

# Lab 1: Ubuntu Deployment on VirtualBox with Networking Modes, Linux Commands, and Nginx Setup

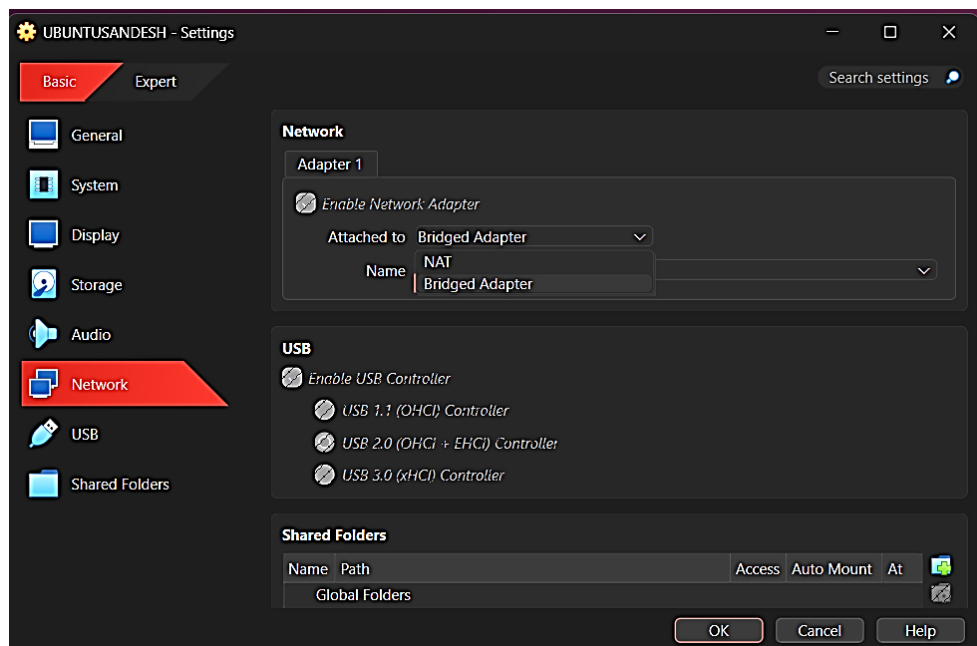
## Objectives

1. Deploy Ubuntu OS using VirtualBox.
2. Understand and configure different networking modes (NAT vs Bridge).
3. Execute essential Linux commands for file and system management.
4. Understand the difference between absolute and relative paths.
5. Install and verify Nginx web server operation.
6. Check network ports and running services.

## Tools and Technologies Used

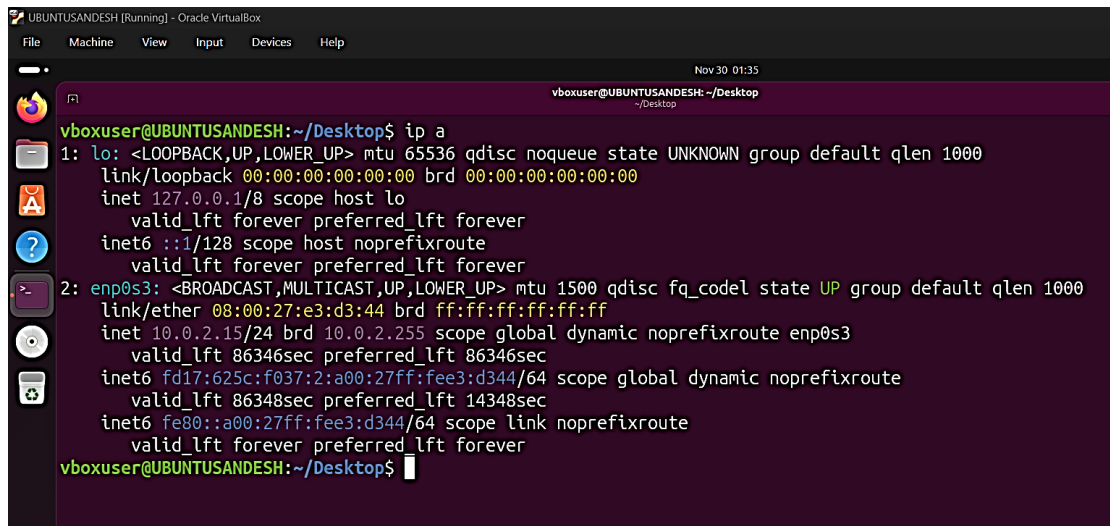
1. Oracle VirtualBox
2. Ubuntu OS (ISO Image)
3. Terminal / Bash Shell
4. Nginx Web Server
5. net-tools package

