

Q1

```
ishaan@Ishaan_HPLaptop:/mnt/c/Users/ishaa/OneDrive/Desktop/IIIT/5th Semester/CN$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 172.21.82.41 netmask 255.255.240.0 broadcast 172.21.95.255
        inet6 fe80::215:5dff:feee:ccbd prefixlen 64 scopeid 0x20<link>
            ether 00:15:5d:ee:cc:bd txqueuelen 1000 (Ethernet)
            RX packets 135 bytes 13386 (13.3 KB)
            RX errors 0 dropped 0 overruns 0 frame 0
            TX packets 9 bytes 726 (726.0 B)
            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
```

The screenshot shows the header of the WhatIsMyIP.com website. It includes the logo, a search bar with placeholder text "Search..", and links for Pricing, API, Sign Up, Login, and Help. Below the header are links for "What Is My IP?", "IP Address Lookup", "IP WHOIS Lookup", "DNS Lookup", "Internet Speed Test", and "Tools".

The screenshot shows the results page for "What Is My IP?". It displays the following information:

- My Public IPv4: [182.69.182.119](#)
- My Public IPv6: [2401:4900:1c0a:7087:292f:2688:4c30:5caa](#)
- My IP Location: Azadpur, DL IN
- My ISP: Bharti Airtel Ltd.

- a) The IP address of my network interface is 192.168.44.128
- b) The IP address of my machine shown by 'whatismyip.com' is: 182.69.182.119

The first IP is assigned by the wifi router, while the second (public) IP is assigned by the ISP, and is seen as the sender's address by the servers.

Q2

```
ishaan@Ishaan_HPLaptop:/mnt/c/Users/ishaa/OneDrive/Desktop/IIIT/5th Semester/CN$ sudo ifconfig eth0 172.69.69.69
ishaan@Ishaan_HPLaptop:/mnt/c/Users/ishaa/OneDrive/Desktop/IIIT/5th Semester/CN$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 172.69.69.69 netmask 255.255.0.0 broadcast 172.69.255.255
        inet6 fe80::215:5dff:feee:ccbd prefixlen 64 scopeid 0x20<link>
            ether 00:15:5d:ee:cc:bd txqueuelen 1000 (Ethernet)
            RX packets 651 bytes 118712 (118.7 KB)
            RX errors 0 dropped 0 overruns 0 frame 0
            TX packets 137 bytes 13821 (13.8 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

ishaan@Ishaan_HPLaptop:/mnt/c/Users/ishaa/OneDrive/Desktop/IIIT/5th Semester/CN$ sudo ifconfig eth0 172.21.82.41
```

Q3

a) and b)

The screenshot shows three terminal windows side-by-side:

- Terminal 1:** Shows the command `netcat -v -l -p 6969` running, listening on port 6969. It receives a connection from localhost port 42164 and identifies it as part of CN PA01.
- Terminal 2:** Shows the command `netcat localhost 6969` running, testing the localhost connection.
- Terminal 3:** Shows the command `netstat -an` running, displaying active Internet connections. It lists two TCP connections: one to 127.0.0.1:42164 (state ESTABLISHED) and one to 127.0.0.1:6969 (state ESTABLISHED).

```
ishaan@Ishaan_HPLaptop:/mnt/c/Users/ishaan/OneDrive/Desktop/II  
IT/5th Semester/CN$ netstat -tn  
Active Internet connections (w/o servers)  
Proto Recv-Q Send-Q Local Address           Foreign Address  
      State  
tcp      0      0 127.0.0.1:6969          127.0.0.1:42166  
        ESTABLISHED  
tcp      0      0 127.0.0.1:42166          127.0.0.1:6969  
        ESTABLISHED  
ishaan@Ishaan_HPLaptop:/mnt/c/Users/ishaan/OneDrive/Desktop/II  
IT/5th Semester/CN$ netstat -tn  
Active Internet connections (w/o servers)  
Proto Recv-Q Send-Q Local Address           Foreign Address  
      State  
tcp      0      0 127.0.0.1:6969          127.0.0.1:42166  
        FIN_WAIT2  
tcp      0      0 127.0.0.1:42166          127.0.0.1:6969  
        CLOSE_WAIT  
ishaan@Ishaan_HPLaptop:/mnt/c/Users/ishaan/OneDrive/Desktop/II  
IT/5th Semester/CN$ netstat -tn  
Active Internet connections (w/o servers)  
Proto Recv-Q Send-Q Local Address           Foreign Address  
      State  
tcp      0      0 127.0.0.1:6969          127.0.0.1:42166  
        TIME_WAIT  
ishaan@Ishaan_HPLaptop:/mnt/c/Users/ishaan/OneDrive/Desktop/II  
IT/5th Semester/CN$
```

