

## Assignment-1

### Question-1


```
keshav@keshav-HP-Laptop-15-da1xxx:~$ ifconfig
eno1: flags=4099<UP,BROADCAST,MULTICAST> mtu 1500
    ether f8:b4:6a:d1:30:0b txqueuelen 1000 (Ethernet)
    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

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 95367 bytes 8879463 (8.8 MB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 95367 bytes 8879463 (8.8 MB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

wlo1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.0.114 netmask 255.255.255.0 broadcast 192.168.0.255
    inet6 fe80::73b0:e38f:1ce0:119e prefixlen 64 scopeid 0x20<link>
    ether b0:68:e6:2a:fc:65 txqueuelen 1000 (Ethernet)
    RX packets 2705634 bytes 1585747044 (1.5 GB)
    RX errors 0 dropped 11 overruns 0 frame 0
    TX packets 463416 bytes 85205048 (85.2 MB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

keshav@keshav-HP-Laptop-15-da1xxx:~$
```

What Is My IP?

My Public IPv4 is: 183.83.212.25 

My Public IPv6 is: Not Detected

My IP Location is: New Delhi, DL IN

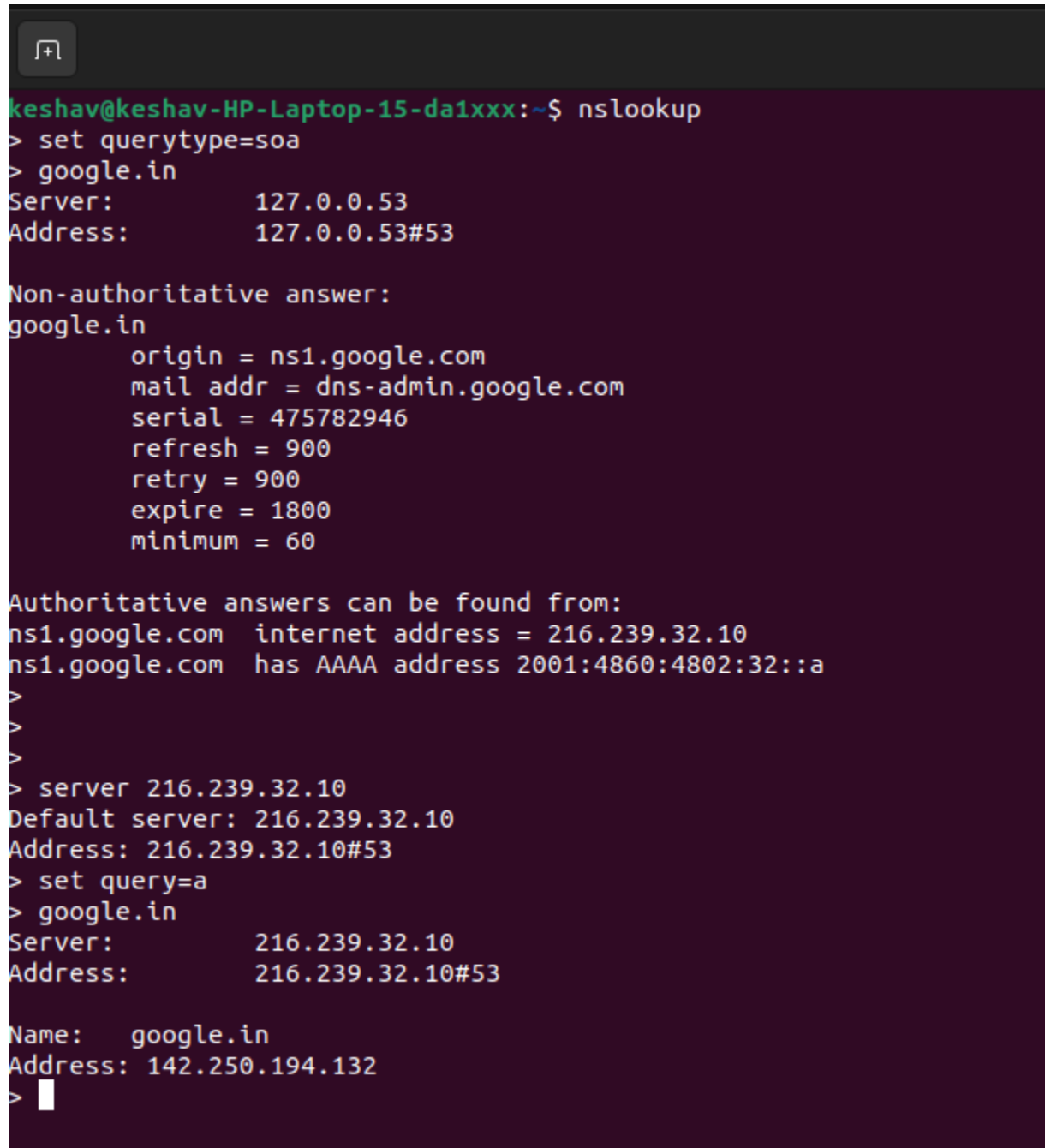
My ISP is: Beam Telecom Pvt Ltd

My IP Information

Hide My IP Address

The IP address assigned to my system using ifconfig is **192.168.0.114** while the ip address found out using <https://www.whatismyip.com/> is **183.83.212.25**. The 2 IPs don't match with each other. This is so because the ip address found using ifconfig command is the local ip address assigned by the router to my pc while the other ip address found using the website is the global ip address assigned to the router by the ISP. So the packet first reaches the router(global ip) and then it is forwarded to my machine by the router using the MAC address of my machine.

