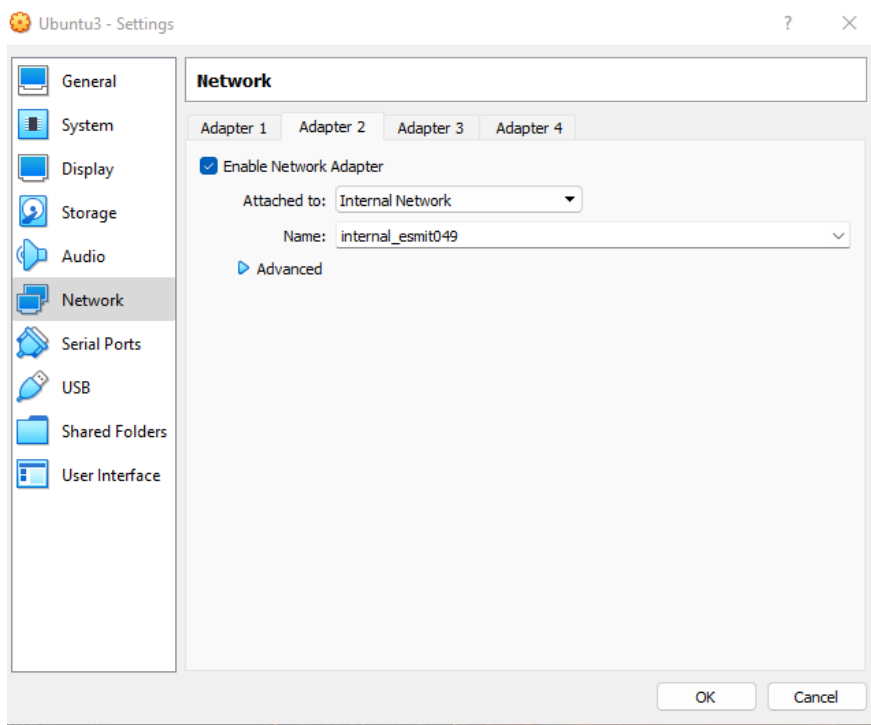


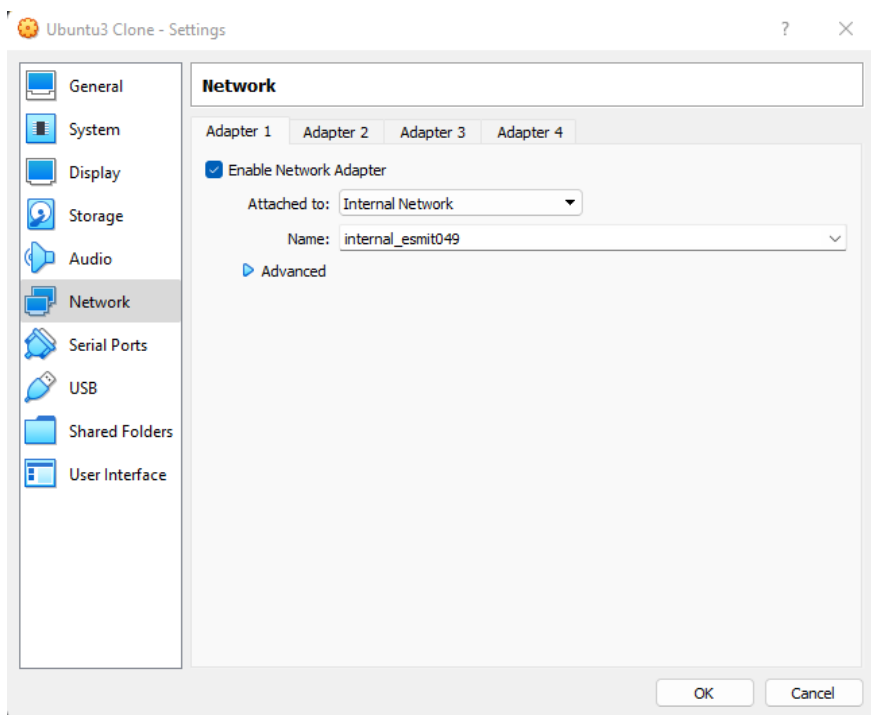
Task A

Step1:

