraded.  
Need to get 29.2 kB of archives.  
After this operation, 160 kB of additional disk space will be used.  
Get:1 http://us.archive.ubuntu.com/ubuntu jammy/main arm64 libavahi-gobject0 arm64 0.8-Subuntu5 [18.5 kB]  
Get:2 http://us.archive.ubuntu.com/ubuntu/universe arm64 spice-webdavd arm64 2.5-1 [10.8 kB]  
Fetched 29.2 kB in 0s (181 kB/s)  
Selecting previous unselected package libavahi-gobject0:arm64.  
(Reading database ... 162717 files and directories currently installed.)  
Preparing to unpack .../libavahi-gobject0_0.8-Subuntu5_arm64.deb ...  
Unpacking libavahi-gobject0:arm64 (0.8-Subuntu5) ...  
Selecting previously unselected package spice-webdavd.  
Preparing to unpack .../spice-webdavd_2.5-1_arm64.deb ...  
Unpacking spice-webdavd (2.5-1) ...  
Setting up libavahi-gobject0:arm64 (0.8-Subuntu5) ...  
Setting up spice-webdavd (2.5-1) ...  
spice-webdavd.service is a disabled or a static unit, not starting it.  
Processing triggers for libc-bin (2.35-Subuntu3.1) ...  
deeksha@deeksha-QEMU-Virtual-Machine:~$
```

10. vi- It is for using a command line text editor- it will create a tetx file and save it to the specified location.



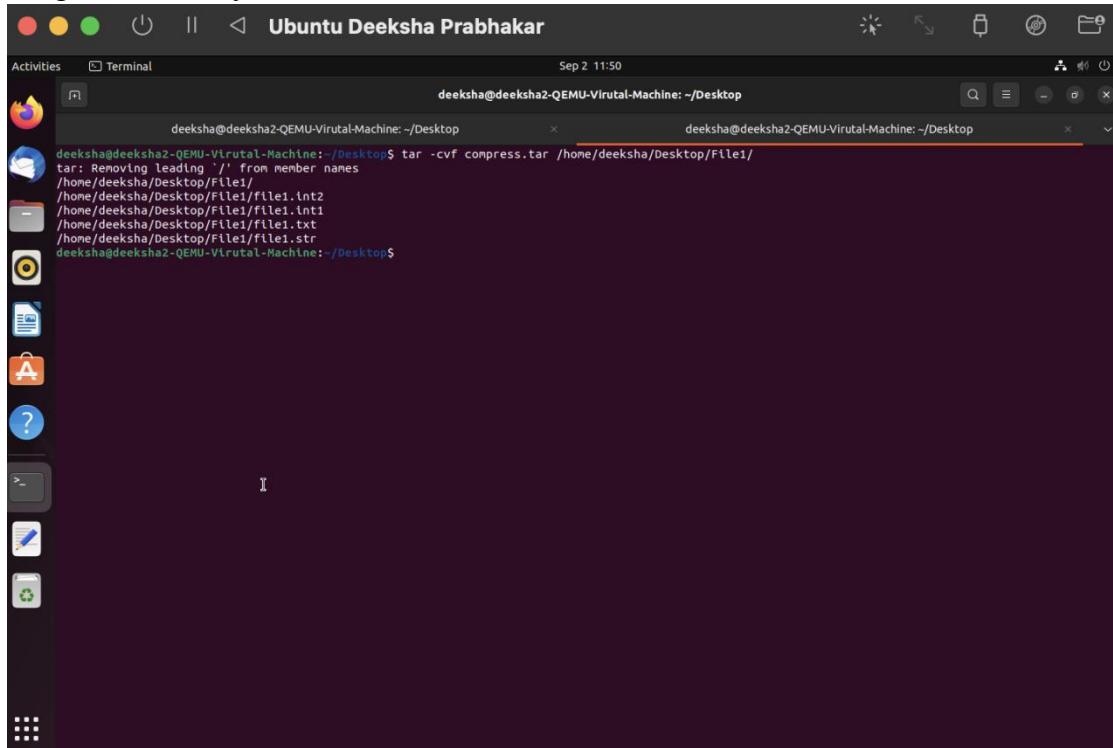
11. time- prints the time taken to execute a bash command or script.



A screenshot of an Ubuntu desktop environment. The title bar says "Ubuntu Deeksha Prabhakar". The desktop has a dark theme with a dock on the left containing icons for Dash, Home, Applications, and others. A terminal window is open in the center, showing the command line. The terminal output is:

```
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$ chmod u+x sort-data.sh
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$ time bash sort-data.sh file1
real    0m16.413s
user    0m17.518s
sys     0m10.035s
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$
```

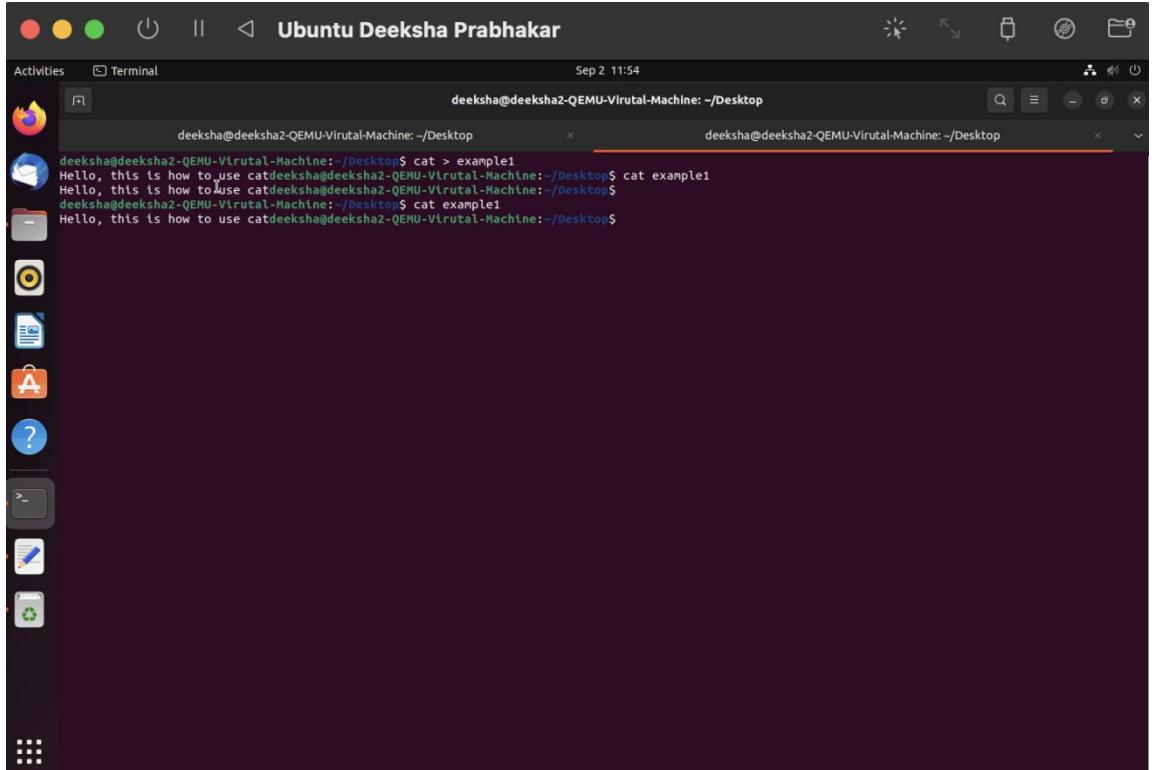
12. tar- It is used to create a tape archive, i.e it will create a tar archive file for the given directory.



A screenshot of an Ubuntu desktop environment. The title bar says "Ubuntu Deeksha Prabhakar". The desktop has a dark theme with a dock on the left containing icons for Dash, Home, Applications, and others. A terminal window is open in the center, showing the command line. The terminal output is:

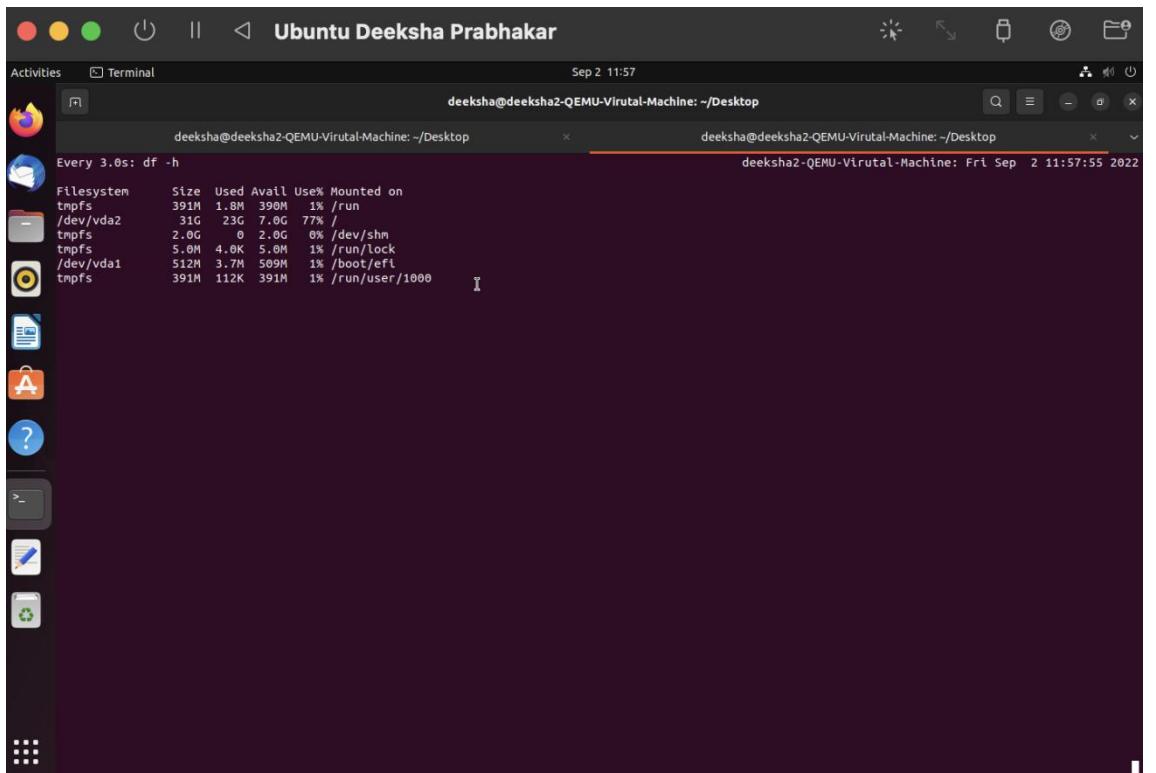
```
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$ tar -cvf compress.tar /home/deeksha/Desktop/File1/
tar: Removing leading '/' from member names
/home/deeksha/Desktop/File1/
/home/deeksha/Desktop/File1/file1.int2
/home/deeksha/Desktop/File1/file1.int1
/home/deeksha/Desktop/File1/file1.txt
/home/deeksha/Desktop/File1/file1.str
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$
```

13. cat- stands for concatenate, it is used to create single or multiple files, view them, concatenate them etc.



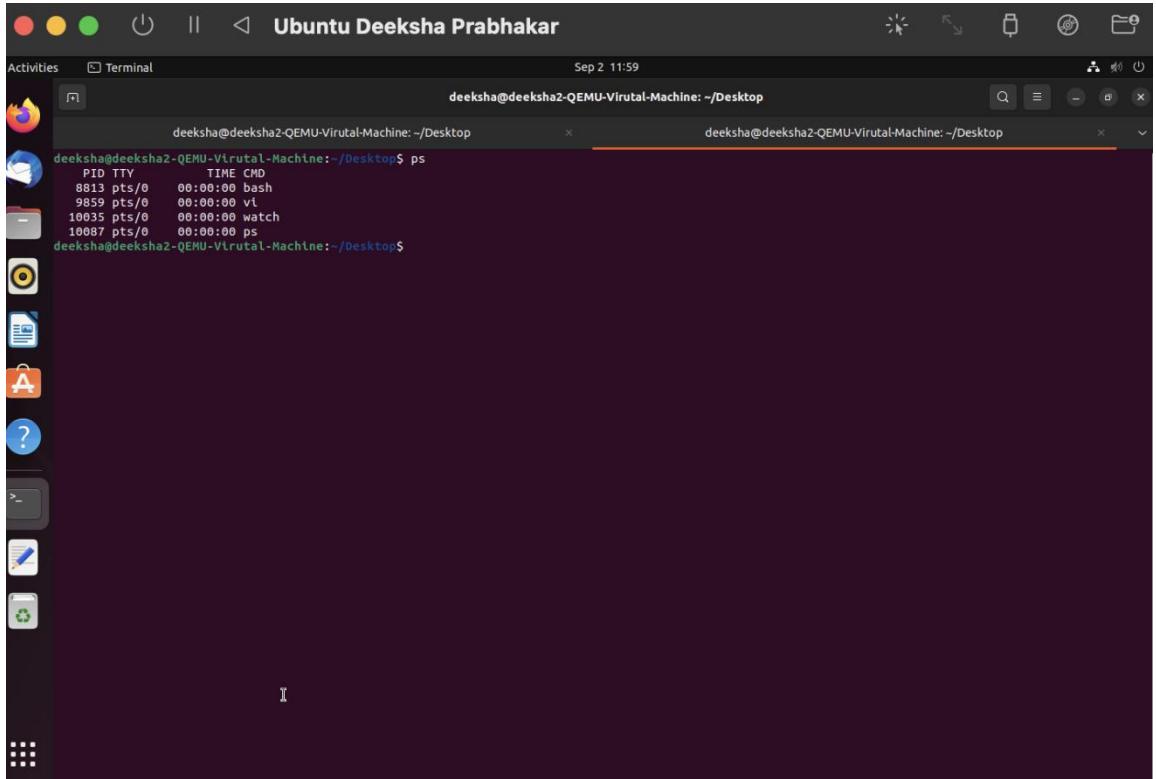
```
deeksha@deeksha2-QEMU-Virutal-Machine: ~/Desktop
deeksha@deeksha2-QEMU-Virutal-Machine: ~/Desktop
Hello, this is how to use cat
deeksha@deeksha2-QEMU-Virutal-Machine: ~/Desktop
deeksha@deeksha2-QEMU-Virutal-Machine: ~/Desktop
Hello, this is how to use cat
```

14. watch- It is used to run a program repeatedly and give the output at a certain time as specified by the user.

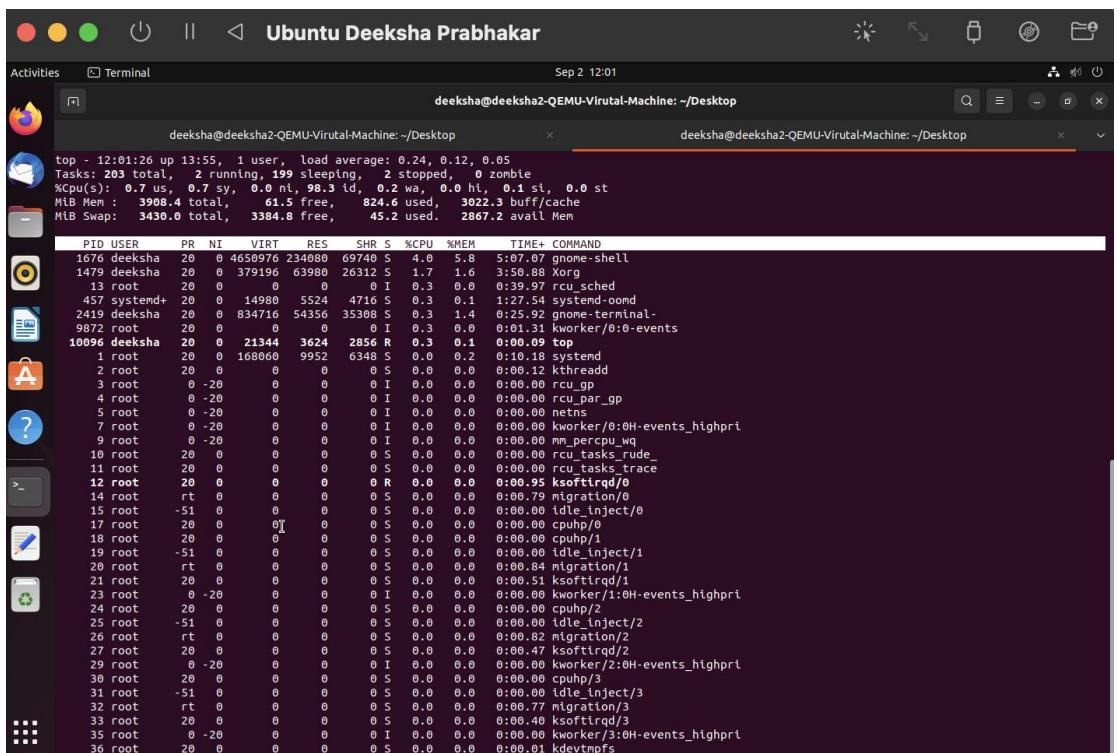