## Question-2



```
keshav@keshav-HP-Laptop-15-da1xxx:~$ nslookup
> set querytype=soa
> google.in
Server:          127.0.0.53
Address:         127.0.0.53#53

Non-authoritative answer:
google.in
    origin = ns1.google.com
    mail addr = dns-admin.google.com
    serial = 475782946
    refresh = 900
    retry = 900
    expire = 1800
    minimum = 60

Authoritative answers can be found from:
ns1.google.com  internet address = 216.239.32.10
ns1.google.com  has AAAA address 2001:4860:4802:32::a
>
>
>
> server 216.239.32.10
Default server: 216.239.32.10
Address: 216.239.32.10#53
> set query=a
> google.in
Server:          216.239.32.10
Address:         216.239.32.10#53

Name:   google.in
Address: 142.250.194.132
> █
```

First we set the querytype to soa to get the name server for getting the ip address for authoritative answer. In this the google name server is at the **ip address 216.239.32.10**. Then I set up the server to the found nameserver. Finally I set query=a to get the authoritative answer and then again looked up nslookup.

```
keshav@keshav-HP-Laptop-15-da1xxx:~$ nslookup -debug google.in
Server:          127.0.0.53
Address:         127.0.0.53#53

-----
      QUESTIONS:
        google.in, type = A, class = IN
      ANSWERS:
        -> google.in
            internet address = 216.58.221.36
            ttl = 165
      AUTHORITY RECORDS:
      ADDITIONAL RECORDS:
-----
Non-authoritative answer:
Name:   google.in
Address: 216.58.221.36
-----
      QUESTIONS:
        google.in, type = AAAA, class = IN
      ANSWERS:
        -> google.in
            has AAAA address 2404:6800:4002:806::2004
            ttl = 260
      AUTHORITY RECORDS:
      ADDITIONAL RECORDS:
-----
Name:   google.in
Address: 2404:6800:4002:806::2004

keshav@keshav-HP-Laptop-15-da1xxx:~$
```

Time to live on local DNS = 260

The entry would expire after 260 sec. TTL is measured in seconds and defines after how much time will the packet die.

### Question-3

a.

```
keshav@keshav-HP-Laptop-15-da1xxx:~$ traceroute google.in
traceroute to google.in (172.217.160.228), 64 hops max
 1  192.168.48.254  10.689ms  9.198ms  9.063ms
 2  192.168.1.99  8.355ms  7.901ms  7.532ms
 3  180.151.15.241  8.498ms  8.988ms  9.707ms
 4  72.14.194.202  8.289ms  8.667ms  9.054ms
 5  108.170.251.97  13.411ms  9.257ms  12.169ms
 6  64.233.174.17  12.828ms  13.366ms  8.162ms
 7  172.217.160.228  7.488ms  7.325ms  7.262ms
keshav@keshav-HP-Laptop-15-da1xxx:~$
```

Hop	Hop IP	Time1 (ms)	Time2 (ms)	Time3 (ms)	Average RTT (ms)	Average Latency
1	192.168.48.254	10.689	9.198	9.063	9.65	4.825
2	192.168.1.99	8.355	7.901	7.532	7.929333333	3.964666667
3	180.151.15.241	8.498	8.988	9.707	9.064333333	4.532166667
4	72.14.194.202	8.289	8.667	9.045	8.667	4.3335
5	108.170.251.97	13.411	9.257	12.169	11.61233333	5.806166667
6	64.233.174.17	12.828	13.366	8.162	11.452	5.726
7	172.217.160.228	7.488	7.325	7.262	7.358333333	3.679166667