## 1. NAT vs Bridge Networking



## NAT (Network Address Translation)

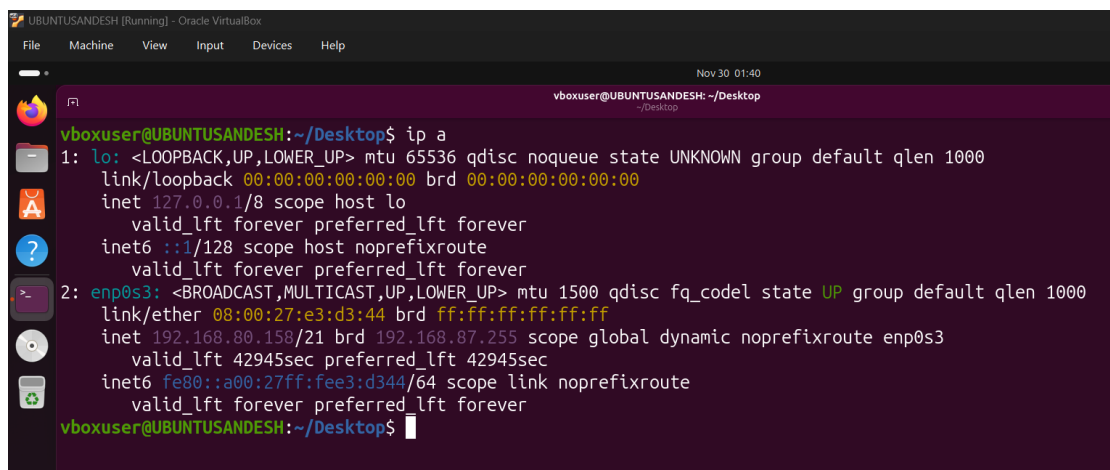
- Default network mode in VirtualBox.
- VM gets a private IP assigned by VirtualBox.
- VM can access the internet, but external devices cannot access the VM directly.
- Useful for isolated setups where you do not want your VM exposed to the local network.



```
UBUNTUSANDESH [Running] - Oracle VirtualBox
File Machine View Input Devices Help
Nov 30 01:35
vboxuser@UBUNTUSANDESH: ~/Desktop
vboxuser@UBUNTUSANDESH:~/Desktop$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
   link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
   inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
   inet6 ::1/128 scope host noprefixroute
       valid_lft forever preferred_lft forever
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
   link/ether 08:00:27:e3:d3:44 brd ff:ff:ff:ff:ff:ff
   inet 10.0.2.15/24 brd 10.0.2.255 scope global dynamic noprefixroute enp0s3
       valid_lft 86346sec preferred_lft 86346sec
   inet6 fd17:625c:f037:2:a00:27ff:fee3:d344/64 scope global dynamic noprefixroute
       valid_lft 86348sec preferred_lft 14348sec
   inet6 fe80::a00:27ff:fee3:d344/64 scope link noprefixroute
       valid_lft forever preferred_lft forever
vboxuser@UBUNTUSANDESH:~/Desktop$
```

