CSE 232: Assignment 1

1.

a)

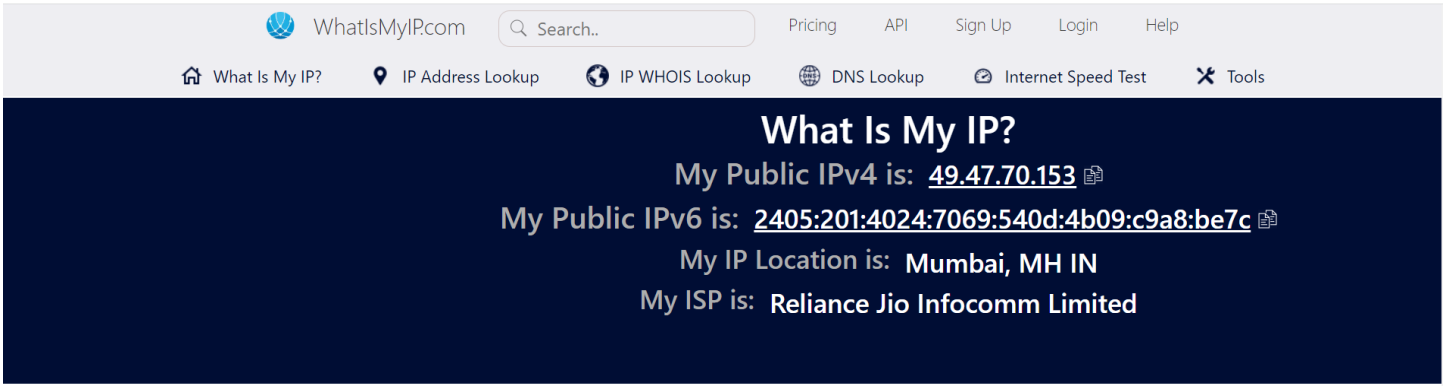
```
vibhor@LAPTOP-QVQGB6UI:~$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 172.25.110.218  netmask 255.255.240.0  broadcast 172.25.111.255
        inet6 fe80::215:5dff:fe7f:2e89  prefixlen 64  scopeid 0x20<link>
        ether 00:15:5d:7f:2e:89  txqueuelen 1000  (Ethernet)
        RX packets 1656  bytes 431985 (431.9 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 94  bytes 6528 (6.5 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 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

vibhor@LAPTOP-QVQGB6UI:~$
```

IP address of my network is 172.25.110.218

b)



IPv4 address of my network is 49.47.70.153

IPv6 address of my network is 2405:201:4024:7069:540d:4b09:c9a8:be7c

The IP adress found using ifconfig command and https://www.whatismyip.com are different. This is so because the ifconfig command provides IP address of the local network interface provided by the local network infrastructure while https://www.whatismyip.com provides external IP address used to communicate with the public network.

2.

a)

```
vibhor@LAPTOP-QVQGB6UI:~$ nslookup -type=ptr google.in
Server:         172.25.96.1
Address:        172.25.96.1#53

Non-authoritative answer:
*** Can't find google.in: No answer

Authoritative answers can be found from:
google.in
        origin = ns1.google.com
        mail addr = dns-admin.google.com
        serial = 558736483
        refresh = 900
        retry = 900
        expire = 1800
        minimum = 60

vibhor@LAPTOP-QVQGB6UI:~$
```

To get an authoritative result for google.in I accessed its PTR record using nslookup with -type flag set to ptr. The section with heading ‘Authoritative answers can be found from:’ gives the required authoritative result.

b)

```
vibhor@LAPTOP-QVQGB6UI:~$ dig +nocmd +noall +answer @ns1.google.com google.com
google.com.             300     IN      A       216.58.196.206
vibhor@LAPTOP-QVQGB6UI:~$
```

The time to live for google.com is 300 seconds on the local DNS. This meams that the information for the DNS will be retained in the cache for 300 seconds in the DNS resolver, following which it will expire.