The first command was run when both the client and receiver were active. The second was run when I pressed Ctrl + C on one terminal, and the third when both the terminals had been stopped.

Q4

a)

```
ishaan@Ishaan_HPLaptop:/mnt/c/Users/ishaan/OneDrive/Desktop/IIIT/5th Semester/CN$ nslookup www.google.in
Server:      172.21.80.1
Address:     172.21.80.1#53

Non-authoritative answer:
Name:   www.google.in
Address: 216.58.196.195
Name:   www.google.in
Address: 2404:6800:4002:80c::2003

ishaan@Ishaan_HPLaptop:/mnt/c/Users/ishaan/OneDrive/Desktop/IIIT/5th Semester/CN$ nslookup -query=soa www.google.in
Server:      172.21.80.1
Address:     172.21.80.1#53

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

Authoritative answers can be found from:
google.in
    origin = ns1.google.com
    mail addr = dns-admin.google.com
    serial = 666268564
    refresh = 900
    retry = 900
    expire = 1800
    minimum = 60

ishaan@Ishaan_HPLaptop:/mnt/c/Users/ishaan/OneDrive/Desktop/IIIT/5th Semester/CN$ nslookup www.google.in ns1.google.com
Server:      ns1.google.com
Address:     216.239.32.10#53

Name:   www.google.in
Address: 142.250.193.227
Name:   www.google.in
Address: 2404:6800:4002:81d::2003
```

-soa stands for “Start of Authority”, and is used to show authoritative answers.

b)

```
ishaan@Ishaan_HPLaptop:/mnt/c/Users/ishaa/OneDrive/Desktop/IIIT/5th Semester/CN$ nslookup -debug iiitd.ac.in
Server:      172.21.80.1
Address:     172.21.80.1#53

-----
QUESTIONS:
    iiitd.ac.in, type = A, class = IN
ANSWERS:
->  iiitd.ac.in
    internet address = 103.25.231.30
    ttl = 0
AUTHORITY RECORDS:
ADDITIONAL RECORDS:
-----
Non-authoritative answer:
Name:  iiitd.ac.in
Address: 103.25.231.30
-----
QUESTIONS:
    iiitd.ac.in, type = AAAA, class = IN
ANSWERS:
AUTHORITY RECORDS:
->  iiitd.ac.in
    origin = ns1.iiitd.edu.in
    mail addr = admin-it.iiitd.ac.in
    serial = 2014013342
    refresh = 86400
    retry = 7200
    expire = 3600000
    minimum = 86400
    ttl = 3600
ADDITIONAL RECORDS:
```

The TTL (Time to Live) indicates the time for which the data is kept before being discarded.

A ttl of 3600 means data is kept for 1 hour.

```
ishaan@Ishaan_HPLaptop:/mnt/c/WINDOWS/system32$ nslookup -debug google.in
Server:      172.21.80.1
Address:     172.21.80.1#53

-----
    QUESTIONS:
        google.in, type = A, class = IN
    ANSWERS:
        -> google.in
            internet address = 142.250.196.164
            ttl = 0
    AUTHORITY RECORDS:
    ADDITIONAL RECORDS:
-----
Non-authoritative answer:
Name:   google.in
Address: 142.250.196.164
-----
    QUESTIONS:
        google.in, type = AAAA, class = IN
    ANSWERS:
        -> google.in
            has AAAA address 2404:6800:4002:813::2004
            ttl = 0
    AUTHORITY RECORDS:
    ADDITIONAL RECORDS:
-----
Name:   google.in
Address: 2404:6800:4002:813::2004

ishaan@Ishaan_HPLaptop:/mnt/c/WINDOWS/system32$ |
```

A ttl of 0 means data is fetched every time it is needed.