## Bridge Mode

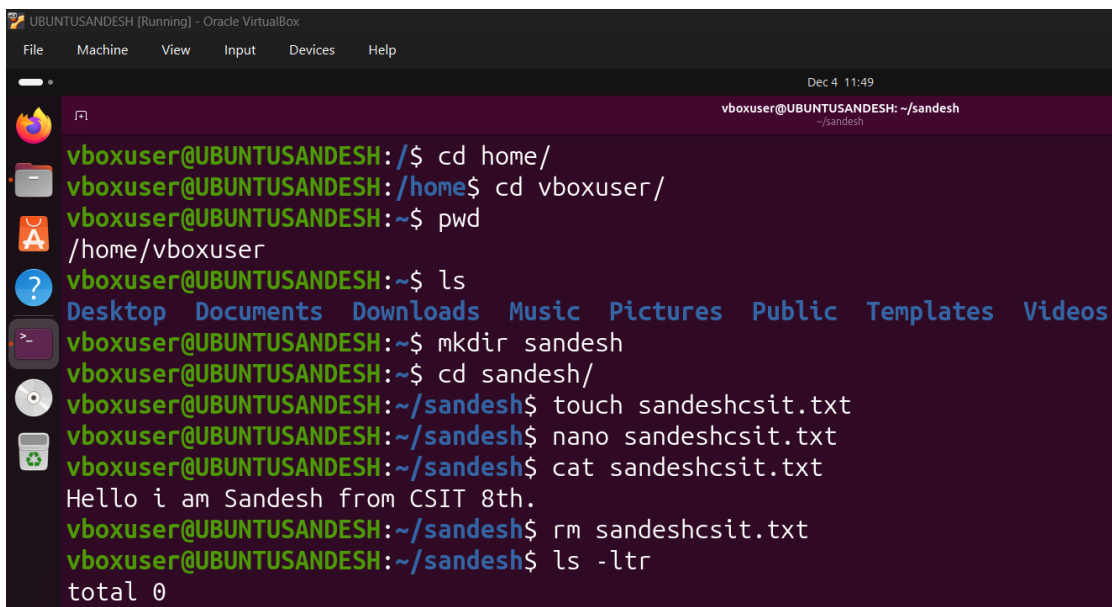
- VM acts as a full device on the local network.
- Gets an IP from the same router as the host machine.
- Other devices in the network can ping or access the VM.
- Useful for hosting services or testing server accessibility.



```
UBUNTUSANDESH [Running] - Oracle VirtualBox
File Machine View Input Devices Help
Nov 30 01:40
vboxuser@UBUNTUSANDESH: ~/Desktop
vboxuser@UBUNTUSANDESH:~/Desktop$ ip a
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default qlen 1000
   link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
   inet 127.0.0.1/8 scope host lo
       valid_lft forever preferred_lft forever
   inet6 ::1/128 scope host noprefixroute
       valid_lft forever preferred_lft forever
2: enp0s3: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
   link/ether 08:00:27:e3:d3:44 brd ff:ff:ff:ff:ff:ff
   inet 192.168.80.158/21 brd 192.168.87.255 scope global dynamic noprefixroute enp0s3
       valid_lft 42945sec preferred_lft 42945sec
   inet6 fe80::a00:27ff:fee3:d344/64 scope link noprefixroute
       valid_lft forever preferred_lft forever
vboxuser@UBUNTUSANDESH:~/Desktop$
```

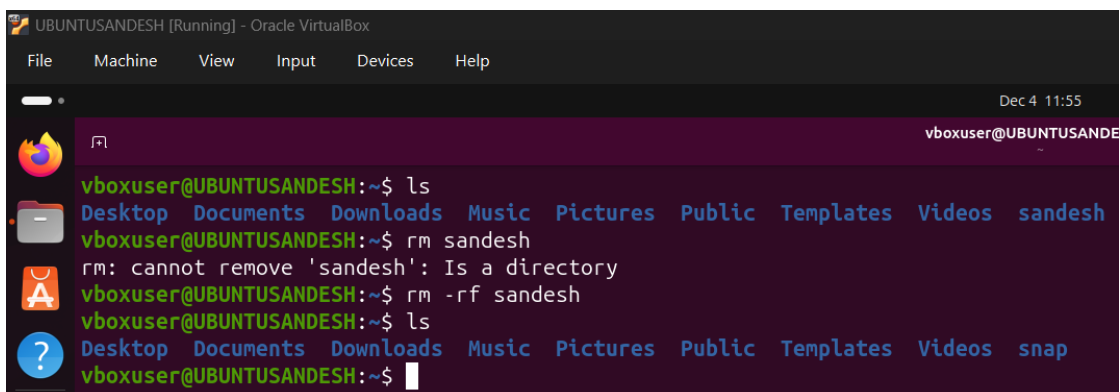
## 2. Basic Linux Commands Used

- a. cd: change directory
- b. pwd: Show current working directory
- c. ls: List files and directories
- d. mkdir <directory>: Create a new directory
- e. touch <file>: Create an empty file
- f. nano <file>: Open file in nano editor (exit: Ctrl X)
- g. cat <file>: Display file contents
- h. rm <file>: Delete a file
- i. ls -ltr: List with details sorted by time



```
UBUNTUSANDESH [Running] - Oracle VirtualBox
File Machine View Input Devices Help
Dec 4 11:49
vboxuser@UBUNTUSANDESH: ~/sandesh
vboxuser@UBUNTUSANDESH:/$ cd home/
vboxuser@UBUNTUSANDESH:/home$ cd vboxuser/
vboxuser@UBUNTUSANDESH:~$ pwd
/home/vboxuser
vboxuser@UBUNTUSANDESH:~$ ls
Desktop Documents Downloads Music Pictures Public Templates Videos
vboxuser@UBUNTUSANDESH:~$ mkdir sandesh
vboxuser@UBUNTUSANDESH:~$ cd sandesh/
vboxuser@UBUNTUSANDESH:~/sandesh$ touch sandeshcsit.txt
vboxuser@UBUNTUSANDESH:~/sandesh$ nano sandeshcsit.txt
vboxuser@UBUNTUSANDESH:~/sandesh$ cat sandeshcsit.txt
Hello i am Sandesh from CSIT 8th.
vboxuser@UBUNTUSANDESH:~/sandesh$ rm sandeshcsit.txt
vboxuser@UBUNTUSANDESH:~/sandesh$ ls -ltr
total 0
```

