

Assignment 1

Mansi Dinesh

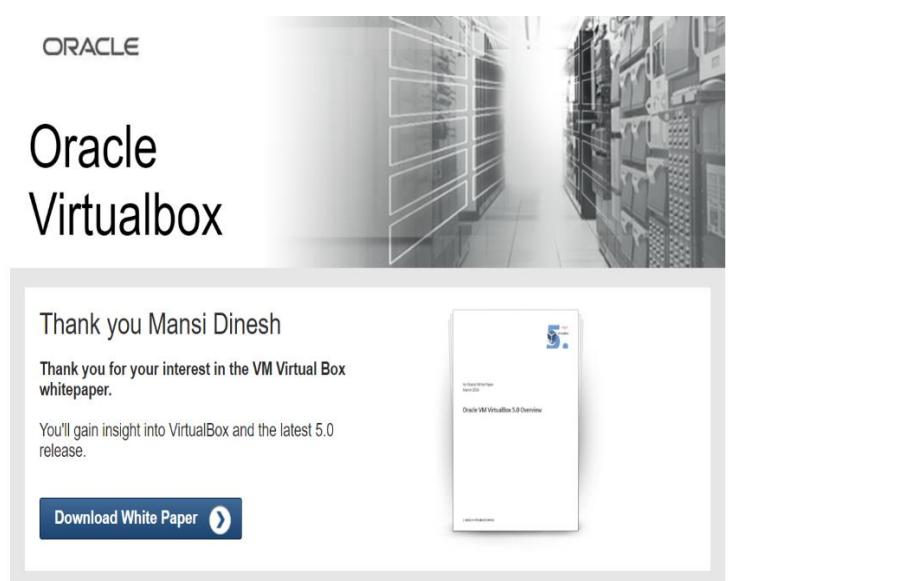
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1. (30 points) Setup VM, Linux, and basic testing – must take screen shots at each step to receive points

a. Read Oracle VirtualBox White Paper

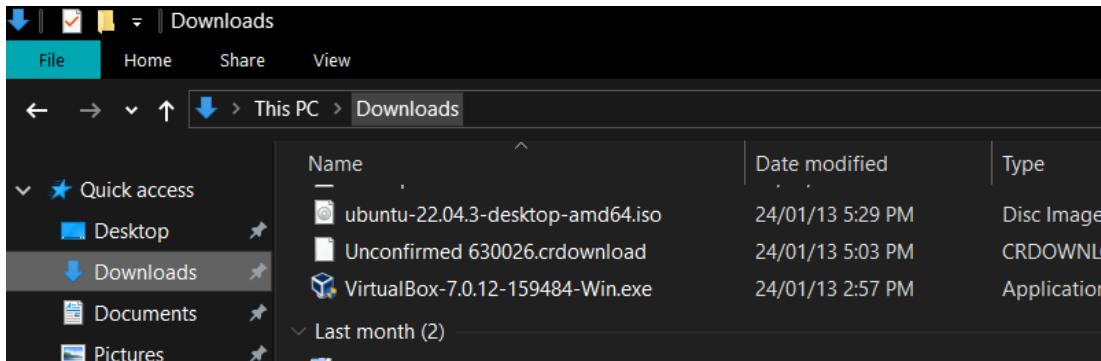
I read the paper, created an email account, and received the mail below. The paper contains the following information: Details about the Oracle VM virtual box.

- Its two components, which are the virtual box expansion pack and the VM virtual box: While the virtual box is free, the extended version has a few extra capabilities and requires a paid licence.
- The use of virtual boxes for functions such as testing new updates, software upgrades, performing demos and parallel execution of demo programmes, and developing and debugging distinct applications that require diverse environments.
- Encryption is used to provide security when sharing data between virtual machines or within your system.
- We can also utilise virtual boxes for training.
- Additionally, a few virtual RDP features concerning the extension pack are provided.



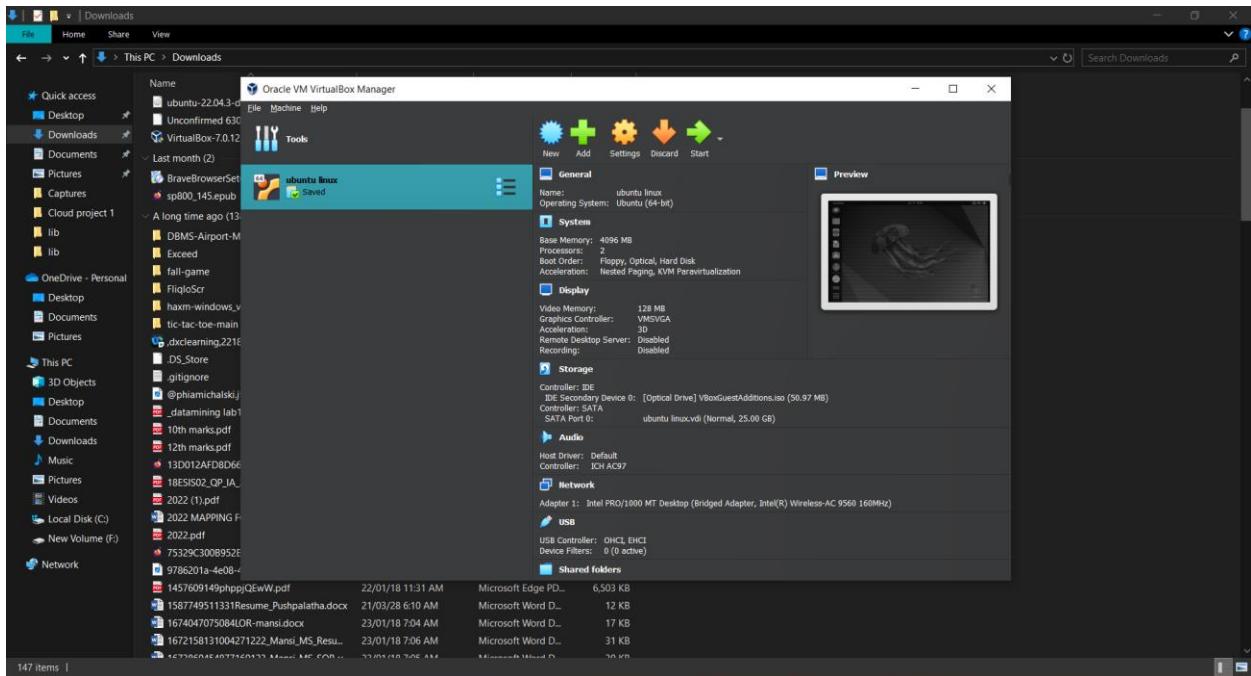
b. Download Oracle VirtualBox 7.0

The screenshot for the downloaded virtual box 7.0 is shown below.



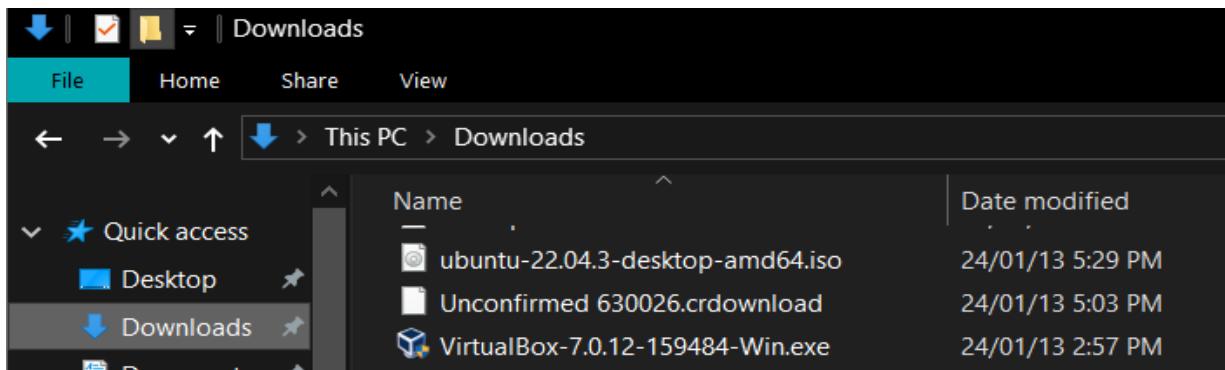
c. Install VirtualBox 7.0 (for M1/M2 Apple, use UTM)

Installed Virtual box on my machine below is the screenshot for the same

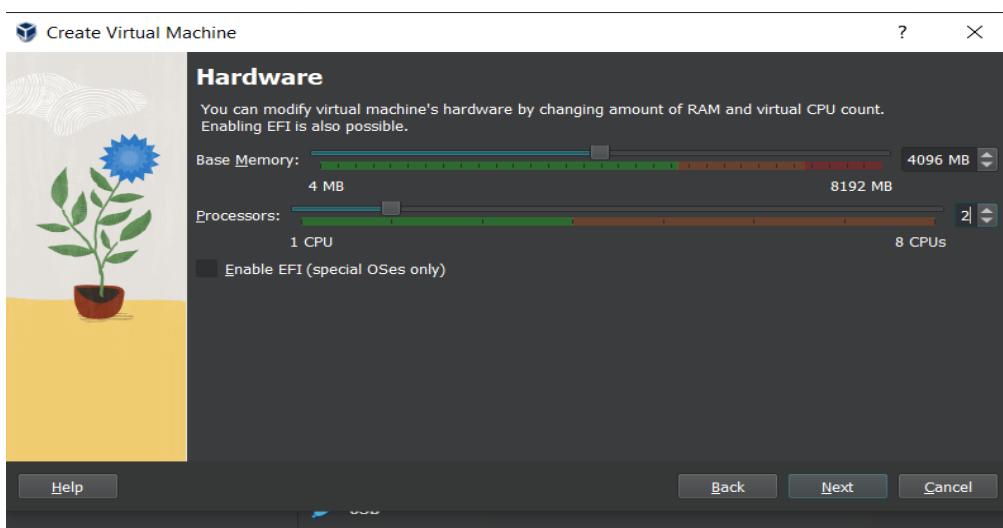
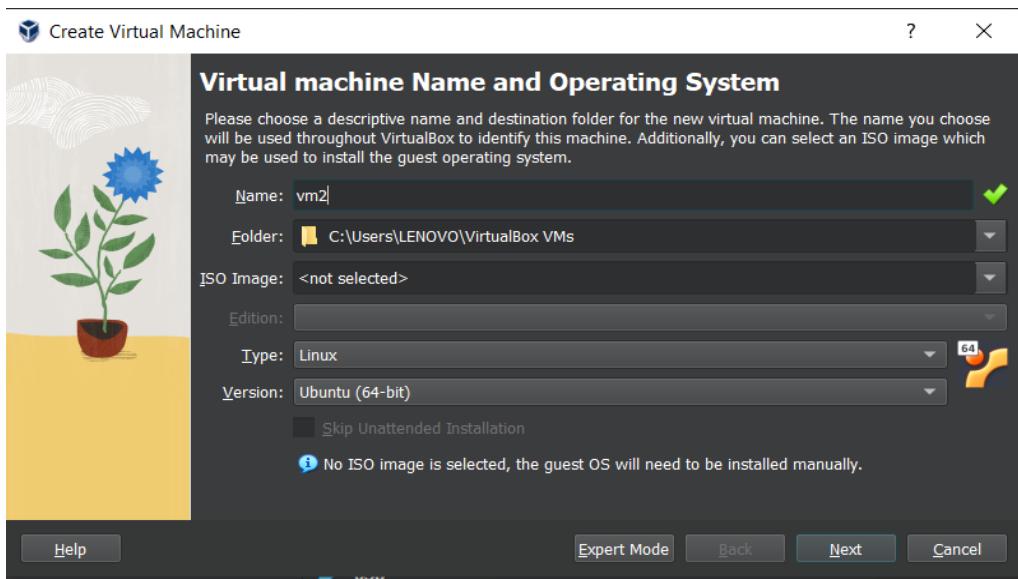


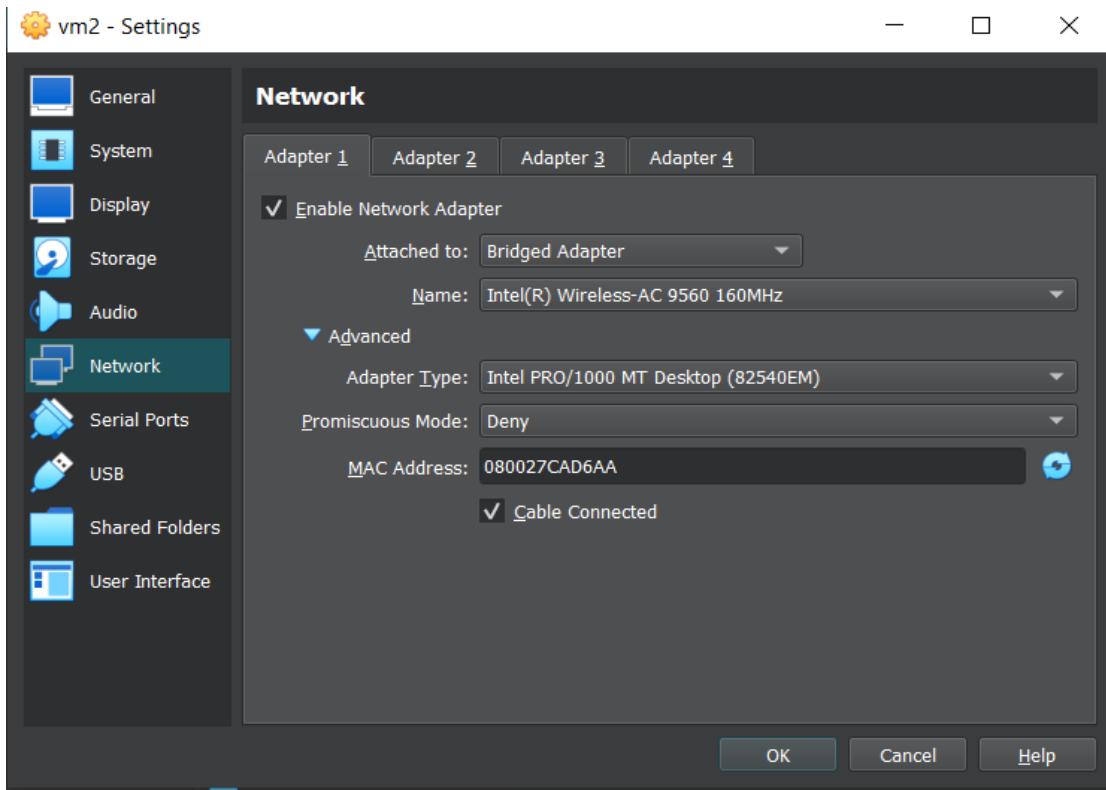
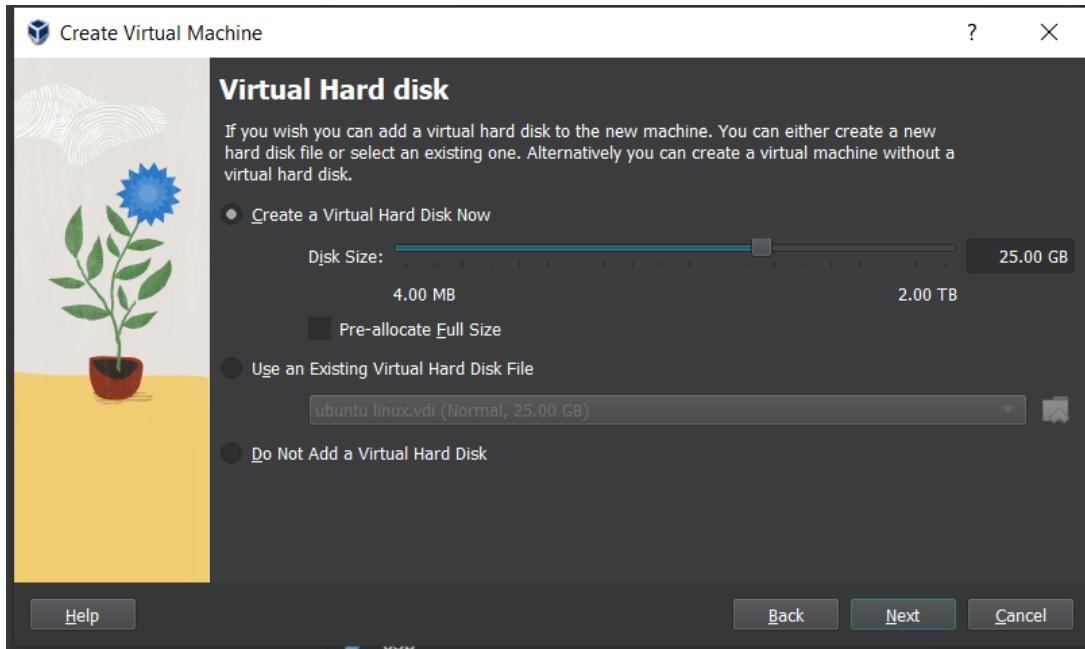
d. Download Ubuntu 22.04 Linux ISO image

The screenshot of Ubuntu 22.04, which was downloaded, is shown below.

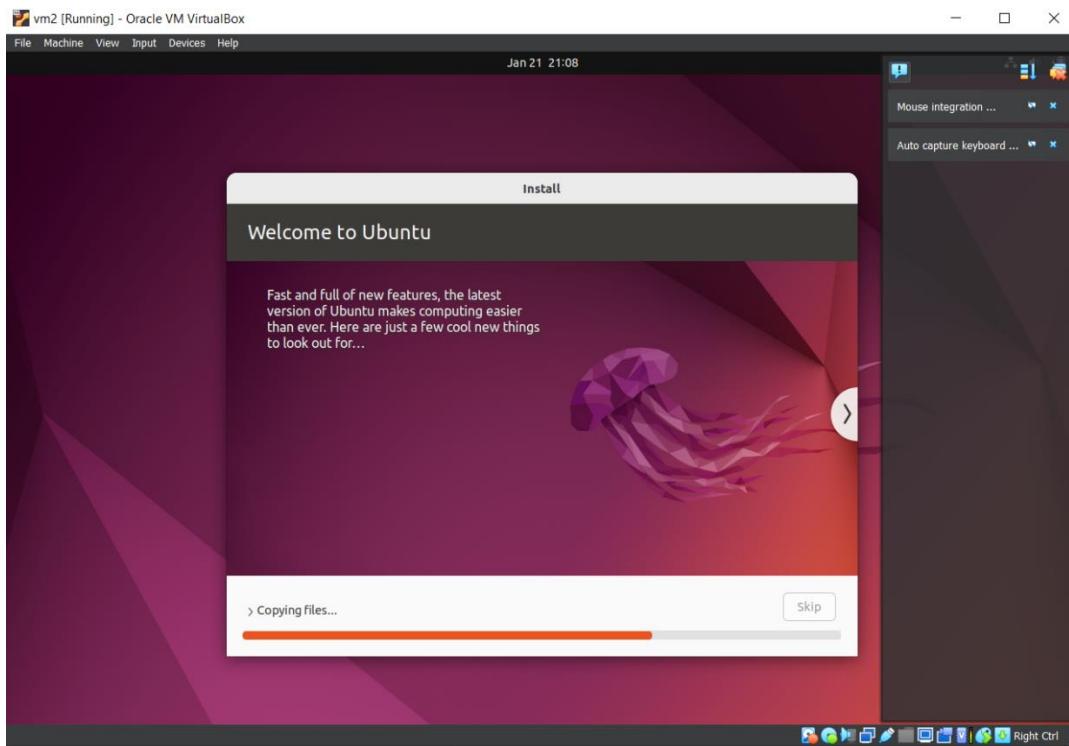


e. Create Virtual Machine (VM), to support Linux, Ubuntu, 64-bit, 4GB RAM, Virtual Disk 25GB, VDI image, dynamically allocated, 2-core, and a network interface (1GbE or WiFi) with Bridged Adapter

