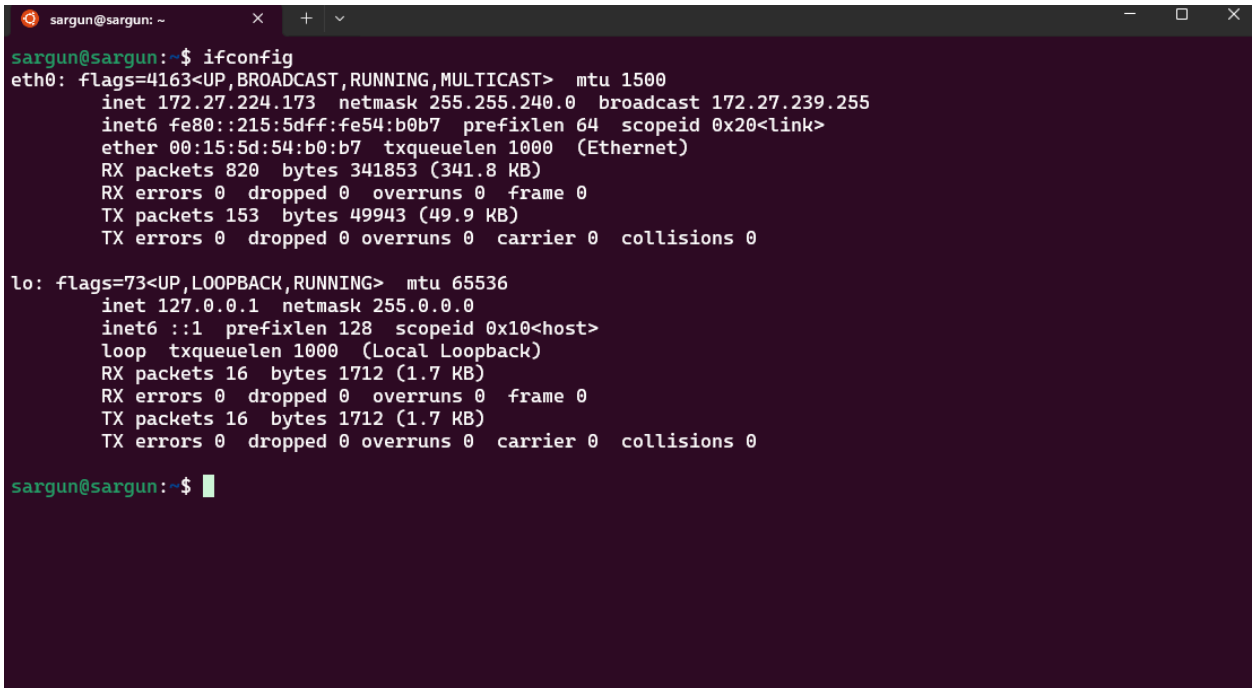
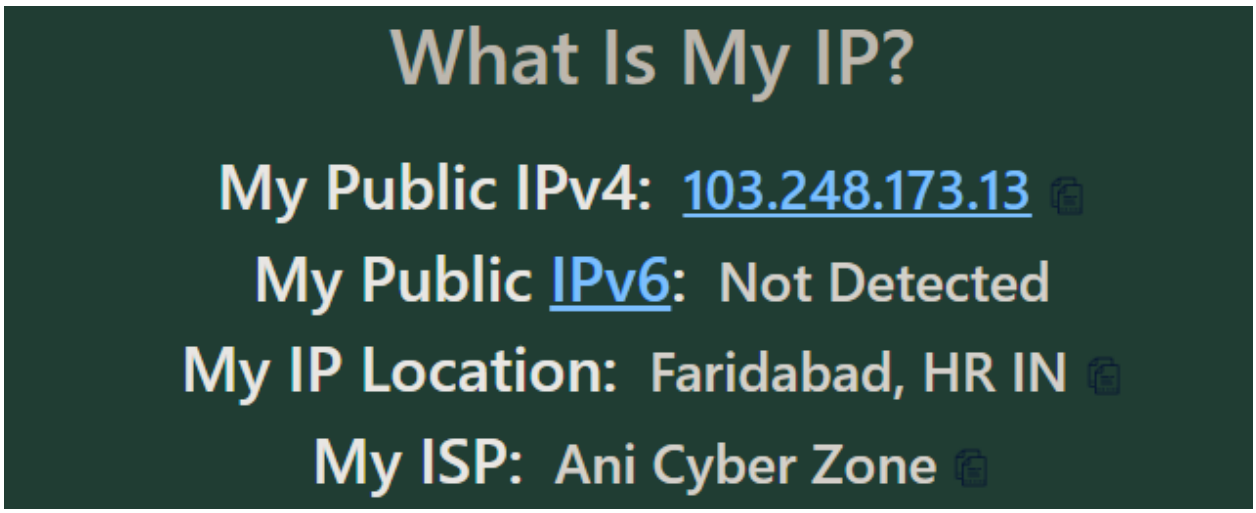
CSE:232 PROGRAMMING ASSIGNMENT 1
2022450-Sargun singh Khurana

