

Computer Network (CSE232)

Programming Assignment – 1

(Date: 30 August 2024)

Q1)

- A) Learn to use the ifconfig command, and figure out the IP address of your network interface. Put a screenshot.

Ans.

```
debjitbanerji@Lenovo-pc:~$ ifconfig -a
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 172.26.88.62 netmask 255.255.240.0 broadcast 172.26.95.255
    inet6 fe80::215:5dff:fe14:e89e prefixlen 64 scopeid 0x20<link>
    ether 00:15:5d:14:e8:9e txqueuelen 1000 (Ethernet)
    RX packets 710 bytes 146148 (146.1 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 21 bytes 1502 (1.5 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

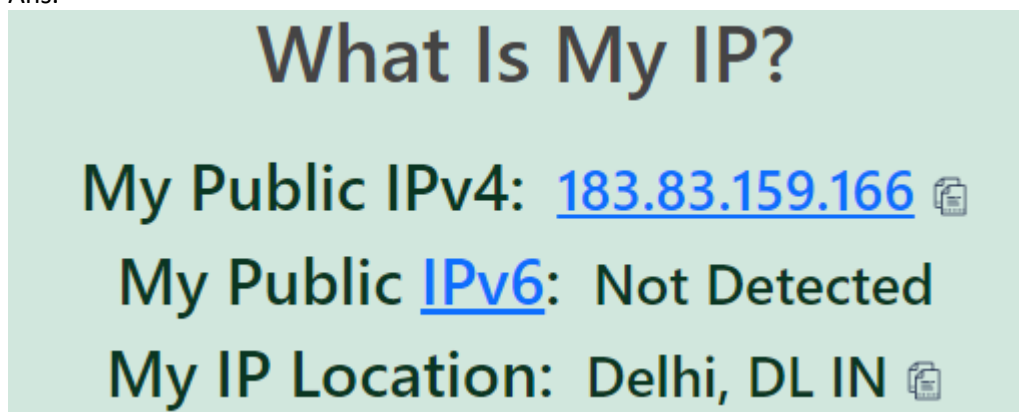
lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    inet6 ::1 prefixlen 128 scopeid 0x10<host>
    loop txqueuelen 1000 (Local Loopback)
    RX packets 4 bytes 591 (591.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 4 bytes 591 (591.0 B)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

Private IPv4 Address: 172.26.88.62

Private IPv6 address: fe80::215:5dff:fe14:e89e

- B) Go to the webpage <https://www.whatismyip.com> and find out what IP is shown for your machine. Are they identical or different? Why?

Ans.



Public IPv4 Address: 183.83.159.166

This IP address is different from the IP address displayed by “ifconfig” command since the IPv4 address displayed by the “ifconfig” command is a private IP address since my device is connected to a home network (LAN). Whereas, the IPv4 address displayed in the above attached screenshot is a global (public) IP address assigned to my device.

Q2) Change the IP address of your network interface using the command line. Put a

screenshot that shows the change. Revert to the original IP address.

Ans.

Before change:

```
debjitbanerji@Lenovo-pc:~$ ifconfig -a
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 172.26.88.62 netmask 255.255.240.0 broadcast 172.26.95.255
    inet6 fe80::215:5dff:fe14:e89e prefixlen 64 scopeid 0x20<link>
    ether 00:15:5d:14:e8:9e txqueuelen 1000 (Ethernet)
    RX packets 710 bytes 146148 (146.1 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 21 bytes 1502 (1.5 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 4 bytes 591 (591.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 4 bytes 591 (591.0 B)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

Line to change the IP address:

```
debjitbanerji@Lenovo-pc:~$ sudo ifconfig eth0 172.26.90.200 netmask 255.255.240.0
```

After change:

```
debjitbanerji@Lenovo-pc:~$ ifconfig -a
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 172.26.90.200 netmask 255.255.240.0 broadcast 172.26.95.255
    inet6 fe80::215:5dff:fe14:e89e prefixlen 64 scopeid 0x20<link>
    ether 00:15:5d:14:e8:9e txqueuelen 1000 (Ethernet)
    RX packets 1124 bytes 225352 (225.3 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 22 bytes 1572 (1.5 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 4 bytes 591 (591.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 4 bytes 591 (591.0 B)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

Line to revert the change:

```
debjitbanerji@Lenovo-pc:~$ sudo ifconfig eth0 172.26.88.62 netmask 255.255.240.0
```

After reverting the change:

