Computer Networks - Assignment-1

<u>**Q1)**</u> **a) IP add = 192.168.51.117**


```
harjeet@harjeet: ~                    Q   ≡   —   ▢   ✕

Try: sudo apt install <deb name>

harjeet@harjeet:~$ ifconfig
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 192322  bytes 61276584 (61.2 MB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 192322  bytes 61276584 (61.2 MB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

wlp0s20f3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.51.117  netmask 255.255.240.0  broadcast 192.168.63.255
        inet6 fe80::f793:cadf:204a:8c00  prefixlen 64  scopeid 0x20<link>
        ether cc:15:31:30:95:62  txqueuelen 1000  (Ethernet)
        RX packets 17018924  bytes 10782515361 (10.7 GB)
        RX errors 0  dropped 74  overruns 0  frame 0
        TX packets 3060444  bytes 922101320 (922.1 MB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

What Is My IP?

My Public IPv4 is: 180.151.15.242 📋

My Public IPv6 is: Not Detected

My IP Location is: Ludhiana, PB IN

My ISP is: Shyam Spectra Pvt Ltd

| My IP Information | Hide My IP Address |

<u>**b)**</u> **ip add = 180.151.15.242**

Both the IP addresses are different because IP on whatismyip is a public IP address whereas IP in the terminal is the private IP address. Public IP uniquely identifies a system on the internet and private IP addresses find a system within a LAN or organization.

Q2) Part a

Step 1
First, we find the name of the primary DNS server or the origin server which has the start of the authoritative file (SOA) using **nslookup -type=soa google.com**

Step2
Then we directly query the primary server using the name of the origin server through this command **nslookup google.com ns1.google.com**

eg ns1.google.com is the primary DNS server for resolving google.com

```
harjeet@harjeet:~$ nslookup -type=soa google.com
Server:          127.0.0.53
Address:         127.0.0.53#53

Non-authoritative answer:
google.com
        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:

harjeet@harjeet:~$ nslookup google.com ns1.google.com
Server:          ns1.google.com
Address:         216.239.32.10#53

Name:    google.com
Address: 216.58.196.206
Name:    google.com
Address: 2404:6800:4002:805::200e
```

Part b)
TTL = time to live for local DNS is 60 seconds. i.e this is the amount of time a data packet will be stored on the local DNS server before it gets dropped.

```
harjeet@harjeet:~$ dig google.com SOA +multiline

; <<>> DiG 9.16.1-Ubuntu <<>> google.com SOA +multiline
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 47920
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 65494
;; QUESTION SECTION:
;google.com.                    IN SOA

;; ANSWER SECTION:
google.com.             28 IN SOA ns1.google.com. dns-admin.google.com. (
                               476050568  ; serial
                               900        ; refresh (15 minutes)
                               900        ; retry (15 minutes)
                               1800       ; expire (30 minutes)
                               60         ; minimum (1 minute)
                               )

;; Query time: 23 msec
;; SERVER: 127.0.0.53#53(127.0.0.53)
;; WHEN: Fri Sep 23 19:54:03 IST 2022
```

Q3)
a)

There are 10 hops

```
harjeet@harjeet:~$ traceroute google.in
traceroute to google.in (142.250.206.164), 64 hops max
  1    192.168.182.42   2.075ms   2.274ms   2.327ms
  2    192.168.31.1   20.026ms   192.168.12.97   21.087ms   20.370ms
  3    192.168.12.85   20.400ms   192.168.13.58   19.282ms   19.710ms
  4    192.168.13.38   19.734ms   125.22.222.121   20.399ms   20.231ms
  5    125.22.222.121   19.718ms   *    *
  6    *   *   *
  7    *   142.250.236.54   49.457ms   24.703ms
  8    72.14.233.30   24.968ms   108.170.251.106   24.961ms   25.169ms
  9    108.170.251.108   56.079ms   74.125.244.193   23.294ms   19.543ms
 10    142.250.206.164   31.522ms   26.436ms   22.832ms
harjeet@harjeet:~$ 
```

Average latency of each intermediate host:-

1s hop :-(2.075 + 2.274 + 2.327)/3 = 2.225 ms
2nd hop :-(20.026 + 21.087 + 20.37)/3 = 20.494 ms
3rd hop :- (20.400 + 19.282 + 19.710)/3 = 19.794 ms
4rd hop :- (19.734 + 20.399 + 20.231)/3 = 20.121 ms
5th hop :- 27.420 + *   *
6th hop:- *   *   *
7th hop:- *   + 49.457 + 24.703
8th hop:- (24.968 + 24.961 + 25.169)/3 = 25.032 ms
9th hop:- (56.079 + 23.29 + 19.543)/3 = 32.970 ms
10th hop:- (31.522 + 26.436 + 22.832)/3 = 26.93 ms

b)