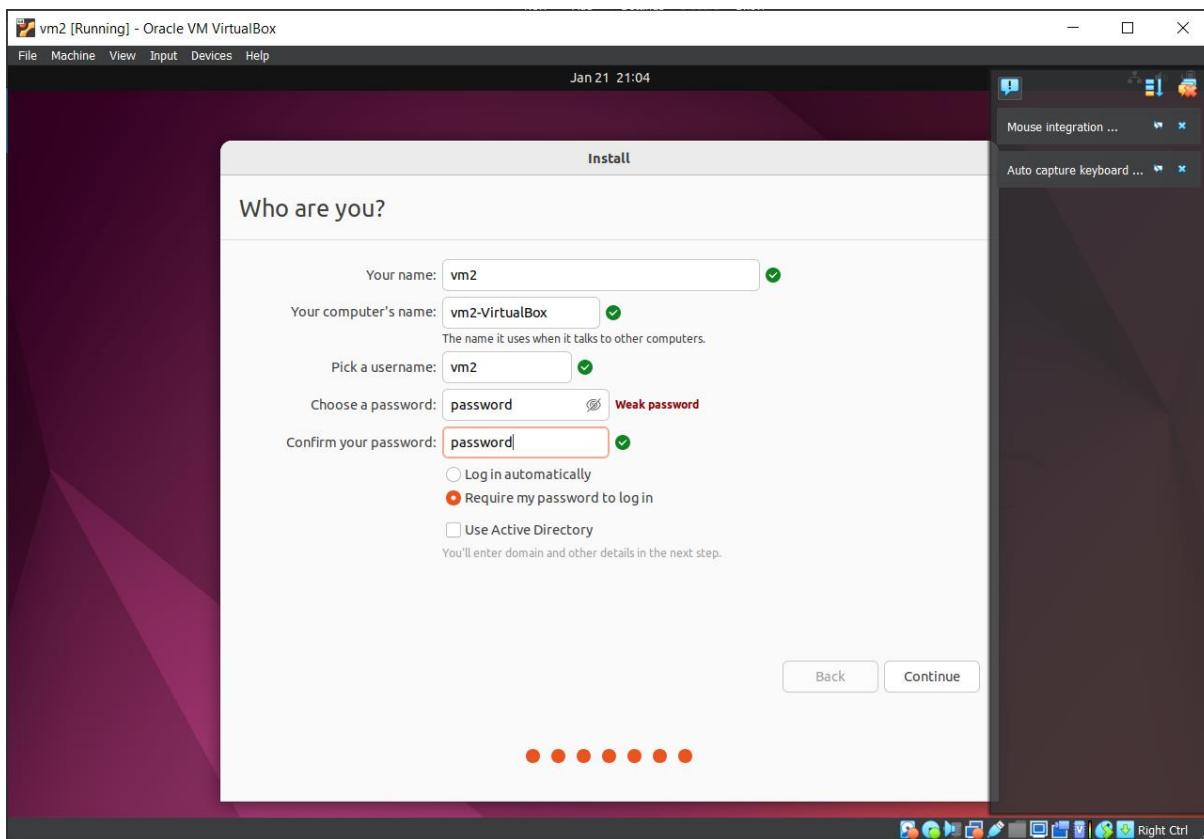




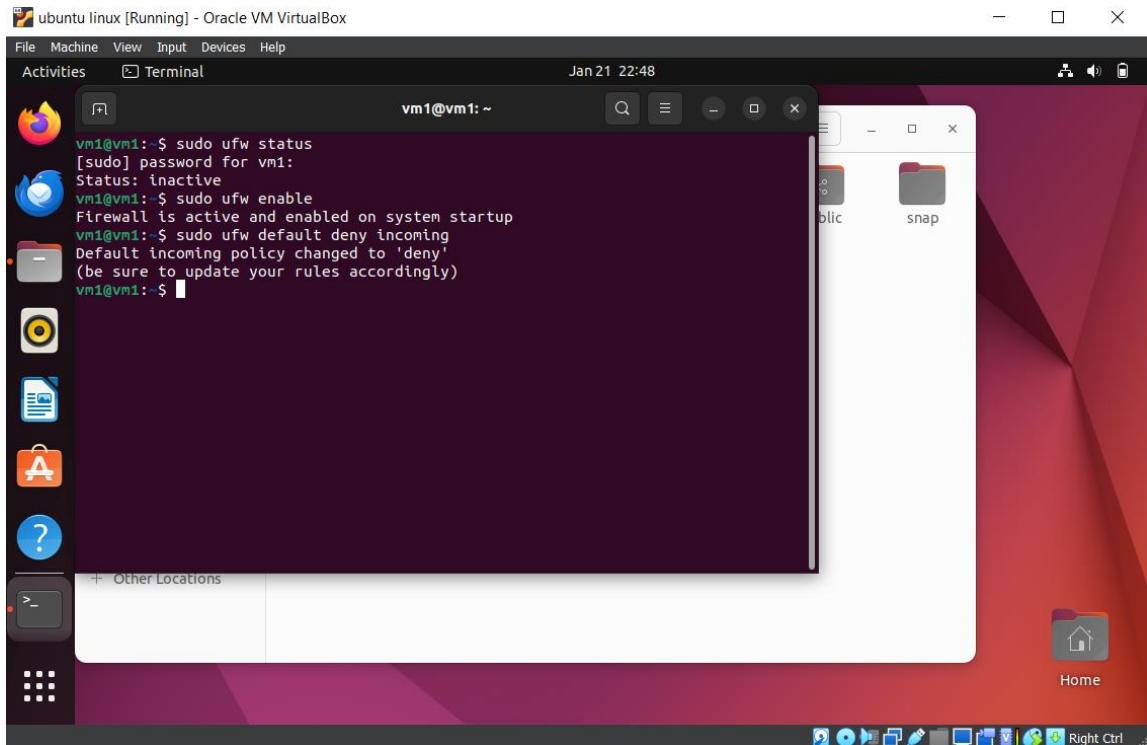
f. Install Linux from the ISO image



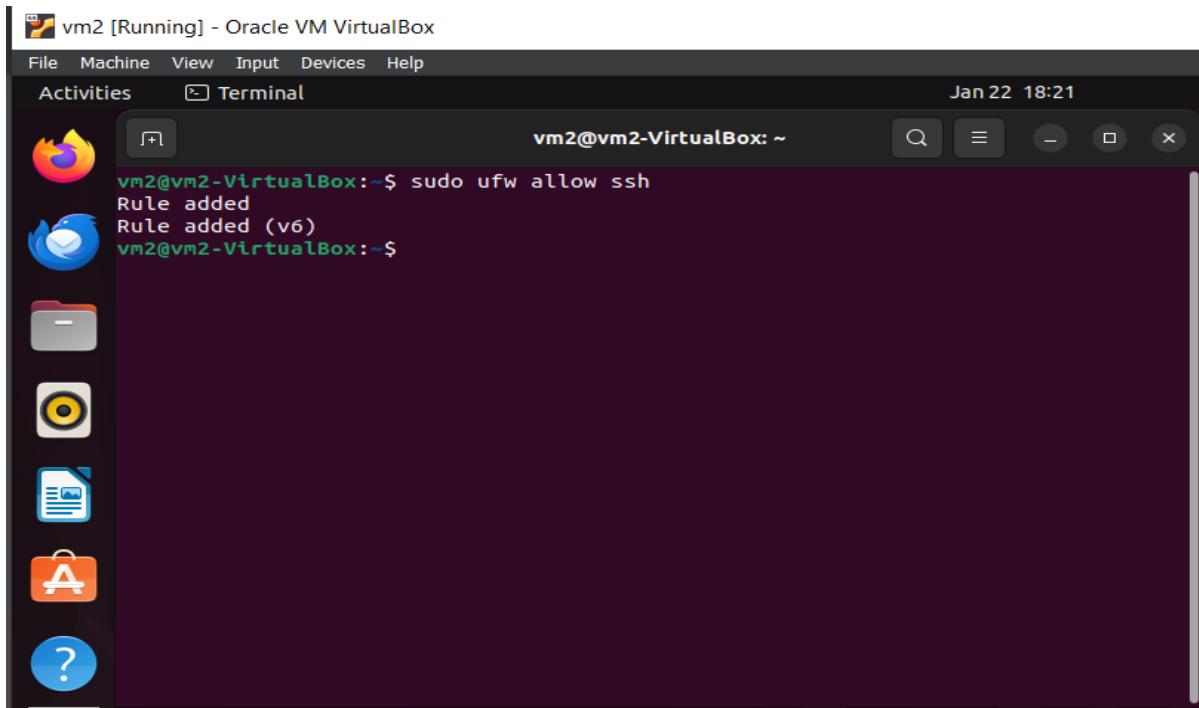
g. Create a user id and password



h. Turn on Firewall and block all ports

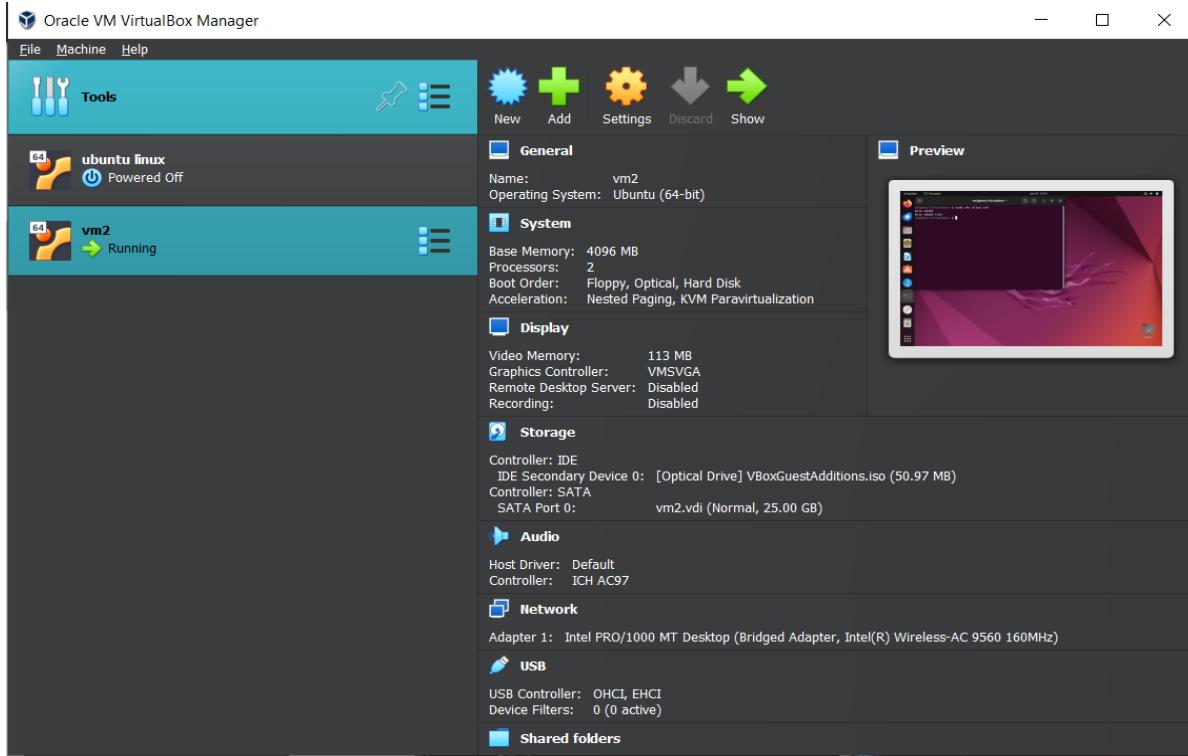


i. Enable SSH access to your new Linux installation; open SSH port in firewall

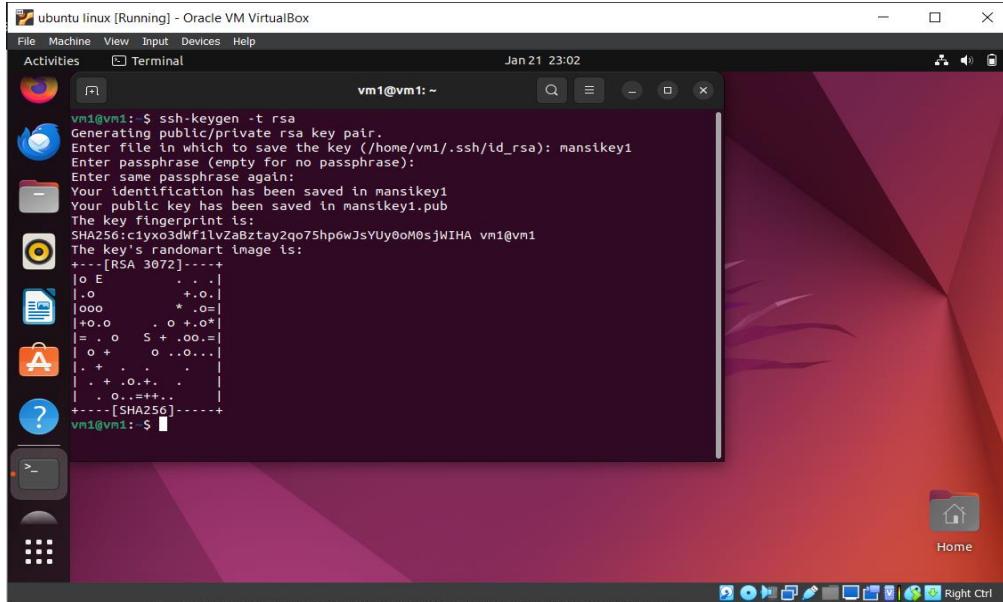


j. Repeat steps 5 through 9, and create another VM with the same specifications as the first one

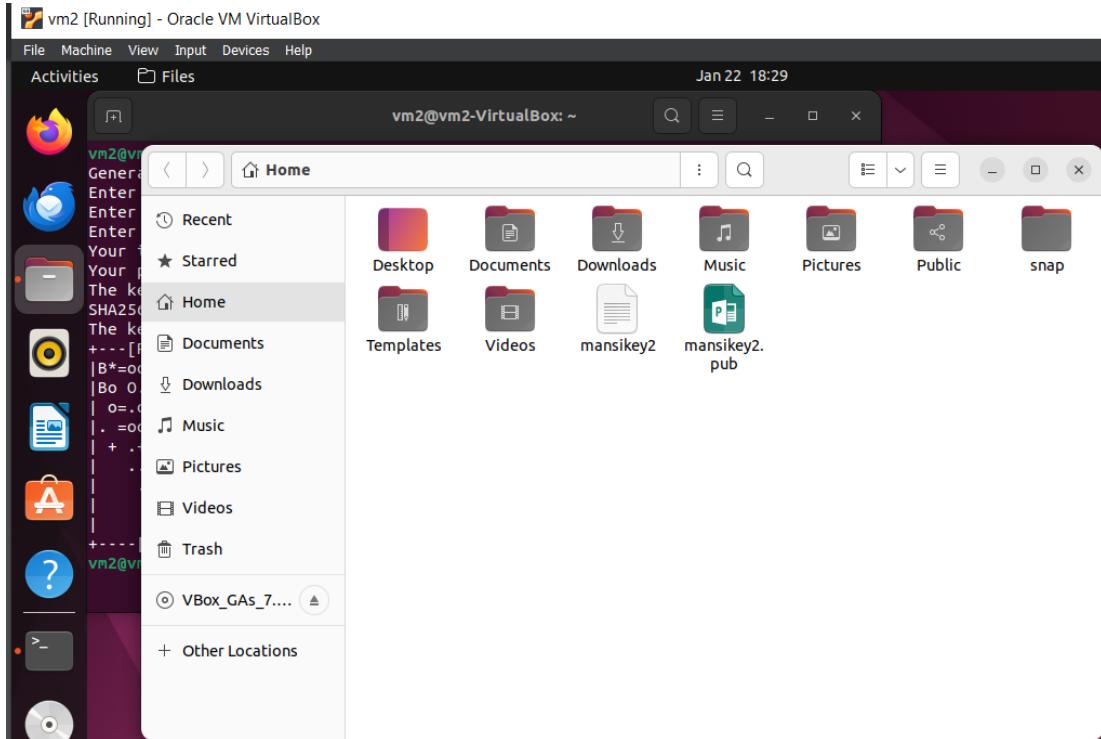
Created another VM with the same details.



k. Create private/public keys and install them properly in both of your new VMs

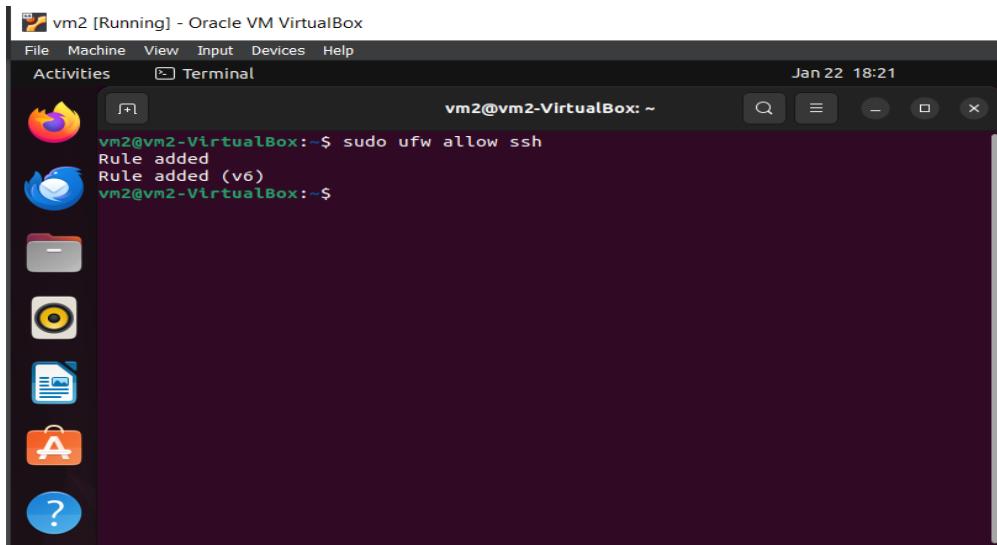


k. Create private/public keys and install them properly in both of your new VMs

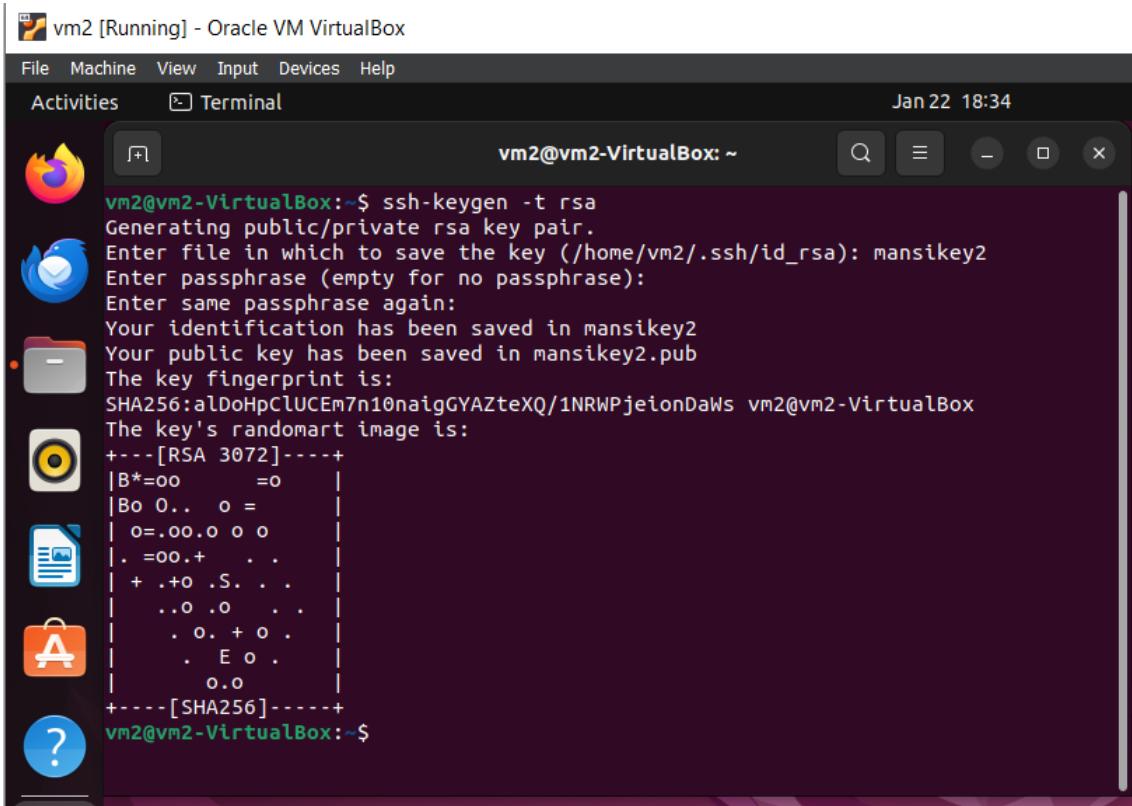


2. (25 points) Show an example of using the following commands (hint: you can use man to find more information about each one); take screen shots of your commands; make sure to clear the screen between each command; explain in your own words what these commands do:

a. ssh: This command creates a secure network between two computers.

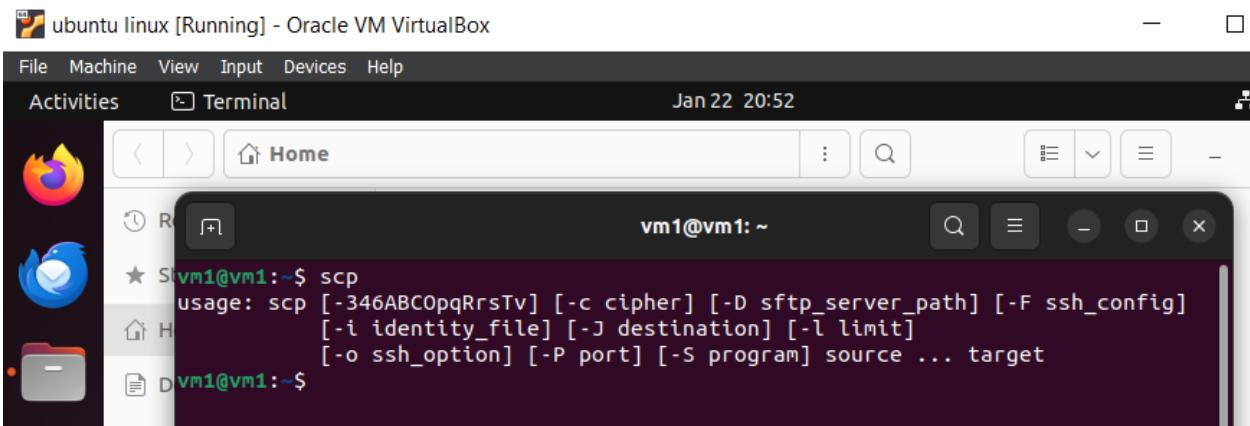


b. Ssh-keygen: This programme generates keys for the Public Key Authentication Protocol.



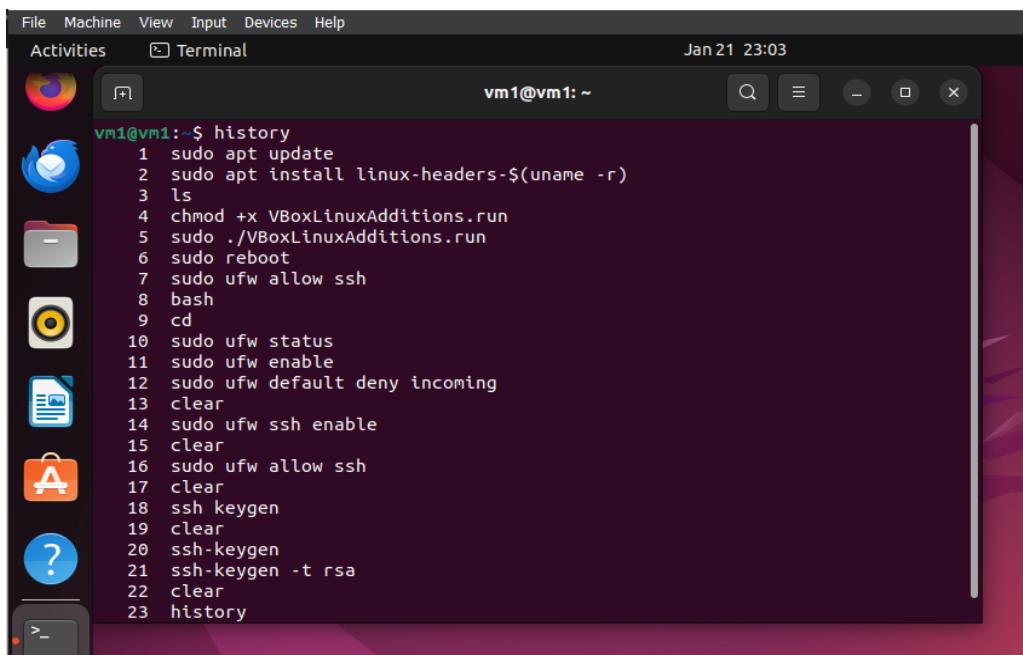
```
vm2@vm2-VirtualBox:~$ ssh-keygen -t rsa
Generating public/private rsa key pair.
Enter file in which to save the key (/home/vm2/.ssh/id_rsa): mansikey2
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in mansikey2
Your public key has been saved in mansikey2.pub
The key fingerprint is:
SHA256:alDoHpClUCEm7n10naigGYAZteXQ/1NRWPjeionDaWs vm2@vm2-VirtualBox
The key's randomart image is:
+---[RSA 3072]---+
|B*=oo      =o   |
|Bo O.. o =   |
| o=..o o o   |
| .=oo.+ . .   |
| + ..o .S. . .   |
| ..o .o . .   |
| . o. + o .   |
| . E o .   |
| o.o   |
+---[SHA256]---+
vm2@vm2-VirtualBox:~$
```

c. Scp: It is used to copy files securely from one host to another.



```
vm1@vm1:~$ scp
usage: scp [-346ABCOpqRrsTv] [-c cipher] [-D sftp_server_path] [-F ssh_config]
           [-i identity_file] [-J destination] [-l limit]
           [-o ssh_option] [-P port] [-S program] source ... target
vm1@vm1:~$
```

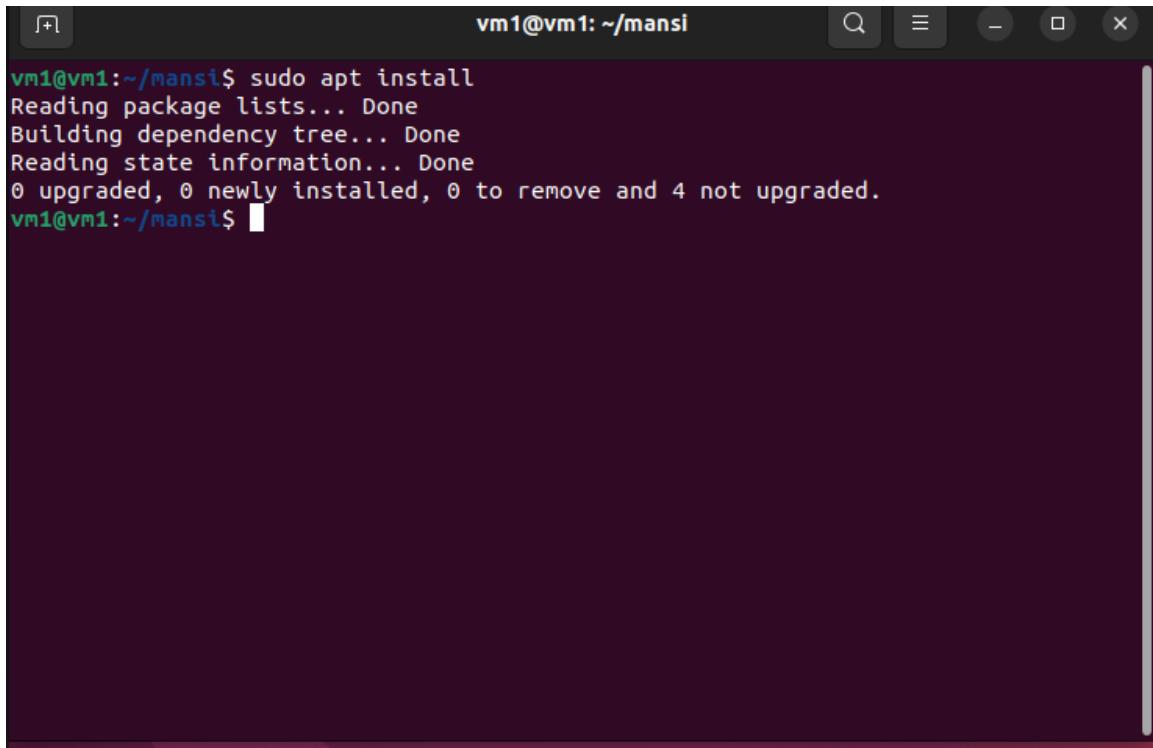
d. History: It offers a list of the commands we have previously used.



A screenshot of a Linux desktop environment, likely Ubuntu, showing a terminal window. The terminal window is titled "vm1@vm1: ~" and shows the output of the "history" command. The history list includes various system administration commands such as sudo apt update, sudo apt install, ls, chmod, ./VBoxLinuxAdditions.run, sudo reboot, sudo ufw allow ssh, bash, cd, sudo ufw status, sudo ufw enable, sudo ufw default deny incoming, clear, sudo ufw ssh enable, sudo ufw allow ssh, clear, ssh keygen, ssh-keygen, ssh-keygen -t rsa, clear, and history. The desktop interface includes a dock with icons for Dash, Home, Applications, and Help, and a sidebar with icons for Dash, Home, Activities, and Terminal. The date and time "Jan 21 23:03" are visible in the top right corner of the terminal window.

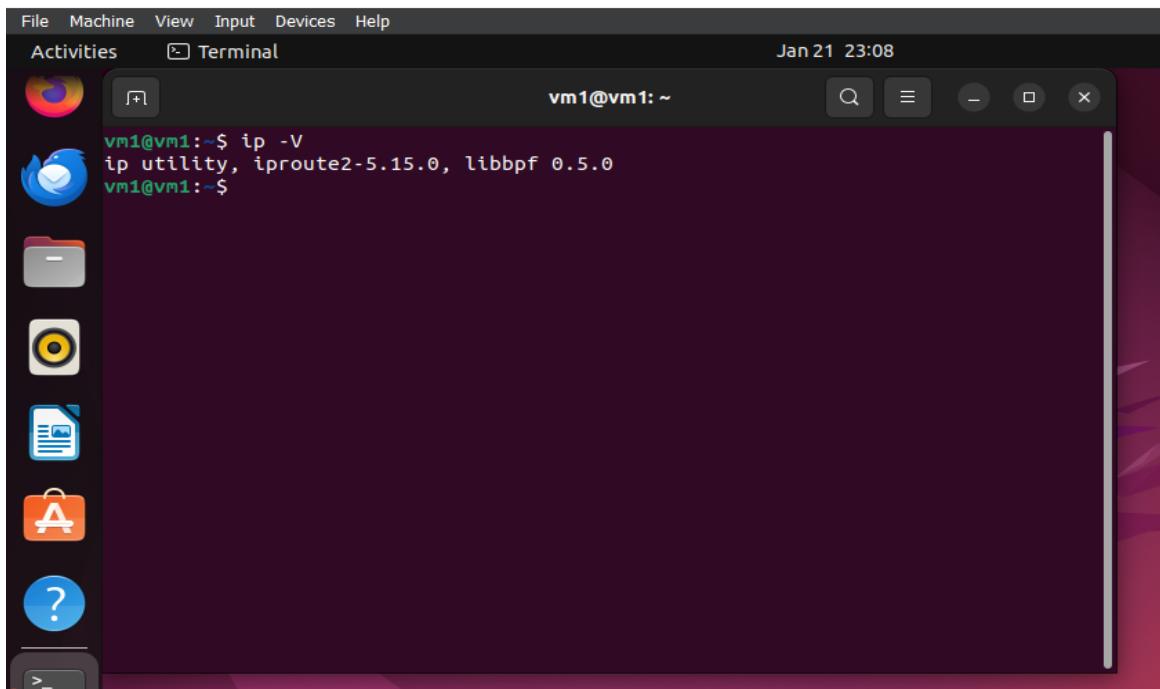
```
File Machine View Input Devices Help
Activities Terminal Jan 21 23:03
vm1@vm1:~$ history
1 sudo apt update
2 sudo apt install linux-headers-$(uname -r)
3 ls
4 chmod +x VBoxLinuxAdditions.run
5 sudo ./VBoxLinuxAdditions.run
6 sudo reboot
7 sudo ufw allow ssh
8 bash
9 cd
10 sudo ufw status
11 sudo ufw enable
12 sudo ufw default deny incoming
13 clear
14 sudo ufw ssh enable
15 clear
16 sudo ufw allow ssh
17 clear
18 ssh keygen
19 clear
20 ssh-keygen
21 ssh-keygen -t rsa
22 clear
23 history
```

e. Sudo : Once a command is executed, Sudo grants further privileges and prompts for the password.