Sum of average latencies of all intermediate host is: 32.86666667 ms

Maximum latency between all intermediate hosts are: 5.806166667 ms

b.

```
keshav@keshav-HP-Laptop-15-da1xxx:~$ ping -c 100 google.in
PING google.in (172.217.160.228) 56(84) bytes of data.
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=1 ttl=118 time=8.82 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=2 ttl=118 time=7.76 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=3 ttl=118 time=12.0 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=4 ttl=118 time=12.7 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=5 ttl=118 time=7.25 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=6 ttl=118 time=7.84 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=7 ttl=118 time=7.15 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=8 ttl=118 time=12.5 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=9 ttl=118 time=27.2 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=10 ttl=118 time=5.17 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=11 ttl=118 time=7.21 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=12 ttl=118 time=7.28 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=13 ttl=118 time=5.18 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=14 ttl=118 time=8.70 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=15 ttl=118 time=7.94 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=16 ttl=118 time=4.24 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=17 ttl=118 time=5.26 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=18 ttl=118 time=23.4 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=19 ttl=118 time=8.44 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=20 ttl=118 time=6.54 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=21 ttl=118 time=15.1 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=22 ttl=118 time=11.2 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=23 ttl=118 time=8.62 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=24 ttl=118 time=6.70 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=25 ttl=118 time=5.71 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=26 ttl=118 time=9.72 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=27 ttl=118 time=14.3 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=28 ttl=118 time=8.06 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=29 ttl=118 time=6.79 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=30 ttl=118 time=8.47 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=31 ttl=118 time=7.48 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=32 ttl=118 time=8.92 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=33 ttl=118 time=7.36 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=34 ttl=118 time=28.2 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=35 ttl=118 time=6.76 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=36 ttl=118 time=21.3 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=37 ttl=118 time=9.45 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=38 ttl=118 time=8.51 ms

64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=86 ttl=118 time=7.05 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=87 ttl=118 time=13.5 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=88 ttl=118 time=7.92 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=89 ttl=118 time=6.66 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=90 ttl=118 time=8.01 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=91 ttl=118 time=21.9 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=92 ttl=118 time=36.4 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=93 ttl=118 time=7.31 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=94 ttl=118 time=5.89 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=95 ttl=118 time=12.4 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=96 ttl=118 time=6.27 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=97 ttl=118 time=6.83 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=98 ttl=118 time=21.6 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=99 ttl=118 time=57.0 ms
64 bytes from del03s09-in-f4.1e100.net (172.217.160.228): icmp_seq=100 ttl=118 time=7.02 ms

--- google.in ping statistics ---
100 packets transmitted, 99 received, 1% packet loss, time 99172ms
rtt min/avg/max/mdev = 3.789/15.521/191.022/25.672 ms
keshav@keshav-HP-Laptop-15-da1xxx:~$
```

Average Ping Latency =  $15.521/2 = 7.7605$



C.

```
keshav@keshav-HP-Laptop-15-da1xxx:~$ ping -c 100 columbia.edu
PING columbia.edu (128.59.105.24) 56(84) bytes of data.
64 bytes from columbiauniversity.net (128.59.105.24): icmp_seq=1 ttl=233 time=306 ms
64 bytes from www-ltm.cc.columbia.edu (128.59.105.24): icmp_seq=2 ttl=233 time=331 ms
64 bytes from childpolicy.org (128.59.105.24): icmp_seq=3 ttl=233 time=251 ms
64 bytes from columbiauniversity.org (128.59.105.24): icmp_seq=4 ttl=233 time=274 ms
64 bytes from neurotheory.columbia.edu (128.59.105.24): icmp_seq=5 ttl=233 time=296 ms
64 bytes from old.columbia.university (128.59.105.24): icmp_seq=6 ttl=233 time=320 ms
64 bytes from gutenber-e.org (128.59.105.24): icmp_seq=7 ttl=233 time=344 ms
64 bytes from neurotheory.columbia.edu (128.59.105.24): icmp_seq=8 ttl=233 time=263 ms
64 bytes from www-ltm.cc.columbia.edu (128.59.105.24): icmp_seq=9 ttl=233 time=285 ms
64 bytes from www.neurotheory.columbia.edu (128.59.105.24): icmp_seq=10 ttl=233 time=309 ms
64 bytes from www-ltm.cc.columbia.edu (128.59.105.24): icmp_seq=11 ttl=233 time=331 ms
64 bytes from p-i-r.org (128.59.105.24): icmp_seq=12 ttl=233 time=252 ms
64 bytes from columbiauniversity.org (128.59.105.24): icmp_seq=13 ttl=233 time=274 ms
64 bytes from teachtechaward.org (128.59.105.24): icmp_seq=14 ttl=233 time=296 ms
64 bytes from columbiauniversity.org (128.59.105.24): icmp_seq=15 ttl=233 time=325 ms
64 bytes from teachtechaward.org (128.59.105.24): icmp_seq=16 ttl=233 time=342 ms
64 bytes from columbiauniversity.org (128.59.105.24): icmp_seq=17 ttl=233 time=263 ms
64 bytes from childpolicy.org (128.59.105.24): icmp_seq=18 ttl=233 time=285 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=19 ttl=233 time=308 ms
64 bytes from p-i-r.org (128.59.105.24): icmp_seq=20 ttl=233 time=334 ms
64 bytes from old.columbia.university (128.59.105.24): icmp_seq=21 ttl=233 time=252 ms
64 bytes from gutenber-e.org (128.59.105.24): icmp_seq=22 ttl=233 time=274 ms
64 bytes from columbiauniversity.org (128.59.105.24): icmp_seq=23 ttl=233 time=296 ms
64 bytes from columbia.edu (128.59.105.24): icmp_seq=24 ttl=233 time=241 ms
64 bytes from childpolicy.org (128.59.105.24): icmp_seq=25 ttl=233 time=245 ms
64 bytes from childpolicy.org (128.59.105.24): icmp_seq=26 ttl=233 time=241 ms
64 bytes from columbiauniversity.net (128.59.105.24): icmp_seq=27 ttl=233 time=253 ms
64 bytes from columbia.edu (128.59.105.24): icmp_seq=28 ttl=233 time=241 ms
64 bytes from www.neurotheory.columbia.edu (128.59.105.24): icmp_seq=29 ttl=233 time=334 ms
64 bytes from www-ltm.cc.columbia.edu (128.59.105.24): icmp_seq=30 ttl=233 time=260 ms
64 bytes from childpolicy.org (128.59.105.24): icmp_seq=31 ttl=233 time=244 ms
64 bytes from www-ltm.cc.columbia.edu (128.59.105.24): icmp_seq=32 ttl=233 time=241 ms
64 bytes from teachtechaward.org (128.59.105.24): icmp_seq=33 ttl=233 time=243 ms
64 bytes from teachtechaward.org (128.59.105.24): icmp_seq=34 ttl=233 time=424 ms
64 bytes from columbiauniversity.us (128.59.105.24): icmp_seq=35 ttl=233 time=247 ms
64 bytes from columbia.edu (128.59.105.24): icmp_seq=36 ttl=233 time=242 ms
64 bytes from neurotheory.columbia.edu (128.59.105.24): icmp_seq=37 ttl=233 time=254 ms
```

```
64 bytes from teachtechaward.org (128.59.105.24): icmp_seq=82 ttl=233 time=311 ms
64 bytes from neurotheory.columbia.edu (128.59.105.24): icmp_seq=83 ttl=233 time=334 ms
64 bytes from columbia.edu (128.59.105.24): icmp_seq=84 ttl=233 time=256 ms
64 bytes from p-i-r.org (128.59.105.24): icmp_seq=85 ttl=233 time=276 ms
64 bytes from columbiauniversity.net (128.59.105.24): icmp_seq=86 ttl=233 time=243 ms
64 bytes from old.columbia.university (128.59.105.24): icmp_seq=87 ttl=233 time=240 ms
64 bytes from columbiauniversity.us (128.59.105.24): icmp_seq=88 ttl=233 time=242 ms
64 bytes from gutenber-e.org (128.59.105.24): icmp_seq=89 ttl=233 time=242 ms
64 bytes from childpolicy.org (128.59.105.24): icmp_seq=90 ttl=233 time=241 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=92 ttl=233 time=336 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=93 ttl=233 time=252 ms
64 bytes from vii.org (128.59.105.24): icmp_seq=94 ttl=233 time=275 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=95 ttl=233 time=299 ms
64 bytes from p-i-r.org (128.59.105.24): icmp_seq=96 ttl=233 time=320 ms
64 bytes from old.columbia.university (128.59.105.24): icmp_seq=97 ttl=233 time=343 ms
64 bytes from childpolicy.org (128.59.105.24): icmp_seq=98 ttl=233 time=266 ms
64 bytes from old.columbia.university (128.59.105.24): icmp_seq=99 ttl=233 time=287 ms
64 bytes from p-i-r.org (128.59.105.24): icmp_seq=100 ttl=233 time=309 ms

--- columbia.edu ping statistics ---
100 packets transmitted, 99 received, 1% packet loss, time 99121ms
rtt min/avg/max/mdev = 240.343/273.139/424.008/37.860 ms
```