Q5

a)

Intermediate Host Number	Average Latency	IP address
1	(0.282+0.261+0.253)/3=0.265ms	172.21.80.1
2	(2.585+3.996+1.435)/3=2.672ms	192.168.1.1
3	(7.405+7.149+7.235)/3=7.263ms	182.69.187.255
4	(8.825+8.520+7.639)/3=8.328ms	125.18.240.153, 125.18.240.149
5	(8.534+8.797+8.527)/3=8.619ms	116.119.109.0
6	(9.051+12.071+12.060)/3=11.061ms	142.250.161.56
7	Hidden	
8	(5.235+9.749+9.518)/3=8.167ms	142.251.52.218, 142.250.225.248, 142.251.54.64
9	(7.952+7.252+7.029)/3=7.411ms	192.178.83.224, 192.178.83.226, 192.178.83.206
10	(40.145+41.345+40.829)/3=40.773ms	142.251.246.209, 192.178.242.79, 142.251.246.203
11	(42.598+39.948+53.417)/3=45.321ms	142.251.50.59, 142.251.246.205, 142.251.50.59
12	(39.490+44.957+39.482)/3=41.310ms	142.251.50.59, 142.250.239.57, 142.251.50.59
13	(45.689+39.543+41.528)/3=42.253ms	108.170.231.129, 108.170.231.131, 108.170.231.129
14	(37.351+43.205+46.729)/3=42.428ms	142.250.196.164

```
ishaan@Ishaan_HPLaptop:/mnt/c/WINDOWS/system32$ traceroute google.in
traceroute to google.in (142.250.196.164), 30 hops max, 60 byte packets
1 Ishaan_HPLaptop.mshome.net (172.21.80.1) 0.282 ms 0.261 ms 0.253 ms
2 dsldevice.lan (192.168.1.1) 2.585 ms 3.996 ms 1.435 ms
3 abts-north-dynamic-255.187.69.182.airtelbroadband.in (182.69.187.255) 7.405 ms 7.149 ms 7.235 ms
4 125.18.240.153 (125.18.240.153) 8.825 ms 8.520 ms 125.18.240.149 (125.18.240.149) 7.639 ms
5 116.119.109.0 (116.119.109.0) 8.534 ms 8.797 ms 8.527 ms
6 142.250.161.56 (142.250.161.56) 9.051 ms 12.071 ms 12.060 ms
7 * * *
8 142.251.52.218 (142.251.52.218) 5.235 ms 142.250.225.248 (142.250.225.248) 9.749 ms 142.251.54.64 (142.251.54.64) 9.518 ms
9 192.178.83.224 (192.178.83.224) 7.952 ms 192.178.83.226 (192.178.83.226) 7.252 ms 192.178.83.206 (192.178.83.206) 7.029 ms
10 142.251.246.209 (142.251.246.209) 40.145 ms 192.178.242.79 (192.178.242.79) 41.345 ms 142.251.246.203 (142.251.246.203) 40.829 ms
11 142.251.50.59 (142.251.50.59) 42.598 ms 142.251.246.205 (142.251.246.205) 39.948 ms 142.251.50.59 (142.251.50.59) 53.417 ms
12 142.251.50.59 (142.251.50.59) 39.490 ms 142.250.239.57 (142.250.239.57) 44.957 ms 142.251.50.59 (142.251.50.59) 39.482 ms
13 108.170.231.129 (108.170.231.129) 45.689 ms 108.170.231.131 (108.170.231.131) 39.543 ms 108.170.231.129 (108.170.231.129) 41.528 ms
14 maa03s47-in-f4.1e100.net (142.250.196.164) 37.351 ms 43.205 ms 46.729 ms
```