```
debjitbanerji@Lenovo-pc:~$ ifconfig -a
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 172.26.88.62 netmask 255.255.240.0 broadcast 172.26.95.255
    inet6 fe80::215:5dff:fe14:e89e prefixlen 64 scopeid 0x20<link>
    ether 00:15:5d:14:e8:9e txqueuelen 1000 (Ethernet)
    RX packets 1138 bytes 227766 (227.7 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 22 bytes 1572 (1.5 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 4 bytes 591 (591.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 4 bytes 591 (591.0 B)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

Q3)

- A) Use “netcat” to set up a TCP client/server connection between your VM and host machine. If you are not using a VM, you can set up the connection with localhost. Put a screenshot.

Ans.

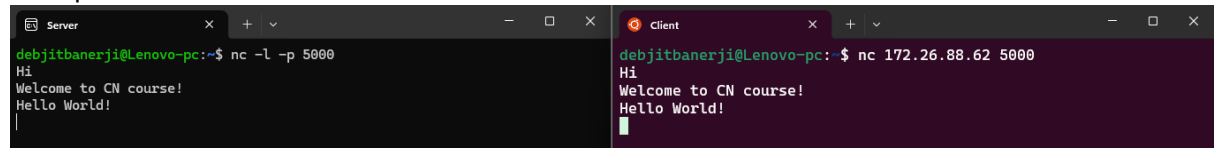
Setting up the netcat server on host machine:

```
debjitbanerji@Lenovo-pc:~$ nc -l -p 5000
```

Connecting to the server on the host machine from the Virtual Machine (VM) or Client Side:

```
debjitbanerji@Lenovo-pc:~$ nc 172.26.88.62 5000
```

Example Communication:



```
Server
debjitbanerji@Lenovo-pc:~$ nc -l -p 5000
Hi
Welcome to CN course!
Hello World!

Client
debjitbanerji@Lenovo-pc:~$ nc 172.26.88.62 5000
Hi
Welcome to CN course!
Hello World!
```

- B) Determine the state of this TCP connection(s) at the client node. Put a screenshot.

Ans.

```
debjitbanerji@Lenovo-pc:~$ netstat -a
Active Internet connections (servers and established)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
tcp        0      0 0.0.0.0:5000             0.0.0.0:*               LISTEN
tcp        0      0 10.255.255.254:domain   0.0.0.0:*               LISTEN
tcp        0      0 172.26.88.62:5000       172.26.88.62:55534     ESTABLISHED
tcp        0      0 172.26.88.62:55534     172.26.88.62:5000     ESTABLISHED
udp        0      0 10.255.255.254:domain   0.0.0.0:*
udp        0      0 localhost:323           0.0.0.0:*
udp6       0      0 ip6-localhost:323      [::]:*
```

The state of the TCP connection between the Host machine and the Virtual Machine (VM) is begin displayed as “ESTABLISHED” in the 3rd line.

Q4)

- A) Get an authoritative result for “google.in” using nslookup. Put a screenshot. Explain how you did it.

Ans. First I used the “nslookup” command with a parameter “type” set as “ns”, to get the authoritative nameservers for google.in. Then, I used one of the authoritative nameservers and queried it manually to get the authoritative answer for google.in.

Querying to get the authoritative nameservers for google.in:

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

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

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

Querying one authoritative nameserver to get the authoritative result:

```
debjitbanerji@Lenovo-pc:~$ nslookup google.in 216.239.32.10
Server:                216.239.32.10
Address:                216.239.32.10#53

Name:   google.in
Address: 216.58.221.36
Name:   google.in
Address: 2404:6800:4002:806::2004
```

- B) Find out the time to live for any website on the local DNS. Put a screenshot. Explain in words (with unit) after how much time this entry would expire from the local DNS server.
Ans.

For this purpose, I used the “dig” command. So, I wrote the following line in the terminal:

```
debjitbanerji@Lenovo-pc:~$ dig google.in
```

Which gave the below attached output:

```
; <<>> DiG 9.18.12-0ubuntu0.22.04.2-Ubuntu <<>> google.in
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 43262
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 512
;; QUESTION SECTION:
;google.in.                IN      A

;; ANSWER SECTION:
google.in.                 203     IN      A      142.250.194.196

;; Query time: 10 msec
;; SERVER: 10.255.255.254#53(10.255.255.254) (UDP)
;; WHEN: Fri Aug 23 16:06:20 IST 2024
;; MSG SIZE rcvd: 54
```

The Time to Live (TTL) is the duration (in seconds) that the DNS record will be cached locally by the local DNS server before the DNS resolver will expire the cached entry and will need to refresh it by querying the authoritative DNS server again.

