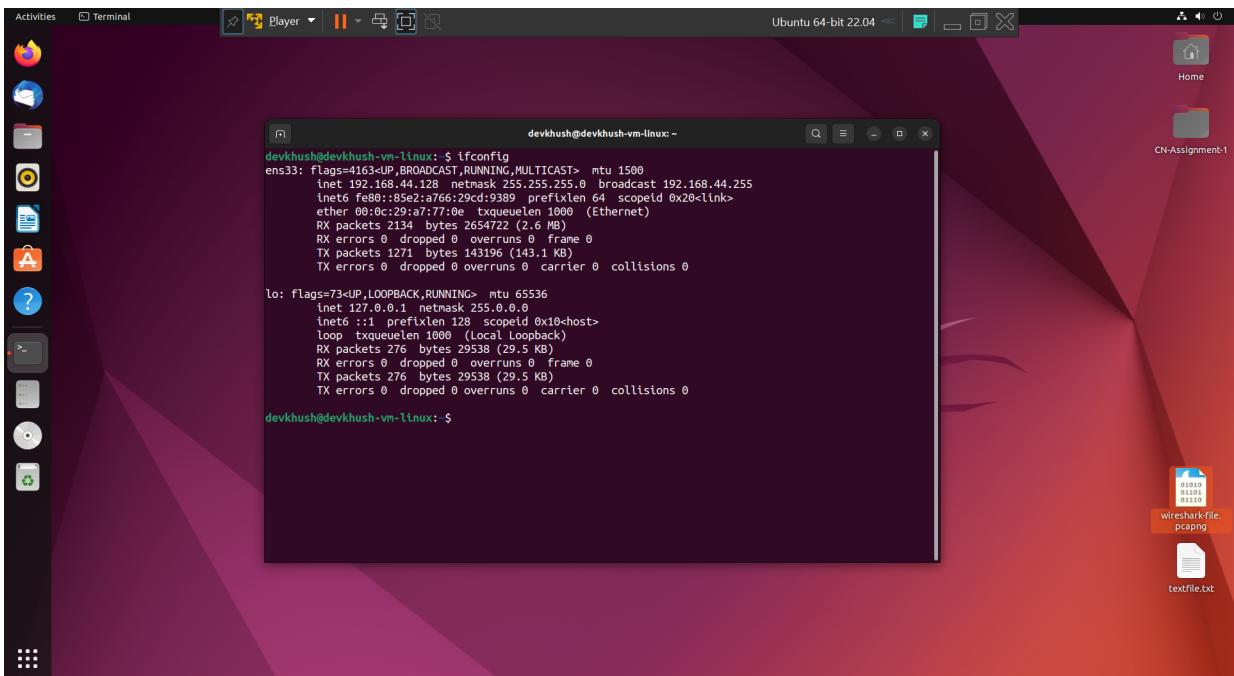


# Computer Networks

## Assignment 1

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### Answer 1)



```
devkhush@devkhush-vn-Linux: ~$ ifconfig
ens33: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
        inet 192.168.44.128 netmask 255.255.255.0 broadcast 192.168.44.255
          inet6 fe80::85e2:a7ff:fe66:29cd%ens33 brd ff:ff:ff:ff:ff:ff scopeid 0x20<link>
            ether 00:0c:29:a7:77:0e txqueuelen 1000 (Ethernet)
              RX packets 2134 bytes 2654722 (2.6 MB)
              RX errors 0 dropped 0 overruns 0 frame 0
              TX packets 1271 bytes 143194 (143.1 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 276 bytes 29538 (29.5 KB)
              RX errors 0 dropped 0 overruns 0 frame 0
              TX packets 276 bytes 29538 (29.5 KB)
              TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

devkhush@devkhush-vn-linux: $
```

What Is My IP?  
My Public IPv4 is: 203.192.212.74   
My Public IPv6 is: Not Detected  
My IP Location is: Delhi, DL IN  
My ISP is: Indusind Media and Communications Ltd.

[My IP Information](#) [Hide My IP Address](#)

- a) The IP address of my network interface is: **192.168.44.128**
- b) The IP address of my machine shown by 'whatismyip.com' is: **203.192.212.74**

Both the IPs shown are **different**.

**Reason:** This is because these websites show the IP address of our computer, whenever we connect to a network via an Internet connection. This IP address is provided by the ISP, which is public, random, and unique.

However, the 'ifconfig' command gives us information about the internal IP address of our computer (such as network adapters, DNS cache, etc.). This IP address is privately configured on the computer and is completely different from the IP address provided by the ISP (while connecting to the Internet).

## Answer 2)

- a) To get the authoritative response from a server via ‘nslookup’. I used google.com as the web server.
- Step1: We first get the authoritative name server of the host “[www.google.com](http://www.google.com)”, via the ‘type=ns’ or ‘type=soa’ command of ‘nslookup’.
- Step2: Use the above authoritative name server to get the authoritative response from the google server. Use the nslookup command with both the host name and authoritative name server.

```
devkush@devkush-vm-linux: ~$ nslookup www.google.com
Server: 127.0.0.53
Address: 127.0.0.53#53
Non-authoritative answer:
Name: www.google.com
Address: 172.217.167.196
Name: www.google.com
Address: 2404:6800:4000::80ff:2004
devkush@devkush-vm-linux: ~$ nslookup -query=ns www.google.com
Server: 127.0.0.53
Address: 127.0.0.53#53
Non-authoritative answer:
*** Can't find www.google.com: No answer
Authoritative answers can be found from:
google.com
origin = ns1.google.com
mail addr = dns-admin.google.com
serial = 47514442
refresh = 900
retry = 900
expire = 1800
minimum = 60
devkush@devkush-vm-linux: ~$ nslookup www.google.com ns1.google.com
Server: ns1.google.com
Address: 216.239.32.10#53
Name: www.google.com
Address: 142.250.194.68
Name: www.google.com
Address: 2404:6800:4000::80ff:2004
devkush@devkush-vm-linux: ~$ nslookup -query=soa www.google.com
Server: 127.0.0.53
Address: 127.0.0.53#53
Non-authoritative answer:
*** Can't find www.google.com: No answer
Authoritative answers can be found from:
google.com
origin = ns1.google.com
mail addr = dns-admin.google.com
serial = 47514442
refresh = 900
retry = 900
expire = 1800
minimum = 60
ns1.google.com internet address = 216.239.32.10
ns1.google.com has AAAA address 2001:4860:4802:32::1
devkush@devkush-vm-linux: ~$ nslookup -query=soa ns1.google.com
```

- b) Time to Live (TTL): This indicates the value of time for which data or records should be kept before discarding.

The TTL value shown below is 5 seconds.