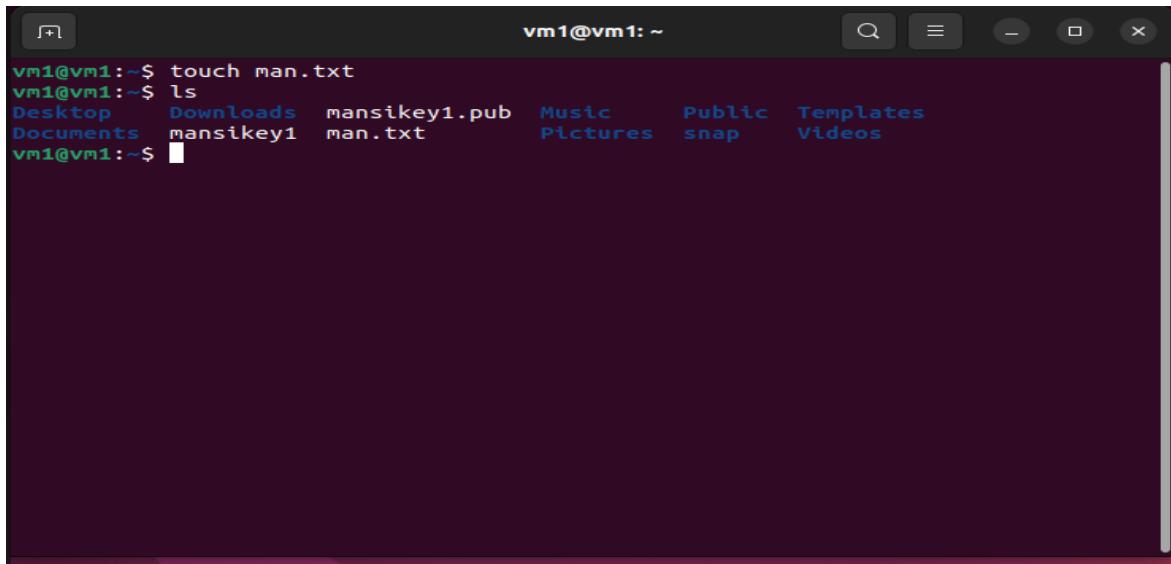
```
vm1@vm1:~/mans1$ sudo apt install
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
0 upgraded, 0 newly installed, 0 to remove and 4 not upgraded.
vm1@vm1:~/mans1$
```

f. Ip: This command provides information on the IP utility; use IP -v to obtain the version of the tool.



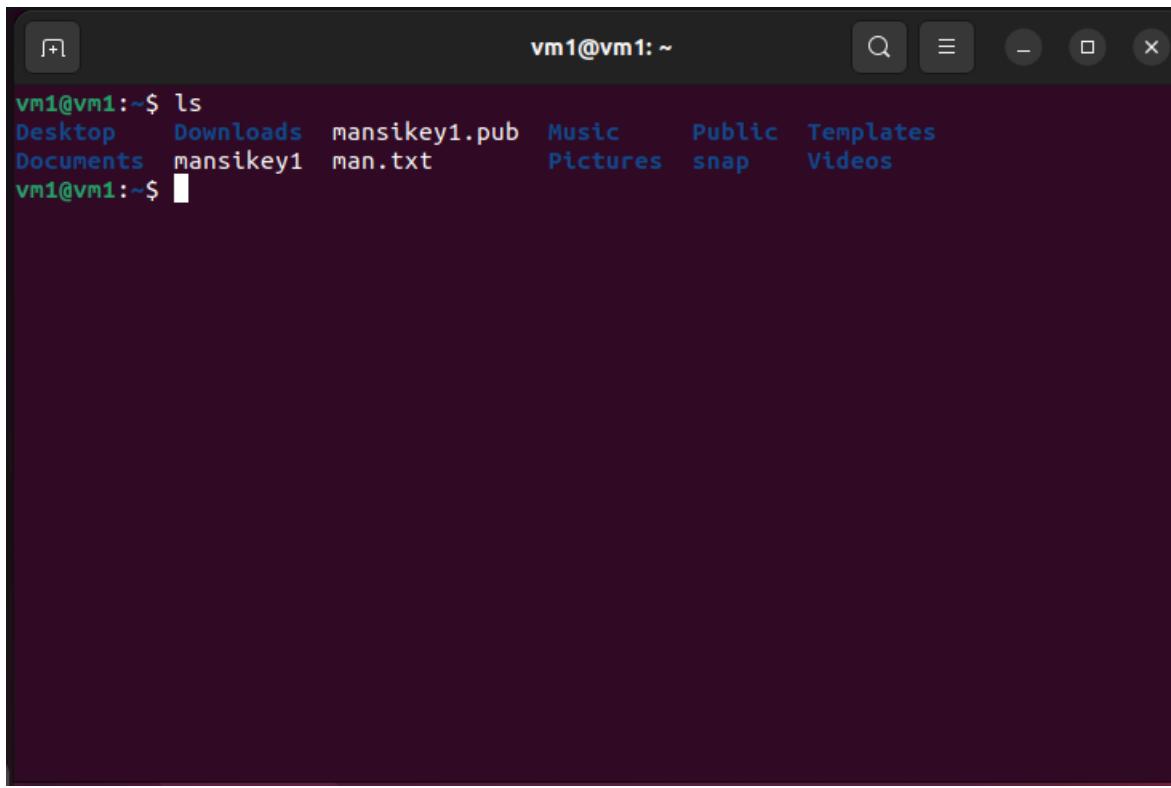
```
File Machine View Input Devices Help
Activities Terminal Jan 21 23:08
vm1@vm1:~$ ip -V
ip utility, iproute2-5.15.0, libbpf 0.5.0
vm1@vm1:~$
```

g. Touch: Using the terminal, Touch is utilised to create files.



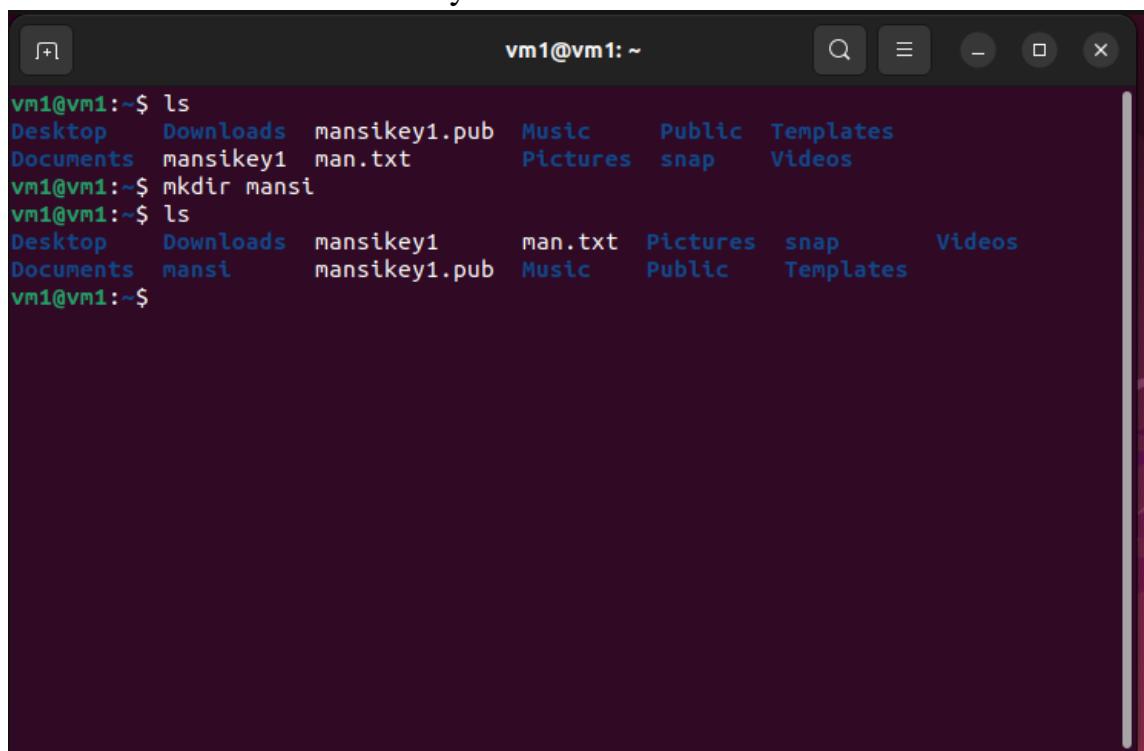
```
vm1@vm1:~$ touch man.txt
vm1@vm1:~$ ls
Desktop  Downloads  mansikey1.pub  Music      Public   Templates
Documents  mansikey1  man.txt        Pictures  snap     Videos
vm1@vm1:~$
```

h. Ls: It prints every piece of information found in the specified directory.



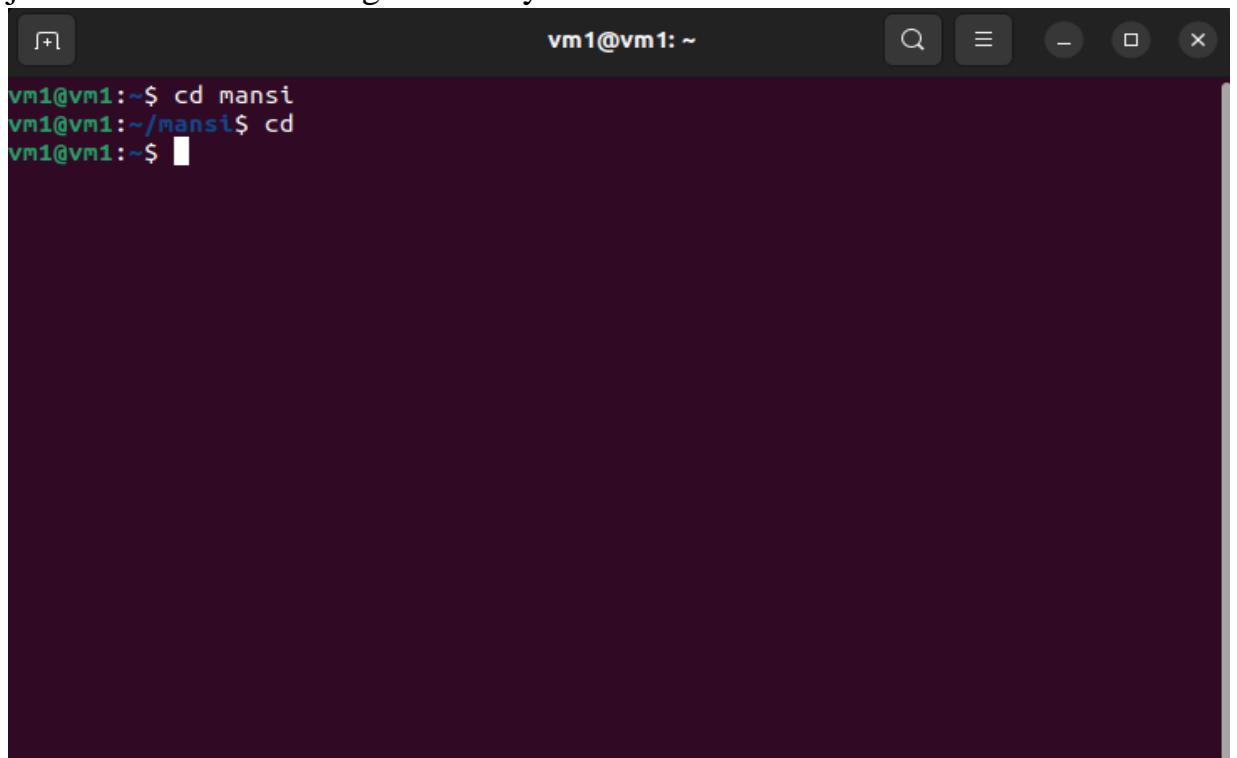
```
vm1@vm1:~$ ls
Desktop  Downloads  mansikey1.pub  Music      Public   Templates
Documents  mansikey1  man.txt        Pictures  snap     Videos
vm1@vm1:~$
```

i. Mkdir: It is a tool for directory creation.



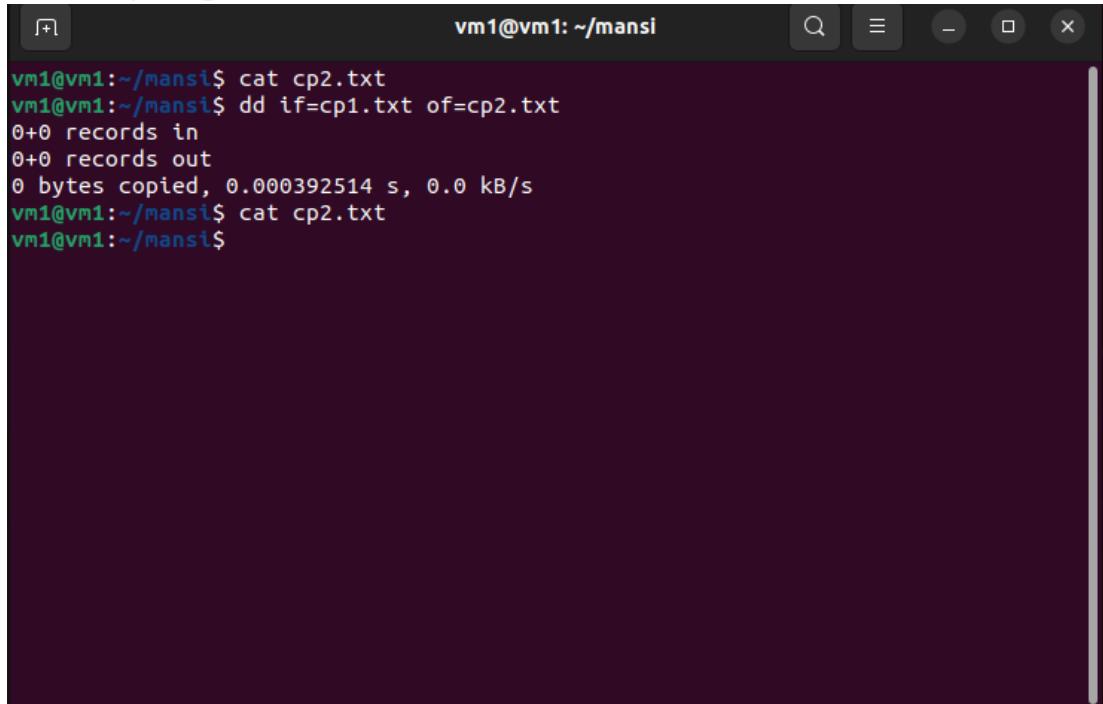
```
vm1@vm1:~$ ls
Desktop  Downloads  mansikey1.pub  Music      Public  Templates
Documents  mansikey1  man.txt        Pictures   snap    Videos
vm1@vm1:~$ mkdir mansi
vm1@vm1:~$ ls
Desktop  Downloads  mansikey1        man.txt  Pictures  snap      Videos
Documents  mansi     mansikey1.pub  Music    Public    Templates
vm1@vm1:~$
```

j. Cd : It is used to change directory



```
vm1@vm1:~$ cd mansi
vm1@vm1:~/mansi$ cd
vm1@vm1:~$
```

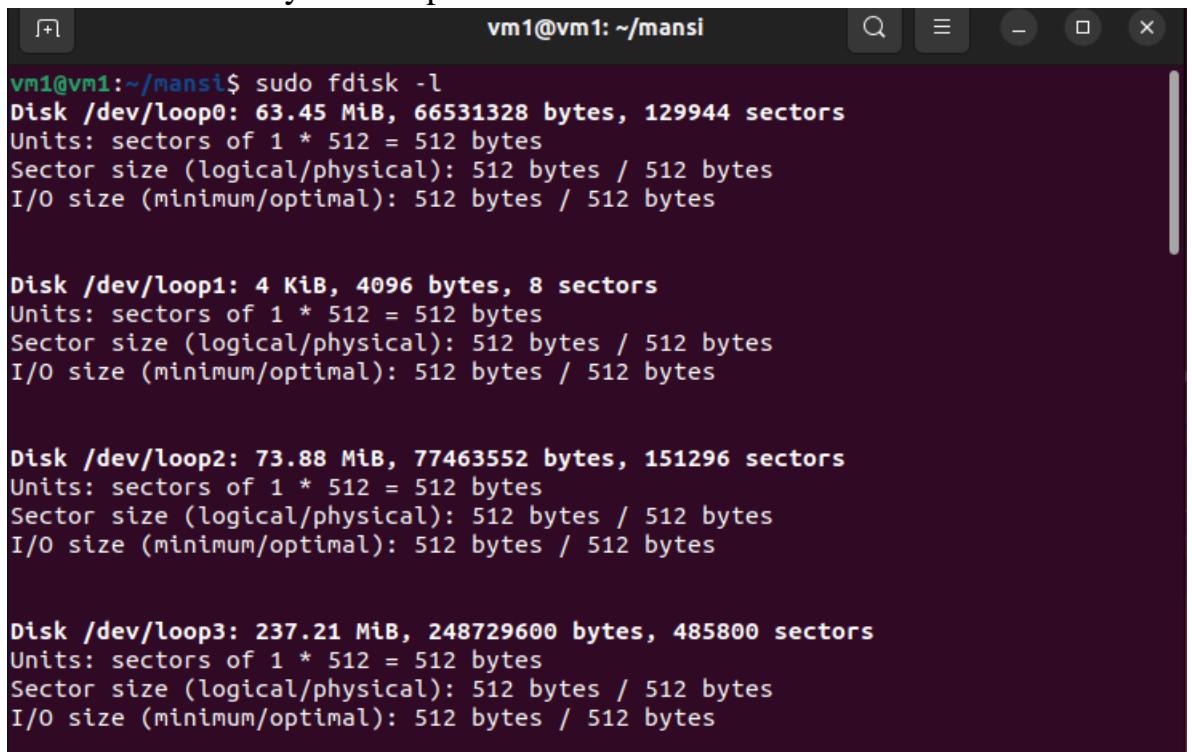
k. dd: It is utilised for file conversion or copying, as well as for backup and image capture of hard drives.



A terminal window titled "vm1@vm1: ~/mans1". The terminal displays the following command sequence:

```
vm1@vm1:~/mans1$ cat cp2.txt
vm1@vm1:~/mans1$ dd if=cp1.txt of=cp2.txt
0+0 records in
0+0 records out
0 bytes copied, 0.000392514 s, 0.0 kB/s
vm1@vm1:~/mans1$ cat cp2.txt
vm1@vm1:~/mans1$
```

1. Fdisk: This programme is used to partition discs and obtain information about the discs on your computer.



A terminal window titled "vm1@vm1: ~/mans1". The terminal displays the output of the "fdisk -l" command, listing four disk partitions (loop0, loop1, loop2, loop3) with their respective sizes, sector counts, and I/O sizes.

```
vm1@vm1:~/mans1$ sudo fdisk -l
Disk /dev/loop0: 63.45 MiB, 66531328 bytes, 129944 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: 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/loop2: 73.88 MiB, 77463552 bytes, 151296 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

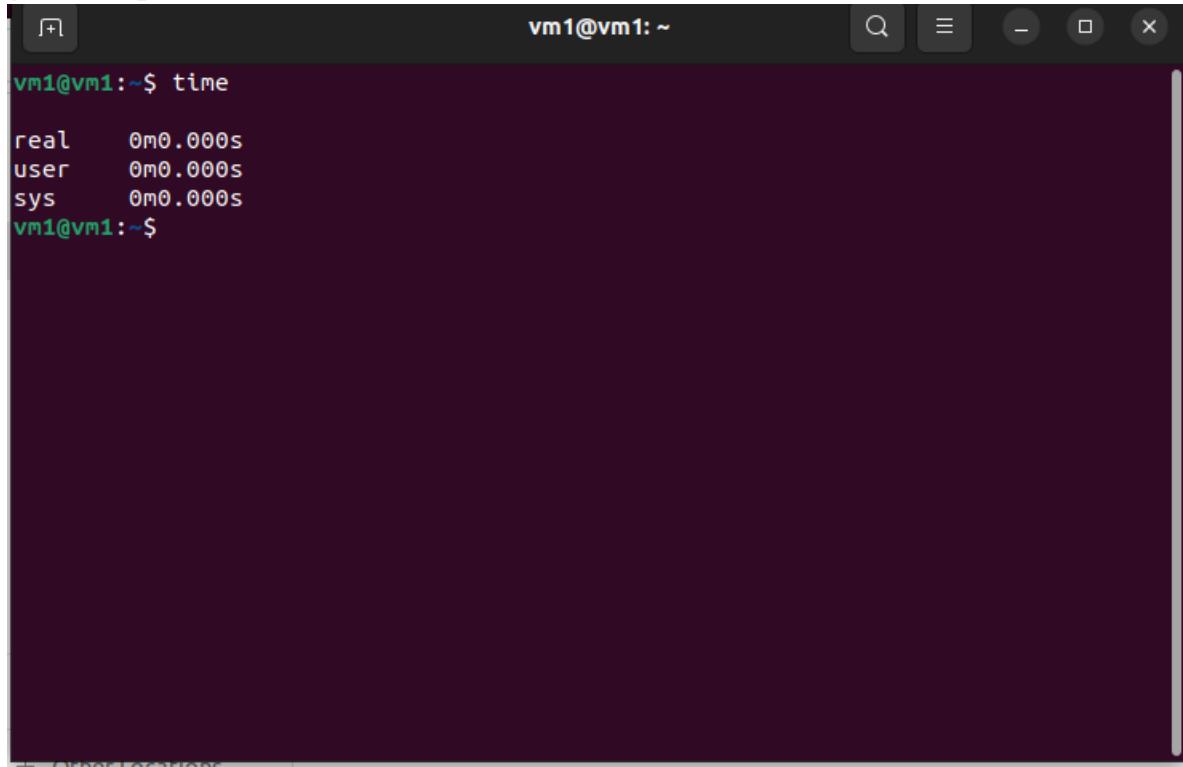
Disk /dev/loop3: 237.21 MiB, 248729600 bytes, 485800 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
```

m. apt: Apt is a sophisticated package tool that is utilised for programme installation and removal.

```
vm1@vm1:~/mansis$ sudo apt install  
Reading package lists... Done  
Building dependency tree... Done  
Reading state information... Done  
0 upgraded, 0 newly installed, 0 to remove and 4 not upgraded.  
vm1@vm1:~/mansis$ █
```

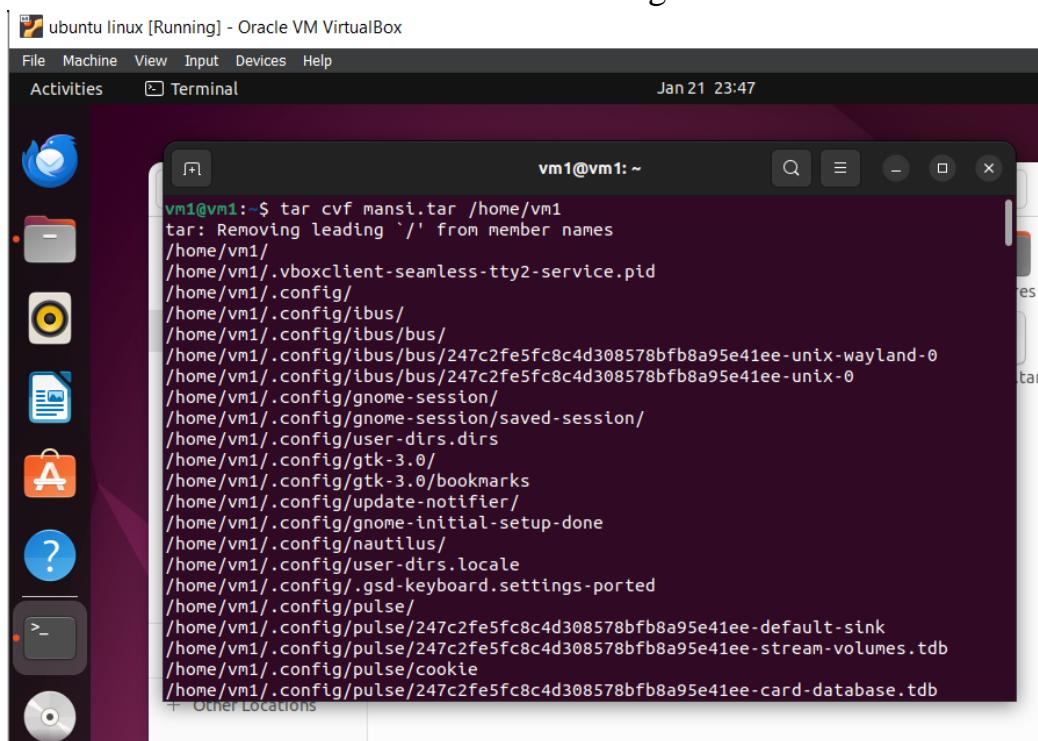
n. vi: This tool is used to add files or updated text to the console. It will create the file if it is not already there, and the user can write into it.