3.

a)

```
vibhor@LAPTOP-QVQGB6UI:~$ traceroute google.in
traceroute to google.in (142.250.194.196), 30 hops max, 60 byte packets
 1  LAPTOP-QVQGB6UI.mshome.net (172.25.96.1)  1.276 ms  0.925 ms  1.245 ms
 2  * * *
 3  10.57.192.1 (10.57.192.1)  11.397 ms  7.907 ms  11.182 ms
 4  172.16.18.1 (172.16.18.1)  10.722 ms  17.617 ms  12.531 ms
 5  192.168.128.134 (192.168.128.134)  17.439 ms 192.168.128.136 (192.168.128.136)  17.116 ms 192.168.128.134 (192.168.128.134)  16.681
 ms
 6  172.27.248.55 (172.27.248.55)  16.726 ms  13.055 ms  15.779 ms
 7  172.27.248.35 (172.27.248.35)  21.235 ms 172.27.248.34 (172.27.248.34)  19.659 ms  16.666 ms
 8  192.168.44.22 (192.168.44.22)  16.870 ms  16.856 ms 192.168.44.28 (192.168.44.28)  14.079 ms
 9  * * *
10  * * *
11  * * 142.250.161.100 (142.250.161.100)  9.361 ms
12  142.250.47.144 (142.250.47.144)  10.610 ms 142.250.168.56 (142.250.168.56)  11.251 ms  9.193 ms
13  * 142.251.76.174 (142.251.76.174)  10.540 ms *
14  142.251.52.207 (142.251.52.207)  8.776 ms 72.14.234.116 (72.14.234.116)  8.252 ms 142.251.54.92 (142.251.54.92)  8.219 ms
15  74.125.243.99 (74.125.243.99)  7.689 ms 108.170.251.113 (108.170.251.113)  9.250 ms 142.251.52.207 (142.251.52.207)  8.931 ms
16  142.251.52.209 (142.251.52.209)  8.991 ms 108.170.251.113 (108.170.251.113)  9.455 ms 108.170.251.97 (108.170.251.97)  7.263 ms
17  142.251.52.209 (142.251.52.209)  10.343 ms del12s07-in-f4.1e100.net (142.250.194.196)  13.761 ms 142.251.52.209 (142.251.52.209)  1
3.667 ms
vibhor@LAPTOP-QVQGB6UI:~$
```

There are 17 intermediate hosts in the path that packets take from my local network interface to google.in

The IP addresses of the intermediate hosts are:

1. 172.25.96.1
2. No IP address available
3. 10.57.192.1
4. 172.16.18.1
5. 192.168.128.134, 192.168.128.136
6. 172.27.248.55
7. 172.27.248.35, 172.27.248.34
8. 192.168.44.22, 192.168.44.28
9. No IP address available
10. No IP address available
11. 142.250.161.100

12. 142.250.47.144, 142.250.168.56, 142.250.161.100
13. 142.251.76.174
14. 142.251.52.207, 72.14.234.116, 142.251.54.92
15. 74.125.243.99, 108.170.251.113, 142.251.52.207
16. 142.251.52.209, 108.170.251.113, 108.170.251.97
17. 142.251.52.209, 142.250.194.196, 142.251.52.209

Average latency to each intermediate host is:

Average latency for Hop 1: (1.276 + 0.925 + 1.245) / 3 = 1.14867 ms

Average latency for Hop 3: (11.397 + 7.907 + 11.182) / 3 = 10.162 ms

Average latency for Hop 4: (10.722 + 17.617 + 12.531) / 3 = 13.29 ms

Average latency for Hop 5: (17.439 + 17.116 + 16.681) / 3 = 17.0787 ms

Average latency for Hop 6: (16.726 + 13.055 + 15.779) / 3 = 15.1867 ms

Average latency for Hop 7: (21.235 + 19.659 + 16.666) / 3 = 19.1867 ms

Average latency for Hop 8: (16.870 + 16.856 + 14.079) / 3 = 15.935 ms

Average latency for Hop 11: (9.361 ms) / 1 = 9.361 ms

Average latency for Hop 12: (10.610 + 11.251 + 9.193) / 3 = 10.6847 ms

Average latency for Hop 13: (10.540 ms) / 1 = 10.540 ms

Average latency for Hop 14: (8.776 + 8.252 + 8.219) / 3 = 8.41567 ms

Average latency for Hop 15: (7.689 + 9.250 + 8.931) / 3 = 8.95667 ms

Average latency for Hop 16: (8.991 + 9.455 + 7.263) / 3 = 8.903 ms

Average latency for Hop 17: (10.343 + 13.761 + 13.667) / 3 = 12.9237 ms

b)

```
vibhor@LAPTOP-QVQGB6UI:~$ ping -c 50 google.in
PING google.in (142.250.194.196) 56(84) bytes of data.
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=1 ttl=51 time=6.95 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=2 ttl=51 time=9.64 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=3 ttl=51 time=8.42 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=4 ttl=51 time=8.99 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=5 ttl=51 time=9.21 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=6 ttl=51 time=9.49 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=7 ttl=51 time=7.22 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=8 ttl=51 time=8.47 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=9 ttl=51 time=8.94 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=10 ttl=51 time=8.93 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=11 ttl=51 time=7.12 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=12 ttl=51 time=8.04 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=13 ttl=51 time=8.38 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=14 ttl=51 time=6.45 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=15 ttl=51 time=7.43 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=16 ttl=51 time=7.88 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=17 ttl=51 time=7.89 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=18 ttl=51 time=8.94 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=19 ttl=51 time=12.7 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=20 ttl=51 time=8.77 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=21 ttl=51 time=9.06 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=22 ttl=51 time=8.32 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=23 ttl=51 time=7.25 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=24 ttl=51 time=10.1 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=25 ttl=51 time=8.23 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=26 ttl=51 time=7.86 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=27 ttl=51 time=8.51 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=28 ttl=51 time=7.73 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=29 ttl=51 time=8.80 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=30 ttl=51 time=8.14 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=31 ttl=51 time=7.32 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=32 ttl=51 time=7.73 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=33 ttl=51 time=9.60 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=34 ttl=51 time=8.38 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=35 ttl=51 time=8.07 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=36 ttl=51 time=7.32 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=37 ttl=51 time=7.73 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=38 ttl=51 time=8.25 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=39 ttl=51 time=8.61 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=40 ttl=51 time=8.29 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=41 ttl=51 time=7.19 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=42 ttl=51 time=7.05 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=43 ttl=51 time=6.82 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=44 ttl=51 time=7.25 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=45 ttl=51 time=8.61 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=46 ttl=51 time=7.13 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=47 ttl=51 time=7.51 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=48 ttl=51 time=9.39 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=49 ttl=51 time=7.13 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=50 ttl=51 time=8.14 ms

--- google.in ping statistics ---
50 packets transmitted, 50 received, 0% packet loss, time 49098ms
rtt min/avg/max/mdev = 6.446/8.227/12.702/1.048 ms
vibhor@LAPTOP-QVQGB6UI:~$
```

Sum of latency times over all ping requests

= 6.95 + 9.64 + 8.42 + 8.99 + 9.21 + 9.49 + 7.22 + 8.47 + 8.94 + 8.93 + 7.12 + 8.04 + 8.38 + 6.45 + 7.43 + 7.88 + 7.89 + 8.94 + 12.7 + 8.77 + 9.06 + 8.32 + 7.25 + 10.1 + 8.23 + 7.86 + 8.51 + 7.73 + 8.80 + 8.14 + 7.32 + 7.73 + 9.60 + 8.38 + 8.07 + 7.32 + 7.73 + 8.25 + 8.61 + 8.29 + 7.19 + 7.05 + 6.82 + 7.25 + 8.61 + 7.13 + 7.51 + 9.39 + 7.13 + 8.14

= 366.04

Number of ping requests = 50

Average Latency = Sum of latency times over all ping requests / Number of ping requests

= 366.04/50

= 7.3208 ms

c)

Sum of average latency of all intermediate host = 1.14867 + 10.162 + 13.29 + 17.0787 + 15.1867 + 19.1867 + 15.935 + 10.6847 + 8.41567 + 8.95667 + 8.903 + 12.9237 = 140.8811 ms

The sum of average latency of all intermediate host (140.8811 ms) obtained in (a) is different from that obtained in any individual ping request in (b) because traceroute and ping command measure latency in different ways. While traceroute measures the round trip time of packet for each intermediate host from source IP address to intermediate host, the ping command measures the round trip time from source IP address to destination IP address.

d)

In practice, the maximum of average latency over all intermediate host (19.1867 ms) obtained in (a) is different from that obtained in any individual ping request in (b). While in theory both quantities must be same but this generally does not happen. This can be due to congestion, distance of intermediate host routers in traceroute command or since packet loss in ping can affect latency differently from packet loss in traceroute which measures latency for a packet from source to each hop and back.