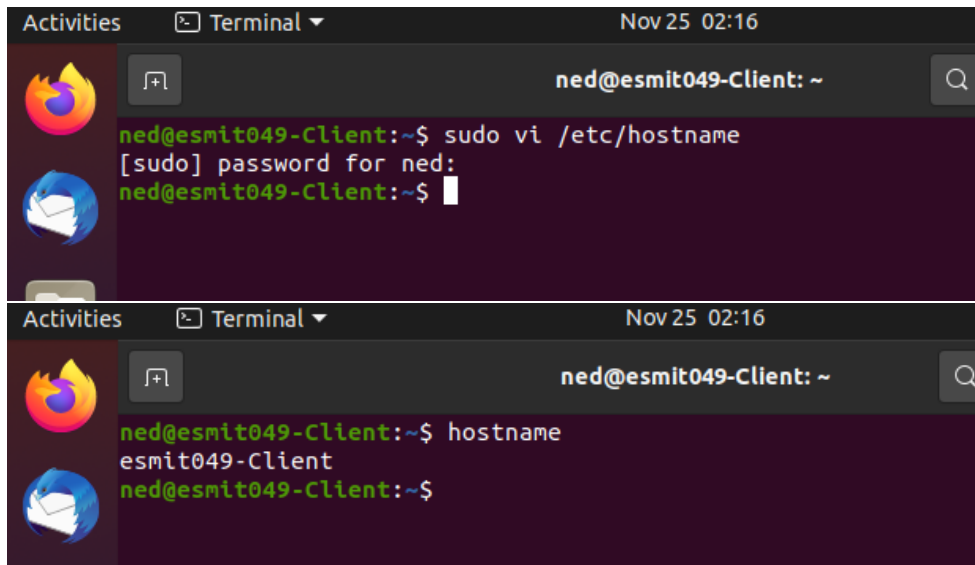
Base VM



Client VM



Step 2

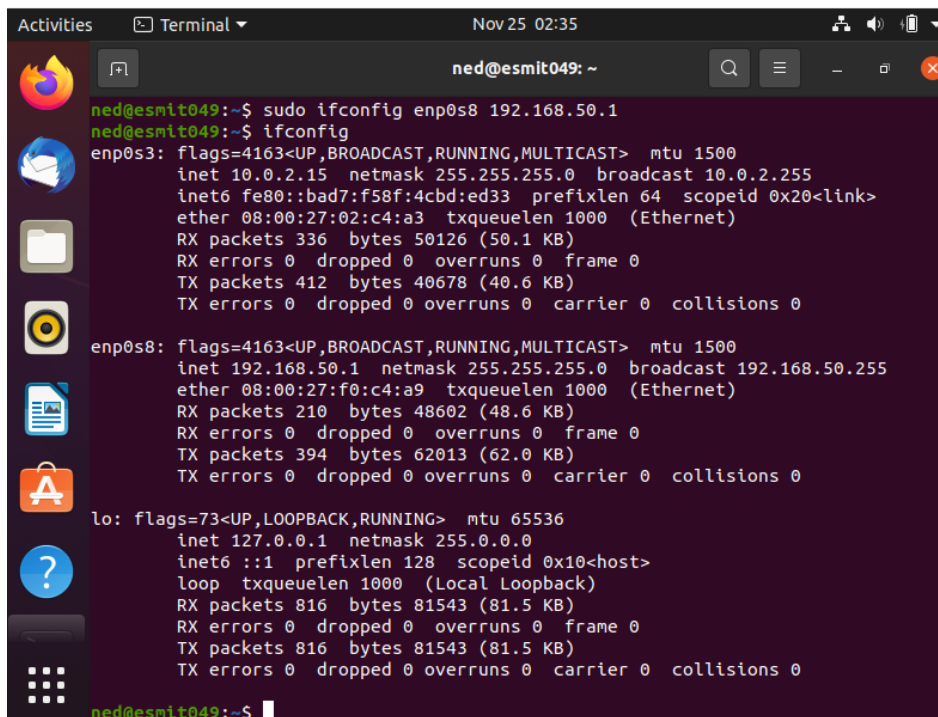


The first screenshot shows a terminal window with the prompt `ned@esmit049-Client: ~`. The user enters `sudo vi /etc/hostname`, and the prompt changes to `[sudo] password for ned:`. The user then enters their password, and the prompt returns to `ned@esmit049-Client: ~`.

The second screenshot shows the same terminal window. The user enters `hostname`, and the output is `esmit049-Client`. The prompt returns to `ned@esmit049-Client: ~`.

Step 3

Base VM



The terminal window shows the user `ned@esmit049: ~` running `sudo ifconfig enp0s8 192.168.50.1`. The prompt then changes to `ned@esmit049:~$ ifconfig`. The output shows the configuration for three network interfaces: `enp0s3`, `enp0s8`, and `lo`.

```
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
        inet 10.0.2.15 netmask 255.255.255.0 broadcast 10.0.2.255
        inet6 fe80::bad7:f58f:4cbd:ed33 prefixlen 64 scopeid 0x20<link>
        ether 08:00:27:02:c4:a3 txqueuelen 1000 (Ethernet)
        RX packets 336 bytes 50126 (50.1 KB)
        RX errors 0 dropped 0 overruns 0 frame 0
        TX packets 412 bytes 40678 (40.6 KB)
        TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

enp0s8: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
        inet 192.168.50.1 netmask 255.255.255.0 broadcast 192.168.50.255