```
Every 3.0s: df -h
Filesystem      Size  Used Avail Use% Mounted on
tmpfs          391M   1.8M  390M  1% /run
/dev/vda2       31G  23G  7.0G 77% /
tmpfs          2.0G    0  2.0G  0% /dev/shm
tmpfs          5.0M  4.0K  5.0M  1% /run/lock
/dev/vda1       512M  3.7M  509M  1% /boot/efi
tmpfs          391M  112K  391M  1% /run/user/1000
```

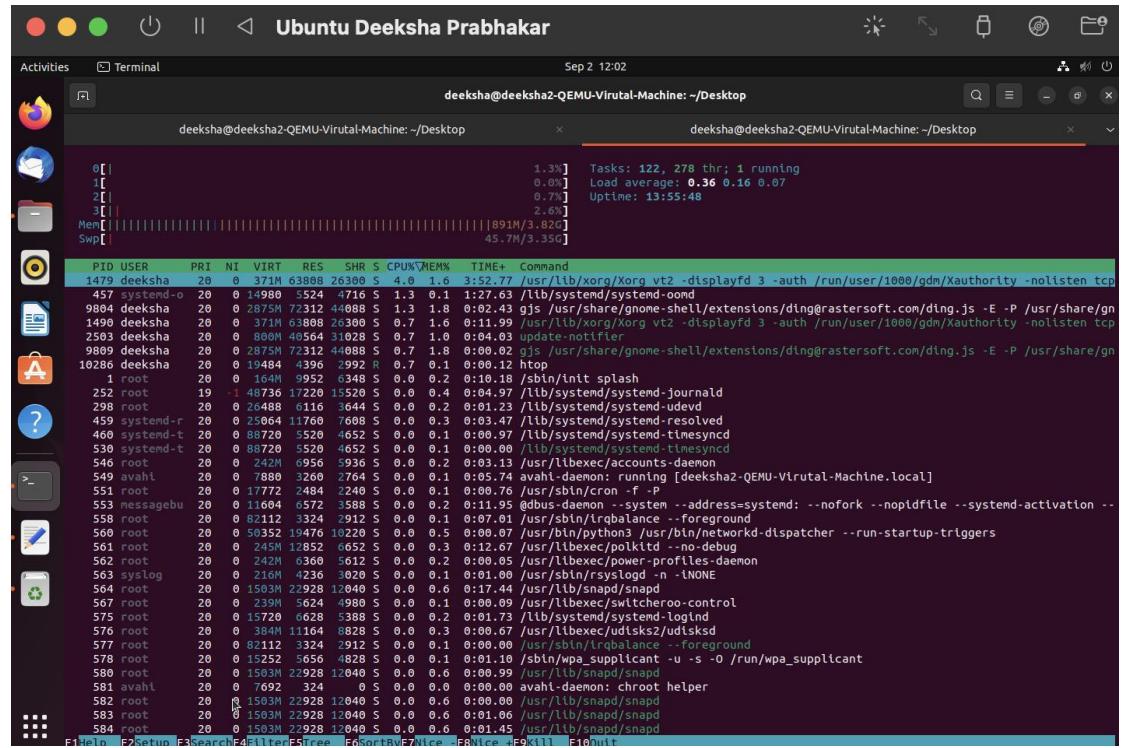
15. ps- shows information about the running processes.



16. top- It is like a task manager that shows running processor operation, kernel managed tasks etc.

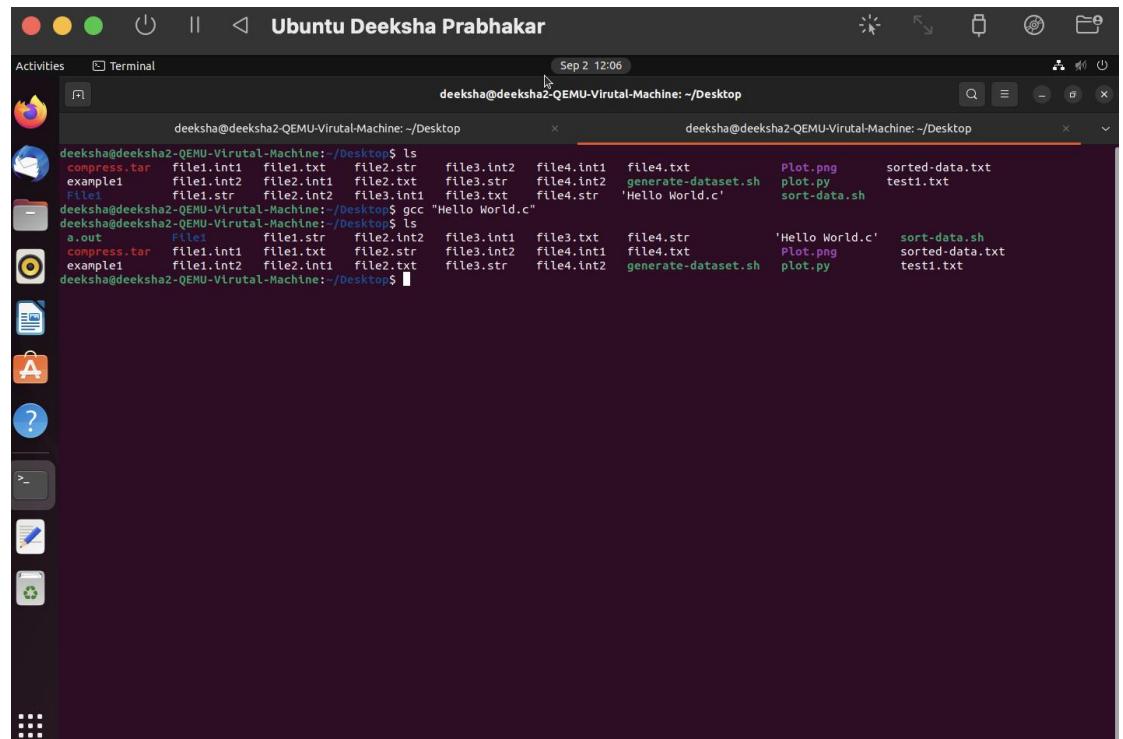


17. htop- shows processes running on the system and various operations like kill for those processes.



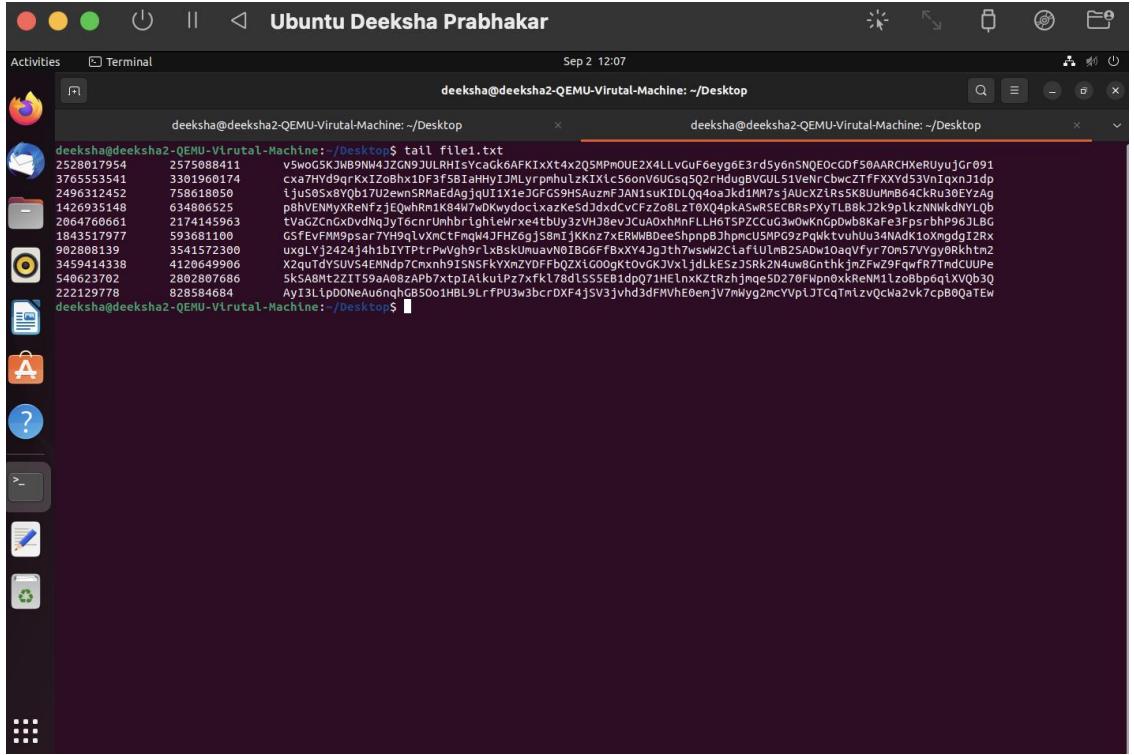
The screenshot shows the Ubuntu desktop environment with the Unity interface. A terminal window titled 'Terminal' is open, displaying the output of the 'htop' command. The 'htop' interface shows a list of processes with columns for PID, USER, PRI, NI, VIRT, RES, SHR, CPU%, %MEM, TIME+, and Command. The terminal window also displays system statistics at the top: Tasks: 122, 278 thr; 1 running, Load average: 0.36 0.16 0.07, and Uptime: 13:55:48. The desktop background is dark, and the Unity dock is visible at the bottom.

18. gcc- It is used to compile C and C++ language programs.



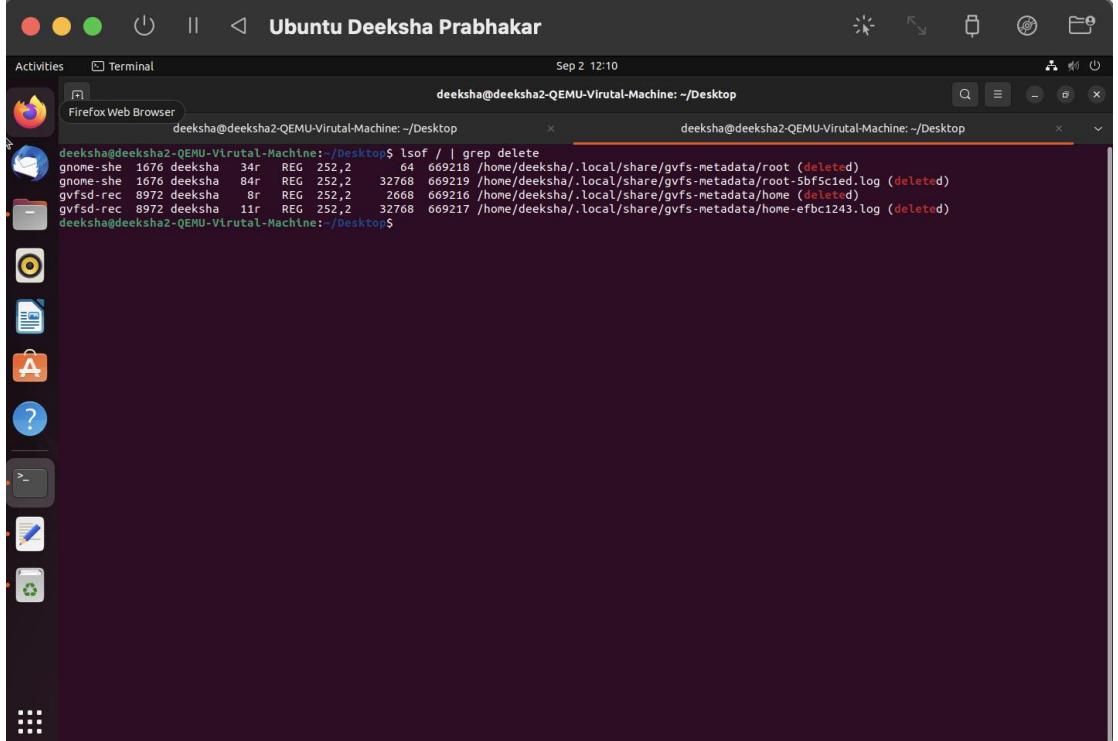
The screenshot shows the Ubuntu desktop environment with the Unity interface. A terminal window titled 'Terminal' is open, displaying the output of the 'gcc' command. The terminal shows the compilation of a C program named 'Hello World.c'. The command entered was 'gcc "Hello World.c"'. The terminal also shows other files in the directory, including 'compress.tar', 'example1', 'file1', 'file2', 'file3', 'file4', 'generate-dataset.sh', 'Plot.png', 'plot.py', 'sorted-data.txt', 'test1.txt', and 'sort-data.sh'. The desktop background is dark, and the Unity dock is visible at the bottom.

19. tail- it is used to run/ display the last few lines of a file.



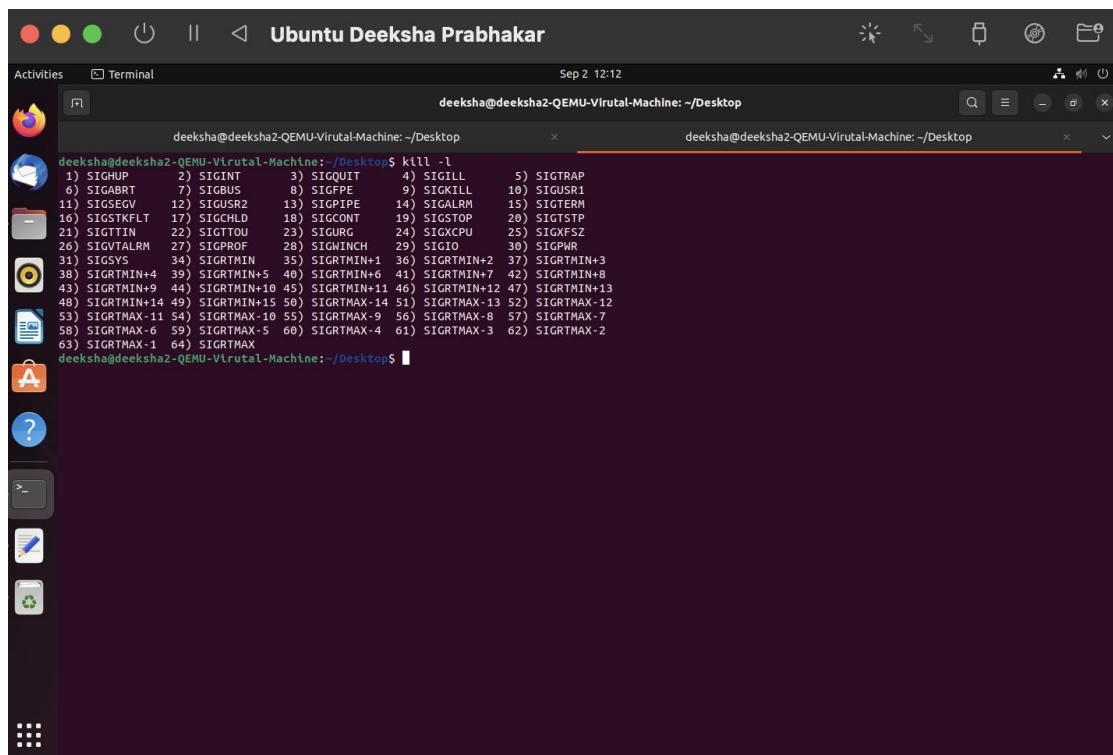
```
deeksha@deeksha2-QEMU-Virtual-Machine:~/Desktop$ tail file1.txt
2575088411 v$woG5KJW89NW4JZGN9JULRH1sycaGk6AFKIXt4x2Q5MPmOUE2X4LLvGuF6eyg6E3rd5y6nSNQEoCGrf50AARCHXeRuyujGr091
3765553541 3301960174 cxa7Hd9qrKxIZobhx1DF3f5B1aHHY1JMlyrphuLzKIXlc56onV6U6sa502fHdugBVGUL51VeNrCbwcZTFFXXYd53VnIqxnJ1dp
2496312452 758618050 iju5oSx8Yqb17U2ewmSRMaeDaqjqu11X1eJGFGS9HSauzmJAN1suK1DLQ4oaJk1M7sJaUcXZ1rs5K8UuMmB64Crkru30EYzAg
1426935148 634806525 p8hVEMNyXRehfzjEqwhRm1K84w7wKwdoxinazKeSdJdxCvCFzZobLzT0X04pkASwRESECBrSPxytLB8kJ2k9p1LzNNNkdYLQb
2064760661 2174145963 tVaGZCnGxDvDNgJyT6cnrUmbrightleWrxe4tbu3zvH38evJCuAOxmFLlH6tSPZCCUG3wKnGpDwbKaFe3PsrhP96JLBG
1843517977 593681100 GSFeVFM9psar7YH9qlvxMcTfmqW4JFHZggJ58n1JKknz7xERwBDeeShnpBjhpncUSMPg9zPqkvtvuhu34NAdk1oxngdg12Rx
902808139 3541572300 uxglY12424j4hb1YTPtrPwgh9rlbSkUmuav0IBG6fbxxXY4JqJch7wsW2c1afLU1mB2SDw10aqVfy70n57Vgy6Rkhtm2
3459414338 4120649906 X2quTDyVS4ENMd7cxnnh91NSNFSkyXmZYDFbzQXLG0ogKtovGJx1JdKE5zJSRK2N4u8wGnThkjnZf9fwfR7TndCUJP
540623702 2802807686 SkSA8MtZ2TT59a08Zapb7xtP1AkluPz7xfkL78dlsSEB1dp071HElnxKzTrzhjmqe5D270fkpn0xkRenM11zobBp6eq1XQb30
222129778 828584684 AyI3Llp0NeAu6nghGB5001HB1L9LrfPu3w3bcrzDXF4jsV3jvhd3dFMvh0emjV7mkyg2ncYVp1JTCqTmlzvQcKa2vk7cpB0qaTeW
deeksha@deeksha2-QEMU-Virtual-Machine:~/Desktop$
```

20. grep- search a file for a particular character or group of characters and return the parts that contain it.



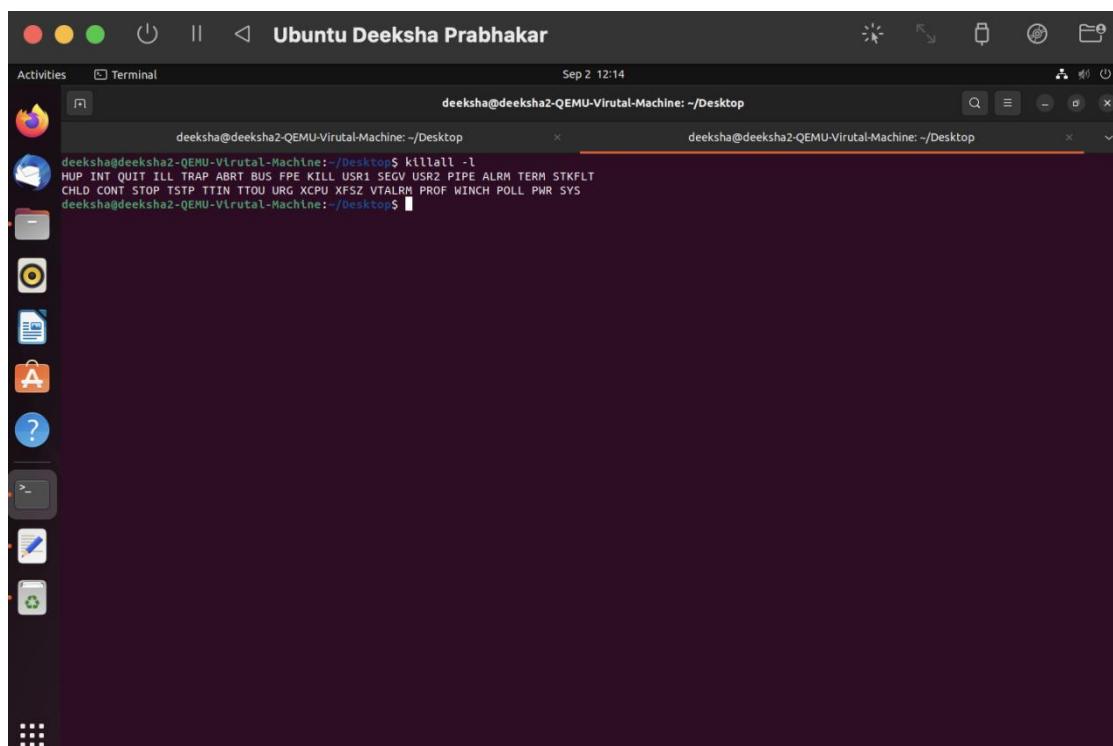
```
deeksha@deeksha2-QEMU-Virtual-Machine:~/Desktop$ lsof / | grep delete
gnome-she 1676 deeksha 34r REG 252,2 64 669218 /home/deeksha/.local/share/gvfs-metadata/root (deleted)
gnome-she 1676 deeksha 84r REG 252,2 32768 669219 /home/deeksha/.local/share/gvfs-metadata/root.sbfscied.log (deleted)
gvfsd-rec 8972 deeksha 8r REG 252,2 2668 669216 /home/deeksha/.local/share/gvfs-metadata/home (deleted)
gvfsd-rec 8972 deeksha 11r REG 252,2 32768 669217 /home/deeksha/.local/share/gvfs-metadata/home-efbc1243.log (deleted)
deeksha@deeksha2-QEMU-Virtual-Machine:~/Desktop$
```

21. kill- it is used to kill the processes by id or name.



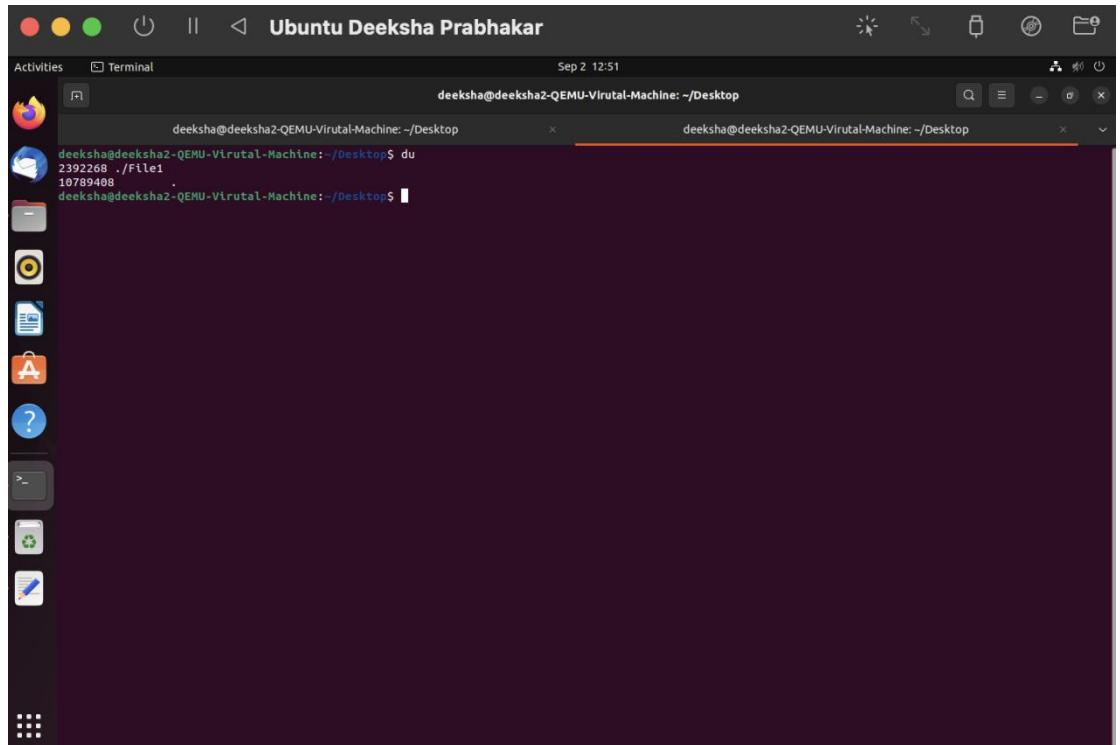
```
Ubuntu Deeksha Prabhakar
Activities Terminal Sep 2 12:12
deeksha@deeksha2-QEMU-Virutal-Machine: ~/Desktop
deeksha@deeksha2-QEMU-Virutal-Machine: ~/Desktop
1) SIGHUP 2) SIGINT 3) SIGQUIT 4) SIGILL 5) SIGTRAP
6) SIGABRT 7) SIGBUS 8) SIGFPE 9) SIGKILL 10) SIGUSR1
11) SIGSEGV 12) SIGUSR2 13) SIGPIPE 14) SIGALRM 15) SIGTERM
16) SIGSTKFLT 17) SIGCHLD 18) SIGCONT 19) SIGSTOP 20) SIGSTP
21) SIGTTIN 22) SIGTTOU 23) SIGURG 24) SIGXCPU 25) SIGXFSZ
26) SIGVTALRM 27) SIGPROF 28) SIGMINCH 29) SIGIO 30) SIGPWR
31) SIGSYS 34) SIGRTMIN 35) SIGRTMIN+1 36) SIGRTMIN+2 37) SIGRTMIN+3
38) SIGRTMIN+4 39) SIGRTMIN+5 40) SIGRTMIN+6 41) SIGRTMIN+7 42) SIGRTMIN+8
43) SIGRTMIN+9 44) SIGRTMIN+10 45) SIGRTMIN+11 46) SIGRTMIN+12 47) SIGRTMIN+13
48) SIGRTMIN+14 49) SIGRTMIN+15 50) SIGRTMAX-14 51) SIGRTMAX-13 52) SIGRTMAX-12
53) SIGRTMAX-11 54) SIGRTMAX-10 55) SIGRTMAX-9 56) SIGRTMAX-8 57) SIGRTMAX-7
58) SIGRTMAX-6 59) SIGRTMAX-5 60) SIGRTMAX-4 61) SIGRTMAX-3 62) SIGRTMAX-2
63) SIGRTMAX-1 64) SIGRTMAX
```

22. killall- It is used to kill all the running processes. If no signal name is specified it send an SIGTERM signal.

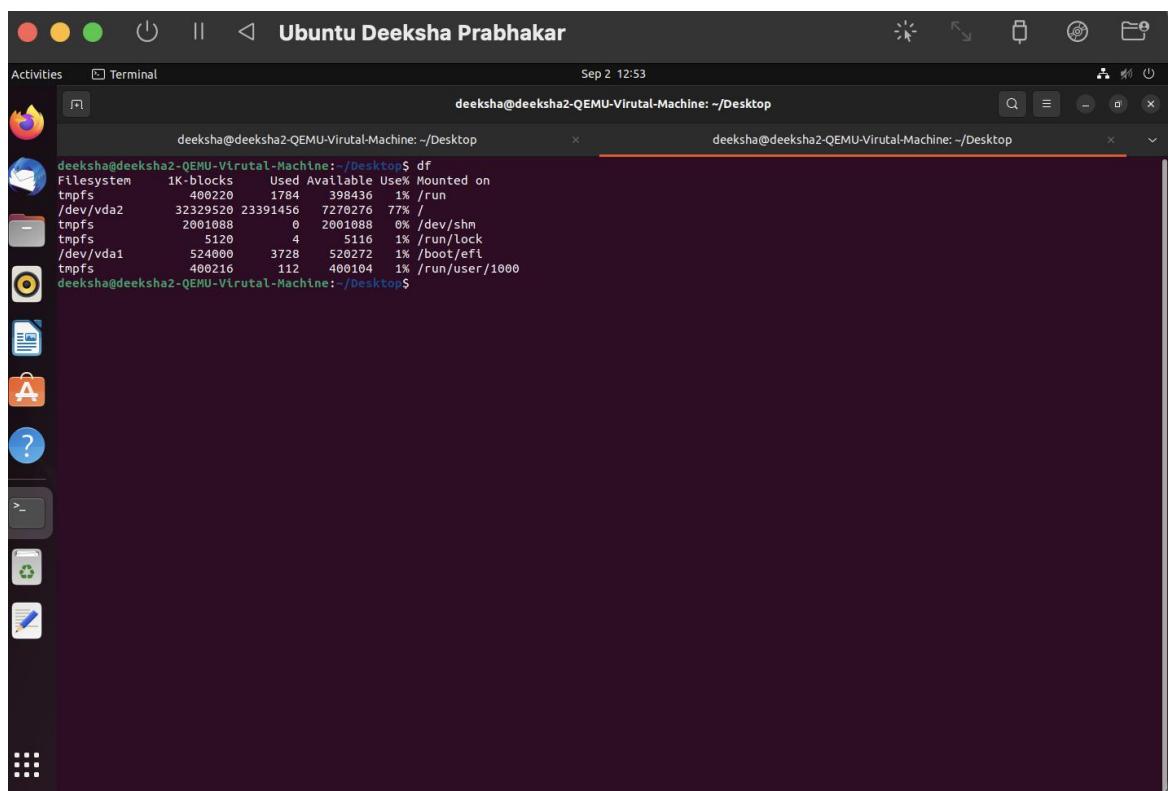