b)

```
ishaan@Ishaan_HPLaptop:/mnt/c/WINDOWS/system32$ ping -c 50 google.in
PING google.in (142.250.196.164) 56(84) bytes of data.
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=1 ttl=59 time=39.0 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=2 ttl=59 time=37.5 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=3 ttl=59 time=40.1 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=4 ttl=59 time=40.3 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=5 ttl=59 time=39.2 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=6 ttl=59 time=38.1 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=7 ttl=59 time=39.0 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=8 ttl=59 time=36.6 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=9 ttl=59 time=37.3 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=10 ttl=59 time=41.6 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=11 ttl=59 time=39.6 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=12 ttl=59 time=39.9 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=13 ttl=59 time=36.9 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=14 ttl=59 time=46.4 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=15 ttl=59 time=38.0 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=16 ttl=59 time=37.5 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=17 ttl=59 time=40.4 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=18 ttl=59 time=38.4 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=19 ttl=59 time=39.6 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=20 ttl=59 time=38.6 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=21 ttl=59 time=69.6 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=22 ttl=59 time=41.2 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=23 ttl=59 time=37.8 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=24 ttl=59 time=40.2 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=25 ttl=59 time=37.9 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=26 ttl=59 time=38.1 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=27 ttl=59 time=39.4 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=28 ttl=59 time=66.7 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=29 ttl=59 time=84.2 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=30 ttl=59 time=38.7 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=31 ttl=59 time=38.0 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=32 ttl=59 time=40.0 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=33 ttl=59 time=40.0 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=34 ttl=59 time=38.9 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=35 ttl=59 time=40.1 ms

64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=36 ttl=59 time=36.6 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=37 ttl=59 time=38.7 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=38 ttl=59 time=39.3 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=39 ttl=59 time=39.6 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=40 ttl=59 time=40.5 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=41 ttl=59 time=43.0 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=42 ttl=59 time=40.5 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=43 ttl=59 time=37.1 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=44 ttl=59 time=38.3 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=45 ttl=59 time=41.7 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=46 ttl=59 time=36.8 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=47 ttl=59 time=37.5 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=48 ttl=59 time=38.2 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=49 ttl=59 time=37.0 ms
64 bytes from maa03s47-in-f4.1e100.net (142.250.196.164): icmp_seq=50 ttl=59 time=36.8 ms

--- google.in ping statistics ---
50 packets transmitted, 50 received, 0% packet loss, time 49083ms
rtt min/avg/max/mdev = 36.577/41.129/84.241/8.576 ms
```

Average Latency: 41.129ms

c)

The total ping latency of all the intermediate hosts is

$$0.265+2.672+7.263+8.328+8.619+11.061+8.167+7.411+40.773+45.321+41.310+42.253+42.428=265.871\text{ms}.$$

The average latency would then be $265.871/13 = 20.452 \text{ ms}$

The average latency obtained in b) is 41.129ms.

The latencies obtained earlier began with a small value, and then the values converged to the range 40-43 ms.

This is close to the average latency. This suggests that the intermediate latency contributes to the overall latency of the connection.

d)

The maximum average latency in the intermediate hosts is 45.321ms, which is higher than the average latency of 41.129ms obtained in b).

The maximum latency signifies the bottleneck in the connection, where the latency is the highest and the speed of the connection would depend on this.

e)

When using the traceroute command, we see multiple entries for a single hop because in 1 hop, we send multiple packets to the next, to get a better accuracy.

f)

```
ishaan@Ishaan_HPLaptop:/mnt/c/WINDOWS/system32$ 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=246 time=240 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=2 ttl=246 time=241 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=3 ttl=246 time=242 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=4 ttl=246 time=241 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=5 ttl=246 time=242 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=6 ttl=246 time=240 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=7 ttl=246 time=241 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=8 ttl=246 time=241 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=9 ttl=246 time=241 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=10 ttl=246 time=241 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=11 ttl=246 time=240 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=12 ttl=246 time=239 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=13 ttl=246 time=241 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=14 ttl=246 time=242 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=15 ttl=246 time=240 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=16 ttl=246 time=241 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=17 ttl=246 time=239 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=18 ttl=246 time=242 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=19 ttl=246 time=241 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=20 ttl=246 time=241 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=21 ttl=246 time=240 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=22 ttl=246 time=241 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=23 ttl=246 time=241 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=24 ttl=246 time=241 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=25 ttl=246 time=239 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=26 ttl=246 time=239 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=27 ttl=246 time=239 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=28 ttl=246 time=242 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=29 ttl=246 time=239 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=30 ttl=246 time=242 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=31 ttl=246 time=243 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=32 ttl=246 time=246 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=33 ttl=246 time=243 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=34 ttl=246 time=241 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=35 ttl=246 time=241 ms

64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=36 ttl=246 time=242 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=37 ttl=246 time=241 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=38 ttl=246 time=239 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=39 ttl=246 time=240 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=40 ttl=246 time=241 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=41 ttl=246 time=240 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=42 ttl=246 time=241 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=43 ttl=246 time=240 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=44 ttl=246 time=261 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=45 ttl=246 time=241 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=46 ttl=246 time=242 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=47 ttl=246 time=241 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=48 ttl=246 time=241 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=49 ttl=246 time=242 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=50 ttl=246 time=241 ms

--- stanford.edu ping statistics ---
50 packets transmitted, 50 received, 0% packet loss, time 49052ms
rtt min/avg/max/mdev = 238.873/241.336/260.921/3.046 ms
```