        ether 08:00:27:f0:c4:a9 txqueuelen 1000 (Ethernet)
        RX packets 210 bytes 48602 (48.6 KB)
        RX errors 0 dropped 0 overruns 0 frame 0
        TX packets 394 bytes 62013 (62.0 KB)
        TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
        inet 127.0.0.1 netmask 255.0.0.0
        inet6 ::1 prefixlen 128 scopeid 0x10<host>
        loop txqueuelen 1000 (Local Loopback)
        RX packets 816 bytes 81543 (81.5 KB)
        RX errors 0 dropped 0 overruns 0 frame 0
        TX packets 816 bytes 81543 (81.5 KB)
        TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

The prompt returns to `ned@esmit049:~$`.

Step 4

IP address

```
Activities Terminal Nov 25 02:21
ned@esmit049-Client: ~
ned@esmit049-Client:~$ sudo ifconfig enp0s3 192.168.50.2
ned@esmit049-Client:~$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.50.2 netmask 255.255.255.0 broadcast 192.168.50.255
    inet6 fe80::bad7:f58f:4cbd:ed33 prefixlen 64 scopeid 0x20<link>
    ether 08:00:27:02:c4:a3 txqueuelen 1000 (Ethernet)
    RX packets 63 bytes 14321 (14.3 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 161 bytes 27300 (27.3 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    inet6 ::1 prefixlen 128 scopeid 0x10<host>
    loop txqueuelen 1000 (Local Loopback)
    RX packets 1713 bytes 124950 (124.9 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 1713 bytes 124950 (124.9 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