```
Ubuntu Deeksha Prabhakar
Activities Terminal Sep 2 12:14
deeksha@deeksha2-QEMU-Virutal-Machine: ~/Desktop
deeksha@deeksha2-QEMU-Virutal-Machine: ~/Desktop
HUP INT QUIT ILL TRAP ABRT BUS FPE KILL USR1 SEGV USR2 PIPE ALRM TERM STKFLT
CHLD CONT STOP TSTP TTIN TTOUT URG XCPU XFSZ VTIME PROF WINCH POLL PWR SYS
deeksha@deeksha2-QEMU-Virutal-Machine: ~/Desktop$
```

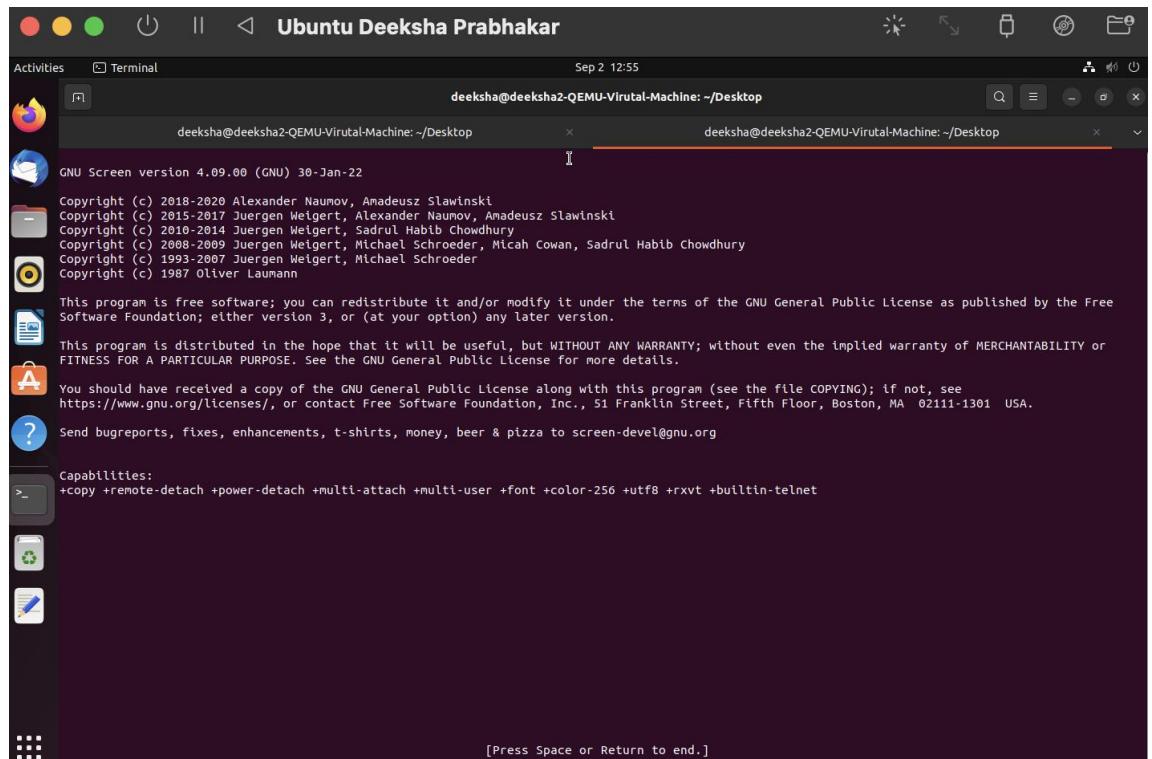
23. du- It is used to see disk storage.



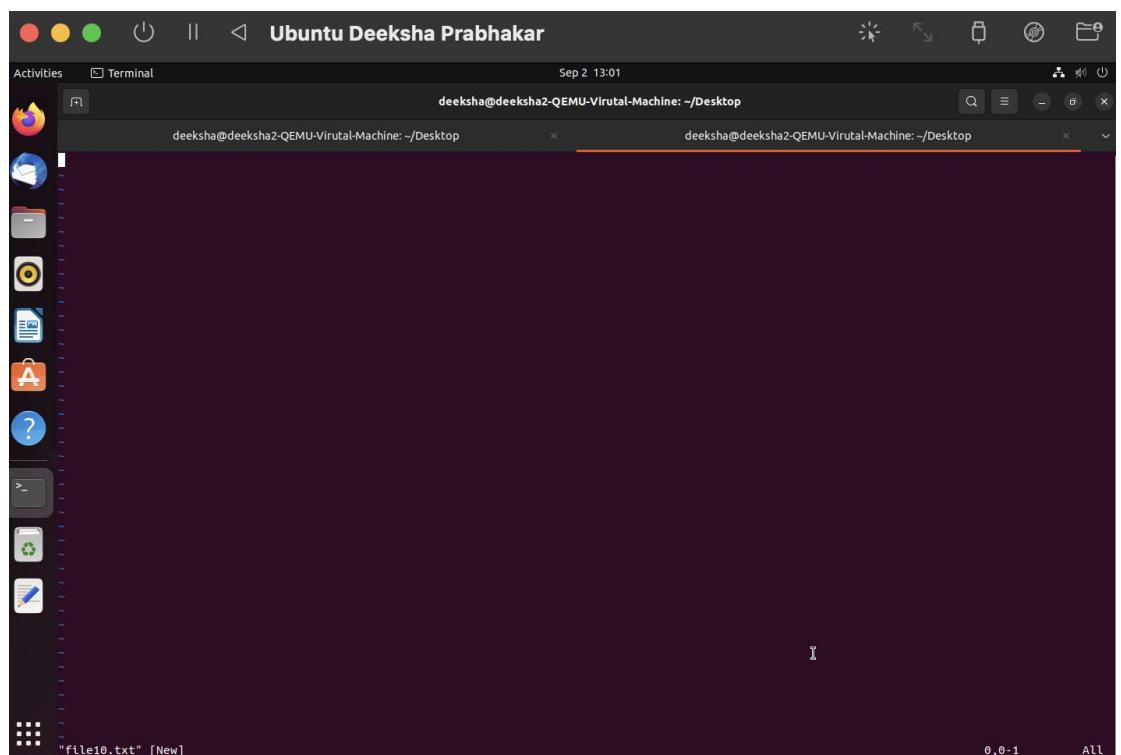
24. df- It is used to see the free storage available on the disk.



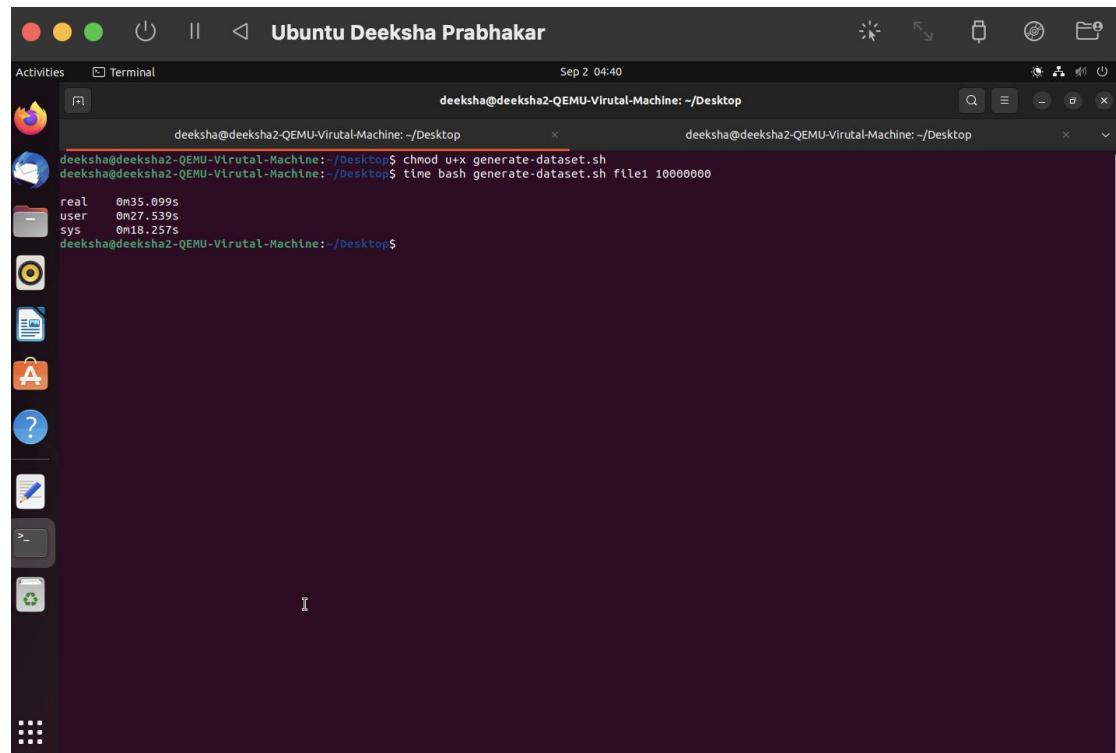
25. screen- It allows the user to have multiple screen sessions inside one terminal.



26. vim- It is used to open a text editor and edit a single file.

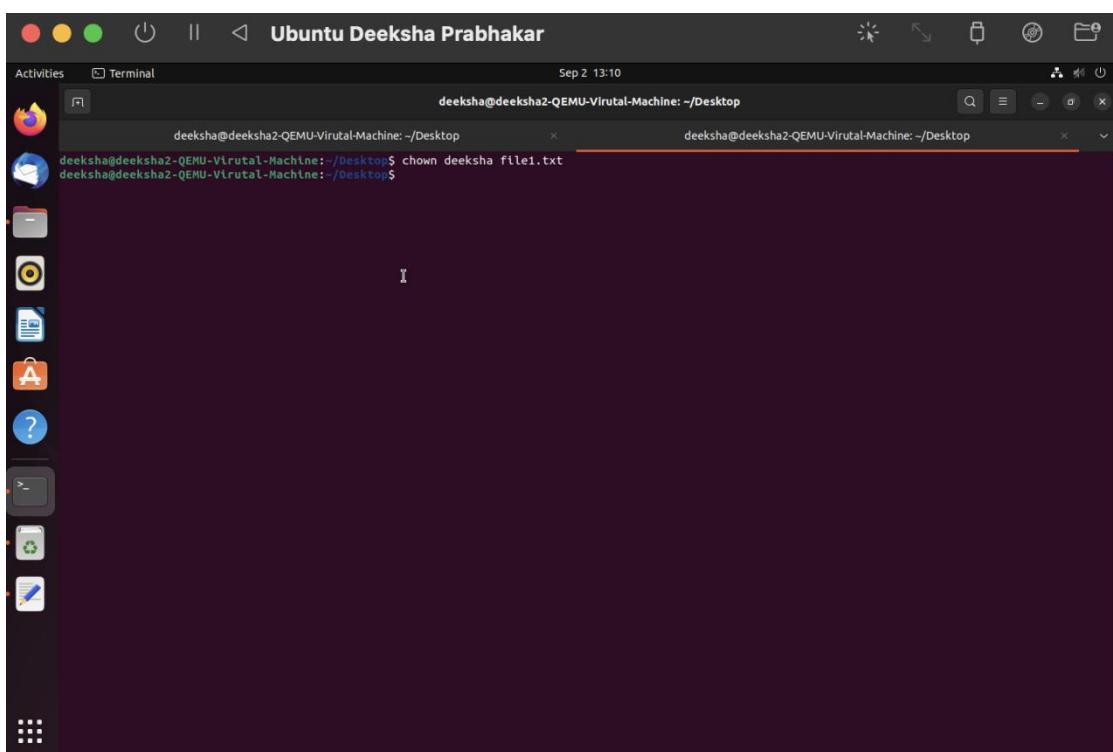


27. chmod- It is used to change modes and permissions for various files so that only users with permissions can access those files.



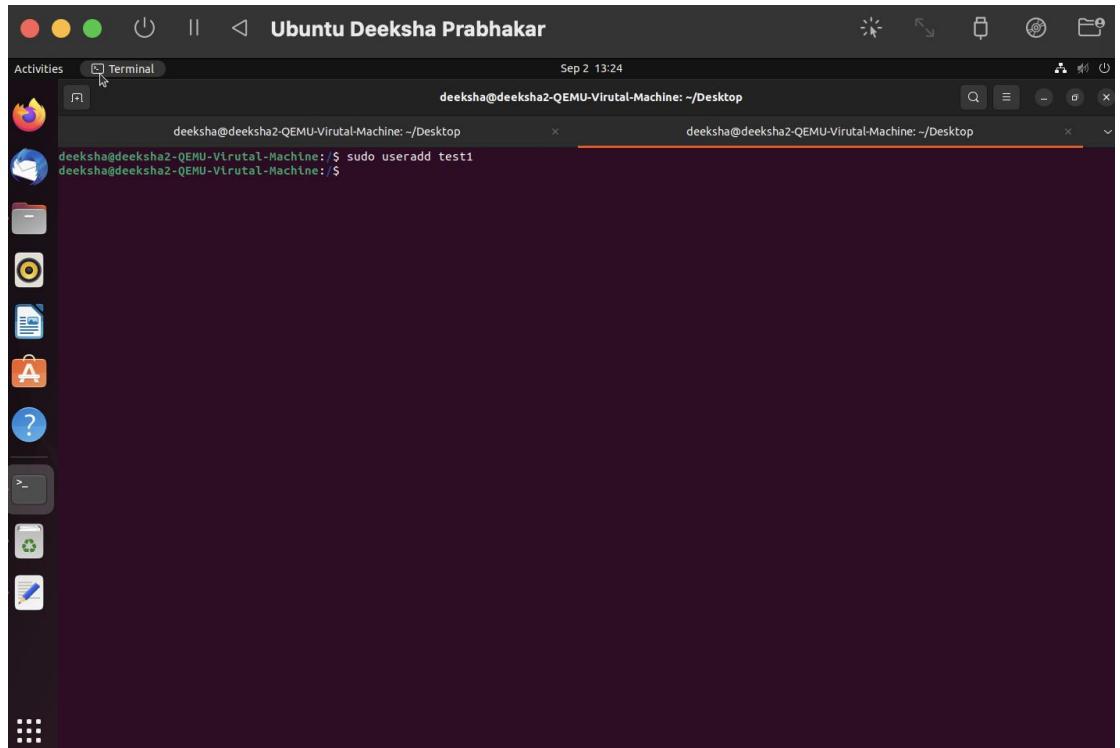
```
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$ chmod u+x generate-dataset.sh
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$ time bash generate-dataset.sh file1 1000000
real    0m35.099s
user    0m27.539s
sys     0m18.257s
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$
```

28. chown- It is used to change ownership of the files or directories.

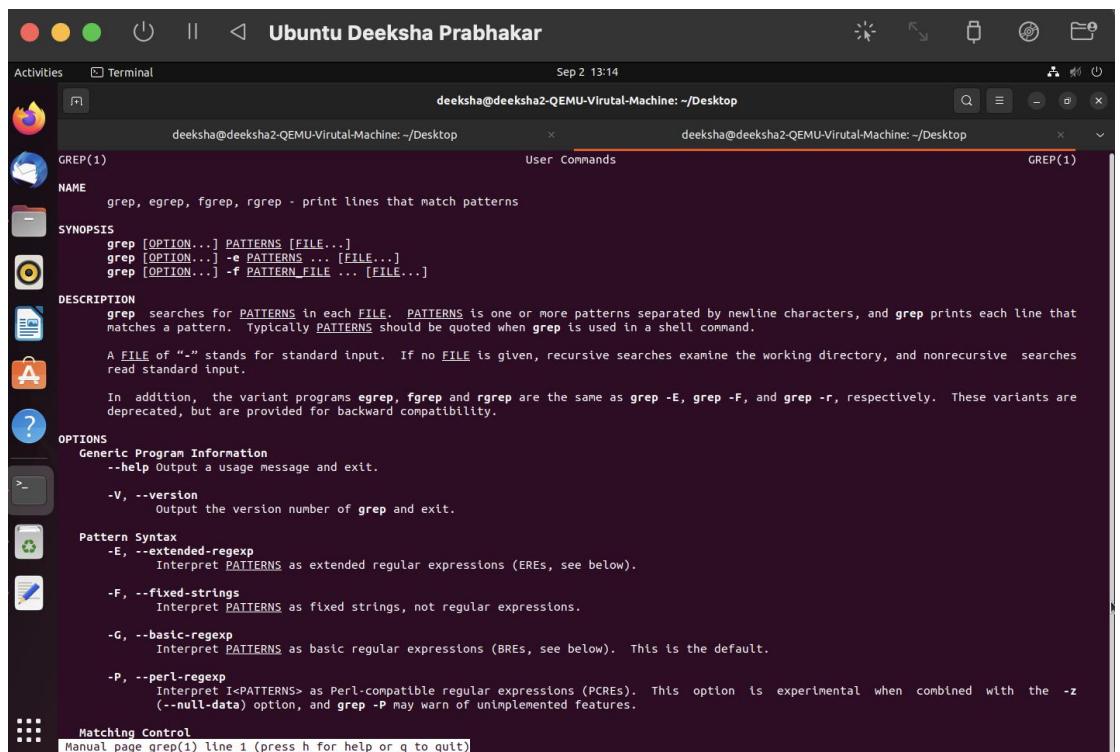


