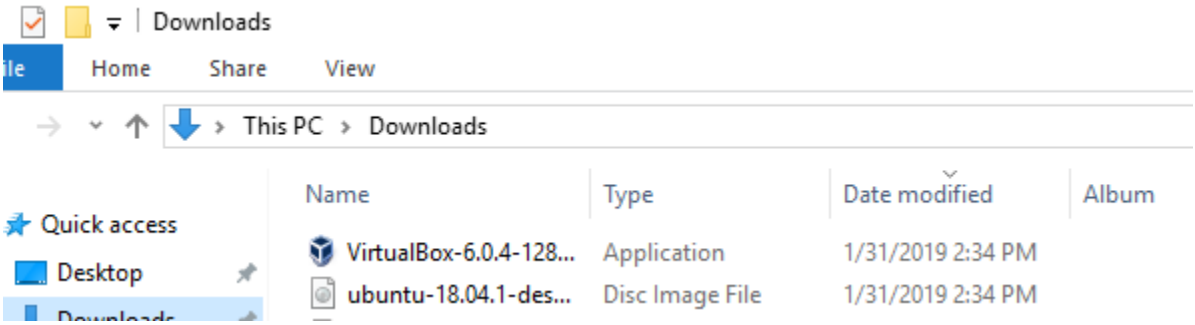
Assignment 1

Questions:

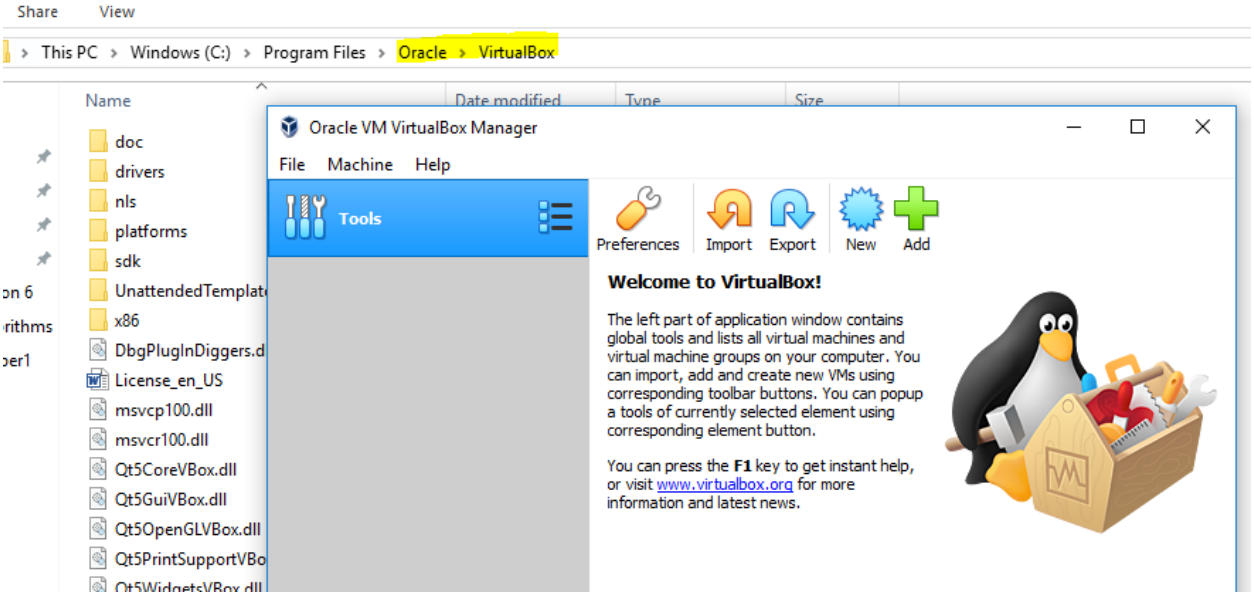
1. **Read Oracle VirtualBox White Paper**
   I have gone through the paper and registered my email id and got below mail. Below information is given in that paper
   - Information about Oracle VM virtual box.
   - Its two components which are VM virtual box and virtual box extension pack: Virtual box is free and extension version requires paid license as it contains few more features.
   - Uses of virtual box which includes development and debugging of the various applications which requires different environment, Testing the new changes, Software upgrades, to perform demos and parallel execution of demo applications.
   - Sharing information between VM's or from your system is secure as it uses encryption.
   - For training purpose also, we can use virtual box.
   - Also features about extension pack are also given few are virtual RDP, It allows hosts to use web-cam through their PC's, Encryption of whole disk data is possible.

2. **Download Oracle VirtualBox 6.0.4**
   Downloaded virtual box 6.0.4 below is the screenshot for that



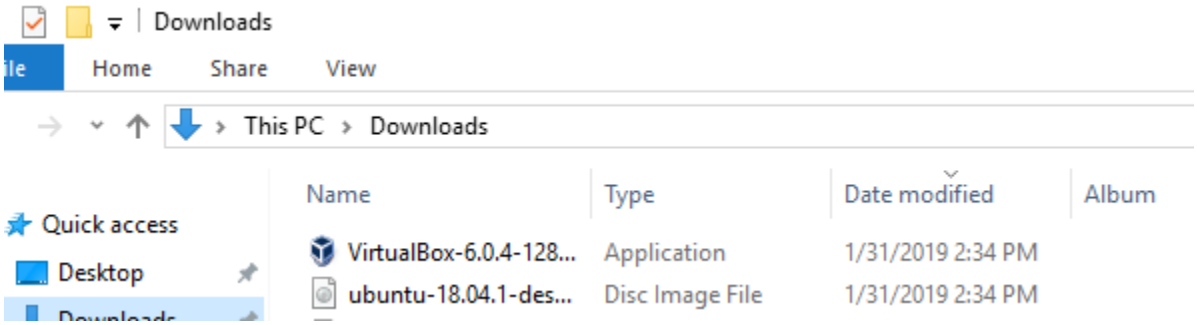
3. **Install VirtualBox**

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

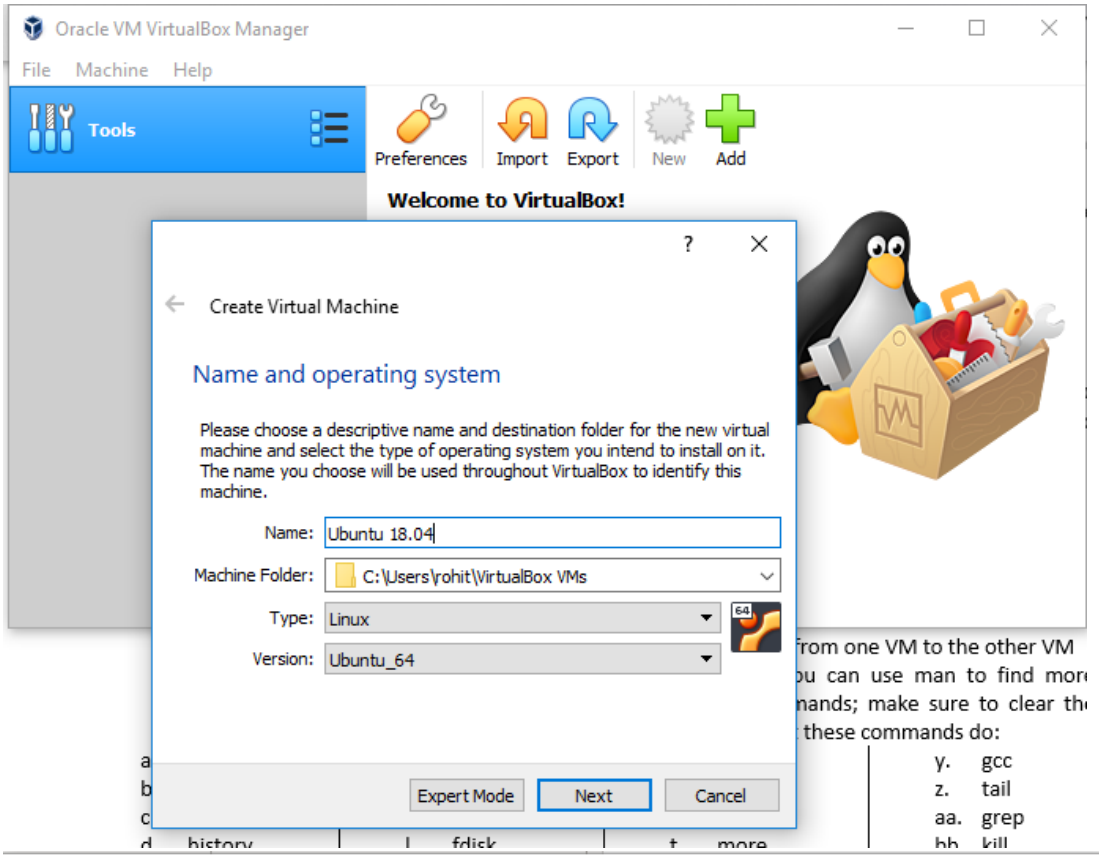


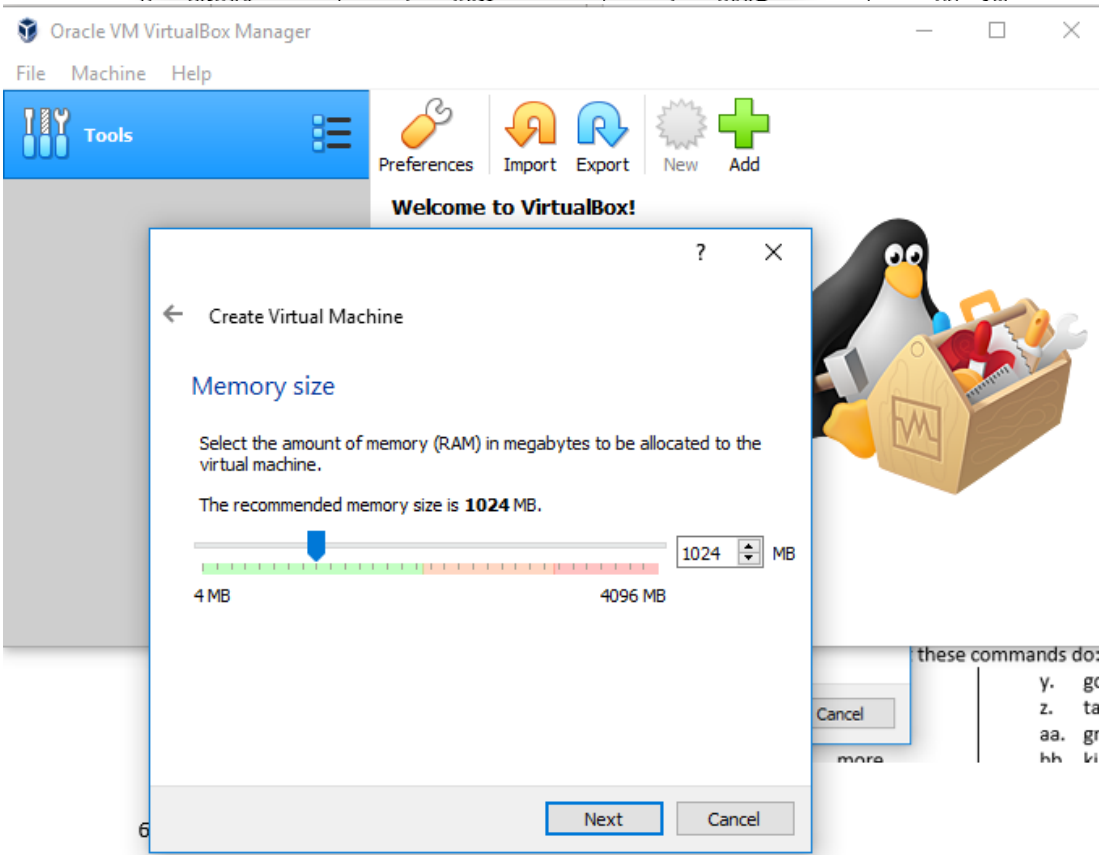
4. Download Ubuntu 18.04.1 Linux ISO image

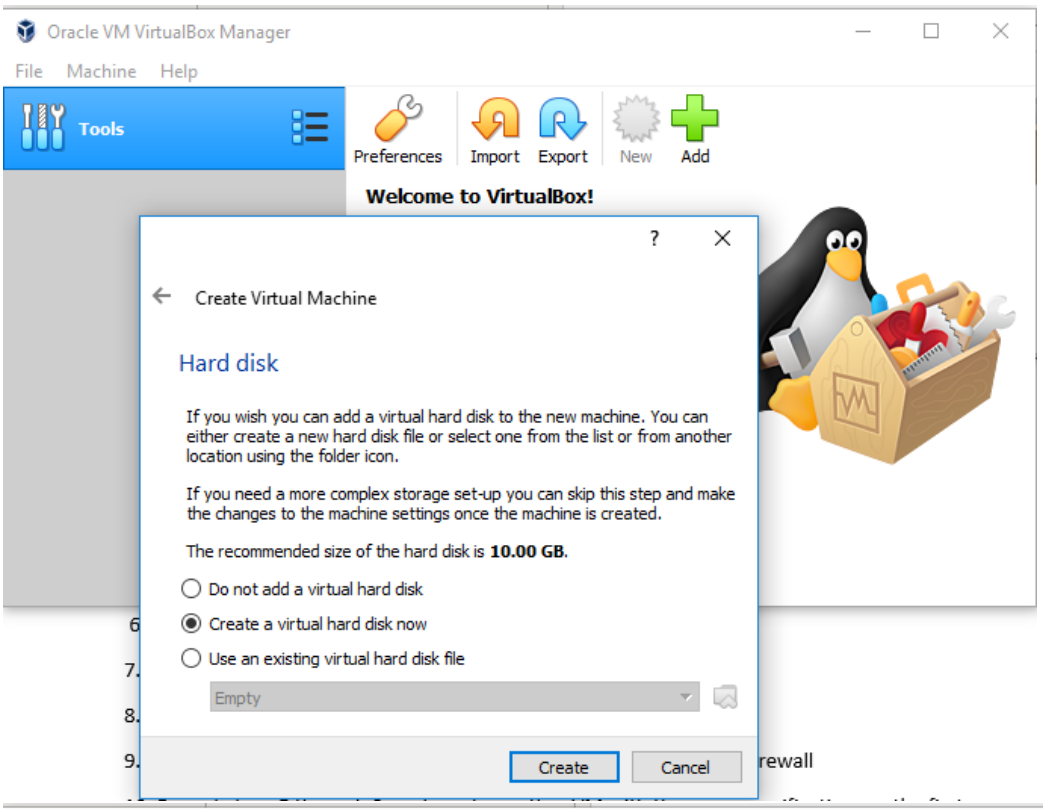
Downloaded Ubuntu 18.04.1 below is the screenshot for the same