- o. Time: Given command is used to measure the time difference between given requests

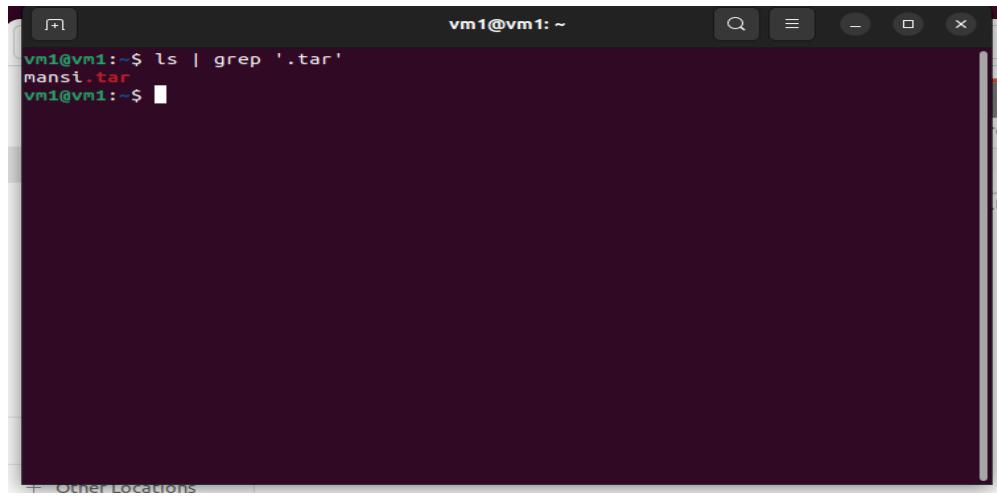


```
vm1@vm1:~$ time
real    0m0.000s
user    0m0.000s
sys     0m0.000s
vm1@vm1:~$
```

- P. Tar: This tool is utilised for file archiving.

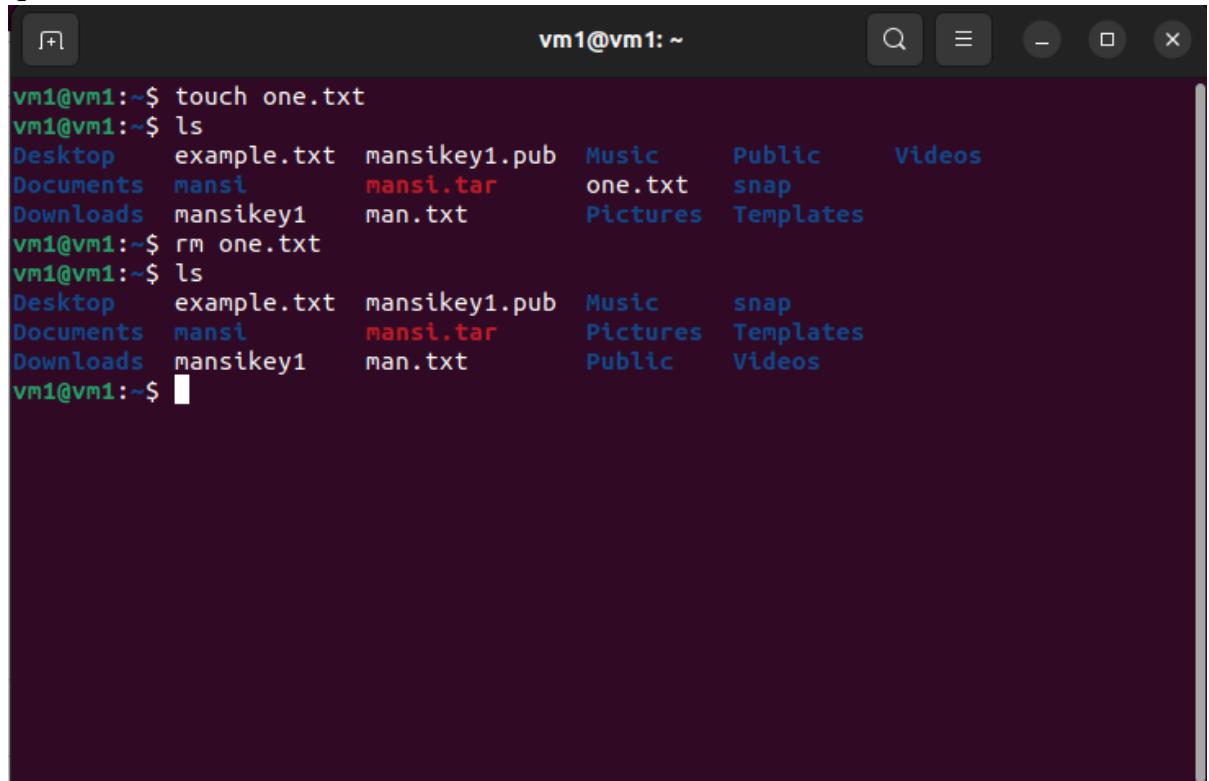


```
ubuntu linux [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Jan 21 23:47
vm1@vm1:~$ tar cvf mansi.tar /home/vm1
tar: Removing leading `/' from member names
/home/vm1/
/home/vm1/.vboxclient-seamless-tty2-service.pid
/home/vm1/.config/
/home/vm1/.config/ibus/
/home/vm1/.config/ibus/bus/
/home/vm1/.config/ibus/bus/247c2fe5fc8c4d308578bfb8a95e41ee-unix-wayland-0
/home/vm1/.config/ibus/bus/247c2fe5fc8c4d308578bfb8a95e41ee-unix-0
/home/vm1/.config/gnome-session/
/home/vm1/.config/gnome-session/saved-session/
/home/vm1/.config/user-dirs.dirs
/home/vm1/.config/gtk-3.0/
/home/vm1/.config/gtk-3.0/bookmarks
/home/vm1/.config/update-notifier/
/home/vm1/.config/gnome-initial-setup-done
/home/vm1/.config/nautilus/
/home/vm1/.config/user-dirs.locale
/home/vm1/.config/.gsd-keyboard.settings-ported
/home/vm1/.config/pulse/
/home/vm1/.config/pulse/247c2fe5fc8c4d308578bfb8a95e41ee-default-sink
/home/vm1/.config/pulse/247c2fe5fc8c4d308578bfb8a95e41ee-stream-volumes.tdb
/home/vm1/.config/pulse/cookie
/home/vm1/.config/pulse/247c2fe5fc8c4d308578bfb8a95e41ee-card-database.tdb
```



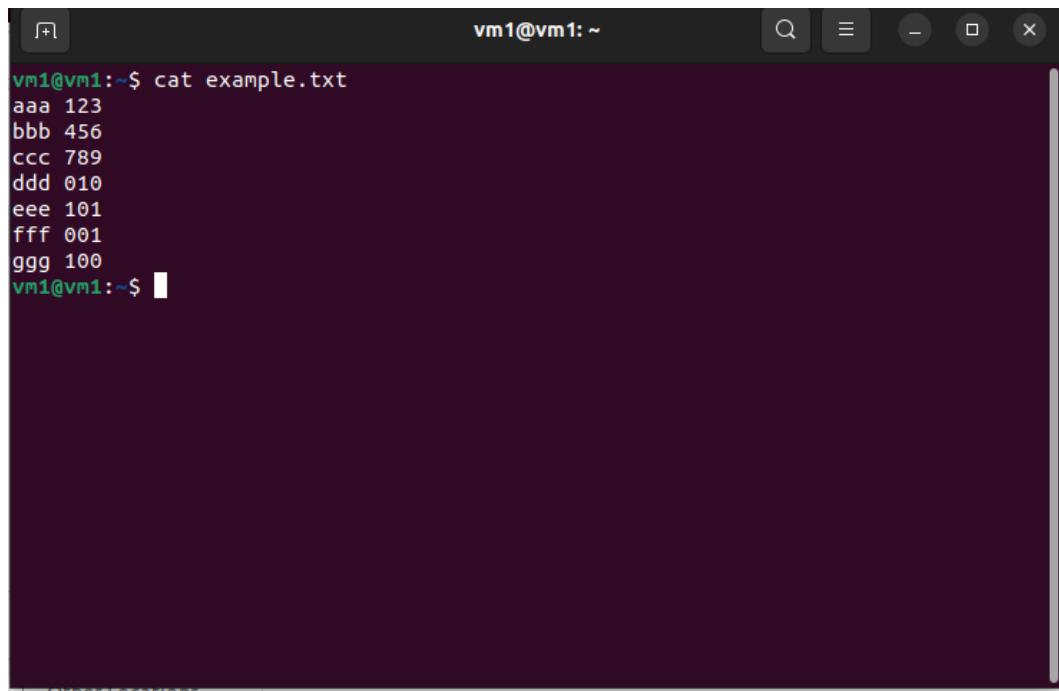
```
vm1@vm1:~$ ls | grep '.tar'
mansi.tar
vm1@vm1:~$
```

q. Rm: To erase or remove files, use the rm command.



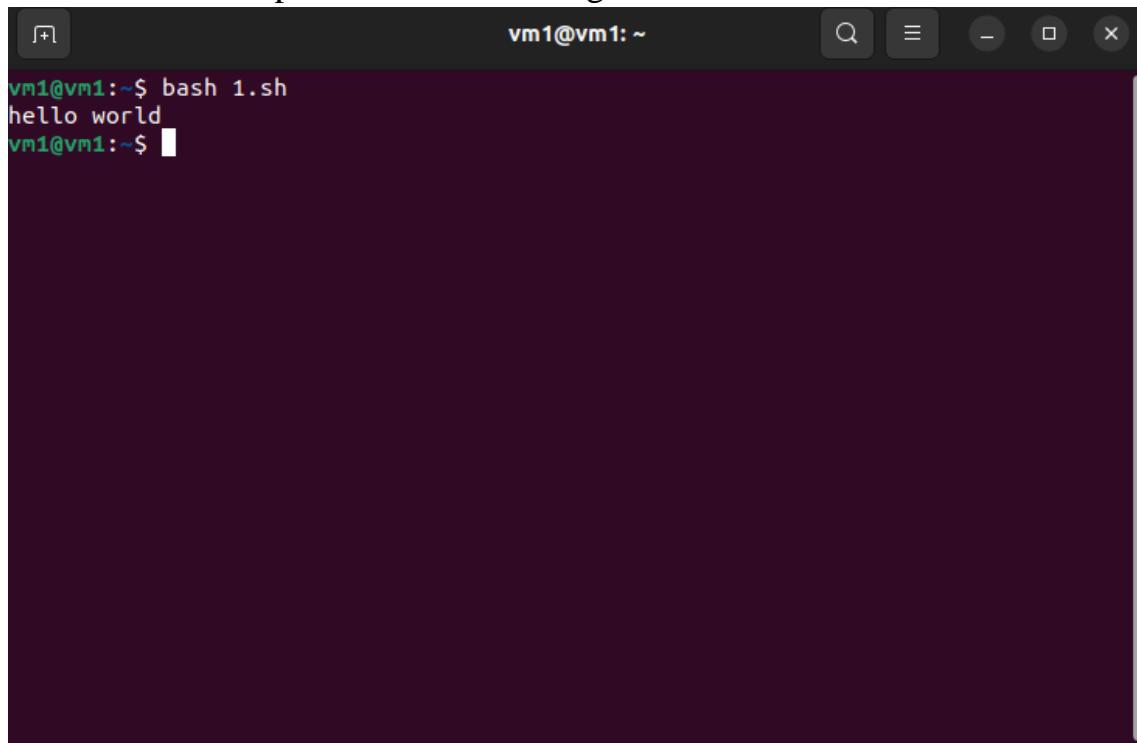
```
vm1@vm1:~$ touch one.txt
vm1@vm1:~$ ls
Desktop example.txt mansikey1.pub Music Public Videos
Documents mansi mansi.tar one.txt snap
Downloads mansikey1 man.txt Pictures Templates
vm1@vm1:~$ rm one.txt
vm1@vm1:~$ ls
Desktop example.txt mansikey1.pub Music snap
Documents mansi mansi.tar Pictures Templates
Downloads mansikey1 man.txt Public Videos
vm1@vm1:~$
```

r. Cat: The content of the file is printed in the output window using cat.



```
vm1@vm1:~$ cat example.txt
aaa 123
bbb 456
ccc 789
ddd 010
eee 101
fff 001
ggg 100
vm1@vm1:~$
```

s. Bash: Shell scripts are executed using the command bash.



```
vm1@vm1:~$ bash 1.sh
hello world
vm1@vm1:~$
```

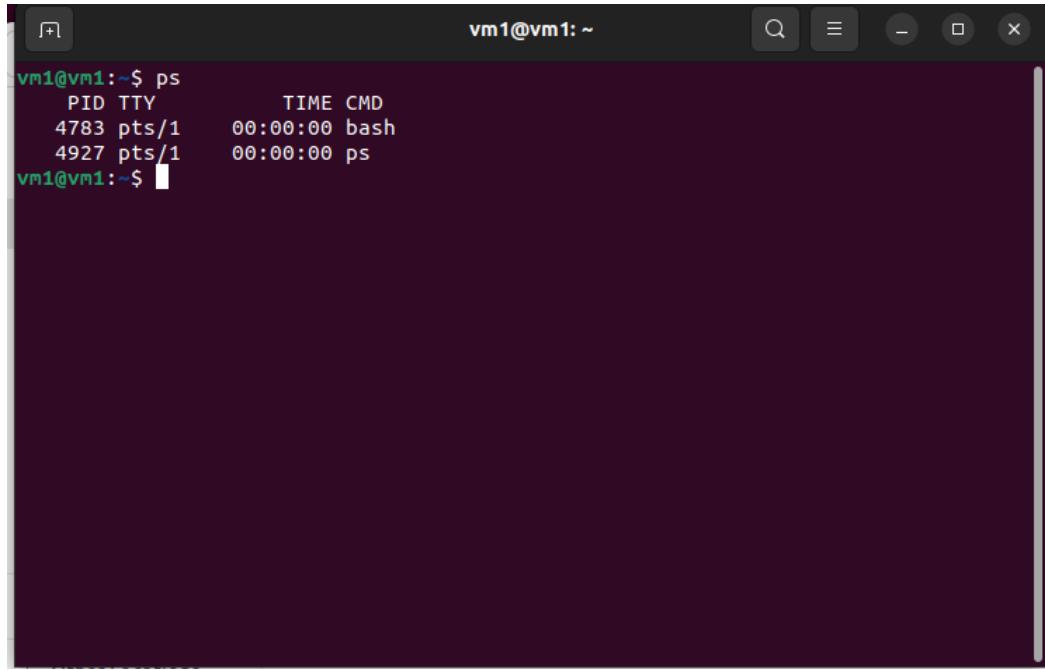
t. More: The system prints each output on the screen, requiring the user to scroll the screen in order to view the outputs. We may refer to this as manual scrolling.

```
File Edit View Search Terminal Help
=
@]
111.txt
1.c
1.sh
222.txt
2.sh
55.sh
abc.tar
checkinte.sh
cp1.txt
cp2.txt
dd.txt
Desktop
disk-benchmark-background-log.txt
disk-benchmark-background.sh
Documents
Downloads
examples.desktop
example.txt
firstshell.sh
Hello
helloworld.py
matplotlib.py
Music
nested-loops.sh
--More--
```

- u. Watch: Given command will run into a loop and display the result of given command after given interval.

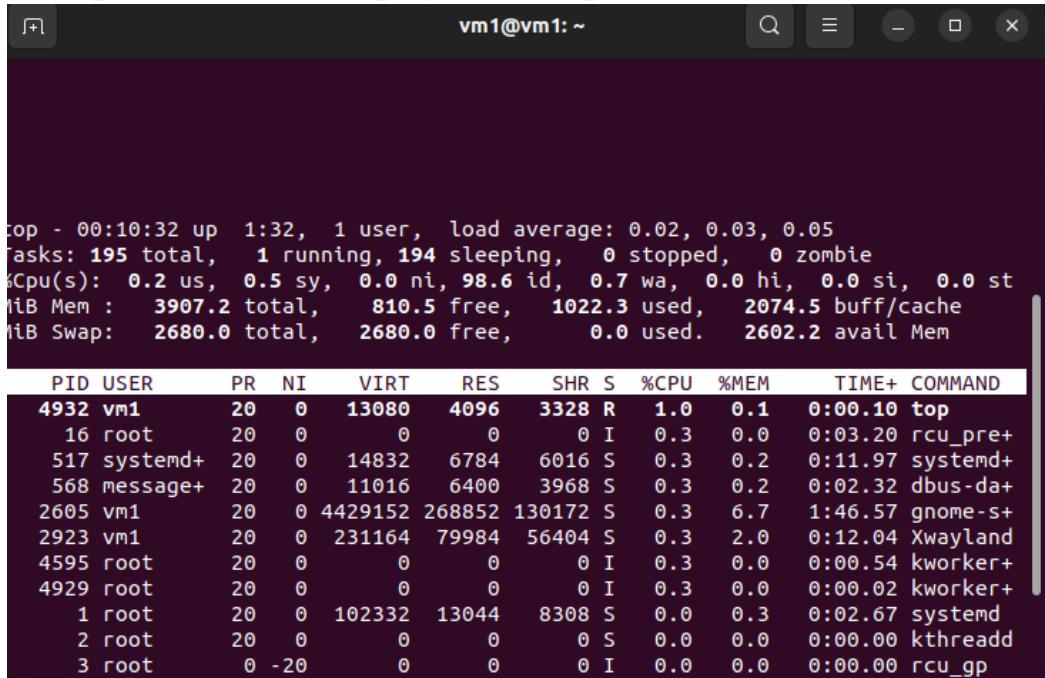
```
vm1@vm1:~$ watch -v
watch from procps-ng 3.3.17
vm1@vm1:~$
```

- v. Ps: It is used to obtain details about the processes that are presently executing as well as their process ids.



```
vm1@vm1:~$ ps
  PID TTY      TIME CMD
 4783 pts/1    00:00:00 bash
 4927 pts/1    00:00:00 ps
vm1@vm1:~$
```

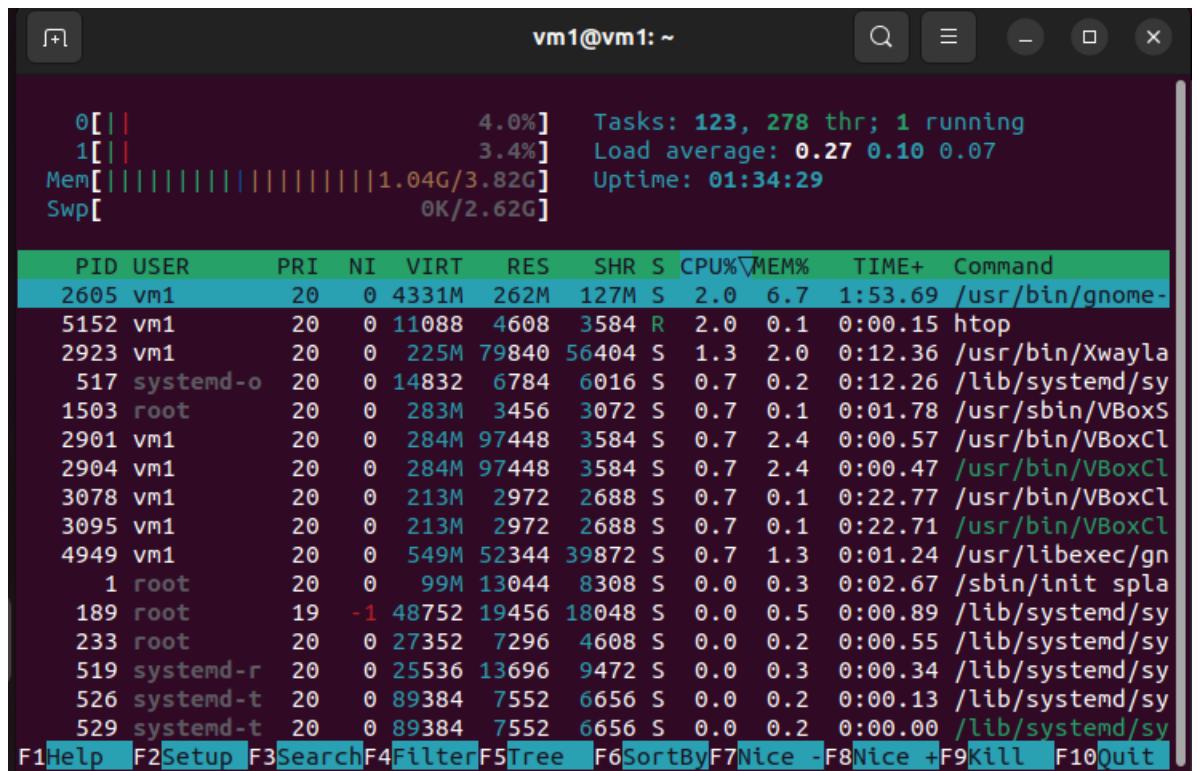
w. Top: It serves as a display for CPU process information.



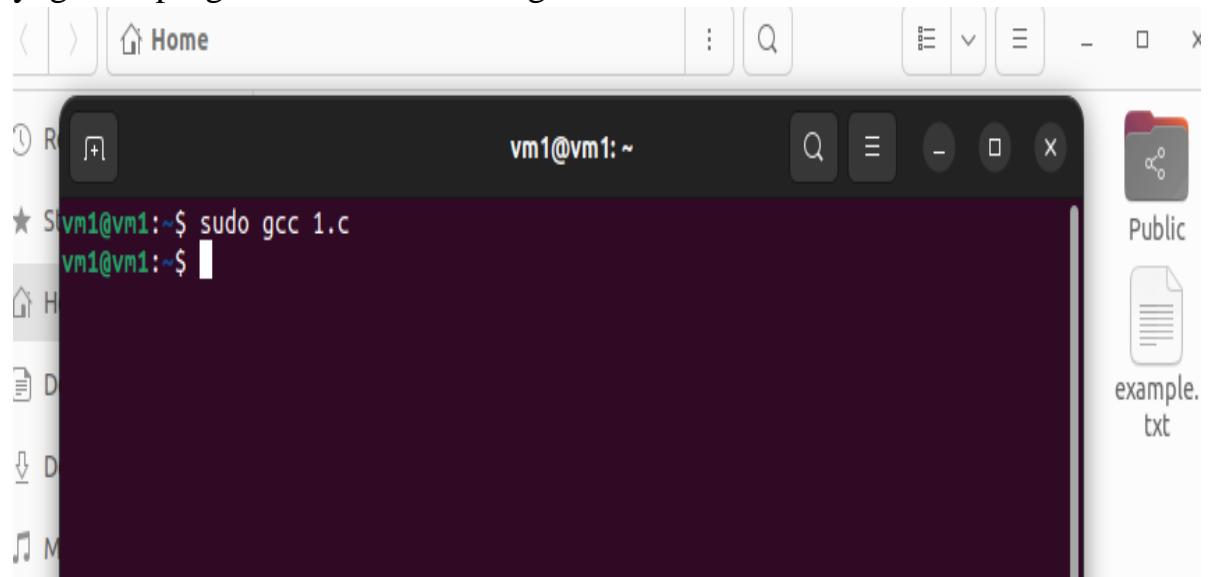
```
top - 00:10:32 up  1:32,  1 user,  load average: 0.02, 0.03, 0.05
Tasks: 195 total,   1 running, 194 sleeping,   0 stopped,   0 zombie
CPU(s):  0.2 us,  0.5 sy,  0.0 ni, 98.6 id,  0.7 wa,  0.0 hi,  0.0 si,  0.0 st
MiB Mem : 3907.2 total,   810.5 free, 1022.3 used, 2074.5 buff/cache
MiB Swap: 2680.0 total,   2680.0 free,     0.0 used. 2602.2 avail Mem

          PID USER      PR  NI    VIRT    RES    SHR S %CPU %MEM     TIME+ COMMAND
 4932 vm1      20   0 13080  4096  3328 R  1.0  0.1  0:00.10 top
    16 root      20   0      0      0      0 I  0.3  0.0  0:03.20 rcu_pre+
  517 systemd+  20   0 14832  6784  6016 S  0.3  0.2  0:11.97 systemd+
  568 message+  20   0 11016  6400  3968 S  0.3  0.2  0:02.32 dbus-da+
 2605 vm1      20   0 4429152 268852 130172 S  0.3  6.7  1:46.57 gnome-s+
 2923 vm1      20   0 231164  79984  56404 S  0.3  2.0  0:12.04 Xwayland
 4595 root      20   0      0      0      0 I  0.3  0.0  0:00.54 kworker+
 4929 root      20   0      0      0      0 I  0.3  0.0  0:00.02 kworker+
    1 root      20   0 102332  13044  8308 S  0.0  0.3  0:02.67 systemd
    2 root      20   0      0      0      0 S  0.0  0.0  0:00.00 kthreadd
    3 root      0 -20      0      0      0 I  0.0  0.0  0:00.00 rcu_gp
```

x. Htop: An interactive process viewer that is easy to use, it displays process details



y. gcc: C programmes are run using it.