- j. rm <directory>: Fails if directory not empty
- k. rm -rf <directory>: Force delete directory



```
UBUNTUSANDESH [Running] - Oracle VirtualBox
File Machine View Input Devices Help
Dec 4 11:55
vboxuser@UBUNTUSANDESH:~$ ls
Desktop Documents Downloads Music Pictures Public Templates Videos sandesh
vboxuser@UBUNTUSANDESH:~$ rm sandesh
rm: cannot remove 'sandesh': Is a directory
vboxuser@UBUNTUSANDESH:~$ rm -rf sandesh
vboxuser@UBUNTUSANDESH:~$ ls
Desktop Documents Downloads Music Pictures Public Templates Videos snap
vboxuser@UBUNTUSANDESH:~$
```

l. `df -h`: Show disk/storage usage

m. `free -mh`: Show RAM usage

```
UBUNTUSANDESH [Running] - Oracle VirtualBox
File Machine View Input Devices Help
Dec 4 11:59
vboxuser@UBUNTUSANDESH: ~
vboxuser@UBUNTUSANDESH:~$ df -h
Filesystem      Size  Used Avail Use% Mounted on
tmpfs           330M  1.6M  328M   1% /run
/dev/sda2       25G   6.3G   17G  27% /
tmpfs           823M    0  823M   0% /dev/shm
tmpfs           5.0M   8.0K   5.0M   1% /run/lock
tmpfs           823M   8.0K   823M   1% /tmp
tmpfs           165M   84K   165M   1% /run/user/1000
/dev/sr0        51M    51M    0 100% /media/vboxuser/VBox_GAs_7.2.4
tmpfs           1.0M    0   1.0M   0% /run/credentials/systemd-resolved.service
tmpfs           1.0M    0   1.0M   0% /run/credentials/systemd-journald.service
vboxuser@UBUNTUSANDESH:~$ free -mh
Mem:            total      used        free      shared  buff/cache   available
Swap:           0B          0B          0B
vboxuser@UBUNTUSANDESH:~$
```

