EX.No:1.a **Installation of VirtualBox /VMware Workstation and Mininet**

Date:

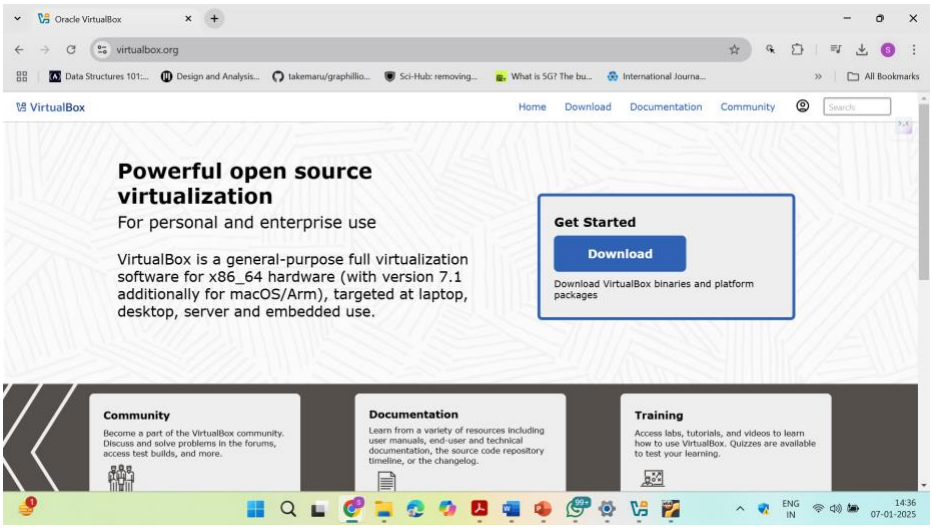
Aim:

To install Virtualbox/VMware Workstation and Mininet environment for Software Defined Network and run basic Virtual box and Mininet commands.

Procedure:

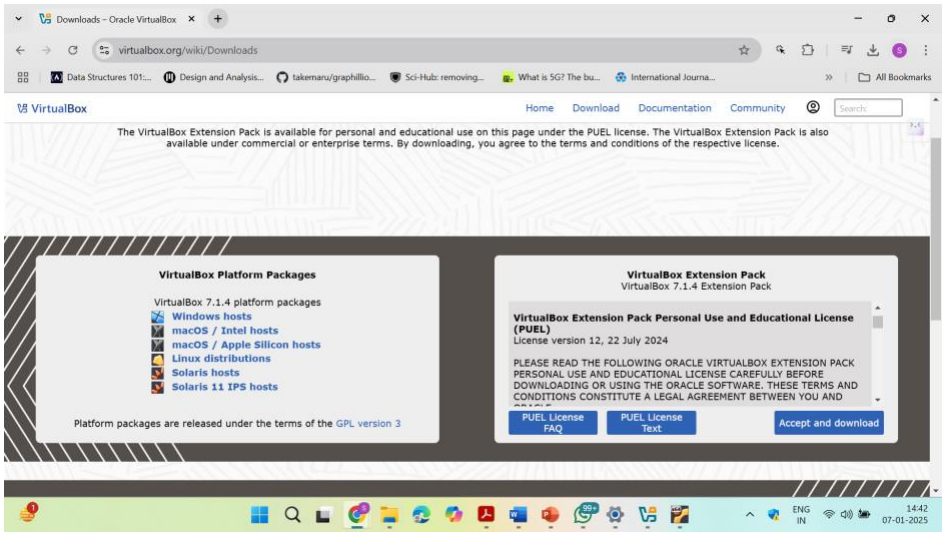
Installation of VirtualBox in Windows

Step 1: Go to the **VirtualBox Website** through the https://www.virtualbox.org/ and click download.

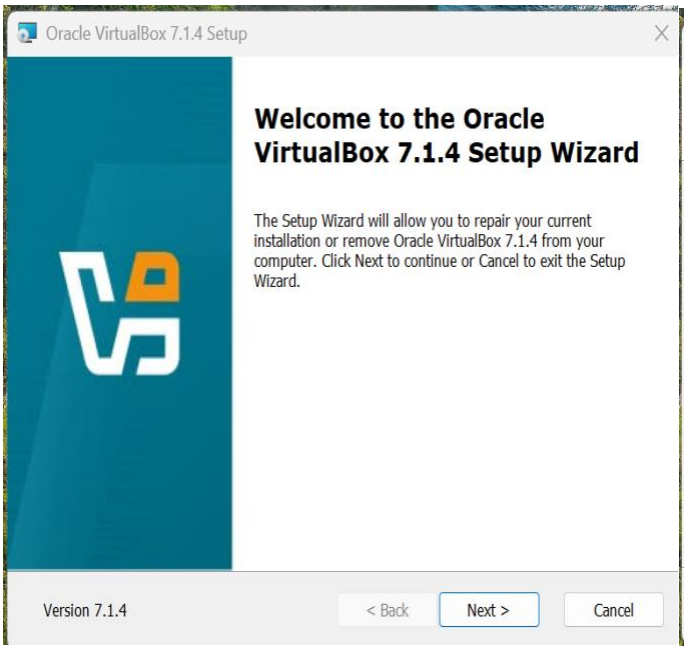


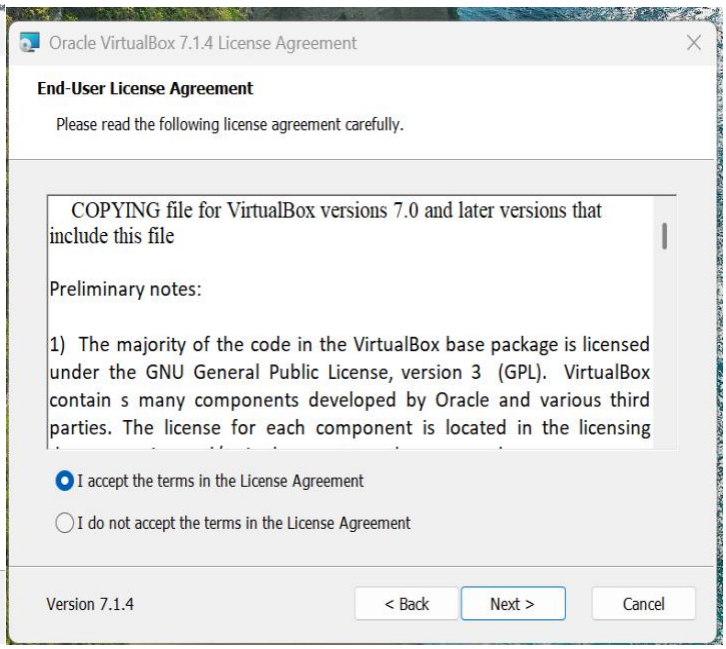
Step 2: Click Windows Host to download Virtual Box for Windows OS.