```
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$ chown deeksha file1.txt
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$
```

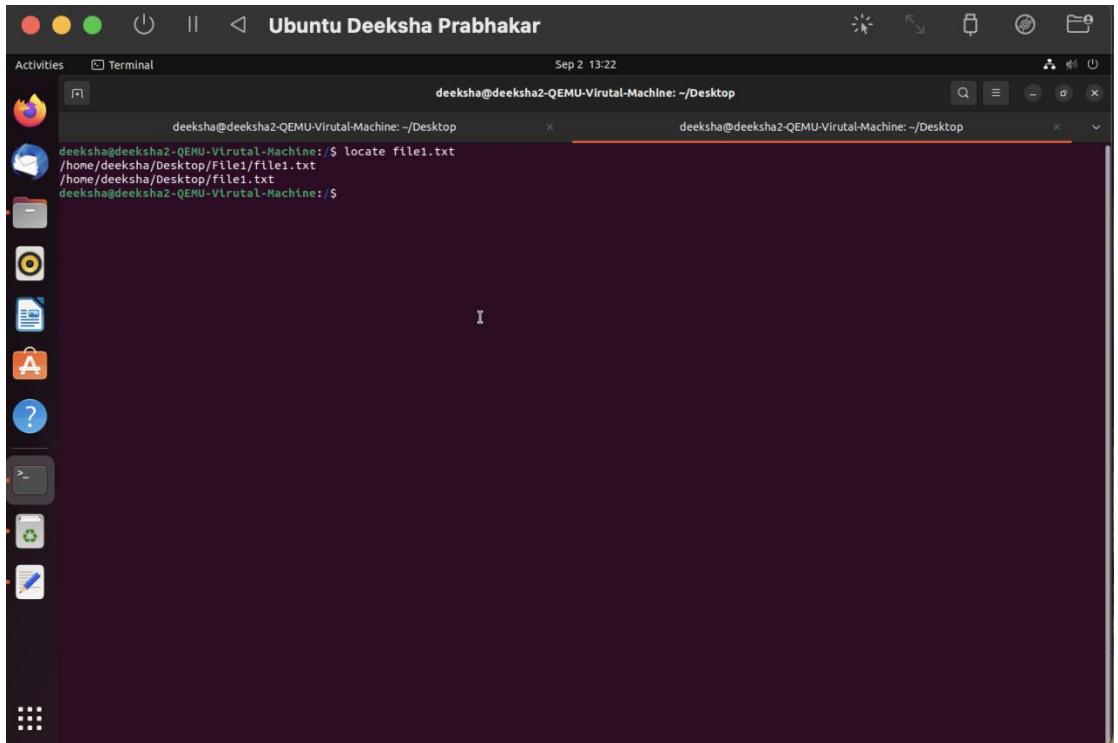
29. useradd- It is used to create or add a new user.



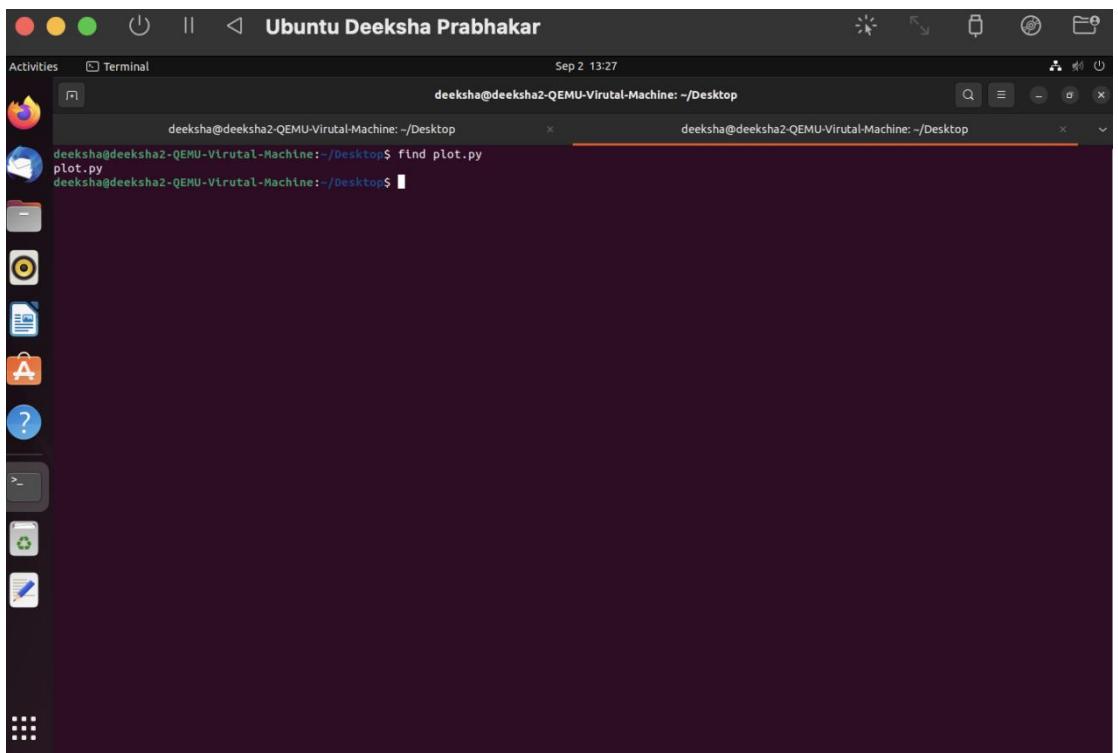
30. man- It is used to display the manual of the different commands.



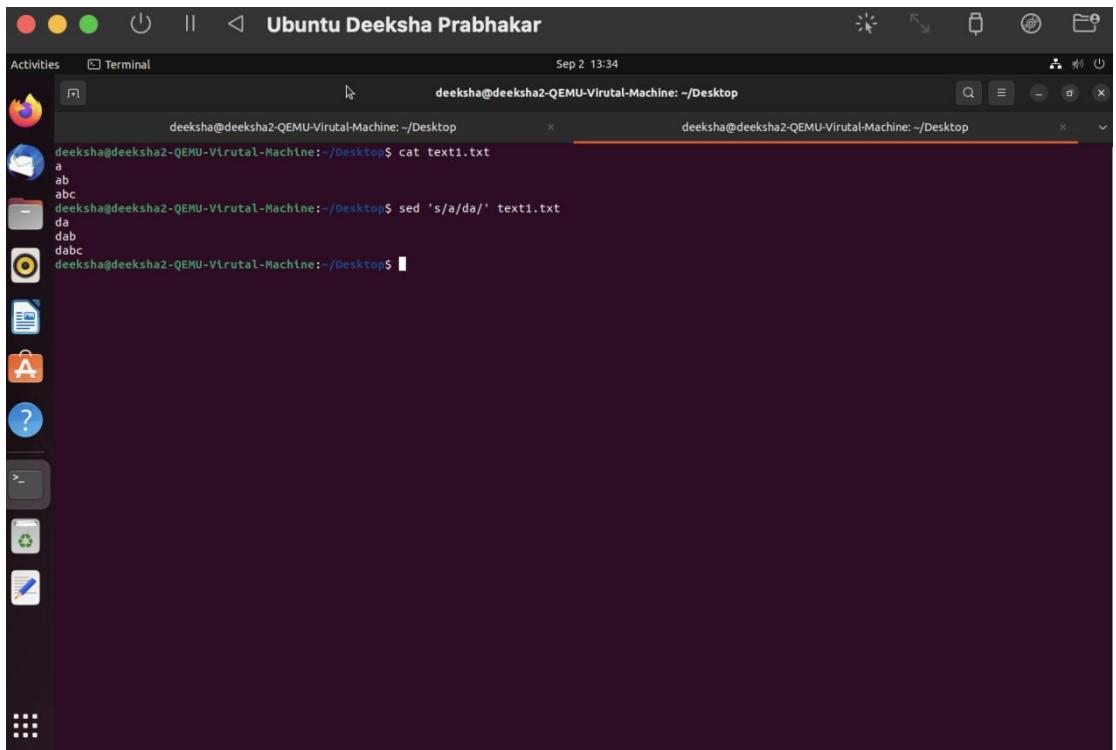
31. locate- Used to locate where the file with the input name is stored.



32. find- It is used to find the file which satisfies the specified conditions.



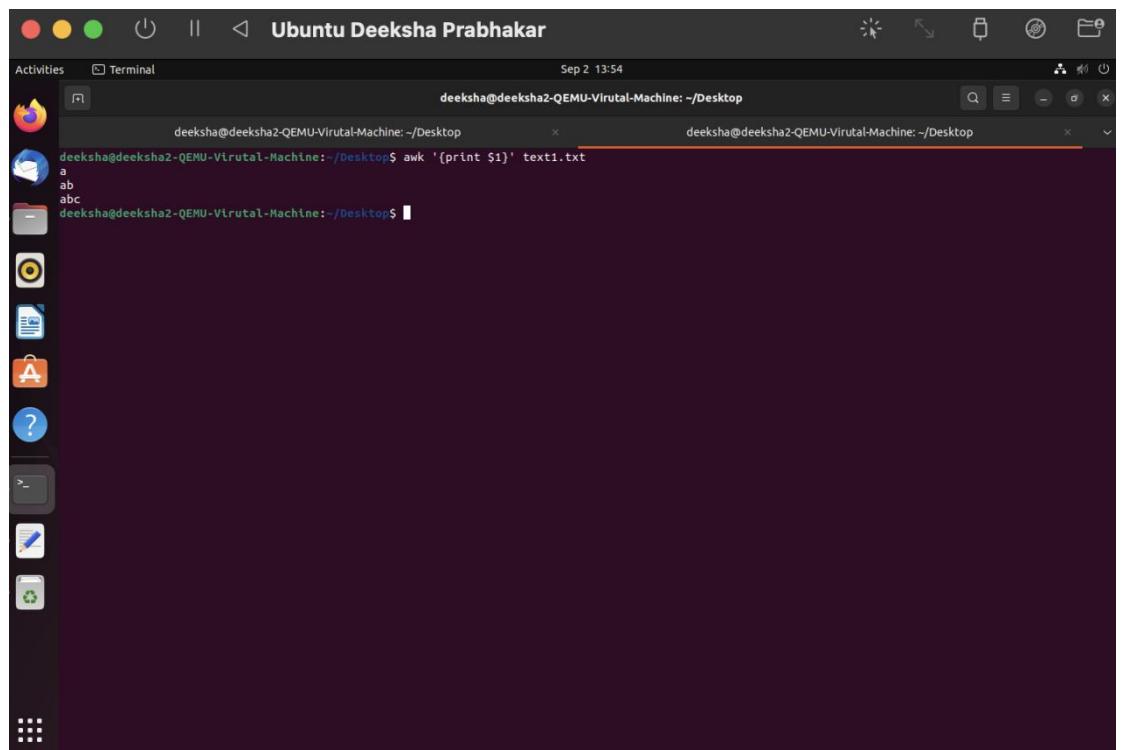
33. sed- It is used to parse through the file and manipulate text in the form of find, replace, insert or delete.



A screenshot of an Ubuntu desktop environment. The terminal window title is "Ubuntu Deeksha Prabhakar". The terminal shows the following session:

```
deeksha@deeksha2-QEMU-Virutal-Machine: ~/Desktop$ cat text1.txt
a
ab
abc
deeksha@deeksha2-QEMU-Virutal-Machine: ~/Desktop$ sed 's/a/da/' text1.txt
da
dab
dabc
deeksha@deeksha2-QEMU-Virutal-Machine: ~/Desktop$
```

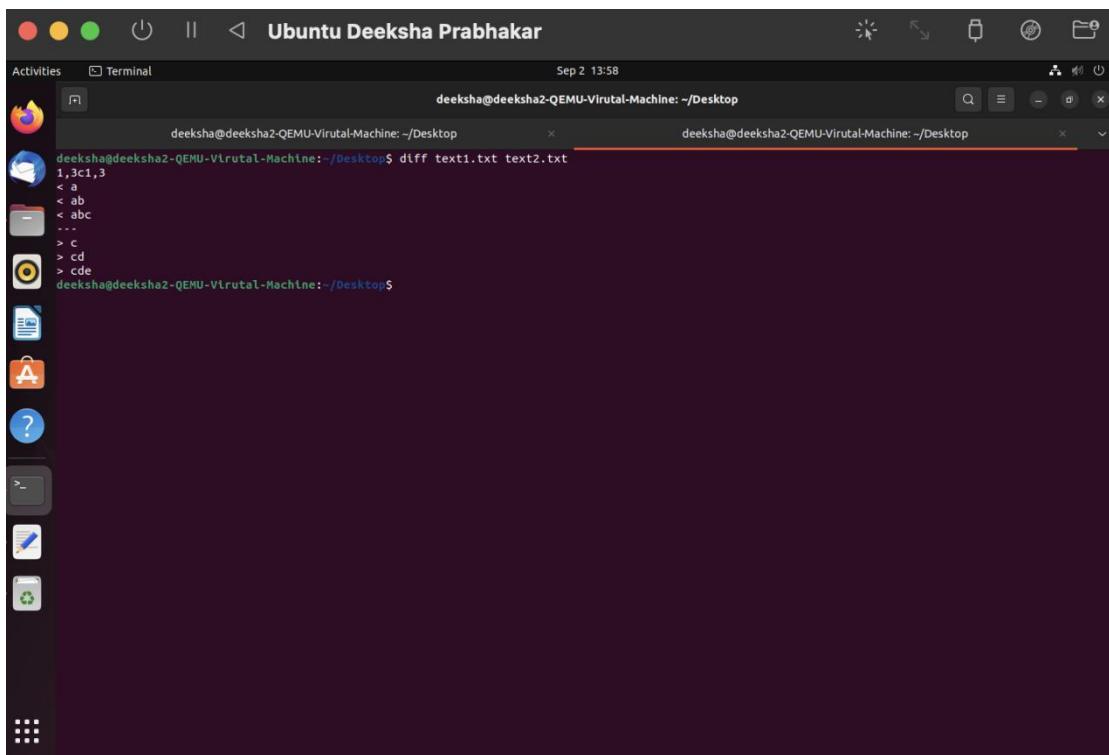
34. awk- It is used to manipulate the output of the print command.



A screenshot of an Ubuntu desktop environment. The terminal window title is "Ubuntu Deeksha Prabhakar". The terminal shows the following session:

```
deeksha@deeksha2-QEMU-Virutal-Machine: ~/Desktop$ awk '{print $1}' text1.txt
a
ab
abc
deeksha@deeksha2-QEMU-Virutal-Machine: ~/Desktop$
```

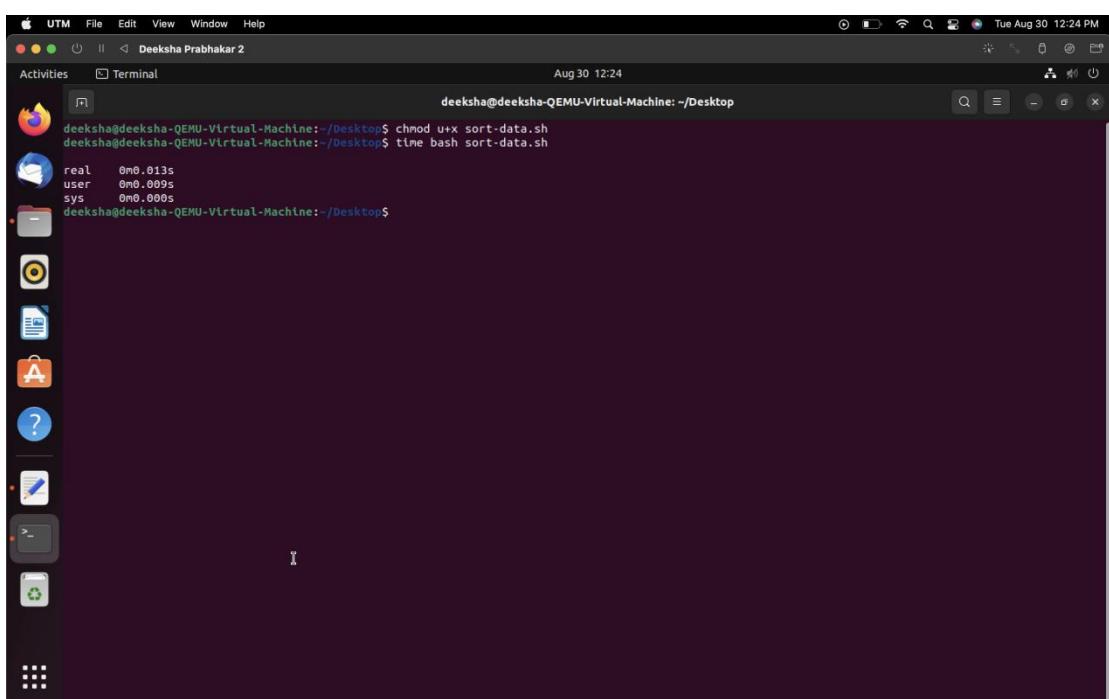
35. diff- It is used for a line by line comparison of two files.



A screenshot of a Linux desktop environment, likely Ubuntu, showing a terminal window titled "Ubuntu Deeksha Prabhakar". The terminal window has two tabs, both labeled "deeksha@deeksha2-QEMU-Virtual-Machine: ~/Desktop". The left tab shows the output of the command "diff text1.txt text2.txt", which displays the differences between two files. The right tab is empty. The terminal window is located on a dark-themed desktop with a dock containing various icons on the left side.