After 5 seconds time, this entry would expire.

```
devkush@devkush-vm-linux: ~$ nslookup -debug www.google.com
Server: 127.0.0.53
Address: 127.0.0.53#53
-----
QUESTION:
    www.google.com, type = A, class = IN
ANSWERS:
-> www.google.com
    internet address = 172.217.167.196
    ttl = 5
AUTHORITY RECORDS:
ADDITIONAL RECORDS:
-----
Non-authoritative answer:
Name: www.google.com
Address: 172.217.167.196
-----
QUESTIONS:
    www.google.com, type = AAAA, class = IN
ANSWERS:
-> www.google.com
    internet address 2404:6800:4000::81e::2004
    ttl = 5
AUTHORITY RECORDS:
ADDITIONAL RECORDS:
-----
Name: www.google.com
Address: 2404:6800:4000::81e::2004
devkush@devkush-vm-linux: ~$
```

## Answer 3)

### a) Tracerouting “google.in”

Numbers of Intermediate hosts encountered: 8

Intermediate host number	Average Latency	IP Address
1	(57ms + 98ms + 39ms)/3 = 64.66ms	172.16.0.1
2	(141 ms + 40 ms + 43ms)/3 = 74.66ms	103.25.231.1
3	(177ms + 99ms + 100ms)/3 = 125.33ms	10.119.234.162
4	(92ms + 97ms + 99ms)/3 = 96ms	72.14.195.56
5	(177ms + 100ms + 98ms)/3 = 125ms	108.170.251.113
6	( 99ms + 66ms + 69ms)/3 = 78ms	216.239.57.113
7	(83ms + 98ms + 100ms)/3 = 93.66ms	216.58.221.36

```
Command Prompt

C:\Users\khush>tracert google.in

Tracing route to google.in [216.58.221.36]
over a maximum of 30 hops:

  1  57 ms   98 ms   39 ms  172.16.0.1
  2  141 ms   40 ms   43 ms  103.25.231.1
  3  *       *       * Request timed out.
  4  177 ms   99 ms  100 ms  10.119.234.162
  5  92 ms   97 ms   99 ms  72.14.195.56
  6  177 ms   100 ms   98 ms  108.170.251.113
  7  99 ms   66 ms   69 ms  216.239.57.113
  8  83 ms   98 ms  100 ms  del03s07-in-f4.1e100.net [216.58.221.36]

Trace complete.

C:\Users\khush>
C:\Users\khush>tracert google.in
```