Q1.



a) The ip address of my computer is: 172.27.224.173

b)



According to https://www.whatismyip.com/ , my public ip address is 103.248.173.13

They are different since ifconfig shows our local IP address, which is used for communication within our network. Ifconfig gives the private ip address.

WhatIsMyIP.com shows our public IP address, which is how our network is identified on the internet.
Most home or office networks use a router that performs Network Address Translation(NAT).
NAT allows multiple devices on a local network to share a single public IP address

When we access the internet, our router translates our local IP (shown by ifconfig) into the public IP (ie shown on WhatIsMyIP.com).

Q2.

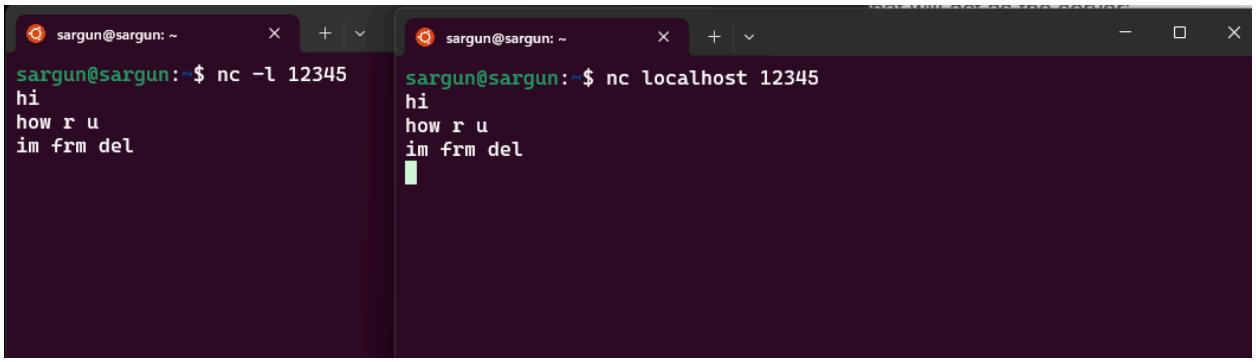
```
sargun@sargun:~$ sudo ifconfig eth0 192.168.1.100 netmask 255.255.240.0
[sudo] password for sargun:
sargun@sargun:~$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.1.100  netmask 255.255.240.0  broadcast 192.168.15.255
        inet6 fe80::215:5dff:fe54:b0b7  prefixlen 64  scopeid 0x20<link>
        ether 00:15:5d:54:b0:b7  txqueuelen 1000  (Ethernet)
        RX packets 1230  bytes 396477 (396.4 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 154  bytes 50013 (50.0 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        inet6 ::1  prefixlen 128  scopeid 0x10<host>
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 16  bytes 1712 (1.7 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 16  bytes 1712 (1.7 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

sargun@sargun:~$
```