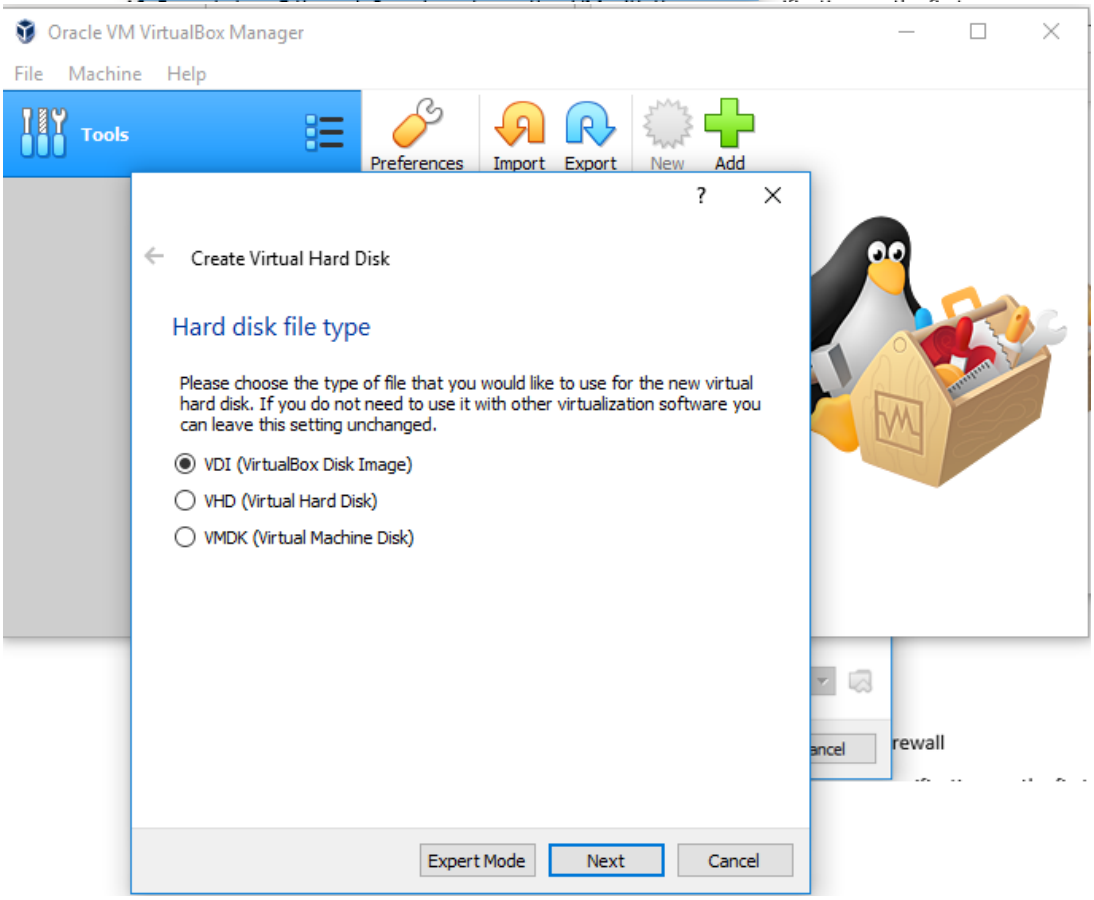


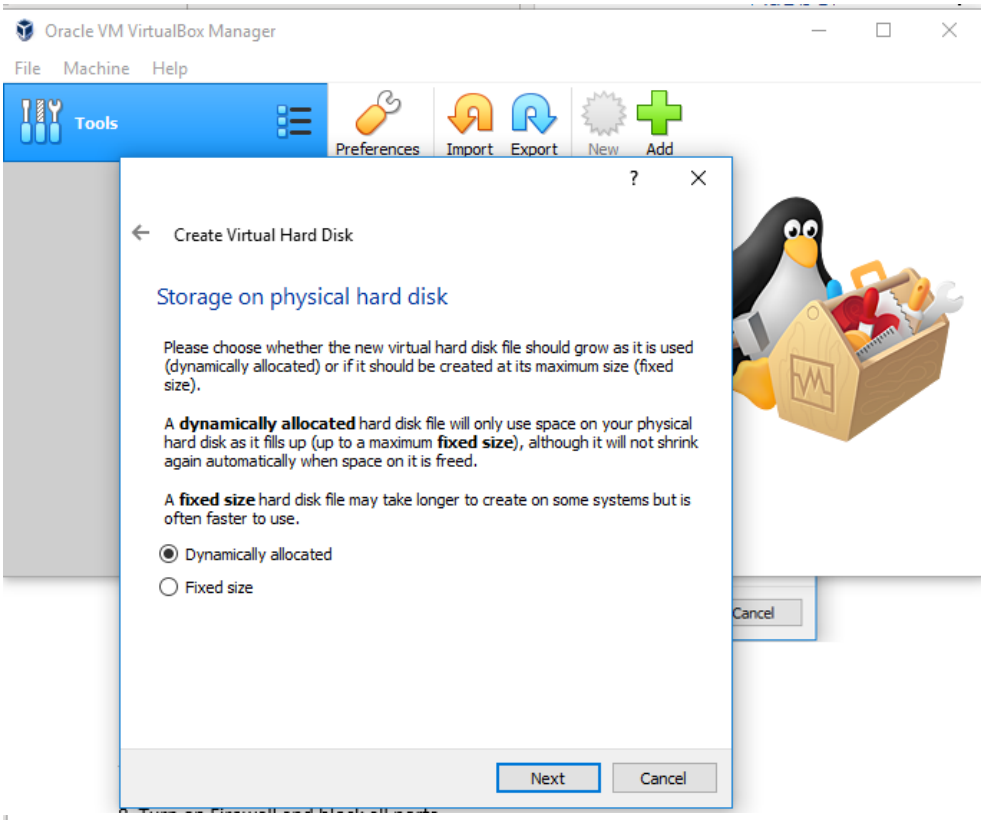
5. **Create Virtual Machine (VM), to support Linux, Ubuntu, 64-bit, 1GB RAM, Virtual Disk 20GB, VDI image, dynamically allocated, 1-core, and a network interface (1GbE or WiFi) with Bridged Adapter**

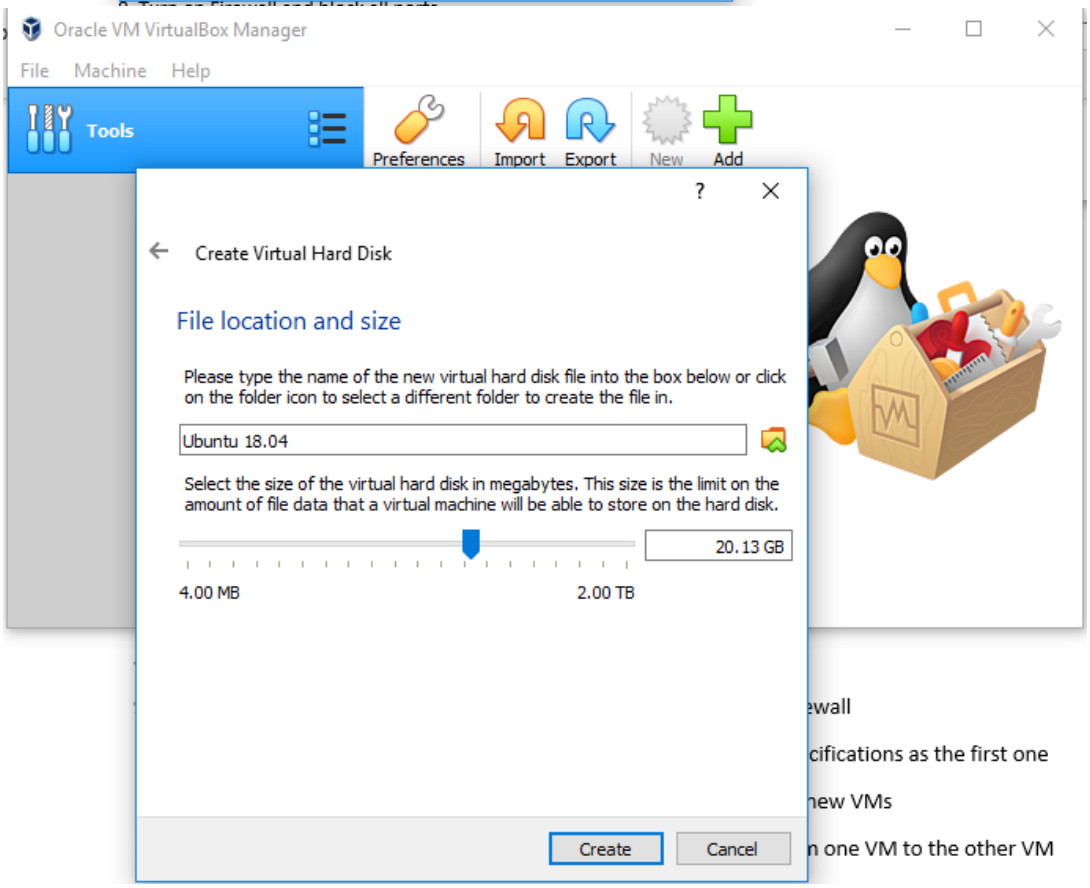

Oracle VM VirtualBox Manager
File Machine Help
Tools
Preferences Import Export New Add
Welcome to VirtualBox!
Create Virtual Machine
Name and operating system
Please choose a descriptive name and destination folder for the new virtual machine and select the type of operating system you intend to install on it. The name you choose will be used throughout VirtualBox to identify this machine.
Name: Ubuntu 18.04
Machine Folder: C:\Users\rohit\VirtualBox VMs
Type: Linux
Version: Ubuntu_64
Expert Mode Next Cancel


Oracle VM VirtualBox Manager
File Machine Help
Tools
Preferences Import Export New Add
Welcome to VirtualBox!
Create Virtual Machine
Memory size
Select the amount of memory (RAM) in megabytes to be allocated to the virtual machine.
The recommended memory size is 1024 MB.
1024 MB
4 MB
4096 MB
Next Cancel


Oracle VM VirtualBox Manager
File Machine Help
Tools
Preferences Import Export New Add
Welcome to VirtualBox!
Create Virtual Machine
Hard disk
If you wish you can add a virtual hard disk to the new machine. You can either create a new hard disk file or select one from the list or from another location using the folder icon.
If you need a more complex storage set-up you can skip this step and make the changes to the machine settings once the machine is created.
The recommended size of the hard disk is 10.00 GB.
Do not add a virtual hard disk
Create a virtual hard disk now
Use an existing virtual hard disk file
Empty
Create
Cancel


Oracle VM VirtualBox Manager
File Machine Help
Tools
Preferences Import Export New Add
Create Virtual Hard Disk
Hard disk file type
Please choose the type of file that you would like to use for the new virtual hard disk. If you do not need to use it with other virtualization software you can leave this setting unchanged.
VDI (VirtualBox Disk Image)
VHD (Virtual Hard Disk)
VMDK (Virtual Machine Disk)
Expert Mode
Next
Cancel





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new VMs

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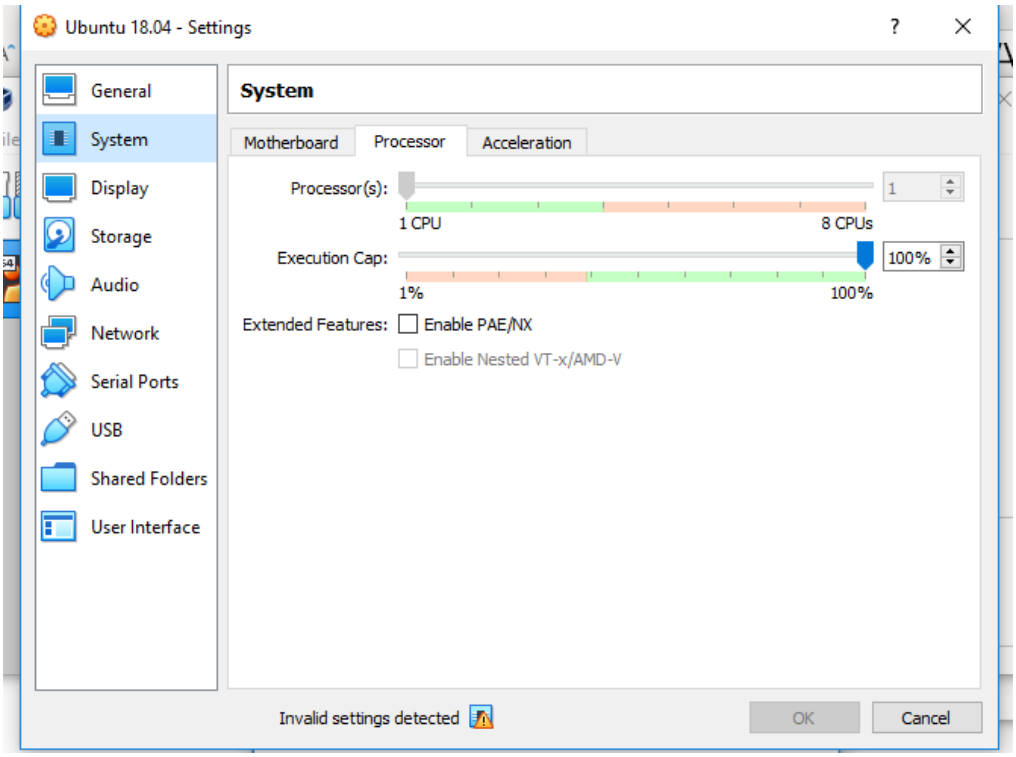
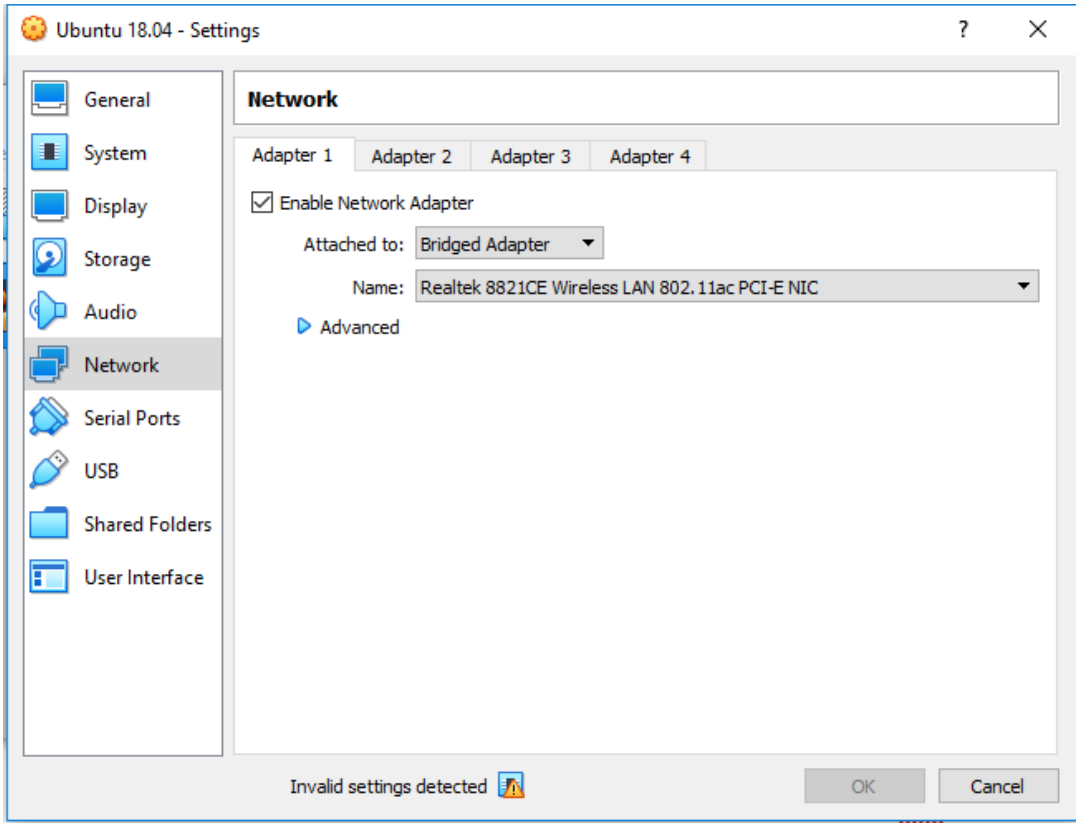
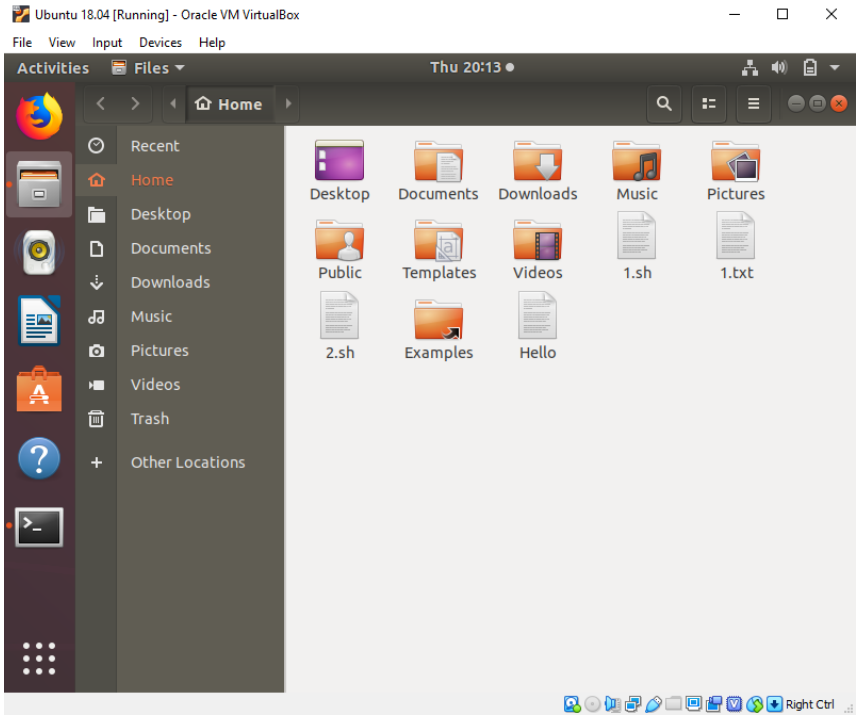
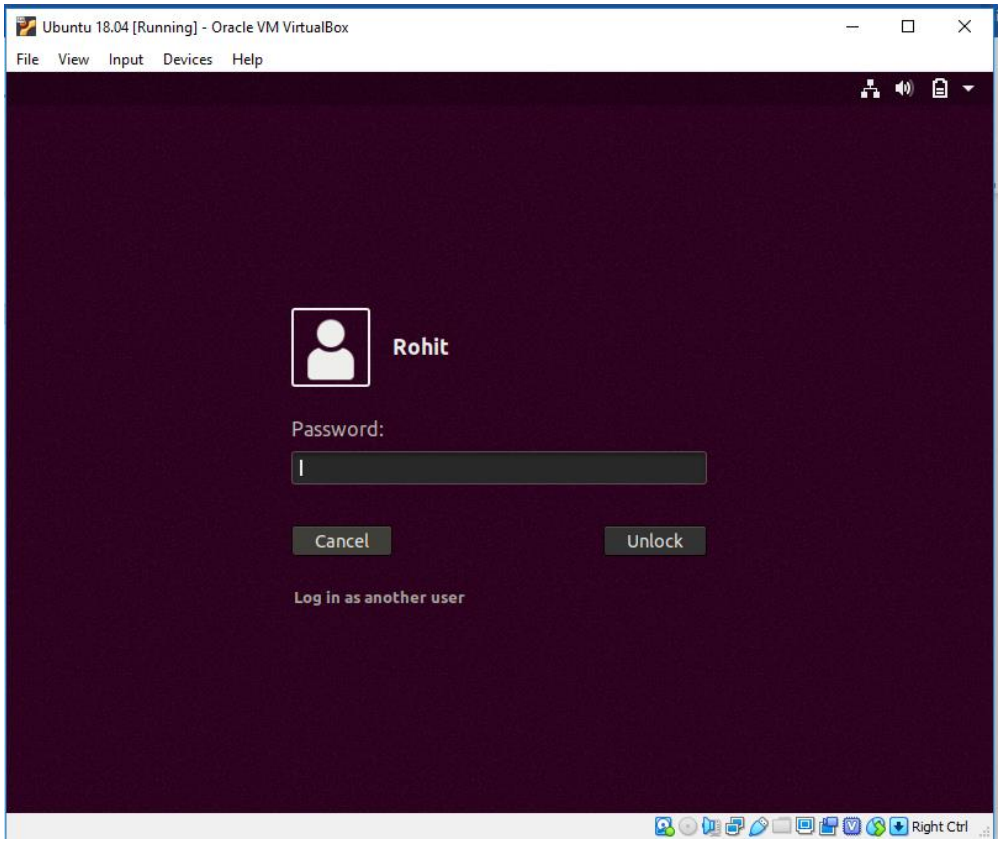