e)

These entries arise from the fact that the traceroute command sends multiple packets to a single hop and records the round trip time time for each one of them. This allows to get a more accurate estimate of the round trip time to each hop and covers up for any inconsistencies due to factors like congestion, load balancing, packet loss.

f)

```
vibhor@LAPTOP-QVQGB6UI:~$ ping -c 50 stanford.edu
PING stanford.edu (171.67.215.200) 56(84) bytes of data.
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=1 ttl=234 time=320 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=2 ttl=234 time=400 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=3 ttl=234 time=278 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=4 ttl=234 time=298 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=5 ttl=234 time=470 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=6 ttl=234 time=289 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=7 ttl=234 time=315 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=8 ttl=234 time=336 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=9 ttl=234 time=359 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=10 ttl=234 time=268 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=11 ttl=234 time=266 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=12 ttl=234 time=326 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=13 ttl=234 time=350 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=14 ttl=234 time=374 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=15 ttl=234 time=297 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=16 ttl=234 time=283 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=17 ttl=234 time=266 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=18 ttl=234 time=366 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=19 ttl=234 time=287 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=20 ttl=234 time=311 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=21 ttl=234 time=335 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=22 ttl=234 time=358 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=23 ttl=234 time=284 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=24 ttl=234 time=303 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=25 ttl=234 time=327 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=26 ttl=234 time=350 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=27 ttl=234 time=376 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=28 ttl=234 time=295 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=29 ttl=234 time=267 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=30 ttl=234 time=341 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=31 ttl=234 time=365 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=32 ttl=234 time=286 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=33 ttl=234 time=268 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=34 ttl=234 time=267 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=35 ttl=234 time=268 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=36 ttl=234 time=278 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=37 ttl=234 time=301 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=38 ttl=234 time=325 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=39 ttl=234 time=349 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=40 ttl=234 time=371 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=41 ttl=234 time=297 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=42 ttl=234 time=316 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=43 ttl=234 time=345 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=44 ttl=234 time=373 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=45 ttl=234 time=284 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=46 ttl=234 time=309 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=47 ttl=234 time=331 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=48 ttl=234 time=355 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=49 ttl=234 time=379 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=50 ttl=234 time=301 ms

--- stanford.edu ping statistics ---
50 packets transmitted, 50 received, 0% packet loss, time 49375ms
rtt min/avg/max/mdev = 265.562/321.213/469.920/42.493 ms
vibhor@LAPTOP-QVQGB6UI:~$
```

Sum of latency times over all ping requests

= 320 + 400 + 278 + 298 + 470 + 289 + 315 + 336 + 359 + 268 + 266 + 326 + 350 + 374 + 297 + 283 + 266 + 366 + 287 + 311 + 335 + 358 + 284 + 303 + 327 + 350 + 376 + 295 + 267 + 341 + 365 + 286 + 268 + 267 + 268 + 278 + 301 + 325 + 349 + 371 + 297 + 316 + 345 + 373 + 284 + 309 + 331 + 355 + 379 + 301

= 15735

Number of ping requests = 50

Average Latency = Sum of latency times over all ping requests / Number of ping requests

