

LAB 2
CONSTRUCT A SIMPLE NETWORK



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*Submission: an **ID_NAME_Lab02.pdf** file describes clearly how did you solve the problem*

Exercise 6:

Answer:

Files:

Lab.conf:

pc1[0]=A

pc2[0]=C

pc3[0]=C

r1[0]=A

r1[1]=B

r2[0]=C

Pc1.startup:

```
ifconfig eth0 195.11.14.5/24 up
```

```
route add default gw 195.11.14.1
```

Pc2.startup:

```
ifconfig eth0 200.1.1.7/24 up
```

```
route add default gw 200.1.1.1
```

Pc3.startup:

```
ifconfig eth0 200.1.1.3/24 up
```

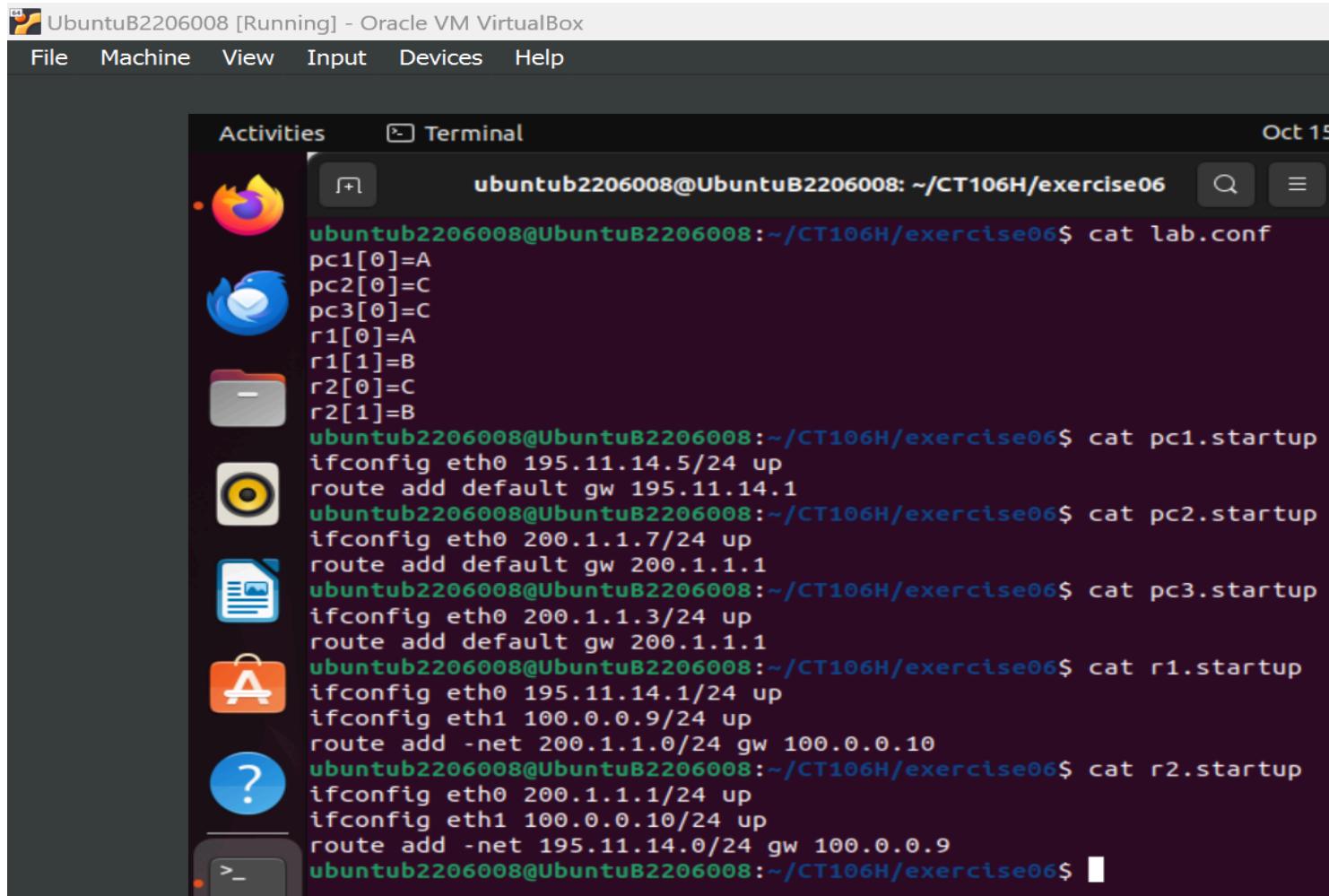
```
route add default gw 20.1.1.1
```

R1.startup:

```
ifconfig eth0 195.11.14.1/24 up  
ifconfig eth1 100.0.0.9/24 up  
route add -net 200.1.1.0/24 gw 100.0.0.10
```

R2.startup:

```
ifconfig eth0 200.1.1.1/24 up  
ifconfig eth1 100.0.0.10/24 up  
route add -net 195.11.14.0/24 gw 100.0.0.9
```

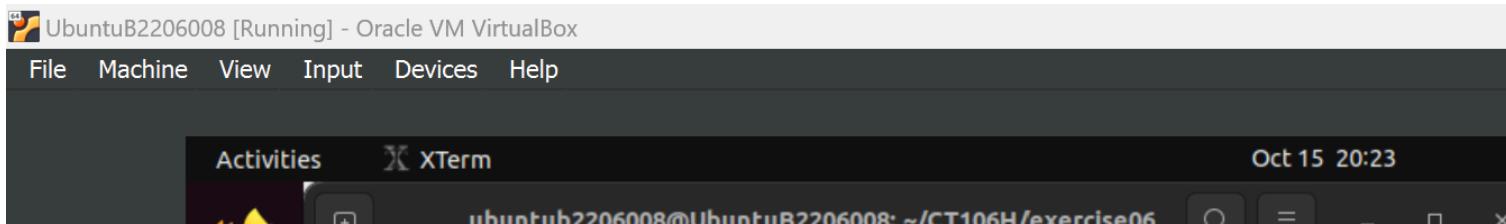


The screenshot shows a Linux desktop environment with a terminal window open. The terminal window title is "Terminal" and the command prompt is "ubuntub2206008@UbuntuB2206008: ~/CT106H/exercise06\$". The terminal displays the following commands and their outputs:

```
cat lab.conf
pc1[0]=A
pc2[0]=C
pc3[0]=C
r1[0]=A
r1[1]=B
r2[0]=C
r2[1]=B
cat pc1.startup
ifconfig eth0 195.11.14.5/24 up
route add default gw 195.11.14.1
cat pc2.startup
ifconfig eth0 200.1.1.7/24 up
route add default gw 200.1.1.1
cat pc3.startup
ifconfig eth0 200.1.1.3/24 up
route add default gw 200.1.1.1
cat r1.startup
ifconfig eth0 195.11.14.1/24 up
ifconfig eth1 100.0.0.9/24 up
route add -net 200.1.1.0/24 gw 100.0.0.10
cat r2.startup
ifconfig eth0 200.1.1.1/24 up
ifconfig eth1 100.0.0.10/24 up
route add -net 195.11.14.0/24 gw 100.0.0.9
```

- Start scenario:

Kathara lstart



The screenshot shows a Linux desktop environment with a terminal window open. The terminal window title is "XTerm" and the command prompt is "ubuntub2206008@UbuntuB2206008: ~/CT106H/exercise06\$". The terminal displays the following commands and their outputs:

```
ifconfig eth0 195.11.14.1/24 up
ifconfig eth1 100.0.0.9/24 up
route add -net 200.1.1.0/24 gw 100.0.0.10
ifconfig eth0 200.1.1.1/24 up
ifconfig eth1 100.0.0.10/24 up
route add -net 195.11.14.0/24 gw 100.0.0.9
```

- **Check connection**

Pc1:

ping 200.1.1.7

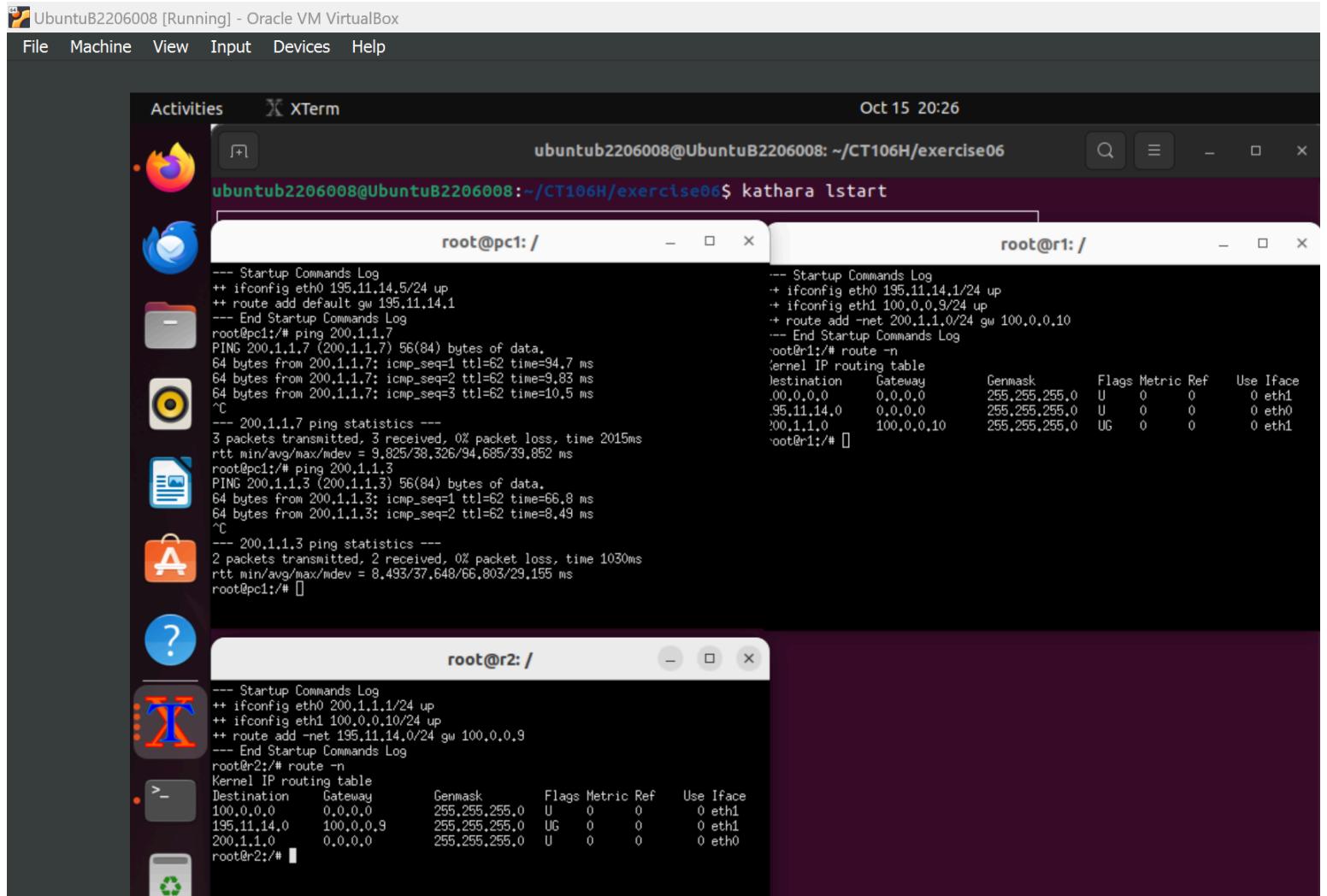
ping 200.1.1.3

R1:

Route -n

R2:

Route -n



Exercise 7:

Solution:

File:

Lab.conf:

pc1[0]=A

pc2[0]=C

pc3[0]=F

r1[0]=A

r1[1]=B

r1[2]=D

r2[0]=B

r2[1]=C

r2[2]=E

r3[0]=D

r3[1]=E

r3[2]=F

Pc1.startup:

```
ifconfig eth0 192.168.0.40/27 up
```

```
route add default gw 192.168.0.33
```

Pc2.startup:

```
ifconfig eth0 192.168.0.100/27 up
```

```
route add default gw 192.168.0.97
```

Pc3.startup:

```
ifconfig eth0 192.168.0.200/27 up
```

```
route add default gw 192.168.0.193
```

R1.startup:

```
ifconfig eth0 192.168.0.33/27 up
```

```
ifconfig eth1 192.168.0.65/27 up
```

```
ifconfig eth2 192.168.0.129/27 up
```

```
route add -net 192.168.0.96/27 gw 192.168.0.66
```

```
route add -net 192.168.0.160/27 gw 192.168.0.66
```

```
route add -net 192.168.0.160/27 gw 192.168.0.130
```

```
route add -net 192.168.0.192/27 gw 192.168.0.130
```

R2.startup:

```
ifconfig eth0 192.168.0.66/27 up  
ifconfig eth1 192.168.0.97/27 up  
ifconfig eth2 192.168.0.161/27 up  
route add -net 192.168.0.32/27 gw 192.168.0.65  
route add -net 192.168.0.128/27 gw 192.168.0.65  
route add -net 192.168.0.128/27 gw 192.168.0.162  
route add -net 192.168.0.192/27 gw 192.168.0.162
```

R3.startup:

```
ifconfig eth0 192.168.0.130/27 up  
ifconfig eth1 192.168.0.162/27 up  
ifconfig eth2 192.168.0.193/27 up  
route add -net 192.168.0.32/27 gw 192.168.0.129  
route add -net 192.168.0.64/27 gw 192.168.0.129  
route add -net 192.168.0.64/27 gw 192.168.0.161  
route add -net 192.168.0.96/27 gw 192.168.0.161
```

UbuntuB2206008 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

ties Terminal

```
ubuntub2206008@UbuntuB2206008:~/CT106H$ cat lab.conf
pc1[0]=A
pc2[0]=C
pc3[0]=F
r1[0]=A
r1[1]=B
r1[2]=D
r2[0]=B
r2[1]=C
r2[2]=E
r3[0]=D
r3[1]=E
r3[2]=F
ubuntub2206008@UbuntuB2206008:~/CT106H$ cat pc1.startup
ifconfig eth0 192.168.0.40/27 up
route add defaullt gw 192.168.0.33
ubuntub2206008@UbuntuB2206008:~/CT106H$ cat pc2.startup
ifconfig eth0 192.168.0.100/27 up
route add default gw 192.168.0.97
ubuntub2206008@UbuntuB2206008:~/CT106H$ cat pc3.starup
cat: pc3.starup: No such file or directory
ubuntub2206008@UbuntuB2206008:~/CT106H$ cat pc3.startup
ifconfig eth0 192.168.0.200/27 up
route add default gw 192.168.0.193
ubuntub2206008@UbuntuB2206008:~/CT106H$ █
```

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ties Terminal

ubuntub2206008@UbuntuB2206008:~/CT106H\$ cat r1.startup

```
ifconfig eth0 192.168.0.33/27 up
ifconfig eth1 192.168.0.65/27 up
ifconfig eth2 192.168.0.129/27 up
route add -net 192.168.0.96/27 gw 192.168.0.66
route add -net 192.168.0.160/27 gw 192.168.0.66
route add -net 192.168.0.160/27 gw 192.168.0.130
route add -net 192.168.0.192/27 gw 192.168.0.130
```

ubuntub2206008@UbuntuB2206008:~/CT106H\$ cat r2.startup

```
ifconfig eth0 192.168.0.66/27 up
ifconfig eth1 192.168.0.97/27 up
ifconfig eth2 192.168.0.161/27 up
route add -net 192.168.0.32/27 gw 192.168.0.65
route add -net 192.168.0.128/27 gw 192.168.0.65
route add -net 192.168.0.128/27 gw 192.168.0.162
route add -net 192.168.0.192/27 gw 192.168.0.162
```