n. `top`: Show running processes

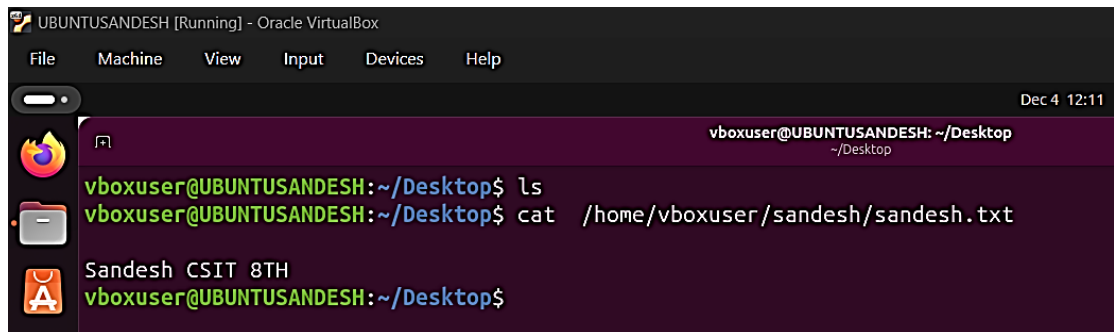
```
UBUNTUSANDESH [Running] - Oracle VirtualBox
File Machine View Input Devices Help
Dec 4 12:04
vboxuser@UBUNTUSANDESH: ~ -- top
top - 12:04:23 up 1:40, 1 user, load average: 0.10, 0.57, 1.52
Tasks: 216 total, 1 running, 211 sleeping, 0 stopped, 4 zombie
%Cpu(s): 0.9 us, 1.4 sy, 0.0 ni, 97.8 id, 0.0 wa, 0.0 hi, 0.0 si, 0.0 st
MiB Mem : 1645.9 total, 86.1 free, 1408.4 used, 378.2 buff/cache
MiB Swap: 0.0 total, 0.0 free, 0.0 used, 237.5 avail Mem

  PID USER      PR  NI  VIRT  RES  SHR S %CPU  %MEM    TIME+  COMMAND
 5973 vboxuser  20   0 4088428 364628 97568 S  4.0  21.6   0:32.31 gnome-shell
 6865 vboxuser  20   0 1725988 211824 70164 S  3.0  12.6   0:22.28 ptxis
 7006 vboxuser  20   0 22216  6188  3992 R  0.7   0.4   0:00.92 top
    1 root      20   0 24964  9984  5188 S  0.3   0.6   20:58.97 systemd
   28 root      20   0    0     0    0 I  0.3   0.0   0:02.14 kworker/u10:0-flush-8:0
 1660 root      20   0 232980  552  284 S  0.3   0.0   0:06.65 VBoxDRMClient
 6163 vboxuser  20   0 586168 12188  4844 S  0.3   0.7   0:02.20 update-notifier
    2 root      20   0    0     0    0 S  0.0   0.0   0:00.11 kthreadd
    3 root      20   0    0     0    0 S  0.0   0.0   0:00.00 pool_workqueue_release
    4 root      0 -20    0     0    0 I  0.0   0.0   0:00.00 kworker/R-rcu_gp
    5 root      0 -20    0     0    0 I  0.0   0.0   0:00.00 kworker/R-sync_wq
    6 root      0 -20    0     0    0 I  0.0   0.0   0:00.00 kworker/R-kvfree_rcu_reclaim
    7 root      0 -20    0     0    0 I  0.0   0.0   0:00.00 kworker/R-slub_flushwq
    8 root      0 -20    0     0    0 I  0.0   0.0   0:00.00 kworker/R-netns
   11 root      0 -20    0     0    0 I  0.0   0.0   0:01.27 kworker/0:0H-kblockd
   12 root      20   0    0     0    0 I  0.0   0.0   0:00.00 kworker/u8:0-ipv6_addrconf
   13 root      0 -20    0     0    0 I  0.0   0.0   0:00.00 kworker/R-mm_percpu_wq
   14 root      20   0    0     0    0 S  0.0   0.0   0:01.59 ksoftirqd/0
   15 root      20   0    0     0    0 I  0.0   0.0   0:03.26 rcu_preempt
   16 root      20   0    0     0    0 S  0.0   0.0   0:00.00 rcu_exp_par_gp_kthread_worker/0
   17 root      20   0    0     0    0 S  0.0   0.0   0:00.17 rcu_exp_gp_kthread_worker
   18 root      rt  0    0     0    0 S  0.0   0.0   0:00.14 migration/0
   19 root     -51  0    0     0    0 S  0.0   0.0   0:00.00 idle_inject/0
   20 root      20   0    0     0    0 S  0.0   0.0   0:00.00 cpuhp/0
   21 root      20   0    0     0    0 S  0.0   0.0   0:00.00 cpuhp/1
   22 root     -51  0    0     0    0 S  0.0   0.0   0:00.00 idle_inject/1
   23 root      rt  0    0     0    0 S  0.0   0.0   0:00.50 migration/1
   24 root      20   0    0     0    0 S  0.0   0.0   0:01.26 ksoftirqd/1
   27 root      20   0    0     0    0 I  0.0   0.0   0:01.64 kworker/u9:0-events_power_efficient
   29 root      20   0    0     0    0 S  0.0   0.0   0:00.00 kdevtmpfs
   30 root      0 -20    0     0    0 I  0.0   0.0   0:00.00 kworker/R-inet_frag_wq
   31 root      20   0    0     0    0 I  0.0   0.0   0:00.00 rcu_tasks_kthread
```