https://download.virtualbox.org/virtualbox/7.1.4/VirtualBox-7.1.4-165100-Win.exe

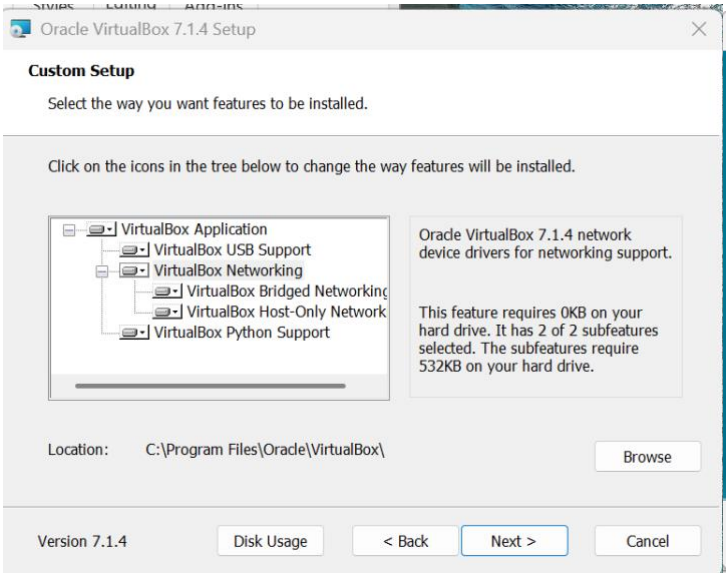


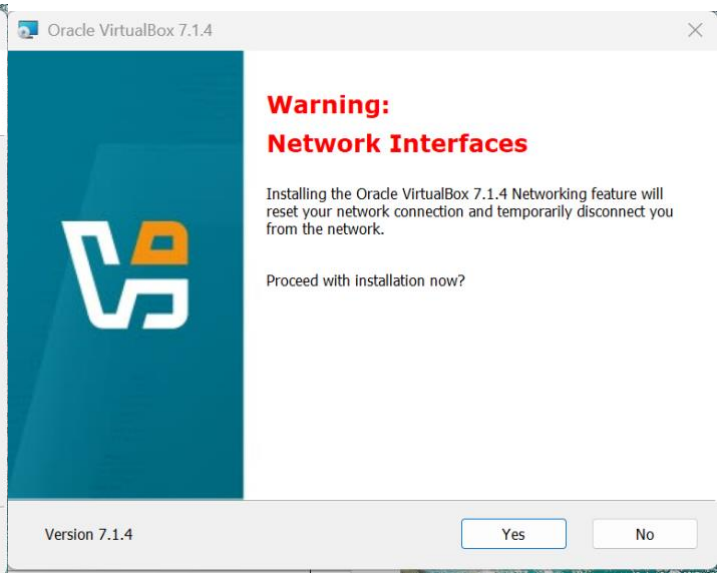
Step 3: Follow the steps to Install virtual box

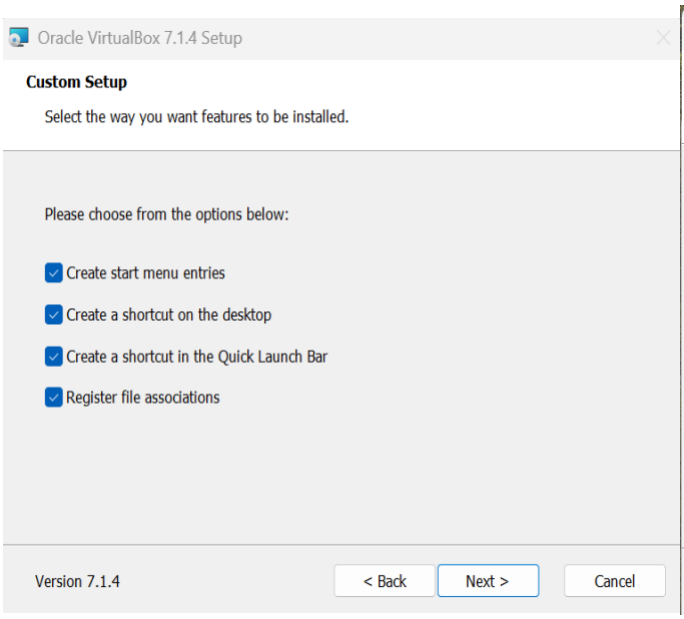


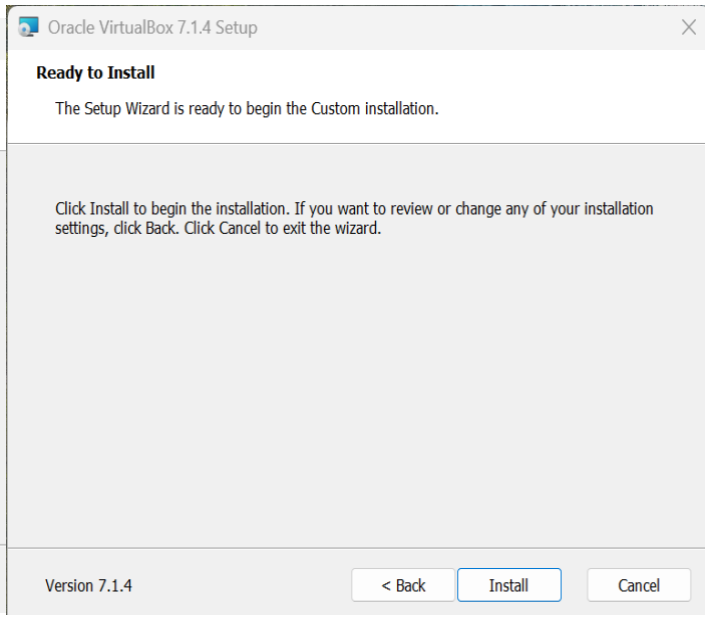


Choose the **installation folder** and click on the **Next** button.