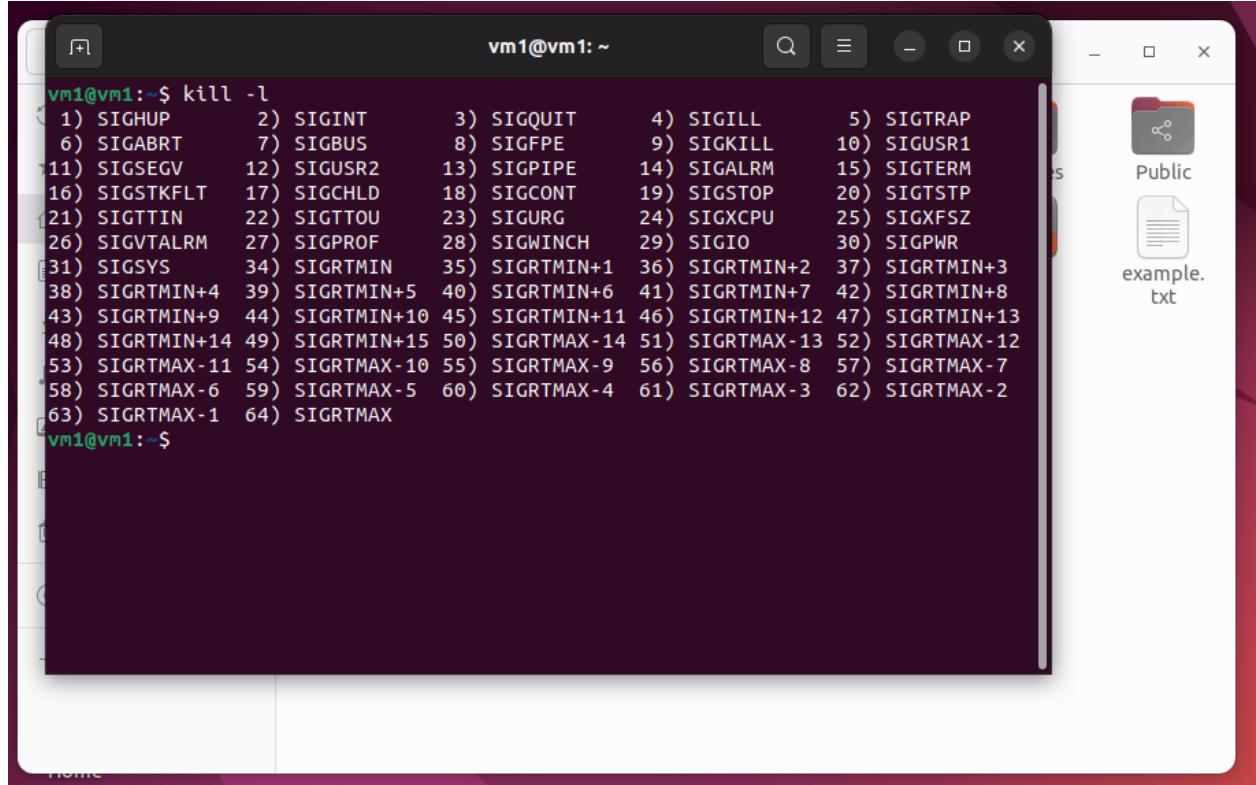
z. Tail The tail of a file is used to retrieve the last or bottom rows.

```
vm1@vm1:~$ cat example.txt
aaa 123
bbb 456
ccc 789
ddd 010
eee 101
fff 001
ggg 100
vm1@vm1:~$ cat example.txt | tail -2
fff 001
ggg 100
vm1@vm1:~$
```

aa. Grep Grep is used for pattern matching

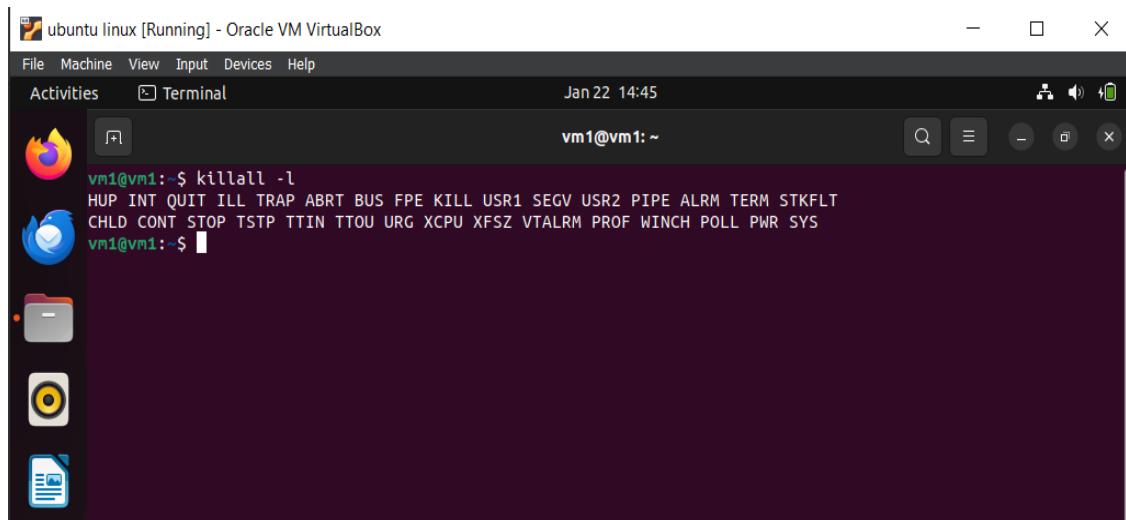
```
vm1@vm1:~$ ls
1.c   Desktop   example.txt  mansikey1.pub  Music      snap
1.sh  Documents  mansi       mansi.tar    Pictures   Templates
a.out Downloads mansikey1   man.txt     Public     Videos
vm1@vm1:~$ ls | grep 'txt'^4
vm1@vm1:~$ ls | grep 'txt'
example.txt
man.txt
vm1@vm1:~$
```

bb. Kill : It is used to get information about the signals and also to kill the specific signals.



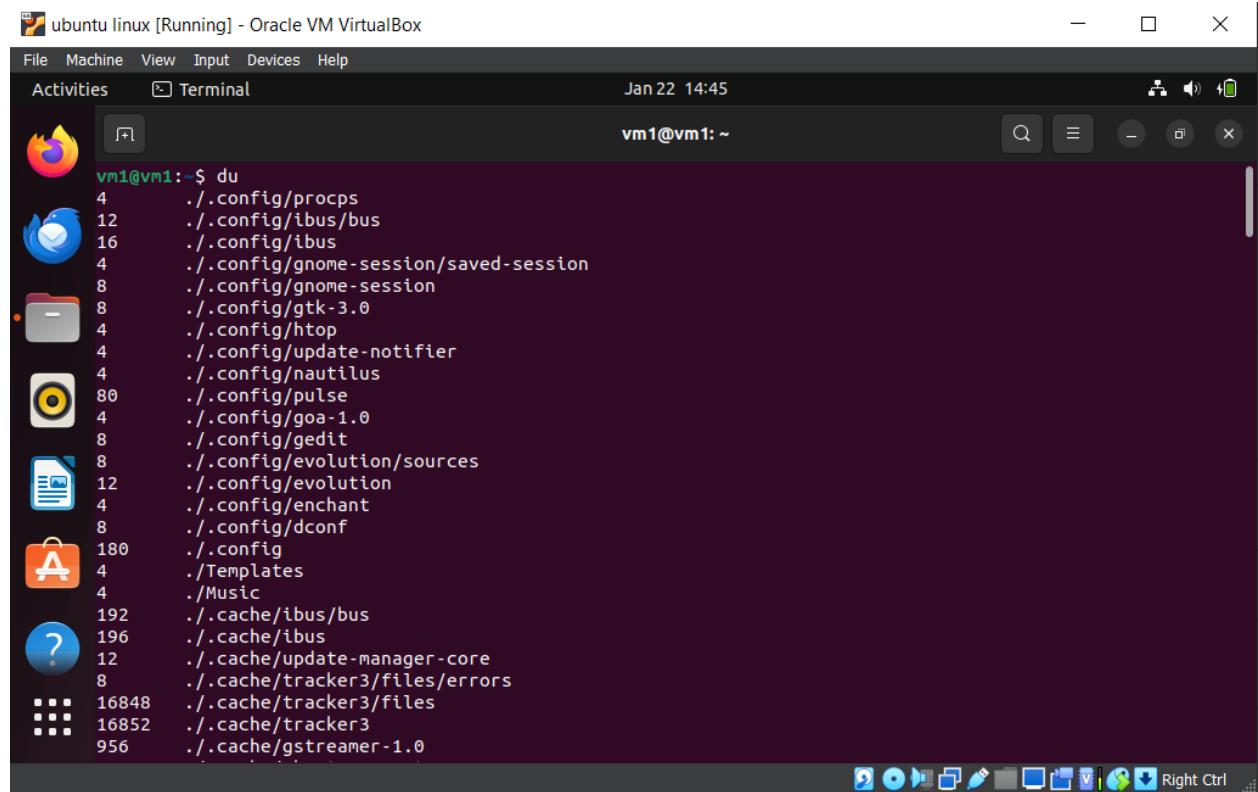
```
vm1@vm1:~$ kill -l
 1) SIGHUP      2) SIGINT      3) SIGQUIT      4) SIGILL      5) SIGTRAP
 6) SIGABRT     7) SIGBUS      8) SIGFPE       9) SIGKILL     10) SIGUSR1
11) SIGSEGV     12) SIGUSR2     13) SIGPIPE     14) SIGALRM     15) SIGTERM
16) SIGSTKFLT   17) SIGCHLD     18) SIGCONT     19) SIGSTOP     20) SIGTSTP
21) SIGTTIN     22) SIGTTOU     23) SIGURG      24) SIGXCPU     25) SIGXFSZ
26) SIGVTALRM   27) SIGPROF     28) SIGWINCH    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
vm1@vm1:~$
```

cc. Killall: This command is used to terminate processes by name; it can also be used to terminate all processes. Alternatively, the user can terminate processes that match particular regular expressions.



```
ubuntu linux [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Jan 22 14:45
vm1@vm1:~$ killall -l
HUP INT QUIT ILL TRAP ABRT BUS FPE KILL USR1 SEGV USR2 PIPE ALRM TERM STKFLT
CHLD CONT STOP TSTP TTIN TTOU URG XCPU XFSZ VTALRM PROF WINCH POLL PWR SYS
vm1@vm1:~$
```

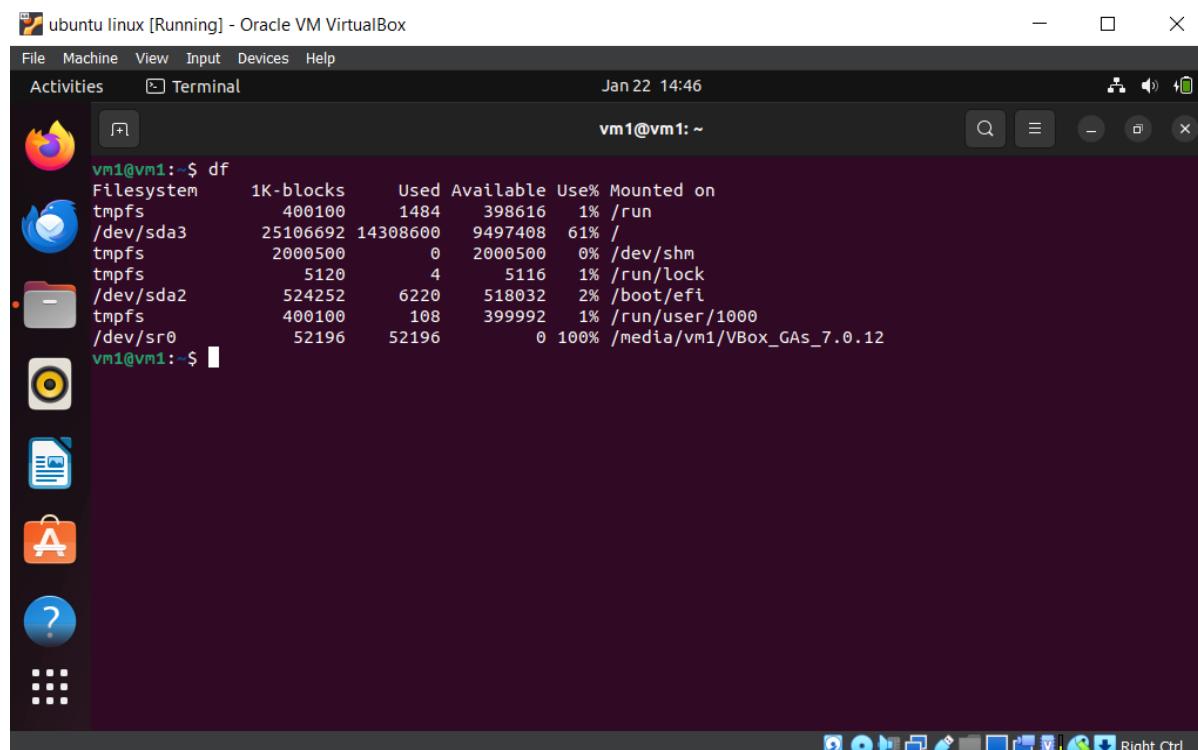
dd. Du : It shows the file space usage



A screenshot of an Ubuntu Linux desktop environment running in Oracle VM VirtualBox. The desktop has a dark theme with icons for various applications like Dash, Home, Applications, and Help. A terminal window is open in the Activities overview, showing the command 'du' being run. The output lists numerous files and their sizes in kilobytes (kbytes) across different paths, such as '/.config/procps', '/.config/ibus/bus', and '/.cache/gstremer-1.0'. The terminal window title is 'vm1@vm1: ~' and the status bar shows the date and time as 'Jan 22 14:45'.

```
vm1@vm1:~$ du
4      ./config/procps
12     ./config/ibus/bus
16     ./config/ibus
4      ./config/gnome-session/saved-session
8      ./config/gnome-session
8      ./config/gtk-3.0
4      ./config/htop
4      ./config/update-notifier
4      ./config/nautlius
80     ./config/pulse
4      ./config/goa-1.0
8      ./config/gedit
8      ./config/evolution/sources
12     ./config/evolution
4      ./config/enchant
8      ./config/dconf
180    ./config
4      ./Templates
4      ./Music
192    ./cache/ibus/bus
196    ./cache/ibus
12     ./cache/update-manager-core
8      ./cache/tracker3/files/errors
16848   ./cache/tracker3/files
16852   ./cache/tracker3
956    ./cache/gstremer-1.0
```

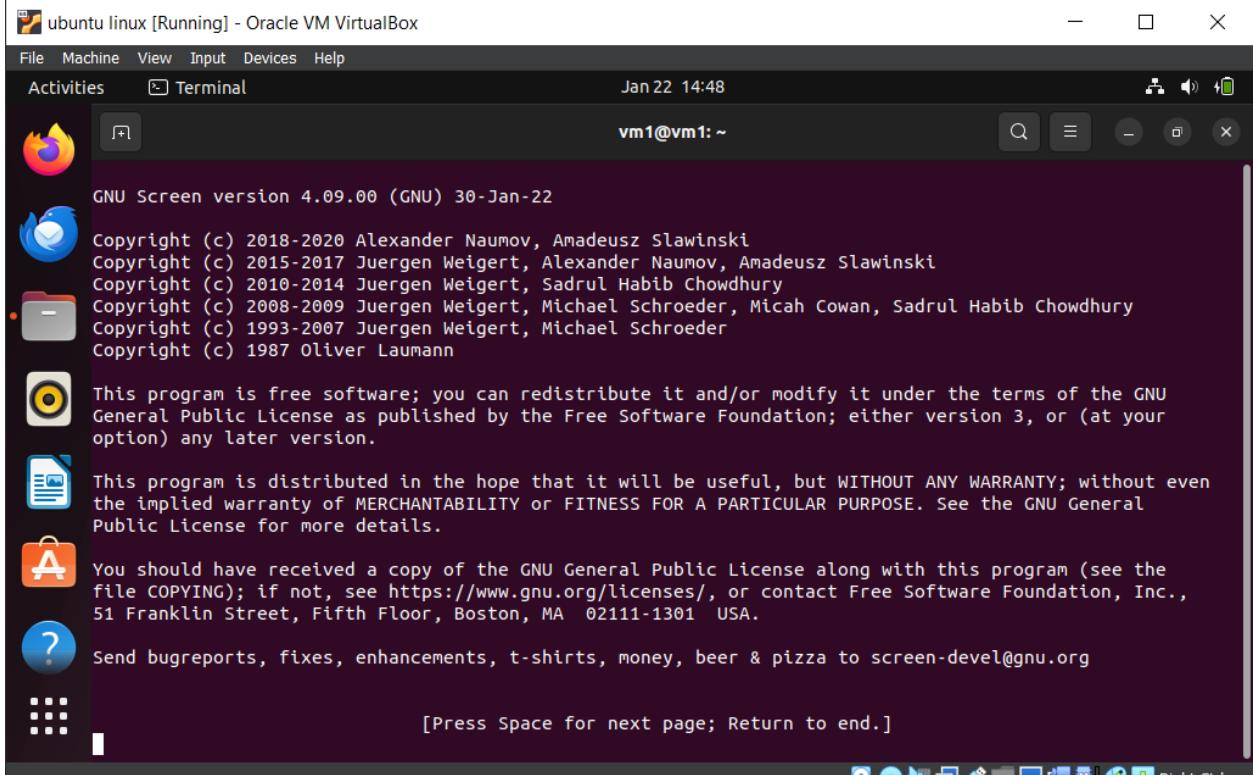
ee. Df: It is same as that of DU, which is used to get disk space usage.



A screenshot of an Ubuntu Linux desktop environment running in Oracle VM VirtualBox. The desktop has a dark theme with icons for Dash, Home, Applications, and Help. A terminal window is open in the Activities overview, showing the command 'df' being run. The output provides disk usage information for various filesystems, including tmpfs, /dev/sda3, /dev/sda2, and /dev/sr0, showing the number of 1K-blocks, used space, available space, usage percentage, and the mount point. The terminal window title is 'vm1@vm1: ~' and the status bar shows the date and time as 'Jan 22 14:46'.

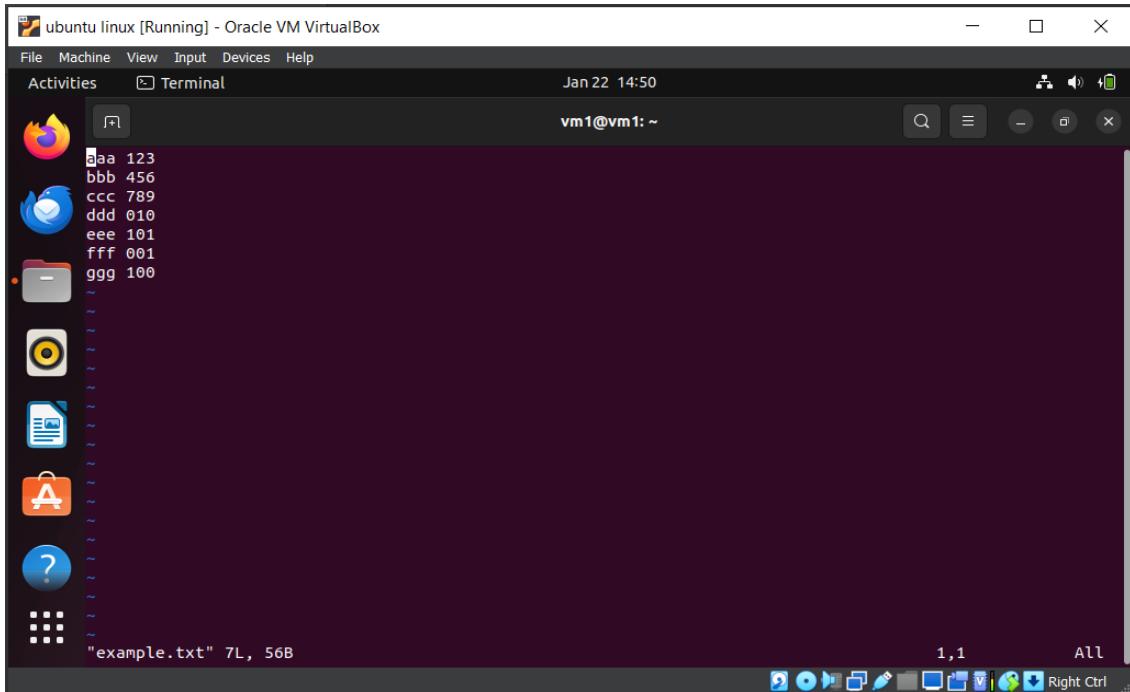
```
vm1@vm1:~$ df
Filesystem      1K-blocks    Used Available Use% Mounted on
tmpfs            400100     1484    398616   1% /run
/dev/sda3        25106692  14308600   9497408  61% /
tmpfs            2000500       0   2000500   0% /dev/shm
tmpfs             5120       4     5116   1% /run/lock
/dev/sda2        524252     6220    518032   2% /boot/efi
tmpfs            400100      108   399992   1% /run/user/1000
/dev/sr0          52196     52196       0 100% /media/vm1/VBox_GAs_7.0.12
vm1@vm1:~$
```

ff. Screen: Multiply given terminal for multiple processes



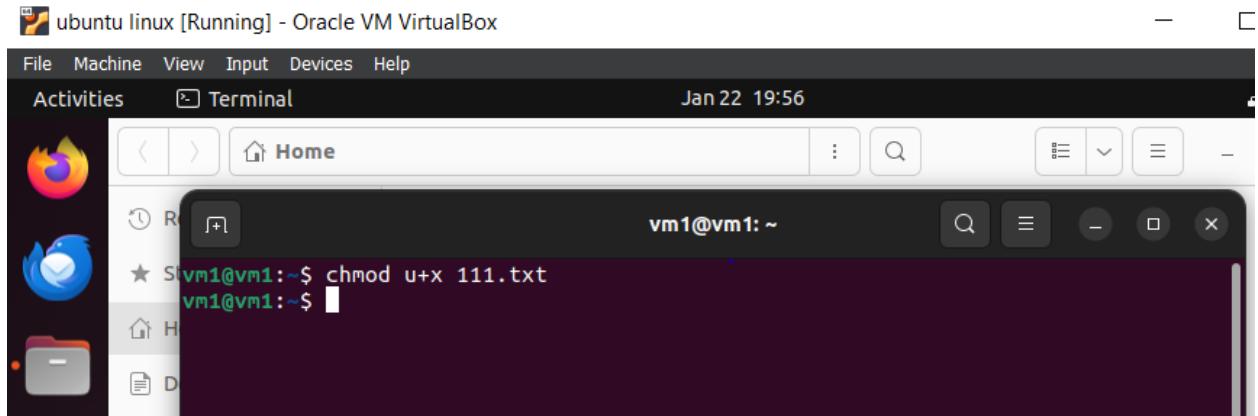
The screenshot shows a terminal window titled "ubuntu linux [Running] - Oracle VM VirtualBox". The window title bar includes standard icons for minimize, maximize, and close. The menu bar has options: File, Machine, View, Input, Devices, Help. Below the menu is a toolbar with "Activities" and "Terminal" buttons. The status bar shows the date and time: "Jan 22 14:48". The terminal window itself displays the "GNU Screen version 4.09.00 (GNU) 30-Jan-22" license text. It includes copyright notices from 1987 to 2020, a summary of the GNU General Public License, and instructions for reporting bugs. At the bottom of the terminal, there is a message "[Press Space for next page; Return to end.]". The desktop background is visible at the bottom of the screen.

gg. Vim : Used to print or edit content of file using console



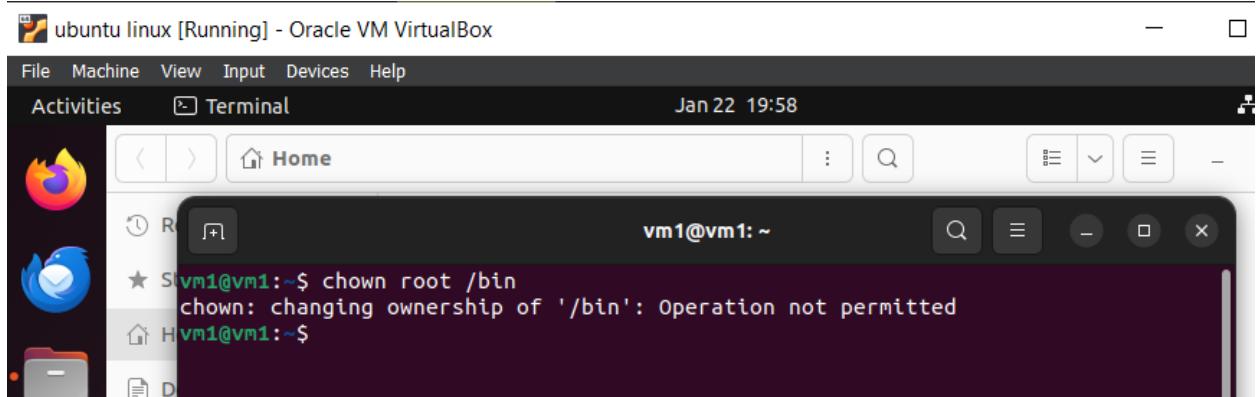
The screenshot shows a terminal window titled "ubuntu linux [Running] - Oracle VM VirtualBox". The window title bar includes standard icons for minimize, maximize, and close. The menu bar has options: File, Machine, View, Input, Devices, Help. Below the menu is a toolbar with "Activities" and "Terminal" buttons. The status bar shows the date and time: "Jan 22 14:50". The terminal window displays the contents of a file named "example.txt", which contains the following text:
aaa 123
bbb 456
ccc 789
ddd 010
eee 101
fff 001
ggg 100
The status bar at the bottom indicates the file name "example.txt", line count "7L", and size "56B". The bottom right corner shows the Vim mode indicator "1,1 All". The desktop background is visible at the bottom of the screen.

hh. Chmod is used to give permissions to file, permissions like read write and execute access