Average latency =  $273.343/2 = 136.6715$  ms

d. e.

Sum of average latency of intermediate hosts of google.in  $\neq$  average latency of 100 ping packets to google.in

Maximum latency of intermediate hosts of google.in  $\approx$  average latency of 100 ping packets to google.in

Reason for such observations

The bottleneck latency is equal to the average latency observed by the ping. In this case bottleneck latency is around 5.8 ms and ping latency is 7.7 ms (minor difference is due to other delays). We can imagine a network as a pipe structure where the network latency is because of the bottleneck pipe.

f.

```
keshav@keshav-HP-Laptop-15-da1xxx:~$ traceroute columbia.edu
traceroute to columbia.edu (128.59.105.24), 64 hops max
 1  192.168.0.1  2.391ms  2.064ms  2.114ms
 2  10.194.0.1  2.997ms  3.043ms  5.175ms
 3  49.207.34.201  3.565ms  3.699ms  3.539ms
 4  49.207.34.161  3.812ms  *  *
 5  49.207.47.210  3.475ms  4.365ms  3.118ms
 6  14.143.30.97  3.042ms  5.086ms  3.324ms
 7  172.28.176.177  70.489ms  101.367ms  22.886ms
 8  180.87.39.25  30.691ms  49.255ms  101.387ms
 9  180.87.38.1  204.545ms  204.792ms  205.618ms
10  *  *  195.219.174.16  239.944ms
11  195.219.174.9  205.678ms  *  *
12  *  *  *
13  130.117.15.69  245.413ms  309.032ms  203.569ms
14  154.54.61.33  204.668ms  204.657ms  204.446ms
15  154.54.61.21  204.799ms  204.530ms  204.828ms
16  154.54.27.169  306.869ms  307.260ms  306.931ms
17  154.54.84.214  307.210ms  306.893ms  306.115ms
18  38.122.8.210  307.772ms  307.114ms  306.988ms
19  128.59.255.5  306.922ms  307.342ms  277.064ms
20  128.59.255.21  337.881ms  306.103ms  307.298ms
21  128.59.105.24  306.753ms  307.504ms  307.847ms
keshav@keshav-HP-Laptop-15-da1xxx:~$
```

Hops for columbia.edu(21) > Hops for google.in (7) (possible bcoz routers have direct access to google.in compared to columbia where packet has to take longer path)

The reason for latency difference between the two websites are:

1. The number of intermediate hosts in columbia.edu > intermediate hosts in google.in
2. The bottleneck latency in case of columbia.edu > bottleneck latency of path of google.in
3. The traceroute for google.in is less as google.in is highly visited website so routers have smaller path access for google.in compared to columbia.edu in which packets needs to have more hops.