```
harjeet@harjeet:~$ ping -c 100  google.in -4
PING google.in (142.250.194.4) 56(84) bytes of data.
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=1 ttl=115 time=28.4 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=2 ttl=115 time=38.6 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=3 ttl=115 time=45.8 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=4 ttl=115 time=27.6 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=5 ttl=115 time=31.5 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=6 ttl=115 time=54.1 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=7 ttl=115 time=22.4 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=8 ttl=115 time=36.7 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=9 ttl=115 time=131 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=10 ttl=115 time=54.0 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=11 ttl=115 time=52.9 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=12 ttl=115 time=51.3 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=13 ttl=115 time=49.4 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=14 ttl=115 time=34.4 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=15 ttl=115 time=25.4 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=16 ttl=115 time=43.3 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=17 ttl=115 time=41.9 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=18 ttl=115 time=46.1 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=19 ttl=115 time=39.4 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=20 ttl=115 time=37.7 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=21 ttl=115 time=35.4 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=22 ttl=115 time=23.6 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=23 ttl=115 time=52.3 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=24 ttl=115 time=49.9 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=25 ttl=115 time=50.0 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=26 ttl=115 time=47.5 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=27 ttl=115 time=30.4 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=28 ttl=115 time=29.0 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=29 ttl=115 time=43.9 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=30 ttl=115 time=26.1 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=31 ttl=115 time=24.4 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=32 ttl=115 time=40.4 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=33 ttl=115 time=36.7 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=34 ttl=115 time=25.1 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=35 ttl=115 time=38.1 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=36 ttl=115 time=36.8 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=37 ttl=115 time=49.9 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=38 ttl=115 time=47.5 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=39 ttl=115 time=35.5 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=40 ttl=115 time=44.3 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=41 ttl=115 time=42.3 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=42 ttl=115 time=40.7 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=43 ttl=115 time=39.8 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=44 ttl=115 time=36.9 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=45 ttl=115 time=36.3 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=46 ttl=115 time=28.7 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=47 ttl=115 time=52.6 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=48 ttl=115 time=51.1 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=49 ttl=115 time=53.8 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=50 ttl=115 time=51.3 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=51 ttl=115 time=45.4 ms
```

```
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=81 ttl=115 time=42.9 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=82 ttl=115 time=52.9 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=83 ttl=115 time=41.4 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=84 ttl=115 time=40.0 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=85 ttl=115 time=23.9 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=86 ttl=115 time=110 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=87 ttl=115 time=84.2 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=88 ttl=115 time=56.3 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=89 ttl=115 time=28.9 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=90 ttl=115 time=53.2 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=91 ttl=115 time=37.1 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=92 ttl=115 time=53.3 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=93 ttl=115 time=48.7 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=94 ttl=115 time=67.3 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=95 ttl=115 time=45.5 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=96 ttl=115 time=45.3 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=97 ttl=115 time=23.5 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=98 ttl=115 time=41.8 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=99 ttl=115 time=39.4 ms
64 bytes from del12s01-in-f4.1e100.net (142.250.194.4): icmp_seq=100 ttl=115 time=37.7 ms

--- google.in ping statistics ---
100 packets transmitted, 100 received, 0% packet loss, time 99961ms
rtt min/avg/max/mdev = 22.357/43.245/130.713/16.213 ms
harjeet@harjeet:~$
```

Average latency = 43.245 ms

c)