Reverting to original ip addr-

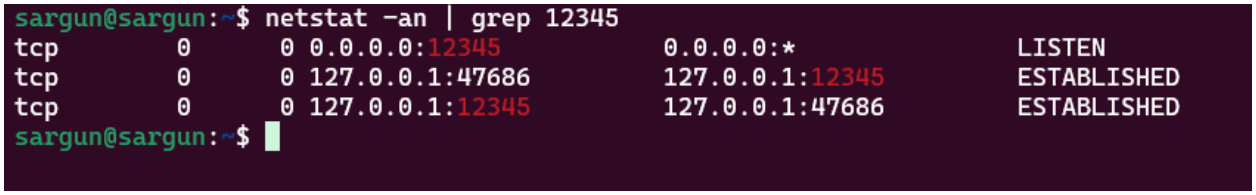
```
sargun@sargun:~$ sudo ifconfig eth0 172.27.224.173 netmask 255.255.240.0
sargun@sargun:~$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 172.27.224.173  netmask 255.255.240.0  broadcast 172.27.239.255
        inet6 fe80::215:5dff:fe54:b0b7  prefixlen 64  scopeid 0x20<link>
        ether 00:15:5d:54:b0:b7  txqueuelen 1000  (Ethernet)
        RX packets 1786  bytes 470518 (470.5 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 166  bytes 53845 (53.8 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 22  bytes 2129 (2.1 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 22  bytes 2129 (2.1 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

sargun@sargun:~$
```

Q3.

a)


sargun@sargun: ~
sargun@sargun:~$ nc -l 12345
hi
how r u
im frm del
sargun@sargun: ~
sargun@sargun:~$ nc localhost 12345
hi
how r u
im frm del

b)


sargun@sargun:~$ netstat -an | grep 12345
tcp 0 0 0.0.0.0:12345 0.0.0.0:* LISTEN
tcp 0 0 127.0.0.1:47686 127.0.0.1:12345 ESTABLISHED
tcp 0 0 127.0.0.1:12345 127.0.0.1:47686 ESTABLISHED
sargun@sargun:~$

Q4.
a)

```
sargun@sargun:~$ nslookup -type=ns google.in
Server:         10.255.255.254
Address:        10.255.255.254#53

Non-authoritative answer:
google.in       nameserver = ns4.google.com.
google.in       nameserver = ns1.google.com.
google.in       nameserver = ns2.google.com.
google.in       nameserver = ns3.google.com.

Authoritative answers can be found from:
ns1.google.com  internet address = 216.239.32.10
ns2.google.com  internet address = 216.239.34.10
ns3.google.com  internet address = 216.239.36.10
ns4.google.com  internet address = 216.239.38.10
ns1.google.com  has AAAA address 2001:4860:4802:32::a
ns2.google.com  has AAAA address 2001:4860:4802:34::a
ns3.google.com  has AAAA address 2001:4860:4802:36::a
ns4.google.com  has AAAA address 2001:4860:4802:38::a
```

```
sargun@sargun:~$ nslookup google.in ns1.google.com
Server:         ns1.google.com
Address:        216.239.32.10#53

Non-authoritative answer:
Name:   google.in
Address: 142.250.192.164
Name:   google.in
Address: 2404:6800:4002:816::2004
```

b)

```
sargun@sargun:~$ nslookup -debug google.in
Server:         10.255.255.254
Address:        10.255.255.254#53

------------
    QUESTIONS:
        google.in, type = A, class = IN
    ANSWERS:
    ->  google.in
        internet address = 142.250.192.228
        ttl = 300
    AUTHORITY RECORDS:
    ADDITIONAL RECORDS:
------------
Non-authoritative answer:
Name:   google.in
Address: 142.250.192.228
------------
    QUESTIONS:
        google.in, type = AAAA, class = IN
    ANSWERS:
    ->  google.in
        has AAAA address 2404:6800:4002:818::2004
        ttl = 300
    AUTHORITY RECORDS:
    ADDITIONAL RECORDS:
------------
Name:   google.in
Address: 2404:6800:4002:818::2004
```

The TTL value in seconds shows how long this DNS record will be stored in the cache of the local DNS server before it expires and needs to be fetched again.
TTL value here is 300ms.