## Answer-4

When the ping is not failing the response looks like as follows:

```
keshav@keshav-HP-Laptop-15-da1xxx:~$ ping -c 4 127.0.0.1
PING 127.0.0.1 (127.0.0.1) 56(84) bytes of data.
64 bytes from 127.0.0.1: icmp_seq=1 ttl=64 time=0.045 ms
64 bytes from 127.0.0.1: icmp_seq=2 ttl=64 time=0.052 ms
64 bytes from 127.0.0.1: icmp_seq=3 ttl=64 time=0.059 ms
64 bytes from 127.0.0.1: icmp_seq=4 ttl=64 time=0.052 ms

--- 127.0.0.1 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3071ms
rtt min/avg/max/mdev = 0.045/0.052/0.059/0.005 ms
```

**Command Run: sudo ifconfig lo down**

After running the above command the ping to the localhost(127.0.0.1) fails.

```
keshav@keshav-HP-Laptop-15-da1xxx:~$ sudo ifconfig lo down
[sudo] password for keshav:
keshav@keshav-HP-Laptop-15-da1xxx:~$
keshav@keshav-HP-Laptop-15-da1xxx:~$
keshav@keshav-HP-Laptop-15-da1xxx:~$
keshav@keshav-HP-Laptop-15-da1xxx:~$ 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 ---
8 packets transmitted, 0 received, 100% packet loss, time 7161ms

keshav@keshav-HP-Laptop-15-da1xxx:~$
```

```
keshav@keshav-HP-Laptop-15-da1xxx:~$ ifconfig
eno1: flags=4099<UP,BROADCAST,MULTICAST> mtu 1500
    ether f8:b4:6a:d1:30:0b txqueuelen 1000 (Ethernet)
    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

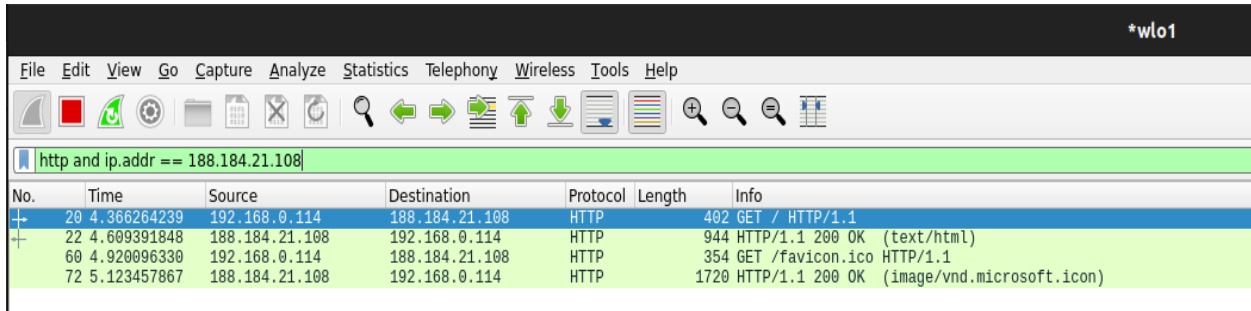
wlo1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.0.114 netmask 255.255.255.0 broadcast 192.168.0.255
    inet6 fe80::73b0:e38f:1ce0:119e prefixlen 64 scopeid 0x20<link>
    ether b0:68:e6:2a:fc:65 txqueuelen 1000 (Ethernet)
    RX packets 3114088 bytes 1995796153 (1.9 GB)
    RX errors 0 dropped 11 overruns 0 frame 0
    TX packets 721210 bytes 173749170 (173.7 MB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

The ping command for localhost is blocked by removing the "lo" interface. Lo interface stands for loopback interface and it is a special interface that a system uses to communicate with itself. Once this is disabled then the self ping won't happen as shown in the above images.



## Answer-5

The following were the request response packets seen on wireshark



No.	Time	Source	Destination	Protocol	Length	Info
20	4.366264239	192.168.0.114	188.184.21.108	HTTP	402	GET / HTTP/1.1
22	4.609391848	188.184.21.108	192.168.0.114	HTTP	944	HTTP/1.1 200 OK (text/html)
60	4.920996330	192.168.0.114	188.184.21.108	HTTP	354	GET /favicon.ico HTTP/1.1
72	5.123457867	188.184.21.108	192.168.0.114	HTTP	1720	HTTP/1.1 200 OK (image/vnd.microsoft.icon)

There were 2 HTTP requests and 2 HTTP responses for the 2 requests given by the browser. In the first request it asked for html content and in the second request it asked for a favicon icon.

For HTTP Request Packets:

HTTP Request type: GET

User Agent Type: Mozilla/5.0 (X11; Linux x86\_64; rv:104.0) Gecko/20100101  
Firefox/104.0

HTTP Request Packet URL: info.cern.ch

HTTP Request packet URI: /

For HTTP Response Packet

HTTP Response Code: 200 OK

HTTP Response Description: OK

Name and version of the web server: Apache

Number of objects downloaded: 2 objects were downloaded and they were not on the same tcp connection.

HTTP is not-persistent in this case.

The following are the images of packets collected from the wireshark. These are http packets and there are 2 such packets. The first one requests for html while the second one requests a favicon icon. The response of the first contains html and the second one contains favicon.