```
harjeet@harjeet:~$ ping -c 100 columbia.edu
PING columbia.edu (128.59.105.24) 56(84) bytes of data.
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=1 ttl=236 time=427 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=2 ttl=236 time=713 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=3 ttl=236 time=401 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=4 ttl=236 time=552 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=5 ttl=236 time=472 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=6 ttl=236 time=392 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=7 ttl=236 time=413 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=8 ttl=236 time=435 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=9 ttl=236 time=458 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=10 ttl=236 time=357 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=11 ttl=236 time=354 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=12 ttl=236 time=415 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=13 ttl=236 time=369 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=14 ttl=236 time=381 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=15 ttl=236 time=415 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=16 ttl=236 time=614 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=17 ttl=236 time=432 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=18 ttl=236 time=502 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=19 ttl=236 time=509 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=20 ttl=236 time=499 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=21 ttl=236 time=559 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=22 ttl=236 time=545 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=23 ttl=236 time=463 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=24 ttl=236 time=591 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=25 ttl=236 time=372 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=26 ttl=236 time=591 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=27 ttl=236 time=659 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=28 ttl=236 time=476 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=29 ttl=236 time=500 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=30 ttl=236 time=521 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=31 ttl=236 time=544 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=32 ttl=236 time=567 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=33 ttl=236 time=385 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=34 ttl=236 time=613 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=35 ttl=236 time=431 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=36 ttl=236 time=455 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=37 ttl=236 time=476 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=38 ttl=236 time=397 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=39 ttl=236 time=727 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=40 ttl=236 time=546 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=41 ttl=236 time=569 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=42 ttl=236 time=592 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=43 ttl=236 time=615 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=44 ttl=236 time=638 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=45 ttl=236 time=457 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=46 ttl=236 time=479 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=47 ttl=236 time=399 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=48 ttl=236 time=525 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=49 ttl=236 time=548 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=50 ttl=236 time=571 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=51 ttl=236 time=348 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=52 ttl=236 time=617 ms
```

```
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=73 ttl=236 time=656 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=74 ttl=236 time=473 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=75 ttl=236 time=495 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=76 ttl=236 time=515 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=77 ttl=236 time=536 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=78 ttl=236 time=559 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=79 ttl=236 time=579 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=80 ttl=236 time=601 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=81 ttl=236 time=419 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=82 ttl=236 time=441 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=83 ttl=236 time=463 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=84 ttl=236 time=688 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=85 ttl=236 time=404 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=86 ttl=236 time=528 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=87 ttl=236 time=550 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=88 ttl=236 time=573 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=89 ttl=236 time=348 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=90 ttl=236 time=618 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=91 ttl=236 time=436 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=92 ttl=236 time=458 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=93 ttl=236 time=378 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=94 ttl=236 time=503 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=95 ttl=236 time=423 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=96 ttl=236 time=343 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=97 ttl=236 time=356 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=98 ttl=236 time=592 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=99 ttl=236 time=410 ms
64 bytes from columbiauniversity.info (128.59.105.24): icmp_seq=100 ttl=236 time=433 ms

--- columbia.edu ping statistics ---
100 packets transmitted, 100 received, 0% packet loss, time 99427ms
rtt min/avg/max/mdev = 343.092/506.023/866.793/111.379 ms
harjeet@harjeet:~$
```

Avg latency = 506.023 ms

d) 2.225+20.494+19.794+20.121+25.032+32.970+26.93 = 147.566 ms

No, they aren't the same because they are following a different route and no intermediate hops are different in both cases. Moreover, in traceroute, there is a round trip of 3 packets from the client to each intermediate hop that why it is higher than ping.

e) max(2.225, 20.494, 19.794, 20.121, 25.032, 32.970, 26.93) = 32.970 ms

Obviously, they won't match because the max of the intermediate hop is the time from the client to one of the intermediate routers whereas the latency in part b) is the time taken from the client to the destination server. They can be the same if the max of part a would have been the destination server.

f)