```
deeksha@deeksha2-QEMU-Virtual-Machine:~/Desktop$ diff text1.txt text2.txt
1,3c1,3
< a
< ab
< abc
...
> c
> cd
> cde
deeksha@deeksha2-QEMU-Virtual-Machine:~/Desktop$
```

36. sort- It is used to sort the data stored in a file.



A screenshot of a Linux desktop environment, likely Ubuntu, showing a terminal window titled "Deeksha Prabhakar 2". The terminal window has two tabs, both labeled "deeksha@deeksha-QEMU-Virtual-Machine: ~/Desktop". The left tab shows the output of the command "time bash sort-data.sh", which includes the execution time (real, user, sys). The right tab is empty. The terminal window is located on a dark-themed desktop with a dock containing various icons on the left side.

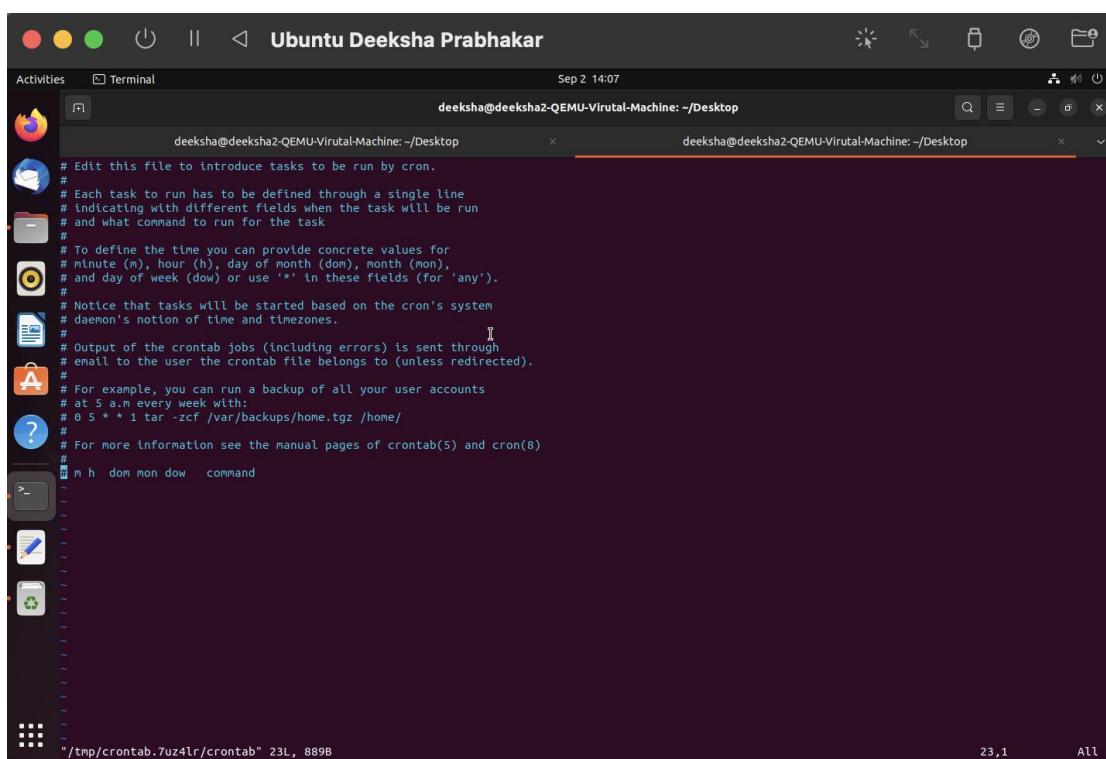
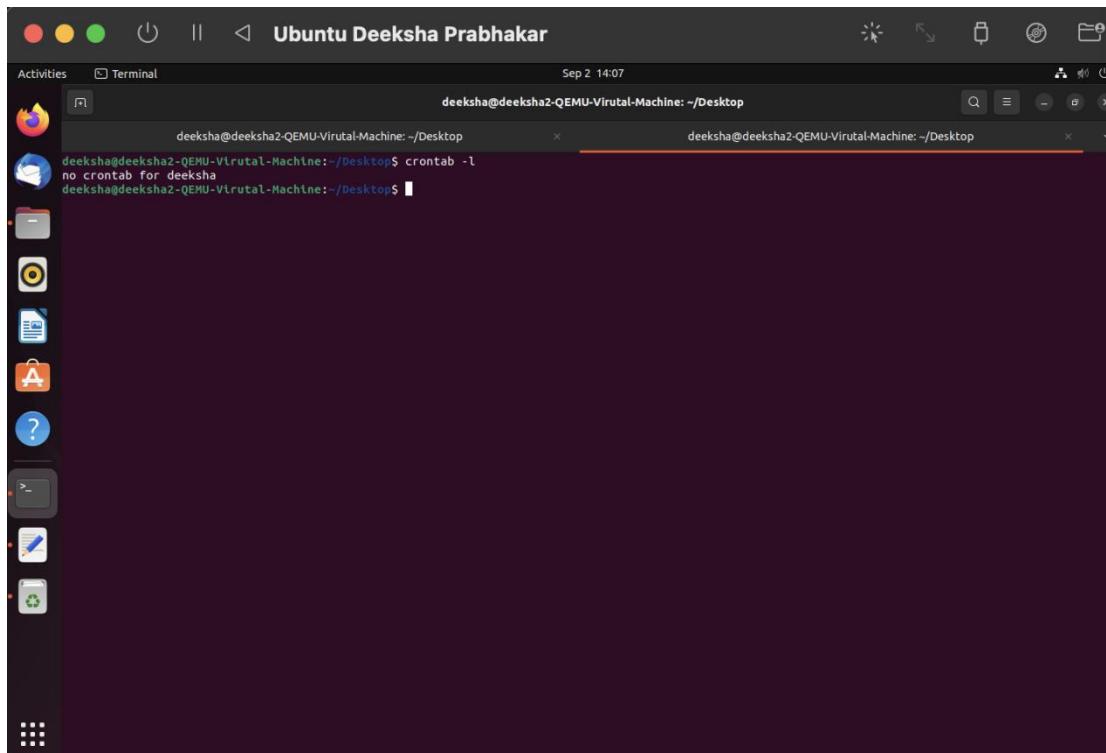
```
deeksha@deeksha-QEMU-Virtual-Machine:~/Desktop$ chmod u+x sort-data.sh
deeksha@deeksha-QEMU-Virtual-Machine:~/Desktop$ time bash sort-data.sh
real    0m0.013s
user    0m0.009s
sys     0m0.000s
deeksha@deeksha-QEMU-Virtual-Machine:~/Desktop$
```

37. **export**- It is used to list the environment variables.

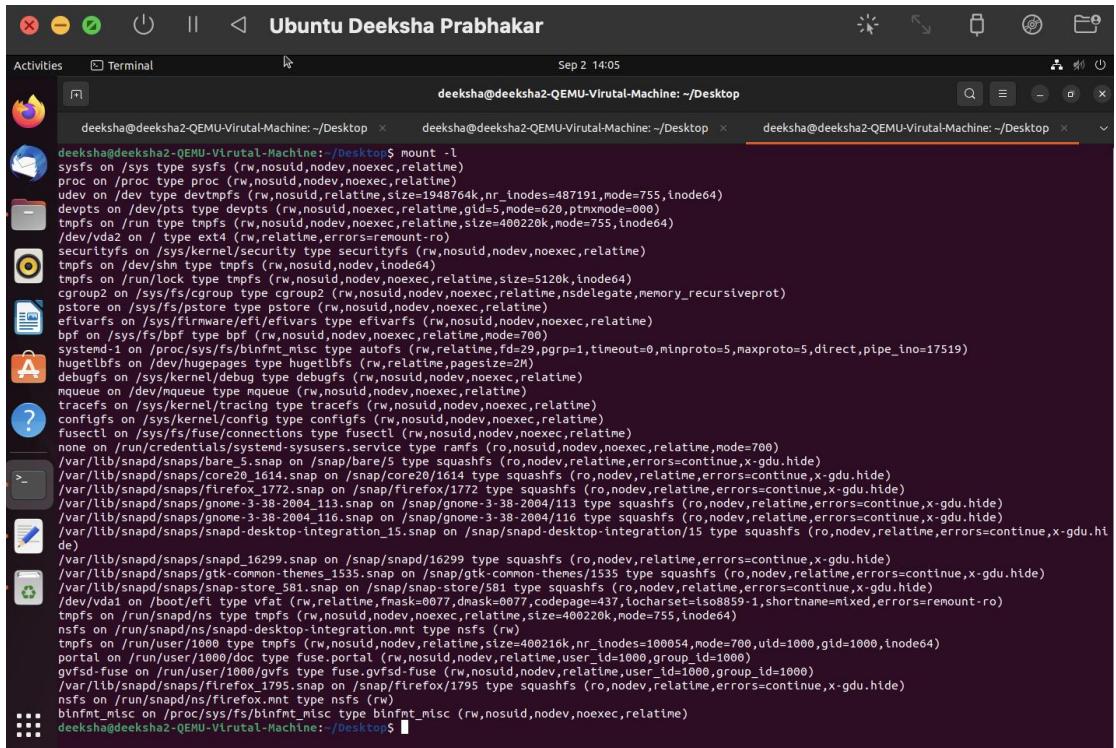
38. `pwd`- It prints the present working directory.

A screenshot of the Ubuntu desktop environment. The top bar shows the title "Ubuntu Deeksha Prabhakar". The desktop has a dark theme. On the left, there's a vertical dock with icons for Activities, Terminal, Home, Dash, Applications, Files, and Settings. A terminal window is open, showing the command "pwd" being run and the output "/home/deeksha/Desktop". The status bar at the bottom indicates the date and time as "Sep 2 14:01".

39. crontab- It is used to show and edit the jobs that are scheduled to run either at a specific time or periodically.

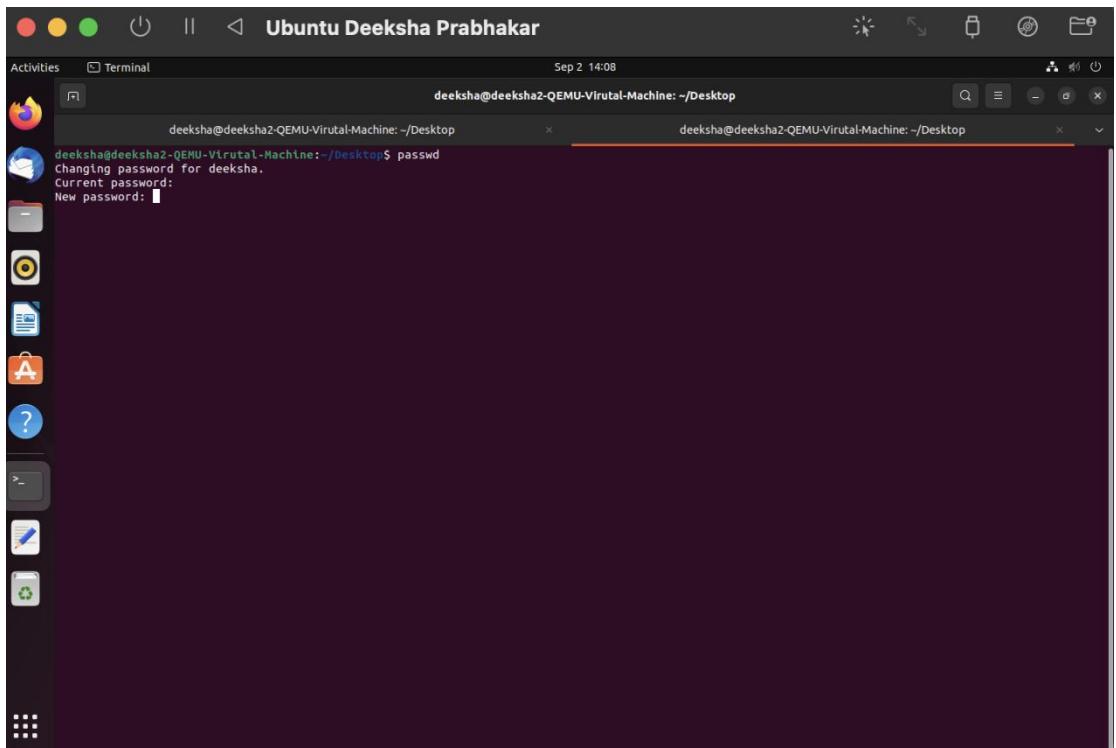


40. mount- It is used to mount certain removable devices and some file-systems or get information about them.



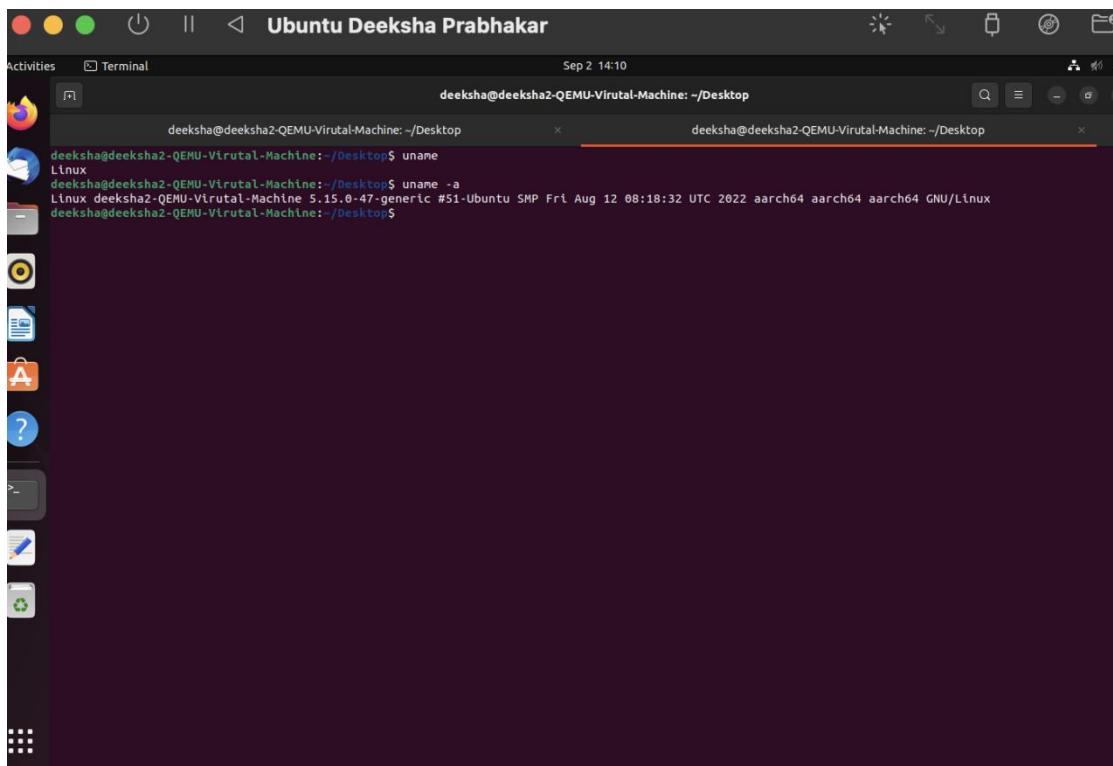
```
deeksha@deeksha2-QEMU-Virtual-Machine: ~/Desktop$ mount -l
sysfs on /sys type sysfs (rw,nosuid,nodev,noexec,relatime)
proc on /proc type proc (rw,nosuid,nodev,noexec,relatime)
udev on /dev type devtmpfs (rw,nosuid,relative,SIZE=1948764k,NR_INODES=487191,MODE=755,INODE64)
devpts on /dev/pts type devpts (rw,nosuid,nodev,noexec,relatime,gid=5,mode=620,PTMXNODE=000)
tmpfs on /run type tmpfs (rw,nosuid,nodev,noexec,relatime,SIZE=406220k,MODE=755,INODE64)
/dev/vda2 on / type ext4 (rw,relative,errors=remount-ro)
securityfs on /sys/kernel/security type securityfs (rw,nosuid,nodev,noexec,relatime)
tmpfs on /dev/shm type tmpfs (rw,nosuid,nodev,inode64)
tmpfs on /run/lock type tmpfs (rw,nosuid,nodev,noexec,relatime,SIZE=5120k,inode64)
cgroup2 on /sys/fs/cgroup type cgroup2 (rw,nosuid,nodev,noexec,relatime,nsdelegate,memory_recursiveprot)
pstore on /sys/fs/pstore type pstore (rw,nosuid,nodev,noexec,relatime)
efivar on /sys/firmware/efi/efivars type efivarfs (rw,nosuid,nodev,noexec,relatime)
bpf on /sys/fs/bpf type bpf (rw,nosuid,nodev,noexec,relatime,mode=700)
systemd-1 on /proc/sys/fs/binfmt_misc type autofs (rw,relative,id=29,prgr=1,timeout=0,minproto=5,maxproto=5,direct,pipe_ino=17519)
hugepages on /dev/hugepages type hugepages (rw,relative,pagesize=2M)
debugfs on /sys/kernel/debug type debugfs (rw,nosuid,nodev,noexec,relatime)
mqqueue on /dev/mqueue type mqueue (rw,nosuid,nodev,noexec,relatime)
traces on /sys/kernel/tracing type traces (rw,nosuid,nodev,noexec,relatime)
configs on /sys/kernel/config type configs (rw,nosuid,nodev,noexec,relatime)
fusionctl on /run/credentials/systemd-sysusers.service type rusectt (rw,nosuid,nodev,noexec,relatime,mode=700)
none on /run/credentials type rusectt (rw,nosuid,nodev,noexec,relatime,mode=700)
/var/lib/snapd/snaps/bar_5.snap on /snap/bare/5 type squashfs (ro,nodev,relative,errors=continue,x-gdu.hide)
/var/lib/snapd/snaps/core20_1614.snap on /snap/core20/1614 type squashfs (ro,nodev,relative,errors=continue,x-gdu.hide)
/var/lib/snapd/snaps/firefox_1772.snap on /snap/firefox/1772 type squashfs (ro,nodev,relative,errors=continue,x-gdu.hide)
/var/lib/snapd/snaps/gnome-3-38-2004_113.snap on /snap/gnome-3-38-2004/113 type squashfs (ro,nodev,relative,errors=continue,x-gdu.hide)
/var/lib/snapd/snaps/gnome-3-38-2004_116.snap on /snap/gnome-3-38-2004/116 type squashfs (ro,nodev,relative,errors=continue,x-gdu.hide)
/var/lib/snapd/snaps/snapd-desktop-integration_15.snap on /snap/snapd-desktop-integration/15 type squashfs (ro,nodev,relative,errors=continue,x-gdu.hide)
/var/lib/snapd/snaps/snapd_16299.snap on /snap/snapd/16299 type squashfs (ro,nodev,relative,errors=continue,x-gdu.hide)
/var/lib/snapd/snaps/gtk-common-themes_1535.snap on /snap/gtk-common-themes/1535 type squashfs (ro,nodev,relative,errors=continue,x-gdu.hide)
/var/lib/snapd/snaps/snap-store_581.snap on /snap/snap-store/581 type squashfs (ro,nodev,relative,errors=continue,x-gdu.hide)
/dev/vda1 on /boot/efi type vfat (rw,relative,mask=0x77,dfmask=0x77,codepage=437,iocharset=iso8859-1,shortname=mixed,errors=remount-ro)
tmpfs on /run/snapd/ns/snapd-desktop-integration_15 type nsfs (rw)
nsfs on /run/snapd/ns/snapd-desktop-integration_15 type nsfs (rw)
tmpfs on /run/user/1000 type tmpfs (rw,nosuid,nodev,relative,SIZE=400216k,NR_INODES=100054,MODE=700,UID=1000,GID=1000,INODE64)
portal on /run/user/1000/portal type fuse.portal (rw,nosuid,nodev,relative,user_id=1000,group_id=1000)
gvfsd-fuse on /run/user/1000/gvfs type gvfsd-fuse (rw,nosuid,nodev,relative,user_id=1000,group_id=1000)
/var/lib/snapd/snaps/firefox_1795.snap on /snap/firefox/1795 type squashfs (ro,nodev,relative,errors=continue,x-gdu.hide)
nsfs on /run/snapd/ns/firefox_mnt type nsfs (rw)
binfmt_misc on /proc/sys/fs/binfmt_misc type binfmt_misc (rw,nosuid,nodev,noexec,relative)
```

41. passwd- It is used to change the user account password.