```
Wireshark · Packet 20 · wlo1

▶ Frame 20: 402 bytes on wire (3216 bits), 402 bytes captured (3216 bits) on interface wlo1, id 0
▶ Ethernet II, Src: Chongqin_2a:fc:65 (b0:68:e6:2a:fc:65), Dst: Tp-LinkT_ec:0e:19 (d8:07:b6:ec:0e:19)
▶ Internet Protocol Version 4, Src: 192.168.0.114, Dst: 188.184.21.108
▶ Transmission Control Protocol, Src Port: 53108, Dst Port: 80, Seq: 1, Ack: 1, Len: 336
▼ Hypertext Transfer Protocol
  ▶ GET / HTTP/1.1\r\n
    Host: info.cern.ch\r\n
    User-Agent: Mozilla/5.0 (X11; Linux x86_64; rv:104.0) Gecko/20100101 Firefox/104.0\r\n
    Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,*/*;q=0.8\r\n
    Accept-Language: en-US,en;q=0.5\r\n
    Accept-Encoding: gzip, deflate\r\n
    Connection: keep-alive\r\n
    Upgrade-Insecure-Requests: 1\r\n
    \r\n
    [Full request URI: http://info.cern.ch/]
    [HTTP request 1/1]
    [Response in frame: 22]
```

## Request-1

```
Wireshark · Packet 22 · wlo1

▶ Frame 22: 944 bytes on wire (7552 bits), 944 bytes captured (7552 bits) on interface wlo1, id 0
▶ Ethernet II, Src: Tp-LinkT_ec:0e:19 (d8:07:b6:ec:0e:19), Dst: Chongqin_2a:fc:65 (b0:68:e6:2a:fc:65)
▶ Internet Protocol Version 4, Src: 188.184.21.108, Dst: 192.168.0.114
▶ Transmission Control Protocol, Src Port: 80, Dst Port: 53108, Seq: 1, Ack: 337, Len: 878
▼ Hypertext Transfer Protocol
  ▶ HTTP/1.1 200 OK\r\n
    Date: Wed, 21 Sep 2022 18:17:38 GMT\r\n
    Server: Apache\r\n
    Last-Modified: Wed, 05 Feb 2014 16:00:31 GMT\r\n
    ETag: "286-4f1aadb3105c0"\r\n
    Accept-Ranges: bytes\r\n
    Content-Length: 646\r\n
    Connection: close\r\n
    Content-Type: text/html\r\n
    \r\n
    [HTTP response 1/1]
    [Time since request: 0.243127609 seconds]
    [Request in frame: 20]
    [Request URI: http://info.cern.ch/]
    File Data: 646 bytes
  ▼ Line-based text data: text/html (13 lines)
    <html><head></head><body><header>\n
    <title>http://info.cern.ch</title>\n
    </header>\n
    \n
    <h1>http://info.cern.ch - home of the first website</h1>\n
    <p>From here you can:</p>\n
    <ul>\n
    <li><a href="http://info.cern.ch/hypertext/WWW/TheProject.html">Browse the first website</a></li>\n
    <li><a href="http://line-mode.cern.ch/www/hypertext/WWW/TheProject.html">Browse the first website using the line-mode browser simulator</a></li>\n
    <li><a href="http://home.web.cern.ch/topics/birth-web">Learn about the birth of the web</a></li>\n
    <li><a href="http://home.web.cern.ch/about">Learn about CERN, the physics laboratory where the web was born</a></li>\n
    </ul>\n
    </body></html>\n
```

## Response-1

```

▶ Frame 60: 354 bytes on wire (2832 bits), 354 bytes captured (2832 bits) on interface wlo1, id 0
▶ Ethernet II, Src: Chongqin_2a:fc:65 (b0:68:e6:2a:fc:65), Dst: Tp-LinkT_ec:0e:19 (d8:07:b6:ec:0e:19)
▶ Internet Protocol Version 4, Src: 192.168.0.114, Dst: 188.184.21.108
▶ Transmission Control Protocol, Src Port: 53118, Dst Port: 80, Seq: 1, Ack: 1, Len: 288
▼ Hypertext Transfer Protocol
  ▶ GET /favicon.ico HTTP/1.1\r\n
    Host: info.cern.ch\r\n
    User-Agent: Mozilla/5.0 (X11; Linux x86_64; rv:104.0) Gecko/20100101 Firefox/104.0\r\n
    Accept: image/avif,image/webp,*/*\r\n
    Accept-Language: en-US,en;q=0.5\r\n
    Accept-Encoding: gzip, deflate\r\n
    Connection: keep-alive\r\n
    Referer: http://info.cern.ch/\r\n
    \r\n
    [Full request URI: http://info.cern.ch/favicon.ico]
    [HTTP request 1/1]
    [Response in frame: 72]

```

## Request-2