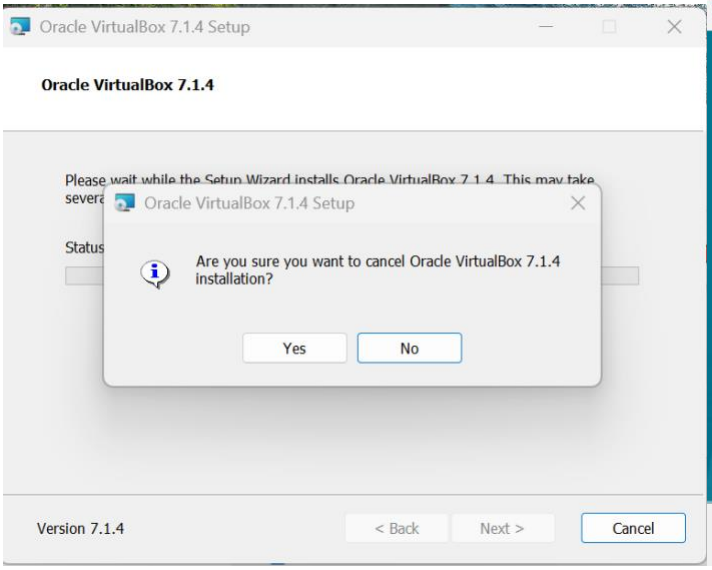


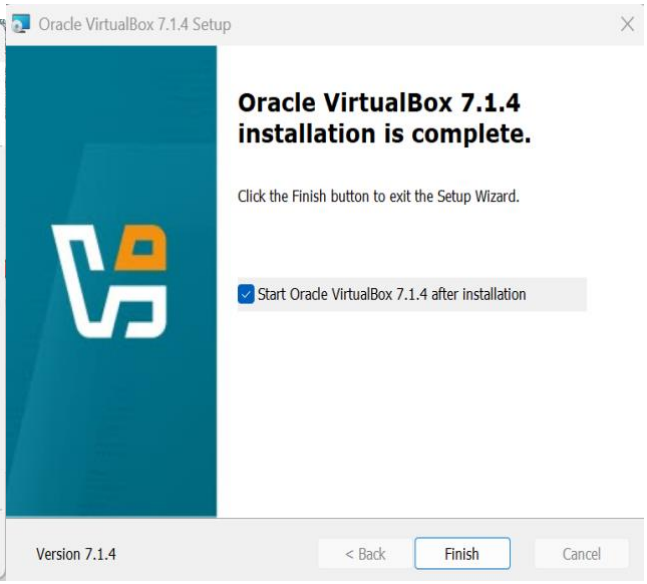






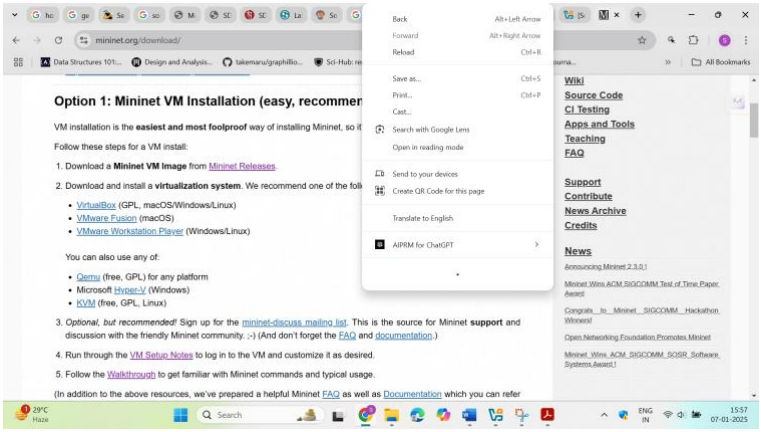
Click on “Yes’ to continue the installation