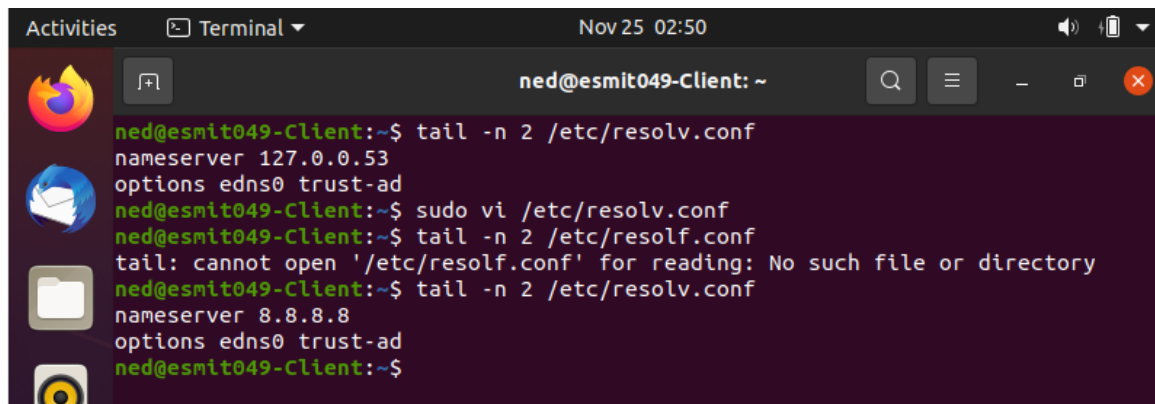
ned@esmit049-Client:~$
```

Routing Table

```
Activities Terminal Nov 25 02:42
ned@esmit049-Client: ~
ned@esmit049-Client:~$ sudo ip route add default via 192.168.50.1
ned@esmit049-Client:~$ sudo ip route add 192.168.50.0/24 dev enp0s3
ned@esmit049-Client:~$ route -n
Kernel IP routing table
Destination Gateway Genmask Flags Metric Ref Use Iface
192.168.50.0 0.0.0.0 255.255.255.0 U 0 0 0 enp0s3
```

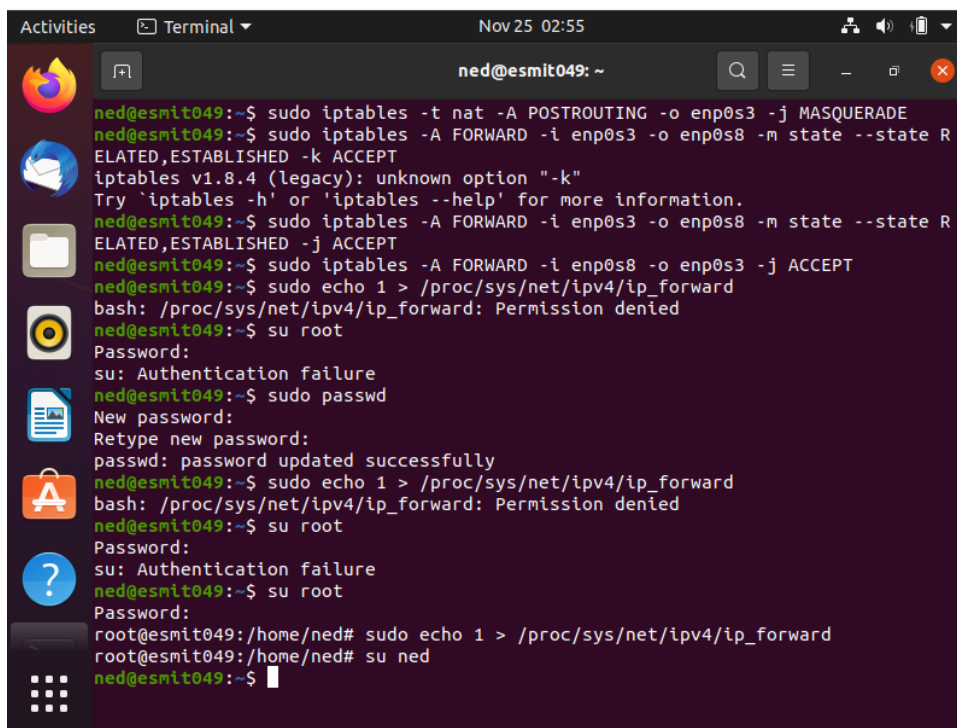
```
Activities Terminal Nov 25 03:01
ned@esmit049-Client: ~
ned@esmit049-Client:~$ sudo ip route add 192.168.50.0/24 dev enp0s3
sudo: unable to resolve host esmit049-Client: Name or service not known
RTNETLINK answers: File exists
ned@esmit049-Client:~$ route -n
Kernel IP routing table
Destination Gateway Genmask Flags Metric Ref Use Iface
0.0.0.0 192.168.50.1 0.0.0.0 UG 0 0 0 enp0s3
192.168.50.0 0.0.0.0 255.255.255.0 U 0 0 0 enp0s3
ned@esmit049-Client:~$
```

Configure DNS

A terminal window titled 'Terminal' with a date/time of 'Nov 25 02:50'. The user is 'ned' on host 'esmit049-Client'. The terminal shows the user checking the last two lines of '/etc/resolv.conf' using 'tail -n 2'. The output shows 'nameserver 127.0.0.53' and 'options edns0 trust-ad'. Then, the user opens the file with 'sudo vi /etc/resolv.conf'. After editing, the user checks the file again with 'tail -n 2', but receives an error: 'tail: cannot open '/etc/resolv.conf' for reading: No such file or directory'. Finally, the user checks the file again with 'tail -n 2 /etc/resolv.conf', and the output shows 'nameserver 8.8.8.8' and 'options edns0 trust-ad'.