```

▶ Frame 72: 1720 bytes on wire (13760 bits), 1720 bytes captured (13760 bits) on interface wlo1, id 0
▶ Ethernet II, Src: Tp-LinkT_ec:0e:19 (d8:07:b6:ec:0e:19), Dst: Chongqin_2a:fc:65 (b0:68:e6:2a:fc:65)
▶ Internet Protocol Version 4, Src: 188.184.21.108, Dst: 192.168.0.114
▶ Transmission Control Protocol, Src Port: 80, Dst Port: 53118, Seq: 1, Ack: 289, Len: 1654
▼ Hypertext Transfer Protocol
  ▶ HTTP/1.1 200 OK\r\n
    Date: Wed, 21 Sep 2022 18:17:39 GMT\r\n
    Server: Apache\r\n
    Last-Modified: Fri, 18 Jan 2008 15:26:11 GMT\r\n
    ETag: "57e-44400c31d2ac0"\r\n
    Accept-Ranges: bytes\r\n
    Content-Length: 1406\r\n
    Connection: close\r\n
    Content-Type: image/vnd.microsoft.icon\r\n
    \r\n
    [HTTP response 1/1]
    [Time since request: 0.203361537 seconds]
    [Request in frame: 60]
    [Request URI: http://info.cern.ch/favicon.ico]
    File Data: 1406 bytes
  ▼ Media Type
    Media type: image/vnd.microsoft.icon (1406 bytes)

```

## Response-2

The connection is not persistent for both HTTP requests. This can be analyzed from the image below.

No.	Time	Source	Destination	Protocol	Length	Info
12	2.283425425	192.168.0.114	188.184.21.108	TCP	74	53108 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=230106822 TSecr=0 WS=128
13	2.458154466	188.184.21.108	192.168.0.114	TCP	74	80 → 53108 [SYN, ACK] Seq=0 Ack=1 Win=28960 Len=0 MSS=1440 SACK_PERM=1 TSval=4269748976 TSecr=230106822 WS=128
14	2.458228538	192.168.0.114	188.184.21.108	TCP	66	53108 → 80 [ACK] Seq=1 Ack=1 Win=64256 Len=0 TSval=230106996 TSecr=4269748976
20	4.366264239	192.168.0.114	188.184.21.108	HTTP	402	GET / HTTP/1.1
21	4.609391256	188.184.21.108	192.168.0.114	TCP	66	80 → 53108 [ACK] Seq=1 Ack=337 Win=30080 Len=0 TSval=4269751059 TSecr=230108905
22	4.609391848	188.184.21.108	192.168.0.114	HTTP	944	HTTP/1.1 200 OK (text/html)
23	4.609473155	192.168.0.114	188.184.21.108	TCP	66	53108 → 80 [ACK] Seq=337 Ack=879 Win=64128 Len=0 TSval=230109148 TSecr=4269751060
24	4.609392013	188.184.21.108	192.168.0.114	TCP	66	80 → 53108 [FIN, ACK] Seq=879 Ack=337 Win=30080 Len=0 TSval=4269751060 TSecr=230108905
25	4.610171357	192.168.0.114	188.184.21.108	TCP	66	53108 → 80 [FIN, ACK] Seq=337 Ack=880 Win=64128 Len=0 TSval=230109148 TSecr=4269751060
50	4.716904950	192.168.0.114	188.184.21.108	TCP	74	53118 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=230109255 TSecr=0 WS=128
54	4.798474754	188.184.21.108	192.168.0.114	TCP	66	80 → 53118 [ACK] Seq=880 Ack=338 Win=30080 Len=0 TSval=4269751302 TSecr=230109148
58	4.919666832	188.184.21.108	192.168.0.114	TCP	74	80 → 53118 [SYN, ACK] Seq=0 Ack=1 Win=28960 Len=0 MSS=1440 SACK_PERM=1 TSval=4269751411 TSecr=230109255 WS=128
59	4.919742863	192.168.0.114	188.184.21.108	TCP	66	53118 → 80 [ACK] Seq=1 Ack=1 Win=64256 Len=0 TSval=230109458 TSecr=4269751411
60	4.920096330	192.168.0.114	188.184.21.108	HTTP	354	GET /favicon.ico HTTP/1.1
71	5.123457450	188.184.21.108	192.168.0.114	TCP	66	80 → 53118 [ACK] Seq=1 Ack=289 Win=30080 Len=0 TSval=4269751616 TSecr=230109458
72	5.123457867	188.184.21.108	192.168.0.114	HTTP	1720	HTTP/1.1 200 OK (image/vnd.microsoft.icon)
73	5.123518103	192.168.0.114	188.184.21.108	TCP	66	53118 → 80 [ACK] Seq=289 Ack=1655 Win=63872 Len=0 TSval=230109662 TSecr=4269751617
74	5.123458002	188.184.21.108	192.168.0.114	TCP	66	80 → 53118 [FIN, ACK] Seq=1655 Ack=289 Win=30080 Len=0 TSval=4269751617 TSecr=230109458
78	5.124089827	192.168.0.114	188.184.21.108	TCP	66	53118 → 80 [FIN, ACK] Seq=289 Ack=1656 Win=64128 Len=0 TSval=230109662 TSecr=4269751617
81	5.328241357	188.184.21.108	192.168.0.114	TCP	66	80 → 53118 [ACK] Seq=1656 Ack=290 Win=30080 Len=0 TSval=4269751817 TSecr=230109662

From the image above we can clearly see that for each HTTP request there is a separate tcp connection (from [syn] → [syn ack] →[ack] packets that is 3 way handshake) hence we can say the connection is non-persistent.

## Answer-6

Command: `sudo netstat -at -tp`

Flags: `-at`: for tcp connections

`-tp`: to list PID/Program name