### b) Pinging messages to “google.in”

```
Activities Terminal ➜ Player ▶ || ⌂ ✎ ☰
devkush@devkush-vm-ubuntu:~$ ping -c 100 google.in
PING google.in (216.58.221.36) 56(84) bytes of data.
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=1 ttl=128 time=14.0 ms
64 bytes From kuto1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=2 ttl=128 time=5.16 ms
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=3 ttl=128 time=11.9 ms
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=4 ttl=128 time=9.33 ms
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=5 ttl=128 time=10.0 ms
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=6 ttl=128 time=8.04 ms
64 bytes From kuto1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=7 ttl=128 time=7.74 ms
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=8 ttl=128 time=5.25 ms
64 bytes From kuto1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=9 ttl=128 time=5.25 ms
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=10 ttl=128 time=11.7 ms
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=11 ttl=128 time=10.0 ms
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=12 ttl=128 time=7.82 ms
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=13 ttl=128 time=5.05 ms
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=14 ttl=128 time=5.23 ms
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=15 ttl=128 time=13.6 ms
64 bytes From kuto1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=16 ttl=128 time=10.1 ms
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=17 ttl=128 time=10.1 ms
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=18 ttl=128 time=0.57 ms
64 bytes From kuto1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=19 ttl=128 time=10.1 ms
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=20 ttl=128 time=12.2 ms
64 bytes From kuto1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=21 ttl=128 time=5.09 ms
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=22 ttl=128 time=10.1 ms
64 bytes From kuto1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=23 ttl=128 time=5.69 ms
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=24 ttl=128 time=11.8 ms
64 bytes From kuto1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=25 ttl=128 time=10.9 ms
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=26 ttl=128 time=7.86 ms
64 bytes From kuto1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=27 ttl=128 time=5.2 ms
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=28 ttl=128 time=9.93 ms
64 bytes From kuto1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=29 ttl=128 time=5.23 ms
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=30 ttl=128 time=10.1 ms
64 bytes From kuto1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=31 ttl=128 time=10.1 ms
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=32 ttl=128 time=7.88 ms
64 bytes From kuto1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=33 ttl=128 time=5.23 ms
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=34 ttl=128 time=10.2 ms
64 bytes From kuto1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=35 ttl=128 time=12.3 ms
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=36 ttl=128 time=5.53 ms
64 bytes From kuto1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=37 ttl=128 time=5.54 ms
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=38 ttl=128 time=13.2 ms
64 bytes From kuto1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=39 ttl=128 time=13.2 ms
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=40 ttl=128 time=12.4 ms
64 bytes From kuto1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=41 ttl=128 time=10.9 ms
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=42 ttl=128 time=7.16 ms
64 bytes From kuto1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=43 ttl=128 time=6.05 ms
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=44 ttl=128 time=10.45 ms
64 bytes From kuto1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=45 ttl=128 time=7.01 ms
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=46 ttl=128 time=6.05 ms
64 bytes From kuto1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=47 ttl=128 time=10.2 ms
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=48 ttl=128 time=6.62 ms
64 bytes From kuto1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=49 ttl=128 time=6.05 ms
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=50 ttl=128 time=5.68 ms
64 bytes From kuto1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=51 ttl=128 time=5.35 ms
64 bytes From del03s07-in-f4.1e100.net (216.58.221.36): icmp_seq=52 ttl=128 time=6.05 ms
64 bytes From kuto1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=53 ttl=128 time=8.57 ms
64 bytes From kuto1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=54 ttl=128 time=6.05 ms
```

```

Activities Terminal Player || | X
Ubuntu 64-bit 22.04 < > | X
devkush@devkush-vm-linux:~
```

```

64 bytes from kulo1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=46 ttl=128 time=6.99 ms
64 bytes from del0s07-in-f4.1e100.net (216.58.221.36): icmp_seq=47 ttl=128 time=5.92 ms
64 bytes from kulo1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=48 ttl=128 time=6.62 ms
64 bytes from kulo1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=49 ttl=128 time=5.79 ms
64 bytes from kulo1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=50 ttl=128 time=5.93 ms
64 bytes from del0s07-in-f4.1e100.net (216.58.221.36): icmp_seq=51 ttl=128 time=5.35 ms
64 bytes from kulo1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=52 ttl=128 time=5.42 ms
64 bytes from kulo1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=53 ttl=128 time=8.57 ms
64 bytes from kulo1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=54 ttl=128 time=6.05 ms
64 bytes from kulo1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=55 ttl=128 time=5.79 ms
64 bytes from kulo1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=56 ttl=128 time=6.03 ms
64 bytes from kulo1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=57 ttl=128 time=7.58 ms
64 bytes from del0s07-in-f4.1e100.net (216.58.221.36): icmp_seq=58 ttl=128 time=4.55 ms
64 bytes from kulo1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=59 ttl=128 time=6.42 ms
64 bytes from del0s07-in-f4.1e100.net (216.58.221.36): icmp_seq=60 ttl=128 time=6.11 ms
64 bytes from kulo1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=61 ttl=128 time=7.89 ms
64 bytes from kulo1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=62 ttl=128 time=6.14 ms
64 bytes from kulo1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=63 ttl=128 time=7.16 ms
64 bytes from del0s07-in-f4.1e100.net (216.58.221.36): icmp_seq=64 ttl=128 time=7.64 ms
64 bytes from kulo1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=65 ttl=128 time=6.51 ms
64 bytes from kulo1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=66 ttl=128 time=6.53 ms
64 bytes from kulo1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=67 ttl=128 time=5.25 ms
64 bytes from kulo1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=68 ttl=128 time=4.95 ms
64 bytes from kulo1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=69 ttl=128 time=4.95 ms
64 bytes from del0s07-in-f4.1e100.net (216.58.221.36): icmp_seq=70 ttl=128 time=8.10 ms
64 bytes from kulo1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=71 ttl=128 time=6.09 ms
64 bytes from kulo1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=72 ttl=128 time=5.13 ms
64 bytes from kulo1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=73 ttl=128 time=6.29 ms
64 bytes from kulo1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=74 ttl=128 time=6.03 ms
64 bytes from kulo1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=75 ttl=128 time=6.20 ms
64 bytes from kulo1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=76 ttl=128 time=6.55 ms
64 bytes from kulo1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=77 ttl=128 time=7.09 ms
64 bytes from del0s07-in-f4.1e100.net (216.58.221.36): icmp_seq=78 ttl=128 time=5.76 ms
64 bytes from del0s07-in-f4.1e100.net (216.58.221.36): icmp_seq=79 ttl=128 time=5.00 ms
64 bytes from del0s07-in-f4.1e100.net (216.58.221.36): icmp_seq=80 ttl=128 time=5.00 ms
64 bytes from del0s07-in-f4.1e100.net (216.58.221.36): icmp_seq=81 ttl=128 time=5.98 ms
64 bytes from kulo1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=82 ttl=128 time=5.69 ms
64 bytes from kulo1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=83 ttl=128 time=11.1 ms
64 bytes from del0s07-in-f4.1e100.net (216.58.221.36): icmp_seq=84 ttl=128 time=6.48 ms
64 bytes from del0s07-in-f4.1e100.net (216.58.221.36): icmp_seq=85 ttl=128 time=5.74 ms
64 bytes from del0s07-in-f4.1e100.net (216.58.221.36): icmp_seq=86 ttl=128 time=5.35 ms
64 bytes from del0s07-in-f4.1e100.net (216.58.221.36): icmp_seq=87 ttl=128 time=4.28 ms
64 bytes from del0s07-in-f4.1e100.net (216.58.221.36): icmp_seq=88 ttl=128 time=10.2 ms
64 bytes from del0s07-in-f4.1e100.net (216.58.221.36): icmp_seq=89 ttl=128 time=6.73 ms
64 bytes from kulo1s10-in-f36.1e100.net (216.58.221.36): icmp_seq=90 ttl=128 time=4.98 ms
64 bytes from del0s07-in-f4.1e100.net (216.58.221.36): icmp_seq=91 ttl=128 time=5.42 ms
64 bytes from del0s07-in-f4.1e100.net (216.58.221.36): icmp_seq=92 ttl=128 time=5.15 ms
64 bytes from del0s07-in-f4.1e100.net (216.58.221.36): icmp_seq=93 ttl=128 time=6.34 ms
64 bytes from del0s07-in-f4.1e100.net (216.58.221.36): icmp_seq=94 ttl=128 time=7.06 ms
64 bytes from del0s07-in-f4.1e100.net (216.58.221.36): icmp_seq=95 ttl=128 time=4.36 ms
64 bytes from del0s07-in-f4.1e100.net (216.58.221.36): icmp_seq=96 ttl=128 time=11.1 ms
64 bytes from del0s07-in-f4.1e100.net (216.58.221.36): icmp_seq=97 ttl=128 time=6.99 ms
64 bytes from del0s07-in-f4.1e100.net (216.58.221.36): icmp_seq=98 ttl=128 time=6.34 ms
64 bytes from del0s07-in-f4.1e100.net (216.58.221.36): icmp_seq=99 ttl=128 time=7.06 ms
64 bytes from del0s07-in-f4.1e100.net (216.58.221.36): icmp_seq=100 ttl=128 time=4.36 ms
-- google.in ping statistics --
100 packets transmitted, 95 received, 5% packet loss, time 99346ms
rtt min/avg/max/ddev = 4.275/7.497/14.625/2.588 ms
devkush@devkush-vm-linux:~
```