### 3. Absolute Path vs Relative Path

#### Absolute Path

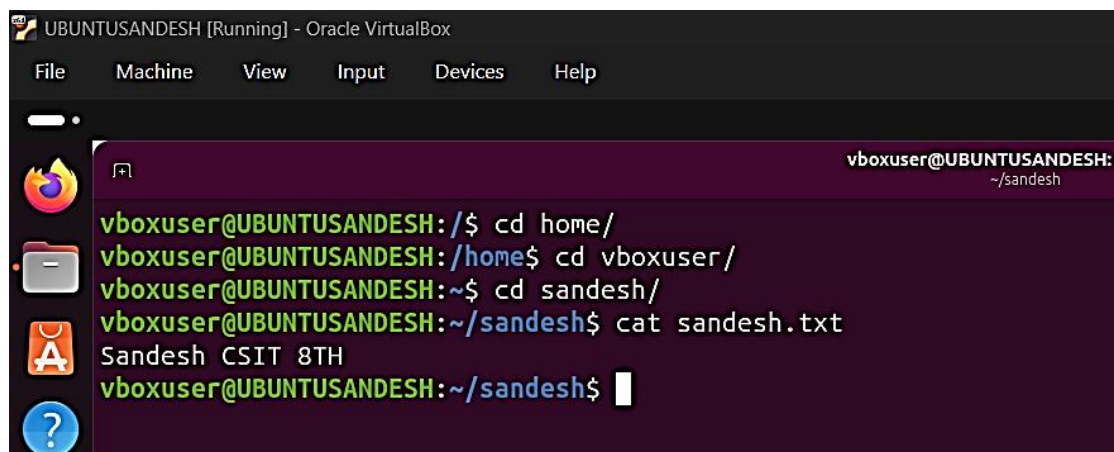
- Starts from root directory /.
- Complete path to a file or folder.
- Example: /home/user/documents/file.txt



The screenshot shows a terminal window titled "UBUNTUSANDESH [Running] - Oracle VirtualBox". The terminal prompt is "vboxuser@UBUNTUSANDESH: ~/Desktop". The user enters the command "ls", and the output is "vboxuser@UBUNTUSANDESH:~/Desktop\$ ls". Then, the user enters the command "cat /home/vboxuser/sandesh/sandesh.txt", and the output is "Sandesh CSIT 8TH". The terminal prompt is "vboxuser@UBUNTUSANDESH:~/Desktop\$".

#### Relative Path

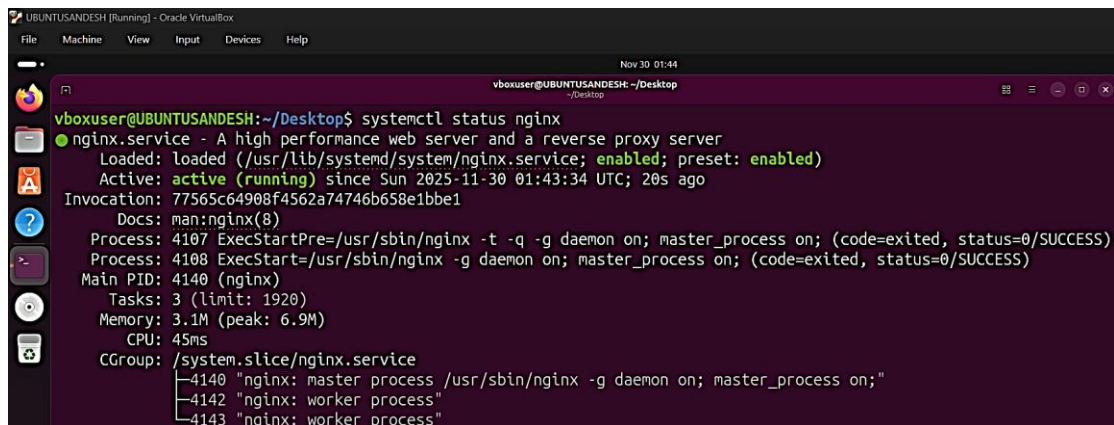
- Based on current working directory.
- Example: ../folder/file.txt or ./file.txt



The screenshot shows a terminal window titled "UBUNTUSANDESH [Running] - Oracle VirtualBox". The terminal prompt is "vboxuser@UBUNTUSANDESH: ~/sandesh". The user enters the command "cd home/", and the output is "vboxuser@UBUNTUSANDESH:/\$ cd home/". Then, the user enters the command "cd vboxuser/", and the output is "vboxuser@UBUNTUSANDESH:/home\$ cd vboxuser/". Then, the user enters the command "cd sandesh/", and the output is "vboxuser@UBUNTUSANDESH:~/sandesh\$ cd sandesh/". Then, the user enters the command "cat sandesh.txt", and the output is "Sandesh CSIT 8TH". The terminal prompt is "vboxuser@UBUNTUSANDESH:~/sandesh\$".