Q5.

a) traceroute google.in

```
sargun@sargun:~$ traceroute google.in
traceroute to google.in (142.250.192.228), 30 hops max, 60 byte packets
 1  sargun.mshome.net (172.27.224.1)  0.942 ms  0.916 ms  0.907 ms
 2  192.168.32.254 (192.168.32.254)  19.732 ms  11.453 ms  11.441 ms
 3  vpn.iiitd.edu.in (192.168.1.99)  11.551 ms  11.510 ms  11.497 ms
 4  103.25.231.1 (103.25.231.1)  11.366 ms  11.357 ms  11.304 ms 5  * * *
 6  10.119.234.162 (10.119.234.162)  13.574 ms  16.619 ms  16.563 ms
 7  72.14.194.160 (72.14.194.160)  10.660 ms 72.14.195.56 (72.14.195.56)  8.104 ms  10.238 ms
 8  192.178.80.159 (192.178.80.159)  30.974 ms  30.262 ms  84.386 ms
 9  142.251.54.63 (142.251.54.63)  84.370 ms  84.366 ms 142.251.54.65 (142.251.54.65)  30.844 ms
10  del11s13-in-f4.1e100.net (142.250.192.228)  83.036 ms  83.025 ms  30.454 ms
sargun@sargun:~$
```

There are 9 intermediate hosts (since the last is destination host because we are asked for intermediate hosts only).

List of ip addresses of intermediate hosts:

- 172.27.224.1
- 192.168.32.254
- 192.168.1.99
- 103.25.231.1
- 10.119.234.16
- 72.14.194.160
- 72.14.195.56
- 192.178.80.159
- 142.251.54.63
- 142.251.54.65

average latency to each intermediate host

- Hop 1: 172.27.224.1
    - Latency: 0.942 ms, 0.916 ms, 0.907 ms
- Hop 2: 192.168.32.254
    - Latency: 19.732 ms, 11.453 ms, 11.441 ms
- Hop 3: 192.168.1.99
    - Latency: 11.551 ms, 11.510 ms, 11.497 ms
- Hop 4: 103.25.231.1
    - Latency: 11.366 ms, 11.357 ms, 11.304 ms
- Hop 5: * * * (unreachable)
- Hop 6: 10.119.234.162
    - Latency: 13.574 ms, 16.619 ms, 16.563 ms
- Hop 7: 72.14.194.160 and 72.14.195.56
    - Latency: 10.660 ms, 8.104 ms, 10.238 ms
- Hop 8: 192.178.80.159
    - Latency: 30.974 ms, 30.262 ms, 84.386 ms

- Hop 9: 142.251.54.63 and 142.251.54.65
    - Latency: 84.370 ms, 84.366 ms, 30.844 ms

average latency for each hop- the mean of the RTT values.

```
• Hop 1 : (0.942 + 0.916 + 0.907)/3 = 0.922 ms
• Hop 2 : (19.732 + 11.453 + 11.441)/3 = 14.209 ms
• Hop 3 : (11.551 + 11.510 + 11.497)/3 = 11.519 ms
• Hop 4 : (11.366 + 11.357 + 11.304)/3 = 11.342 ms
• Hop 5 :  (unreachable, so skipped)
• Hop 6 : (13.574 + 16.619 + 16.563)/3 = 15.585 ms
• Hop 7 : (10.660 + 8.104 + 10.238)/3 = 9.667 ms
• Hop 8 : (30.974 + 30.262 + 84.386)/3 = 48.541 ms
• Hop 9 : (84.370 + 84.366 + 30.844)/3 = 66.527 ms
```