Ubuntu 18.04 - Settings
General
System
Display
Storage
Audio
Network
Serial Ports
USB
Shared Folders
User Interface
System
Motherboard
Processor
Acceleration
Processor(s):
1
1 CPU
8 CPUs
Execution Cap:
100%
1%
100%
Extended Features:
Enable PAE/NX
Enable Nested VT-x/AMD-V
Invalid settings detected
OK
Cancel


Ubuntu 18.04 - Settings
General
System
Display
Storage
Audio
Network
Serial Ports
USB
Shared Folders
User Interface
Network
Adapter 1
Adapter 2
Adapter 3
Adapter 4
Enable Network Adapter
Attached to:
Bridged Adapter
Name:
Realtek 8821CE Wireless LAN 802.11ac PCI-E NIC
Advanced
Invalid settings detected
OK
Cancel

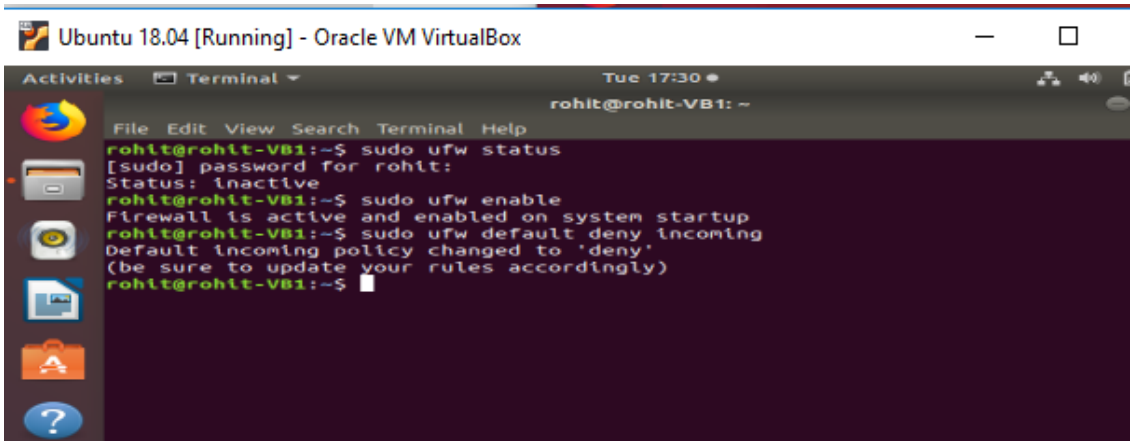
6. **Install Linux from the ISO image**



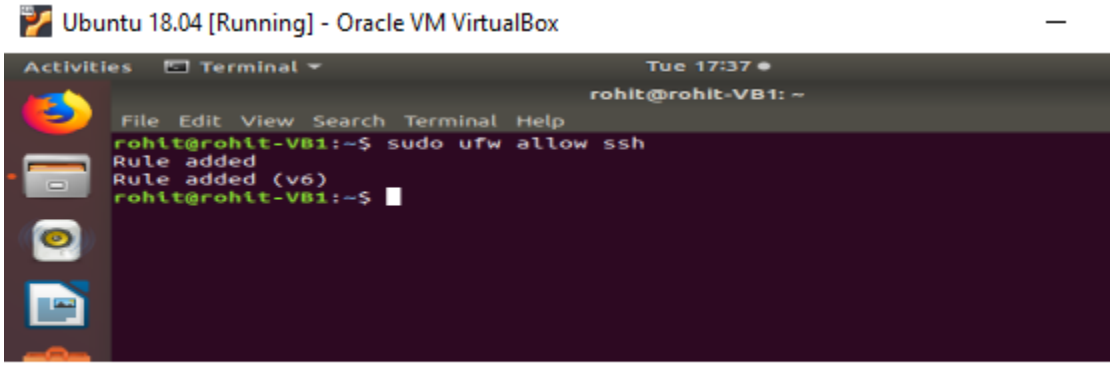
7. **Create a user id and password**



8. **Turn on Firewall and block all ports**

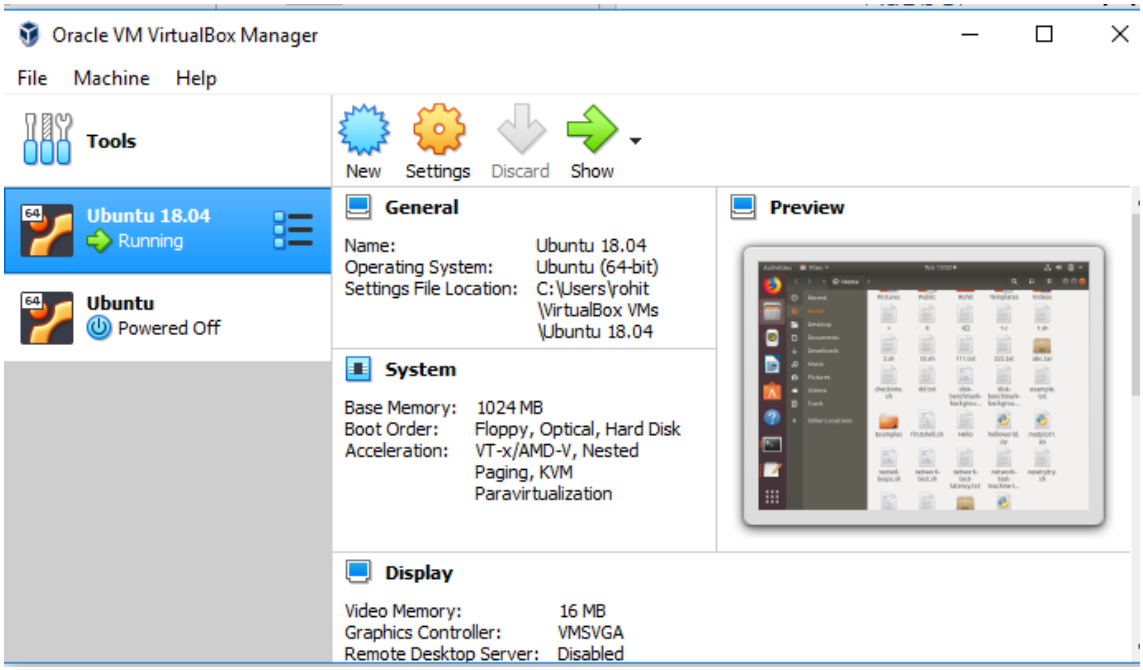


9. **Enable SSH access to your new Linux installation; open SSH port in firewall**

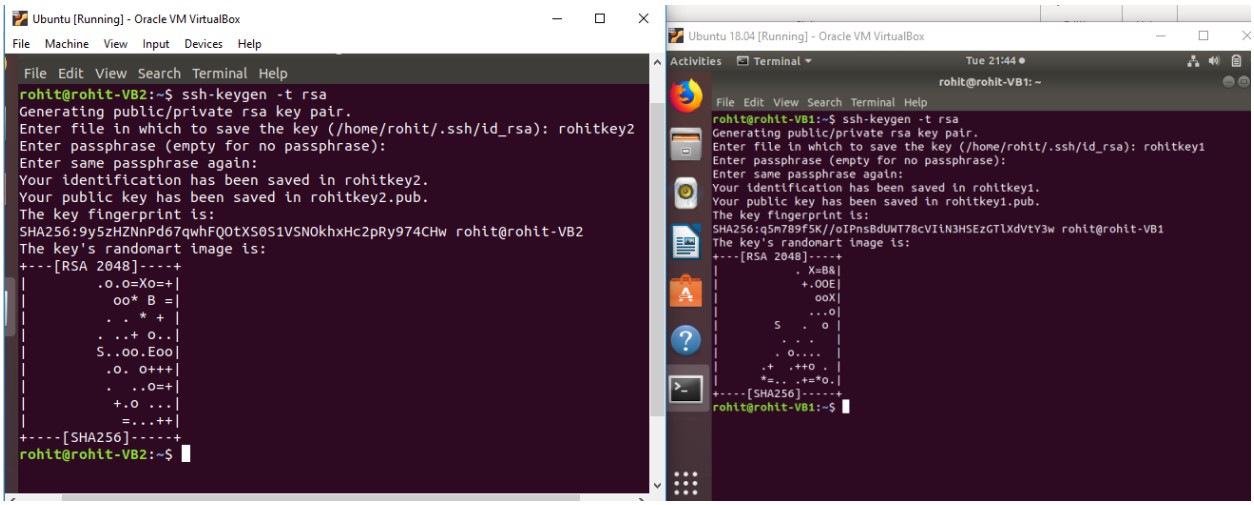


10. **Repeat steps 5 through 9, and create another VM with the same specifications as the first one**

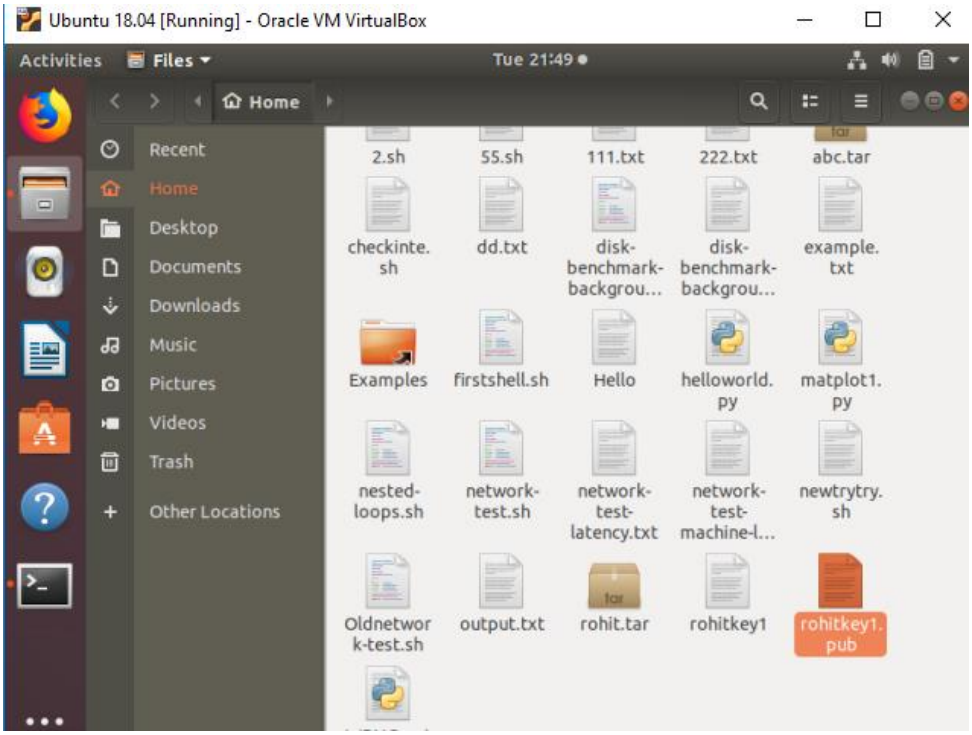
Created another VM with the same details



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

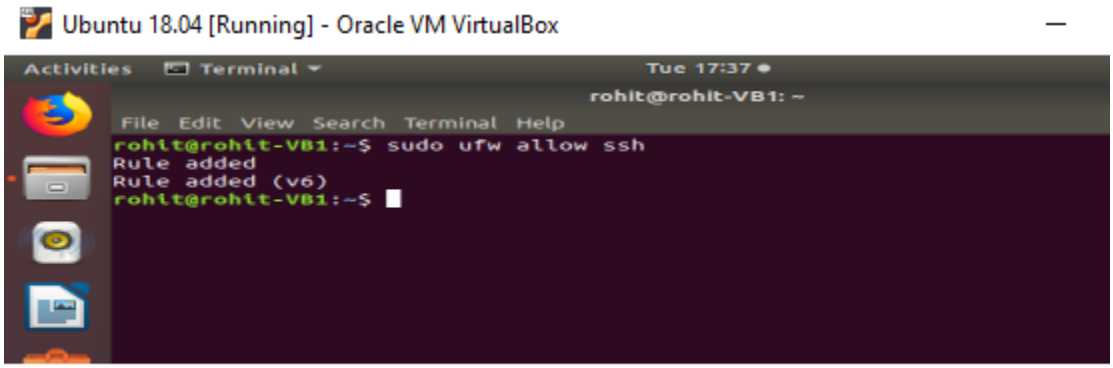


11. Test that you can connect remotely to your VMs with your keys, from one VM to the other VM

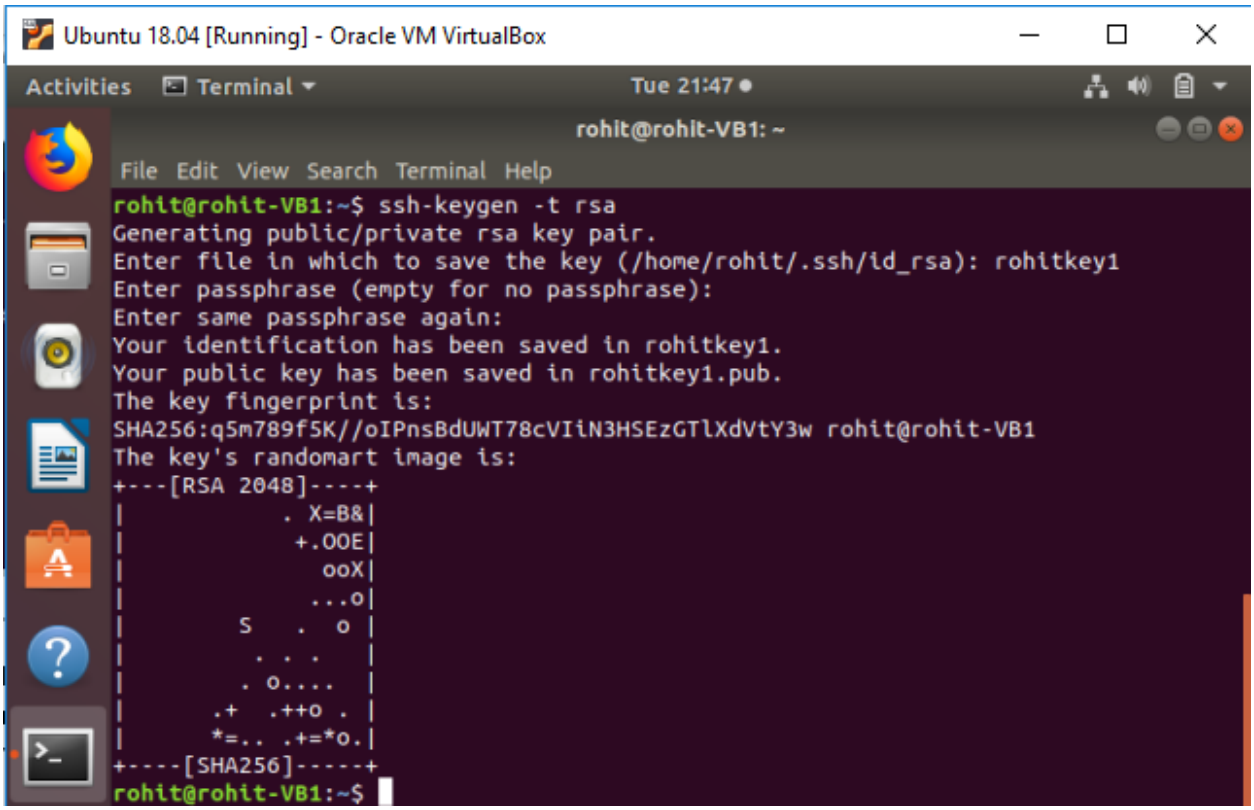


13. Show an example of using the following commands (hint: you can use man to find more information about each one); take screen shots of your commands; make sure to clear the screen between each command; explain in your own words what these commands do:

a. **Ssh:** Given command is used to establish a secure network between two machines.