Average latency = 7.497ms

### c) Pinging messages to “columbia.edu”

```

Activities Terminal Player || | X
Ubuntu 64-bit 22.04 < > | X
devkush@devkush-vm-linux:~
```

```

PING columbia.edu (128.59.105.24) 56(84) bytes of data.
64 bytes from old.columbia.university (128.59.105.24): icmp_seq=1 ttl=128 time=623 ms
64 bytes from chomp.columbia.edu (128.59.105.24): icmp_seq=2 ttl=128 time=247 ms
64 bytes from www-ltm.cc.columbia.edu (128.59.105.24): icmp_seq=3 ttl=128 time=247 ms
64 bytes from www.neurotheory.columbia.edu (128.59.105.24): icmp_seq=4 ttl=128 time=246 ms
64 bytes from teachtechaward.org (128.59.105.24): icmp_seq=5 ttl=128 time=245 ms
64 bytes from www-csc.columbia.edu (128.59.105.24): icmp_seq=6 ttl=128 time=246 ms
64 bytes from www.old.columbia.university (128.59.105.24): icmp_seq=7 ttl=128 time=245 ms
64 bytes from www.neurotheory.columbia.edu (128.59.105.24): icmp_seq=8 ttl=128 time=245 ms
64 bytes from old.columbia.university (128.59.105.24): icmp_seq=9 ttl=128 time=245 ms
64 bytes from old.columbia.university (128.59.105.24): icmp_seq=10 ttl=128 time=245 ms
64 bytes from old.columbia.university (128.59.105.24): icmp_seq=11 ttl=128 time=247 ms
64 bytes from columbauniversity.org (128.59.105.24): icmp_seq=12 ttl=128 time=250 ms
64 bytes from www.oldpolicy.org (128.59.105.24): icmp_seq=13 ttl=128 time=246 ms
64 bytes from www.oldpolicy.org (128.59.105.24): icmp_seq=14 ttl=128 time=246 ms
64 bytes from old.columbia.university (128.59.105.24): icmp_seq=15 ttl=128 time=247 ms
64 bytes from www.neurotheory.columbia.edu (128.59.105.24): icmp_seq=16 ttl=128 time=244 ms
64 bytes from p-i-r (128.59.105.24): icmp_seq=17 ttl=128 time=24 ms
64 bytes from www.neurotheory.columbia.edu (128.59.105.24): icmp_seq=18 ttl=128 time=246 ms
64 bytes from www.oldpolicy.org (128.59.105.24): icmp_seq=19 ttl=128 time=247 ms
64 bytes from old.columbia.university (128.59.105.24): icmp_seq=20 ttl=128 time=247 ms
64 bytes from www.oldpolicy.org (128.59.105.24): icmp_seq=21 ttl=128 time=247 ms
64 bytes from columba.edu (128.59.105.24): icmp_seq=22 ttl=128 time=245 ms
64 bytes from columba.edu (128.59.105.24): icmp_seq=23 ttl=128 time=245 ms
64 bytes from columba.edu (128.59.105.24): icmp_seq=24 ttl=128 time=246 ms
64 bytes from columbauniversity.info (128.59.105.24): icmp_seq=25 ttl=128 time=245 ms
64 bytes from columbauniversity.info (128.59.105.24): icmp_seq=26 ttl=128 time=245 ms
64 bytes from columba.edu (128.59.105.24): icmp_seq=27 ttl=128 time=248 ms
64 bytes from columbauniversity.info (128.59.105.24): icmp_seq=28 ttl=128 time=245 ms
64 bytes from vlt.org (128.59.105.24): icmp_seq=29 ttl=128 time=246 ms
64 bytes from www.neurotheory.columbia.edu (128.59.105.24): icmp_seq=30 ttl=128 time=247 ms
64 bytes from columbauniversity.info (128.59.105.24): icmp_seq=31 ttl=128 time=246 ms
64 bytes from columbauniversity.info (128.59.105.24): icmp_seq=32 ttl=128 time=246 ms
64 bytes from columbauniversity.info (128.59.105.24): icmp_seq=33 ttl=128 time=240 ms
64 bytes from www.neurotheory.columbia.edu (128.59.105.24): icmp_seq=34 ttl=128 time=246 ms
64 bytes from old.columbia.university (128.59.105.24): icmp_seq=35 ttl=128 time=244 ms
64 bytes from columba.edu (128.59.105.24): icmp_seq=36 ttl=128 time=246 ms
64 bytes from columba.edu (128.59.105.24): icmp_seq=37 ttl=128 time=245 ms
64 bytes from columbauniversity.info (128.59.105.24): icmp_seq=38 ttl=128 time=245 ms
64 bytes from columbauniversity.info (128.59.105.24): icmp_seq=39 ttl=128 time=245 ms
64 bytes from columbauniversity.info (128.59.105.24): icmp_seq=40 ttl=128 time=245 ms
64 bytes from columbauniversity.info (128.59.105.24): icmp_seq=41 ttl=128 time=245 ms
64 bytes from columbauniversity.info (128.59.105.24): icmp_seq=42 ttl=128 time=245 ms
64 bytes from columbauniversity.info (128.59.105.24): icmp_seq=43 ttl=128 time=245 ms
64 bytes from columbauniversity.info (128.59.105.24): icmp_seq=44 ttl=128 time=246 ms
64 bytes from vlt.org (128.59.105.24): icmp_seq=45 ttl=128 time=245 ms
64 bytes from childpolicy.org (128.59.105.24): icmp_seq=46 ttl=128 time=245 ms
64 bytes from columbauniversity.info (128.59.105.24): icmp_seq=47 ttl=128 time=245 ms
64 bytes from columbauniversity.info (128.59.105.24): icmp_seq=48 ttl=128 time=246 ms
64 bytes from columbauniversity.info (128.59.105.24): icmp_seq=49 ttl=128 time=245 ms
64 bytes from columbauniversity.info (128.59.105.24): icmp_seq=50 ttl=128 time=245 ms
64 bytes from columbauniversity.net (128.59.105.24): icmp_seq=51 ttl=128 time=245 ms
64 bytes from vlt.org (128.59.105.24): icmp_seq=52 ttl=128 time=247 ms
64 bytes from columbauniversity.us (128.59.105.24): icmp_seq=53 ttl=128 time=245 ms
64 bytes from columbauniversity.us (128.59.105.24): icmp_seq=54 ttl=128 time=244 ms
64 bytes from www.neurotheory.columbia.edu (128.59.105.24): icmp_seq=55 ttl=128 time=245 ms
```

```

Activities Terminal Player || | X
Ubuntu 64-bit 22.04 < > | X
devkush@devkush-vm-linux: ~

64 bytes from columbiauniversity.net (128.59.105.24): icmp_seq=51 ttl=128 time=245 ms
64 bytes from vtl.org (128.59.105.24): icmp_seq=52 ttl=128 time=247 ms
64 bytes from columbiauniversity.us (128.59.105.24): icmp_seq=53 ttl=128 time=245 ms
64 bytes from www.vtl.cc.columbia.edu (128.59.105.24): icmp_seq=54 ttl=128 time=244 ms
64 bytes from www.vtl.cc.columbia.edu (128.59.105.24): icmp_seq=55 ttl=128 time=245 ms
64 bytes from old.columbia.university (128.59.105.24): icmp_seq=56 ttl=128 time=245 ms
64 bytes From columbauniversity.net (128.59.105.24): icmp_seq=57 ttl=128 time=246 ms
64 bytes From old.columbia.university (128.59.105.24): icmp_seq=58 ttl=128 time=243 ms
64 bytes From columbauniversity.us (128.59.105.24): icmp_seq=59 ttl=128 time=246 ms
64 bytes From columbauniversity.us (128.59.105.24): icmp_seq=60 ttl=128 time=245 ms
64 bytes From columbauniversity.us (128.59.105.24): icmp_seq=61 ttl=128 time=245 ms
64 bytes From columbauniversity.us (128.59.105.24): icmp_seq=62 ttl=128 time=247 ms
64 bytes From columbauniversity.org (128.59.105.24): icmp_seq=63 ttl=128 time=247 ms
64 bytes From teachtechaward.org (128.59.105.24): icmp_seq=64 ttl=128 time=245 ms
64 bytes From columbauniversity.net (128.59.105.24): icmp_seq=65 ttl=128 time=246 ms
64 bytes From columbauniversity.net (128.59.105.24): icmp_seq=66 ttl=128 time=245 ms
64 bytes From www.neurotheory.columbia.edu (128.59.105.24): icmp_seq=67 ttl=128 time=245 ms
64 bytes From www.neurotheory.columbia.edu (128.59.105.24): icmp_seq=68 ttl=128 time=245 ms
64 bytes From columbauniversity.net (128.59.105.24): icmp_seq=69 ttl=128 time=245 ms
64 bytes From www.neurotheory.columbia.edu (128.59.105.24): icmp_seq=70 ttl=128 time=245 ms
64 bytes From columbauniversity.net (128.59.105.24): icmp_seq=71 ttl=128 time=245 ms
64 bytes From old.columbia.university (128.59.105.24): icmp_seq=72 ttl=128 time=247 ms
64 bytes From columbauniversity.net (128.59.105.24): icmp_seq=73 ttl=128 time=261 ms
64 bytes From www.vtl.cc.columbia.edu (128.59.105.24): icmp_seq=74 ttl=128 time=248 ms
64 bytes From vtl.org (128.59.105.24): icmp_seq=75 ttl=128 time=245 ms
64 bytes From columbauniversity.net (128.59.105.24): icmp_seq=76 ttl=128 time=248 ms
64 bytes From childpolicy.org (128.59.105.24): icmp_seq=77 ttl=128 time=244 ms
64 bytes From columbauniversity.info (128.59.105.24): icmp_seq=78 ttl=128 time=245 ms
64 bytes From neurotheory.columbia.edu (128.59.105.24): icmp_seq=79 ttl=128 time=245 ms
64 bytes From columbauniversity.org (128.59.105.24): icmp_seq=80 ttl=128 time=245 ms
64 bytes From p-l-berg.e.org (128.59.105.24): icmp_seq=81 ttl=128 time=245 ms
64 bytes From gutemberg-e.org (128.59.105.24): icmp_seq=82 ttl=128 time=245 ms
64 bytes From vtl.org (128.59.105.24): icmp_seq=83 ttl=128 time=245 ms
64 bytes From gutemberg-e.org (128.59.105.24): icmp_seq=84 ttl=128 time=244 ms
64 bytes From columbauniversity.net (128.59.105.24): icmp_seq=85 ttl=128 time=245 ms
64 bytes From columbauniversity.org (128.59.105.24): icmp_seq=86 ttl=128 time=244 ms
64 bytes From vtl.org (128.59.105.24): icmp_seq=87 ttl=128 time=245 ms
64 bytes From columbauniversity.us (128.59.105.24): icmp_seq=88 ttl=128 time=245 ms
64 bytes From columbauniversity.info (128.59.105.24): icmp_seq=89 ttl=128 time=245 ms
64 bytes From columbauniversity.net (128.59.105.24): icmp_seq=90 ttl=128 time=245 ms
64 bytes From columbauniversity.net (128.59.105.24): icmp_seq=91 ttl=128 time=246 ms
64 bytes From columbauniversity.us (128.59.105.24): icmp_seq=92 ttl=128 time=247 ms
64 bytes From neurotheory.columbia.edu (128.59.105.24): icmp_seq=93 ttl=128 time=246 ms
64 bytes From columbauniversity.us (128.59.105.24): icmp_seq=94 ttl=128 time=246 ms
64 bytes From childpolicy.org (128.59.105.24): icmp_seq=95 ttl=128 time=245 ms
64 bytes From old.columbia.university (128.59.105.24): icmp_seq=96 ttl=128 time=244 ms
64 bytes From columbauniversity.net (128.59.105.24): icmp_seq=97 ttl=128 time=245 ms
64 bytes From columbauniversity.org (128.59.105.24): icmp_seq=98 ttl=128 time=245 ms
64 bytes From www.vtl.cc.columbia.edu (128.59.105.24): icmp_seq=99 ttl=128 time=246 ms
64 bytes From columbauniversity.us (128.59.105.24): icmp_seq=100 ttl=128 time=245 ms

... columbauniversity ping statistics ...
100 packets transmitted, 99 received, 1% packet loss, time 103639ms
rtt min/avg/max/dev = 243.339/254.275/718.402/60.191 ms
devkush@devkush-vm-linux: ~