```
ned@esmit049-Client:~$ tail -n 2 /etc/resolv.conf
nameserver 127.0.0.53
options edns0 trust-ad
ned@esmit049-Client:~$ sudo vi /etc/resolv.conf
ned@esmit049-Client:~$ tail -n 2 /etc/resolv.conf
tail: cannot open '/etc/resolv.conf' for reading: No such file or directory
ned@esmit049-Client:~$ tail -n 2 /etc/resolv.conf
nameserver 8.8.8.8
options edns0 trust-ad
ned@esmit049-Client:~$
```

Step 5

A terminal window titled 'Terminal' with a date/time of 'Nov 25 02:55'. The user is 'ned' on host 'esmit049'. The terminal shows the user configuring iptables for NAT and forwarding. First, they run 'sudo iptables -t nat -A POSTROUTING -o enp0s3 -j MASQUERADE'. Then, they run 'sudo iptables -A FORWARD -i enp0s3 -o enp0s8 -m state --state RELATED,ESTABLISHED -k ACCEPT', which results in an error: 'iptables v1.8.4 (legacy): unknown option "-k"'. They then run 'sudo iptables -A FORWARD -i enp0s3 -o enp0s8 -m state --state RELATED,ESTABLISHED -j ACCEPT'. Next, they run 'sudo iptables -A FORWARD -i enp0s8 -o enp0s3 -j ACCEPT'. Then, they attempt to write '1' to '/proc/sys/net/ipv4/ip_forward' using 'sudo echo 1 > /proc/sys/net/ipv4/ip_forward', but receive a 'Permission denied' error. They then try to become root with 'su root', but fail with 'Authentication failure'. They then run 'sudo passwd' to change their password. They then try to become root again with 'su root', but fail with 'Authentication failure'. Finally, they run 'sudo echo 1 > /proc/sys/net/ipv4/ip_forward' again, which succeeds. They then become root with 'su root' and run 'echo 1 > /proc/sys/net/ipv4/ip_forward' again, which also succeeds. Finally, they become 'ned' again with 'su ned'.