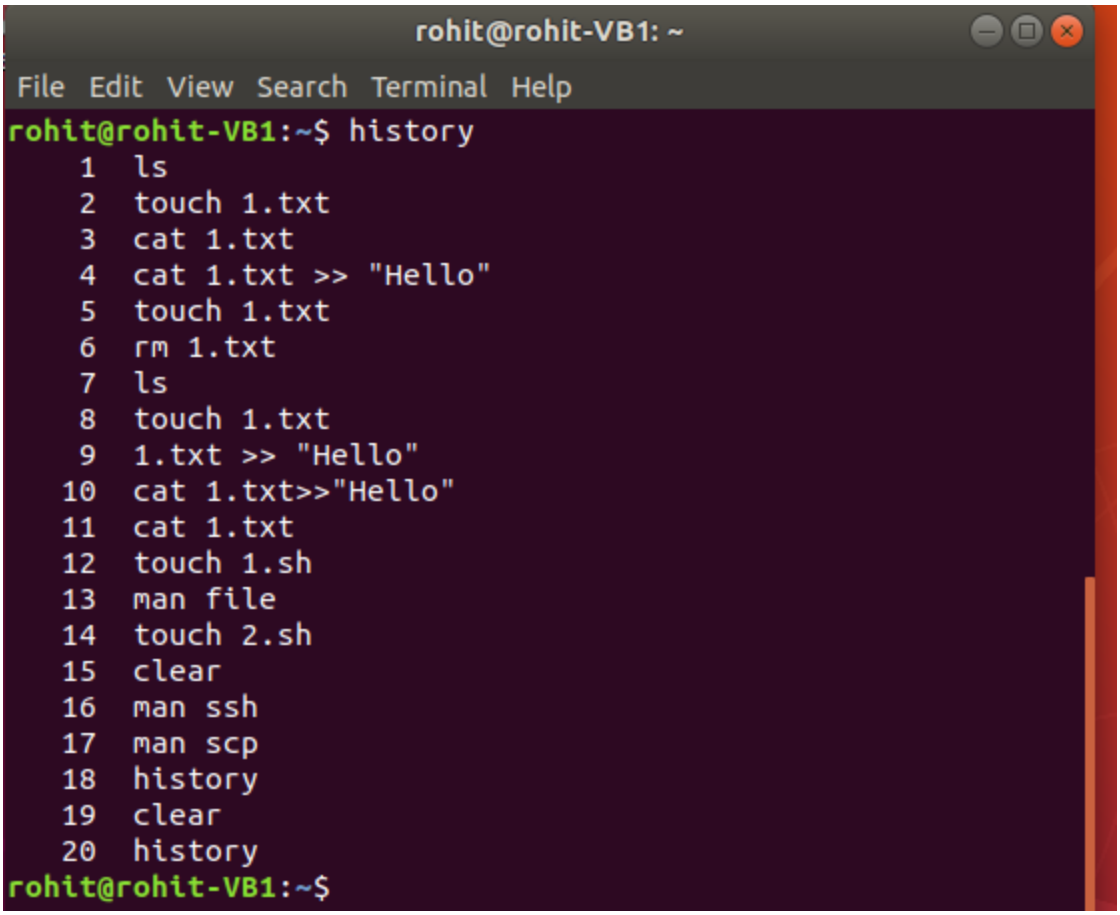


b. **Ssh-keygen:** It is used for key generation in public key authentication protocol



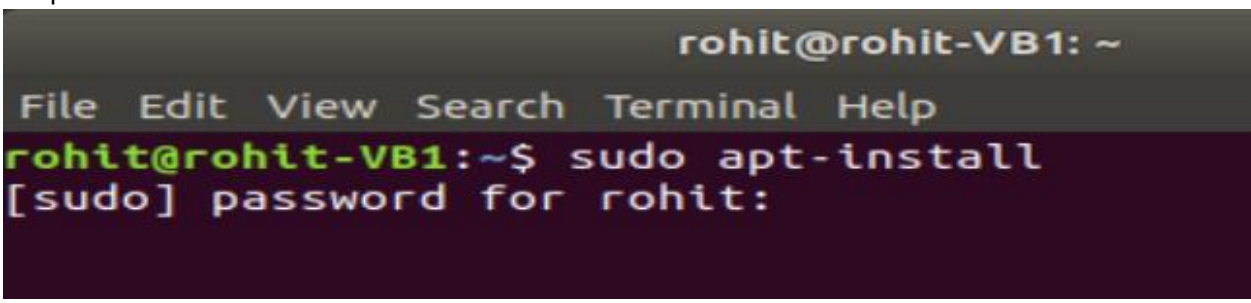
c. **Scp:** It is used to copy files securely from one host to another

d. **History:** It provides list of commands which we used in past

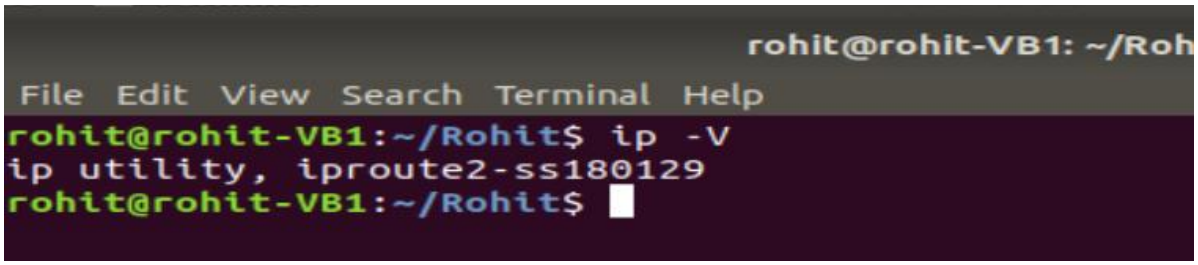


e. Sudo

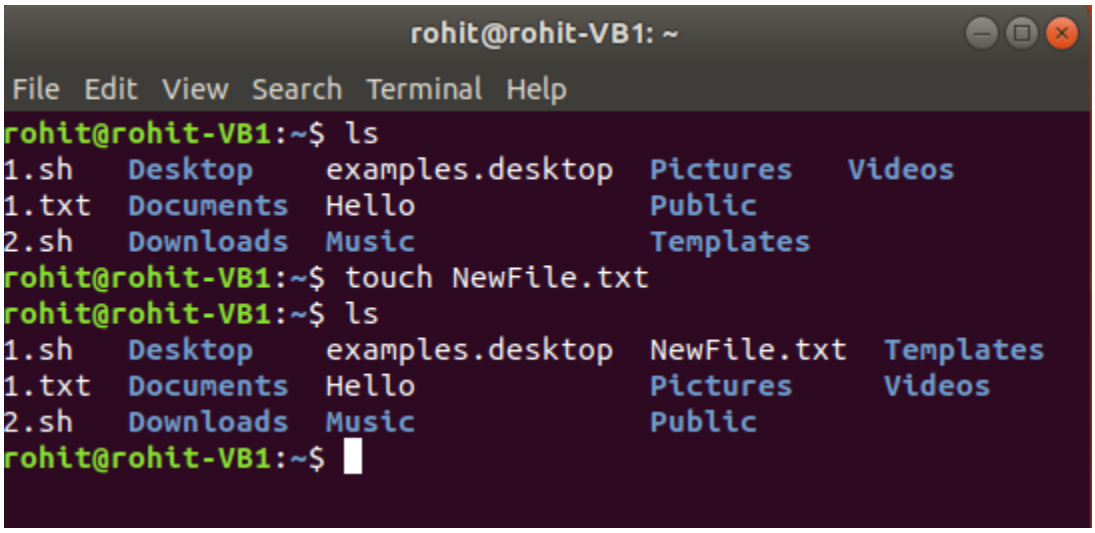
Sudo gives higher privileges while running the commands, after running it, it will ask for the password



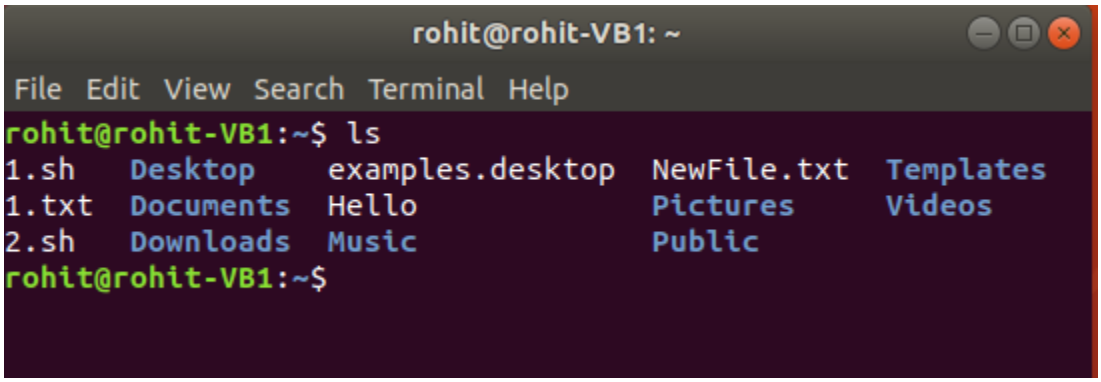
f. Ip: It is used to get information about ip utility, Ip -v can be used to get version of ip utility.



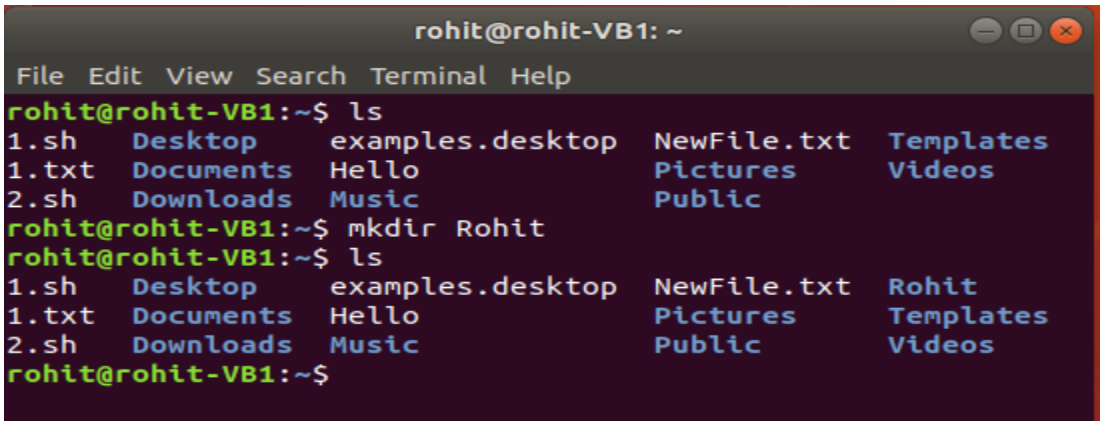
g. Touch: Touch is used for creating files through terminal



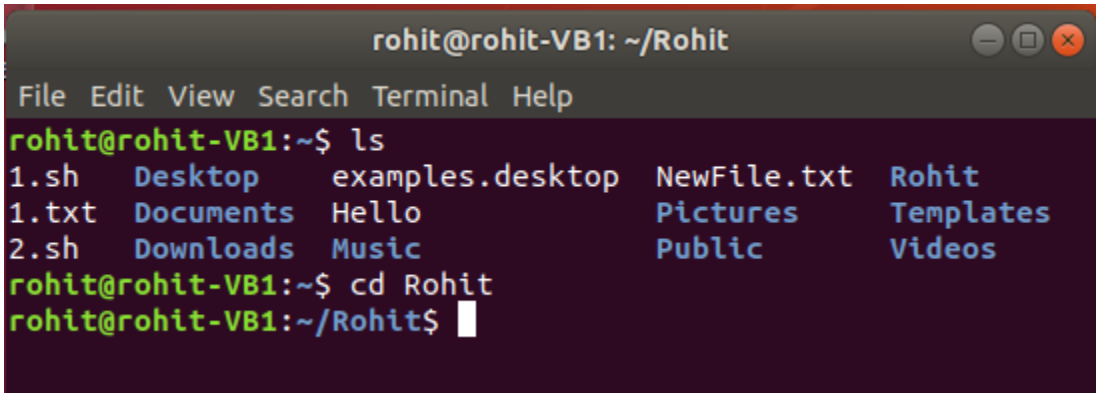
h. Ls: It is used to print all content present in given directory.



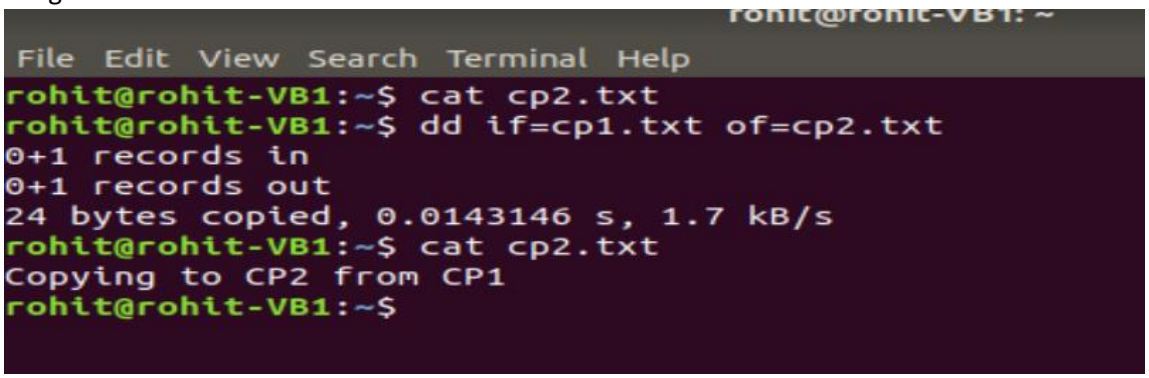
i. Mkdir : It is used to create directory.