```

Average Latency = 254.275ms

- d) On pinging columbia.edu 100 times,

Adding up the Ping latency of all the intermediate hosts = Average \* 100 = 25427.5 ms  
= 25.4275 seconds

On pinging google.in 100 times,

Adding up the Ping latency of all the intermediate hosts = Average \* 100 = 7.497 ms \* 100  
= 749.7ms

**Observation:** They are not matching. The sum of latencies for all the pings in columbia.edu is much greater, than the sum of latencies for all the pings in google.in.

**Reason:** The distance between my system and the server hosting columbia.edu is much greater than the distance between my system and the server hosting google.com.

So, the packets will take longer time to reach the server hosting columbia.edu (than google.in's server). So, in each ping, the ping latency of columbia.edu's server will be greater than the ping latency of google.in's server. So, the sum of latencies for all the pings in columbia.edu will also be greater than the sum of latencies for all the pings in google.in server.

- e) On pinging columbia.edu 100 times,

Maximum ping latency among all the intermediate hosts = 14.625 ms.

On pinging google.in 100 times,

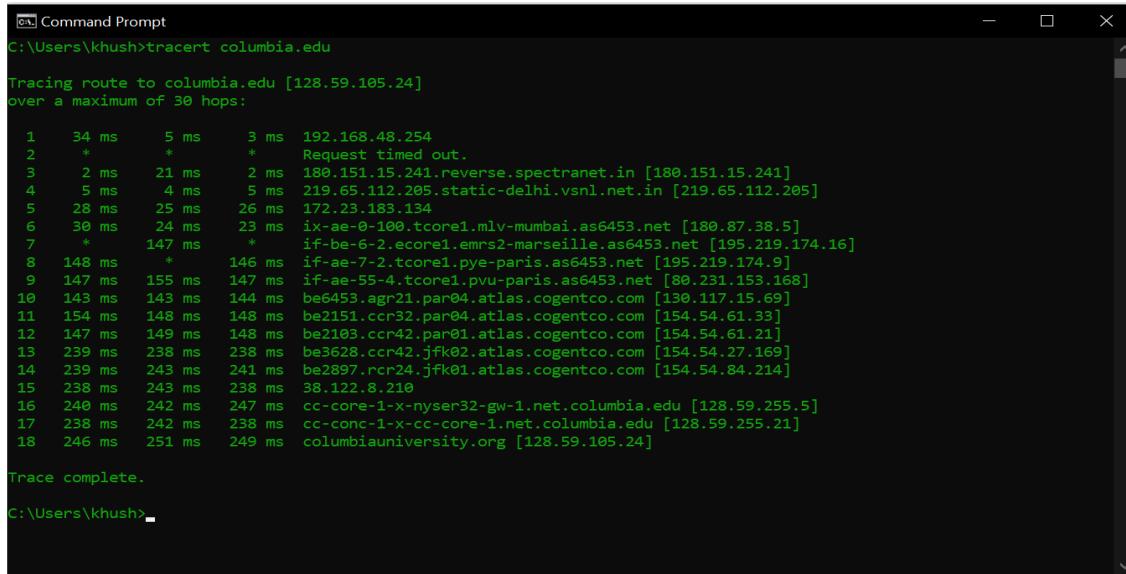
Maximum ping latency among the intermediate hosts = 718.402 ms

**Observation:** They are not matching. The maximum ping latency among all the pings in columbia.edu is much greater, than the maximum ping latency among all the pings in google.in.