```
harjeet@harjeet:~$ traceroute columbia.edu
traceroute to columbia.edu (128.59.105.24), 64 hops max
  1    192.168.182.42   2.040ms   2.442ms   2.662ms
  2    192.168.31.1   33.239ms   192.168.12.73   39.914ms   27.472ms
  3    192.168.12.73   22.071ms   192.168.13.48   30.169ms   19.210ms
  4    192.168.13.68   20.804ms   125.22.222.125   20.021ms   23.413ms
  5    125.22.222.125   29.560ms   *   *
  6    *   *   *
  7    *   *   *
  8    *   *   *
  9    *   *   *
 10    *   *   *
 11    *   *   *
 12    *   *   *
 13    *   *   *
 14    *   *   *
 15    *   38.122.8.210   337.884ms   343.881ms
 16    38.122.8.210   347.374ms   128.59.255.5   339.293ms   339.617ms
 17    128.59.255.5   345.744ms   128.59.255.21   334.987ms   337.470ms
 18    128.59.255.21   342.953ms   128.59.105.24   337.867ms   331.133ms
harjeet@harjeet:~$
```

No of the hops was 10 in google.in and for columbia.edu is 18
Latency is different because both are different sever and the route followed by both the commands. And for google.in no of hops in less because it is geographically closer than columbia.edu so the path followed for the later case will be longer.

Q4)

```
harjeet@harjeet:~$ sudo ifconfig lo down
harjeet@harjeet:~$ ifconfig
wlp0s20f3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.182.57  netmask 255.255.255.0  broadcast 192.168.182.255
        inet6 2401:4900:4120:b9e7:10a6:9265:a0ea:3d2f  prefixlen 64  scopeid 0x0<global>
        inet6 2401:4900:4120:b9e7:eba3:75c1:fab6:5234  prefixlen 64  scopeid 0x0<global>
        inet6 fe80::ddbc:d414:ed5:a971  prefixlen 64  scopeid 0x20<link>
        ether cc:15:31:30:95:62  txqueuelen 1000  (Ethernet)
        RX packets 74154  bytes 31728747 (31.7 MB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 69947  bytes 34310761 (34.3 MB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

harjeet@harjeet:~$ ping 127.0.0.1 -c 5
PING 127.0.0.1 (127.0.0.1) 56(84) bytes of data.

--- 127.0.0.1 ping statistics ---
5 packets transmitted, 0 received, 100% packet loss, time 4076ms

harjeet@harjeet:~$
```

First, disable the localhost using **ifconfig lo down** command. Now when we ping using the 127.0.0.1 (IP address localhost) there is no response for the command and there is 100% packet loss because the localhost is down.

Q5)
HTTP Request 1

No.	Time	Source	Destination	Protocol	Length	Info
39	4.413346877	2401:4900:4120:b9e7…	2001:1458:d00:34::1…	HTTP	502	GET / HTTP/1.1
47	4.635971865	2401:4900:4120:b9e7…	2001:1458:d00:34::1…	HTTP	456	GET /favicon.ico HTTP/1.1
43	4.616374808	2001:1458:d00:34::1…	2401:4900:4120:b9e7…	HTTP	964	HTTP/1.1 200 OK (text/html)
54	4.836363795	2001:1458:d00:34::1…	2401:4900:4120:b9e7…	HTTP	1740	HTTP/1.1 200 OK (image/vnd.microsoft.icon)

```
▶ Frame 39: 502 bytes on wire (4016 bits), 502 bytes captured (4016 bits) on interface wlp0s20f3, id 0
▶ Ethernet II, Src: cc:15:31:30:95:62 (cc:15:31:30:95:62), Dst: 5e:76:40:25:d5:b9 (5e:76:40:25:d5:b9)
▶ Internet Protocol Version 6, Src: 2401:4900:4120:b9e7:9cc2:a32f:2f0b:6878, Dst: 2001:1458:d00:34::100:125
▶ Transmission Control Protocol, Src Port: 53346, Dst Port: 80, Seq: 1, Ack: 1, Len: 416
▼ Hypertext Transfer Protocol
  ▶ GET / HTTP/1.1\r\n
    Host: info.cern.ch\r\n
    Connection: keep-alive\r\n
    Cache-Control: max-age=0\r\n
    Upgrade-Insecure-Requests: 1\r\n
    User-Agent: Mozilla/5.0 (X11; Linux x86_64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/105.0.0.0 Safari/537.36\r\n
    Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,image/apng,*/*;q=0.8\r\n
    Sec-GPC: 1\r\n
    Accept-Language: en-GB,en;q=0.7\r\n
    Accept-Encoding: gzip, deflate\r\n
    \r\n
    [Full request URI: http://info.cern.ch/]
    [HTTP request 1/1]
    [Response in frame: 43]
```