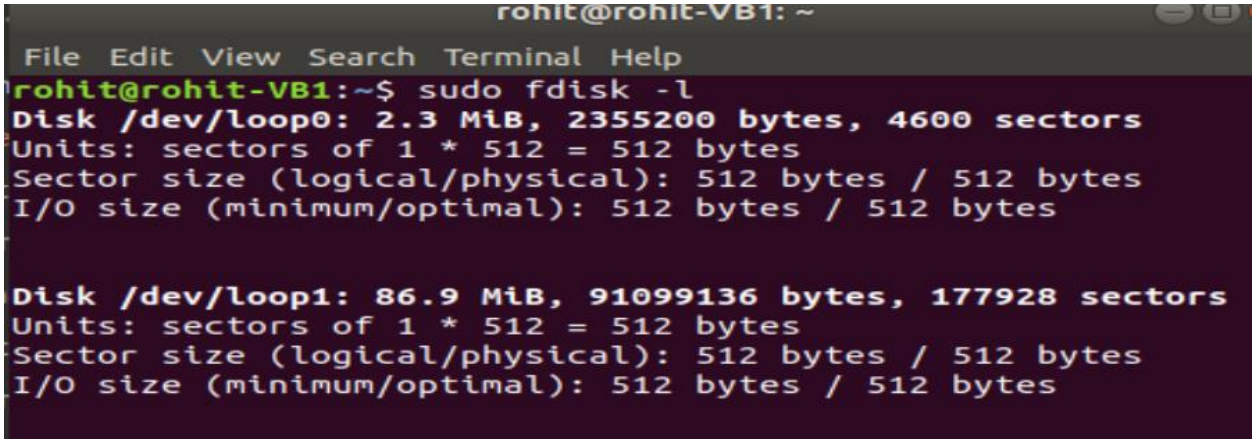
j. Cd : It is used to change directory.



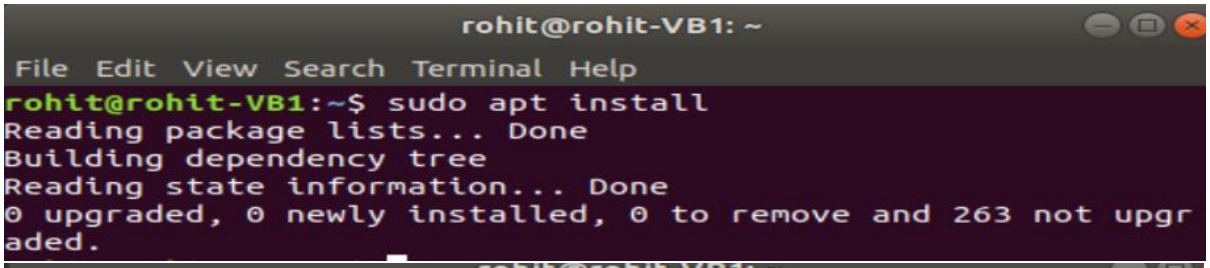
k. **Dd:** It is used to copy or convert the files, Even it is used for backup, restore of taking image of hard drive.

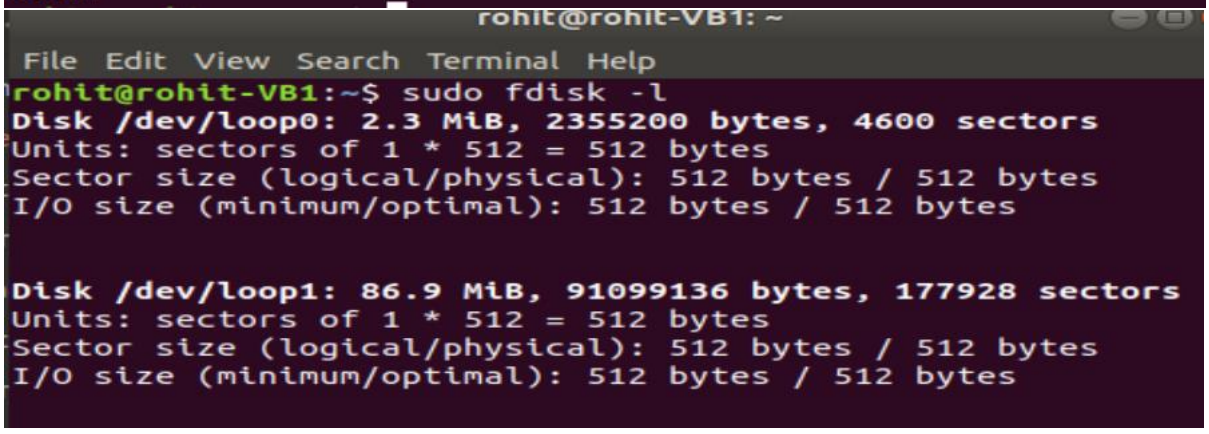


l. Fdisk: fdisk is used for disk partitioning or getting details about disks in your system



m. Apt : Apt is nothing but advanced package tool which is used for installation and uninstallation of software's





n. Vi :

It is used to insert update text or files in console. If file is not present then it will create that file and vi I user can write into the file.

```
File  Edit  View  Search  Terminal  Help
abc 500
dhf 634
wqs 721
gls 396
pqr 400
wnf 550
qmd 300
aws 200
acz 250
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
"example.txt" 9 lines, 72 characters
```

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

```
                                                    rohit@rohit-VB1: ~
 Firefox Web Browser
File  Edit  View  Search  Terminal  Help
rohit@rohit-VB1:~$ vi example.txt

[1]+  Stopped                 vi example.txt
rohit@rohit-VB1:~$ time

real    0m0.000s
user    0m0.000s
sys     0m0.000s
rohit@rohit-VB1:~$ time ping www.google.com
ping: www.google.com: Name or service not known

real    0m10.059s
user    0m0.005s
sys     0m0.000s
rohit@rohit-VB1:~$
```

p. Tar: It is used to archive the file

```
File  Edit  View  Search  Terminal  Help
tar: Exiting with failure status due to previous errors
rohit@rohit-VB1:~$ tar cvf rohit.tar /home/rohit
tar: Removing leading `/' from member names
/home/rohit/
/home/rohit/firstshell.sh
/home/rohit/Videos/
/home/rohit/.local/
/home/rohit/.local/lib/
/home/rohit/.local/lib/python2.7/
/home/rohit/.local/lib/python2.7/site-packages/
/home/rohit/.local/lib/python2.7/site-packages/numpy/
/home/rohit/.local/lib/python2.7/site-packages/numpy/tests/
/home/rohit/.local/lib/python2.7/site-packages/numpy/tests/__init__.
/home/rohit/.local/lib/python2.7/site-packages/numpy/tests/test_nump
```

```
File  Edit  View  Search  Terminal  Help
rohit@rohit-VB1:~$ ls | grep '.tar'
abc.tar
rohit.tar
rohit@rohit-VB1:~$
```

q. Rm: Command rm is used to remove or delete the files

```
rohit@rohit-VB1: ~
File  Edit  View  Search  Terminal  Help
rohit@rohit-VB1:~$ touch tryrm.txt
rohit@rohit-VB1:~$ ls
'='                     matplot1.py
 0                      Music
 0]]                    nested-loops.sh
 1.sh                   network-test-latency.txt
 1.txt                  network-test-machine-list.txt
 2.sh                   network-test.sh
 55.sh                  NewFile.txt
 checkinte.sh           Oldnetwork-test.sh
 Desktop                output.txt
 Documents              Pictures
 Downloads              Public
 examples.desktop       Rohit
 example.txt            Templates
 firstshell.sh          tryrm.txt
 Hello                  Videos
 helloworld.py          WRNGmatplot2.py
rohit@rohit-VB1:~$ rm tryrm.txt
rohit@rohit-VB1:~$ ls | grep 'try'
rohit@rohit-VB1:~$
```

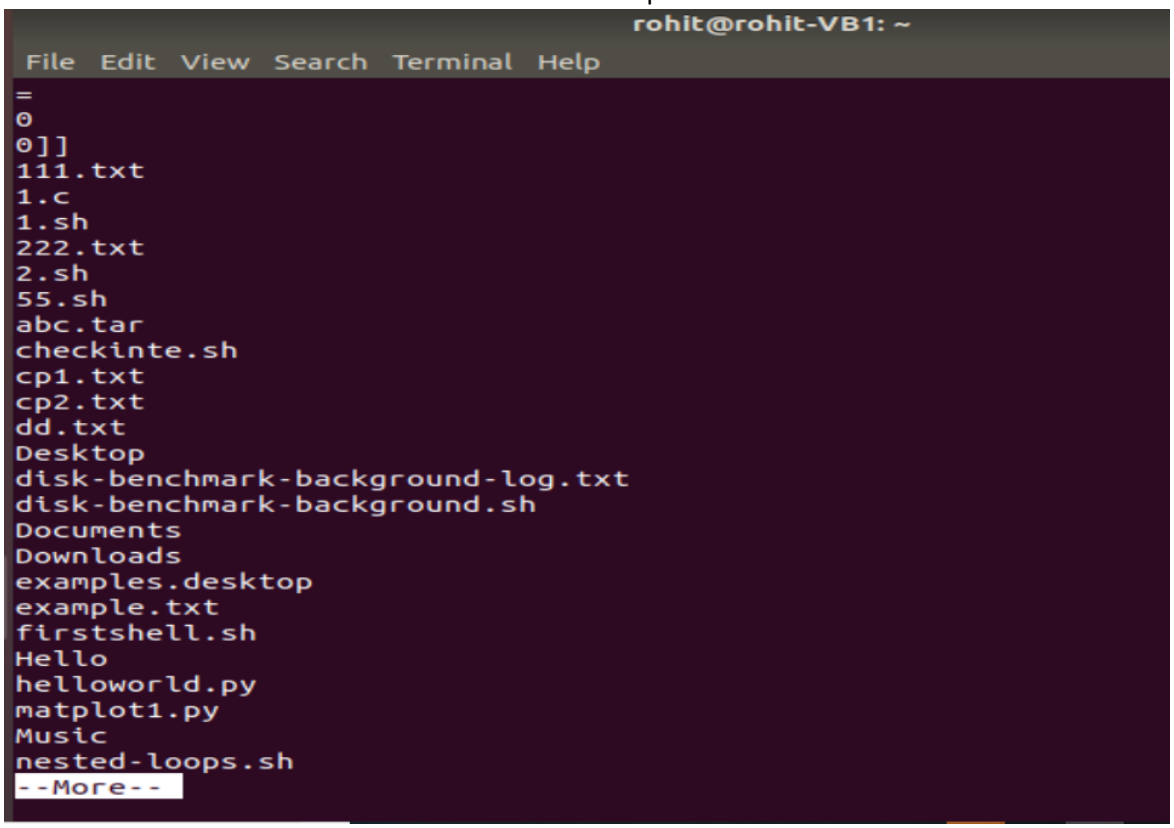
r. Cat: cat is used to print content of the file in output window

```
rohit@rohit-VB1: ~
File  Edit  View  Search  Terminal  Help
rohit@rohit-VB1:~$ cat example.txt
abc 500
dhf 634
wqs 721
gls 396
pqr 400
wnf 550
qmd 300
aws 200
acz 250
rohit@rohit-VB1:~$
```

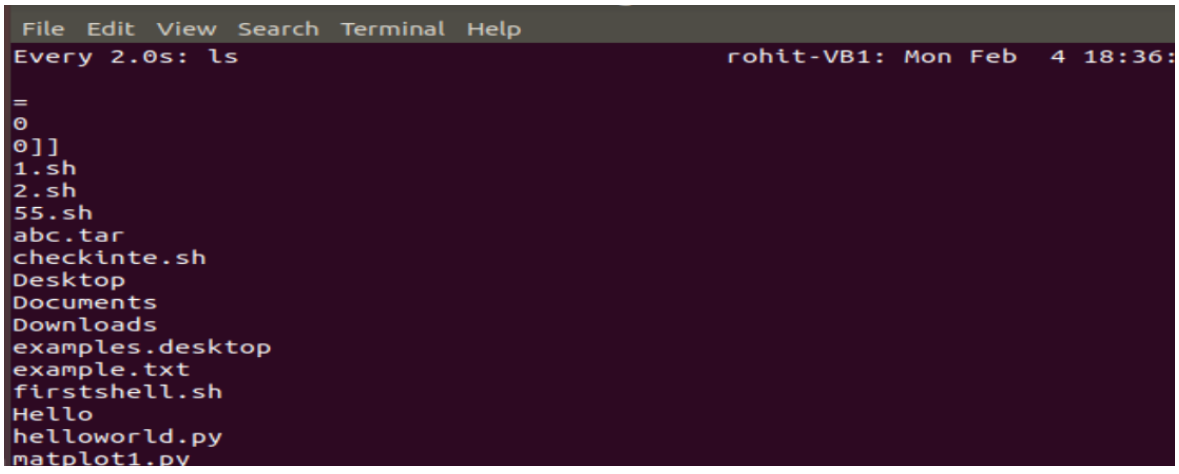
s. Bash : Command bash is used to run shell scripts

```
File  Edit  View  Search  Terminal  Help
rohit@rohit-VB1:~$ bash firstshell.sh
Please enters values of i, j & k seperated by space 2 3
0
0
```

t. **More:** We can say it is manual scroll, Without more system prints every output on your screen and user has to scroll the screen to see the outputs



u. **Watch:** Given command will display the output of given command after given interval and it will run into a loop



v. **Ps:** It is used to get information about currently running processes and their process ids

```
rohit@rohit-VB1: ~/Rohit
File  Edit  View  Search  Terminal  Help
rohit@rohit-VB1:~/Rohit$ ps
  PID TTY          TIME CMD
 3285 pts/0    00:00:00 bash
 3513 pts/0    00:00:00 ps
rohit@rohit-VB1:~/Rohit$
```

w. Top :

It is used to display information about CPU processes

```
rohit@rohit-VB1: ~
File  Edit  View  Search  Terminal  Help
top - 18:39:53 up  4:40,  1 user,  load average: 0.01, 0.04, 0.07
Tasks: 201 total,   1 running, 168 sleeping,   2 stopped,   0 zombie
%Cpu(s):  6.0 us,  2.0 sy,  0.0 ni, 92.0 id,  0.0 wa,  0.0 hi,  0.0 si,  0
KiB Mem :  1009112 total,    72100 free,   662392 used,   274620 buff/cach
KiB Swap:   976320 total,   656064 free,   320256 used.   197844 avail Mem

  PID USER      PR  NI    VIRT    RES    SHR S  %CPU %MEM     TIME+ COMMAND
 1529 rohit     20   0 2983020 177432  27572 S   4.3 17.6   8:55.88 gnome-s
 1385 rohit     20   0  361720  35012  11432 S   2.0  3.5   1:41.73 Xorg
 3932 rohit     20   0  799616  35592  25852 S   1.0  3.5   0:04.08 gnome-t
 4153 rohit     20   0   51188   4036   3352 R   1.0  0.4   0:00.11 top
    1 root      20   0  225320   5024   3208 S   0.0  0.5   0:03.23 systemd
    2 root      20   0       0      0      0 S   0.0  0.0   0:00.00 kthread
    4 root       0 -20       0      0      0 I   0.0  0.0   0:00.00 kworker
    6 root       0 -20       0      0      0 I   0.0  0.0   0:00.00 mm_perc
    7 root      20   0       0      0      0 S   0.0  0.0   0:00.54 ksoftir
    8 root      20   0       0      0      0 I   0.0  0.0   0:02.40 rcu_sch
```

x. Htop :