**Reason:** The distance between my system and the server hosting columbia.edu is much greater than the distance between my system and the server hosting google.com. So, the packets will take longer time to reach the server hosting columbia.edu (than

google.in's server). So, in each ping, the ping latency of columbia.edu's server will be greater than the ping latency of google.in's server. So, the maximum ping latency among all the pings in columbia.edu will also be greater than the maximum ping latency among all the pings in google.in server.

f) Tracerouting “columbia.edu”



```
Windows Command Prompt
C:\Users\khush>tracert columbia.edu

Tracing route to columbia.edu [128.59.105.24]
over a maximum of 30 hops:

  1  34 ms      5 ms      3 ms  192.168.48.254
  2  *          *          * Request timed out.
  3  2 ms       21 ms     2 ms  180.151.15.241.reverse.spectranet.in [180.151.15.241]
  4  5 ms       4 ms      5 ms  219.65.112.205.static-delhi.vsnl.net.in [219.65.112.205]
  5  28 ms      25 ms     26 ms  172.23.183.134
  6  30 ms      24 ms     23 ms  ix-ae-0-100.tcore1.mlv-mumbai.as6453.net [188.87.38.5]
  7  *          147 ms     *      if-be-6-2.ecore1.emrs2-marseille.as6453.net [195.219.174.16]
  8  148 ms      *      146 ms  if-ae-7-2.tcore1.pye-paris.as6453.net [195.219.174.9]
  9  147 ms      155 ms    147 ms  if-ae-55-4.tcore1.pvu-paris.as6453.net [80.231.153.168]
 10  143 ms      143 ms    144 ms  be6453.agr21.par04.atlas.cogentco.com [130.117.15.69]
 11  154 ms      148 ms    148 ms  be2151.ccr32.par04.atlas.cogentco.com [154.54.61.33]
 12  147 ms      149 ms    148 ms  be2103.ccr42.par01.atlas.cogentco.com [154.54.61.21]
 13  239 ms      238 ms    238 ms  be3628.ccr42.jfk02.atlas.cogentco.com [154.54.27.169]
 14  239 ms      243 ms    241 ms  be2897.rcr24.jfk01.atlas.cogentco.com [154.54.84.214]
 15  238 ms      243 ms    238 ms  38.122.8.210
 16  240 ms      242 ms    247 ms  cc-core-1-x-nyser32-gw-1.net.columbia.edu [128.59.255.5]
 17  238 ms      242 ms    238 ms  cc-conc-1-x-cc-core-1.net.columbia.edu [128.59.255.21]
 18  246 ms      251 ms    249 ms  columbiauniversity.org [128.59.105.24]

Trace complete.

C:\Users\khush>
```

**Comparing the number of hops between google.in and columbia.edu:**

The no. of hops (or Intermediate hosts) observed in tracerouting the columbia.edu is greater, than the no. of hops observed in tracerouting the google.in.

This is because the distance between my system and the server hosting columbia.edu is greater than the distance between my system and the server hosting google.com.

So, the no. of hops (or Intermediate hosts) encountered in the path to columbia.edu's server will be greater, than the of no. of hops encountered in the path to google.in's server.

**Reason for Latency difference between google.in and columbia.edu:**

The distance between my system and the server hosting columbia.edu is much greater than the distance between my system and the server hosting google.com.

So, the packets will take longer time to reach the server hosting columbia.edu (than google.in's server). So, in each ping, the ping latency of columbia.edu's server will be greater than the ping latency of google.in's server. So, the server hosting columbia.edu will offer more latency to the packets transmitted to and fro from it, than the server hosting the google.in.

## **Answer 4)**

Steps to make ping command fail for 127.0.0.1 (with 100% packet loss):