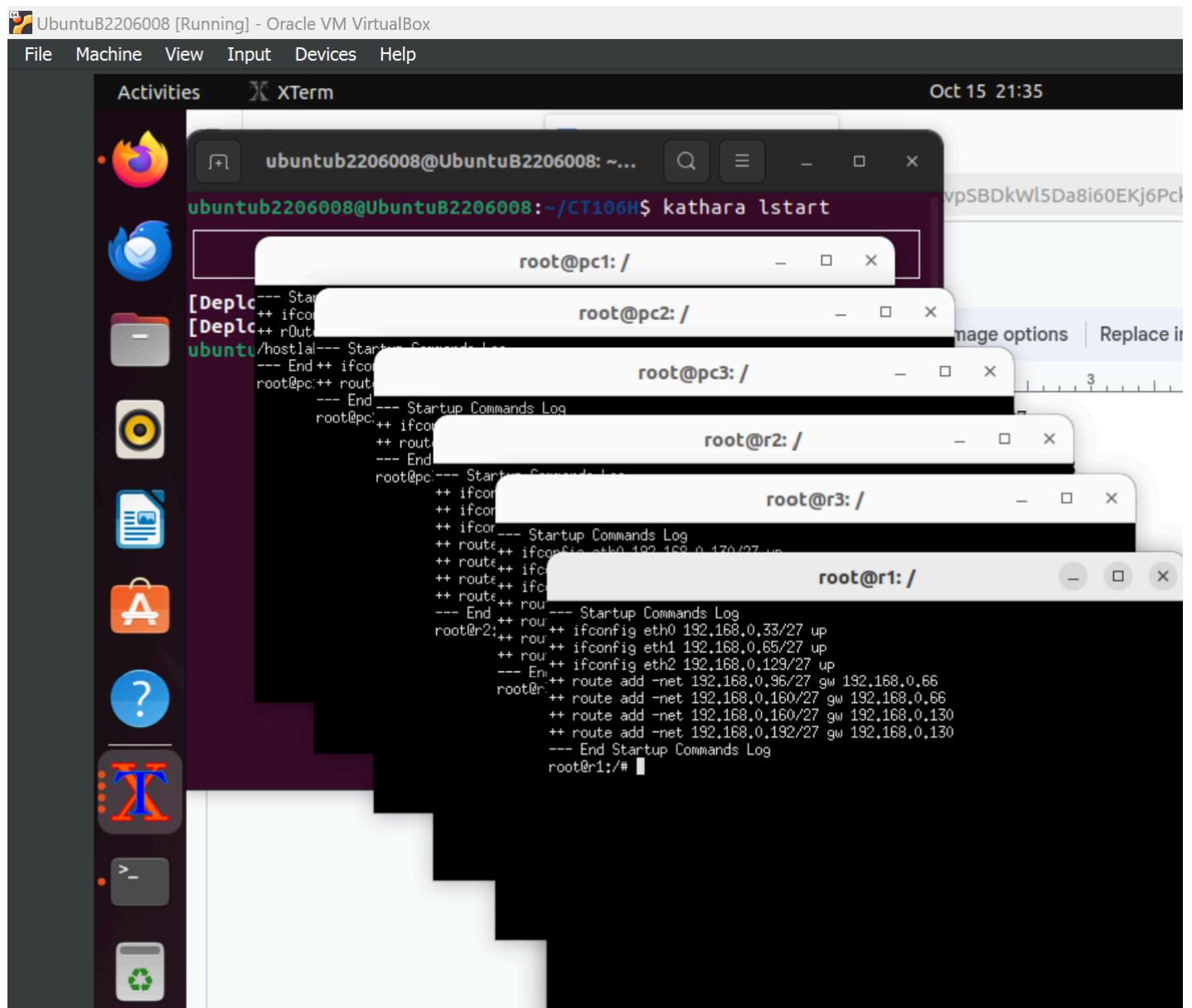
ubuntub2206008@UbuntuB2206008:~/CT106H\$ cat r3.startup

```
ifconfig eth0 192.168.0.130/27 up
ifconfig eth1 192.168.0.162/27 up
ifconfig eth2 192.168.0.193/27 up
route add -net 192.168.0.32/27 gw 192.168.0.129
route add -net 192.168.0.64/27 gw 192.168.0.129
route add -net 192.168.0.64/27 gw 192.168.0.161
route add -net 192.168.0.96/27 gw 192.168.0.161
```

ubuntub2206008@UbuntuB2206008:~/CT106H\$

- Start scenario

Kathara lstart



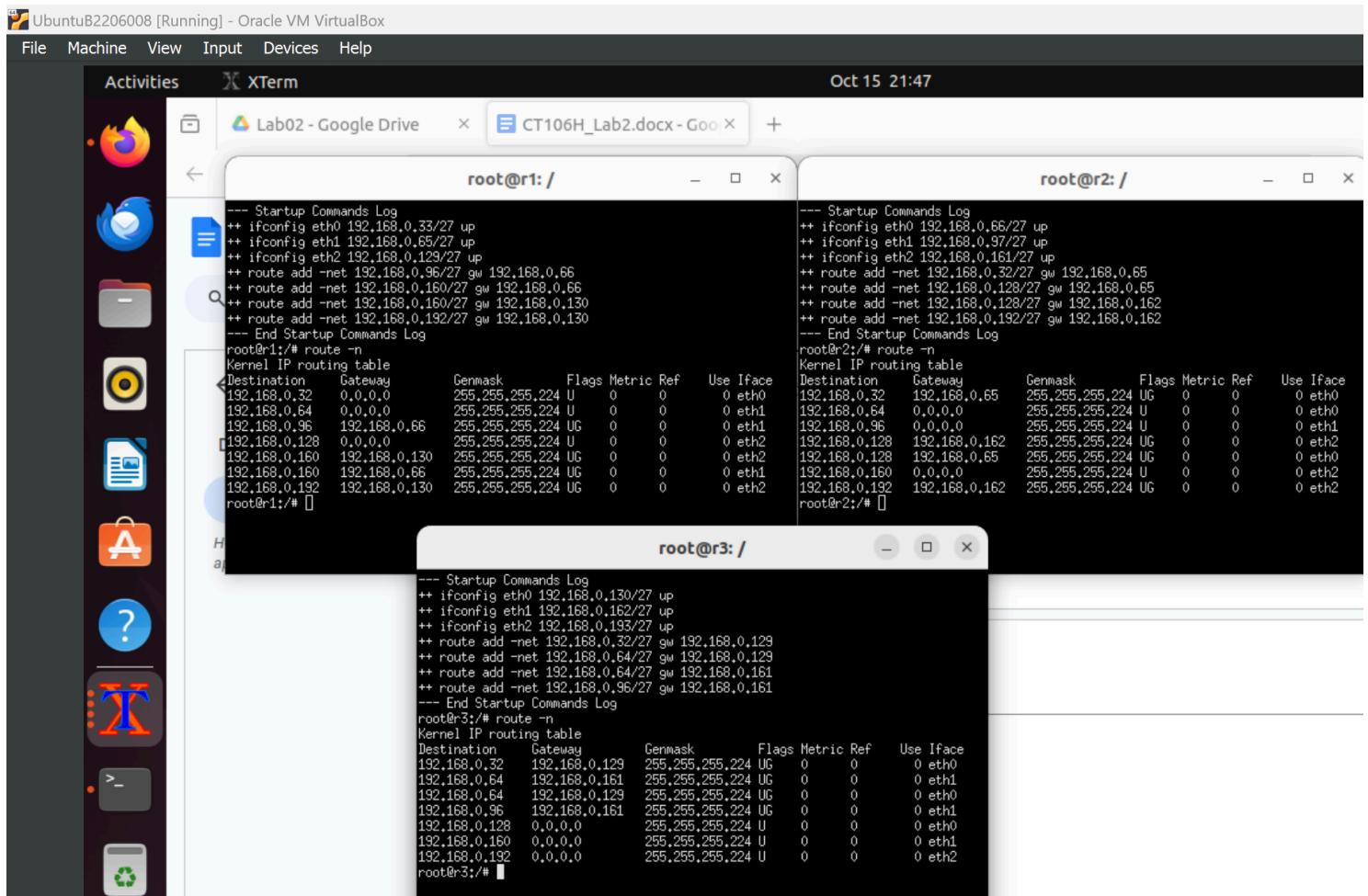
- Check connection

```
pc1: ping 192.168.0.100
    Ping 192.168.0.200
pc2: ping 192.168.0.40
    Ping 192.168.0.200
pc3: ping 192.168.0.40
    Ping 192.168.0.100

R1: route -n
R2: route -n
R3: route -n
```

The screenshot shows a desktop environment with three windows open:

- Activities:** A docked window showing icons for various applications like a browser, file manager, terminal, and file editor.
- XTerm:** A terminal window titled "root@pc1:/". It displays the output of a "route -n" command, showing routes for 192.168.0.100 and 192.168.0.200.
- root@pc3:/**: Another terminal window showing the output of "route -n" for PC3, which has routes for 192.168.0.40 and 192.168.0.100.
- root@pc2:/**: A terminal window showing the output of "route -n" for PC2, which has routes for 192.168.0.40 and 192.168.0.200.
- Document Editor:** A window titled "Headings you add to the document appear here." It contains placeholder text for headings.



Exercise 8:

Solution:

Files:

Lab.conf:

pc1[0]=A

pc2[0]=B

pc3[0]=C

pc4[0]=D

sw[0]=A

sw[1]=B

sw[2]=C

sw[3]=D

Pc1.startup:

ifconfig eth0 10.0.0.10/24 up

ifconfig eth0 hw ether 00:00:00:00:00:10

Pc2.startup:

ifconfig eth0 10.0.0.20/24 up

ifconfig eth0 hw ether 00:00:00:00:00:20

Pc3.startup:

ifconfig eth0 10.0.0.30/24 up

```
ifconfig eth0 hw ether 00:00:00:00:00:30
```

Pc4.startup:

```
ifconfig eth0 10.0.0.40/24 up
```

```
ifconfig eth0 hw ether 00:00:00:00:00:40
```

Sw.startup:

```
ifconfig eth0 up
```

```
ifconfig eth0 hw ether 00:00:00:00:10:10
```

```
ifconfig eth1 up
```

```
ifconfig eth1 hw ether 00:00:00:00:20:20
```

```
ifconfig eth2 up
```

```
ifconfig eth2 hw ether 00:00:00:00:30:30
```

```
ifconfig eth3 up
```

```
ifconfig eth3 hw ether 00:00:00:00:40:40
```

```
brctl addbr br0
```

```
brctl addif br0 eth0
```

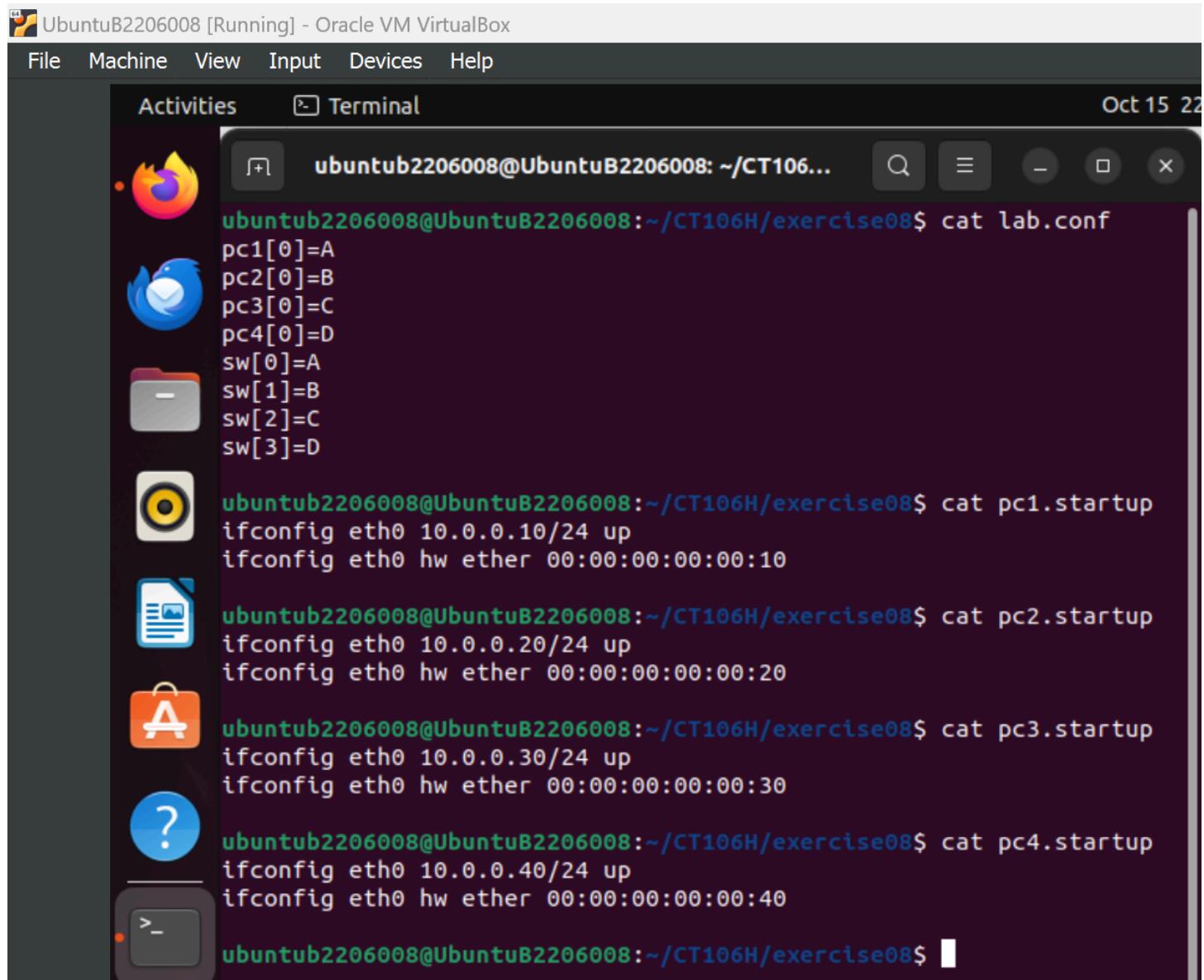
```
brctl addif br0 eth1
```

```
brctl addif br0 eth2
```

```
brctl addif br0 eth3
```

```
brctl stp br0 on
```

ifconfig br0 up



The screenshot shows a terminal window titled "Terminal" running on an Ubuntu 22.04 LTS system. The terminal displays several commands related to network configuration:

- `cat lab.conf` output:

```
pc1[0]=A
pc2[0]=B
pc3[0]=C
pc4[0]=D
sw[0]=A
sw[1]=B
sw[2]=C
sw[3]=D
```
- `cat pc1.startup` output:

```
ifconfig eth0 10.0.0.10/24 up
ifconfig eth0 hw ether 00:00:00:00:00:10
```
- `cat pc2.startup` output:

```
ifconfig eth0 10.0.0.20/24 up
ifconfig eth0 hw ether 00:00:00:00:00:20
```
- `cat pc3.startup` output:

```
ifconfig eth0 10.0.0.30/24 up
ifconfig eth0 hw ether 00:00:00:00:00:30
```
- `cat pc4.startup` output:

```
ifconfig eth0 10.0.0.40/24 up
ifconfig eth0 hw ether 00:00:00:00:00:40
```

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File Machine View Input Devices Help