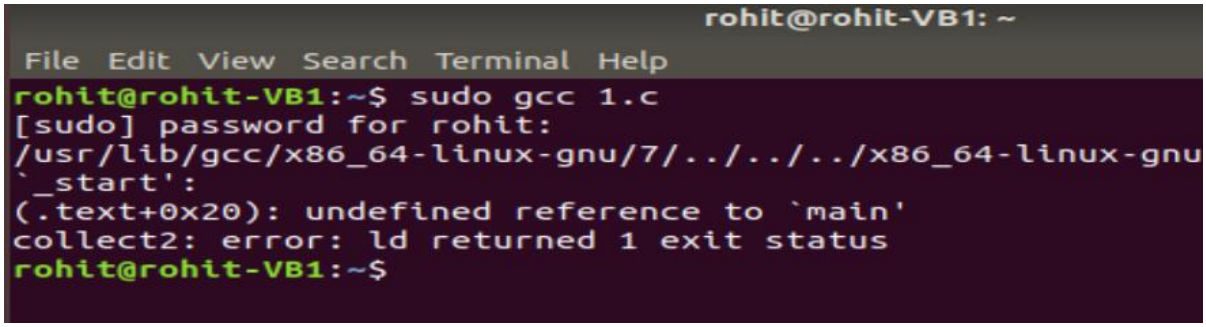
It's an user friendly process viewer, Which shows process details in interactive way

```
rohit@rohit-VB1: ~
File  Edit  View  Search  Terminal  Help
  CPU[||                          5.2%]   Tasks: 136, 294 thr; 1 running
  Mem[||||||||||||||||||705M/985M]   Load average: 0.84 0.36 0.15
  Swp[|||||||||          271M/953M]   Uptime: 01:40:50

  PID USER      PRI  NI  VIRT   RES   SHR S CPU% MEM%   TIME+  Command
 2549 rohit      20   0 40600  4432  3628 R  2.6  0.4  0:00.25 htop
 1148 rohit      20   0 2896M  168M 24244 S  1.3 17.1  1:11.53 /usr/bin/gnome-
 1018 rohit      20   0  352M 31220 10940 S  0.7  3.1  0:09.70 /usr/lib/xorg/X
 1679 rohit      20   0  708M 17892  8884 S  0.7  1.8  0:02.30 /usr/lib/gnome-
 1024 rohit      20   0  352M 31220 10940 S  0.0  3.1  0:01.40 /usr/lib/xorg/X
  643 messagebu  20   0 51628  3268  1476 S  0.0  0.3  0:03.71 /usr/bin/dbus-d
  811 gdm        20   0 2843M 41212 12336 S  0.0  4.1  0:01.21 /usr/bin/gnome-
    1 root       20   0  220M  3488  1740 S  0.0  0.3  0:02.21 /sbin/init spla
  225 root       19  -1 95176  5488  4956 S  0.0  0.5  0:00.97 /lib/systemd/sy
  244 root       20   0 47460  1012   984 S  0.0  0.1  0:00.53 /lib/systemd/sy
```

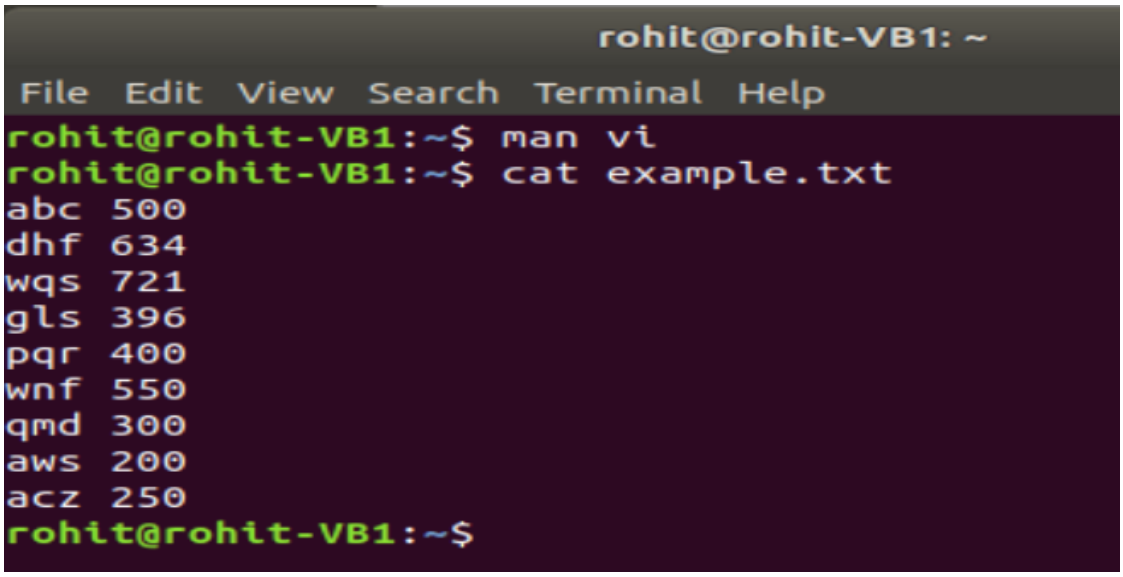
y. Gcc

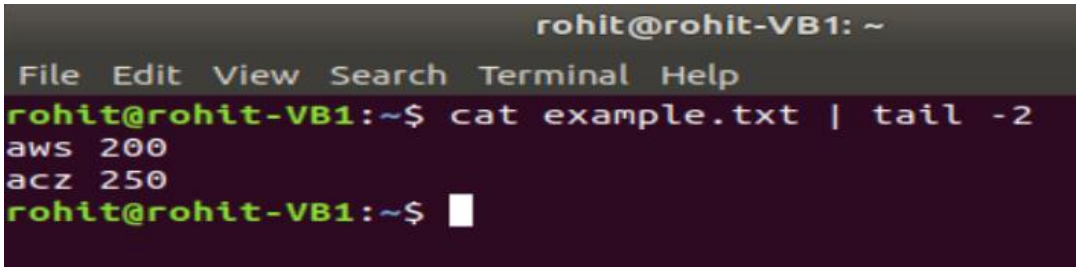
It is used to execute c programs



z. Tail

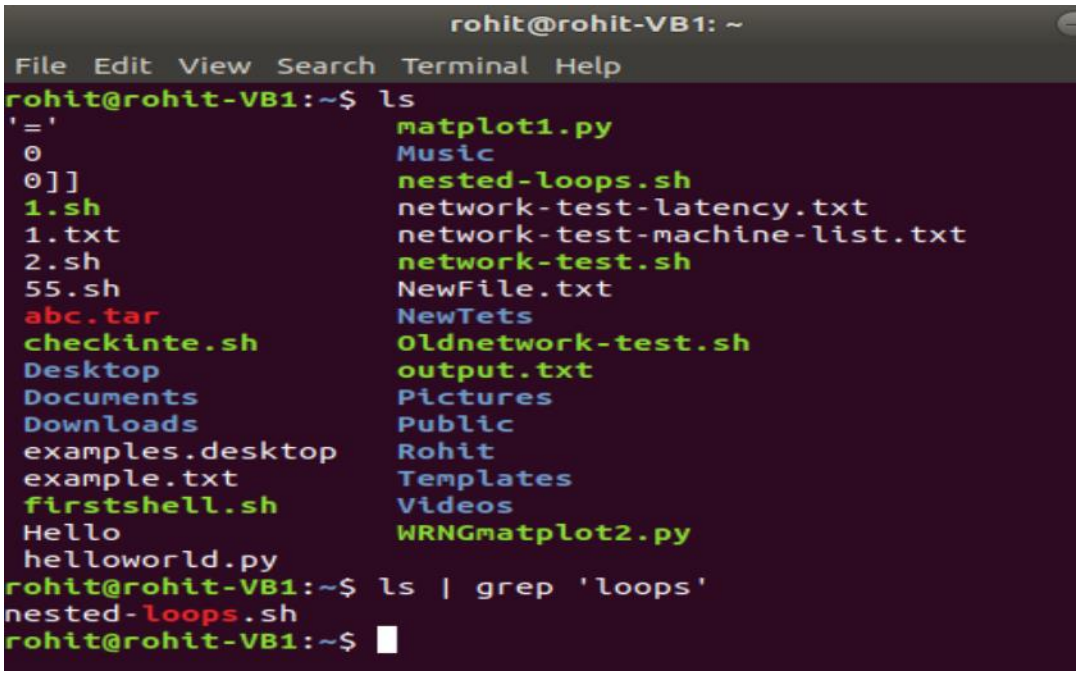
Tail is used to get last rows or bottom rows from file





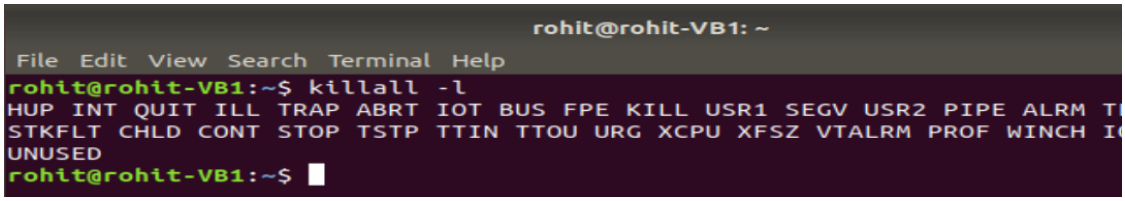
aa. Grep

Grep is used for pattern matching

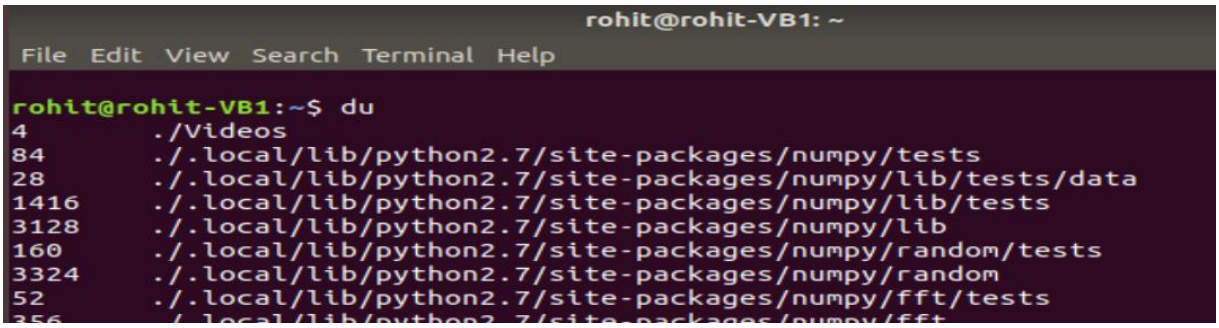


bb. Kill : It is used to get information about the signals and also to kill the specific signals.

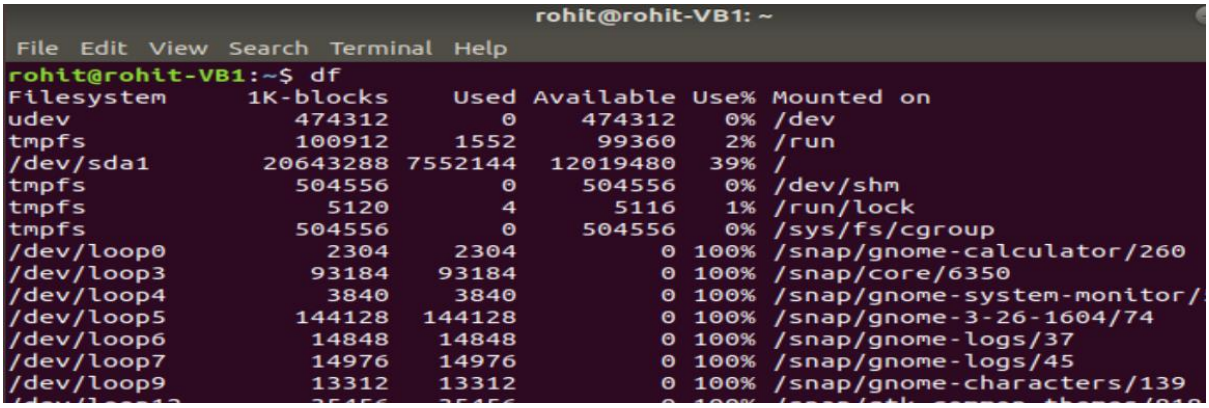
cc. Killall : It is used to kill the processes by name, even it is possible to kill all processes using this command, Or user can kill processes which follows specific regular expressions



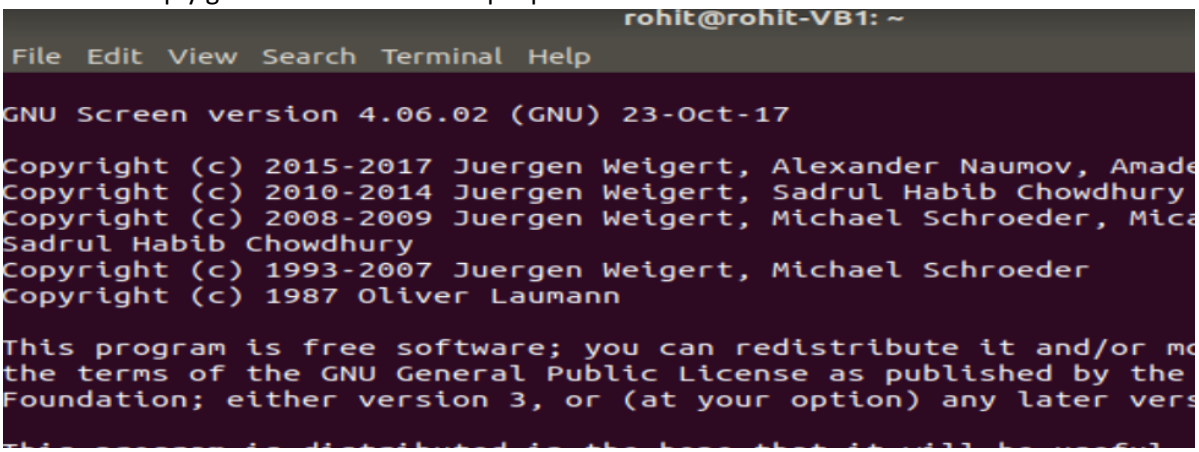
dd. **Du :** It shows the file space usage



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

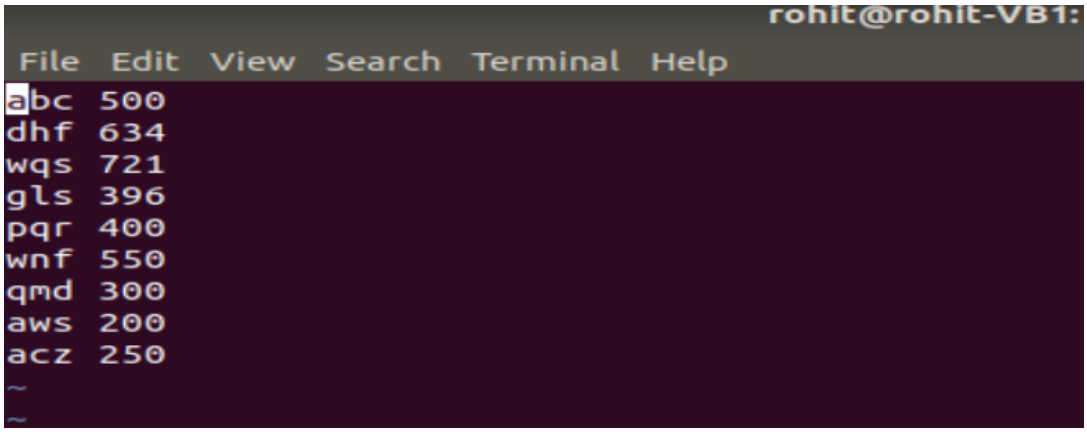


ff. Screen: Multiply given terminal for multiple processes

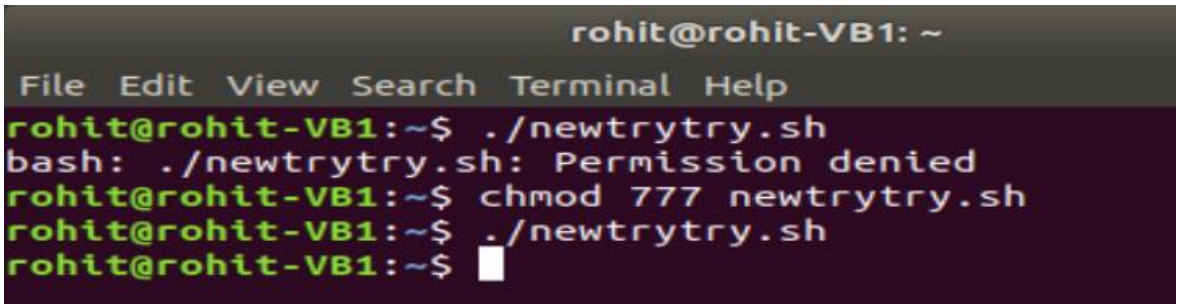


gg. Vim :

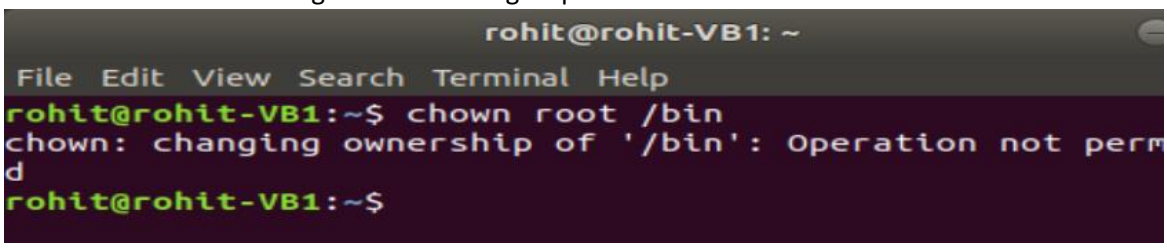
Used to print or edit content of file using console



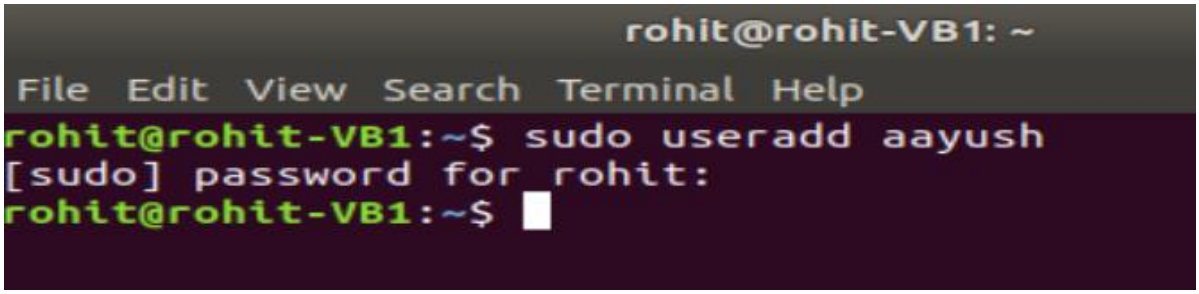
hh. **Chmod :** Chmod is used to give permissions to file, permissions like read write and execute access. There are three users to which we assign permissions and users are like user, group, other. 777 means give access to all the users and all the accesses.