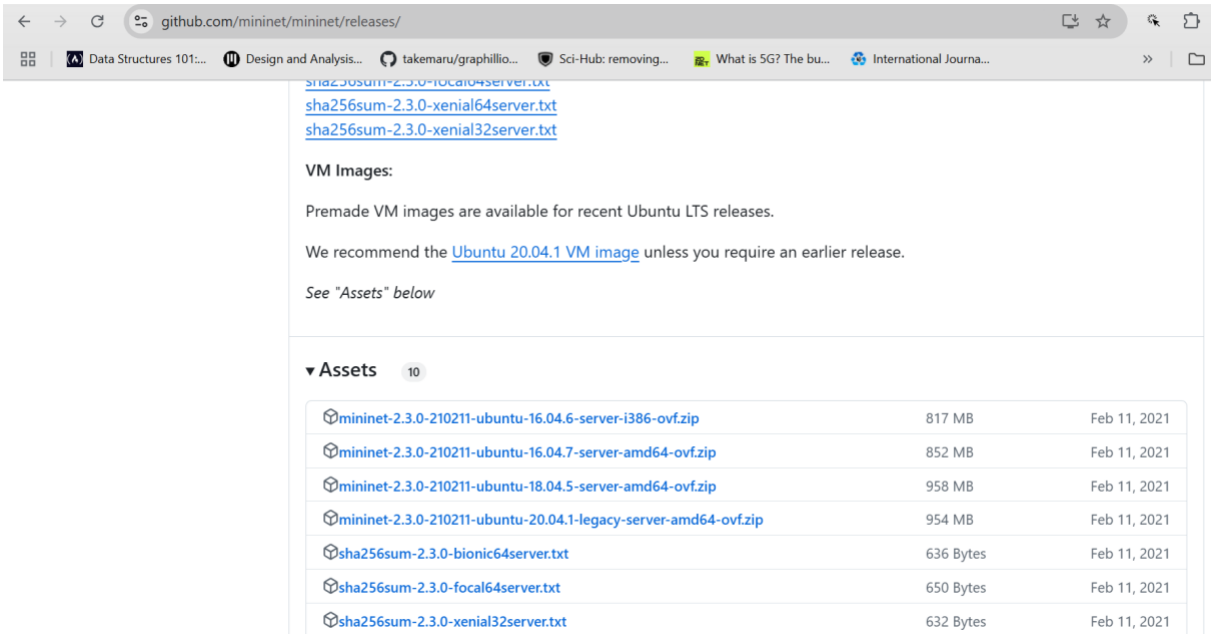


Steps to interface Mininet in Virtual Box

Step 1: Download and Install Mininet from https://mininet.org/download/



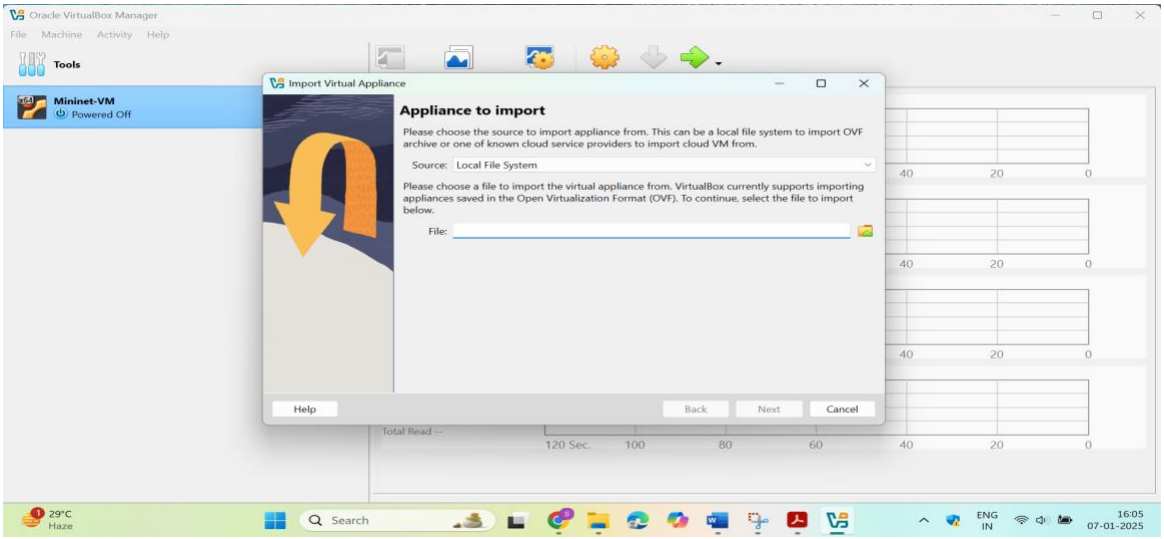
Step 2: Click on Download a **Mininet VM Image** from Mininet Releases.

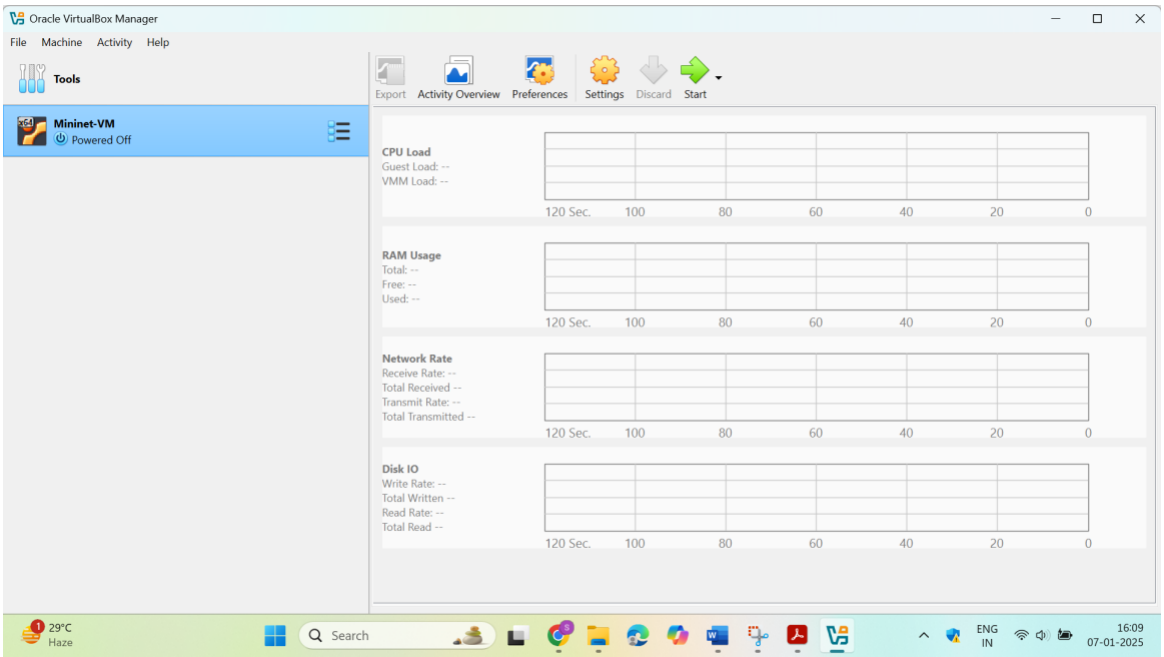


Click on mininet-2.3.0-210211-ubuntu-16.04.6-server-i386-ovf.zip from Asset https://github.com/mininet/mininet/releases/download/2.3.0/mininet-2.3.0-210211-ubuntu-16.04.6-server-i386-ovf.zip