b)
ping -c 50 google.in

```
sargun@sargun:~$ ping -c 50 google.in
PING google.in (142.250.192.228) 56(84) bytes of data.
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=1 ttl=55 time=46.2 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=2 ttl=55 time=44.5 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=3 ttl=55 time=39.5 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=4 ttl=55 time=32.1 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=5 ttl=55 time=60.9 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=6 ttl=55 time=39.7 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=7 ttl=55 time=36.8 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=8 ttl=55 time=30.0 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=9 ttl=55 time=32.6 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=10 ttl=55 time=30.3 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=11 ttl=55 time=40.6 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=12 ttl=55 time=32.0 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=13 ttl=55 time=29.4 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=14 ttl=55 time=31.4 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=15 ttl=55 time=31.0 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=16 ttl=55 time=34.3 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=17 ttl=55 time=41.1 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=18 ttl=55 time=29.2 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=19 ttl=55 time=31.8 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=20 ttl=55 time=41.4 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=21 ttl=55 time=60.6 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=22 ttl=55 time=45.8 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=23 ttl=55 time=29.5 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=24 ttl=55 time=36.1 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=25 ttl=55 time=45.0 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=26 ttl=55 time=51.7 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=27 ttl=55 time=54.0 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=28 ttl=55 time=44.0 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=29 ttl=55 time=52.6 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=30 ttl=55 time=36.0 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=31 ttl=55 time=35.5 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=32 ttl=55 time=31.3 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=33 ttl=55 time=29.5 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=34 ttl=55 time=46.1 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=35 ttl=55 time=42.8 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=36 ttl=55 time=67.5 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=37 ttl=55 time=30.5 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=38 ttl=55 time=30.5 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=39 ttl=55 time=65.7 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=40 ttl=55 time=78.6 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=41 ttl=55 time=29.4 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=42 ttl=55 time=29.2 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=43 ttl=55 time=29.3 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=44 ttl=55 time=36.6 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=45 ttl=55 time=30.2 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=46 ttl=55 time=32.4 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=47 ttl=55 time=32.3 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=48 ttl=55 time=31.2 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=49 ttl=55 time=31.4 ms
64 bytes from del11s13-in-f4.1e100.net (142.250.192.228): icmp_seq=50 ttl=55 time=29.6 ms

--- google.in ping statistics ---
50 packets transmitted, 50 received, 0% packet loss, time 49079ms
rtt min/avg/max/mdev = 29.173/39.192/78.564/11.522 ms
```

Average latency: 39.192 ms

c)

Total Summed Latency of Intermediate Hosts (from Q.5a):

- 0.922+14.209+11.519+11.342+15.585+9.667+48.541+66.527+65.505=243.817 ms

Comparin with Q.5b Average Latency:

- Average Ping Latency from Q.5b: 39.192 ms

- The total latency from adding all intermediate hops (243.817 ms) is significantly higher than the average ping latency (39.192 ms).
- The sum of latencies across all hops is expected to be higher because it accounts for the round-trip time (RTT) at each individual hop, while the ping command provides a single RTT for the entire path to the destination and back. Network conditions, varying routes, and the nature of traceroute vs. ping can contribute to these differences

.

d)

The maximum ping latency amongst the intermediate hosts (in (a)) was : 66.527 ms

The maximum ping latency amongst the intermediate hosts (in (b)) was: 67.5 ms

While traceroute measures the time taken for packets to travel to each hop and back, ping measures the time for packets to travel to the destination and back. This can lead to slight differences in reported latencies.

Discrepancies can arise due to differences between one-way and round-trip measurements and network variability.

e) Multiple entries for a single hop in traceroute indicate that the router at that hop is load-balancing traffic across multiple paths. The host might have multiple network interfaces, and traceroute could show responses from each interface. Each path might have a different response time, resulting in multiple RTT measurements.

f) ping -c 50 stanford.edu

```
sargun@sargun:~$ 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=241 time=293 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=2 ttl=241 time=285 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=3 ttl=241 time=284 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=4 ttl=241 time=285 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=5 ttl=241 time=314 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=6 ttl=241 time=291 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=7 ttl=241 time=303 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=8 ttl=241 time=286 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=9 ttl=241 time=287 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=10 ttl=241 time=287 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=11 ttl=241 time=284 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=12 ttl=241 time=290 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=13 ttl=241 time=285 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=14 ttl=241 time=287 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=15 ttl=241 time=285 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=16 ttl=241 time=285 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=17 ttl=241 time=287 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=18 ttl=241 time=285 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=19 ttl=241 time=286 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=20 ttl=241 time=285 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=21 ttl=241 time=298 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=22 ttl=241 time=288 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=23 ttl=241 time=284 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=24 ttl=241 time=286 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=25 ttl=241 time=288 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=26 ttl=241 time=288 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=27 ttl=241 time=287 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=28 ttl=241 time=291 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=29 ttl=241 time=299 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=30 ttl=241 time=289 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=31 ttl=241 time=285 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=32 ttl=241 time=295 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=33 ttl=241 time=309 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=34 ttl=241 time=285 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=35 ttl=241 time=285 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=36 ttl=241 time=293 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=37 ttl=241 time=291 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=38 ttl=241 time=315 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=39 ttl=241 time=285 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=40 ttl=241 time=288 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=41 ttl=241 time=308 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=42 ttl=241 time=287 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=43 ttl=241 time=286 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=44 ttl=241 time=287 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=45 ttl=241 time=286 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=46 ttl=241 time=285 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=47 ttl=241 time=289 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=48 ttl=241 time=296 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=49 ttl=241 time=285 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=50 ttl=241 time=286 ms

--- stanford.edu ping statistics ---
50 packets transmitted, 50 received, 0% packet loss, time 49031ms
rtt min/avg/max/mdev = 284.315/289.974/314.666/7.621 ms
```