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



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



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

```
File  Edit  View  Search  Terminal  Help
rohit@rohit-VB1:~$ sudo mv NewFile.txt /Public
rohit@rohit-VB1:~$ cd Public
rohit@rohit-VB1:~/Public$ ls
NewFile.txt
rohit@rohit-VB1:~/Public$
```

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

```
rohit@rohit-VB1: ~/Public
File  Edit  View  Search  Terminal  Help
LS(1)                          User Commands

NAME
       ls - list directory contents

SYNOPSIS
       ls [OPTION]... [FILE]...

DESCRIPTION
       List  information  about the FILEs (the current directory
       Sort entries alphabetically if none of -cftuvSUX nor --so
       fied.
```

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

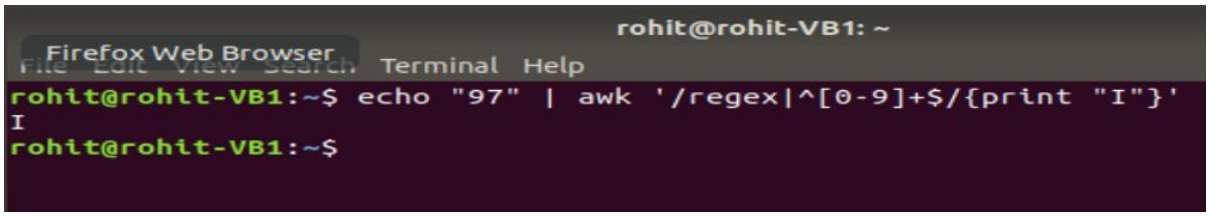
```
File  Edit  View  Search  Terminal  Help
locate: no pattern to search for specified
rohit@rohit-VB1:~/Public$ locate -A '.txt'
/boot/grub/gfxblacklist.txt
/etc/X11/rgb.txt
/etc/brltty/Input/ba/all.txt
/etc/brltty/Input/bd/all.txt
/etc/brltty/Input/bl/18.txt
/etc/brltty/Input/bl/40_m20_m40.txt
/etc/brltty/Input/ec/all.txt
/etc/brltty/Input/ec/spanish.txt
```

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

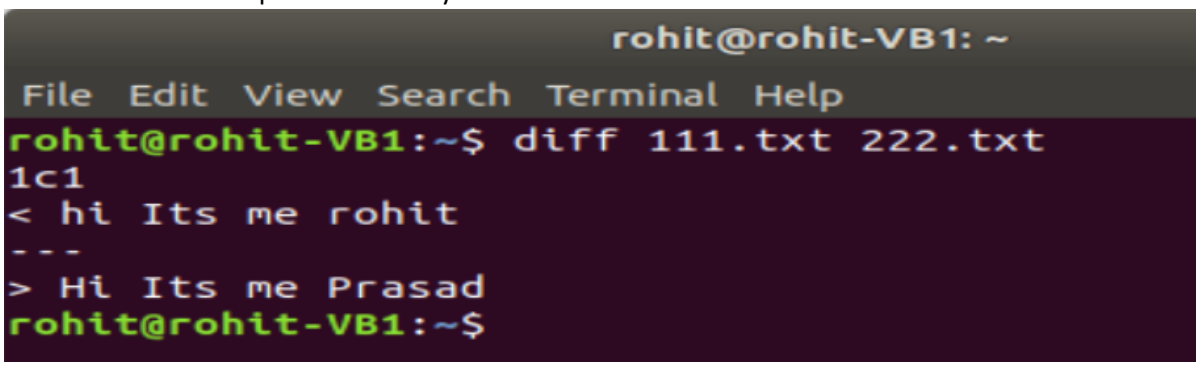
```
rohit@rohit-VB1: ~
File  Edit  View  Search  Terminal  Help
rohit@rohit-VB1:~$ find example.txt
example.txt
rohit@rohit-VB1:~$
```

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

pp. **Awk:** Used for pattern matching

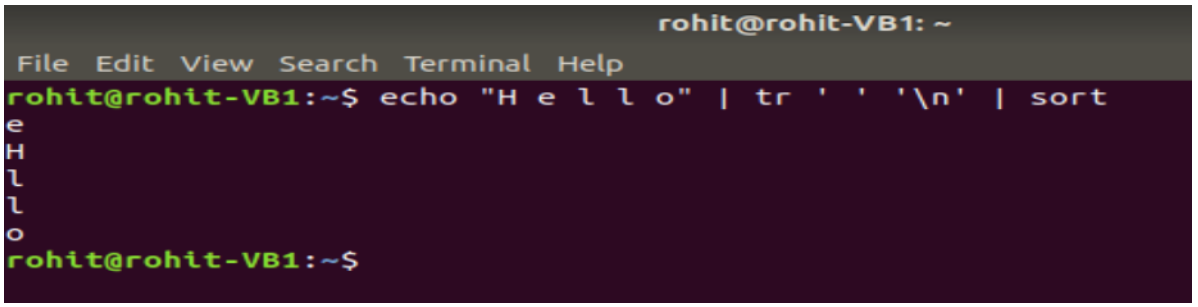


qq. Diff: It is used to compare files line by line

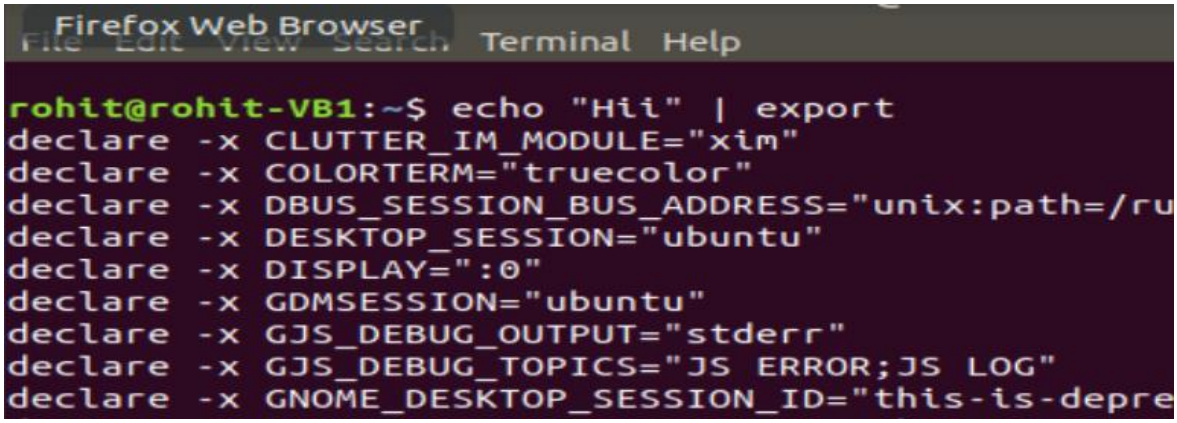


rr. Sort

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

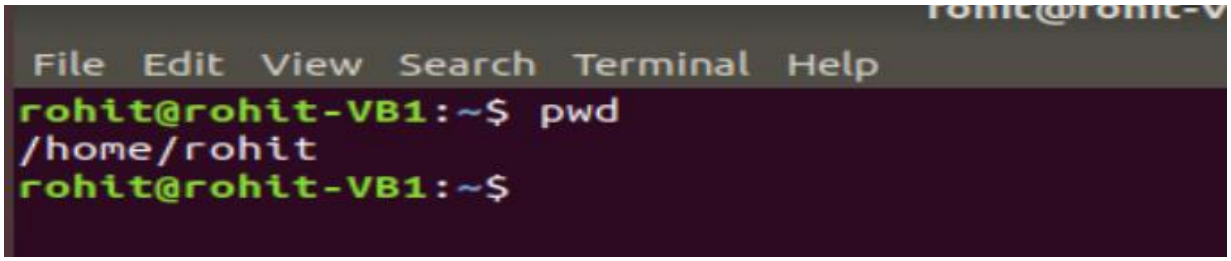


ss. Export: Used to export the value of variables available to child processes or other resources



tt. Pwd

Used to print working directory



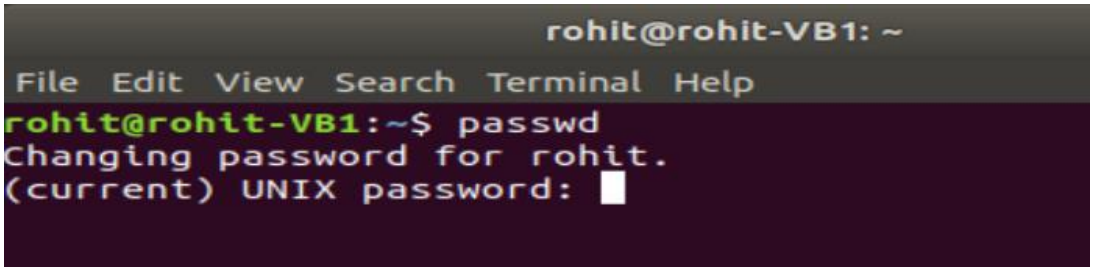
uu. Crontab:

Used to maintain crontab program files for individual users

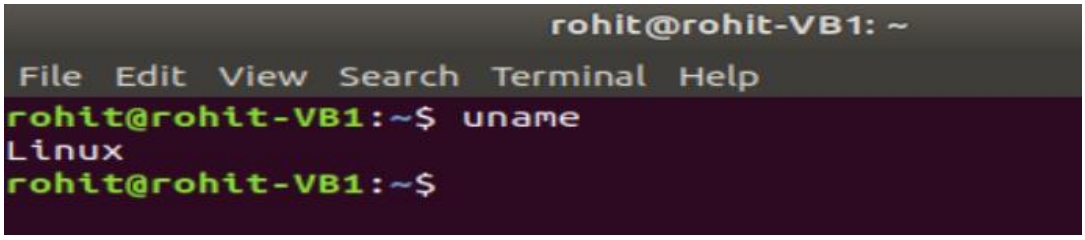
vv. Mount: All files in Ubuntu are maintained in a tree, Mount is used to attach filesystem found on other system to tree

ww. Passwd

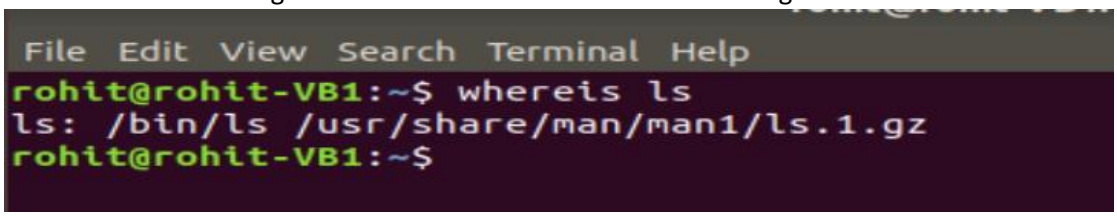
Given command is used to change the password



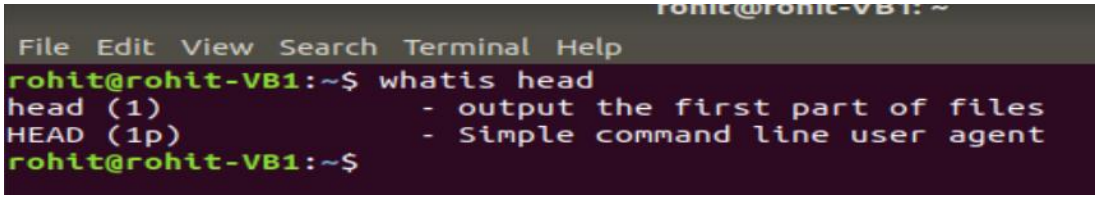
xx. Uname : Is is used to get username



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

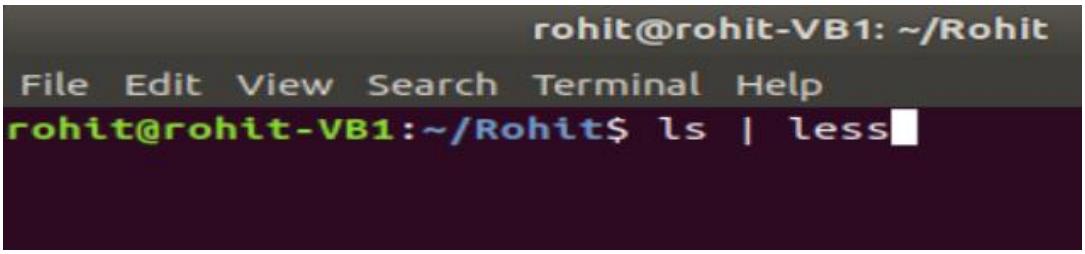


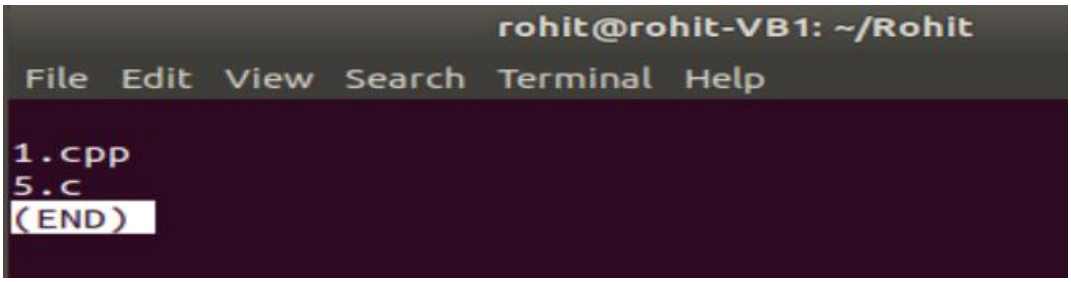
zz. Whatis : It is used to get single line summary of linux commands