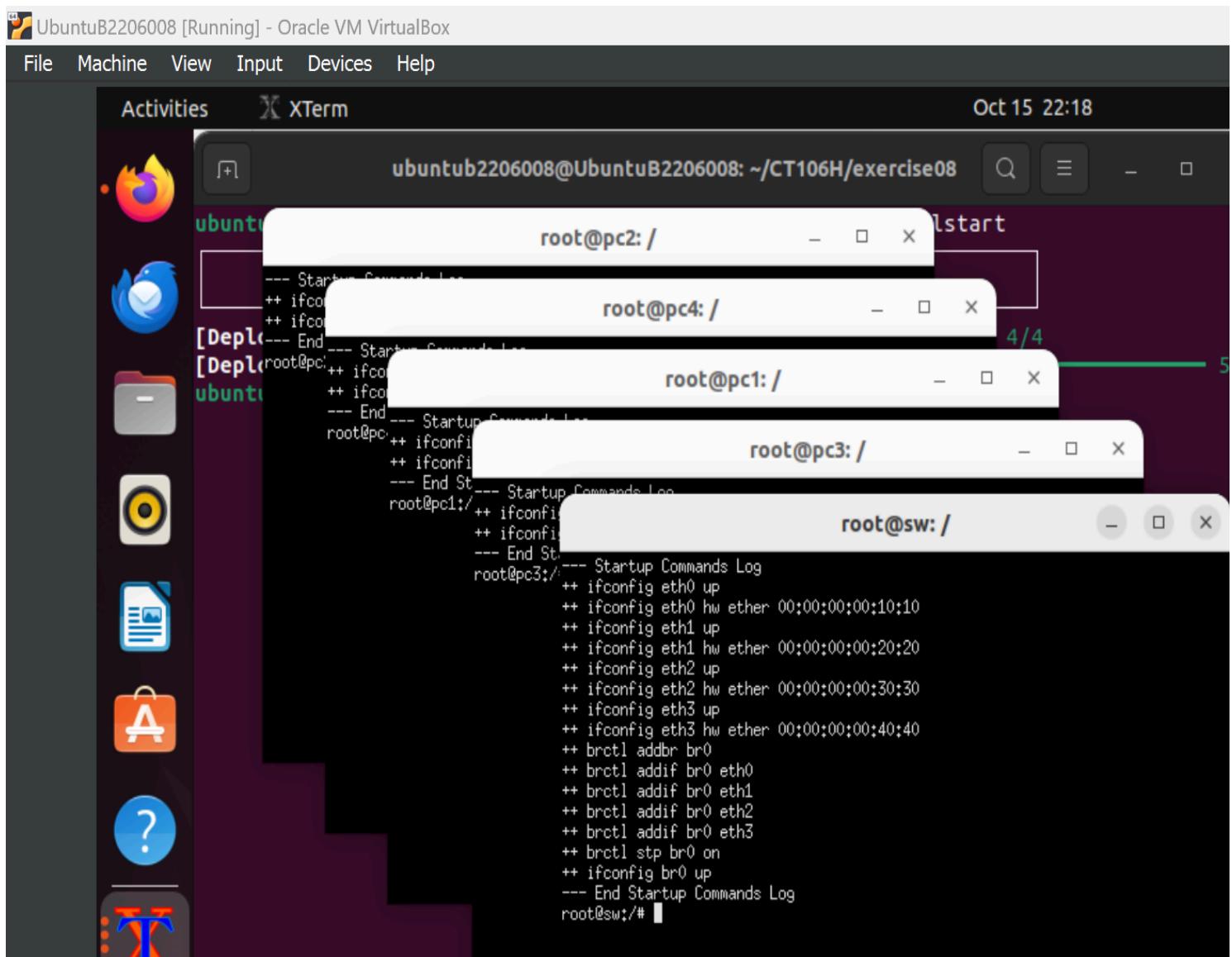
Activities Terminal Oct 15

```
ubuntub2206008@UbuntuB2206008: ~/CT106H/exercise08$ cat sw.startup
ifconfig eth0 up
ifconfig eth0 hw ether 00:00:00:00:10:10
ifconfig eth1 up
ifconfig eth1 hw ether 00:00:00:00:20:20
ifconfig eth2 up
ifconfig eth2 hw ether 00:00:00:00:30:30
ifconfig eth3 up
ifconfig eth3 hw ether 00:00:00:00:40:40
brctl addbr br0
brctl addif br0 eth0
brctl addif br0 eth1
brctl addif br0 eth2
brctl addif br0 eth3
brctl stp br0 on
ifconfig br0 up

ubuntub2206008@UbuntuB2206008: ~/CT106H/exercise08$
```

- Start the scenario

Kathara lstart



- Check the network

Sw:

Brctl showmacs br0

```
root@sw:/ # 
++ ifconfig eth1 hw ether 00:00:00:00:20:20
++ ifconfig eth2 up
++ ifconfig eth2 hw ether 00:00:00:00:30:30
++ ifconfig eth3 up
++ ifconfig eth3 hw ether 00:00:00:00:40:40
++ brctl addbr br0
++ brctl addif br0 eth0
++ brctl addif br0 eth1
++ brctl addif br0 eth2
++ brctl addif br0 eth3
++ brctl stp br0 on
++ ifconfig br0 up
--- End Startup Commands Log
root@sw:/ # brctl showmacs br0
port no mac addr      is local?    ageing timer
      1 00:00:00:00:10:10  yes          0.00
      1 00:00:00:00:10:10  yes          0.00
      2 00:00:00:00:20:20  yes          0.00
      2 00:00:00:00:20:20  yes          0.00
      3 00:00:00:00:30:30  yes          0.00
      3 00:00:00:00:30:30  yes          0.00
      4 00:00:00:00:40:40  yes          0.00
      4 00:00:00:00:40:40  yes          0.00
root@sw:/ #
```

- Explain: the table shows all MAC addresses of devices that connected to the switch (local devices) and the aging of those devices is 0 means they wouldn't be aged out. All ports are local since they are all connected to the switch.

2/

Sw:

Tcpdump -e -q -w /shared/exercise08_switch.pcap

Pc1:

Tcpdump -e -q -w /shared/exercise08_pc1.pcap

Pc3:

Tcpdump -e -q -w /shared/exercise08_pc3.pcap

Pc2:

Ping 10.0.0.30

UbuntuB2206008 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Xterm Oct 15 22:34

root@pc2: /

```
--- Startup Commands Log
++ ifconfig eth0 10.0.0.20/24 up
++ ifconfig eth0 hw ether 00:00:00:00:00:20
--- End Startup Commands Log
root@pc2: # ping 10.0.0.30
PING 10.0.0.30 (10.0.0.30) 56(84) bytes of data.
64 bytes from 10.0.0.30: icmp_seq=1 ttl=64 time=24.2 ms
64 bytes from 10.0.0.30: icmp_seq=2 ttl=64 time=113 ms
64 bytes from 10.0.0.30: icmp_seq=3 ttl=64 time=31.1 ms
64 bytes from 10.0.0.30: icmp_seq=4 ttl=64 time=47.1 ms
64 bytes from 10.0.0.30: icmp_seq=5 ttl=64 time=12.0 ms
64 bytes from 10.0.0.30: icmp_seq=6 ttl=64 time=8.46 ms
64 bytes from 10.0.0.30: icmp_seq=7 ttl=64 time=83.4 ms
64 bytes from 10.0.0.30: icmp_seq=8 ttl=64 time=44.6 ms
64 bytes from 10.0.0.30: icmp_seq=9 ttl=64 time=42.8 ms
64 bytes from 10.0.0.30: icmp_seq=10 ttl=64 time=5.24 ms
64 bytes from 10.0.0.30: icmp_seq=11 ttl=64 time=28.3 ms
64 bytes from 10.0.0.30: icmp_seq=12 ttl=64 time=13.9 ms
64 bytes from 10.0.0.30: icmp_seq=13 ttl=64 time=5.07 ms
^C
--- 10.0.0.30 ping statistics ---
13 packets transmitted, 13 received, 0% packet loss, time 13453ms
rtt min/avg/max/mdev = 5.068/35.302/112.707/30.779 ms
root@pc2: #
```

root@pc3: /

```
--- Startup Commands Log
++ ifconfig eth0 10.0.0.30/24 up
++ ifconfig eth0 hw ether 00:00:00:00:00:30
--- End Startup Commands Log
root@pc3: # tcpdump -e -q -w /shared/exercise08_pc3.pcap
tcpdump: listening on eth0, link-type EN10MB (Ethernet), snapshot length 262144 bytes
^C42 packets captured
42 packets received by filter
0 packets dropped by kernel
root@pc3: #
```

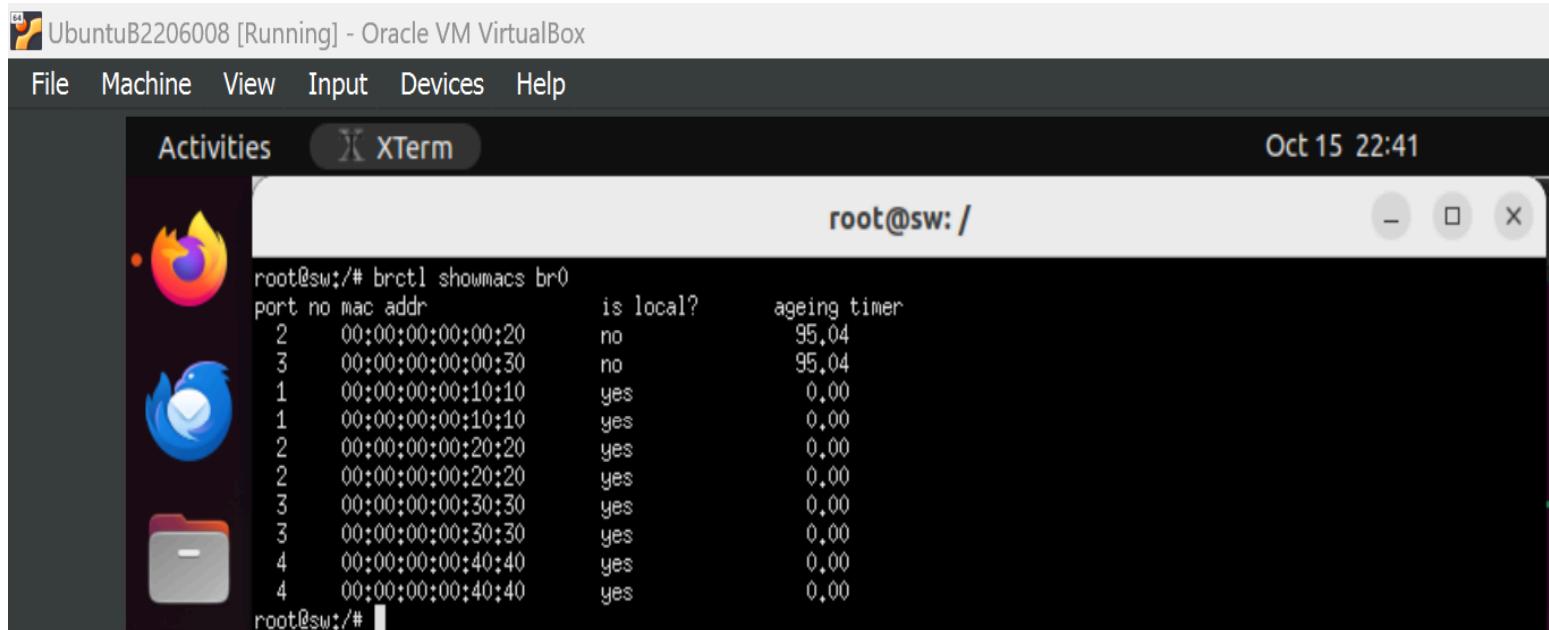
root@sw: /

```
++ brctl addif br0 eth0
++ brctl addif br0 eth1
++ brctl addif br0 eth2
++ brctl addif br0 eth3
++ brctl stp br0 on
++ ifconfig br0 up
--- End Startup Commands Log
root@sw: # brctl showmacs br0
port no mac addr      is local?    ageing timer
  1  00:00:00:00:10:10  yes          0.00
  1  00:00:00:00:10:10  yes          0.00
  2  00:00:00:00:20:20  yes          0.00
  2  00:00:00:00:20:20  yes          0.00
  3  00:00:00:00:30:30  yes          0.00
  3  00:00:00:00:30:30  yes          0.00
  4  00:00:00:00:40:40  yes          0.00
  4  00:00:00:00:40:40  yes          0.00
root@sw: # tcpdump -e -q -w /shared/exercise08_switch.pcap
tcpdump: listening on br0, link-type EN10MB (Ethernet), snapshot length 262144 bytes
^C30 packets captured
30 packets received by filter
0 packets dropped by kernel
root@sw: #
```

root@pc1: /

```
--- Startup Commands Log
++ ifconfig eth0 10.0.0.10/24 up
++ ifconfig eth0 hw ether 00:00:00:00:00:10
--- End Startup Commands Log
root@pc1: # tcpdump -e -q -w /shared/exercise08_pc1.pcap
tcpdump: listening on eth0, link-type EN10MB (Ethernet), snapshot length 262144 bytes
^C12 packets captured
12 packets received by filter
0 packets dropped by kernel
root@pc1: #
```

3/



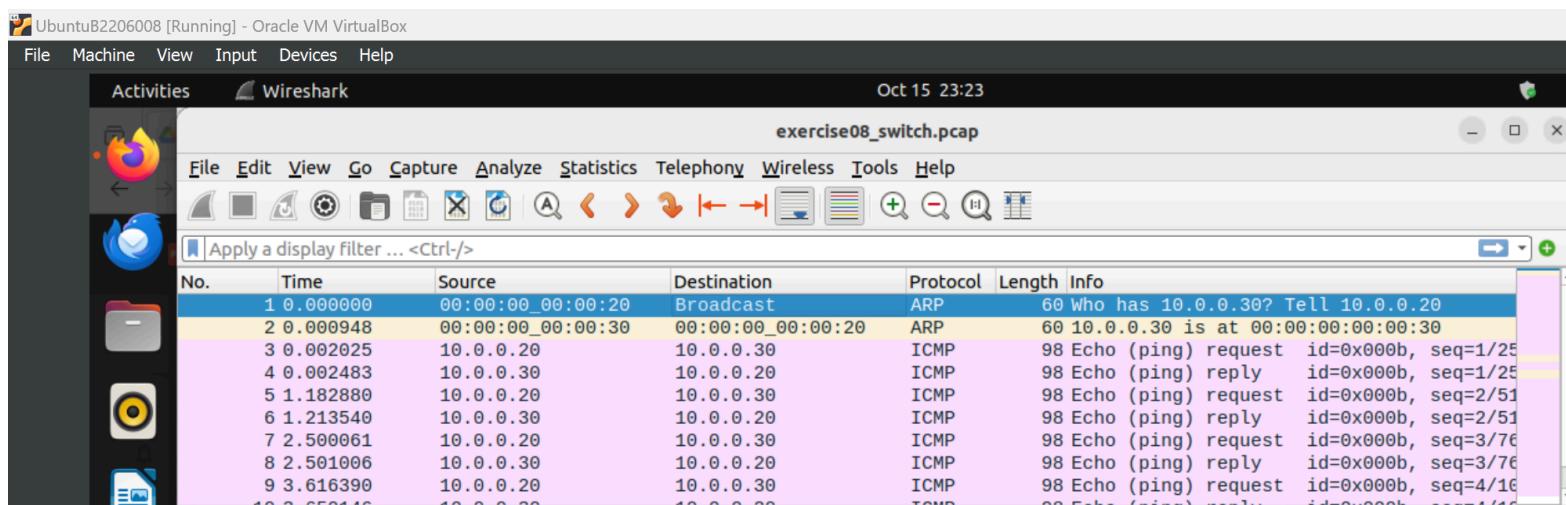
UbuntuB2206008 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