```
0000  5e 76 40 25 d5 b9 cc 15  31 30 95 62 86 dd 60 08   ^v@%···· 10·b··`·
0010  3e 02 01 c0 06 fe 24 01  49 00 41 20 b9 e7 9c c2   >·····$· I·A ····
0020  a3 2f 2f 0b 68 78 20 01  14 58 0d 00 00 34 00 00   ·//·hx · ·X···4··
0030  00 00 01 00 01 25 d0 62  00 50 2a f9 59 2c 5a 81   ·····%·b ·P*·Y,Z·
0040  62 b7 80 18 01 fb 84 f7  00 00 01 01 08 0a 29 bd   b······· ······).
0050  61 f4 08 87 ad 0c 47 45  54 20 2f 20 48 54 54 50   a·····GE T / HTTP
0060  2f 31 2e 31 0d 0a 48 6f  73 74 3a 20 69 6e 66 6f   /1.1··Ho st: info
0070  2e 63 65 72 6e 2e 63 68  0d 0a 43 6f 6e 6e 65 63   .cern.ch ··Connec
0080  74 69 6f 6e 3a 20 6b 65  65 70 2d 61 6c 69 76 65   tion: ke ep-alive
0090  0d 0a 43 61 63 68 65 2d  43 6f 6e 74 72 6f 6c 3a   ··Cache- Control:
00a0  20 6d 61 78 2d 61 67 65  3d 30 0d 0a 55 70 67 72    max-age =0··Upgr
00b0  61 64 65 2d 49 6e 73 65  63 75 72 65 2d 52 65 71   ade-Inse cure-Req
00c0  75 65 73 74 73 3a 20 31  0d 0a 55 53 72 2d 41      uests: 1 ··User-A
00d0  67 65 6e 74 3a 20 4d 6f  7a 69 6c 6c 61 2f 35 2e   gent: Mo zilla/5.
00e0  30 20 28 58 31 31 3b 20  4c 69 6e 75 78 20 78 38   0 (X11;  Linux x8
00f0  36 5f 36 34 29 20 41 70  70 6c 65 57 65 62 4b 69   6_64) Ap pleWebKi
0100  74 2f 35 33 37 2e 33 36  20 28 4b 48 54 4d 4c 2c   t/537.36  (KHTML,
0110  20 6c 69 6b 65 20 47 65  63 6b 6f 29 20 43 68 72    like Ge cko) Chr
0120  6f 6d 65 2f 31 30 35 2e  30 2e 30 2e 30 20 53 61   ome/105. 0.0.0 Sa
0130  66 61 72 69 2f 35 33 37  2e 33 36 0d 0a 41 63 63   fari/537 .36··Acc
0140  65 70 74 3a 20 74 65 78  74 2f 68 74 6d 6c 2c 61   ept: tex t/html,a
```

○ 📝   wlp0s20f3: <live capture in progress>

HTTP Request Type : - GET
User-Agent: Mozilla/5.0 (X11; Linux x86_64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/105.0.0.0 Safari/537.36\r\n
HTTP Request packet's URL: http://info.cern.ch/

HTTP Response 1

* HTTP Response Code: 200
* HTTP Response Description: OK
* Name and Version of Server: Apache

HTTP Request 2

HTTP Request Type : - GET

User-Agent: Mozilla/5.0 (X11; Linux x86_64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/105.0.0.0 Safari/537.36\r\n

HTTP Request packet's URL: http://info.cern.ch/favicon.ico

HTTP Response 2