- 1) Shut down the “loopback” network interface (lo interface) via “down command of nslookup”.
  - 2) Use the ping command to send packets to 127.0.0.1 (say 100 times).
  - 3) Since the ‘loopback’ interface (which is used by the system to communicate with itself) is being turned down. So, 100% packet loss will be reported.

```
[+] devkhush@devkhush-vm-linux:~$ sudo ifconfig lo down
[sudo] password for devkhush:
devkhush@devkhush-vm-linux:~$ ifconfig
ens33: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.44.128  netmask 255.255.255.0  broadcast 192.168.44.255
              inet6 fe80::85e2:a766:29cd:9389  prefixlen 64  scopeid 0x20<link>
                ether 00:0c:29:a7:77:0e  txqueuelen 1000  (Ethernet)
                  RX packets 33  bytes 13251 (13.2 KB)
                  RX errors 0  dropped 0  overruns 0  frame 0
                  TX packets 109  bytes 19067 (19.0 KB)
                  TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0

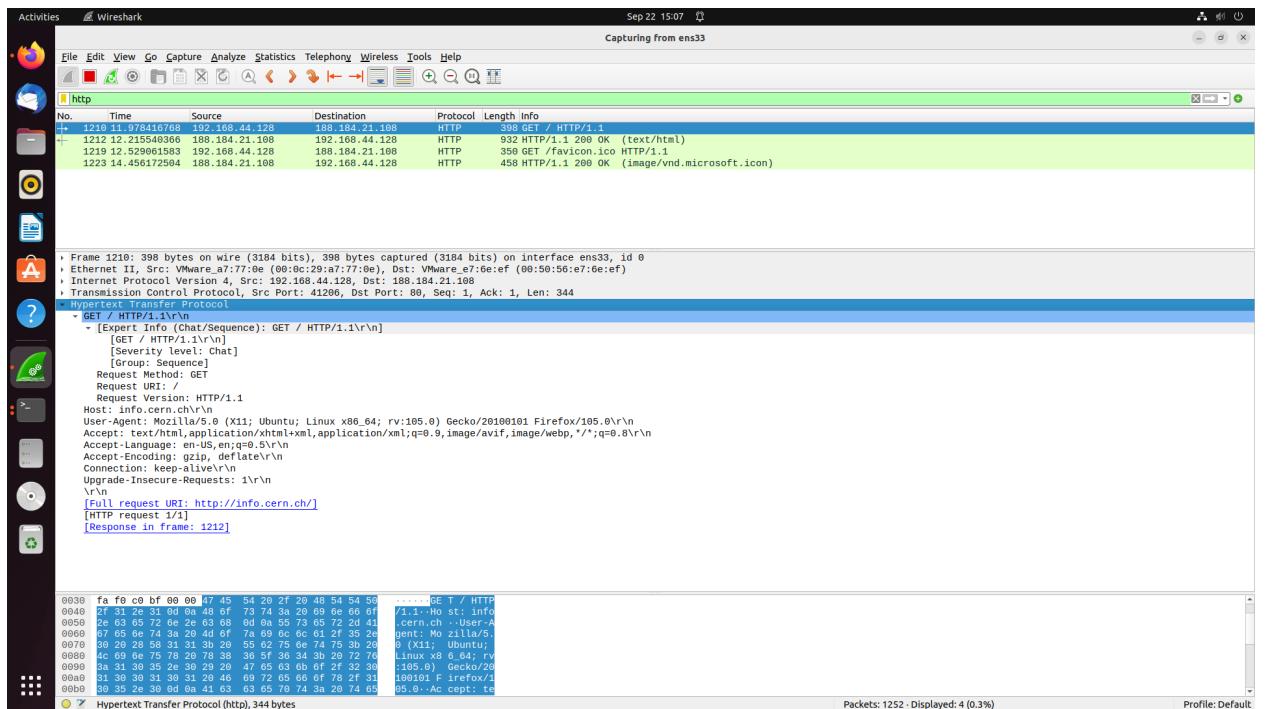
devkhush@devkhush-vm-linux:~$ ping -c 100 127.0.0.1
PING 127.0.0.1 (127.0.0.1) 56(84) bytes of data.

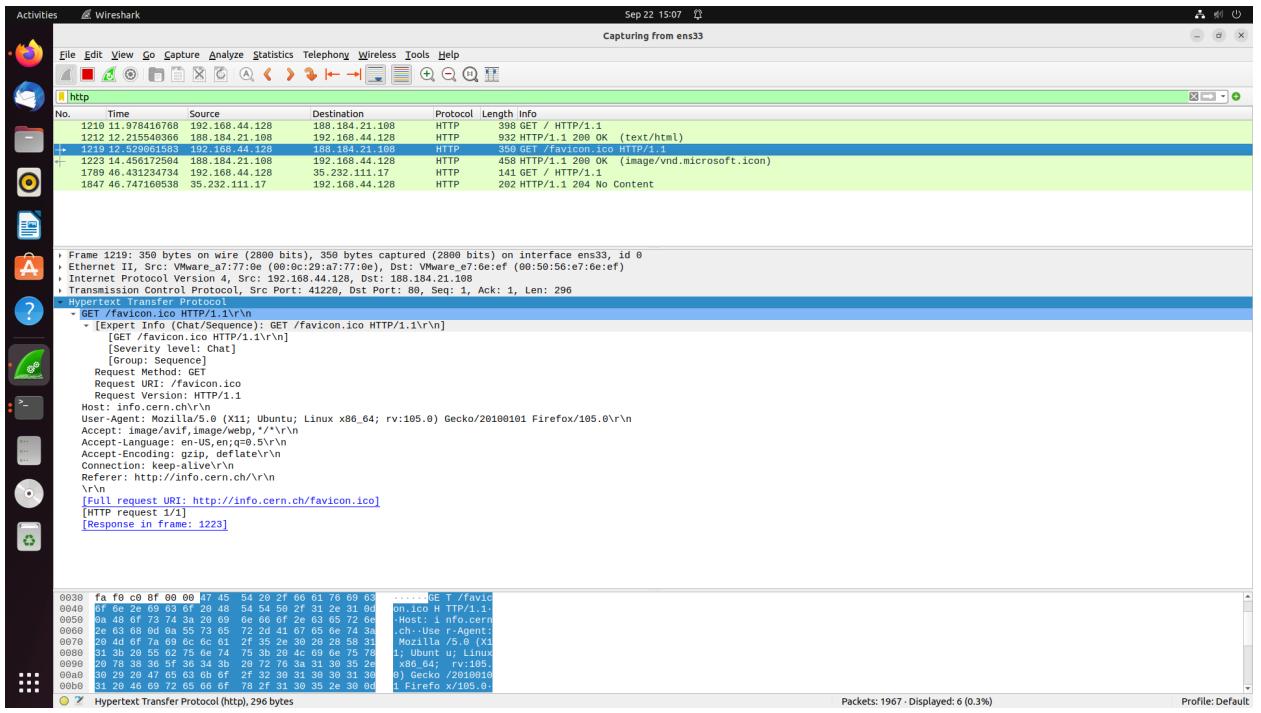
--- 127.0.0.1 ping statistics ---
100 packets transmitted, 0 received, 100% packet loss, time 101368ms

devkhush@devkhush-vm-linux:~$ █
```