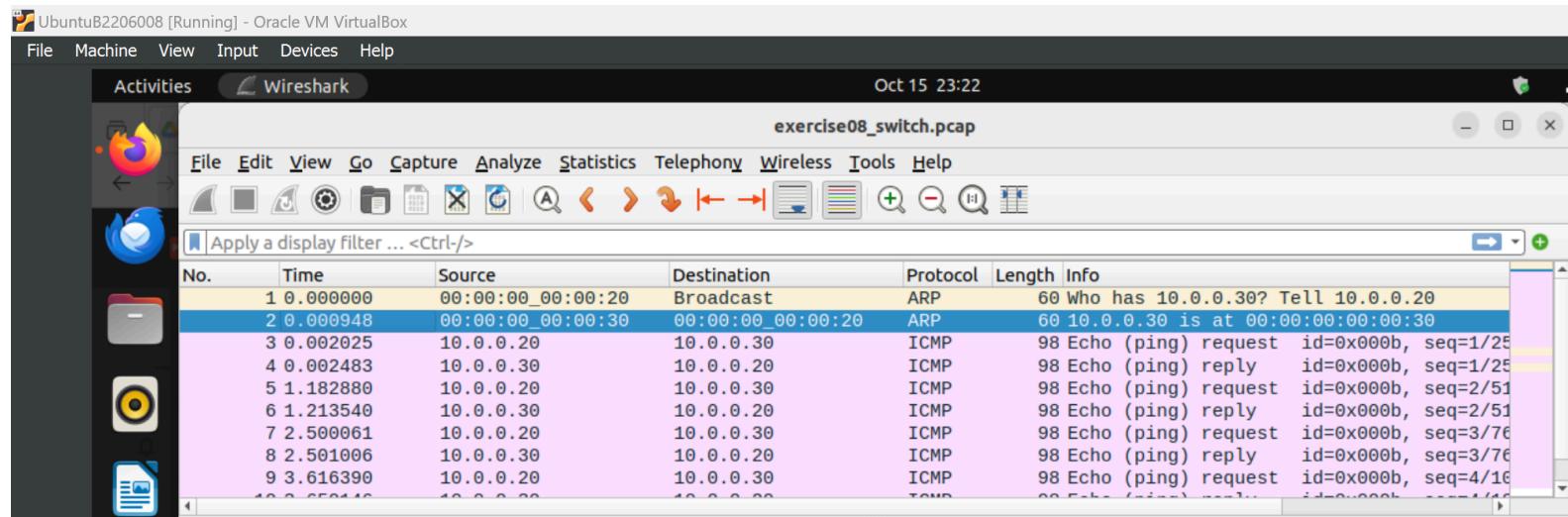
Activities XTerm Oct 15 22:41

```
root@sw:/# brctl showmacs br0
port no mac addr      is local?    ageing timer
  2  00:00:00:00:00:20  no          95.04
  3  00:00:00:00:00:30  no          95.04
  1  00:00:00:00:10:10  yes         0.00
  1  00:00:00:00:10:10  yes         0.00
  2  00:00:00:00:20:20  yes         0.00
  2  00:00:00:00:20:20  yes         0.00
  3  00:00:00:00:30:30  yes         0.00
  3  00:00:00:00:30:30  yes         0.00
  4  00:00:00:00:40:40  yes         0.00
  4  00:00:00:00:40:40  yes         0.00
root@sw:/#
```

*Explain: the ageing timer of pc2 and pc3 is not 0 because pc2 is pinging to pc3, then their MAC address entries indicate that activating. When they've finished pinging, the timer ends, then the switch resets all the ageing timer to 0.

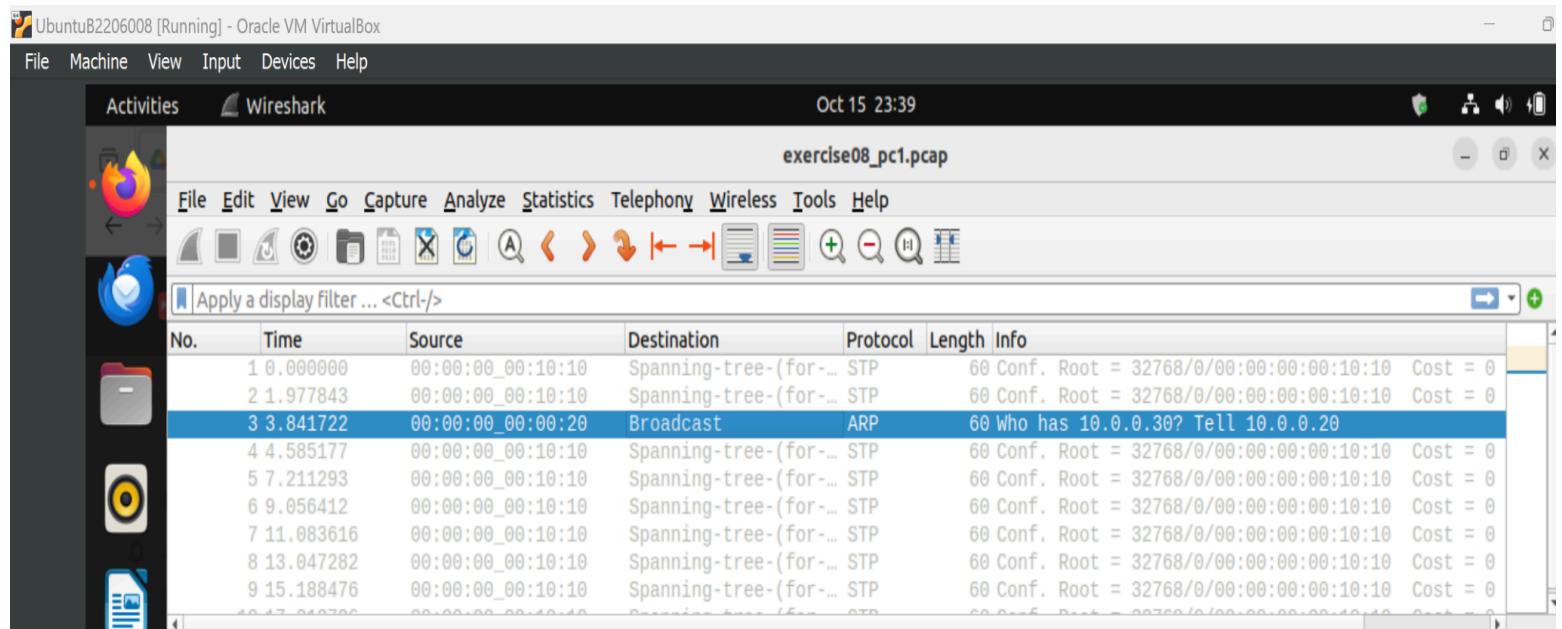
4/ Use Wireshark, open exercise08_switch.pcap and explain content of the frame with source MAC address 00:00:00:00:00:30

- Issued at 00:00 (when pc2 start to ping to pc3)
- Source: 00:00:00:00:20 (MAC address of pc2)
- Destination: broadcast (pc2 use ARP protocol to ask for MAC address of 10.0.0.30 or pc3)
- Frame length: 60 bytes
- Protocol: ARP

5/ Use Wireshark, open exercise08_switch.pcap and explain content of the frame with source MAC address 00:00:00:00:00:20

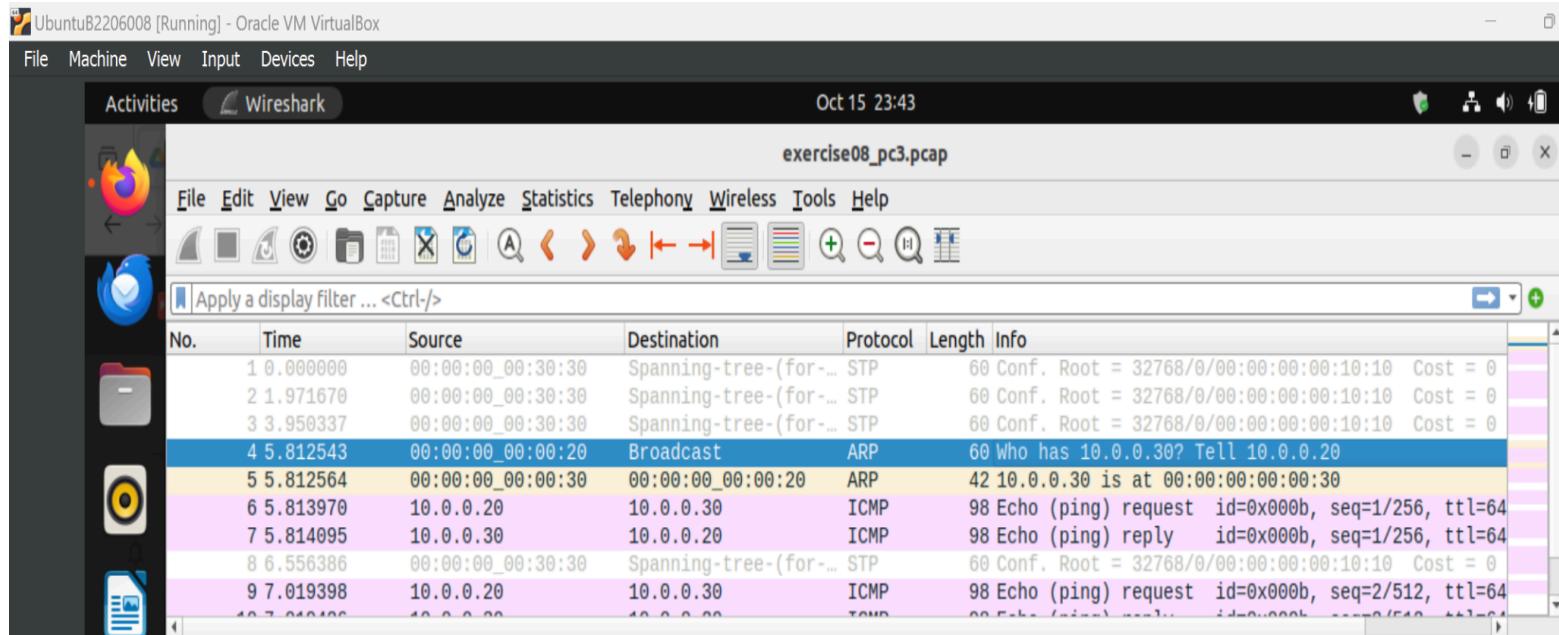
- Issued at 0.000948 (when pc3 replies request of pc2)
- Source: 00:00:00:00:00:30 (MAC address of pc3)
- Destination: 00:00:00:00:00:20 (pc3 has received MAC address of pc2, it then replies to pc2 through MAC address).
- Frame length: 60 bytes
- Protocol: ARP

6/ Use Wireshark, open exercise08_pc1.pcap and explain content of the frame with source MAC address 00:00:00:00:00:20 (00:00:00:00:00:30 if exist)



- Since pc2 ping to pc3, it broadcasts to all over the network and ask for 10.0.0.30 MAC address or pc3 MAC address, that's why pc1 received an ARP protocol frame from source 00:00:00:00:00:20.

7/ Use Wireshark, open exercise08_pc3.pcap and explain content of the frame with source MAC address 00:00:00:00:00:20 (and 00:00:00:00:00:30 if exist)



- Frame with source 00:00:00:00:00:20:
 - The request is an ARP protocol broadcasting request from pc2 to pc3 to ask for MAC address of IP 10.0.0.30 or pc3.
- Frame with source 00:00:00:00:00:30:
 - This is the reply of pc3 to pc2, saying that 10.0.0.30 is at 00:00:00:00:00:30 or is itself.

Exercise 9:

Solution:

Files:

Lab.conf:

```
pc1[0]=A  
pc2[0]=B  
pc3[0]=C  
pc4[0]=D  
pc5[0]=E  
pc6[0]=F  
pc7[0]=G  
pc8[0]=H  
sw1[0]=A  
sw1[1]=B  
sw1[2]=C  
sw1[3]=D  
sw1[4]=K  
sw2[0]=E  
sw2[1]=F  
sw2[2]=G  
sw2[3]=H  
sw2[4]=K
```

Pc1.startup:

```
ifconfig eth0 10.0.0.10/24 up  
ifconfig eth0 hw ether 00:00:00:00:00:10
```

Pc2.startup:

```
ifconfig eth0 10.0.0.20/24 up  
ifconfig eth0 hw ether 00:00:00:00:00:20
```

Pc3.startup:

```
ifconfig eth0 10.0.0.30/24 up  
ifconfig eth0 hw ether 00:00:00:00:00:30
```

Pc4.startup:

```
ifconfig eth0 10.0.0.40/24 up  
ifconfig eth0 hw ether 00:00:00:00:00:40
```

Pc5.startup:

```
ifconfig eth0 10.0.0.11/24 up  
ifconfig eth0 hw ether 00:00:00:00:77:10
```

Pc6.startup:

```
ifconfig eth0 10.0.0.22/24 up  
ifconfig eth0 hw ether 00:00:00:00:77:20
```

Pc7.startup:

```
ifconfig eth0 10.0.0.33/24 up  
ifconfig eth0 hw ether 00:00:00:00:77:30
```

Pc8.startup:

```
ifconfig eth0 10.0.0.44/24 up  
ifconfig eth0 hw ether 00:00:00:00:77:40
```

Sw1.startup:

```
ifconfig eth0 up  
ifconfig eth0 hw ether 00:00:00:00:10:10  
ifconfig eth1 up  
ifconfig eth1 hw ether 00:00:00:00:20:20  
ifconfig eth2 up  
ifconfig eth2 hw ether 00:00:00:00:30:30  
ifconfig eth3 up  
ifconfig eth3 hw ether 00:00:00:00:40:40  
ifconfig eth4 up  
brctl addbr br0  
brctl addif br0 eth0  
brctl addif br0 eth1  
brctl addif br0 eth2  
brctl addif br0 eth3  
brctl addif br0 eth4  
brctl stp br0 on  
ifconfig br0 up
```

Sw2.startup:

```
ifconfig eth0 up  
ifconfig eth0 hw ether 00:00:00:00:88:10  
ifconfig eth1 up  
ifconfig eth1 hw ether 00:00:00:00:88:20  
ifconfig eth2 up  
ifconfig eth2 hw ether 00:00:00:00:88:30  
ifconfig eth3 up  
ifconfig eth3 hw ether 00:00:00:00:88:40  
ifconfig eth4 up  
brctl addbr br0  
brctl addif br0 eth0  
brctl addif br0 eth1  
brctl addif br0 eth2  
brctl addif br0 eth3  
brctl addif br0 eth4  
brctl stp br0 on  
ifconfig br0 up
```

UbuntuB2206008 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Terminal Oct 16 21:02

```
ubuntub2206008@UbuntuB2206008: ~/CT106H/exercise09$ tree
```

```
.
```

```
+- lab.conf
```

```
+- pc1
```

```
+- pc1.startup
```

```
+- pc2
```

```
+- pc2.startup
```

```
+- pc3
```

```
+- pc3.startup
```

```
+- pc4
```

```
+- pc4.startup
```

```
+- pc5
```

```
+- pc5.startup
```

```
+- pc6
```

```
+- pc6.startup
```

```
+- pc7
```

```
+- pc7.startup
```

```
+- pc8
```

```
+- pc8.startup
```

```
+- sw1
```

```
+- sw1.startup
```

```
+- sw2
```

```
+- sw2.startup
```

10 directories, 11 files

UbuntuB2206008 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Terminal Oct 16 2

```
ubuntub2206008@UbuntuB2206008: ~/CT106H/exercise09$ tree
```

```
+- sw2
```

```
+- sw2.startup
```