```
 http

No.      Time              Source                Destination          ▼ Protocol  Length Info
     39 4.413346877       2401:4900:4120:b9e7…  2001:1458:d00:34::1…   HTTP      502 GET / HTTP/1.1
     47 4.635971865       2401:4900:4120:b9e7…  2001:1458:d00:34::1…   HTTP      456 GET /favicon.ico HTTP/1.1
     43 4.616374808       2001:1458:d00:34::1…  2401:4900:4120:b9e7…   HTTP      964 HTTP/1.1 200 OK  (text/html)
     54 4.836363795       2001:1458:d00:34::1…  2401:4900:4120:b9e7…   HTTP     1740 HTTP/1.1 200 OK  (image/vnd.microsoft.icon)
   1025 170.323820430     192.168.182.57        35.224.170.84          HTTP      153 GET / HTTP/1.1
   1037 170.634675777     35.224.170.84         192.168.182.57         HTTP      214 HTTP/1.1 204 No Content
```

```
▶ Frame 54: 1740 bytes on wire (13920 bits), 1740 bytes captured (13920 bits) on interface wlp0s20f3, id 0
▶ Ethernet II, Src: 5e:76:40:25:d5:b9 (5e:76:40:25:d5:b9), Dst: cc:15:31:30:95:62 (cc:15:31:30:95:62)
▶ Internet Protocol Version 6, Src: 2001:1458:d00:34::100:125, Dst: 2401:4900:4120:b9e7:9cc2:a32f:2f0b:6878
▶ Transmission Control Protocol, Src Port: 80, Dst Port: 53348, Seq: 1, Ack: 371, Len: 1654
▼ Hypertext Transfer Protocol
  ▶ HTTP/1.1 200 OK\r\n
    Date: Fri, 23 Sep 2022 17:03:04 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: 0.200391930 seconds]
    [Request in frame: 47]
    [Request URI: http://info.cern.ch/favicon.ico]
    File Data: 1406 bytes
▶ Media Type
```

```
0000  cc 15 31 30 95 62 5e 76  40 25 d5 b9 86 dd 60 00   ··10·b^v @%····`·
0010  00 00 06 96 06 30 20 01  14 58 0d 00 00 34 00 00   ·····0 ··X··4·
0020  00 00 01 00 01 25 24 01  49 00 41 20 b9 e7 9c c2   ·····%$· I·A····
0030  a3 2f 2f 0b 68 78 00 50  d0 64 ee 3b 3f 55 c7 b8   ·//·hx·P ·d·;?U·
0040  c5 10 80 18 00 e8 89 cd  00 00 01 01 08 0a 08 87   ··············
0050  ae ae 29 bd 62 d3 48 54  54 50 2f 31 2e 31 20 32   ··)·b·HT TP/1.1 2
0060  30 30 20 4f 4b 0d 0a 44  61 74 65 3a 20 46 72 69   00 OK··D ate: Fri
0070  2c 20 32 33 20 53 65 70  20 32 30 32 32 20 31 37   , 23 Sep  2022 17
0080  3a 30 33 3a 30 34 20 47  4d 54 0d 0a 53 65 72 76   :03:04 G MT··Serv
0090  65 72 3a 20 41 70 61 63  68 65 0d 0a 4c 61 73 74   er: Apac he··Last
00a0  2d 4d 6f 64 69 66 69 65  64 3a 20 46 72 69 2c 20   -Modifie d: Fri,
00b0  31 38 20 4a 61 6e 20 32  30 30 38 20 31 35 3a 32   18 Jan 2 008 15:2
00c0  36 3a 31 31 20 47 4d 54  0d 0a 45 54 61 67 3a 20   6:11 GMT ··ETag:
00d0  22 35 37 65 2d 34 34 34  30 30 63 33 31 64 32 61   "57e-444 00c31d2a
00e0  63 30 22 0d 0a 41 63 63  65 70 74 2d 52 61 6e 67   c0"··Acc ept-Rang
00f0  65 73 3a 20 62 79 74 65  73 0d 0a 43 6f 6e 74 65   es: byte s··Conte
0100  6e 74 2d 4c 65 6e 67 74  68 3a 20 31 34 30 36 0d   nt-Lengt h: 1406·
0110  0a 43 6f 6e 6e 65 63 74  69 6f 6e 3a 20 63 6c 6f   ·Connect ion: clo
0120  73 65 0d 0a 43 6f 6e 74  65 6e 74 2d 54 79 70 65   se··Cont ent-Type
0130  3a 20 69 6d 61 67 65 2f  76 6e 64 2e 6d 69 63 72   : image/ vnd.micr
0140  6f 73 6f 66 74 2e 69 63  6f 6e 0d 0a 0d 0a 00 00   osoft.ic on······
```