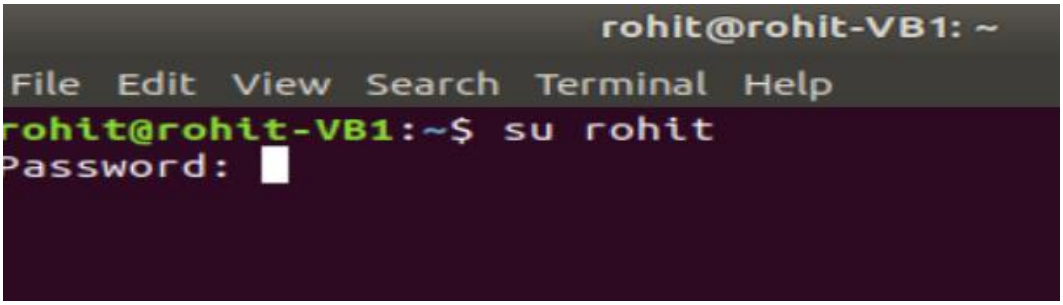
aaa. Less

Used to print less outputs on console screen



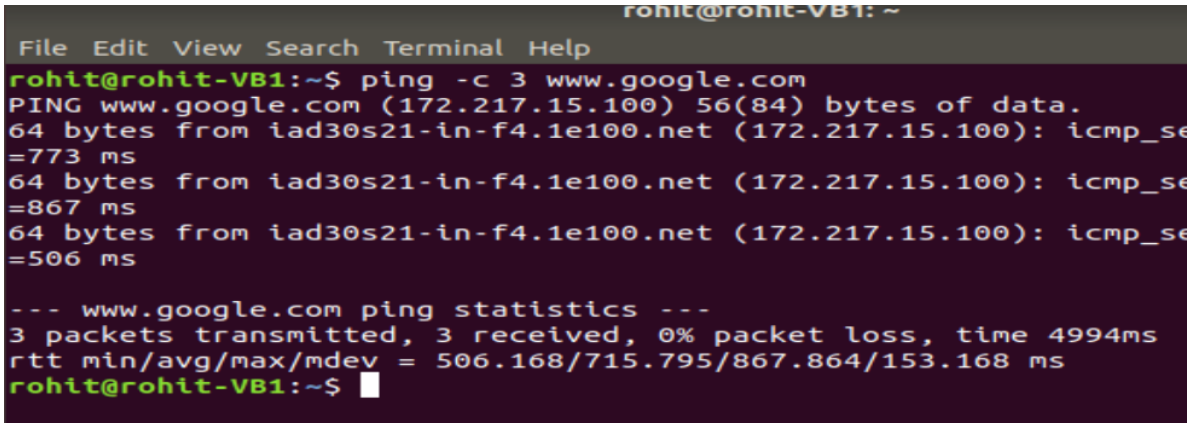


bbb. Su : It is used to change the user for given session

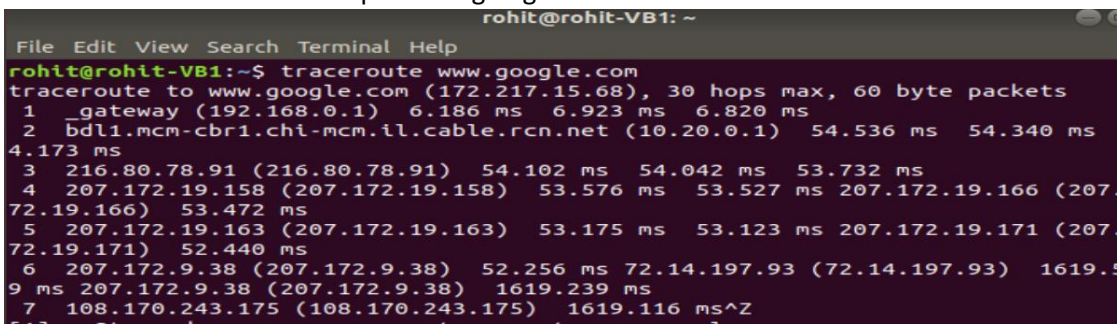


ccc. Ping

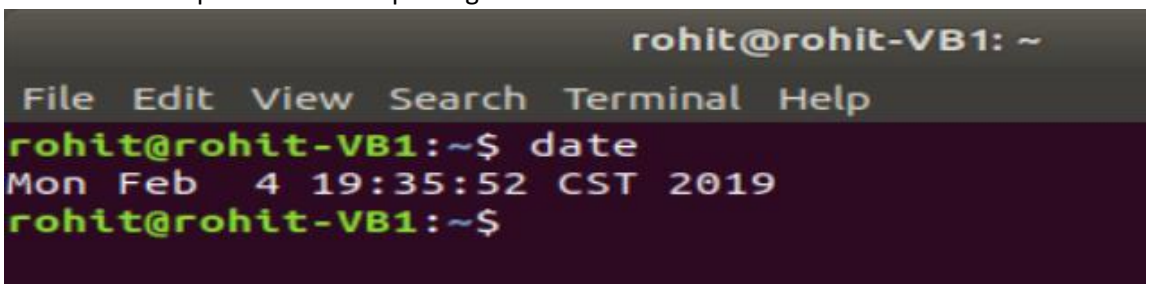
Ping command is used to get response time from a server of DNS which is also called as latency



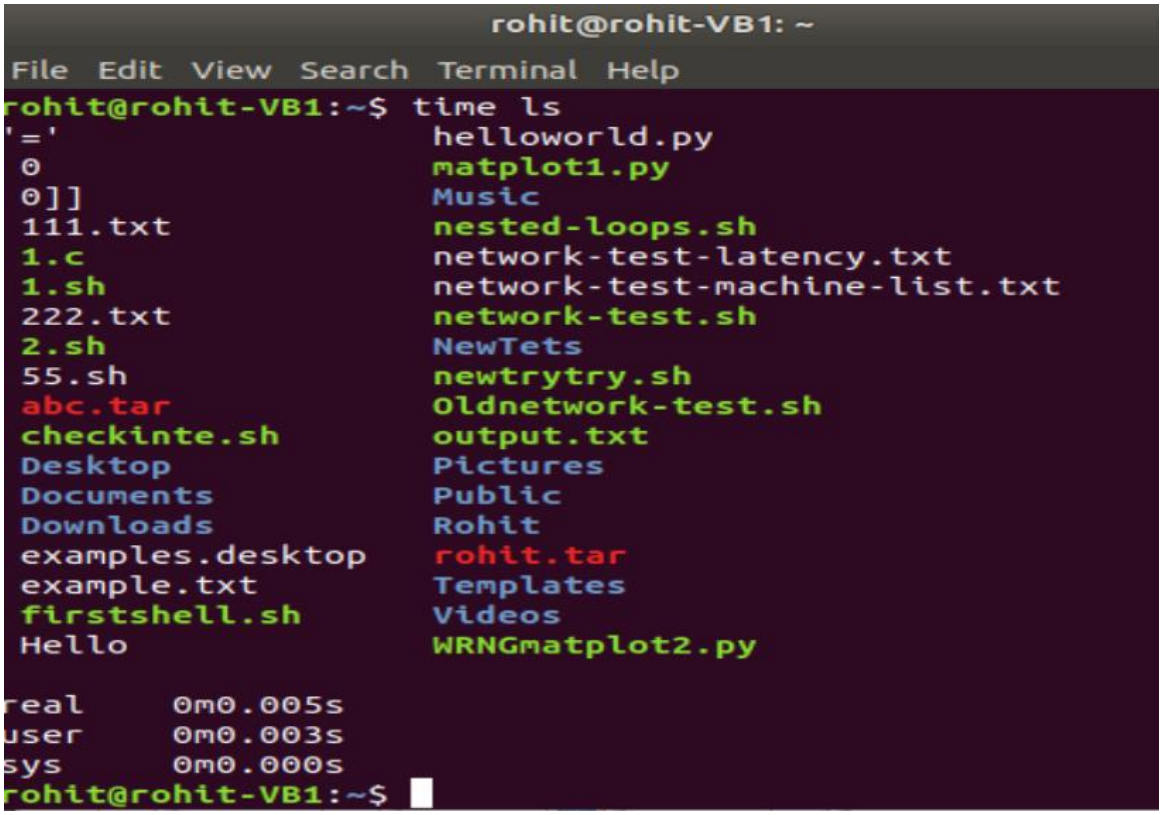
ddd. **Traceroute:** It is used to see how our packet is travelling in internet it given all the server names from which out packet is going



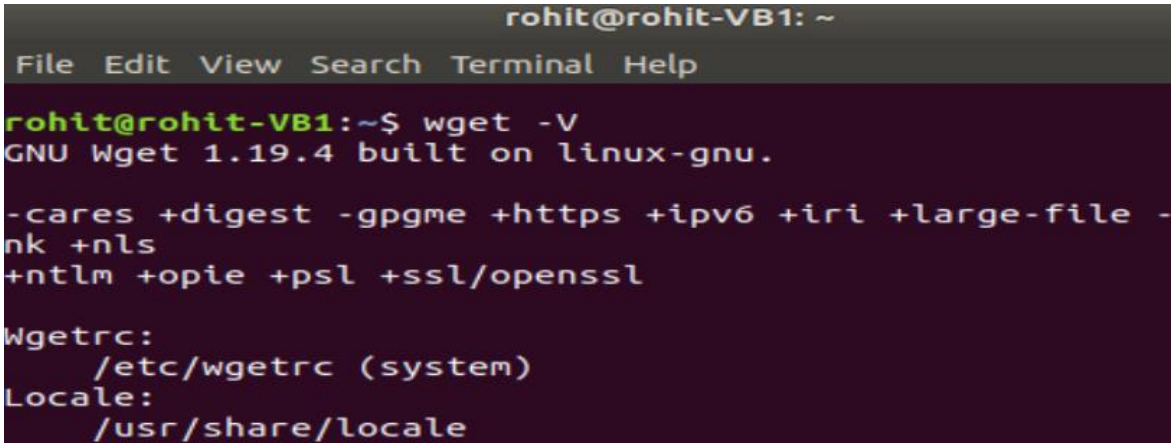
eee. **Date:** It prints date stamp along with zone



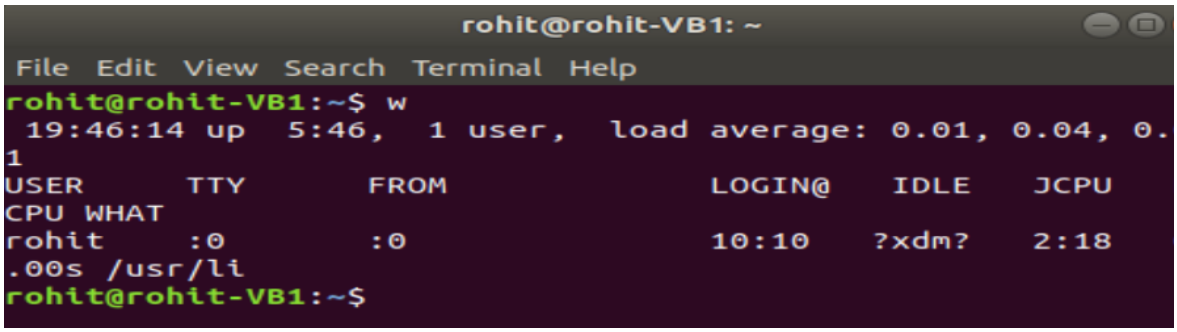
fff. **Time :** Gives time required to complete given request



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

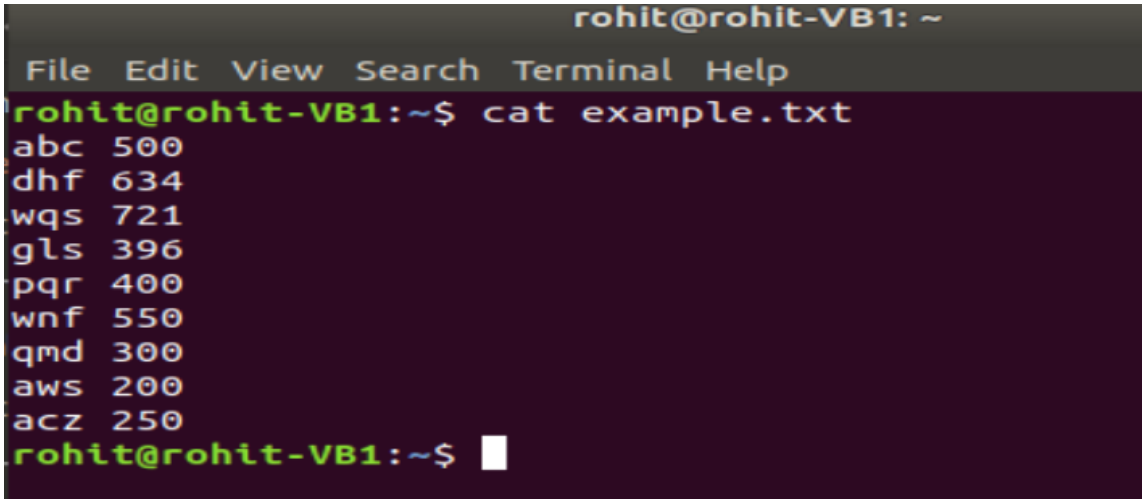


hhh. **W :** It is used to get information about users and their instances

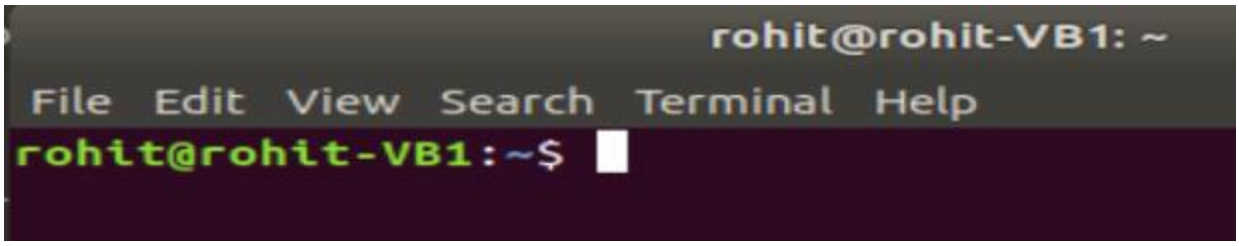


iii. Clear

Command clear is used to clear the content of console

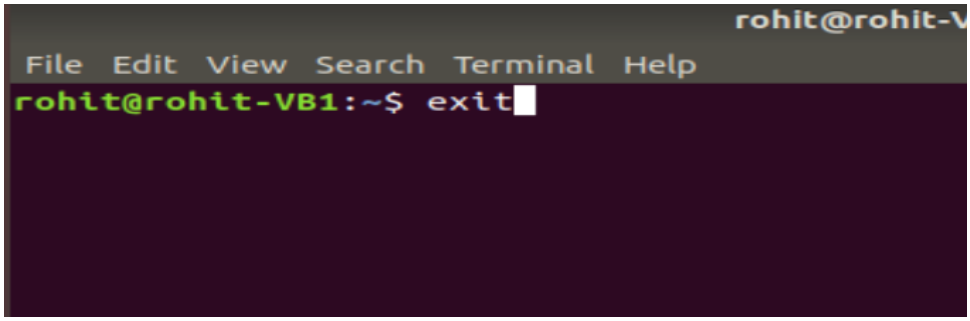


Clear cleared all the results



jjj. Exit

Exit is used to exit the console.



14. Write bash scripts to do the following:

a. Write a script called “nested-loops.sh” that takes in 3 arguments (I, J, and K), each with numerical values, which then will implement 3 nested for loops that iterate from 0 to I, J, and K. You should test the input arguments that they are integers, and that they are a positive number; if they are not, the script should exit with the appropriate error message. If there are more, or less arguments than the required 3 arguments, the script should again fail with the appropriate message.

b. 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.

c. 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.

d. Write a script using Ploticus or Matplotlib (pick one) 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.

15. Answer the following questions:

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?

To some extent it will improve the performance of your system keeping your RAM constant but to improve it to further level we must increase the RAM. If you consider the case where you are allocating more than one processor to system but virtualization techniques are not present in the BIOS then it wont help in maximizing the performance. Allocating more processors to VM can cause spin lock situation in which host is blocked by the multiprocessor guest system. Sharing more CPU's with guest can cause problems like degradation in the responsiveness of host, glitches. If user wants his/her host to perform at peak then it is good to allocate minimum processors to 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 provides the partial virtualization options which we can provide to guest operating system

1. None: No paravirtualization
2. Legacy: It is for older virtual box applications.
3. Minimal: This is for mac OS guest users, It provides TSC and APIC frequency to guest operating systems.
4. Hyper-V: This is for windows guest machines, commonly identified by windows 7 or newer windows systems. It supports features like Para virtualized clocks, Guest crash reporting and relaxed timer clocks
5. KVM: This is for good for Linux systems, It supports Para virtualized clocks and SMP sniplocks.
   KVM good for Linux reasons:
   - Smaller and faster
   - Can be used with other guests
   - Can save machines state on hard drive and close.

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 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

When we need to process critical applications with heavy databases at that time we have to use NVMe, For high capacity, low availability and sequential needs we need SATA else for regular processing IDE is required.

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