## 4. Use of Nginx on Ubuntu

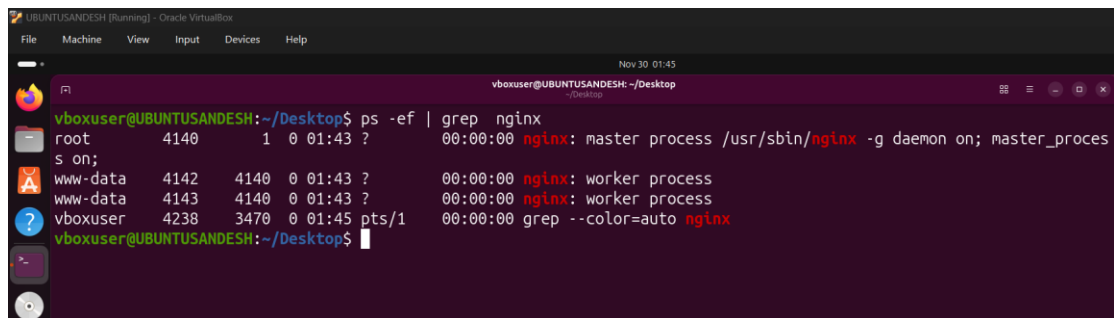
Check if Nginx is running:



A terminal window titled 'vboxuser@UBUNTUSANDESH: ~/Desktop' showing the output of the command 'systemctl status nginx'. The output indicates that the nginx.service is active (running) and has been loaded from the system. It also shows the invocation details, including the main PID (4140) and the tasks (3) running under the service.

```
vboxuser@UBUNTUSANDESH:~/Desktop$ systemctl status nginx
● nginx.service - A high performance web server and a reverse proxy server
   Loaded: loaded (/usr/lib/systemd/system/nginx.service; enabled; preset: enabled)
   Active: active (running) since Sun 2025-11-30 01:43:34 UTC; 20s ago
     Invocation: 77565c64908f4562a74746b658e1bbe1
       Docs: man:nginx(8)
    Process: 4107 ExecStartPre=/usr/sbin/nginx -t -q -g daemon on; master_process on; (code=exited, status=0/SUCCESS)
    Process: 4108 ExecStart=/usr/sbin/nginx -g daemon on; master_process on; (code=exited, status=0/SUCCESS)
   Main PID: 4140 (nginx)
      Tasks: 3 (limit: 1920)
     Memory: 3.1M (peak: 6.9M)
        CPU: 45ms
    CGroup: /system.slice/nginx.service
            └─4140 "nginx: master process /usr/sbin/nginx -g daemon on; master_process on;"
              └─4142 "nginx: worker process"
                └─4143 "nginx: worker process"
```

ps -ef | grep nginx

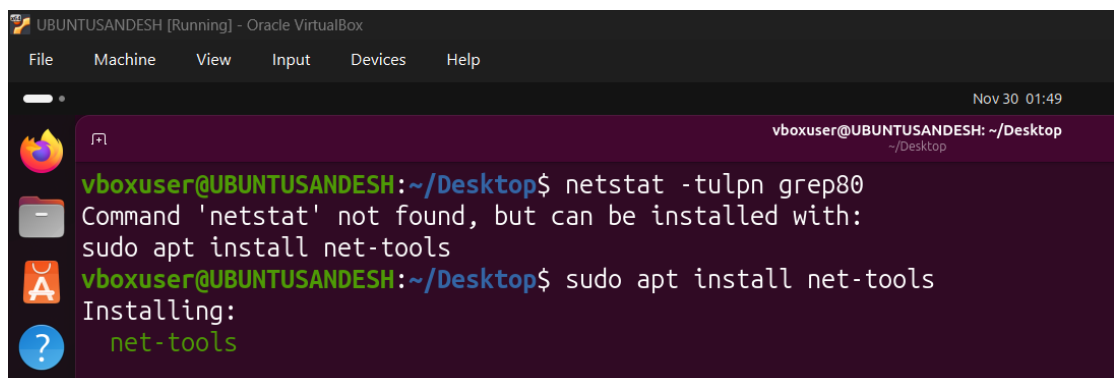


A terminal window titled 'vboxuser@UBUNTUSANDESH: ~/Desktop' showing the output of the command 'ps -ef | grep nginx'. The output lists the master process and two worker processes, all running under the root user.

```
vboxuser@UBUNTUSANDESH:~/Desktop$ ps -ef | grep nginx
root      4140      1   0 01:43 ?        00:00:00 nginx: master process /usr/sbin/nginx -g daemon on; master_proces
s on;
www-data  4142    4140   0 01:43 ?        00:00:00 nginx: worker process
www-data  4143    4140   0 01:43 ?        00:00:00 nginx: worker process
vboxuser  4238    3470   0 01:45 pts/1    00:00:00 grep --color=auto nginx
```