So, here we can see in the image that the TTL for google.in on the local DNS server is 203 seconds (as written in the second column under the “Answer Section”). This means that the DNS record will stay on the local DNS Server for 203 seconds and after that it will have to be queried again to the authoritative DNS Server.

Q5)

- A) Run the command, `tracert google.in`. How many intermediate hosts do you see? What are the IP addresses? Compute the average latency to each intermediate host. Put a screenshot.

Ans.

There are 11 intermediate hosts and 9 hosts if we exclude the intermediate hosts which have “***”.

The IP address of the intermediate hosts along with their average latencies are:

- 1) 172.26.80.1 (172.26.80.1) – Average Latency: 7.16233 ms
- 2) Archer (192.168.0.1) – Average Latency: 4.43733 ms
- 3) ***
- 4) broadband.actcorp.in (49.207.34.226) – Average Latency: 12.33533 ms
- 5) broadband.actcorp.in (49.207.47.221) – Average Latency: 52.11667 ms
- 6) ***
- 7) 142.251.52.200 (142.251.52.200), 172.253.67.86 (172.253.67.86), 142.251.54.86 (142.251.54.86) – Average Latency: 7.302 ms
- 8) 142.251.255.54 (142.251.255.54), 192.178.83.226 (192.178.83.226), 192.178.82.238 (192.178.82.238) – Average Latency: 5.87633 ms
- 9) 209.85.250.56 (209.85.250.56), 142.250.63.116 (142.250.63.116), 192.178.242.77 (192.178.242.77) – Average Latency: 19.12833 ms
- 10) 142.251.229.251 (142.251.229.251), 192.178.242.101 (192.178.242.101), 192.178.242.77 (192.178.242.77) – Average Latency: 37.680667 ms
- 11) 172.253.75.15 (172.253.75.15), 142.251.229.251 (142.251.229.251), 209.85.253.85 (209.85.253.85) – Average Latency: 36.178667 ms
- 12) 209.85.247.251 (209.85.247.251), maa05s23-in-f4.1e100.net (142.250.183.228) – Average Latency: 37.104667 ms

```
debjitbanerji@lenovo-pc:~$ tracert google.in
tracert to google.in (142.250.183.228), 30 hops max, 60 byte packets
 1 172.26.80.1 (172.26.80.1)  7.088 ms  7.227 ms  7.172 ms
 2  Archer (192.168.0.1)  5.831 ms  4.469 ms  3.012 ms
 3  * * *
 4  broadband.actcorp.in (49.207.34.226)  12.556 ms  12.470 ms  11.980 ms
 5  broadband.actcorp.in (49.207.47.221)  52.178 ms  52.108 ms  52.064 ms
 6  * * *
 7  142.251.52.200 (142.251.52.200)  7.563 ms  172.253.67.86 (172.253.67.86)  7.757 ms  142.251.54.86 (142.251.54.86)  6.586 ms
 8  142.251.255.54 (142.251.255.54)  6.385 ms  192.178.83.226 (192.178.83.226)  5.704 ms  192.178.82.238 (192.178.82.238)  5.540 ms
 9  209.85.250.56 (209.85.250.56)  7.308 ms  142.250.63.116 (142.250.63.116)  6.889 ms  192.178.242.77 (192.178.242.77)  43.188 ms
10  142.251.229.251 (142.251.229.251)  38.530 ms  192.178.242.101 (192.178.242.101)  36.129 ms  192.178.242.77 (192.178.242.77)  38.383 ms
11  172.253.75.15 (172.253.75.15)  36.328 ms  142.251.229.251 (142.251.229.251)  37.977 ms  209.85.253.85 (209.85.253.85)  34.231 ms
12  209.85.247.251 (209.85.247.251)  37.740 ms  maa05s23-in-f4.1e100.net (142.250.183.228)  36.825 ms  36.749 ms
```