10 directories, 11 files

```
ubuntub2206008@UbuntuB2206008: ~/CT106H/exercise09$ cat lab.conf
```

```
pc1[0]=A
```

```
pc2[0]=B
```

```
pc3[0]=C
```

```
pc4[0]=D
```

```
pc5[0]=E
```

```
pc6[0]=F
```

```
pc7[0]=G
```

```
pc8[0]=H
```

```
sw1[0]=A
```

```
sw1[1]=B
```

```
sw1[2]=C
```

```
sw1[3]=D
```

```
sw1[4]=K
```

```
sw2[0]=E
```

```
sw2[1]=F
```

```
sw2[2]=G
```

```
sw2[3]=H
```

```
sw2[4]=K
```

ubuntub2206008@UbuntuB2206008: ~/CT106H/exercise09\$

UbuntuB2206008 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Terminal Oct 16 21:04

```
ubuntub2206008@UbuntuB2206008:~/CT106H/exercise09$ cat pc1.startup
ifconfig eth0 10.0.0.10/24 up
ifconfig eth0 hw ether 00:00:00:00:00:10

ubuntub2206008@UbuntuB2206008:~/CT106H/exercise09$ cat pc2.startup
ifconfig eth0 10.0.0.20/24 up
ifconfig eth0 hw ether 00:00:00:00:00:20

ubuntub2206008@UbuntuB2206008:~/CT106H/exercise09$ cat pc3.startup
ifconfig eth0 10.0.0.30/24 up
ifconfig eth0 hw ether 00:00:00:00:00:30

ubuntub2206008@UbuntuB2206008:~/CT106H/exercise09$ cat pc4.startup
ifconfig eth0 10.0.0.40/24 up
ifconfig eth0 hw ether 00:00:00:00:00:40

ubuntub2206008@UbuntuB2206008:~/CT106H/exercise09$
```

UbuntuB2206008 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Terminal Oct 16 21:04

```
ubuntub2206008@UbuntuB2206008:~/CT106H/exercise09$ cat pc5.startup
ifconfig eth0 10.0.0.11/24 up
ifconfig eth0 hw ether 00:00:00:00:77:10

ubuntub2206008@UbuntuB2206008:~/CT106H/exercise09$ cat pc6.startup
ifconfig eth0 10.0.0.22/24 up
ifconfig eth0 hw ether 00:00:00:00:77:20

ubuntub2206008@UbuntuB2206008:~/CT106H/exercise09$ cat pc7.startup
ifconfig eth0 10.0.0.33/24 up
ifconfig eth0 hw ether 00:00:00:00:77:30

ubuntub2206008@UbuntuB2206008:~/CT106H/exercise09$ cat pc8.startup
ifconfig eth0 10.0.0.44/24 up
ifconfig eth0 hw ether 00:00:00:00:77:40

ubuntub2206008@UbuntuB2206008:~/CT106H/exercise09$
```

UbuntuB2206008 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Terminal Oct 16 21:00

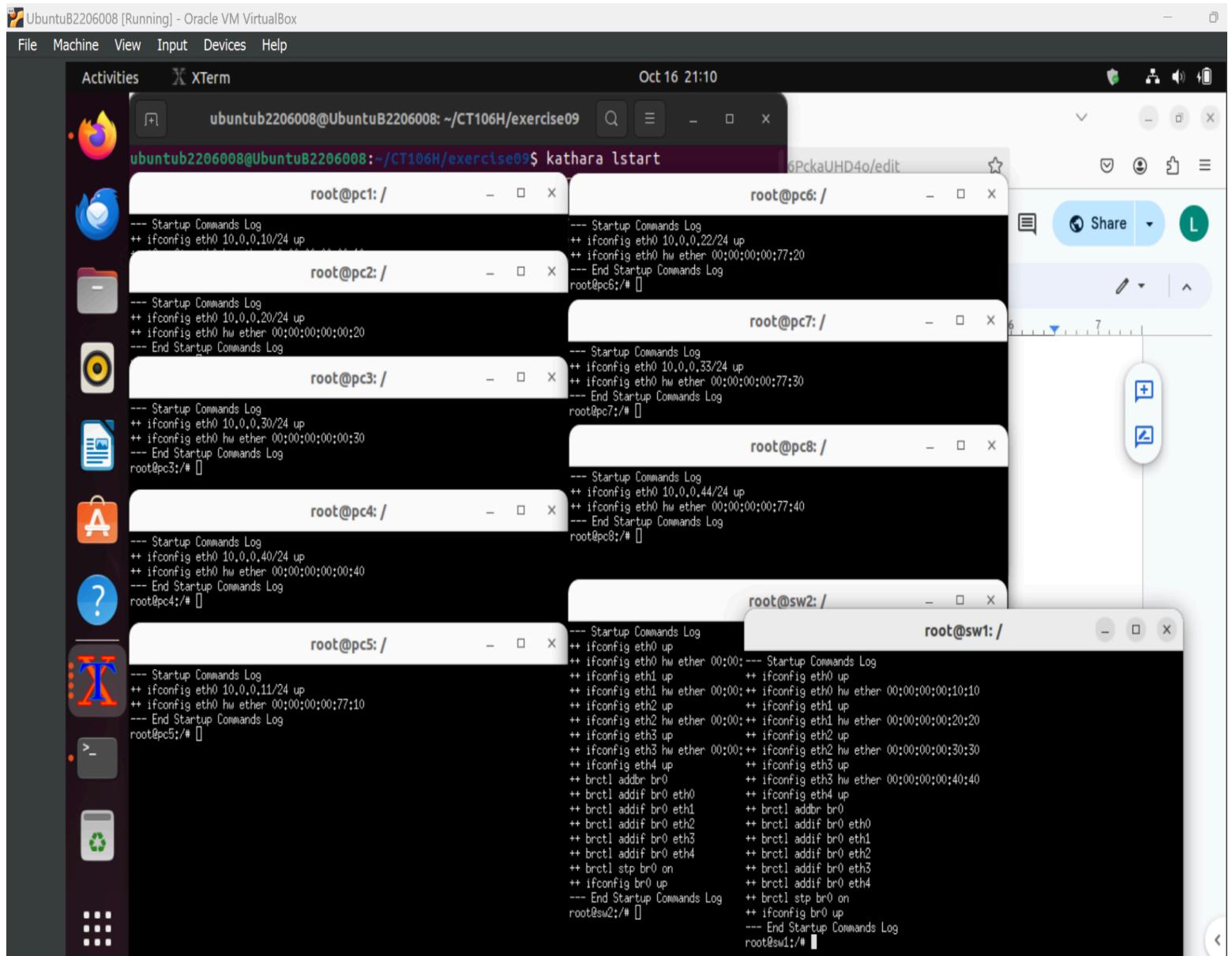
```
ubuntub2206008@UbuntuB2206008: ~/CT106H/exercise09$ cat sw1.startup
ifconfig eth0 up
ifconfig eth0 hw ether 00:00:00:00:10:10
ifconfig eth1 up
ifconfig eth1 hw ether 00:00:00:00:20:20
ifconfig eth2 up
ifconfig eth2 hw ether 00:00:00:00:30:30
ifconfig eth3 up
ifconfig eth3 hw ether 00:00:00:00:40:40
ifconfig eth4 up
brctl addbr br0
brctl addif br0 eth0
brctl addif br0 eth1
brctl addif br0 eth2
brctl addif br0 eth3
brctl addif br0 eth4
brctl stp br0 on
ifconfig br0 up

ubuntub2206008@UbuntuB2206008: ~/CT106H/exercise09$ cat sw2.startup
ifconfig eth0 up
ifconfig eth0 hw ether 00:00:00:00:88:10
ifconfig eth1 up
ifconfig eth1 hw ether 00:00:00:00:88:20
ifconfig eth2 up
ifconfig eth2 hw ether 00:00:00:00:88:30
ifconfig eth3 up
ifconfig eth3 hw ether 00:00:00:00:88:40
ifconfig eth4 up
brctl addbr br0
brctl addif br0 eth0
brctl addif br0 eth1
brctl addif br0 eth2
brctl addif br0 eth3
brctl addif br0 eth4
brctl stp br0 on
ifconfig br0 up

ubuntub2206008@UbuntuB2206008: ~/CT106H/exercise09$
```

- Start scenario

Kathara lstart



- Check MAC lookup table on 2 switches

UbuntuB2206008 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities XTerm

XTerm window (root@sw1: /)

```
++ ifconfig eth4 up
++ brctl addbr br0
++ brctl addif br0 eth0
++ brctl addif br0 eth1
++ brctl addif br0 eth2
++ brctl addif br0 eth3
++ brctl addif br0 eth4
++ brctl stp br0 on
++ ifconfig br0 up
--- End Startup Commands Log
root@sw1:/# brctl showmacs br0
port no mac addr      is local?    ageing timer
  1  00:00:00:00:10:10  yes          0.00
  1  00:00:00:00:10:10  yes          0.00
  2  00:00:00:00:20:20  yes          0.00
  2  00:00:00:00:20:20  yes          0.00
  3  00:00:00:00:30:30  yes          0.00
  3  00:00:00:00:30:30  yes          0.00
  4  00:00:00:00:40:40  yes          0.00
  4  00:00:00:00:40:40  yes          0.00
  5  12:64:f1:18:54:c8  no           294.70
  5  de:25:7e:9b:ac:64  yes          0.00
  5  de:25:7e:9b:ac:64  yes          0.00
root@sw1:/#
```

XTerm window (root@sw2: /)

```
++ brctl addif br0 eth0
++ brctl addif br0 eth1
++ brctl addif br0 eth2
++ brctl addif br0 eth3
++ brctl addif br0 eth4
++ brctl stp br0 on
++ ifconfig br0 up
--- End Startup Commands Log
root@sw2:/# brctl showmacs br0
bash: brctl: command not found
root@sw2:/# brctl showmacs br0
port no mac addr      is local?    ageing timer
  1  00:00:00:00:88:10  yes          0.00
  1  00:00:00:00:88:10  yes          0.00
  2  00:00:00:00:88:20  yes          0.00
  2  00:00:00:00:88:20  yes          0.00
  3  00:00:00:00:88:30  yes          0.00
  3  00:00:00:00:88:30  yes          0.00
  4  00:00:00:00:88:40  yes          0.00
  4  00:00:00:00:88:40  yes          0.00
  5  12:64:f1:18:54:c8  yes          0.00
  5  12:64:f1:18:54:c8  yes          0.00
  5  de:25:7e:9b:ac:64  no           1.76
root@sw2:/#
```

- Check connection and MAC lookup table

Sw1:

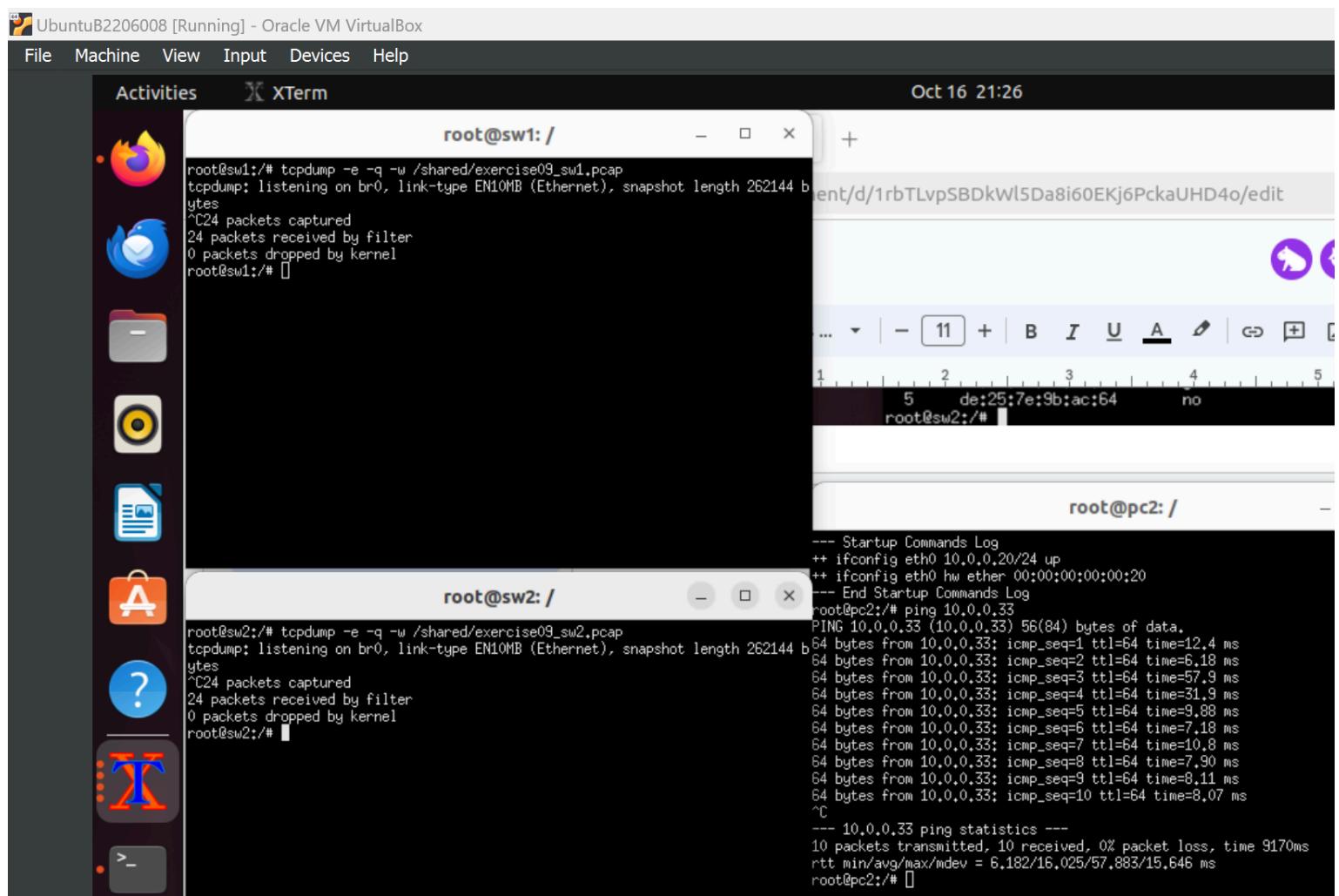
```
Tcpdump -e -q -w /shared/exercise09_sw1.pcap
```

Sw2:

```
Tcpdump -e -q -w /shared/exercise09_sw2.pcap
```

Pc2:

```
Ping 10.0.0.33
```



- Check MAC lookup table again

Sw1:

Brcctl showmacs br0

Sw2:

Brcctl showmacs br0

```

root@sw1:/# tcpdump -e -q -w shared/exercise09_sw1.pcap
tcpdump: listening on br0, link-type EN10MB (Ethernet), snapshot length 262144 bytes
18 packets captured^C
18 packets received by filter
0 packets dropped by kernel
root@sw1:/# brcctl showmacs br0
port no mac addr      is local?      ageing timer
  2 00:00:00:00:00:20  no           19.37
  1 00:00:00:00:10:10 yes           0.00
  1 00:00:00:00:10:10 yes           0.00
  2 00:00:00:00:20:20 yes           0.00
  2 00:00:00:00:20:20 yes           0.00
  3 00:00:00:00:30:30 yes           0.00
  3 00:00:00:00:30:30 yes           0.00
  4 00:00:00:00:40:40 yes           0.00
  4 00:00:00:00:40:40 yes           0.00
  5 00:00:00:00:77:30 no            19.37
  5 e6:be:03:79:16:20 yes           0.00
  5 e6:be:03:79:16:20 yes           0.00
root@sw1:/#

```

```

--- Startup Commands Log
++ ifconfig eth0 10.0.0.20/24 up
++ ifconfig eth0 hw ether 00:00:00:00:00:20
--- End Startup Commands Log
root@pc2:/# ping 10.0.0.33
PING 10.0.0.33 (10.0.0.33) 56(84) bytes of data.
64 bytes from 10.0.0.33: icmp_seq=1 ttl=64 time=45.1 ms
64 bytes from 10.0.0.33: icmp_seq=2 ttl=64 time=5.16 ms
64 bytes from 10.0.0.33: icmp_seq=3 ttl=64 time=42.6 ms
64 bytes from 10.0.0.33: icmp_seq=4 ttl=64 time=7.83 ms
64 bytes from 10.0.0.33: icmp_seq=5 ttl=64 time=12.0 ms
64 bytes from 10.0.0.33: icmp_seq=6 ttl=64 time=5.89 ms
64 bytes from 10.0.0.33: icmp_seq=7 ttl=64 time=4.92 ms
^C
--- 10.0.0.33 ping statistics ---
7 packets transmitted, 7 received, 0% packet loss, time 6784ms
rtt min/avg/max/mdev = 4.917/17.640/45.058/16.727 ms
root@pc2:/#