```
deeksha@deeksha2-QEMU-Virtual-Machine: ~/Desktop$ passwd
Changing password for deeksha.
Current password: [REDACTED]
New password: [REDACTED]
```

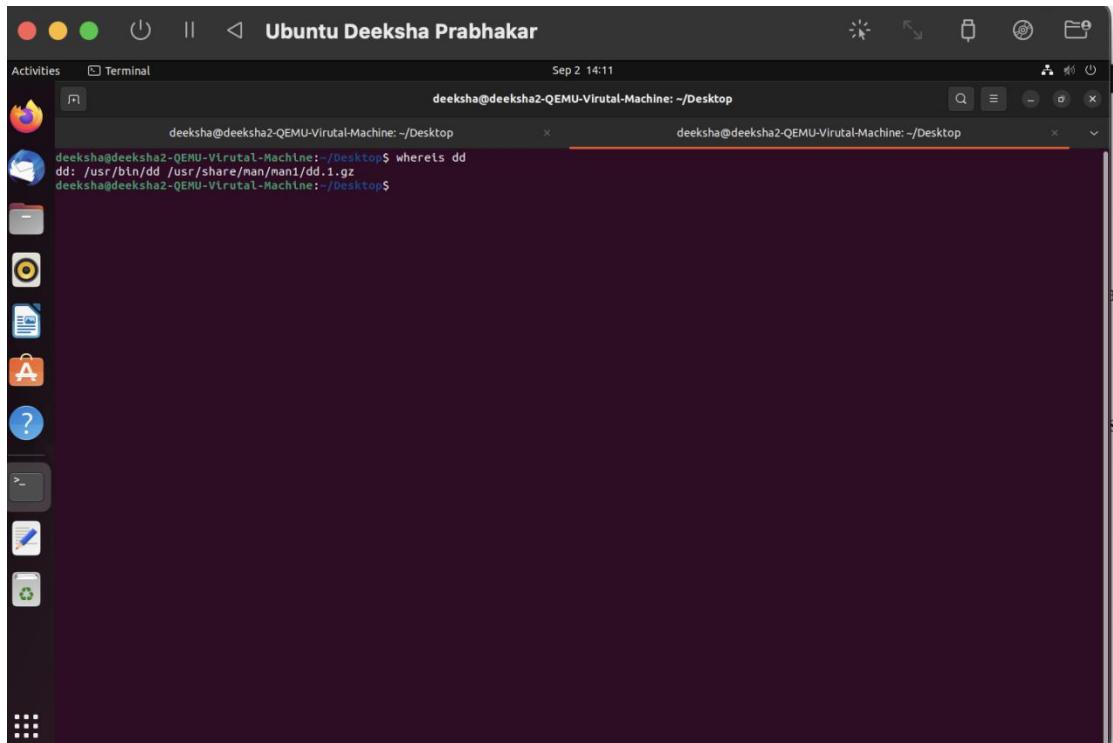
42. **uname**- It is used to show basic information about the machines hardware and software.



A screenshot of a Linux desktop environment, likely Ubuntu, showing a terminal window titled "Ubuntu Deeksha Prabhakar". The terminal window has two tabs, both labeled "Terminal". The left tab shows the output of the "uname" command, which includes "Linux" and "Ubuntu SMP Fri Aug 12 08:18:32 UTC 2022 aarch64 aarch64 aarch64 GNU/Linux". The right tab is empty. The desktop background is dark, and the Unity interface is visible on the left side.

```
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$ uname
Linux
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$ uname -a
Linux deeksha2-QEMU-Virutal-Machine 5.15.0-47-generic #51-Ubuntu SMP Fri Aug 12 08:18:32 UTC 2022 aarch64 aarch64 aarch64 GNU/Linux
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$
```

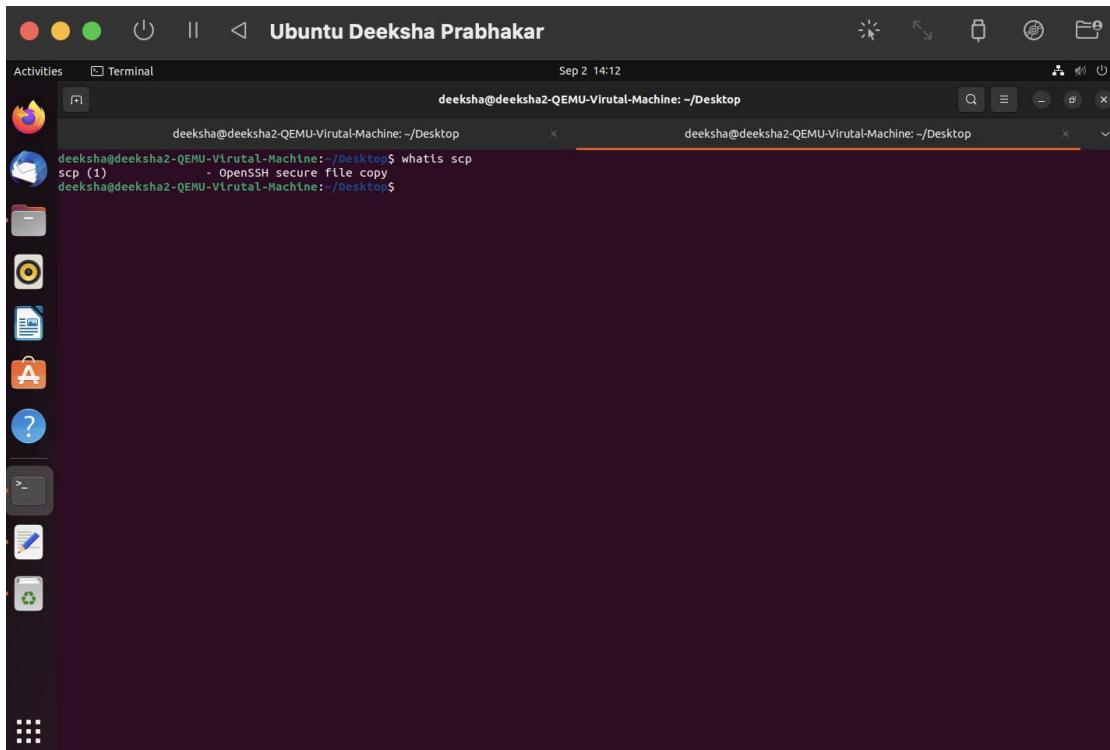
43. **whereis**- This is used to find the binary libraries, manual page files of the commands.



A screenshot of a Linux desktop environment, likely Ubuntu, showing a terminal window titled "Ubuntu Deeksha Prabhakar". The terminal window has two tabs, both labeled "Terminal". The left tab shows the output of the "whereis dd" command, which includes "dd: /usr/bin/dd /usr/share/man/man1/dd.1.gz". The right tab is empty. The desktop background is dark, and the Unity interface is visible on the left side.

```
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$ whereis dd
dd: /usr/bin/dd /usr/share/man/man1/dd.1.gz
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$
```

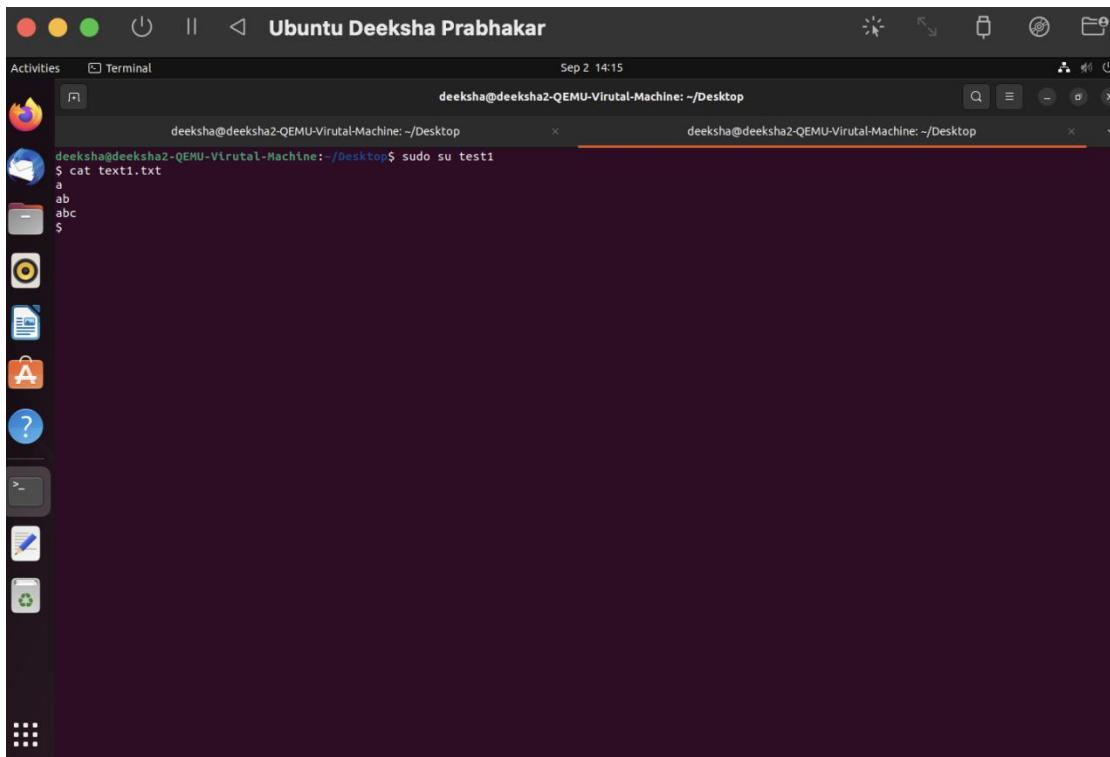
44. whatis- It prints a small description about the commands.



A screenshot of an Ubuntu desktop environment. The terminal window shows the command `whatis scp` being run, which describes it as "OpenSSH secure file copy". The desktop interface includes a dock with various icons and a central workspace with a dark background.

```
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$ whatis scp
scp (1)
- OpenSSH secure file copy
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$
```

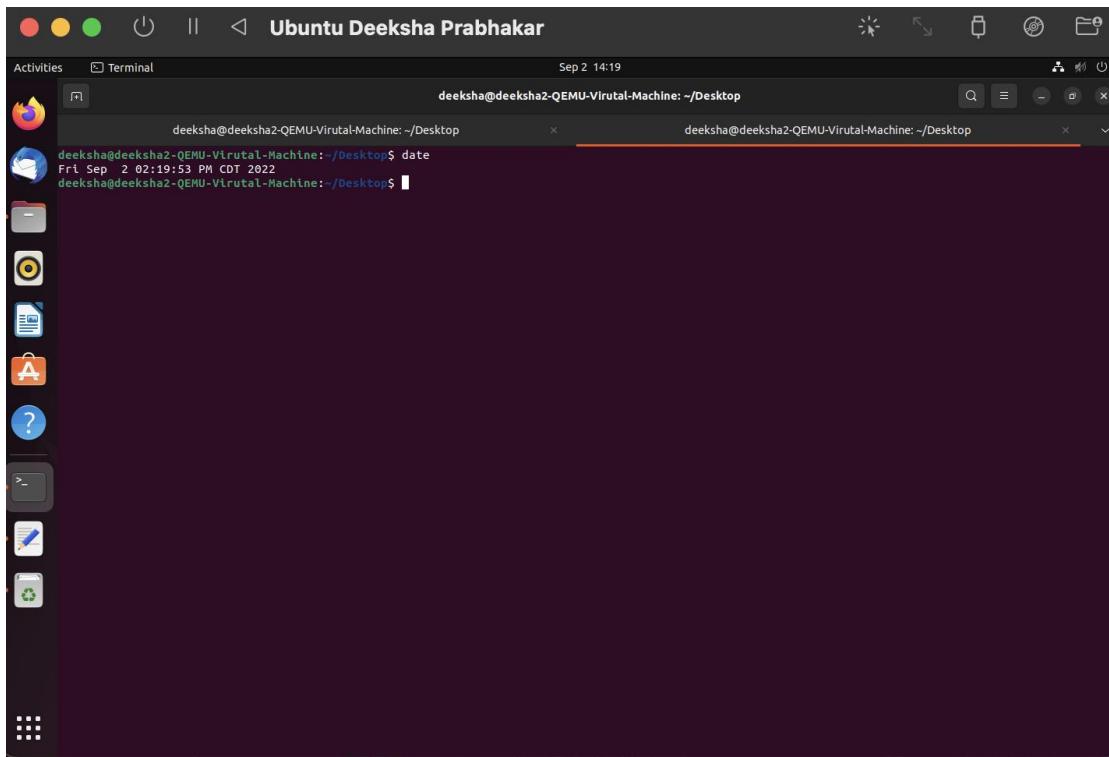
45. su- It allows the user to run or execute commands as a different user.



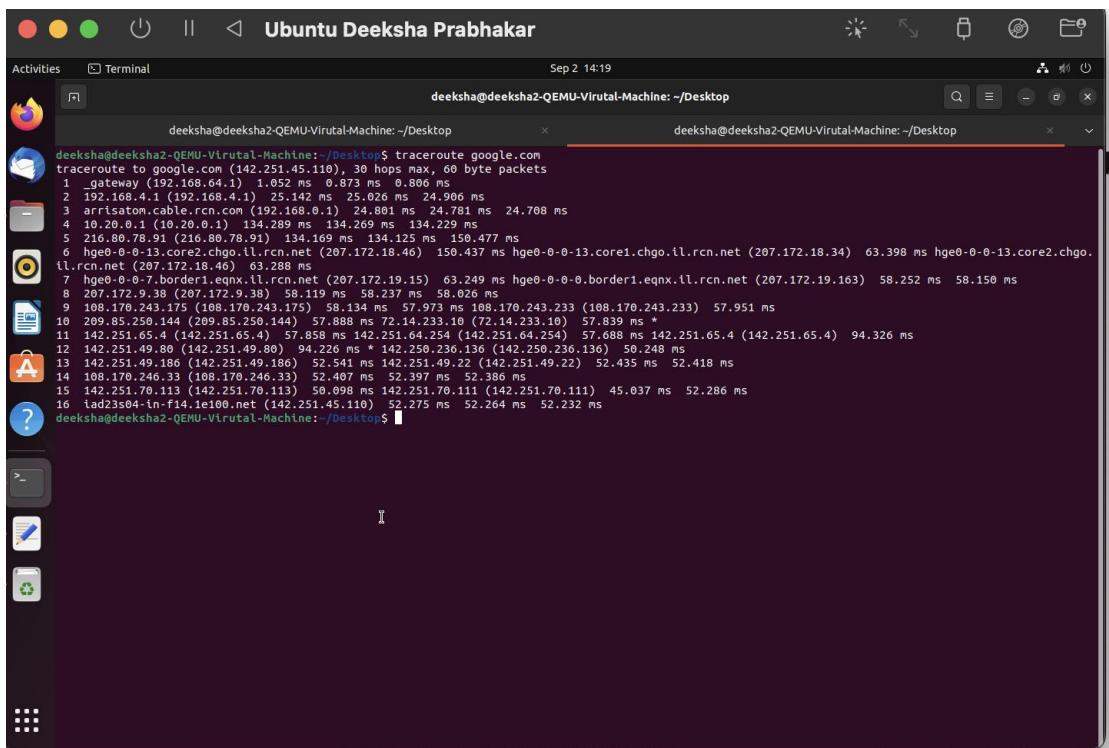
A screenshot of an Ubuntu desktop environment. The terminal window shows the command `sudo su test1` being run, followed by the contents of a file named `text1.txt` which contains the letters 'a', 'ab', and 'abc'. The desktop interface includes a dock with various icons and a central workspace with a dark background.