- B) Send 50 ping messages to google.in, Determine the average latency. Put a screenshot.
- Ans.


```

debjitbanerji@Lenovo-pc:~$ 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=118 time=5.00 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=2 ttl=118 time=6.41 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=3 ttl=118 time=5.44 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=4 ttl=118 time=5.07 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=5 ttl=118 time=3.75 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=6 ttl=118 time=8.52 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=7 ttl=118 time=4.68 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=8 ttl=118 time=4.51 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=9 ttl=118 time=5.67 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=10 ttl=118 time=4.77 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=11 ttl=118 time=6.51 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=12 ttl=118 time=4.71 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=13 ttl=118 time=5.01 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=14 ttl=118 time=4.10 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=15 ttl=118 time=4.61 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=16 ttl=118 time=4.91 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=17 ttl=118 time=4.90 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=18 ttl=118 time=4.26 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=19 ttl=118 time=6.18 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=20 ttl=118 time=4.09 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=21 ttl=118 time=4.95 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=22 ttl=118 time=5.18 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=23 ttl=118 time=5.21 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=24 ttl=118 time=4.25 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=25 ttl=118 time=13.8 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=26 ttl=118 time=4.91 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=27 ttl=118 time=7.37 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=28 ttl=118 time=4.51 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=29 ttl=118 time=24.2 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=30 ttl=118 time=5.22 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=31 ttl=118 time=4.89 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=32 ttl=118 time=3.25 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=33 ttl=118 time=5.79 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=34 ttl=118 time=24.7 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=35 ttl=118 time=5.90 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=36 ttl=118 time=73.6 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=37 ttl=118 time=4.03 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=38 ttl=118 time=73.4 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=39 ttl=118 time=4.24 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=40 ttl=118 time=4.61 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=41 ttl=118 time=4.01 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=42 ttl=118 time=5.13 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=43 ttl=118 time=6.87 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=44 ttl=118 time=4.58 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=45 ttl=118 time=4.72 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=46 ttl=118 time=3.98 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=47 ttl=118 time=5.00 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=48 ttl=118 time=4.97 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=49 ttl=118 time=4.51 ms
64 bytes from del12s07-in-f4.1e100.net (142.250.194.196): icmp_seq=50 ttl=118 time=4.30 ms

--- google.in ping statistics ---
50 packets transmitted, 50 received, 0% packet loss, time 49091ms
rtt min/avg/max/mdev = 3.254/8.700/73.559/13.830 ms

```

The average latency is 8.700 ms.

- C) Add up the ping latency of all the intermediate hosts obtained in (a) and compare with (b). Are they matching, explain?

Ans.

The average ping latency of all the intermediate hosts obtained in (a): 182.217654 ms

The average ping latency obtained in (b): 8.700 ms.

The ping latencies are not matching since in part (a) we had two hops with “***” and the average latencies of these two hops are unknown to us. So, maybe after adding the average latencies of these two unknown hops, we might get an average latency close to what we got in (b). Also, in part (a) there are only 3 iterations, while in part (b) there are 50 iterations. So, maybe the average latency of part(a) is affected by an outlier maximum value which might due to the network traffic at the point of time.

- D) Take the maximum ping latency amongst the intermediate hosts (in (a)) and compare it with (b). Are they matching, explain?

Ans.

The maximum ping latency of all the intermediate hosts obtained in (a): 52.11667 ms
The average ping latency obtained in (b): 8.700 ms

The ping latencies are not matching since in part (a) we are taking the maximum ping latency among the intermediate hosts for 3 iterations while in part (b) we are taking the average ping latency over 50 iterations of the entire route.

- E) You may see multiple entries for a single hop while using the traceroute command. What do these entries mean?

Ans. Some routers and switches use load balancing to distribute traffic across multiple paths or devices to manage network load more efficiently. So, multiple IP addresses may be associated with the same hop because the router or switch is using several interfaces or paths to balance the incoming traffic. Switches and routers may have multiple IP addresses for redundancy and failover purposes. If one IP address or path fails, the other can be used.

- F) Send 50 ping messages to stanford.edu, Determine the average latency. Put a screenshot.