```

```

root@sw2:/# tcpdump -e -q -w shared/exercise09_sw2.pcap
tcpdump: listening on br0, link-type EN10MB (Ethernet), snapshot length 262144 bytes
^C18 packets captured
18 packets received by filter
0 packets dropped by kernel
root@sw2:/# brcctl showmacs br0
port no mac addr      is local?      ageing timer
  5 00:00:00:00:00:20  no           26.12
  3 00:00:00:00:77:30 no           26.12
  1 00:00:00:00:88:10 yes          0.00
  1 00:00:00:00:88:10 yes          0.00
  2 00:00:00:00:88:20 yes          0.00
  2 00:00:00:00:88:20 yes          0.00
  3 00:00:00:00:88:30 yes          0.00
  3 00:00:00:00:88:30 yes          0.00
  4 00:00:00:00:88:40 yes          0.00
  4 00:00:00:00:88:40 yes          0.00
  5 7a:06:f5:f6:5f:4c yes          0.00
  5 7a:06:f5:f6:5f:4c yes          0.00
  5 e6:be:03:79:16:20 no           0.91
root@sw2:/#

```

Exercise 10:

Solution:

Files:

lab.conf

```
pc1[0]=sw1
pc2[0]=sw1
pc3[0]=sw2
pc4[0]=sw2
sw1[0]=pc1
sw1[1]=pc2
sw1[2]=r1
sw2[0]=pc3
sw2[1]=pc4
sw2[2]=r1
r1[0]=sw1
r1[1]=sw2
```

Pc1.startup

```
ifconfig eth0 192.168.10.10/24
ifconfig eth0 hw ether 00:00:00:00:10:10
route add default gw 192.168.10.1
```

Pc2.startup

```
ifconfig eth0 192.168.10.11/24
ifconfig eth0 hw ether 00:00:00:00:10:11
route add default gw 192.168.10.1
```

Pc3.startup

```
ifconfig eth0 192.168.11.10/24
ifconfig eth0 hw ether 00:00:00:00:11:10
route add default gw 192.168.11.1
```

Pc4.startup

```
ifconfig eth0 192.168.11.11/24
ifconfig eth0 hw ether 00:00:00:00:11:11
route add default gw 192.168.11.1
```

Sw1.startup

```
ifconfig eth0 up
ifconfig eth0 hw ether 00:00:00:10:10:10
ifconfig eth1 up
ifconfig eth1 hw ether 00:00:00:10:10:11
ifconfig eth2 up
ifconfig eth2 hw ether 00:00:00:10:10:12
brctl addbr br0
brctl addif br0 eth0
brctl addif br0 eth1
brctl addif br0 eth2
brctl stp br0 on
```

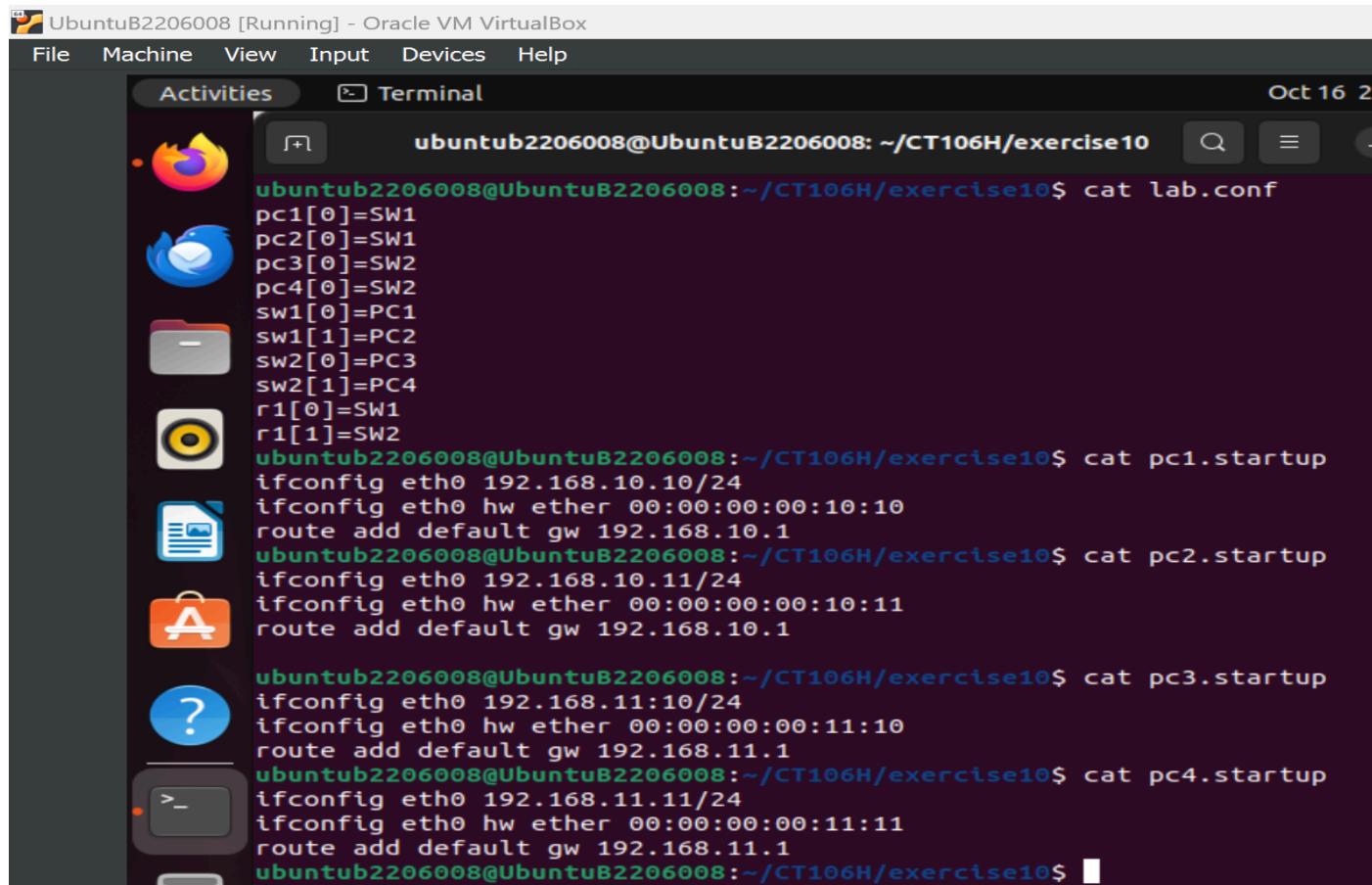
```
ifconfig br0 up
```

Sw2.startup

```
ifconfig eth0 up
ifconfig eth0 hw ether 00:00:00:20:11:10
ifconfig eth1 up
ifconfig eth1 hw ether 00:00:00:20:11:11
ifconfig eth2 up
ifconfig eth2 hw ether 00:00:00:20:11:12
brctl addbr br1
brctl addif br1 eth0
brctl addif br1 eth1
brctl addif br1 eth2
brctl stp br1 on
ifconfig br1 up
```

R1.startup

```
ifconfig eth0 192.168.10.1/24 up
ifconfig eth0 hw ether 00:00:00:50:10:10
ifconfig eth1 192.168.11.1/24 up
ifconfig eth1 hw ether 00:00:00:50:11:10
```

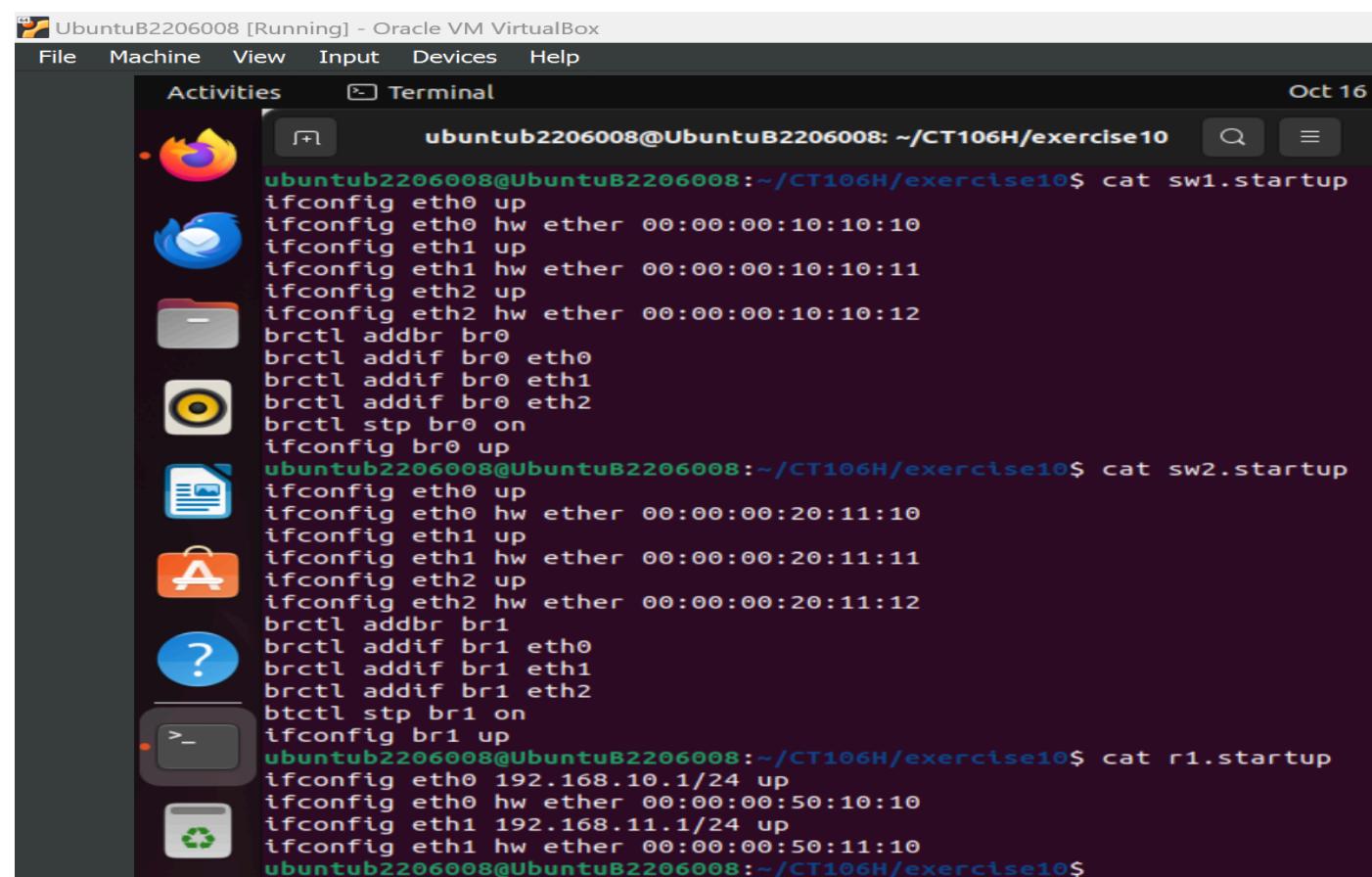


UbuntuB2206008 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Terminal Oct 16 2023

```
ubuntub2206008@UbuntuB2206008: ~/CT106H/exercise10$ cat lab.conf
pc1[0]=SW1
pc2[0]=SW1
pc3[0]=SW2
pc4[0]=SW2
sw1[0]=PC1
sw1[1]=PC2
sw2[0]=PC3
sw2[1]=PC4
r1[0]=SW1
r1[1]=SW2
ubuntub2206008@UbuntuB2206008: ~/CT106H/exercise10$ cat pc1.startup
ifconfig eth0 192.168.10.10/24
ifconfig eth0 hw ether 00:00:00:00:10:10
route add default gw 192.168.10.1
ubuntub2206008@UbuntuB2206008: ~/CT106H/exercise10$ cat pc2.startup
ifconfig eth0 192.168.10.11/24
ifconfig eth0 hw ether 00:00:00:00:10:11
route add default gw 192.168.10.1
ubuntub2206008@UbuntuB2206008: ~/CT106H/exercise10$ cat pc3.startup
ifconfig eth0 192.168.11.10/24
ifconfig eth0 hw ether 00:00:00:00:11:10
route add default gw 192.168.11.1
ubuntub2206008@UbuntuB2206008: ~/CT106H/exercise10$ cat pc4.startup
ifconfig eth0 192.168.11.11/24
ifconfig eth0 hw ether 00:00:00:00:11:11
route add default gw 192.168.11.1
ubuntub2206008@UbuntuB2206008: ~/CT106H/exercise10$
```



UbuntuB2206008 [Running] - Oracle VM VirtualBox

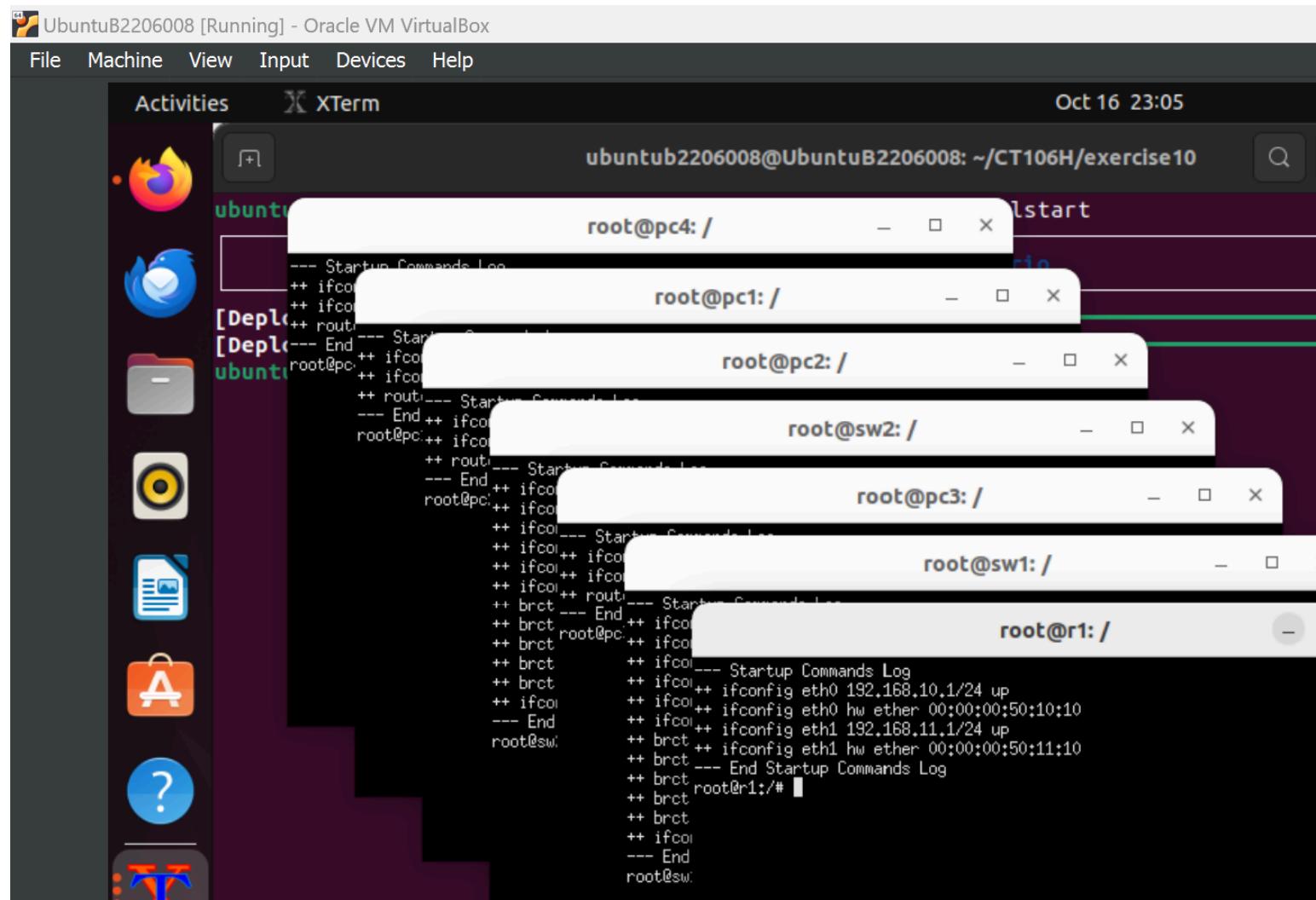
File Machine View Input Devices Help

Activities Terminal Oct 16 2023

```
ubuntub2206008@UbuntuB2206008: ~/CT106H/exercise10$ cat sw1.startup
ifconfig eth0 up
ifconfig eth0 hw ether 00:00:00:10:10:10
ifconfig eth1 up
ifconfig eth1 hw ether 00:00:00:10:10:11
ifconfig eth2 up
ifconfig eth2 hw ether 00:00:00:10:10:12
brctl addbr br0
brctl addif br0 eth0
brctl addif br0 eth1
brctl addif br0 eth2
brctl stp br0 on
ifconfig br0 up
ubuntub2206008@UbuntuB2206008: ~/CT106H/exercise10$ cat sw2.startup
ifconfig eth0 up
ifconfig eth0 hw ether 00:00:00:20:11:10
ifconfig eth1 up
ifconfig eth1 hw ether 00:00:00:20:11:11
ifconfig eth2 up
ifconfig eth2 hw ether 00:00:00:20:11:12
brctl addbr br1
brctl addif br1 eth0
brctl addif br1 eth1
brctl addif br1 eth2
brctl stp br1 on
ifconfig br1 up
ubuntub2206008@UbuntuB2206008: ~/CT106H/exercise10$ cat r1.startup
ifconfig eth0 192.168.10.1/24 up
ifconfig eth0 hw ether 00:00:00:50:10:10
ifconfig eth1 192.168.11.1/24 up
ifconfig eth1 hw ether 00:00:00:50:11:10
ubuntub2206008@UbuntuB2206008: ~/CT106H/exercise10$
```