Install net-tools:

sudo apt install net-tools



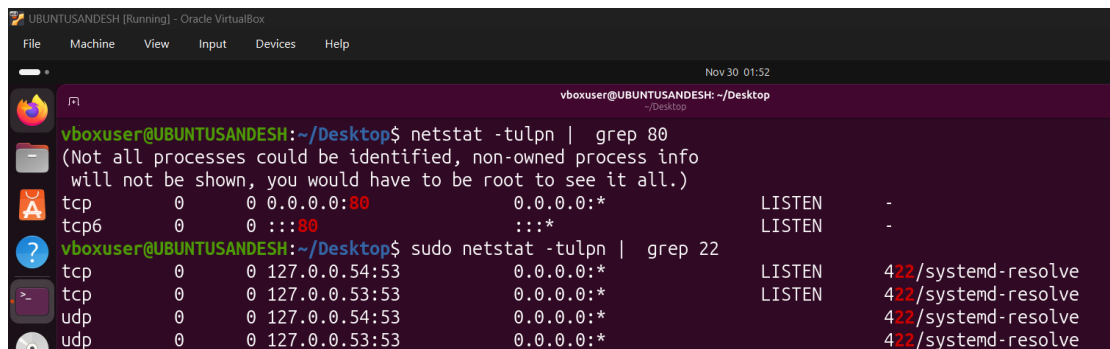
A terminal window titled 'vboxuser@UBUNTUSANDESH: ~/Desktop' showing the installation of net-tools. The user runs 'netstat -tulpn grep80', which fails because the command is not found. They then run 'sudo apt install net-tools', which successfully installs the package.

```
vboxuser@UBUNTUSANDESH:~/Desktop$ netstat -tulpn grep80
Command 'netstat' not found, but can be installed with:
sudo apt install net-tools
vboxuser@UBUNTUSANDESH:~/Desktop$ sudo apt install net-tools
Installing:
 net-tools
```

Check listening ports (for port 80 or 22):

```
netstat -tulpn | grep 80
```

```
sudo netstat -tulpn | grep 22
```



The screenshot shows a terminal window titled 'UBUNTUSANDESH (Running) - Oracle VM VirtualBox'. The user 'vboxuser' is at the prompt 'vboxuser@UBUNTUSANDESH: ~/Desktop'. The first command executed is 'netstat -tulpn | grep 80', which shows two listening entries for port 80: 'tcp 0 0 0.0.0.0:80 0.0.0.0:\* LISTEN -' and 'tcp6 0 0 :::80 :::\* LISTEN -'. The second command is 'sudo netstat -tulpn | grep 22', which shows four listening entries for port 22, all associated with 'systemd-resolve': 'tcp 0 0 127.0.0.54:53 0.0.0.0:\* LISTEN 422/systemd-resolve', 'tcp 0 0 127.0.0.53:53 0.0.0.0:\* LISTEN 422/systemd-resolve', 'udp 0 0 127.0.0.54:53 0.0.0.0:\* 422/systemd-resolve', and 'udp 0 0 127.0.0.53:53 0.0.0.0:\* 422/systemd-resolve'.

```
vboxuser@UBUNTUSANDESH:~/Desktop$ netstat -tulpn | grep 80
(Not all processes could be identified, non-owned process info
will not be shown, you would have to be root to see it all.)
tcp        0      0 0.0.0.0:80          0.0.0.0:*           LISTEN    -
tcp6       0      0 :::80              :::*                 LISTEN    -
vboxuser@UBUNTUSANDESH:~/Desktop$ sudo netstat -tulpn | grep 22
tcp        0      0 127.0.0.54:53      0.0.0.0:*           LISTEN    422/systemd-resolve
tcp        0      0 127.0.0.53:53      0.0.0.0:*           LISTEN    422/systemd-resolve
udp        0      0 127.0.0.54:53      0.0.0.0:*           422/systemd-resolve
udp        0      0 127.0.0.53:53      0.0.0.0:*           422/systemd-resolve
```

## Conclusion

This lab focused on installing and working with Ubuntu inside VirtualBox. NAT and Bridge modes were compared, followed by hands-on use of basic Linux commands. Path concepts were clarified (absolute vs relative), and Nginx installation and network port checks were performed.