```
 ○ 📝  wlp0s20f3: <live capture in progress>
```

* HTTP Response Code: 200
* HTTP Response Description: OK
* Name and Version of Server: Apache

   ● No packets downloaded are 2.
Yes, they were over the different TCP connections.

   ● The HTTP connection is NON-PERSISTENT as it is making new connections for
     each packet.

Q6)
command
netstat -p   or
netstat -tcp   or
netstat -p -tcp -a

```
harjeet@harjeet:~$ netstat -p --tcp -a
(Not all processes could be identified, non-owned process info
 will not be shown, you would have to be root to see it all.)
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      -
tcp        0      0 0.0.0.0:ssh             0.0.0.0:*               LISTEN      -
tcp        0      0 localhost:ipp           0.0.0.0:*               LISTEN      -
tcp        0      0 harjeet:56000           server-18-66-63-7:https ESTABLISHED 9564/firefox
tcp        0      0 harjeet:55998           server-18-66-63-7:https ESTABLISHED 9564/firefox
tcp        0      0 harjeet:60210           server-18-66-63-6:https ESTABLISHED 9564/firefox
tcp        0      0 harjeet:60208           server-18-66-63-6:https ESTABLISHED 9564/firefox
tcp        0      0 harjeet:56008           server-18-66-63-7:https ESTABLISHED 9564/firefox
tcp        0      0 harjeet:42944           ec2-54-70-239-215:https ESTABLISHED 9564/firefox
tcp        0      0 harjeet:60218           server-18-66-63-6:https ESTABLISHED 9564/firefox
tcp        0      0 harjeet:34804           239.237.117.34.bc:https ESTABLISHED 9564/firefox
tcp        0      0 harjeet:48236           36.75.98.34.bc.go:https TIME_WAIT   -
tcp        0      0 harjeet:59536           ec2-54-197-94-219:https ESTABLISHED 2240/brave --type=u
tcp        0      0 harjeet:56006           server-18-66-63-7:https ESTABLISHED 9564/firefox
tcp        0      0 harjeet:51440           server-18-66-85-2:https ESTABLISHED 2240/brave --type=u
tcp        0      0 harjeet:56002           server-18-66-63-7:https ESTABLISHED 9564/firefox
tcp        0      0 harjeet:60214           server-18-66-63-6:https ESTABLISHED 9564/firefox
tcp        0      0 harjeet:56004           server-18-66-63-7:https ESTABLISHED 9564/firefox
tcp        0      0 harjeet:60216           server-18-66-63-6:https ESTABLISHED 9564/firefox
tcp        0      0 harjeet:60212           server-18-66-63-6:https ESTABLISHED 9564/firefox
tcp6       0      0 ip6-localhost:ipp       [::]:*                  LISTEN      -
tcp6       0      0 [::]:ssh                [::]:*                  LISTEN      -
tcp6       0      0 harjeet:53394           webafs706.cern.ch:http  ESTABLISHED 2240/brave --type=u
tcp6       0      0 harjeet:38092           del11s04-in-x0a.1:https ESTABLISHED 2240/brave --type=u
tcp6       0      0 harjeet:35856           2600:9000:2244:cc:https TIME_WAIT   -
tcp6       0      0 harjeet:55498           del11s13-in-x05.1:https ESTABLISHED 2240/brave --type=u
tcp6       0      0 harjeet:37868           2600:9000:2244:5c:https ESTABLISHED 9564/firefox
tcp6       0      0 harjeet:37370           whatsapp-cdn6-shv:https ESTABLISHED 2240/brave --type=u
tcp6       0      0 harjeet:54362           del12s10-in-x0e.1:https TIME_WAIT   -
harjeet@harjeet:~$ 
```

The TCP connection is ESTABLISHED

HARJEET SINGH YADAV - CSAI - 2020561, COMPUTER NETWORKS