Ans.

```
debjitbanerji@Lenovo-pc:~$ 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=267 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=2 ttl=241 time=267 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=3 ttl=241 time=268 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=4 ttl=241 time=267 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=5 ttl=241 time=266 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=6 ttl=241 time=267 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=7 ttl=241 time=266 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=8 ttl=241 time=266 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=9 ttl=241 time=268 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=10 ttl=241 time=267 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=11 ttl=241 time=266 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=12 ttl=241 time=267 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=13 ttl=241 time=274 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=14 ttl=241 time=267 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=15 ttl=241 time=266 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=16 ttl=241 time=268 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=17 ttl=241 time=267 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=18 ttl=241 time=267 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=19 ttl=241 time=267 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=20 ttl=241 time=267 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=21 ttl=241 time=268 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=22 ttl=241 time=269 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=23 ttl=241 time=267 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=24 ttl=241 time=267 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=25 ttl=241 time=266 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=26 ttl=241 time=267 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=27 ttl=241 time=269 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=28 ttl=241 time=267 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=29 ttl=241 time=267 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=30 ttl=241 time=266 ms
```

```

64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=31 ttl=241 time=267 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=32 ttl=241 time=268 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=33 ttl=241 time=269 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=34 ttl=241 time=267 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=35 ttl=241 time=267 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=36 ttl=241 time=268 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=37 ttl=241 time=269 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=38 ttl=241 time=267 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=39 ttl=241 time=267 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=40 ttl=241 time=267 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=41 ttl=241 time=268 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=42 ttl=241 time=268 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=43 ttl=241 time=272 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=44 ttl=241 time=266 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=45 ttl=241 time=268 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=46 ttl=241 time=268 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=47 ttl=241 time=267 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=48 ttl=241 time=268 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=49 ttl=241 time=267 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=50 ttl=241 time=266 ms

--- stanford.edu ping statistics ---
50 packets transmitted, 50 received, 0% packet loss, time 49070ms
rtt min/avg/max/mdev = 265.794/267.469/274.484/1.457 ms

```

Average latency: 267.469 ms

- G) Run the command, traceroute stanford.edu. Compare the number of hops between google.in and stanford.edu.

Ans.

```

debjitbanerji@Lenovo-pc:~$ traceroute stanford.edu
traceroute to stanford.edu (171.67.215.200), 30 hops max, 60 byte packets
 1 172.26.80.1 (172.26.80.1) 0.555 ms 0.506 ms 0.537 ms
 2 Archer (192.168.0.1) 7.342 ms 6.916 ms 6.893 ms
 3 * * *
 4 broadband.actcorp.in (49.207.47.217) 6.644 ms * *
 5 * * 14.143.30.97.static-delhi.vsnl.net.in (14.143.30.97) 7.332 ms
 6 172.28.176.253 (172.28.176.253) 25.978 ms 172.23.183.134 (172.23.183.134) 60.630 ms 28.057 ms
 7 * * ix-ae-0-100.tcore1.mlv-mumbai.as6453.net (180.87.38.5) 28.598 ms
 8 * * if-bundle-6-2.qcore1.emrs2-marseille.as6453.net (195.219.174.16) 145.730 ms
 9 if-bundle-15-2.qcore1.pye-paris.as6453.net (80.231.154.32) 144.784 ms * *
10 * * if-ae-13-2.tcore1.pye-paris.as6453.net (80.231.154.24) 149.343 ms
11 if-ae-11-2.tcore1.pvu-paris.as6453.net (80.231.153.49) 143.102 ms * *
12 * * *
13 stanford-university.e0-62.core2.pa01.he.net (184.105.177.238) 272.475 ms 266.918 ms 266.012 ms
14 campus-ial-nets-b-vl1118.SUNet (171.66.255.228) 266.108 ms campus-ial-nets-a-vl1018.SUNet (171.64.255.228) 269.732 ms campus-east-rtr-vl1118.SUNet (171.66.255.228) 270.678 ms
15 * * *
16 web.stanford.edu (171.67.215.200) 263.989 ms 266.068 ms 266.016 ms

```

The no. of intermediate hops for “Stanford.edu” was 15 which was more than the hops required for “google.in” which required 11 intermediate hops.

- H) Can you explain the reason for the latency difference between google.in and stanford.edu?

Ans. The reason is that “Stanford.edu” had to be retrieved from a foreign network/ data centre which is farther away, while google.in might have been retrieved from a national (Indian) network/ data centre.

Q6) Make your ping command fail for 127.0.0.1 (with 100% packet loss). Explain how you do it. Put a screenshot that it failed.

Ans. We can forcefully make the ping command fail for 127.0.0.1 by shutting down the driver for the loopback interface using the following line:

```
debjitbanerji@Lenovo-pc:~$ sudo ifconfig lo down
```

The given IP Address (127.0.0.1) corresponds to the Loopback interface which is used to test network applications on the local machine.

Result:

```

debjitbanerji@Lenovo-pc:~$ 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 ---
73 packets transmitted, 0 received, 100% packet loss, time 74878ms

```