Average latency: 289.974 ms

g) Traceroute Result Comparison Between google.in and stanford.edu

```
sargun@sargun:~$ traceroute stanford.edu
traceroute to stanford.edu (171.67.215.200), 30 hops max, 60 byte packets
 1  sargun.mshome.net (172.27.224.1)  0.829 ms  0.801 ms  0.789 ms
 2  * * *
 3  * * *
 4  * vl207.tyo-eq8-core-1.cdn77.com (169.150.194.142)  195.438 ms vl208.tyo-eq8-core-2.cdn77.com (169.150.194.190)  195.428 ms
 5  * * *
 6  * * *
 7  * * *
 8  * * port-channel4.core2.pdx1.he.net (184.105.64.138)  251.482 ms
 9  stanford-university.e0-62.core2.pao1.he.net (184.105.177.238)  275.978 ms  275.968 ms *
10  campus-nw-rtr-vl1102.sunet (171.66.255.196)  274.189 ms stanford-university.e0-62.core2.pao1.he.net (184.105.177.238)  289.551 ms
 campus-ial-nets-a-vl1002.sunet (171.64.255.196)  289.491 ms
11  campus-nw-rtr-vl1002.sunet (171.64.255.196)  289.465 ms *  289.411 ms
12  * * *
13  web.stanford.edu (171.67.215.200)  265.189 ms  265.175 ms  265.171 ms
sargun@sargun:~$
```

- **Number of Hops**: 13(including destination)

comparison:

- The traceroute for google.in had 10 hops(including destination)

h) Latency Difference Between google.in and stanford.edu

Latency Comparison:

- Average Ping Latency to google.in (Q.5b): 39.192 ms
- Average Ping Latency to stanford.edu (Q.5f): 289.974 ms

- The latency difference is primarily due to the physical distance between the server locations.The higher latency for stanford.edu compared to google.in is due to a combination of longer distance, more hops, and possibly less optimized routing paths.
- This geographical distance naturally results in more hops as the packets hv to travel across more networks.

Q.6.

1. I used **sudo ifconfig lo down** command to disable the loopback interface which will cause 100% packet loss for pings to 127.0.0.1
2. After disabling the loopback interface,I pinged the loopback address 127.0.0.1
   By using
   - ping 127.0.0.1

```
sargun@sargun:~$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 172.27.224.173  netmask 255.255.240.0  broadcast 172.27.239.255
        inet6 fe80::215:5dff:fe54:b462  prefixlen 64  scopeid 0x20<link>
        ether 00:15:5d:54:b4:62  txqueuelen 1000  (Ethernet)
        RX packets 9142  bytes 32577399 (32.5 MB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 3354  bytes 295841 (295.8 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 296  bytes 27630 (27.6 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 296  bytes 27630 (27.6 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

sargun@sargun:~$ sudo ifconfig lo down
sargun@sargun:~$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 172.27.224.173  netmask 255.255.240.0  broadcast 172.27.239.255
        inet6 fe80::215:5dff:fe54:b462  prefixlen 64  scopeid 0x20<link>
        ether 00:15:5d:54:b4:62  txqueuelen 1000  (Ethernet)
        RX packets 9158  bytes 32580430 (32.5 MB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 3354  bytes 295841 (295.8 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

sargun@sargun:~$ ping 127.0.0.1
PING 127.0.0.1 (127.0.0.1) 56(84) bytes of data.
^C
--- 127.0.0.1 ping statistics ---
83 packets transmitted, 0 received, 100% packet loss, time 85262ms
```