```
ned@esmit049:~$ sudo iptables -t nat -A POSTROUTING -o enp0s3 -j MASQUERADE
ned@esmit049:~$ sudo iptables -A FORWARD -i enp0s3 -o enp0s8 -m state --state R
ELATED,ESTABLISHED -k ACCEPT
iptables v1.8.4 (legacy): unknown option "-k"
Try 'iptables -h' or 'iptables --help' for more information.
ned@esmit049:~$ sudo iptables -A FORWARD -i enp0s3 -o enp0s8 -m state --state R
ELATED,ESTABLISHED -j ACCEPT
ned@esmit049:~$ sudo iptables -A FORWARD -i enp0s8 -o enp0s3 -j ACCEPT
ned@esmit049:~$ sudo echo 1 > /proc/sys/net/ipv4/ip_forward
bash: /proc/sys/net/ipv4/ip_forward: Permission denied
ned@esmit049:~$ su root
Password:
su: Authentication failure
ned@esmit049:~$ sudo passwd
New password:
Retype new password:
passwd: password updated successfully
ned@esmit049:~$ sudo echo 1 > /proc/sys/net/ipv4/ip_forward
bash: /proc/sys/net/ipv4/ip_forward: Permission denied
ned@esmit049:~$ su root
Password:
su: Authentication failure
ned@esmit049:~$ su root
Password:
root@esmit049:/home/ned# sudo echo 1 > /proc/sys/net/ipv4/ip_forward
root@esmit049:/home/ned# su ned
ned@esmit049:~$
```

Step 6 (Test ping)

```
Activities Terminal Nov 25 03:04
ned@esmit049-Client: ~
ned@esmit049-Client:~$ sudo ip route add 192.168.50.0/24 dev enp0s3
sudo: unable to resolve host esmit049-Client: Name or service not known
RTNETLINK answers: File exists
ned@esmit049-Client:~$ route -n
Kernel IP routing table
Destination Gateway Genmask Flags Metric Ref Use Iface
0.0.0.0 192.168.50.1 0.0.0.0 UG 0 0 0 enp0s3
192.168.50.0 0.0.0.0 255.255.255.0 U 0 0 0 enp0s3
ned@esmit049-Client:~$ ping 8.8.8.8
PING 8.8.8.8 (8.8.8.8) 56(84) bytes of data.
64 bytes from 8.8.8.8: icmp_seq=1 ttl=58 time=24.5 ms
64 bytes from 8.8.8.8: icmp_seq=2 ttl=58 time=21.4 ms
64 bytes from 8.8.8.8: icmp_seq=3 ttl=58 time=18.4 ms
^C
--- 8.8.8.8 ping statistics ---
4 packets transmitted, 3 received, 25% packet loss, time 3019ms
rtt min/avg/max/mdev = 18.394/21.423/24.475/2.482 ms
ned@esmit049-Client:~$ ping google.com
PING google.com (172.253.63.101) 56(84) bytes of data.
64 bytes from bi-in-f101.1e100.net (172.253.63.101): icmp_seq=1 ttl=105 time=19.8 ms
64 bytes from bi-in-f101.1e100.net (172.253.63.101): icmp_seq=2 ttl=105 time=18.3 ms
^C
--- google.com ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1016ms
rtt min/avg/max/mdev = 18.253/19.005/19.758/0.752 ms
ned@esmit049-Client:~$
```

Task B

Step 1-2

Base VM

```
Activities Terminal Nov 25 03:42
ned@esmit049: ~
ned@esmit049:~$ sudo iptables -A INPUT -s 192.168.50.2 -p icmp -j DROP
[sudo] password for ned:
ned@esmit049:~$ sudo iptables -A OUTPUT -s 192.168.50.2 -p icmp -j DROP
ned@esmit049:~$ ping 192.168.50.2
PING 192.168.50.2 (192.168.50.2) 56(84) bytes of data.
^C
--- 192.168.50.2 ping statistics ---
6 packets transmitted, 0 received, 100% packet loss, time 5629ms
ned@esmit049:~$
```

Client VM

```
Activities Terminal Nov 25 03:41
ned@esmit049-Client: ~
ned@esmit049-Client:~$ ping 192.168.50.1
PING 192.168.50.1 (192.168.50.1) 56(84) bytes of data.
^C
--- 192.168.50.1 ping statistics ---
12 packets transmitted, 0 received, 100% packet loss, time 11854ms
ned@esmit049-Client:~$
```