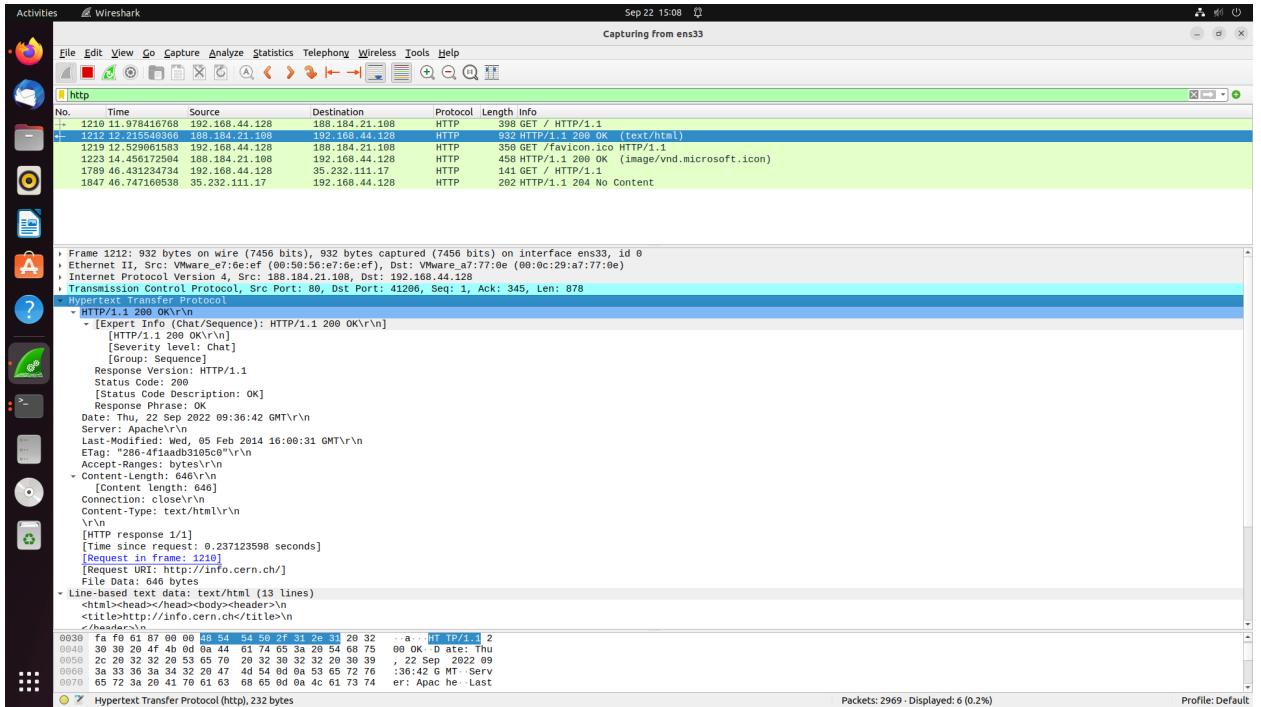
## **Answer 5)**

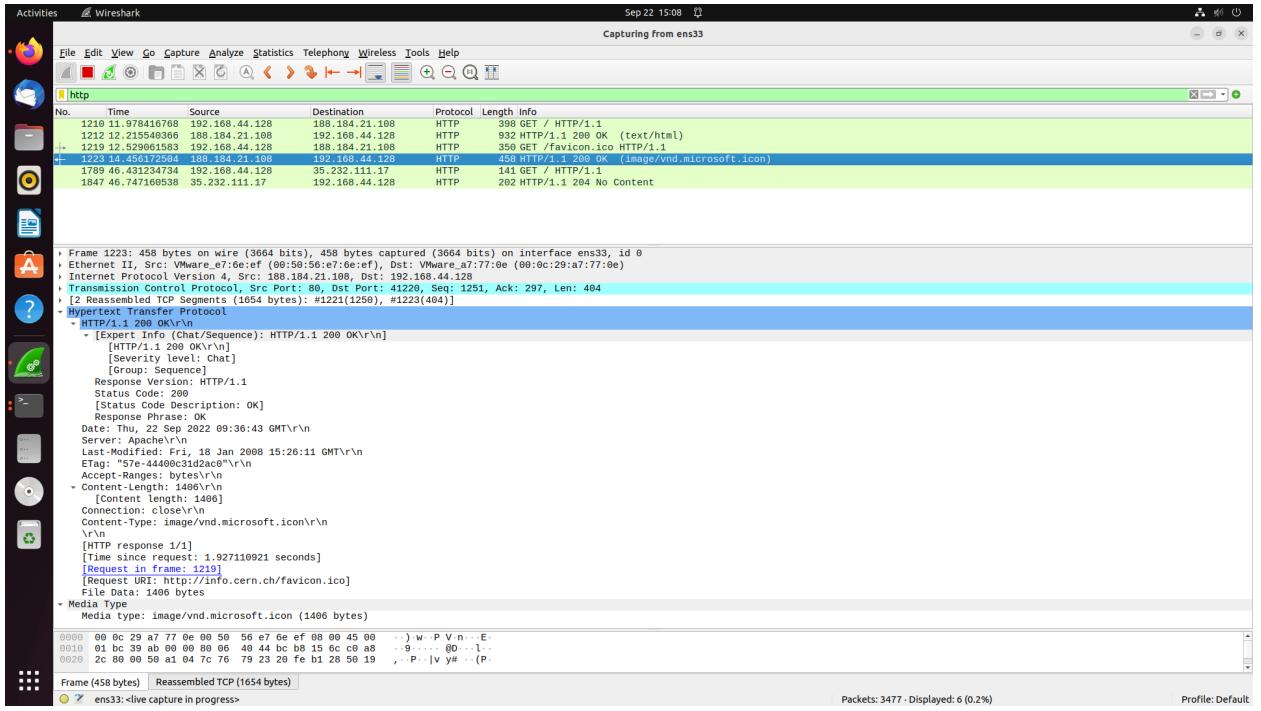
## Screenshot for HTTP request packets:





## Screenshot for HTTP response packets:





### Details for each captured packets:

- 1) For HTTP request packets:
  - a) HTTP request type: HTTP GET request
  - b) User-agent type: Mozilla Firefox version 105.0 (Ubuntu Linux x86\_64)
  - c) HTTP request packet's URL:
    - 1) In first GET Request, request packet's URL: '/'
    - 2) In second GET Request, request packet's URL: '/favicon.ico'
- 2) For HTTP response packets:
  - a) HTTP response code: 200
  - b) HTTP response description: OK (request is succeeded)
  - c) Name and version of the web server: HTTP 1.1 version
- 3) Two Web objects have been downloaded: a **HTML/Text** data and an **Image** data.  
 Both of these objects were transferred over different TCP connections because the Source port and Destination port are different in their respective TCP connections. Each TCP connection is uniquely determined by Source Port, Destination Port, Source IP, and Destination IP.  
 Two TCP connections were opened to transfer HTML and Image data, because of different file types.
- 4) HTTP 1.1 is persistent.

## Answer 6)

- a) Command used to display all active TCP connections: “netstat -p -at info.cern.ch”

The screenshot shows a Wireshark interface with the following details:

- Netstat Output:**

```
devkhush@devkhush-vm-linux:~$ sudo netstat -p -at
Active Internet connections (servers and established)
          Proto Recv-Q Send-Q Local Address           Foreign Address         State      PID/Program name
+---+-----+-----+-----+
  10  0.225  Proto  Recv-Q  Send-Q  Local Address           Foreign Address         State      PID/Program name
  25  11.917  tcp    0      0      localhost:ipp          0.0.0.0:*
                           LISTEN
  27  12.137  tcp    0      0      localhost:domain       0.0.0.0:*
                           LISTEN
  109 155.370  tcp    0      0      devkhush-vm-linux:59054 ec2-35-161-6-128.https ESTABLISHED 8198/firefox
  111 156.370  tcp    0      0      devkhush-vm-linux:48830 239.237.117.34.bc:https ESTABLISHED 8199/firefox
+---+-----+-----+-----+
```

```
devkhush@devkhush-vm-linux:~$ sudo netstat -p -at info.cern.ch
Active Internet connections (servers and established)
          Proto Recv-Q Send-Q Local Address           Foreign Address         State      PID/Program name
  10  0.225  Proto  Recv-Q  Send-Q  Local Address           Foreign Address         State      PID/Program name
  25  11.917  tcp    0      0      localhost:ipp          0.0.0.0:*
                           LISTEN
  27  12.137  tcp    0      0      localhost:domain       0.0.0.0:*
                           LISTEN
  109 155.370  tcp    0      0      devkhush-vm-linux:59054 ec2-35-161-6-128.https ESTABLISHED 8198/firefox
  111 156.370  tcp    0      0      devkhush-vm-linux:48830 239.237.117.34.bc:https ESTABLISHED 8199/firefox
+---+-----+-----+-----+
```
- Selected HTTP Request:**

```
GET / HTTP/1.1\r\n
[Expert Info (Chat/Sequence): GET / HTTP/1.1\r\n]
```

The selected packet is a GET request to info.cern.ch. The details pane shows the raw bytes and ASCII representation of the request.

- b) States of the TCP connection(s) to server ‘<http://info.cern.ch>’ are:

- 1) LISTEN (this implies waiting for the connection request from a TCP port)
- 2) ESTABLISHED (this implies an open TCP connection; data can be transmitted to the destination using an open TCP connection).