```
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$ sudo su test1
cat text1.txt
a
ab
abc
$
```

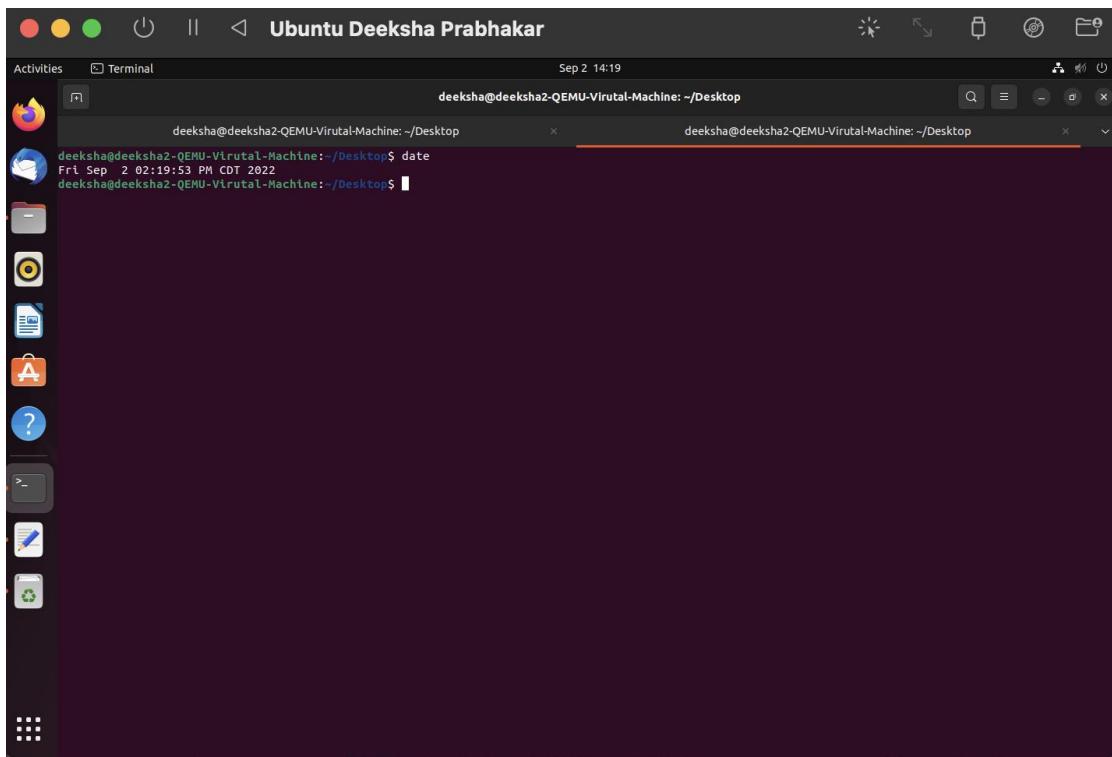
46. ping- It is used to troubleshoot and debug network connectivity issues. It shows if the other machine is responding to requests sent.



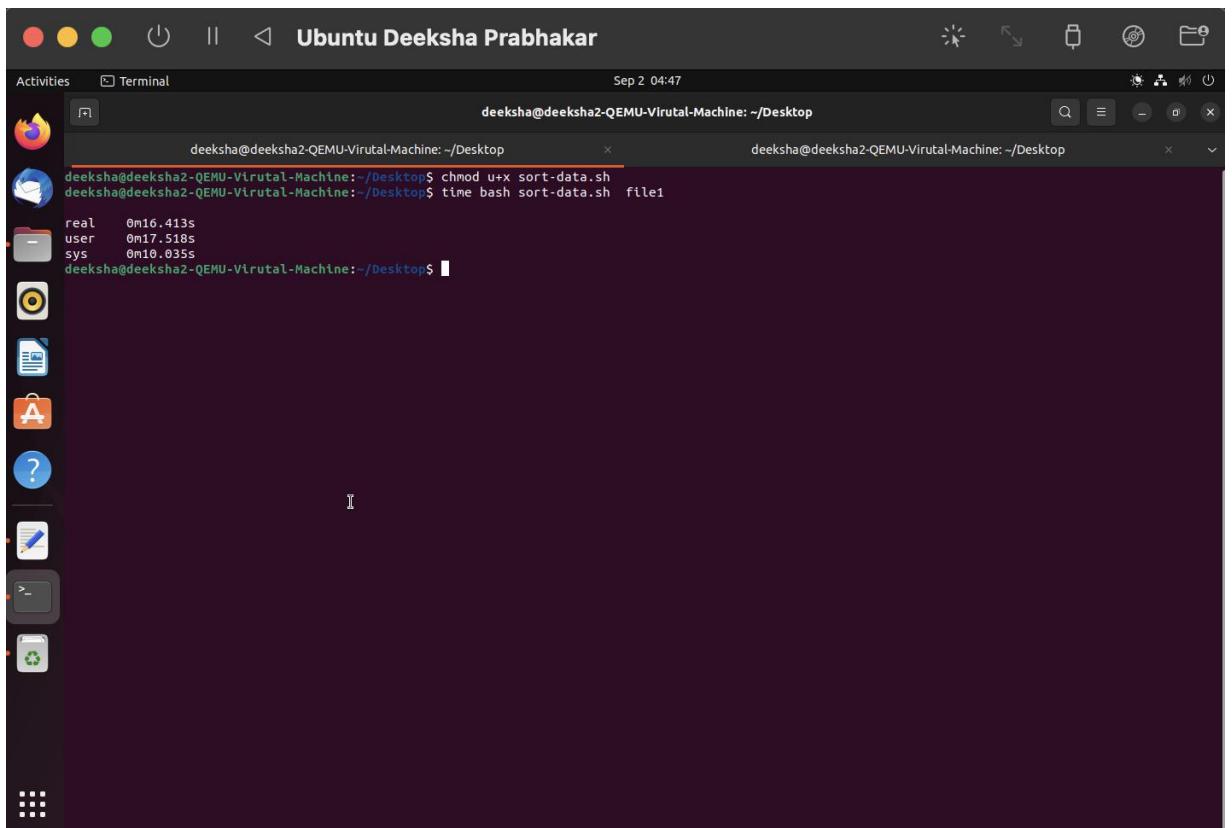
47. traceroute- It prints all points on the route the data packets take to reach the host machine from the server.



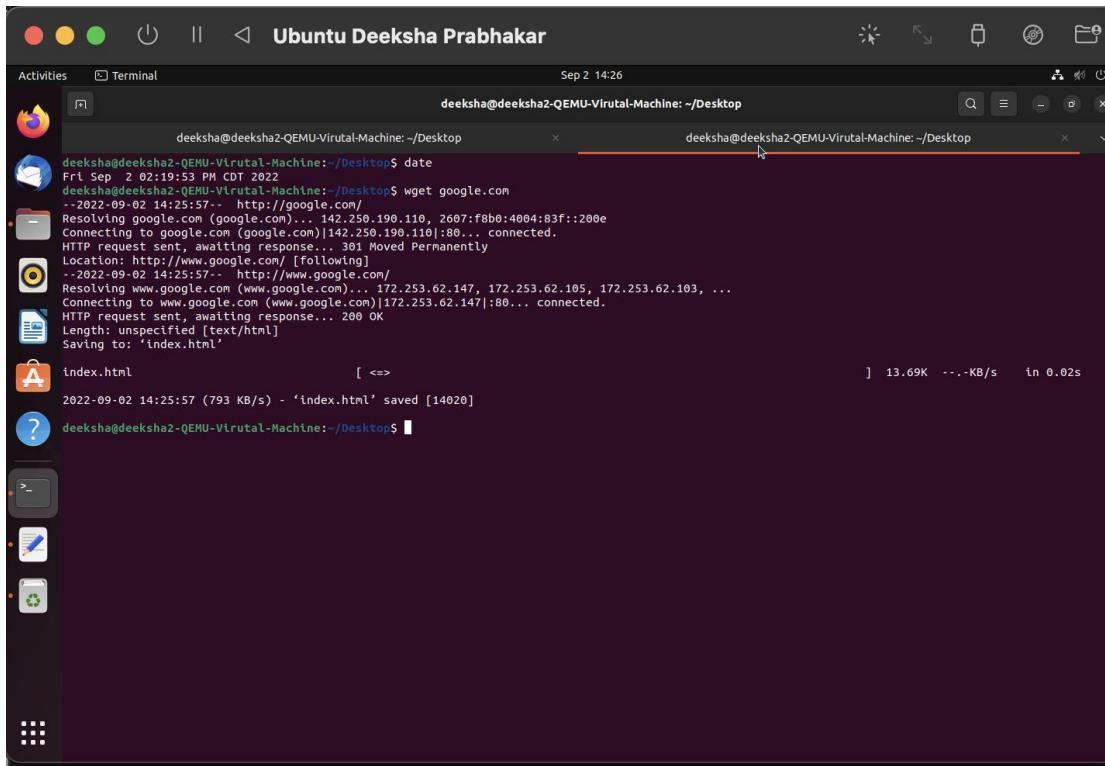
48. date- It is used to display the current date.



49. time- prints the time taken to execute a bash command or script.



50. wget- It is used to download files from the internet.

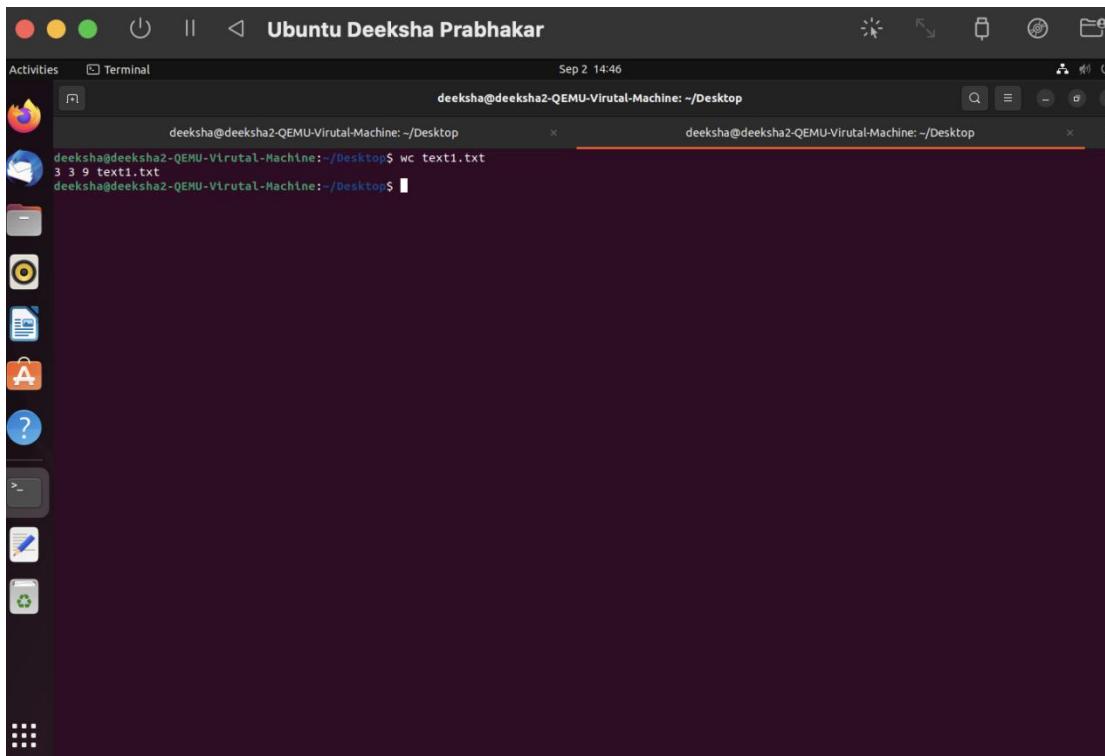


```
deeksha@deeksha2-QEMU-Virutal-Machine: ~/Desktop$ date
Fri Sep  2 02:19:53 PM CDT 2022
deeksha@deeksha2-QEMU-Virutal-Machine: ~/Desktop$ wget google.com
--2022-09-02 14:25:57-- http://google.com/
Resolving google.com (google.com)... 142.250.190.110, 2607:f8b0:4004:83f::200e
Connecting to google.com (google.com)|142.250.190.110|:80... connected.
HTTP request sent, awaiting response... 301 Moved Permanently
Location: http://www.google.com/ [following]
--2022-09-02 14:25:57-- http://www.google.com/
Resolving www.google.com (www.google.com)... 172.253.62.147, 172.253.62.105, 172.253.62.103, ...
Connecting to www.google.com (www.google.com)|172.253.62.147|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: unspecified [text/html]
Saving to: 'index.html'

index.html                                     [ =>                               ]  13.69K  --.-KB/s   in  0.02s

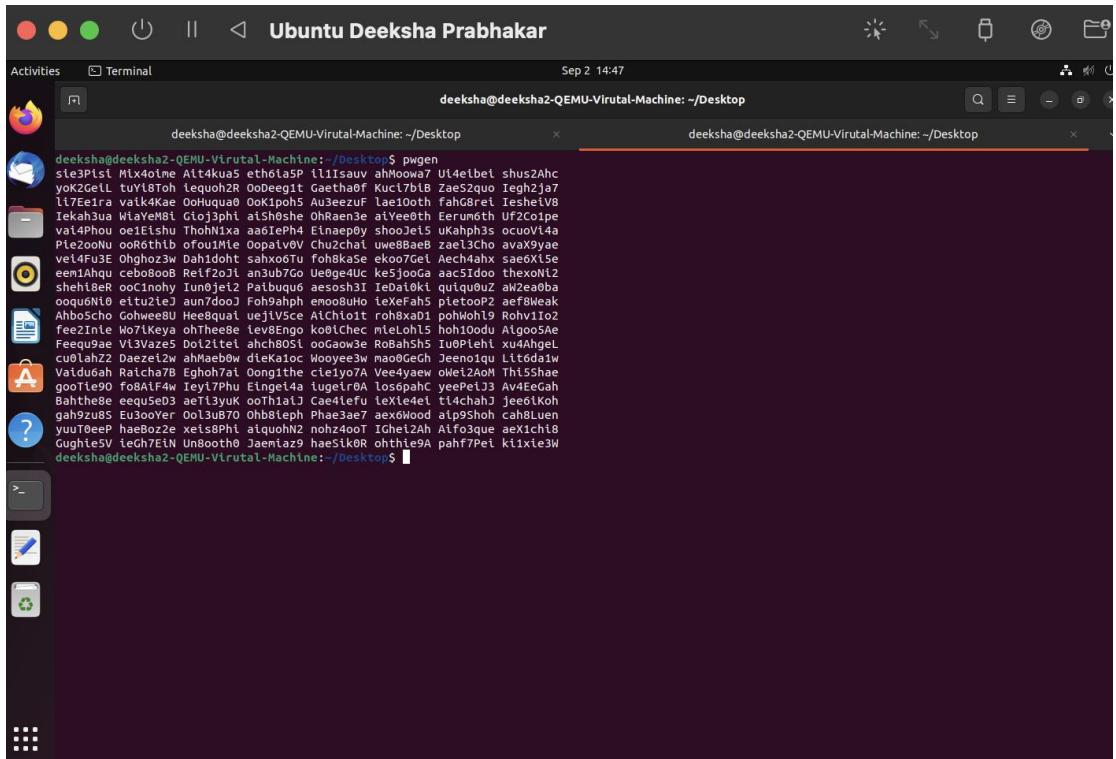
2022-09-02 14:25:57 (793 KB/s) - 'index.html' saved [14020]
deeksha@deeksha2-QEMU-Vlrutal-Machine: ~/Desktop$
```

51. wc- It is used to print new line, get byte counts etc.



```
deeksha@deeksha2-QEMU-Virutal-Machine: ~/Desktop$ wc text1.txt
3 3 9 text1.txt
deeksha@deeksha2-QEMU-Virutal-Machine: ~/Desktop$
```

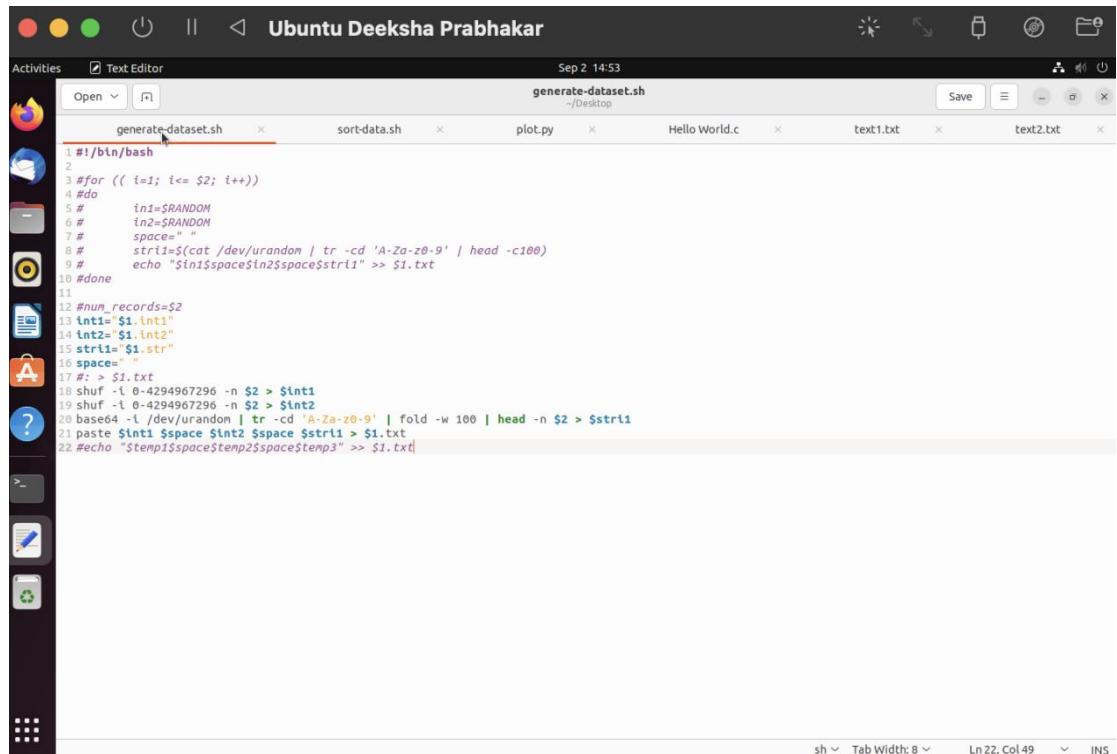
52. pwgen- It is used to generate a random password.



The screenshot shows a standard Ubuntu desktop interface with a dark theme. A terminal window is open in the center, titled 'Terminal'. The command 'deeksha@deeksha2-QEMU-Virutal-Machine: ~/Desktop\$ pwgen' is entered, and the output is displayed as a long string of random characters: 'sie3Plst Mlx4oIm Alt4ku5 eth6la5P ll1saav ahMoow7 Ul4elbel shus2Ahc yok2Gell tuYl8Toh lequohZR Oobeegit Gaetha0f Kuc7b1B Zae52quo Iegh2ja7 ll7feira valk4Kan OoHuqua0 Ook1ph05 Au3eezuF lae10oth fahg8rei IeshelV8 Iekah3ua WlaYem8bi Glioj3ph1 aishoShi OhRaen3e aiYee0th Eerum6th UF2coipe val4Phou oe1Eshu ThohNixa aa6TePh4 Elnaep0y shooJel5 ukahph3s ocuovl4a Ple2zooNu ooR6thib ofouIMle OopaiVbV Chuzechat uwe8Ba8 zael3Cho ava9yae vel4Fu3E Ohghoz3z Dahidoht sahx06t fohekaSe ekoo7Gel Aech4axx sae6X15e eem1Ahq ceb08000 Relf2oJl an3ub7Cu Ue0ge4Uc ke5j0oGa aac5Idoo thexoNl2 sheh18Er oocInohy Iun0jel2 Paibusqu aessosh3I Iedai0ki quiqu0uZ aw2ea0ba oogusNl0 eltu2ieJ aun7dooj Foh9ahph emoo8uHo iexFahh pletooP2 aef8Weak Ahbo5cho Gohwe8u Hee8qual uejiv5ce AlChloit roh8xaD1 pohiWoh19 Rohv1lo2 Fee2Inle Wo7lkeyh ohThee8e iev8Engo ko0lChec mieloh15 hoh10odu Aigoo5Ae Feequ9aae VL3Vaze5 Dol2itel ahch80Si ooGaow3e RobahSh1 Iu0Plehl xu4AqgeL cuolahZ2 Daezel2 ahMaeb0w dieKa1oW Wooyee3w mao0GeGh Jeenoiqu Lit6dal1 Valdu6ah Raich7aB Eghoh7ai Oongitha cieiy07A Vee4yaew olw12AoM Th15Shae gooTle90 fo8AtF4w Ieyl7phu Eingel4a iugeir0A los6paHC yeePeli3 Av4EcGah Bahthe8e eequ5ed3 aeT13yUK ooThiaJ Cae4lefU iexle4ei tl4chahJ jee6lkoh gah9zu8S Eu30oVer Ool3uB70 Ohb8Leph Phae3a7eJ aex6blood alp9Shoh cal8Luen yuuT9eeP haeb0zz xeis8phi aiquoHN2 nohz4ooT JIche12ah Alfo3que aeXichi8 Gughie5V ieCh7EIN Un8oothh Jaemiaz9 haesik0R ohthie9A paht7Pei k1xie3W'. The terminal window has two tabs: 'deeksha@deeksha2-QEMU-Virutal-Machine: ~/Desktop' and another tab that is partially visible.

A3.

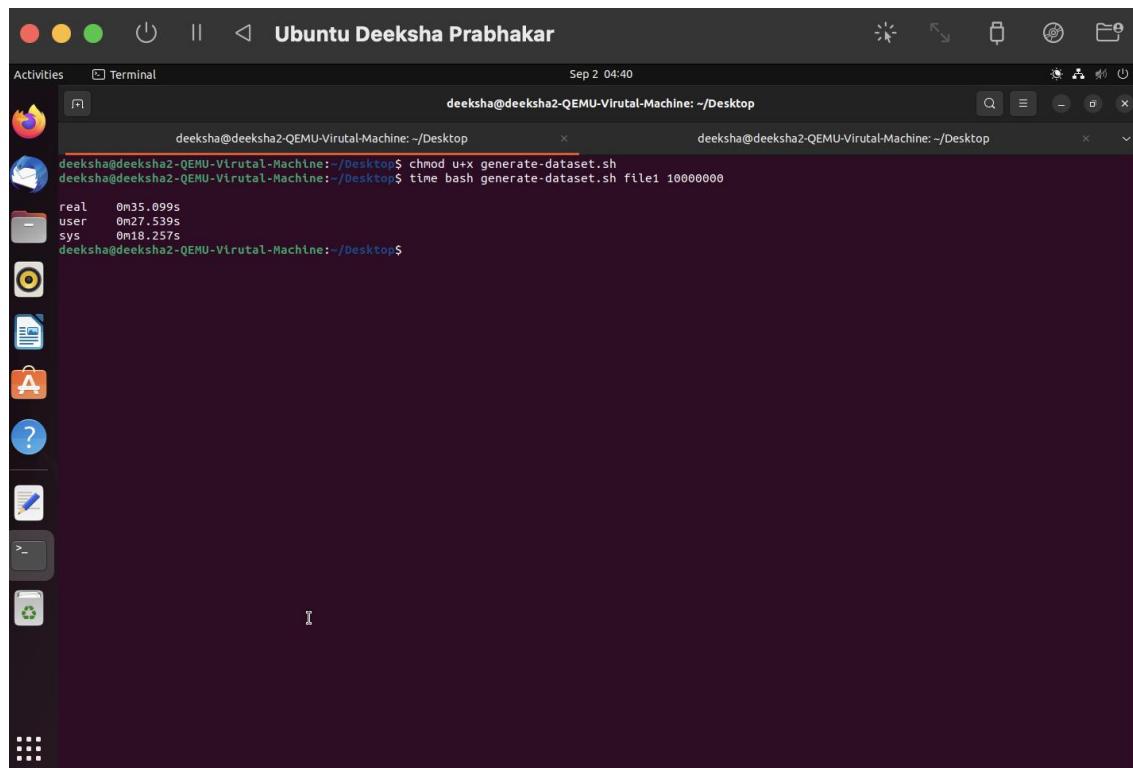
1.



The screenshot shows a Linux desktop environment with a dark theme. A terminal window titled "Ubuntu Deeksha Prabhakar" is open, showing the command line interface. Below the terminal, a text editor window titled "generate-dataset.sh" is displayed, containing the following shell script:

```
#!/bin/bash
# for ( i=1; i<= $2; i++)
# do
#     in1=$RANDOM
#     in2=$RANDOM
#     space=" "
#     str1=$(cat /dev/urandom | tr -cd 'A-Za-z0-9' | head -c100)
#     echo "$in1$space$in2$space$str1" >> $1.txt
# done
#
#num_records=$2
#int1="$1.int1"
#int2="$1.int2"
#str1="$1.str"
#space=" "
#; > $1.txt
shuf -i 0-4294967296 -n $2 > $int1
shuf -i 0-4294967296 -n $2 > $int2
base64 -l /dev/urandom | tr -cd 'A-Za-z0-9' | fold -w 100 | head -n $2 > $str1
paste $int1 $space $int2 $space $str1 > $1.txt
#echo "temp1$space$temp2$space$temp3" >> $1.txt
```

The terminal window also shows the command `time bash generate-dataset.sh file1 10000000` being run, with performance metrics displayed below it.



The screenshot shows a Linux desktop environment with a dark theme. A terminal window titled "Ubuntu Deeksha Prabhakar" is open, showing the command line interface. The terminal window has multiple tabs, one of which is titled "Terminal". The terminal window shows the command line history and the output of the script execution:

```
deeksha@deeksha2-QEMU-Virutal-Machine: ~/Desktop
deeksha@deeksha2-QEMU-Virutal-Machine: ~/Desktop$ chmod u+x generate-dataset.sh
deeksha@deeksha2-QEMU-Virutal-Machine: ~/Desktop$ time bash generate-dataset.sh file1 10000000
real    0m35.099s
user    0m27.539s
sys     0m18.257s
deeksha@deeksha2-QEMU-Virutal-Machine: ~/Desktop$
```

2.

A screenshot of the Ubuntu desktop environment. The window title is "Ubuntu Deeksha Prabhakar". The application is a Text Editor with multiple tabs open. The current tab is "sort-data.sh" located at "/Desktop". The code in the editor is:

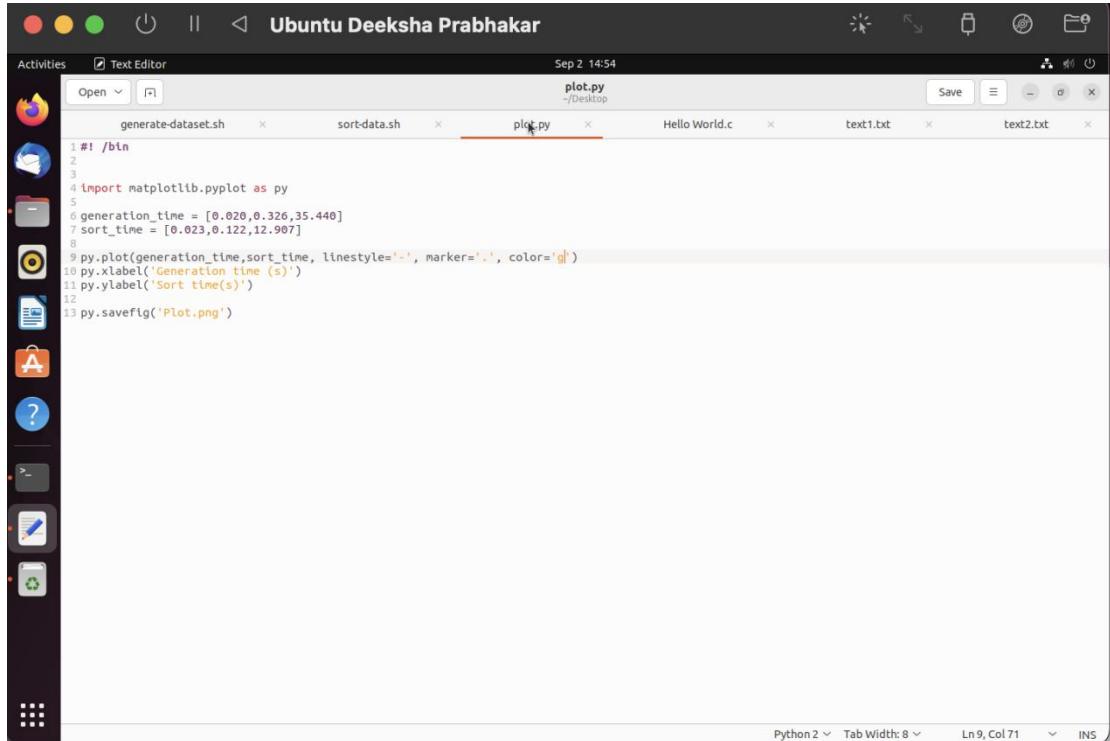
```
#!/bin/bash
sort -nk1,1 $1.txt > sorted-data.txt
```

The status bar at the bottom shows "sh" and "Tab Width: 8".

A screenshot of the Ubuntu desktop environment. The window title is "Ubuntu Deeksha Prabhakar". The application is a Terminal window. The command history shows:

```
deeksha@deeksha2-QEMU-Virutal-Machine: ~/Desktop
deeksha@deeksha2-QEMU-Virutal-Machine: ~/Desktop$ chmod u+x sort-data.sh
deeksha@deeksha2-QEMU-Virutal-Machine: ~/Desktop$ time bash sort-data.sh file1
real    0m16.41s
user    0m17.51s
sys     0m10.035s
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$
```

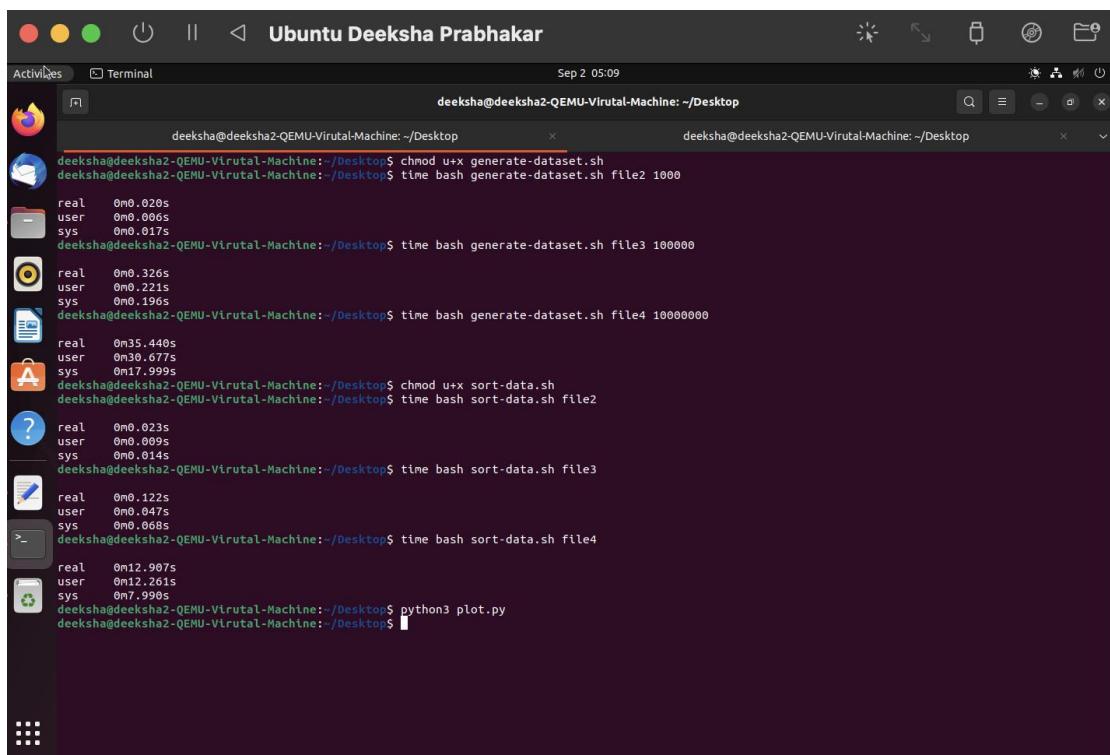
3.



The screenshot shows a terminal window titled "Ubuntu Deeksha Prabhakar" with the date "Sep 2 14:54". The window has several tabs open, including "plot.py" which contains the following Python code:

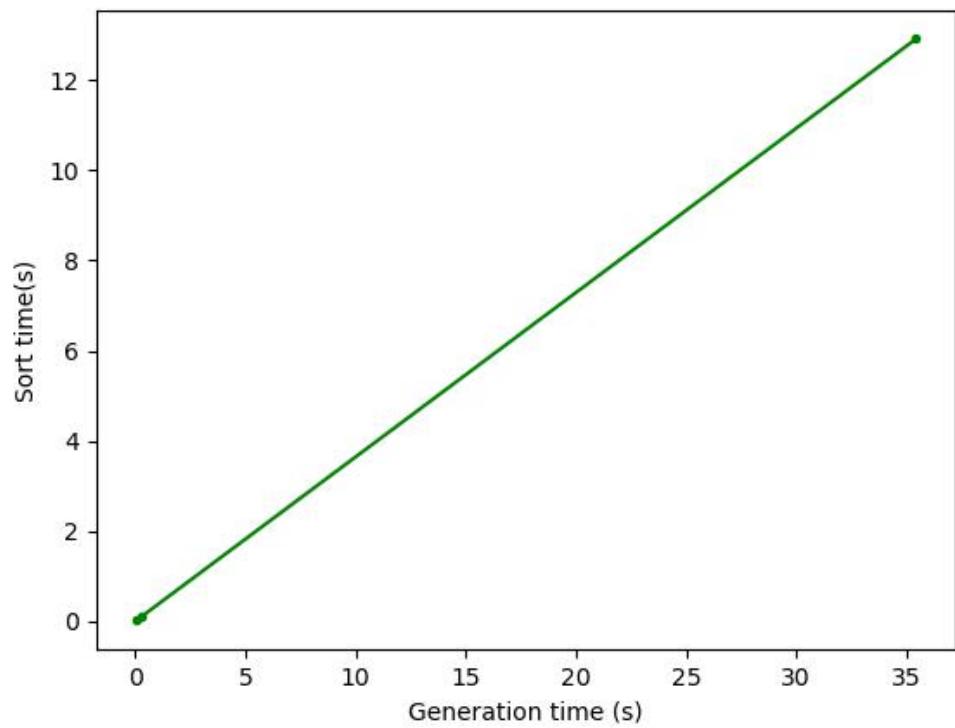
```
1 #!/bin
2
3
4 import matplotlib.pyplot as py
5
6 generation_time = [0.020, 0.326, 35.440]
7 sort_time = [0.023, 0.122, 12.907]
8
9 py.plot(generation_time,sort_time, linestyle='-.', marker='.', color='g')
10 py.xlabel('Generation time (s)')
11 py.ylabel('Sort time(s)')
12
13 py.savefig('Plot.png')
```

The terminal interface includes a vertical application menu on the left and standard window control buttons at the top right.



The screenshot shows a terminal window titled "Ubuntu Deeksha Prabhakar" with the date "Sep 2 05:09". The terminal window displays a command-line session:

```
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$ chmod u+x generate-dataset.sh
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$ time bash generate-dataset.sh file2 1000
real    0m0.020s
user    0m0.006s
sys     0m0.017s
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$ time bash generate-dataset.sh file3 10000
real    0m0.326s
user    0m0.221s
sys     0m0.196s
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$ time bash generate-dataset.sh file4 1000000
real    0m35.440s
user    0m30.677s
sys     0m17.999s
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$ chmod u+x sort-data.sh
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$ time bash sort-data.sh file2
real    0m0.023s
user    0m0.009s
sys     0m0.014s
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$ time bash sort-data.sh file3
real    0m0.122s
user    0m0.047s
sys     0m0.068s
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$ time bash sort-data.sh file4
real    0m12.907s
user    0m12.261s
sys     0m7.990s
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$ python3 plot.py
deeksha@deeksha2-QEMU-Virutal-Machine:~/Desktop$
```



A4.

- A. Changing the number of processors a VM has can greatly alter its performance. Increasing the number of processors for the VM basically means increasing the number of processors it has access to and can use at a given point of time. We can assign minimum number of processors to the VM in situations where the host operating system is performing severe workload computations and the VM has to perform basic tasks or a single process. We can assign maximum number of processors to the VM if the VM is performing a lot of parallel operations or data-intensive computations whereas the host OS does not need that much computing power. It is a bad idea to assign maximum processors to the VM as the host operating system still needs to run a lot of background or supporting processes. This will cause the host OS to run slowly and in turn could lead to the computer itself crashing. Along with that, the more cores the VM has, the more overhead they will cause due to context switching.

B. The different paravirtualization options are:

- a) **None:** It straight away turns off exposure to paravirtualization interface.
- b) **Legacy:** This option is for machines that have been created with older versions of VirtualBox and they will choose a paravirtualization interface to ensure smooth running of the VM.
- c) **Minimal:** It just announces the existence of a virtual environment. This is mandatory for any Mac OS X guests.
- d) **Hyper-V:** It uses a Microsoft Hyper-V hypervisor interface. It basically allows one VM to run on top of another VM. It is recommended for Windows guests.
- e) **KVM:** It provides a Linux KVM hypervisor module that gives the Linux kernel native virtualization capabilities. This is recommended for Linux guests.

KVM would be best to use with Ubuntu (or Linux) because it does not require modifying the guests OS.

C. Different types of Storage Controllers:

- a) **IDE:** IDE storage controllers expose the IDE disks to Virtual machines. It is based on IBM PC Industry Standard Architecture 16-bit bus standard. It is the only one available for Legacy OSes (as they don't support other storage controllers).
- b) **SATA:** It is a serial ATA controller. It is a modern controller that can support a higher number of devices. It runs faster than IDE. It is useful in cases where you have to connect upto 30 storage devices to the VM.
- c) **NVMe:** This interface is built specially for non-volatile storage media like SSDs. It is faster than SATA controllers and can be used in cases where low

response time is required. It can be used in scenarios where you want to connect upto 255 storage devices to the VM.

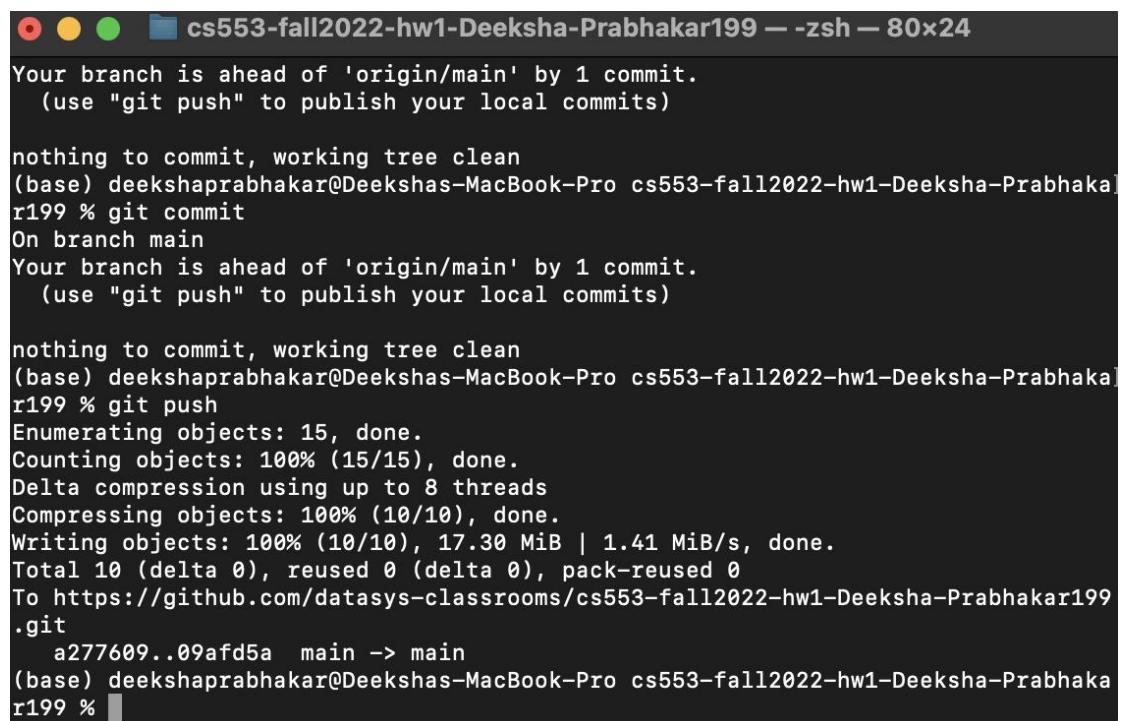
D. Different types of Network Adapters are:

- a) **NAT (Network Address Translation):** It masks all network activity from the VM under the Host OS and thus the VM can access most of the client applications over any network connection that the host has. It is good for browsing the web and downloading files.
- b) **Bridged Adapter:** Connects to one of the local cards and exchanges network packets directly without going through the host network. It is useful for running servers.
- c) **Internal Network:** It can directly communicate with any other VM present on the same host that is connected to the same internal network. It is used for testing firewalls.
- d) **Host only network:** It is a combination of internal and bridged where the VMs are connected to each other and the host. It is used for testing client/server softwares.

E.

- a) **USB 1.1:** It is supported for all virtual machine hardware options. It's maximum bandwidth is 12 Mbps.
- b) **USB 2.0:** It is supported only by compatible VM Hardware versions. It's bandwidth is 480 Mbps.
- c) **USB 3.0:** It is supported by Linux guests with Kernel version 2.6.35 or later and for Windows 8 guests. It's maximum bandwidth is 4.8 Gbps.

CONFIRMATION SCREENSHOT:



```
cs553-fall2022-hw1-Deeksha-Prabhakar199 — -zsh — 80x24
Your branch is ahead of 'origin/main' by 1 commit.
  (use "git push" to publish your local commits)

nothing to commit, working tree clean
(base) deekshaprabhakar@Deekshas-MacBook-Pro cs553-fall2022-hw1-Deeksha-Prabhakar199 % git commit
On branch main
Your branch is ahead of 'origin/main' by 1 commit.
  (use "git push" to publish your local commits)

nothing to commit, working tree clean
(base) deekshaprabhakar@Deekshas-MacBook-Pro cs553-fall2022-hw1-Deeksha-Prabhakar199 % git push
Enumerating objects: 15, done.
Counting objects: 100% (15/15), done.
Delta compression using up to 8 threads
Compressing objects: 100% (10/10), done.
Writing objects: 100% (10/10), 17.30 MiB | 1.41 MiB/s, done.
Total 10 (delta 0), reused 0 (delta 0), pack-reused 0
To https://github.com/datasys-classrooms/cs553-fall2022-hw1-Deeksha-Prabhakar199.git
  a277609..09af5a  main -> main
(base) deekshaprabhakar@Deekshas-MacBook-Pro cs553-fall2022-hw1-Deeksha-Prabhakar199 %
```