```
keshav@keshav-HP-Laptop-15-da1xxx:~$ sudo netstat -at -tp
Active Internet connections (servers and established)
Proto Recv-Q Send-Q Local Address           Foreign Address         State       PID/Program name
tcp        0      0 localhost:domain        0.0.0.0:*               LISTEN      884/systemd-resolve
tcp        0      0 localhost:ipp           0.0.0.0:*               LISTEN      997/cupsd
tcp        0      0 keshav-HP-Laptop-:47864 del11s16-in-f13.1:https TIME_WAIT   -
tcp        0      0 keshav-HP-Laptop-:55308 102.115.120.34.bc:https ESTABLISHED 16646/firefox
tcp        0      0 keshav-HP-Laptop-:35406 del11s20-in-f14.1:https TIME_WAIT   -
tcp        0      0 keshav-HP-Laptop-:35370 webafs706.cern.ch:http  TIME_WAIT   -
tcp        0      0 keshav-HP-Laptop-:46262 76.237.120.34.bc.:https ESTABLISHED 16646/firefox
tcp        0      0 keshav-HP-Laptop-:50828 82.221.107.34.bc.g:http ESTABLISHED 16646/firefox
tcp        0      0 keshav-HP-Laptop-:47776 del11s04-in-f3.1e1:http ESTABLISHED 16646/firefox
tcp        0      0 keshav-HP-Laptop-:49272 broadband.actcorp.:http ESTABLISHED 16646/firefox
tcp        0      0 keshav-HP-Laptop-:37338 ec2-52-35-167-249:https ESTABLISHED 16646/firefox
tcp        0      0 keshav-HP-Laptop-:35378 webafs706.cern.ch:http  TIME_WAIT   -
tcp        0      0 keshav-HP-Laptop-:48854 server-18-66-63-1:https ESTABLISHED 16646/firefox
tcp        0      0 keshav-HP-Laptop-:49620 117.18.237.29:http     ESTABLISHED 16646/firefox
tcp        0      0 keshav-HP-Laptop-:59232 239.237.117.34.bc:https ESTABLISHED 16646/firefox
tcp        0      0 keshav-HP-Laptop-:53608 del11s21-in-f3.1e:https ESTABLISHED 16646/firefox
tcp        0      0 keshav-HP-Laptop-:46288 broadband.actcorp.:http ESTABLISHED 16646/firefox
tcp        0      0 keshav-HP-Laptop-:33120 123.208.120.34.bc:https ESTABLISHED 16646/firefox
tcp        0      0 keshav-HP-Laptop-:49632 117.18.237.29:http     TIME_WAIT   -
tcp        0      0 keshav-HP-Laptop-:43750 nrt12s12-in-f195.:https ESTABLISHED 16646/firefox
tcp        1      0 keshav-HP-Laptop-:42098 _gateway:netbios-ssn   CLOSE_WAIT  8981/gvfsd-smb-brow
tcp        0      0 keshav-HP-Laptop-:47780 del11s04-in-f3.1e1:http ESTABLISHED 16646/firefox
tcp        0      0 keshav-HP-Laptop-:59906 nrt12s12-in-f202.:https ESTABLISHED 16646/firefox
tcp        0      0 keshav-HP-Laptop-:55480 del12s02-in-f3.1e:https TIME_WAIT   -
tcp        0      0 keshav-HP-Laptop-:50708 del11s04-in-f14.1:https TIME_WAIT   -
tcp        0      0 keshav-HP-Laptop-:50836 82.221.107.34.bc.g:http ESTABLISHED 16646/firefox
tcp        0      0 keshav-HP-Laptop-:44430 server-18-66-78-9:https ESTABLISHED 16646/firefox
tcp        0      0 keshav-HP-Laptop-:35382 del11s13-in-f14.1:https ESTABLISHED 16646/firefox
tcp6       0      0 ip6-localhost:ipp      [::]:*                 LISTEN      997/cupsd
keshav@keshav-HP-Laptop-15-da1xxx:~$
```

Foreign Address: webafs706.cern.ch: http

State of the connection: Time\_wait