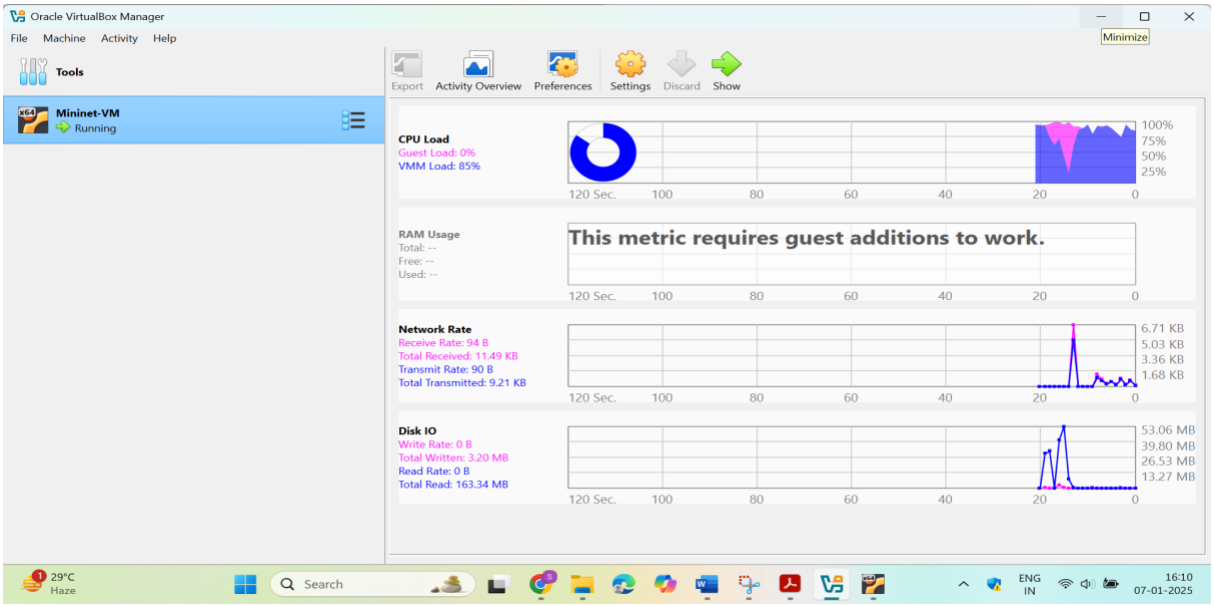
The Zip file Contains Open Virtualization Format file mininet-2.3.0-210211-ubuntu-20.04.1-legacy-server-amd64.ovf

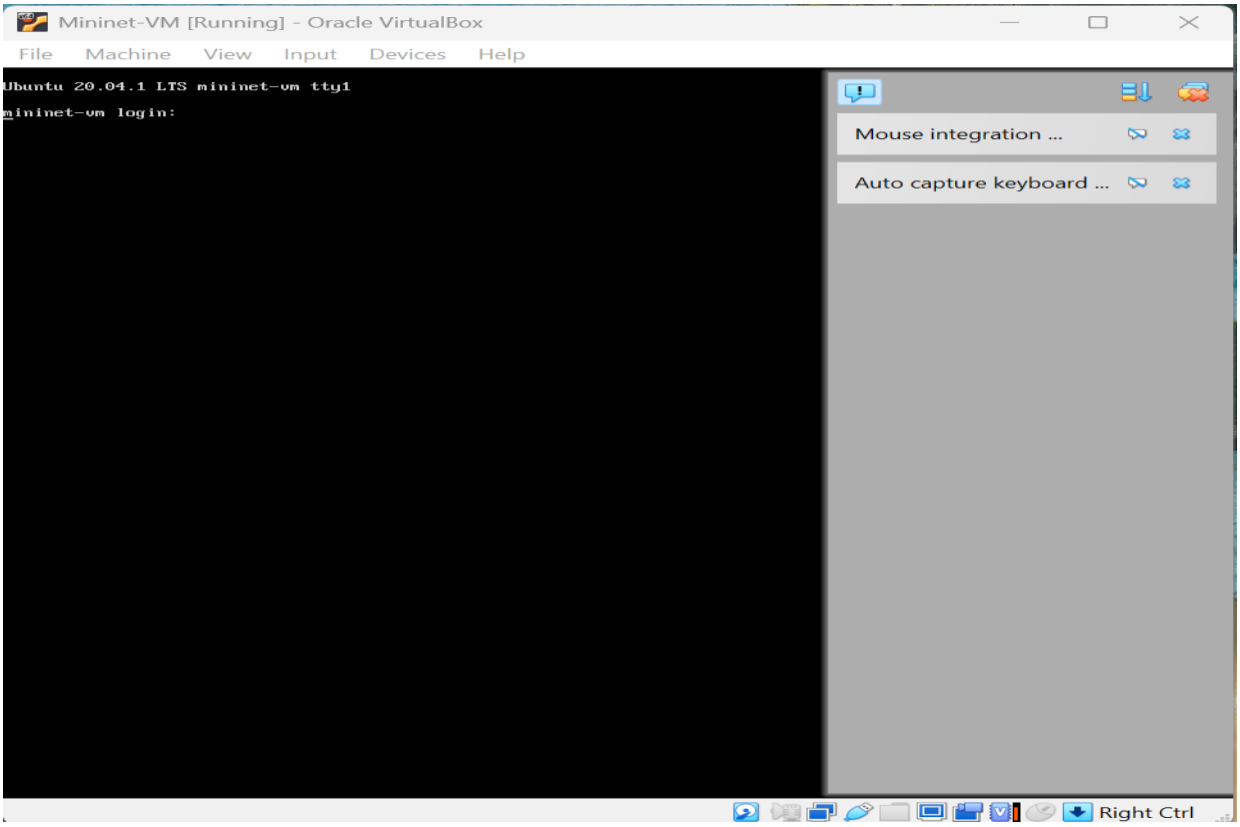
Step 3: Open Virtual Box 7.1.4
And click on Import virtual appliance and upload the above OVF file in Mininet





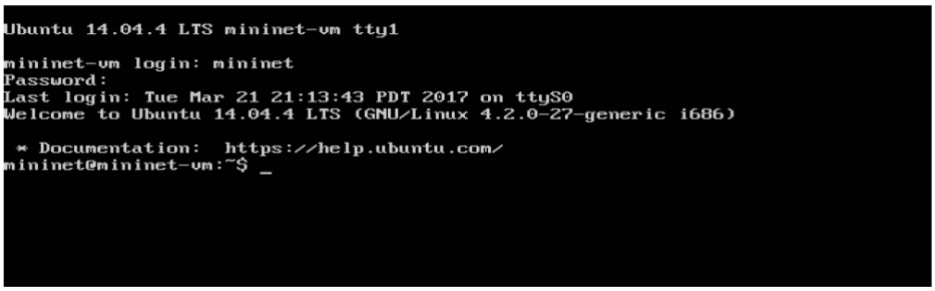
Step 4: Click on start to start the Mininet Virtual Machine.