= 15735/50

= 314.7 ms

g)

```
vibhor@LAPTOP-QVQGB6UI:~$ traceroute stanford.edu
traceroute to stanford.edu (171.67.215.200), 30 hops max, 60 byte packets
 1  LAPTOP-QVQGB6UI.mshome.net (172.25.96.1)  1.027 ms  0.987 ms  1.302 ms
 2  reliance.reliance (192.168.29.1)  4.161 ms  12.117 ms  12.001 ms
 3  10.57.192.1 (10.57.192.1)  12.339 ms  12.773 ms  12.762 ms
 4  172.16.26.1 (172.16.26.1)  12.263 ms 172.16.18.1 (172.16.18.1)  14.667 ms 172.16.26.1 (172.16.26.1)  14.650 ms
 5  192.168.128.134 (192.168.128.134)  14.649 ms 192.168.128.138 (192.168.128.138)  14.513 ms  14.494 ms
 6  172.27.248.53 (172.27.248.53)  14.328 ms  12.889 ms  12.866 ms
 7  172.27.248.35 (172.27.248.35)  6.685 ms  6.144 ms  73.583 ms
 8  192.168.44.28 (192.168.44.28)  73.521 ms  73.505 ms  68.910 ms
 9  * * *
10  * * *
11  * * *
12  * * *
13  * 103.198.140.176 (103.198.140.176)  32.936 ms *
14  103.198.140.56 (103.198.140.56)  199.284 ms  165.904 ms 103.198.140.98 (103.198.140.98)  166.177 ms
15  103.198.140.79 (103.198.140.79)  166.317 ms 103.198.140.56 (103.198.140.56)  166.067 ms 103.198.140.81 (103.198.140.81)  166.305 ms
16  103.198.140.98 (103.198.140.98)  165.826 ms * *
17  103.198.140.98 (103.198.140.98)  166.114 ms *  165.651 ms
18  port-channel14.core3.nyc4.he.net (184.104.198.153)  226.446 ms * *
19  * * *
20  * * *
21  * * *
22  stanford-university.100gigabitethernet5-1.core1.pao1.he.net (184.105.177.238)  296.296 ms  296.284 ms  296.270 ms
23  stanford-university.100gigabitethernet5-1.core1.pao1.he.net (184.105.177.238)  296.258 ms woa-west-rtr-vl2.SUNet (171.64.255.132)
292.105 ms web.stanford.edu (171.67.215.200)  285.500 ms
vibhor@LAPTOP-QVQGB6UI:~$
```

The number of hops for google.in is 17 while that for stanford.edu is 23. The number of hops for google.in is 6 less than that for stanford.edu

h)

The latency difference between google.in and stanford.edu arises from the cumulative resullt of a variety of factors like the distance between my location and the servers of google.in and stanford.edu, server responsiveness, routing paths taken by packets for to and fro from my location to servers of google.in and stanford.edu, peer relationship between diiferent networks that connect my location to servers of google.in and stanford.edu, etc.

4.

```
vibhor@LAPTOP-QVQGB6UI:~$ ping 127.0.0.1
PING 127.0.0.1 (127.0.0.1) 56(84) bytes of data.
ping: sendmsg: Operation not permitted
ping: sendmsg: Operation not permitted
ping: sendmsg: Operation not permitted
ping: sendmsg: Operation not permitted
ping: sendmsg: Operation not permitted
ping: sendmsg: Operation not permitted
ping: sendmsg: Operation not permitted
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ping: sendmsg: Operation not permitted
ping: sendmsg: Operation not permitted
```
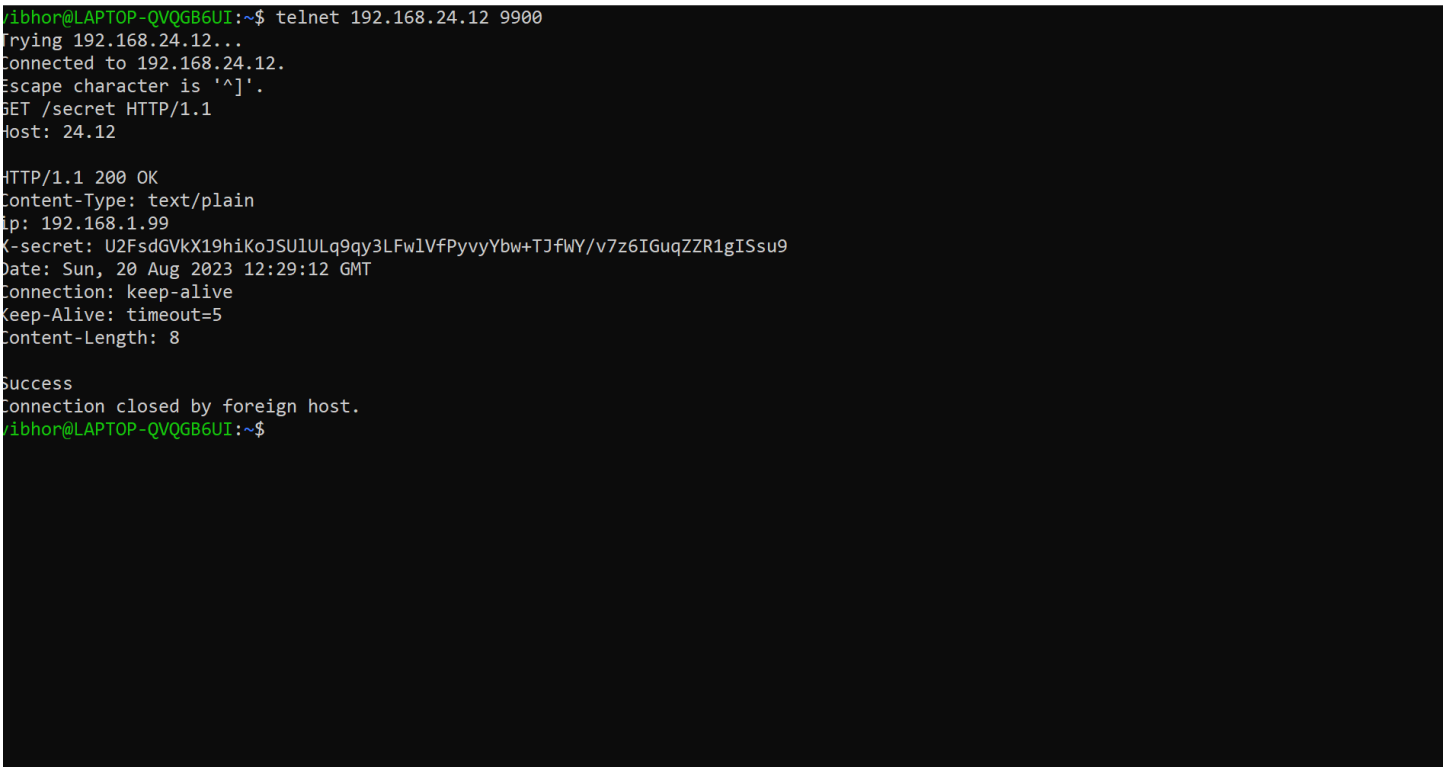