Average Latency is 241.336ms

g)

```
ishaan@Ishaan_HPLaptop:/mnt/c/WINDOWS/system32$ traceroute stanford.edu
traceroute to stanford.edu (171.67.215.200), 30 hops max, 60 byte packets
 1 Ishaan_HPLaptop.mshome.net (172.21.80.1) 0.301 ms 0.270 ms 0.264 ms
 2 dsldevice.lan (192.168.1.1) 1.275 ms 1.565 ms 2.562 ms
 3 abts-north-dynamic-255.187.69.182.airtelbroadband.in (182.69.187.255) 8.897 ms 8.893 ms 8.888 ms
 4 125.18.240.149 (125.18.240.149) 8.194 ms 125.18.240.153 (125.18.240.153) 8.143 ms 8.124 ms
 5 116.119.44.134 (116.119.44.134) 240.999 ms 229.818 ms 116.119.44.136 (116.119.44.136) 246.808 ms
 6 * *
 7 port-channel8.core2.lax1.he.net (184.104.197.109) 237.730 ms 240.872 ms *
 8 * port-channel12.core3.sjc2.he.net (184.104.195.50) 246.916 ms *
 9 * port-channel9.core2.pao1.he.net (184.105.81.101) 248.690 ms *
10 stanford-university.e0-62.core2.pao1.he.net (184.105.177.238) 248.642 ms 238.713 ms 261.579 ms
11 campus-ial-nets-b-vl1118.SUNet (171.66.255.228) 254.476 ms campus-nw-rtr-vl1102.SUNet (171.66.255.196) 247.172 ms campus-ial-nets-b-vl1118.SUNet (171.66.255.228) 253.592 ms
12 * *
13 web.stanford.edu (171.67.215.200) 244.241 ms 251.538 ms 243.835 ms
```

Stanford.edu has 13 hops, while google had 14.

h)

The average latency for google.in was 41.129ms and for Stanford.edu, it was 241.336ms.

This difference is because google has servers in India as well, while Stanford's servers are in the USA, leading to a longer geographical distance. Also, google's servers are optimized for performance, and can easily handle multiple requests and larger loads.

Q6

```
ishaan@Ishaan_HPLaptop:/mnt/c/WINDOWS/system32$ sudo ifconfig lo down
[sudo] password for ishaan:
ishaan@Ishaan_HPLaptop:/mnt/c/WINDOWS/system32$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
        inet 172.21.82.219 netmask 255.255.240.0 broadcast 172.21.95.255
        inet6 fe80::215:5dff:feee:c474 prefixlen 64 scopeid 0x20<link>
          ether 00:15:5d:ee:c4:74 txqueuelen 1000 (Ethernet)
            RX packets 2769 bytes 387766 (387.7 KB)
            RX errors 0 dropped 0 overruns 0 frame 0
            TX packets 846 bytes 85851 (85.8 KB)
            TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

ishaan@Ishaan_HPLaptop:/mnt/c/WINDOWS/system32$ ping -c 100 127.0.0.1
PING 127.0.0.1 (127.0.0.1) 56(84) bytes of data.

--- 127.0.0.1 ping statistics ---
100 packets transmitted, 0 received, 100% packet loss, time 102944ms
```

Shutdown the loopback interface (lo). This interface is used by the system to communicate with itself, and as we have turned it down, 100% packet loss is reported when we try to ping.