Login: mininet

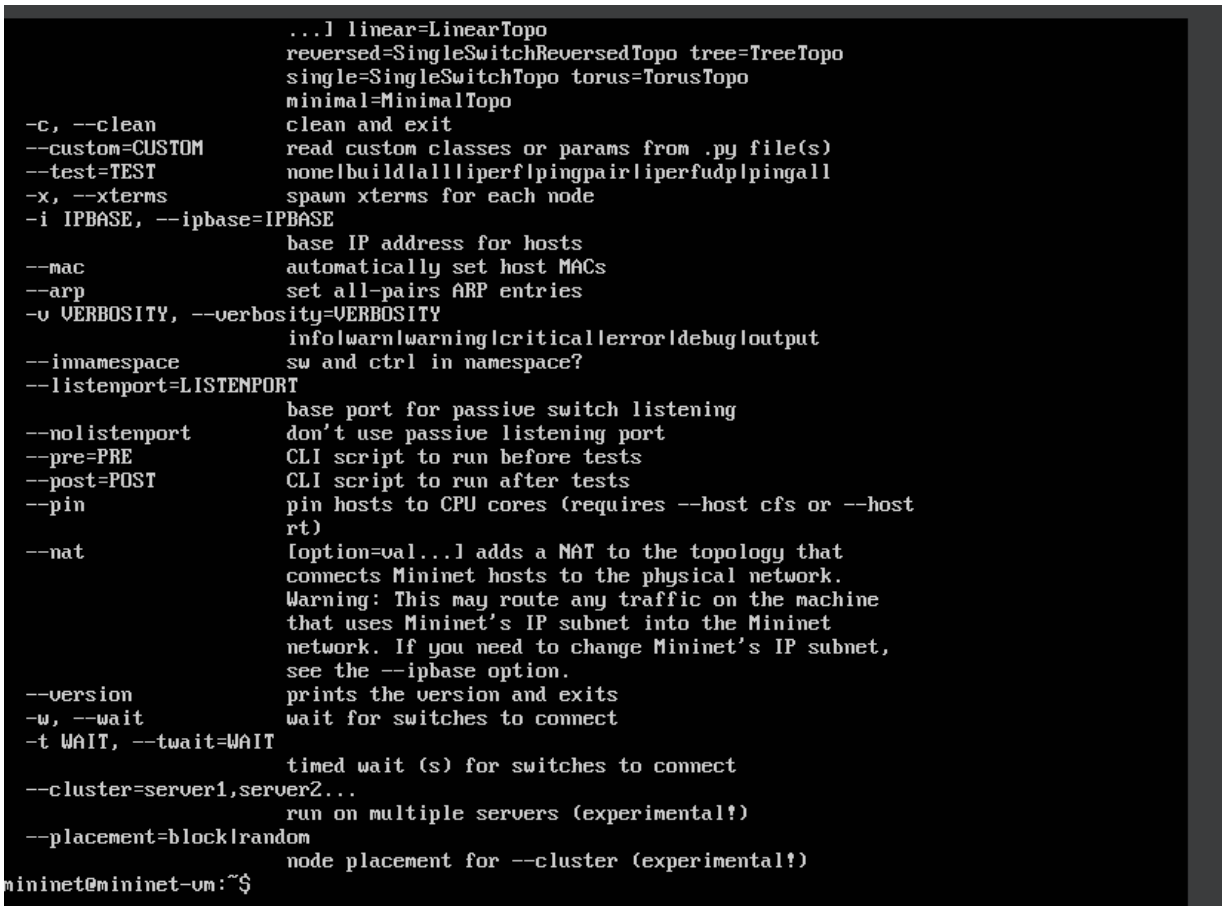
Password: mininet



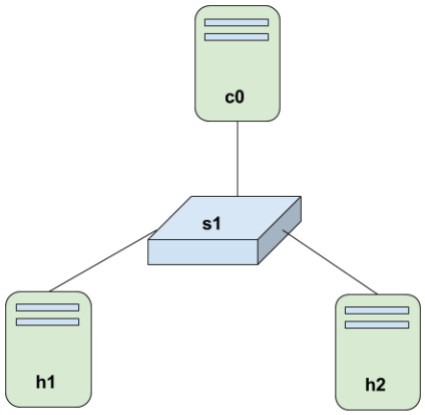
Mininet Comments and its usage:

1. Command to display a help message describing Mininet's startup options

   $ sudo mn –h



2. Create a minimal topology network which includes one OpenFlow kernel switch connected to two hosts, plus the OpenFlow reference controller.



$ sudo mn

```
mininet@mininet-vm:~$ sudo mn
*** Creating network
*** Adding controller
*** Adding hosts:
h1 h2
*** Adding switches:
s1
*** Adding links:
(h1, s1) (h2, s1)
*** Configuring hosts
h1 h2
*** Starting controller
c0
*** Starting 1 switches
s1 ...
*** Starting CLI:
mininet>
```

3. Display Mininet CLI commands

mininet> help

```
mininet> help

Documented commands (type help <topic>):
========================================
EOF    gterm  iperfudp  nodes        pingpair      py      switch  xterm
dpctl  help   link      noecho       pingpairfull  quit    time
dump   intfs  links     pingall      ports         sh      wait
exit   iperf  net       pingallfull  px            source  x

You may also send a command to a node using:
  <node> command {args}
For example:
  mininet> h1 ifconfig

The interpreter automatically substitutes IP addresses
for node names when a node is the first arg, so commands
like
  mininet> h2 ping h3
should work.

Some character-oriented interactive commands require
noecho:
  mininet> noecho h2 vi foo.py
However, starting up an xterm/gterm is generally better:
  mininet> xterm h2

mininet> _
```