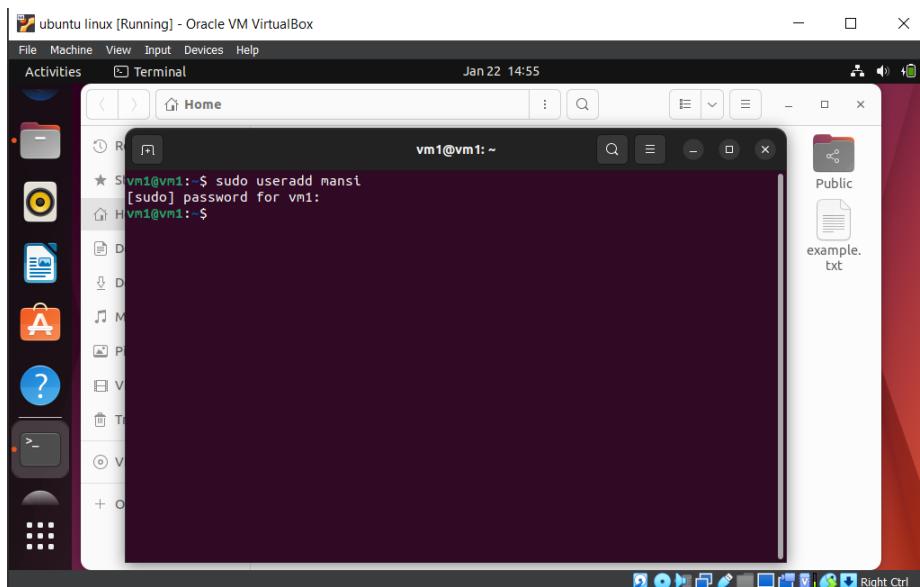
```
ubuntu linux [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Jan 22 19:56
vm1@vm1:~$ chmod u+x 111.txt
vm1@vm1:~$
```

ii. Chown : It is used to change file owner or group



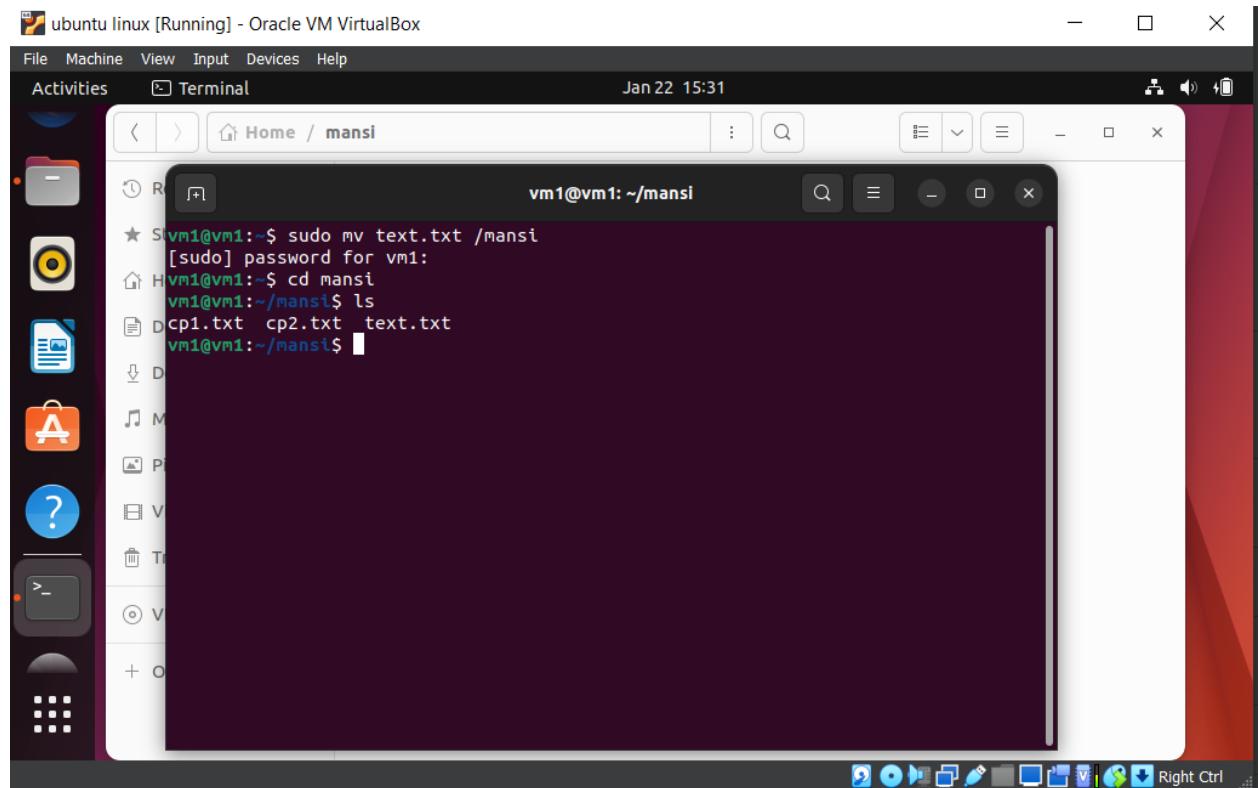
```
ubuntu linux [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Jan 22 19:58
vm1@vm1:~$ chown root /bin
chown: changing ownership of '/bin': Operation not permitted
vm1@vm1:~$
```

jj. useradd : Used to add new user to existing system



```
ubuntu linux [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Jan 22 14:55
vm1@vm1:~$ sudo useradd mansi
[sudo] password for vm1:
vm1@vm1:~$
```

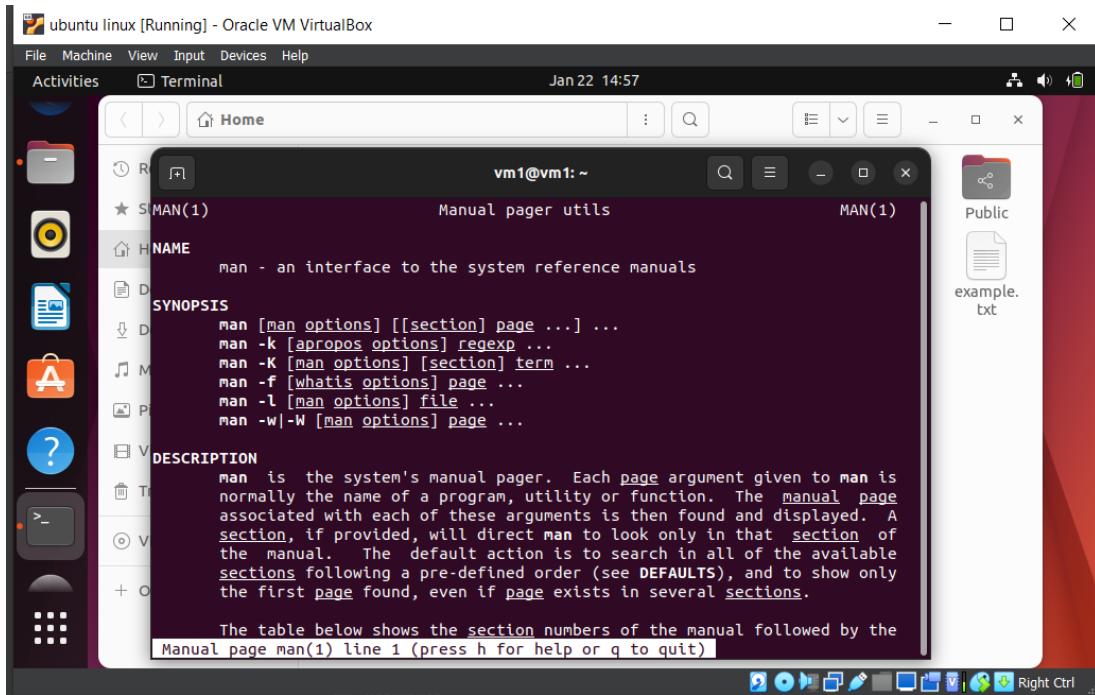
kk. Mv : It is used to move the file from one folder to another



A screenshot of a Linux desktop environment in Oracle VM VirtualBox. The desktop has a dark theme with a dock at the bottom containing icons for various applications like a browser, file manager, and terminal. A terminal window is open in the center, showing the following command history:

```
vm1@vm1:~$ sudo mv text.txt /mansi
[sudo] password for vm1:
vm1@vm1:~$ cd mansi
vm1@vm1:~/mansi$ ls
cp1.txt cp2.txt text.txt
vm1@vm1:~/mansi$
```

ll. Man : It is used to get user manual information for given command, See below output for man ls command

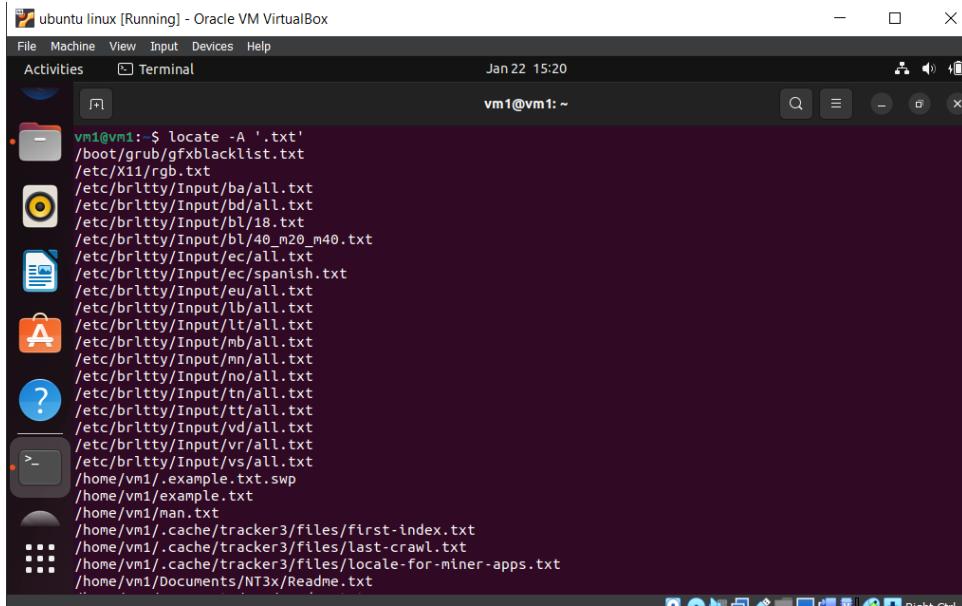


A screenshot of a Linux desktop environment in Oracle VM VirtualBox. The desktop has a dark theme with a dock at the bottom containing icons for various applications like a browser, file manager, and terminal. A terminal window is open in the center, showing the following output of the man ls command:

```
SIMAN(1)          Manual pager utils          MAN(1)
NAME
      man - an interface to the system reference manuals
SYNOPSIS
      man [man options] [[section] page ...]
      man -k [apropos options] regexp ...
      man -K [man options] [section] term ...
      man -f [whatis options] page ...
      man -l [man options] file ...
      man -w|-W [man options] page ...
DESCRIPTION
      man  is  the  system's  manual  pager.  Each  page  argument  given  to  man  is
      normally  the  name  of  a  program,  utility  or  function.  The  manual  page
      associated  with  each  of  these  arguments  is  then  found  and  displayed.  A
      section,  if  provided,  will  direct  man  to  look  only  in  that  section  of
      the  manual.  The  default  action  is  to  search  in  all  of  the  available
      sections  following  a  pre-defined  order  (see  DEFAULTS),  and  to  show  only
      the  first  page  found,  even  if  page  exists  in  several  sections.

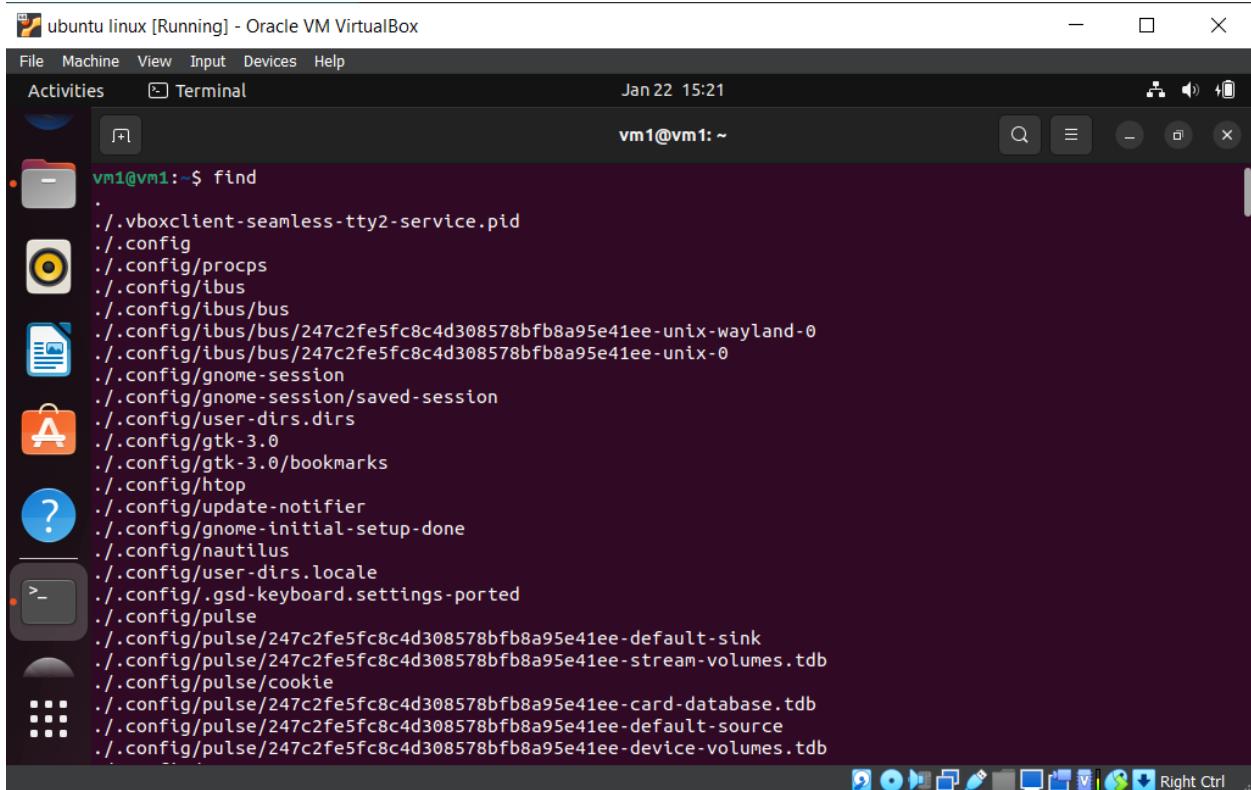
      The  table  below  shows  the  section  numbers  of  the  manual  followed  by  the
      Manual  page  man(1)  line  1  (press  h  for  help  or  q  to  quit) |
```

mm. Locate : It is used to find the files which matches given pattern



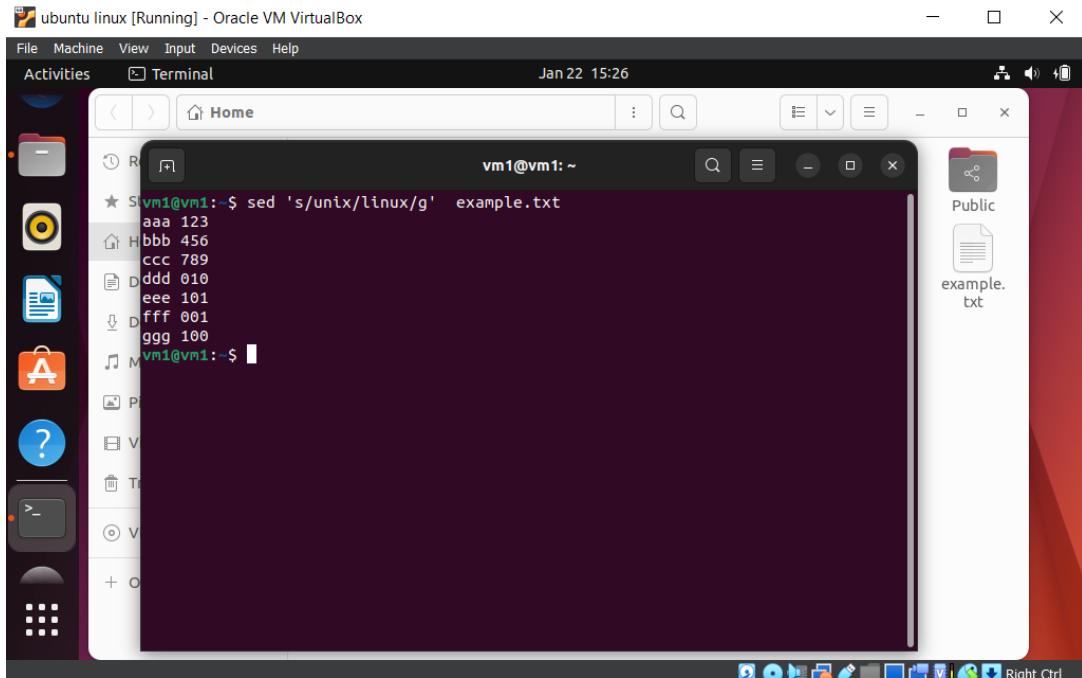
```
ubuntu linux [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Jan 22 15:20
vm1@vm1: ~
vm1@vm1:~$ locate -A '.txt'
/boot/grub/gfxblacklist.txt
/etc/X11/rgb.txt
/etc/brltty/Input/ba/all.txt
/etc/brltty/Input/bd/all.txt
/etc/brltty/Input/bl/18.txt
/etc/brltty/Input/bl/40_m20_m40.txt
/etc/brltty/Input/ec/all.txt
/etc/brltty/Input/ec/spanish.txt
/etc/brltty/Input/eu/all.txt
/etc/brltty/Input/lb/all.txt
/etc/brltty/Input/lt/all.txt
/etc/brltty/Input/mb/all.txt
/etc/brltty/Input/mn/all.txt
/etc/brltty/Input/no/all.txt
/etc/brltty/Input/tm/all.txt
/etc/brltty/Input/tt/all.txt
/etc/brltty/Input/vd/all.txt
/etc/brltty/Input/vr/all.txt
/etc/brltty/Input/vs/all.txt
/home/vm1/.example.txt.swp
/home/vm1/example.txt
/home/vm1/man.txt
/home/vm1/.cache/tracker3/files/first-index.txt
/home/vm1/.cache/tracker3/files/last-crawl.txt
/home/vm1/.cache/tracker3/files/locale-for-miner-apps.txt
/home/vm1/Documents/NT3x/Readme.txt
```

nn. Find: Used to search a file in given folder

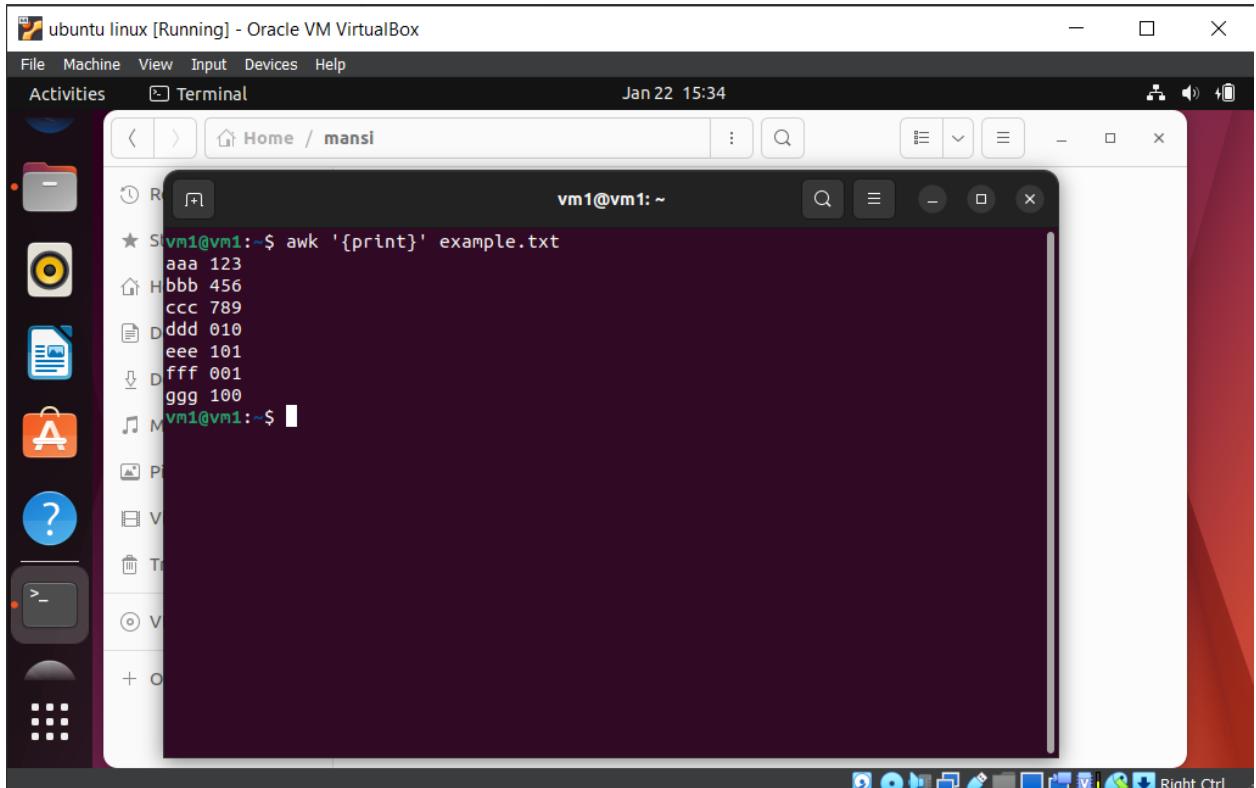


```
ubuntu linux [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Jan 22 15:21
vm1@vm1: ~
vm1@vm1:~$ find
./
./.vboxclient-seamless-tty2-service.pid
./config
./config/procps
./config/ibus
./config/ibus/bus
./config/ibus/bus/247c2fe5fc8c4d308578bfb8a95e41ee-unix-wayland-0
./config/ibus/bus/247c2fe5fc8c4d308578bfb8a95e41ee-unix-0
./config/gnome-session
./config/gnome-session/saved-session
./config/user-dirs.dirs
./config/gtk-3.0
./config/gtk-3.0/bookmarks
./config/htop
./config/update-notifier
./config/gnome-initial-setup-done
./config/nautlius
./config/user-dirs.locale
./config/.gsd-keyboard.settings-ported
./config/pulse
./config/pulse/247c2fe5fc8c4d308578bfb8a95e41ee-default-sink
./config/pulse/247c2fe5fc8c4d308578bfb8a95e41ee-stream-volumes.tdb
./config/pulse/cookie
./config/pulse/247c2fe5fc8c4d308578bfb8a95e41ee-card-database.tdb
./config/pulse/247c2fe5fc8c4d308578bfb8a95e41ee-default-source
./config/pulse/247c2fe5fc8c4d308578bfb8a95e41ee-device-volumes.tdb
```

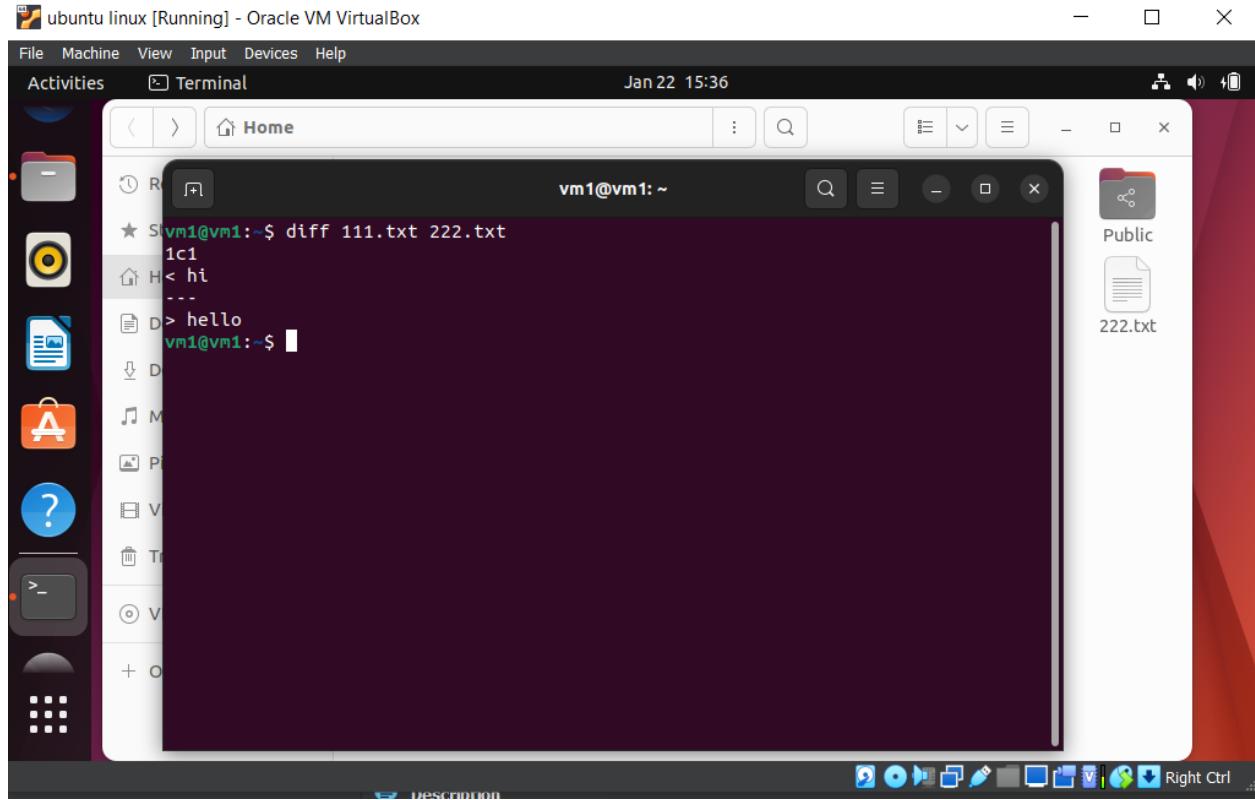
oo. Sed: it is used to edit or transform the text in console



pp. Awk: Used for pattern matching



qq. Diff: It is used to compare files line by line

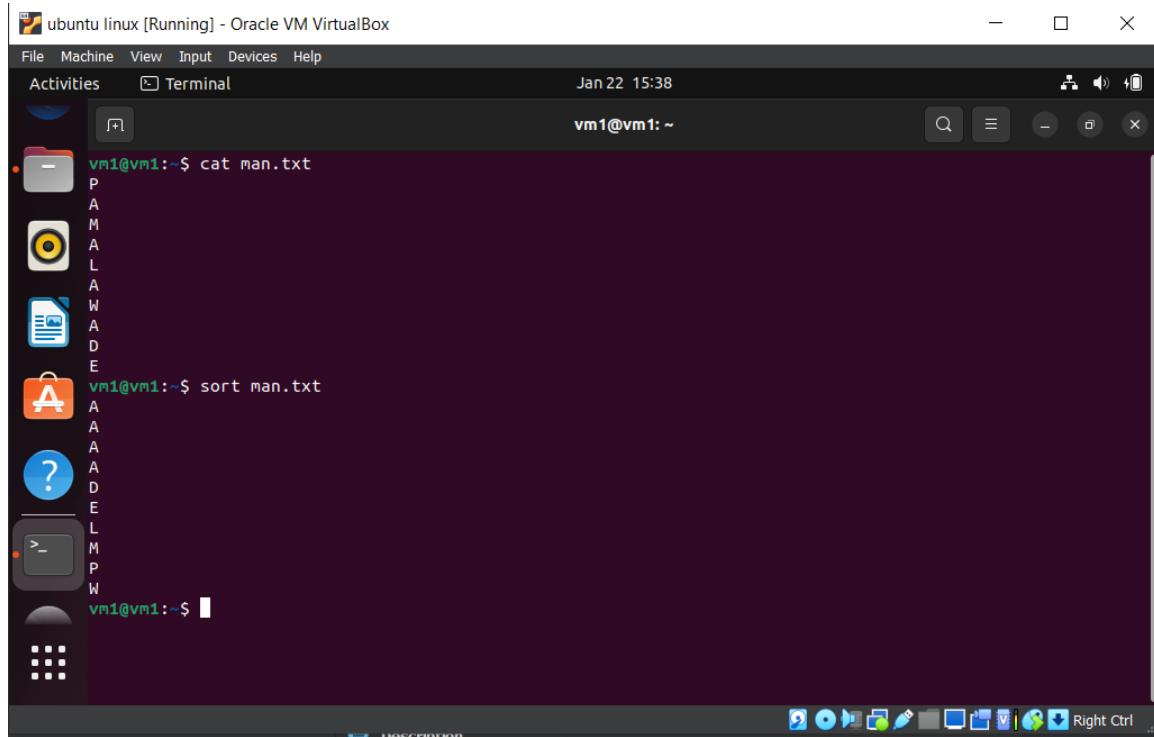


A screenshot of a Linux desktop environment in Oracle VM VirtualBox. The desktop has a dark theme with a dock at the bottom containing icons for various applications like Dash, Home, Activities, and Terminal. A terminal window titled 'vm1@vm1: ~' is open, showing the output of the 'diff' command comparing '111.txt' and '222.txt'. The terminal shows the following output:

```
vm1@vm1:~$ diff 111.txt 222.txt
1c1
< hi
...
> hello
vm1@vm1:~$
```

The desktop also shows a file browser window on the right side, with a folder named 'Public' containing a file named '222.txt'.