- Start scenario

Kathara lstart



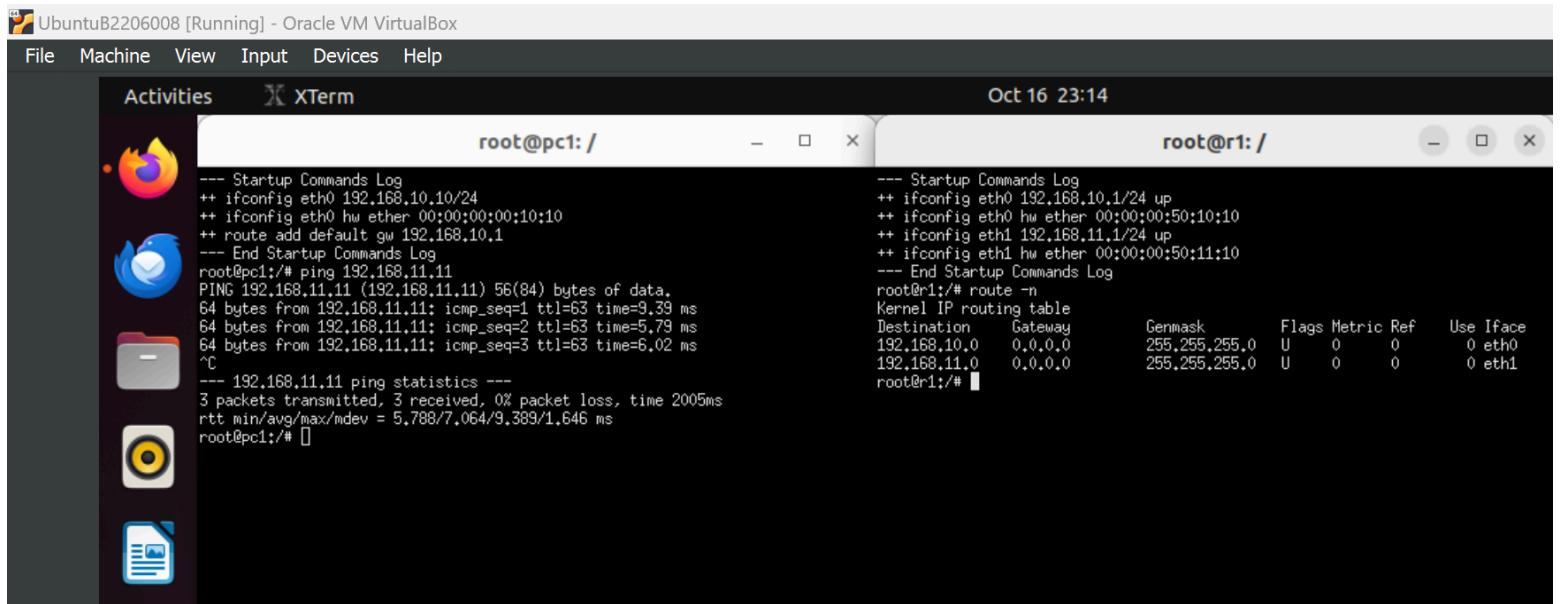
- Check routing and connection

R1:

Route -n

Pc1:

Ping 192.168.11.11



Exercise 11:

Solution:

Files:

Lab.conf:

```
pc1[0]=A  
pc2[0]=B  
pc3[0]=C  
pc4[0]=D  
pc5[0]=G  
pc6[0]=H  
pc7[0]=I  
pc8[0]=J  
sw1[0]=A  
sw1[1]=B  
sw1[2]=E  
sw2[0]=C  
sw2[1]=D  
sw2[2]=F  
sw3[0]=G  
sw3[1]=H  
sw3[2]=K  
sw4[0]=I  
sw4[1]=J  
sw4[2]=O  
r1[0]=E  
r1[1]=F  
r1[2]=M  
r2[1]=K  
r2[0]=O  
r2[2]=M
```

Pc1.startup:

```
ifconfig eth0 192.168.10.10/24  
ifconfig eth0 hw ether 00:00:00:00:00:10  
route add default gw 192.168.10.1
```

Pc2.startup:

```
ifconfig eth0 192.168.10.11/24  
ifconfig eth0 hw ether 00:00:00:00:00:20  
route add default gw 192.168.10.1
```

Pc3.startup:

```
ifconfig eth0 192.168.11.10/24  
ifconfig eth0 hw ether 00:00:00:00:11:10  
route add default gw 192.168.11.1
```

Pc4.startup:

```
ifconfig eth0 192.168.11.11/24  
ifconfig eth0 hw ether 00:00:00:00:11:20
```

```
route add default gw 192.168.11.1
```

Pc5.startup:

```
ifconfig eth0 192.168.20.10/24  
ifconfig eth0 hw ether 00:00:00:00:22:10  
route add default gw 192.168.20.1
```

Pc6.startup:

```
ifconfig eth0 192.168.20.11/24  
ifconfig eth0 hw ether 00:00:00:00:22:20  
route add default gw 192.168.20.1
```

Pc7.startup:

```
ifconfig eth0 192.168.21.10/24  
ifconfig eth0 hw ether 00:00:00:00:33:10  
route add default gw 192.168.21.1
```

Pc8.startup:

```
ifconfig eth0 192.168.21.11/24  
ifconfig eth0 hw ether 00:00:00:00:33:20  
route add default gw 192.168.21.1
```

Sw1.startup:

```
ifconfig eth0 up  
ifconfig eth0 hw ether 00:00:00:00:10:10  
ifconfig eth1 up  
ifconfig eth1 hw ether 00:00:00:00:10:20  
ifconfig eth2 up  
ifconfig eth2 hw ether 00:00:00:00:10:30  
brctl addbr br0  
brctl addif br0 eth0  
brctl addif br0 eth1  
brctl addif br0 eth2  
brctl stp br0 on  
ifconfig br0 up
```

Sw2.startup:

```
ifconfig eth0 up  
ifconfig eth0 hw ether 00:00:00:00:88:10  
ifconfig eth1 up  
ifconfig eth1 hw ether 00:00:00:00:88:20  
ifconfig eth2 up  
ifconfig eth2 hw ether 00:00:00:00:88:30  
brctl addbr br0  
brctl addif br0 eth0  
brctl addif br0 eth1  
brctl addif br0 eth2  
brctl stp br0 on  
ifconfig br0 up
```

Sw3.startup:

```
ifconfig eth0 up  
ifconfig eth0 hw ether 00:00:00:00:20:10  
ifconfig eth1 up  
ifconfig eth1 hw ether 00:00:00:00:20:20
```

```
ifconfig eth2 up  
ifconfig eth2 hw ether 00:00:00:00:20:30  
brctl addbr br0  
brctl addif br0 eth0  
brctl addif br0 eth1  
brctl addif br0 eth2  
brctl stp br0 on  
ifconfig br0 up
```

Sw4.startup:

```
ifconfig eth0 up  
ifconfig eth0 hw ether 00:00:00:00:44:10  
ifconfig eth1 up  
ifconfig eth1 hw ether 00:00:00:00:44:20  
ifconfig eth2 up  
ifconfig eth2 hw ether 00:00:00:00:44:30  
brctl addbr br0  
brctl addif br0 eth0  
brctl addif br0 eth1  
brctl addif br0 eth2  
brctl stp br0 on  
ifconfig br0 up
```

R1.startup:

```
ifconfig eth0 192.168.10.1 netmask 255.255.255.0 up  
ifconfig eth1 192.168.11.1 netmask 255.255.255.0 up  
ifconfig eth2 10.0.0.2 netmask 255.255.255.252 up  
route add -net 192.168.20.0 netmask 255.255.255.0 gw 10.0.0.2  
route add -net 192.168.21.0 netmask 255.255.255.0 gw 10.0.0.2
```

R2.startup:

```
ifconfig eth0 192.168.21.1 netmask 255.255.255.0 up  
ifconfig eth1 192.168.20.1 netmask 255.255.255.0 up  
ifconfig eth2 10.0.0.1 netmask 255.255.255.252 up  
route add -net 192.168.10.0 netmask 255.255.255.0 gw 10.0.0.1  
route add -net 192.168.11.0 netmask 255.255.255.0 gw 10.0.0.1
```

UbuntuB2206008 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Terminal Oct 17 00:05

```
ubuntub2206008@UbuntuB2206008: ~/CT106H/exercise11$ tree
.
├── lab.conf
├── pc1.startup
├── pc2.startup
├── pc3.startup
├── pc4.startup
├── pc5.startup
├── pc6.startup
├── pc7.startup
├── pc8.startup
├── r1.startup
└── r2.startup
    └── shared
        ├── sw1.startup
        ├── sw2.startup
        ├── sw3.startup
        └── sw4.startup

1 directory, 15 files
```

UbuntuB2206008 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Terminal Oct 17 00:05

```
ubuntub2206008@UbuntuB2206008: ~/CT106H/exercise11$ cat lab.conf
pc1[0]=A
pc2[0]=B
pc3[0]=C
pc4[0]=D
pc5[0]=G
pc6[0]=H
pc7[0]=I
pc8[0]=J
sw1[0]=A
sw1[1]=B
sw1[2]=E
sw2[0]=C
sw2[1]=D
sw2[2]=F
sw3[0]=G
sw3[1]=H
sw3[2]=K
sw4[0]=I
sw4[1]=J
sw4[2]=O
r1[0]=E
r1[1]=F
r1[2]=M
r2[1]=K
r2[0]=O
r2[2]=M

ubuntub2206008@UbuntuB2206008: ~/CT106H/exercise11$ cat pc1.startup
ifconfig eth0 192.168.10.10/24
ifconfig eth0 hw ether 00:00:00:00:00:10
route add default gw 192.168.10.1
```

UbuntuB2206008 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Terminal Oct 17 00:07

```
ifconfig eth0 192.168.10.10/24
ifconfig eth0 hw ether 00:00:00:00:00:10
route add default gw 192.168.10.1

ubuntub2206008@UbuntuB2206008:~/CT106H/exercise11$ cat pc2.startup
ifconfig eth0 192.168.10.11/24
ifconfig eth0 hw ether 00:00:00:00:00:20
route add default gw 192.168.10.1

ubuntub2206008@UbuntuB2206008:~/CT106H/exercise11$ cat pc3.startup
ifconfig eth0 192.168.11.10/24
ifconfig eth0 hw ether 00:00:00:00:11:10
route add default gw 192.168.11.1

ubuntub2206008@UbuntuB2206008:~/CT106H/exercise11$ cat pc4.startup
ifconfig eth0 192.168.11.11/24
ifconfig eth0 hw ether 00:00:00:00:11:20
route add default gw 192.168.11.1

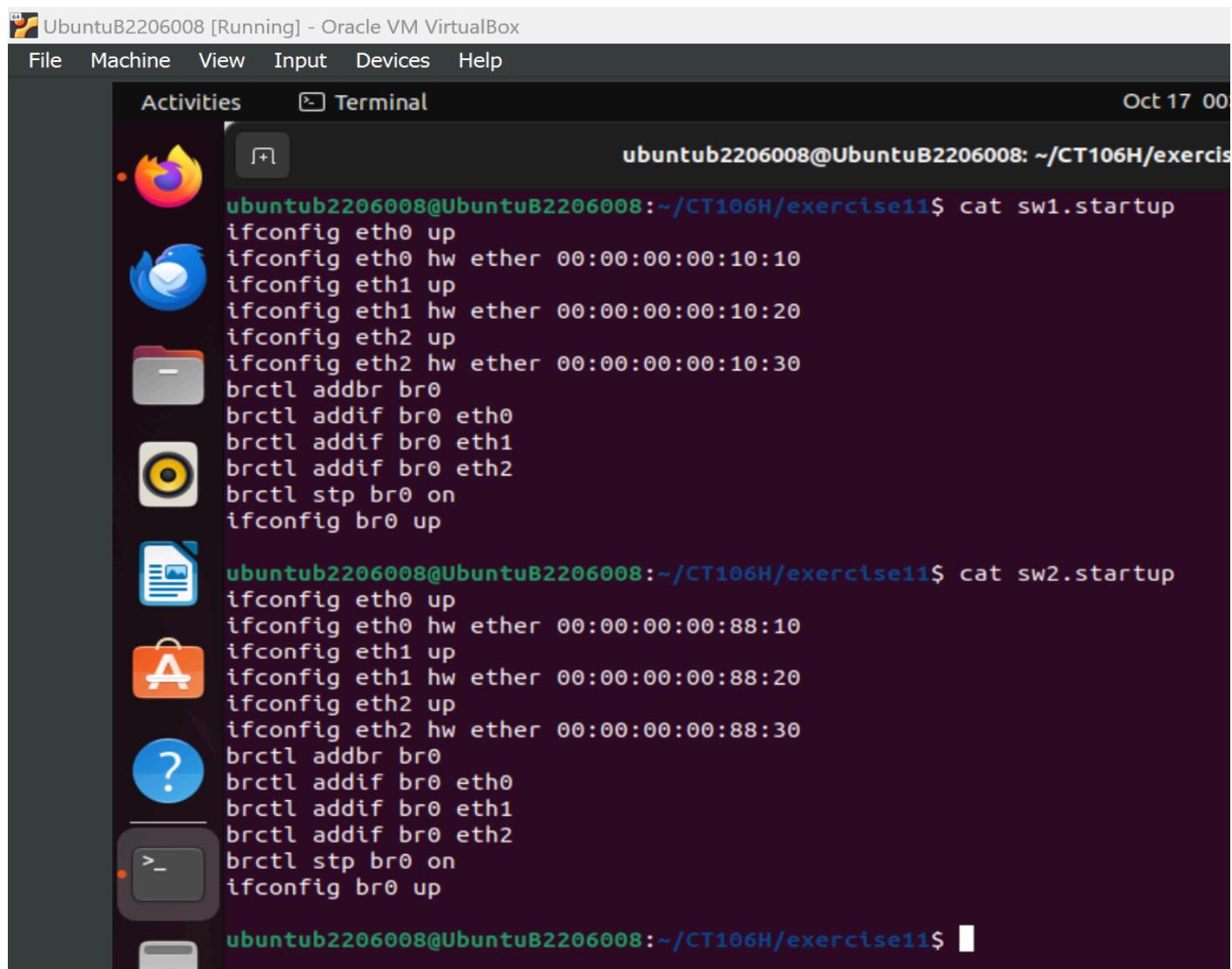
ubuntub2206008@UbuntuB2206008:~/CT106H/exercise11$ cat pc5.startup
ifconfig eth0 192.168.20.10/24
ifconfig eth0 hw ether 00:00:00:00:22:10
route add default gw 192.168.20.1

ubuntub2206008@UbuntuB2206008:~/CT106H/exercise11$ cat pc6.startup
ifconfig eth0 192.168.20.11/24
ifconfig eth0 hw ether 00:00:00:00:22:20
route add default gw 192.168.20.1

ubuntub2206008@UbuntuB2206008:~/CT106H/exercise11$ cat pc7.startup
ifconfig eth0 192.168.21.10/24
ifconfig eth0 hw ether 00:00:00:00:33:10
route add default gw 192.168.21.1

ubuntub2206008@UbuntuB2206008:~/CT106H/exercise11$ cat pc8.startup
ifconfig eth0 192.168.21.11/24
ifconfig eth0 hw ether 00:00:00:00:33:20
route add default gw 192.168.21.1

ubuntub2206008@UbuntuB2206008:~/CT106H/exercise11$
```