4. Display nodes

   mininet> nodes

```
mininet> nodes
available nodes are:
c0 h1 h2 s1
mininet> _
```

5. Display links

   mininet> net

```
mininet> net
h1 h1-eth0:s1-eth1
h2 h2-eth0:s1-eth2
s1 lo:  s1-eth1:h1-eth0 s1-eth2:h2-eth0
c0
mininet> _
```

6. Dump information about all nodes:

   mininet> dump

```
mininet> dump
<Host h1: h1-eth0:10.0.0.1 pid=2489>
<Host h2: h2-eth0:10.0.0.2 pid=2492>
<OVSSwitch s1: lo:127.0.0.1,s1-eth1:None,s1-eth2:None pid=2498>
<Controller c0: 127.0.0.1:6653 pid=2482>
mininet> _
```

7. View the network interfaces on *h1*

   mininet> h1 ifconfig -a

```
mininet> h1 ifconfig -a
h1-eth0   Link encap:Ethernet  HWaddr 62:df:3b:1d:92:66
          inet addr:10.0.0.1  Bcast:10.255.255.255  Mask:255.0.0.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          UP LOOPBACK RUNNING  MTU:65536  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

mininet>
```

8. Show the switch interfaces, plus the VM's connection out (eth0).

   mininet> s1 ifconfig –a

```
lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          UP LOOPBACK RUNNING  MTU:65536  Metric:1
          RX packets:253 errors:0 dropped:0 overruns:0 frame:0
          TX packets:253 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1
          RX bytes:14708 (14.7 KB)  TX bytes:14708 (14.7 KB)

ovs-system Link encap:Ethernet  HWaddr b2:c5:38:d5:51:6b
          BROADCAST MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

s1        Link encap:Ethernet  HWaddr 16:ad:fa:e2:9a:49
          BROADCAST MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

s1-eth1   Link encap:Ethernet  HWaddr c2:a3:e8:5d:de:28
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

s1-eth2   Link encap:Ethernet  HWaddr c6:d4:01:99:5b:8f
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

mininet>
```

9. Print the process list from a host process:

   mininet> h1 ps –a

```
mininet> h1 ps -a
  PID TTY          TIME CMD
 1634 tty1     00:00:00 bash
 2476 tty1     00:00:00 sudo
 2477 tty1     00:00:00 mn
 2521 pts/0    00:00:00 controller
 2680 pts/1    00:00:00 ps
mininet> _
```

10. Print the process list from root network namespace

mininet> s1 ps –a

```
mininet> s1 ps -a
  PID TTY          TIME CMD
 1634 tty1     00:00:00 bash
 2476 tty1     00:00:00 sudo
 2477 tty1     00:00:00 mn
 2521 pts/0    00:00:00 controller
 2692 pts/3    00:00:00 ps
mininet>
```

11. Test connectivity between hosts

mininet> h1 ping -c 1 h2

mininet> pingall

```
mininet> h1 ping -c 1 h2
PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data.
64 bytes from 10.0.0.2: icmp_seq=1 ttl=64 time=1.27 ms

--- 10.0.0.2 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 1.271/1.271/1.271/0.000 ms
mininet> pingall
*** Ping: testing ping reachability
h1 -> h2
h2 -> h1
*** Results: 0% dropped (2/2 received)
mininet>
```

12. To Run a simple web server and client

mininet> h1 python -m http.server 80 &

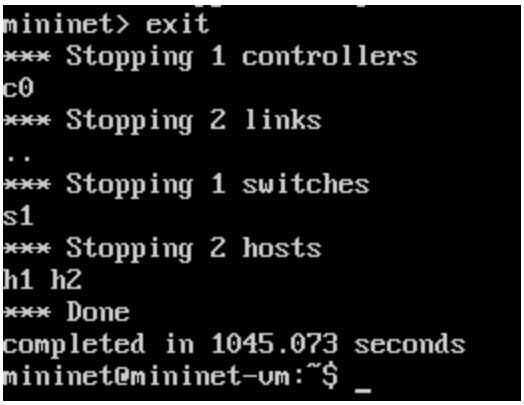
mininet> h2 wget -O - h1

mininet> h1 kill %python

```
mininet> h1 python -m http.server 80 &
mininet> h2 wget -O - h1
--2025-01-07 20:49:18--  http://10.0.0.1/
Connecting to 10.0.0.1:80... failed: Connection refused.
mininet> h1 kill % python
/usr/bin/python: No module named http
bash: kill: python: arguments must be process or job IDs
mininet> _
```

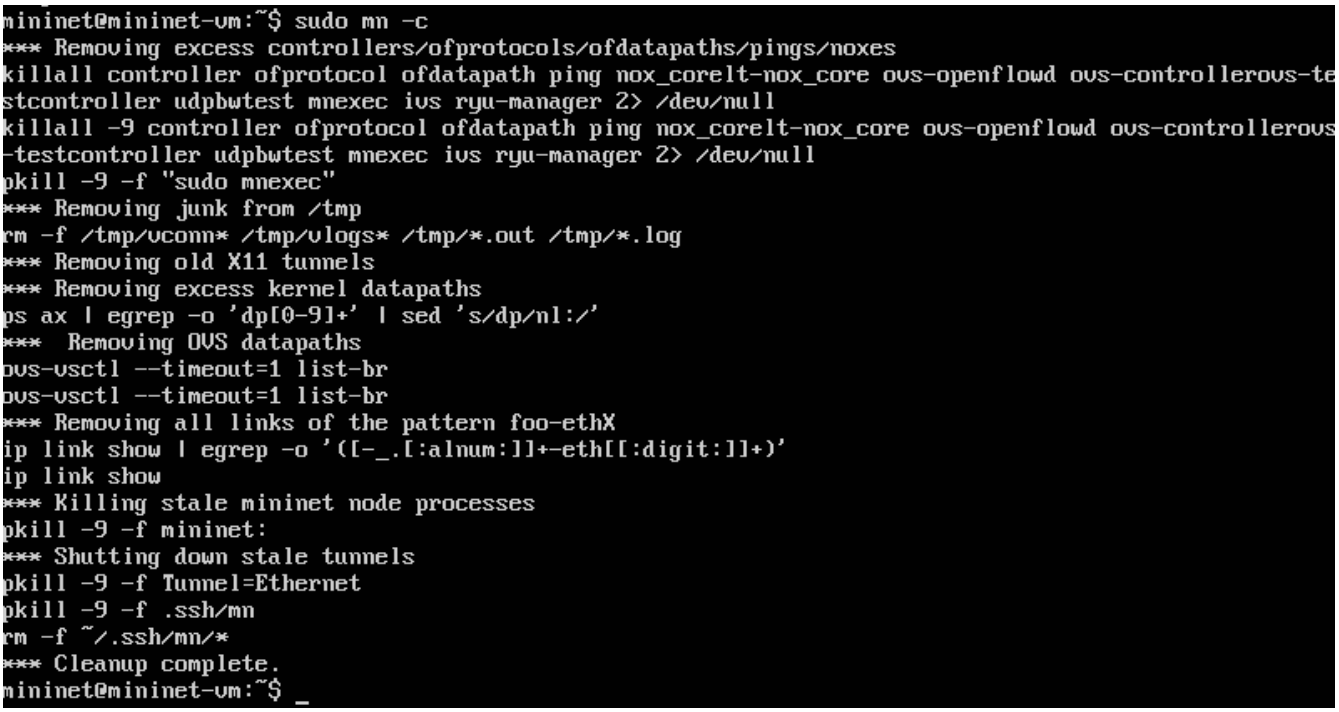
13. To Exit the Mininet CLI:

    mininet> exit



14. To Cleanup Mininet

    $ sudo mn -c



15. Create a minimal Mininet, run an iperf server on one host, run an iperf client on the second host, and parse the bandwidth achieved

    $ sudo mn --test iperf

```
mininet@mininet-vm:~$ sudo mn --test iperf
*** Creating network
*** Adding controller
*** Adding hosts:
h1 h2
*** Adding switches:
s1
*** Adding links:
(h1, s1) (h2, s1)
*** Configuring hosts
h1 h2
*** Starting controller
c0
*** Starting 1 switches
s1 ...
*** Waiting for switches to connect
s1
*** Iperf: testing TCP bandwidth between h1 and h2
*** Results: ['71.5 Gbits/sec', '71.6 Gbits/sec']
*** Stopping 1 controllers
c0
*** Stopping 2 links
..
*** Stopping 1 switches
s1
*** Stopping 2 hosts
h1 h2
*** Done
completed in 10.487 seconds
mininet@mininet-vm:~$
```

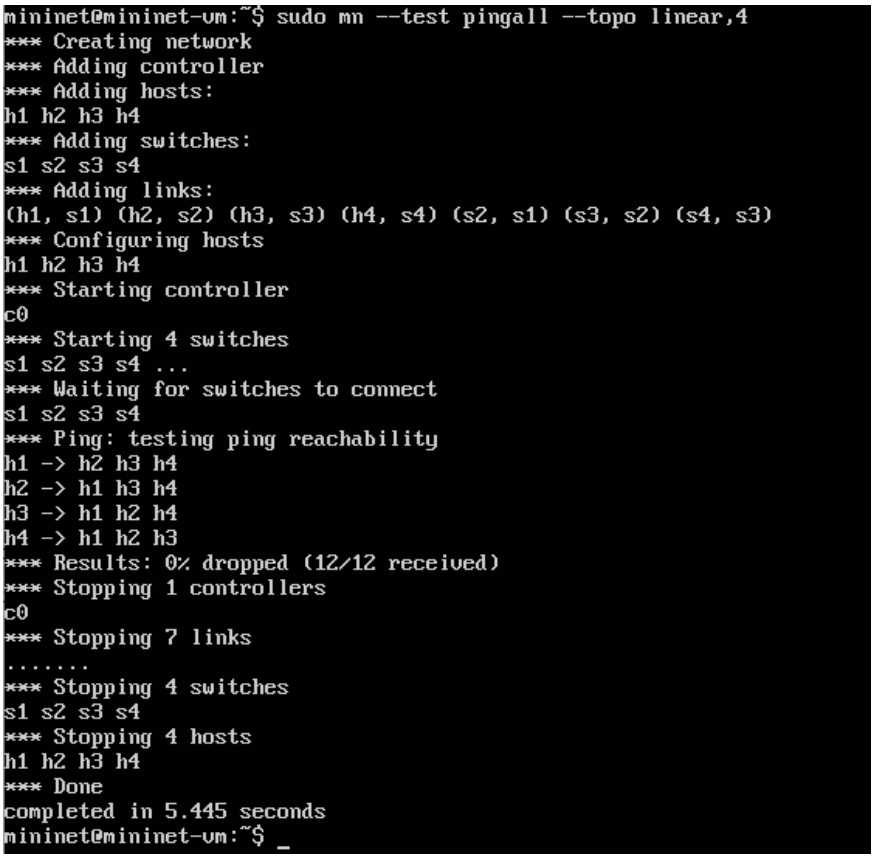
16. To verify all-pairs ping connectivity with one switch and three hosts:

    $ sudo mn --test pingall --topo single,3

```
mininet@mininet-vm:~$ sudo mn --test pingall --topo single,3
*** Creating network
*** Adding controller
*** Adding hosts:
h1 h2 h3
*** Adding switches:
s1
*** Adding links:
(h1, s1) (h2, s1) (h3, s1)
*** Configuring hosts
h1 h2 h3
*** Starting controller
c0
*** Starting 1 switches
s1 ...
*** Waiting for switches to connect
s1
*** Ping: testing ping reachability
h1 -> h2 h3
h2 -> h1 h3
h3 -> h1 h2
*** Results: 0% dropped (6/6 received)
*** Stopping 1 controllers
c0
*** Stopping 3 links
...
*** Stopping 1 switches
s1
*** Stopping 3 hosts
h1 h2 h3
*** Done
completed in 5.204 seconds
mininet@mininet-vm:~$
```

17. Verify all-pairs ping connectivity with a linear topology (where each switch has one host, and all switches connect in a line

    $ sudo mn --test pingall --topo linear,4



Result: Thus vitualBox and Mininet environment for working with software defined networks has been successfully installed and Mininet CLI commands are executed.