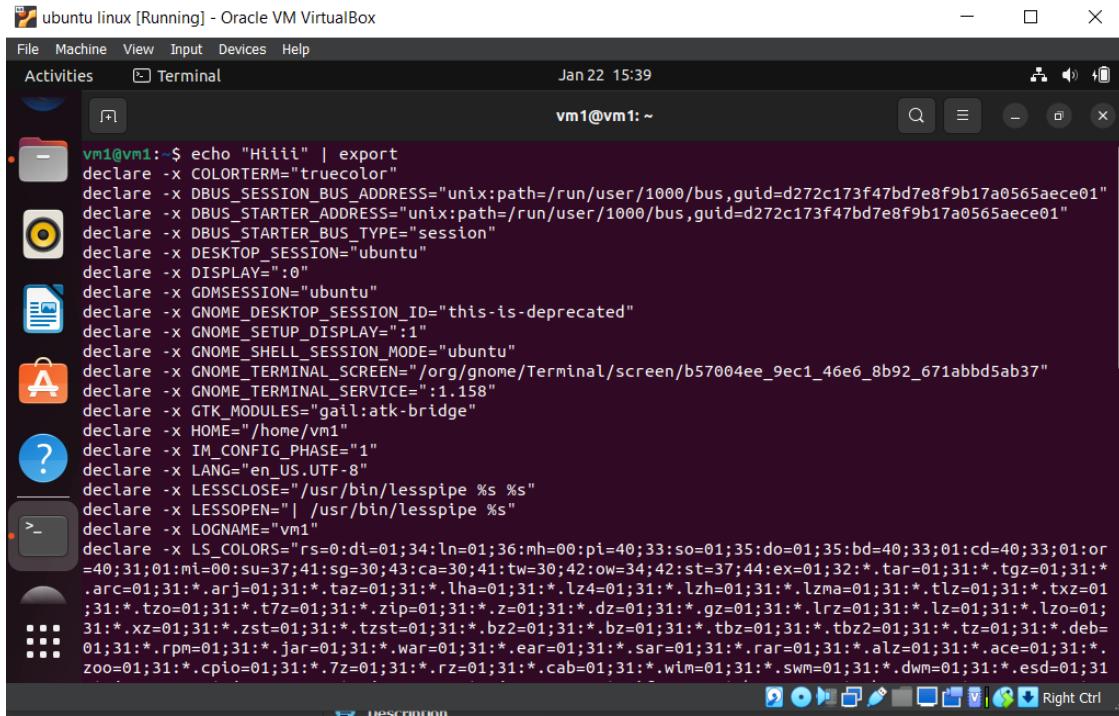
rr. Sort: Sort is used to sort records according to ascending or descending order



A screenshot of a Linux desktop environment in Oracle VM VirtualBox. The desktop has a dark theme with a dock at the bottom containing icons for various applications like Dash, Home, Activities, and Terminal. A terminal window titled 'vm1@vm1: ~' is open, showing the output of the 'cat' command followed by the 'sort' command. The terminal shows the following output:

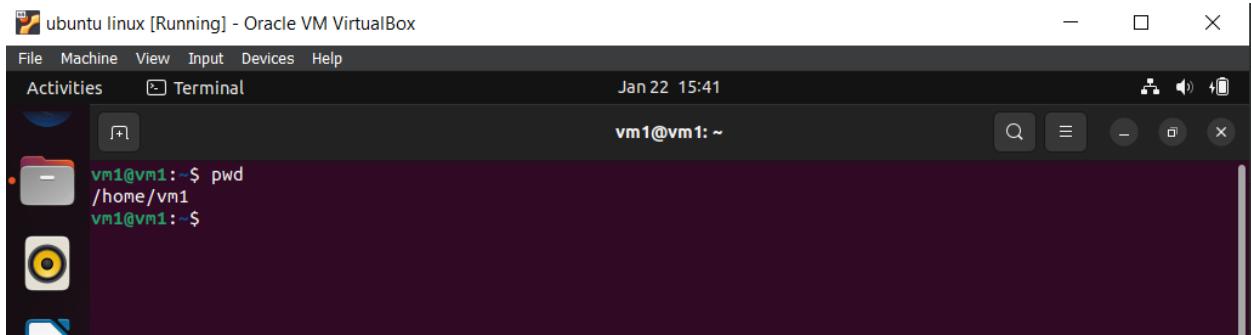
```
vm1@vm1:~$ cat man.txt
P
A
M
A
L
A
W
A
D
E
vm1@vm1:~$ sort man.txt
A
A
A
A
D
E
L
M
P
W
vm1@vm1:~$
```

ss. Export: Used to export the value of variables available to child processes or other resources



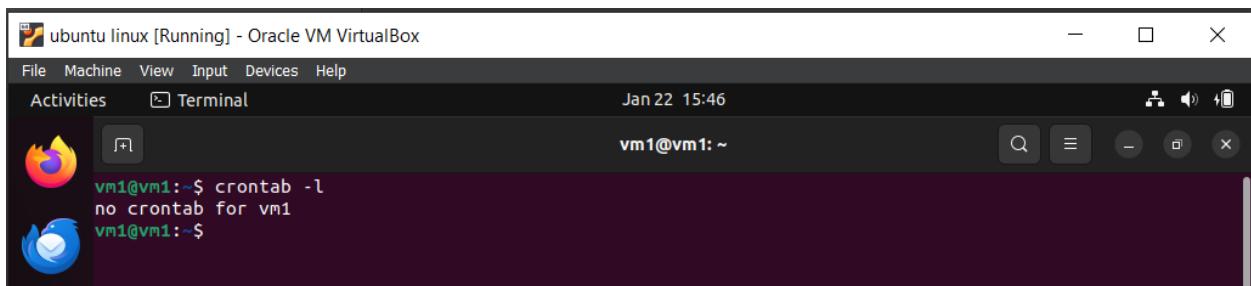
```
ubuntu linux [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Jan 22 15:39
vm1@vm1: ~
vm1@vm1: $ echo "Hiiii" | export
declare -x COLORTERM="truecolor"
declare -x DBUS_SESSION_BUS_ADDRESS="unix:path=/run/user/1000/bus,guid=d272c173f47bd7e8f9b17a0565aece01"
declare -x DBUS_STARTER_ADDRESS="unix:path=/run/user/1000/bus,guid=d272c173f47bd7e8f9b17a0565aece01"
declare -x DBUS_STARTER_BUS_TYPE="session"
declare -x DESKTOP_SESSION="ubuntu"
declare -x DISPLAY=:0"
declare -x GDMSESSION="ubuntu"
declare -x GNOME_DESKTOP_SESSION_ID="this-is-deprecated"
declare -x GNOME_SETUP_DISPLAY=:1"
declare -x GNOME_SHELL_SESSION_MODE="ubuntu"
declare -x GNOME_TERMINAL_SCREEN="/org/gnome/Terminal/screen/b57004ee_9ec1_46e6_8b92_671abbd5ab37"
declare -x GNOME_TERMINAL_SERVICE=:1.158"
declare -x GTK_MODULES="gail:atk-bridge"
declare -x HOME="/home/vm1"
declare -x IM_CONFIG_PHASE="2"
declare -x LANG="en_US.UTF-8"
declare -x LESSCLOSE="/usr/bin/lesspipe %s %s"
declare -x LESSOPEN="| /usr/bin/lesspipe %s"
declare -x LOGNAME="vm1"
declare -x LS_COLORS="rs=0:di=01;34:ln=01;36:mh=00:pi=40;33:so=01;35:do=01;35:bd=40;33:01:cd=40;33:01:or=40;31:01:ml=00:su=37;41:sg=30;43:ca=30;41:tw=30;42:ow=34;42:st=37;44:ex=01;32:*.tar=01;31:*.tgz=01;31:*.arc=01;31:*.arj=01;31:*.taz=01;31:*.lha=01;31:*.lz4=01;31:*.lzh=01;31:*.lzma=01;31:*.tlz=01;31:*.txz=01;31:*.tzo=01;31:*.t7z=01;31:*.zip=01;31:*.z=01;31:*.dz=01;31:*.gz=01;31:*.lrz=01;31:*.lz=01;31:*.lzo=01;31:*.xz=01;31:*.zst=01;31:*.bz2=01;31:*.bz=01;31:*.tbz=01;31:*.tbz2=01;31:*.tz=01;31:*.deb=01;31:*.rpm=01;31:*.jar=01;31:*.war=01;31:*.ear=01;31:*.sar=01;31:*.rar=01;31:*.alz=01;31:*.ace=01;31:*.zoo=01;31:*.cpio=01;31:*.7z=01;31:*.rz=01;31:*.cab=01;31:*.wim=01;31:*.swm=01;31:*.dwm=01;31:*.esd=01;31
Right Ctrl ...
```

tt. Pwd: Used to print working directory



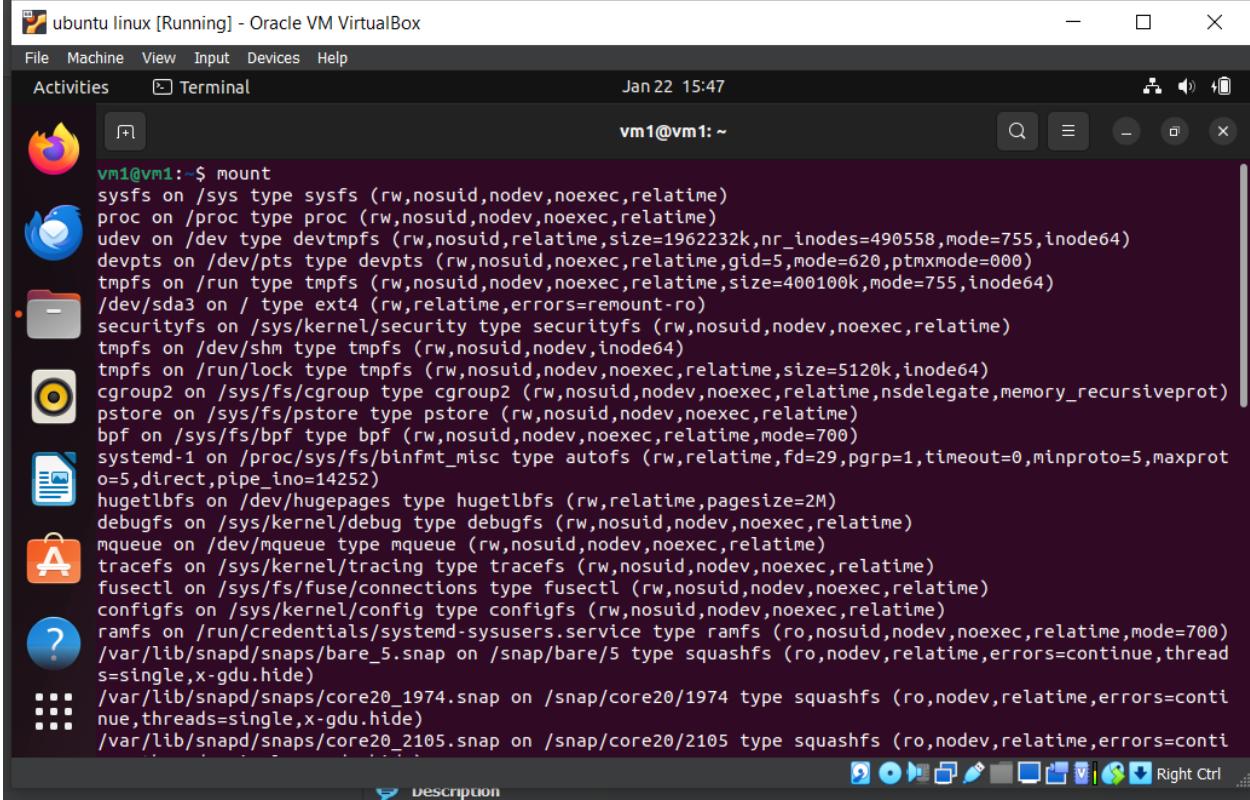
```
ubuntu linux [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Jan 22 15:41
vm1@vm1: ~
vm1@vm1: $ pwd
/home/vm1
vm1@vm1: ~
```

uu. Crontab: Used to maintain crontab program files for individual users



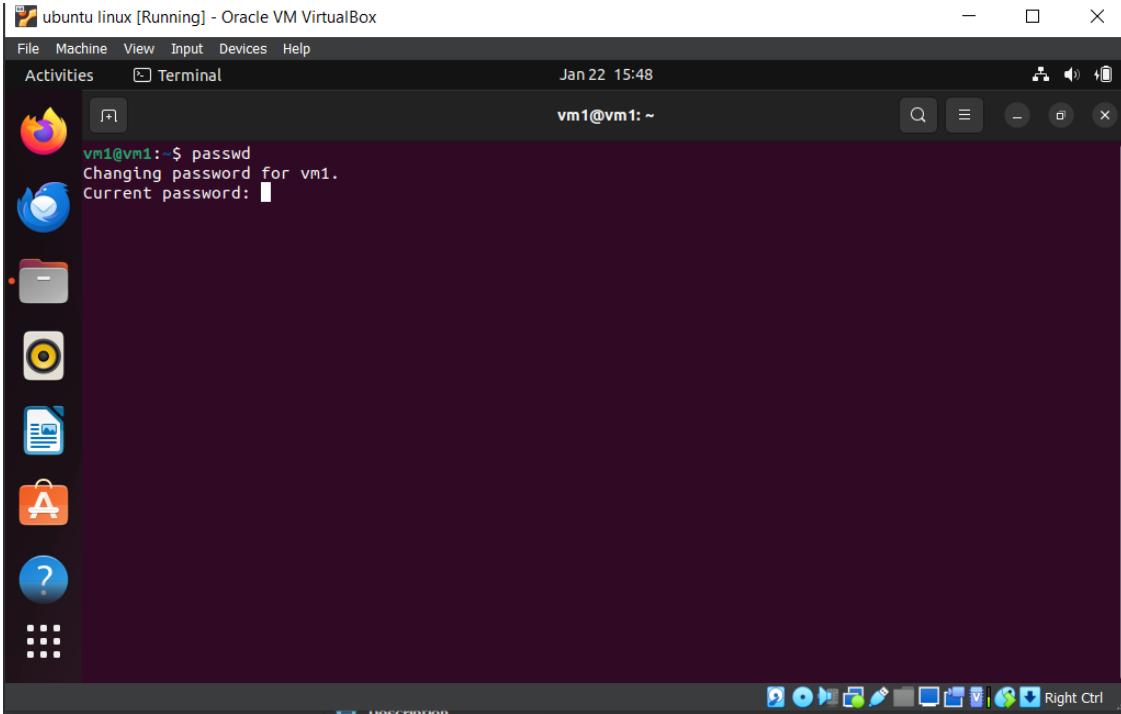
```
ubuntu linux [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Jan 22 15:46
vm1@vm1: ~
vm1@vm1: $ crontab -l
no crontab for vm1
vm1@vm1: ~
```

vv. Mount: All files in Ubuntu are maintained in a tree, Mount is used to attach filesystem found on other system to tree



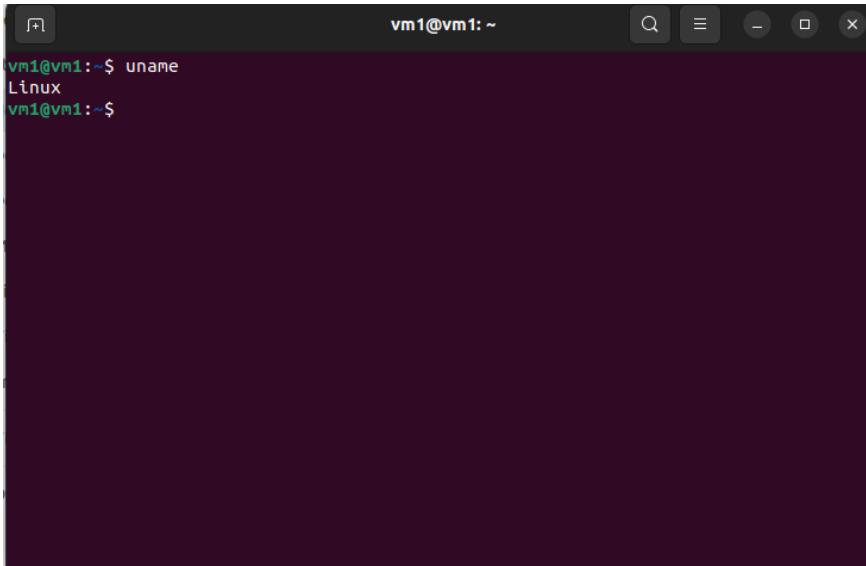
```
ubuntu linux [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Jan 22 15:47
vm1@vm1: ~
vm1@vm1:~$ mount
sysfs on /sys type sysfs (rw,nosuid,nodev,noexec,relatime)
proc on /proc type proc (rw,nosuid,nodev,noexec,relatime)
udev on /dev type devtmpfs (rw,nosuid,relatime,size=1962232k,nr_inodes=490558,mode=755,inode64)
devpts on /dev/pts type devpts (rw,nosuid,noexec,relatime,gid=5,mode=620,ptmxmode=000)
tmpfs on /run type tmpfs (rw,nosuid,nodev,noexec,relatime,size=400100k,mode=755,inode64)
/dev/sda3 on / type ext4 (rw,relatime,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)
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,relatime,fd=29,pgrp=1,timeout=0,minproto=5,maxproto=5,direct,pipe_ino=14252)
hugetlbfs on /dev/hugepages type hugetlbfs (rw,relatime,pagesize=2M)
debugfs on /sys/kernel/debug type debugfs (rw,nosuid,nodev,noexec,relatime)
mqueue on /dev/mqueue type mqueue (rw,nosuid,nodev,noexec,relatime)
traces on /sys/kernel/tracing type tracefs (rw,nosuid,nodev,noexec,relatime)
fusectl on /sys/fs/fuse/connections type fusectl (rw,nosuid,nodev,noexec,relatime)
configfs on /sys/kernel/config type configfs (rw,nosuid,nodev,noexec,relatime)
ramfs on /run/credentials/systemd-sysusers.service type ramfs (ro,nosuid,nodev,noexec,relatime,mode=700)
/var/lib/snapd/snaps/bare_5.snap on /snap/bare/5 type squashfs (ro,nodev,relatime,errors=continue,threads=single,x-gdu.hide)
/var/lib/snapd/snaps/core20_1974.snap on /snap/core20/1974 type squashfs (ro,nodev,relatime,errors=continue,threads=single,x-gdu.hide)
/var/lib/snapd/snaps/core20_2105.snap on /snap/core20/2105 type squashfs (ro,nodev,relatime,errors=continue,threads=single,x-gdu.hide)
```

ww. Passwd: Given command is used to change the password



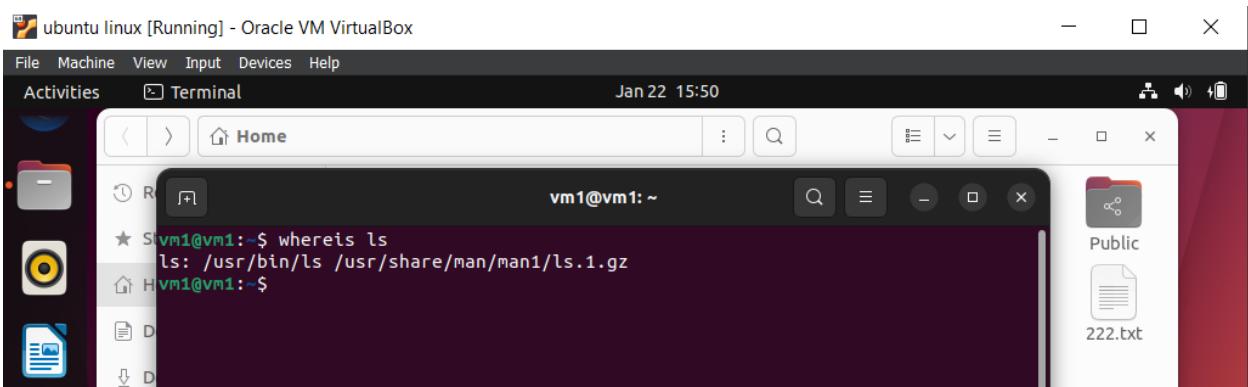
```
ubuntu linux [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Jan 22 15:48
vm1@vm1: ~
vm1@vm1:~$ passwd
Changing password for vm1.
Current password: ■
```

xx. . Uname : It is used to get username



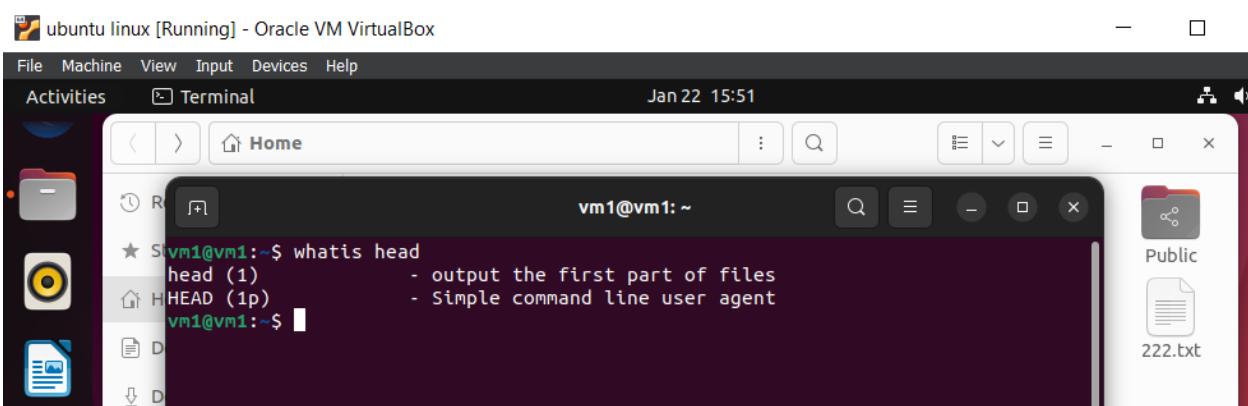
```
vm1@vm1:~$ uname
Linux
vm1@vm1:~$
```

yy. Whereis : It is used to get location of executable source code for given command