The image shows a screenshot of an Ubuntu desktop environment running in Oracle VM VirtualBox. The desktop has a dark theme with a dock containing icons for the Dash, Home, Applications, and Help. A terminal window is open in the center, displaying command-line output. The terminal title bar says "Terminal" and the date "Oct 17 00". The terminal content shows two separate sessions of commands being run:

```
ubuntub2206008@UbuntuB2206008:~/CT106H/exercise11$ cat sw1.startup
ifconfig eth0 up
ifconfig eth0 hw ether 00:00:00:00:10:10
ifconfig eth1 up
ifconfig eth1 hw ether 00:00:00:00:10:20
ifconfig eth2 up
ifconfig eth2 hw ether 00:00:00:00:10:30
brctl addbr br0
brctl addif br0 eth0
brctl addif br0 eth1
brctl addif br0 eth2
brctl stp br0 on
ifconfig br0 up

ubuntub2206008@UbuntuB2206008:~/CT106H/exercise11$ cat sw2.startup
ifconfig eth0 up
ifconfig eth0 hw ether 00:00:00:00:88:10
ifconfig eth1 up
ifconfig eth1 hw ether 00:00:00:00:88:20
ifconfig eth2 up
ifconfig eth2 hw ether 00:00:00:00:88:30
brctl addbr br0
brctl addif br0 eth0
brctl addif br0 eth1
brctl addif br0 eth2
brctl stp br0 on
ifconfig br0 up

ubuntub2206008@UbuntuB2206008:~/CT106H/exercise11$ █
```

UbuntuB2206008 [Running] - Oracle VM VirtualBox

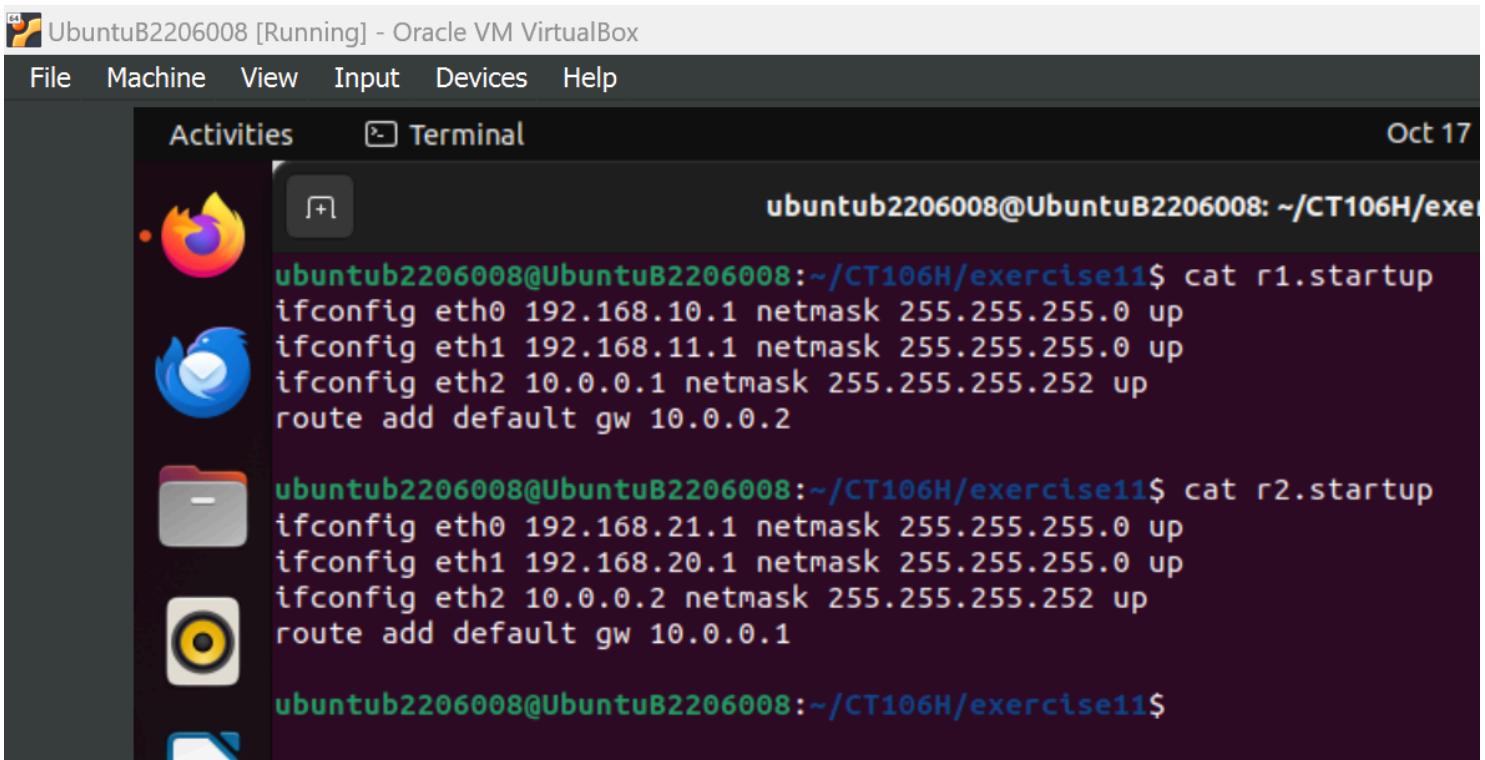
File Machine View Input Devices Help

Activities Terminal Oct 17 0

```
ubuntub2206008@UbuntuB2206008:~/CT106H/exercise11$ cat sw3.startup
ifconfig eth0 up
ifconfig eth0 hw ether 00:00:00:00:20:10
ifconfig eth1 up
ifconfig eth1 hw ether 00:00:00:00:20:20
ifconfig eth2 up
ifconfig eth2 hw ether 00:00:00:00:20:30
brctl addbr br0
brctl addif br0 eth0
brctl addif br0 eth1
brctl addif br0 eth2
brctl stp br0 on
ifconfig br0 up

ubuntub2206008@UbuntuB2206008:~/CT106H/exercise11$ cat sw4.startup
ifconfig eth0 up
ifconfig eth0 hw ether 00:00:00:00:44:10
ifconfig eth1 up
ifconfig eth1 hw ether 00:00:00:00:44:20
ifconfig eth2 up
ifconfig eth2 hw ether 00:00:00:00:44:30
brctl addbr br0
brctl addif br0 eth0
brctl addif br0 eth1
brctl addif br0 eth2
brctl stp br0 on
ifconfig br0 up

ubuntub2206008@UbuntuB2206008:~/CT106H/exercise11$
```



The screenshot shows a Linux desktop environment with a dark theme. At the top is a menu bar with "File", "Machine", "View", "Input", "Devices", and "Help". Below the menu is a docked "Activities" panel on the left and a "Terminal" window on the right. The terminal window has a title bar showing the date "Oct 17". Inside the terminal, there are two sets of command-line outputs:

```
ubuntub2206008@UbuntuB2206008:~/CT106H/exercise11$ cat r1.startup
ifconfig eth0 192.168.10.1 netmask 255.255.255.0 up
ifconfig eth1 192.168.11.1 netmask 255.255.255.0 up
ifconfig eth2 10.0.0.1 netmask 255.255.255.252 up
route add default gw 10.0.0.2

ubuntub2206008@UbuntuB2206008:~/CT106H/exercise11$ cat r2.startup
ifconfig eth0 192.168.21.1 netmask 255.255.255.0 up
ifconfig eth1 192.168.20.1 netmask 255.255.255.0 up
ifconfig eth2 10.0.0.2 netmask 255.255.255.252 up
route add default gw 10.0.0.1

ubuntub2206008@UbuntuB2206008:~/CT106H/exercise11$
```

- Start scenario

Kathara lstart

The screenshot shows a desktop environment with multiple terminal windows open in an XTerm window. The terminals are running on an Ubuntu host (UbuntuB2206008). Each terminal window displays a startup log for a different host or router. The hosts include pc1, pc2, pc3, pc4, pc5, pc6, pc7, pc8, sw1, sw2, sw3, sw4, r1, and r2. The logs show the execution of ifconfig commands to bring up interfaces and set up default routes.

```

root@pc1:/ --- Startup Commands Log
++ ifconfig eth0 192.168.10.10/24
++ ifconfig eth0 hw ether 00:00:00:00:10:10
++ route add default gw 192.168.10.1
--- End Startup Commands Log
root@pc1:/# 

root@pc2:/ --- Startup Commands Log
++ ifconfig eth0 192.168.10.11/24
++ ifconfig eth0 hw ether 00:00:00:00:20:10
++ route add default gw 192.168.10.1
--- End Startup Commands Log
root@pc2:/# 

root@pc3:/ --- Startup Commands Log
++ ifconfig eth0 192.168.11.10/24
++ ifconfig eth0 hw ether 00:00:00:00:11:10
++ route add default gw 192.168.11.1
--- End Startup Commands Log
root@pc3:/# 

root@pc4:/ --- Startup Commands Log
++ ifconfig eth0 192.168.11.11/24
++ ifconfig eth0 hw ether 00:00:00:00:11:20
++ route add default gw 192.168.11.1
--- End Startup Commands Log
root@pc4:/# 

root@pc5:/ --- Startup Commands Log
++ ifconfig eth0 192.168.20.10/24
++ ifconfig eth0 hw ether 00:00:00:22:10
++ route add default gw 192.168.20.1
--- End Startup Commands Log
root@pc5:/# 

root@pc6:/ --- Startup Commands Log
++ ifconfig eth0 192.168.20.11/24
++ ifconfig eth0 hw ether 00:00:00:22:20
++ route add default gw 192.168.20.1
--- End Startup Commands Log
root@pc6:/# 

root@pc7:/ --- Startup Commands Log
++ ifconfig eth0 192.168.21.10/24
++ ifconfig eth0 hw ether 00:00:00:33:10
++ route add default gw 192.168.21.1
--- End Startup Commands Log
root@pc7:/# 

root@pc8:/ --- Startup Commands Log
++ ifconfig eth0 192.168.21.11/24
++ ifconfig eth0 hw ether 00:00:00:33:20
++ route add default gw 192.168.21.1
--- End Startup Commands Log
root@pc8:/# 

root@sw1:/ --- Startup Commands Log
++ brctl addif br0
++ brctl addif br0 eth0
++ brctl addif br0 eth1
++ brctl addif br0 eth2
++ brctl stp br0 on
++ ifconfig br0 up
--- End Startup Commands Log
root@sw1:/# 

root@sw2:/ --- Startup Commands Log
++ ifconfig eth0 up
++ ifconfig eth0 hw ether 00:00:00:00:88:10
++ ifconfig eth1 up
++ ifconfig eth1 hw ether 00:00:00:00:88:20
++ ifconfig eth2 up
--- End Startup Commands Log
root@sw2:/# 

root@sw3:/ --- Startup Commands Log
++ ifconfig eth0 up
++ ifconfig eth0 hw ether 00:00:00:00:20:10
++ ifconfig eth1 up
++ ifconfig eth1 hw ether 00:00:00:00:20:20
++ ifconfig eth2 up
--- End Startup Commands Log
root@sw3:/# 

root@sw4:/ --- Startup Commands Log
++ ifconfig eth0 up
++ ifconfig eth0 hw ether 00:00:00:44:10
++ ifconfig eth1 up
++ ifconfig eth1 hw ether 00:00:00:44:20
++ ifconfig eth2 up
++ ifconfig eth2 hw ether 00:00:00:44:30
--- End Startup Commands Log
root@sw4:/# 

root@r1:/ --- Startup Commands Log
++ ifconfig eth0 192.168.10.1 netmask 255.255.255.0 up
++ ifconfig eth1 192.168.11.1 netmask 255.255.255.0 up
++ ifconfig eth2 10.0.0.1 netmask 255.255.255.252 up
++ route add default gw 10.0.0.1
--- End Startup Commands Log
root@r1:/# 

root@r2:/ --- Startup Commands Log
++ ifconfig eth0 192.168.21.1 netmask 255.255.255.0 up
++ ifconfig eth1 192.168.20.1 netmask 255.255.255.0 up
++ ifconfig eth2 10.0.0.2 netmask 255.255.255.252 up
++ route add default gw 10.0.0.1
--- End Startup Commands Log
root@r2:/# 

```

- Ping check from pc1 to pc3, pc5, pc7.

```
root@pc1: /  
--- Startup Commands Log  
++ ifconfig eth0 192.168.10.10/24  
++ ifconfig eth0 hw ether 00:00:00:00:00:10  
++ route add default gw 192.168.10.1  
--- End Startup Commands Log  
root@pc1:/# ping 192.168.11.10  
PING 192.168.11.10 (192.168.11.10) 56(84) bytes of data.  
64 bytes from 192.168.11.10: icmp_seq=1 ttl=63 time=68.8 ms  
64 bytes from 192.168.11.10: icmp_seq=2 ttl=63 time=9.07 ms  
^C  
--- 192.168.11.10 ping statistics ---  
2 packets transmitted, 2 received, 0% packet loss, time 1006ms  
rtt min/avg/max/mdev = 9.073/38.930/68.787/29.857 ms  
root@pc1:/# ping 192.168.20.10  
PING 192.168.20.10 (192.168.20.10) 56(84) bytes of data.  
64 bytes from 192.168.20.10: icmp_seq=1 ttl=62 time=8.42 ms  
64 bytes from 192.168.20.10: icmp_seq=2 ttl=62 time=7.53 ms  
^C  
--- 192.168.20.10 ping statistics ---  
2 packets transmitted, 2 received, 0% packet loss, time 1008ms  
rtt min/avg/max/mdev = 7.529/7.976/8.424/0.447 ms  
root@pc1:/#
```

```
root@pc1: /  
root@pc1:/# ping 192.168.21.10  
PING 192.168.21.10 (192.168.21.10) 56(84) bytes of data.  
64 bytes from 192.168.21.10: icmp_seq=1 ttl=62 time=54.1 ms  
64 bytes from 192.168.21.10: icmp_seq=2 ttl=62 time=9.13 ms  
^C  
--- 192.168.21.10 ping statistics ---  
2 packets transmitted, 2 received, 0% packet loss, time 1005ms  
rtt min/avg/max/mdev = 9.128/31.606/54.085/22.478 ms  
root@pc1:/#
```