To fail the ping command for 127.0.0.1 with 100 packet loss, the firewall rules are modified. We add a firewall rule to drop incoming ICMP packets from the mentioned domain using the iptables utility. The rule is **sudo iptables -A OUTPUT -p icmp --icmp-type echo-request -d 127.0.0.1 -j DROP**

After adding this rule to firewall rules in Linux kernel the ping command to 127.0.0.1 fails with 100% packet loss.

5.



X-secret: U2FsdGVkX19hiKoJSUlULq9qy3LFwlVfPyvyYbw+TJfWY/v7z6IGuqZZR1gISsu9

6.

```
vibhor@LAPTOP-QVQGB6UI:~$ telnet 192.168.24.12 smtp
Trying 192.168.24.12...
Connected to 192.168.24.12.
Escape character is '^]'.
220 Welcome to CSE232 Mail Server
helo cse232.com
250 xeon01-rs-iiitd.iiitd.edu.in
EHLO cse232.com
250-xeon01-rs-iiitd.iiitd.edu.in
250-PIPELINING
250-SIZE 1048576
250-VRFY
250-ETRN
250-ENHANCEDSTATUSCODES
250-8BITMIME
250-DSN
250 SMTPUTF8
MAIL FROM: 21111@cse232.com
250 2.1.0 Ok
RCPT TO: 21111@cse232.com
250 2.1.5 Ok
DATA
354 End data with <CR><LF>.<CR><LF>
Subject: Mailbox creation
From: 21111@cse232.com
To: 21111@cse232.com

Hello,

Your mailbox has been created.

.
250 2.0.0 Ok: queued as 5E2F86F643B7
```

```
EHLO cse232.com
250-xeon01-rs-iiitd.iiitd.edu.in
250-PIPELINING
250-SIZE 1048576
250-VRFY
250-ETRN
250-ENHANCEDSTATUSCODES
250-8BITMIME
250-DSN
250 SMTPUTF8
MAIL FROM: 21111@cse232.com
250 2.1.0 Ok
RCPT TO: 21066@cse232.com
250 2.1.5 Ok
DATA
354 End data with <CR><LF>.<CR><LF>
Subject: Email for CSE232 Assignment 1
From: 21111@cse232.com
To: 21066@cse232.com

Hello,

This email is sent as part of CSE232 Assignment 1.

Regards,
2021111
.
250 2.0.0 Ok: queued as 398D66F643B7
QUIT
221 2.0.0 Bye
Connection closed by foreign host.
vibhor@LAPTOP-QVQGB6UI:~$
```

Id of message: 398D66F643B7