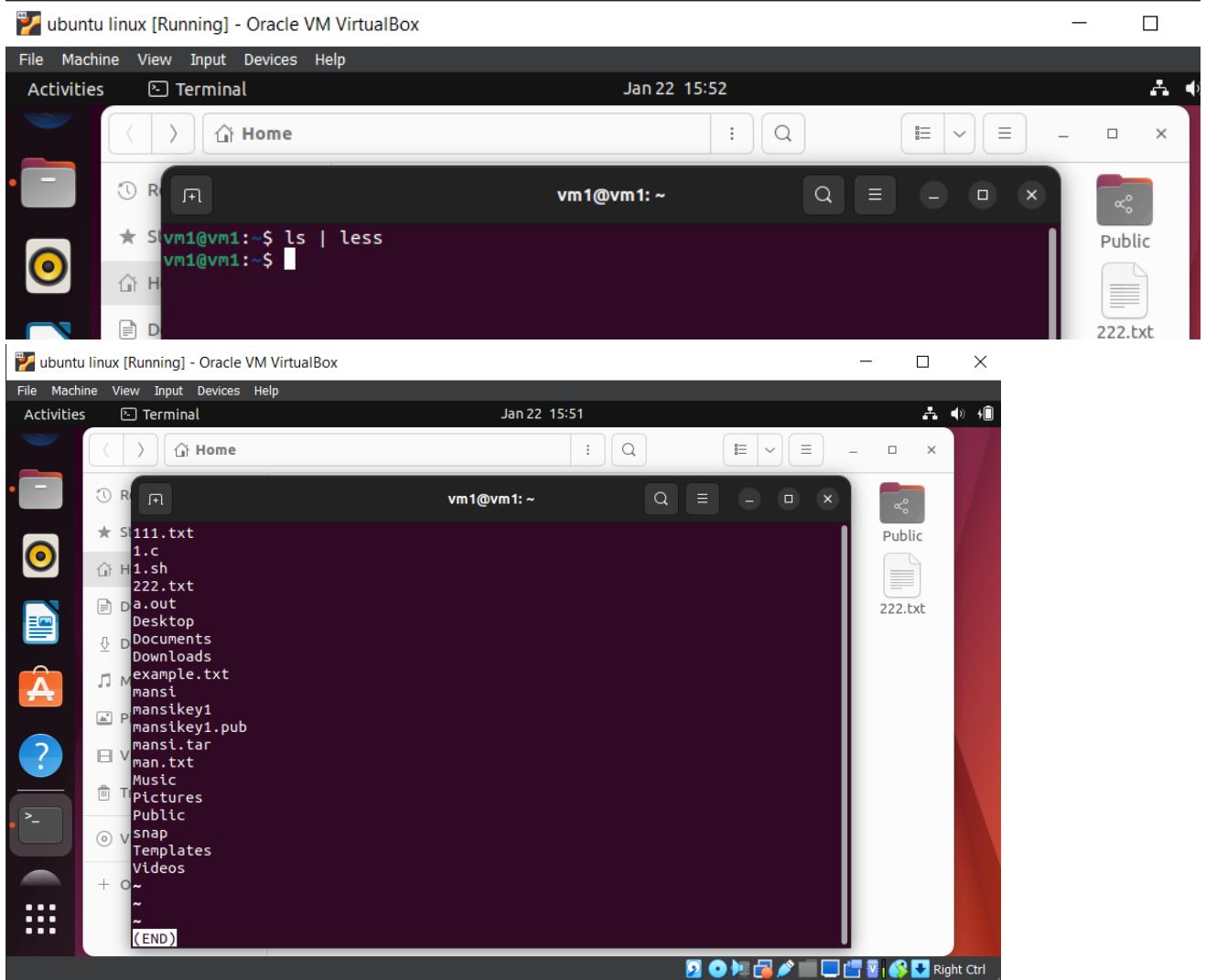
```
ubuntu linux [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Jan 22 15:50
vm1@vm1:~$ whereis ls
ls: /usr/bin/ls /usr/share/man/man1/ls.1.gz
vm1@vm1:~$
```

zz. Whatis : It is used to get single line summary of linux commands

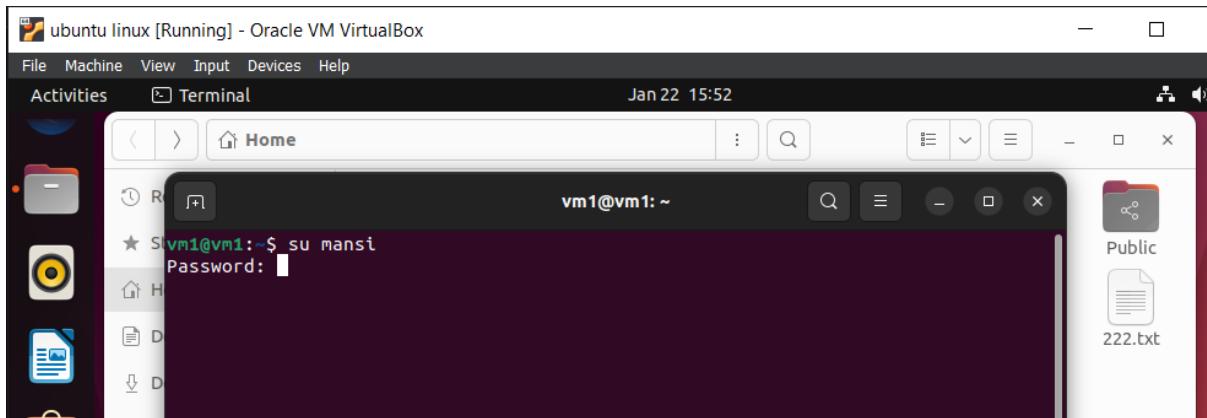


```
ubuntu linux [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Jan 22 15:51
vm1@vm1:~$ whatis head
head (1)          - output the first part of files
HEAD (1p)         - Simple command line user agent
vm1@vm1:~$
```

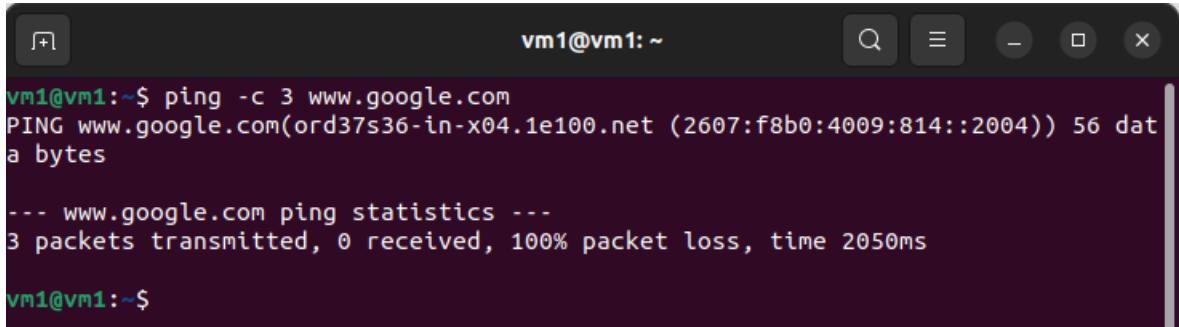
aaa. Less: Used to print less outputs on console screen



bbb. Su : It is used to change the user for given session



ccc. Ping: Ping command is used to get response time from a server of DNS which is also called as latency

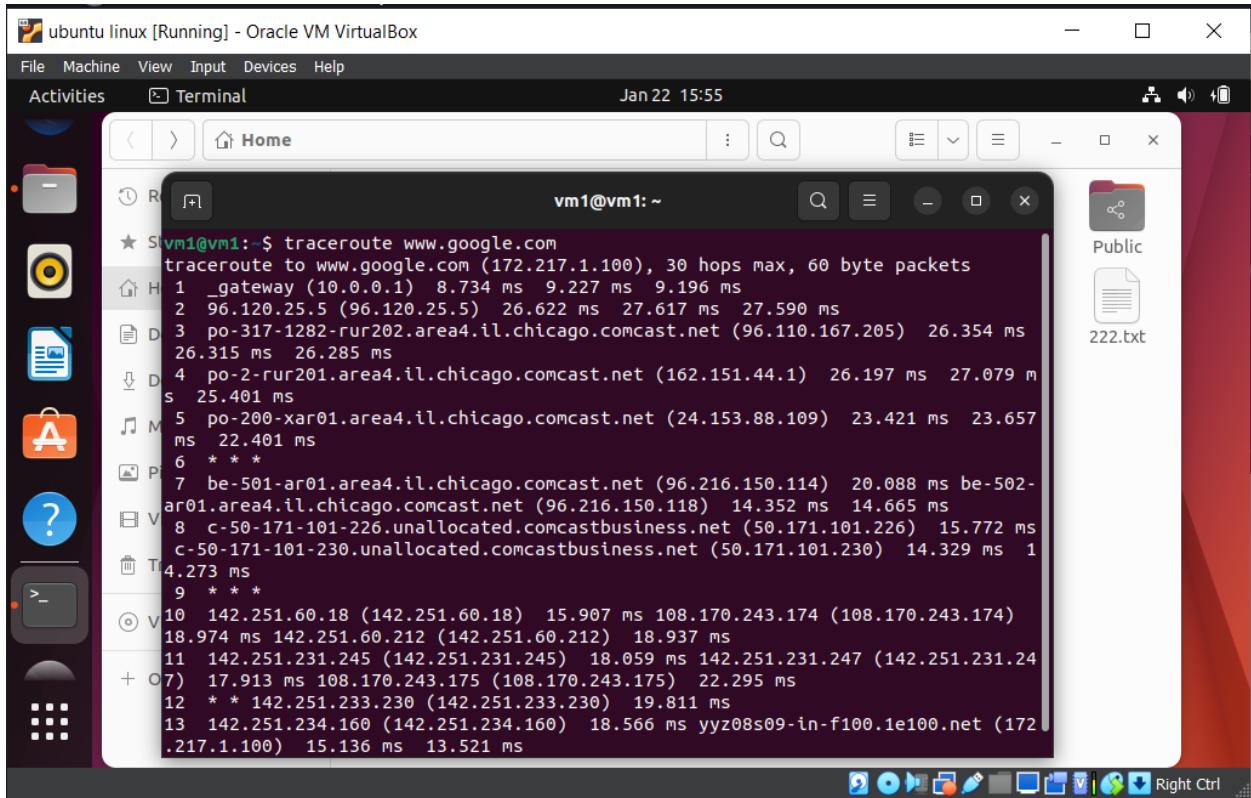


```
vm1@vm1:~$ ping -c 3 www.google.com
PING www.google.com(ord37s36-in-x04.1e100.net (2607:f8b0:4009:814::2004)) 56 dat
a bytes

--- www.google.com ping statistics ---
3 packets transmitted, 0 received, 100% packet loss, time 2050ms

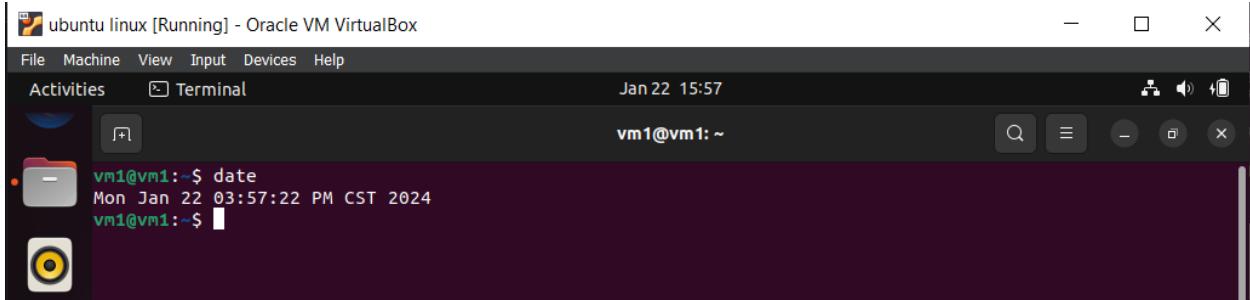
vm1@vm1:~$
```

ddd. Traceroute: It is used to see how our packet is travelling in internet it given all the server names from which out packet is going



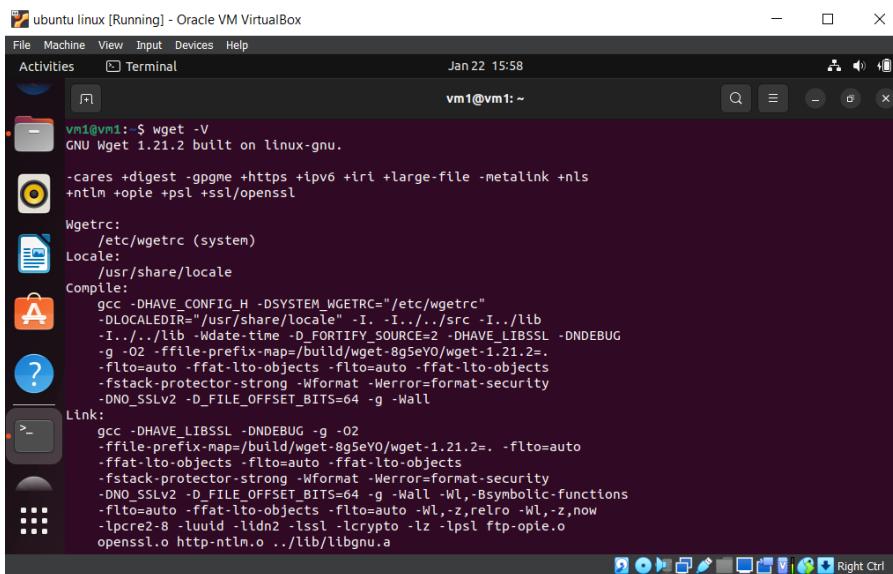
```
ubuntu linux [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal Jan 22 15:55
vm1@vm1:~$ traceroute www.google.com
traceroute to www.google.com (172.217.1.100), 30 hops max, 60 byte packets
 1 _gateway (10.0.0.1)  8.734 ms  9.227 ms  9.196 ms
 2 96.120.25.5 (96.120.25.5)  26.622 ms  27.617 ms  27.590 ms
 3 po-317-1282-rur202.area4.il.chicago.comcast.net (96.110.167.205)  26.354 ms
   26.315 ms  26.285 ms
 4 po-2-rur201.area4.il.chicago.comcast.net (162.151.44.1)  26.197 ms  27.079 ms
   25.401 ms
 5 po-200-xar01.area4.il.chicago.comcast.net (24.153.88.109)  23.421 ms  23.657 ms
   22.401 ms
 6 * * *
 7 be-501-ar01.area4.il.chicago.comcast.net (96.216.150.114)  20.088 ms be-502-
ar01.area4.il.chicago.comcast.net (96.216.150.118)  14.352 ms  14.665 ms
 8 c-50-171-101-226.unallocated.comcastbusiness.net (50.171.101.226)  15.772 ms
c-50-171-101-230.unallocated.comcastbusiness.net (50.171.101.230)  14.329 ms  1
 4.273 ms
 9 * * *
10 142.251.60.18 (142.251.60.18)  15.907 ms 108.170.243.174 (108.170.243.174)
18.974 ms 142.251.60.212 (142.251.60.212)  18.937 ms
11 142.251.231.245 (142.251.231.245)  18.059 ms 142.251.231.247 (142.251.231.24
+ 7)  17.913 ms 108.170.243.175 (108.170.243.175)  22.295 ms
12 * * 142.251.233.230 (142.251.233.230)  19.811 ms
13 142.251.234.160 (142.251.234.160)  18.566 ms yyz08s09-in-f100.1e100.net (172
.217.1.100)  15.136 ms  13.521 ms
```

eee. Date: It prints date stamp along with zone



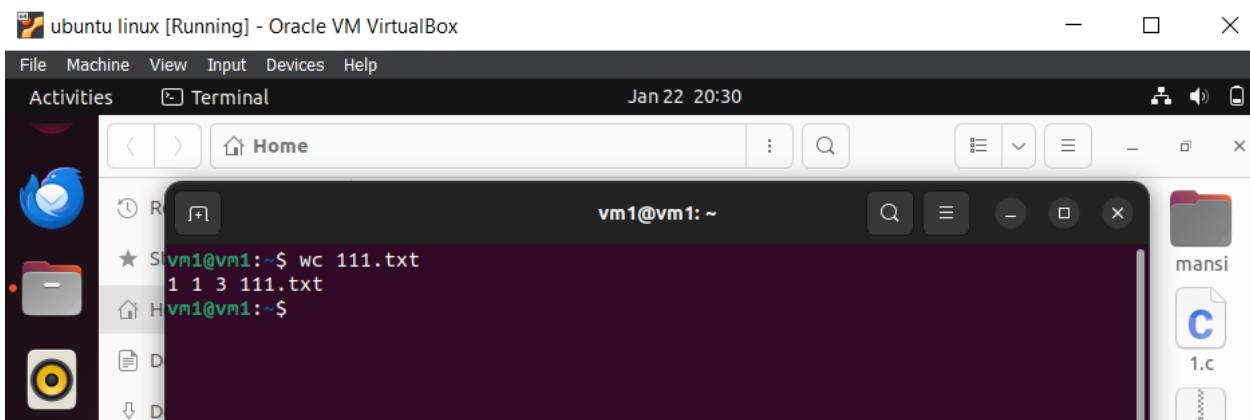
A screenshot of a Linux desktop environment showing a terminal window titled "ubuntu linux [Running] - Oracle VM VirtualBox". The terminal window has tabs for "Activities" and "Terminal". The date is displayed as "Jan 22 15:57". The terminal window shows the command "date" being run, followed by its output: "Mon Jan 22 03:57:22 PM CST 2024".

fff. Wget : It's a non-interactive network downloader



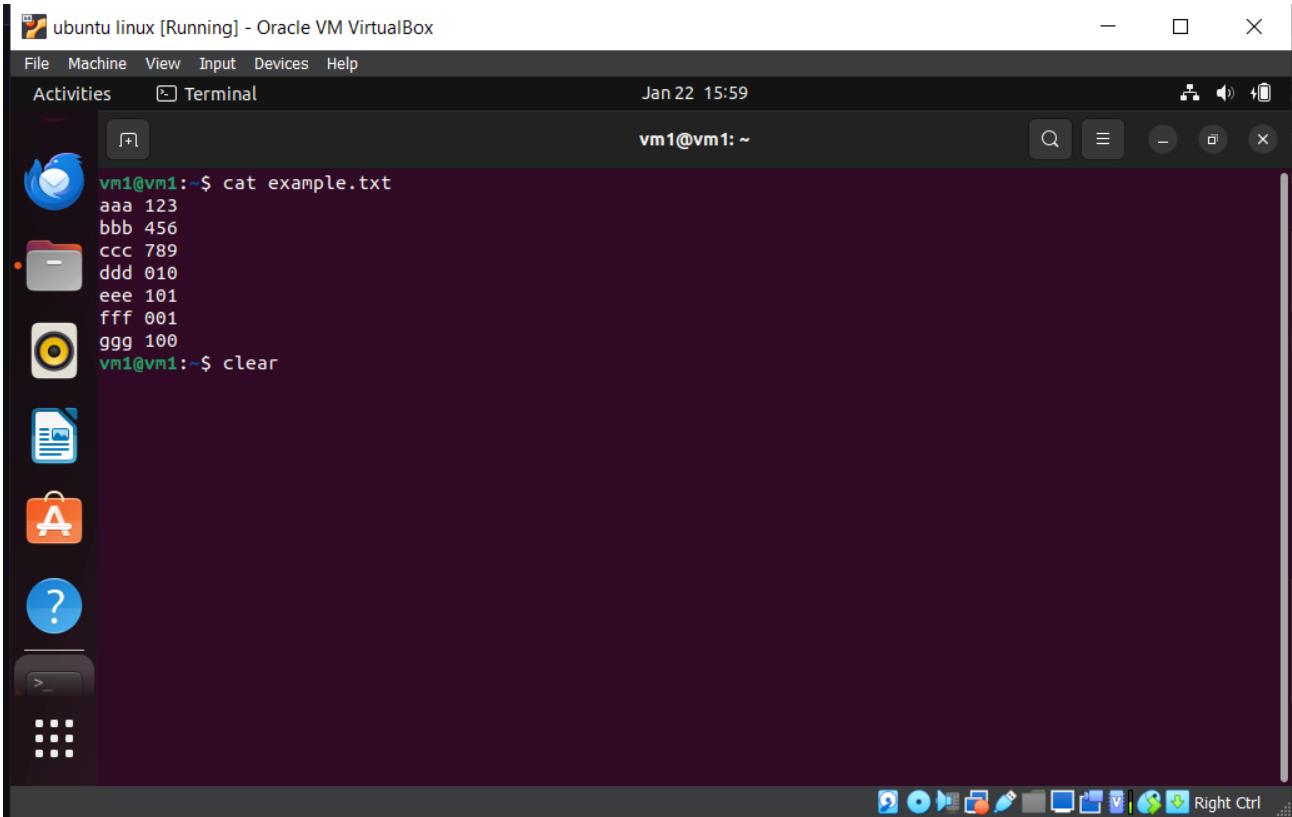
A screenshot of a Linux desktop environment showing a terminal window titled "ubuntu linux [Running] - Oracle VM VirtualBox". The terminal window shows the command "wget -V" being run, followed by its output. The output includes details about the version (1.21.2), build environment (linux-gnu), configuration options, and compilation details.

ggg. Wc: The Linux wc command calculates a file's word, line, character, or byte count.



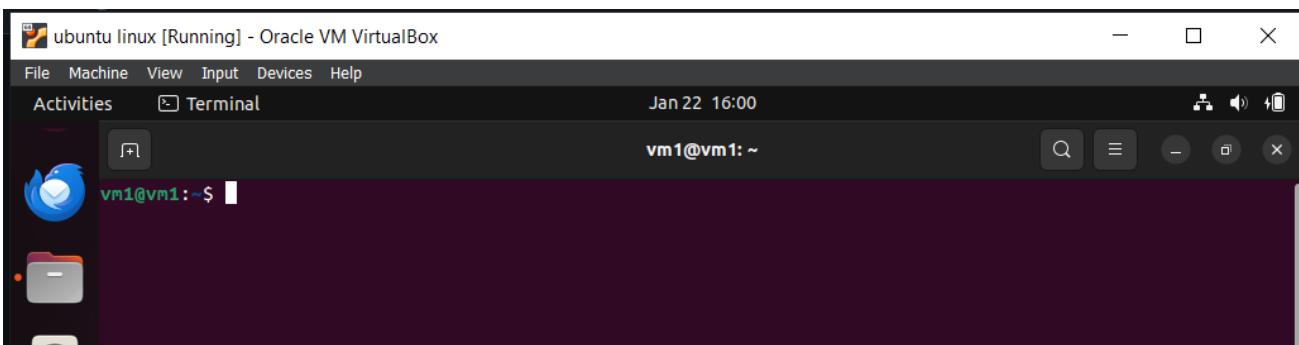
A screenshot of a Linux desktop environment showing a terminal window titled "ubuntu linux [Running] - Oracle VM VirtualBox". The terminal window shows the command "wc 111.txt" being run, followed by its output: "1 1 3 111.txt".

hh. Clear: Command clear is used to clear the content of console



A screenshot of a Linux desktop environment, likely Ubuntu, running in Oracle VM VirtualBox. The desktop has a dark theme. On the left is a dock with icons for Dash, Home, Activities, and other applications. A terminal window titled 'Terminal' is open, showing the command 'cat example.txt' followed by its output:

```
vm1@vm1:~$ cat example.txt
aaa 123
bbb 456
ccc 789
ddd 010
eee 101
fff 001
ggg 100
vm1@vm1:~$ clear
```



A screenshot of the same Linux desktop environment. The terminal window now shows the command 'clear' being run, indicated by the cursor at the end of the line:

```
vm1@vm1:~$ clear
```

3. Write bash scripts to do the following:

- Write a script called "disk-benchmark-background.sh" that uses the dd command to run a benchmark against the local disk in the background, that captures all the output (both standard out and error output) to a file "disk-benchmark-background-log.txt". Use the "time" command to show how long the benchmark took to complete. The benchmark should run for at least 10 seconds, and it should complete even if the ssh (or bash) session is terminated.

b. Write a script called “network-test.sh” that takes input a file “network-test-machinelist.txt” with a list of DNS names (e.g. google.com, iit.edu, anl.gov), each name on a separate line, and runs the ping utility collecting 3 samples from each DNS name, and writing the RTT (round trip time) average latency into a file “network-test-latency.txt” where each line will have the DNS name and average RTT separated by a space. Make sure it works with at least 10 DNS names, but it should work for an unspecified number of DNS names.

c. Write a Python matplotlib script to generate a graph of the “network-test-latency.txt” data. The graph should automatically adjust to the number of entries, and the scale of the data.

ALL THE CODING ANSWERS ARE IN REPOSITORY WITH OUTPUT SCREENSHOT

4. (20 points) Answer the following questions about VMs:

a. In the system configuration of the VM, explain how changing the number of processors changes the behavior of your VM. Explain a scenario where you want to set this to the minimum, and a scenario where you want to set it to the maximum. Why is setting it to the maximum potentially a bad idea?

Boosting system performance relies on maintaining constant RAM, but further improvement requires increasing it. Allocating multiple CPUs can enhance performance, contingent on BIOS virtualization support. However, excessive CPU allocation to a virtual machine may lead to issues like spin locks and reduced host responsiveness. For optimal host operation, assign the minimum required processors to the guest system. Sharing more CPUs with guests might lead to issues such as reduced host responsiveness and malfunctions. If the user wants his or her host to run optimally, it is best to assign the bare minimum of processors to the guest system.

b. In the system configuration of the VM, under the Acceleration Tab, explain the difference between the paravirtualization options: None, Legacy, Minimal, Hyper-V, and KVM. Explain which one would be best to use with Ubuntu Linux, and why.

Given options provide the partial virtualisation options that we can provide to the guest operating system 1. None: No paravirtualisation

2. Legacy: It is intended for older virtual box applications.

3. Minimal: This is for Mac OS guest users and offers TSC and APIC frequency for guest operating systems.

4. Hyper-V: This applies to Windows guest PCs, which are typically Windows 7 or newer systems. Features include Para virtualized clocks, guest crash reporting, and relaxed timer clocks.

5. KVM: This is helpful for Linux systems because it supports paravirtualized clocks and SMP spin locks. KVM good for Linux reasons:

- Smaller and faster.
- Applicable to used by additional visitors. Has the ability to shut down and save machine state on the hard disk.

c. In storage devices when configuring the VM, there are multiple types of storage controllers: explain the difference between the IDE, SATA, and NVMe controller. Give an HW1 example for each type of storage controller of a scenario where you may want to use this type of controller.

Points	IDE	SATA	NVMe
Pin	40	9	Around 70
Connections	Two devices	Allows only one connection	Two
Speed	133 mebibytes/second	1.5Gbits/second	3.5GB/sec
Developed by	Western Digital Electronics in association	Serial ATA Working Group	NVM express
Cost	Better value for money	Least expensive	Higher cost

IDE is necessary for regular processing; NVMe is required for processing essential applications with large databases at that time. SATA is needed for high capacity, low availability, and sequential needs.

d. In the network configuration of the VM, there are multiple types of network adapters: explain the difference between NAT, Bridged Adapter, Internal Network, and Host-only Network. Give an example for each type of network of a scenario where you may want to use this type of network.

Connectivity	NAT	Bridged Adapter	Internal Network	Host Only
VM & Host connectivity	No	Yes	No	Yes
Between two VM's	No	Yes	Yes	Yes
VM to internet	Yes	Yes	No	No
Internet to VM	No (Can be done by port forwarding)	Yes	No	No
Network activities	Mask all network activities	Replicates another node in current network	Can directly communicate to outside network	Network operations with host OS

e. For the USB configuration of the VM, explain the difference between USB 1.1, 2.0, and 3.0 controllers.

Attributes	USB 1.1	USB 2.0	USB 3.0
Bandwidth	12 Mbps	480 Mbps	4.8 Gbps
Ideal For	Keyboard, Mouse, Printers	Mass storage devices, Video adapters, Data transfer cables	Large mass storage devices, Video adapters
Power required for configured devices	500mA	500mA	900-1000mA
Power required for non-configured devices	100mA	100mA	150mA
Speed	Average speed	High speed	Super high speed
Backward compatible	NA	USB 1.1	USB 2.0/USB 1.1