CSE-232: COMPUTER NETWORKS
ASSIGNMENT 1

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Q1):

```
ritika@ritika-virtual-machine:~$ ifconfig
ens33: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.147.128  netmask 255.255.255.0  broadcast 192.168.147.255
        inet6 fe80::17a2:9235:2add:6819  prefixlen 64  scopeid 0x20<link>
        ether 00:0c:29:36:d2:ae  txqueuelen 1000  (Ethernet)
        RX packets 402873  bytes 598175358 (598.1 MB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 24097  bytes 3067128 (3.0 MB)
        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 1135  bytes 324560 (324.5 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 1135  bytes 324560 (324.5 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

The IP address shown on WhatIsMyIP is a public IP address, which can also be called an external IP address. Moreover, an internal IP address starts with 192.186.1.*, 172.16.*.*, or 10.0.0.*. These IPv4 internal blocks are reserved via (IANA) and not assigned as public or external IPs.

Q2):

```
C:\Users\ritik>nslookup -type=soa www.google.com
Server:  ns3.iiitd.edu.in
Address:  192.168.1.8

google.com
        primary name server = ns1.google.com
        responsible mail addr = dns-admin.google.com
        serial  = 475109091
        refresh = 900 (15 mins)
        retry   = 900 (15 mins)
        expire  = 1800 (30 mins)
        default TTL = 60 (1 min)
ns1.google.com  internet address = 216.239.32.10
ns1.google.com  AAAA IPv6 address = 2001:4860:4802:32::a
```

a) Typically, most of the responses to our nsloopup queries are non-authoritative, which means they are from a cached copy from a third party and not from the primary DNS server holding the master copy. To get an authoritative answer, we need to specify the authoritative name server as part of the request. To do this include the -type=soa switch and nslookup will respond back with the name of the authoritative name server.

```
ritika@ritika-virtual-machine:~$ dig A www.google.com

; <<>> DiG 9.16.1-Ubuntu <<>> A www.google.com
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 32139
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

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

;; ANSWER SECTION:
www.google.com.         5       IN      A       142.250.207.228

;; Query time: 4 msec
;; SERVER: 127.0.0.53#53(127.0.0.53)
;; WHEN: Mon Sep 19 10:30:17 IST 2022
;; MSG SIZE  rcvd: 59
```

b) This entry would expire in 5s since TTL is a value that implies how long the data should be kept before discarding by DNS.

Q3):
a)

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

Tracing route to google.in [142.250.193.68]
over a maximum of 30 hops:

  1     2 ms     2 ms     1 ms  MYGROUP [192.168.1.1]
  2     3 ms     3 ms     3 ms  103.212.157.12
  3     6 ms     *       10 ms  103.212.157.1
  4     *        *        *     Request timed out.
  5     5 ms     5 ms     4 ms  142.250.160.212
  6     7 ms     7 ms     8 ms  142.251.78.139
  7     5 ms     6 ms     6 ms  142.251.54.85
  8     6 ms     7 ms     9 ms  del11s16-in-f4.1e100.net [142.250.193.68]

Trace complete.
```

There are 8 intermediate hosts in total.
Their average latencies are

Table 1

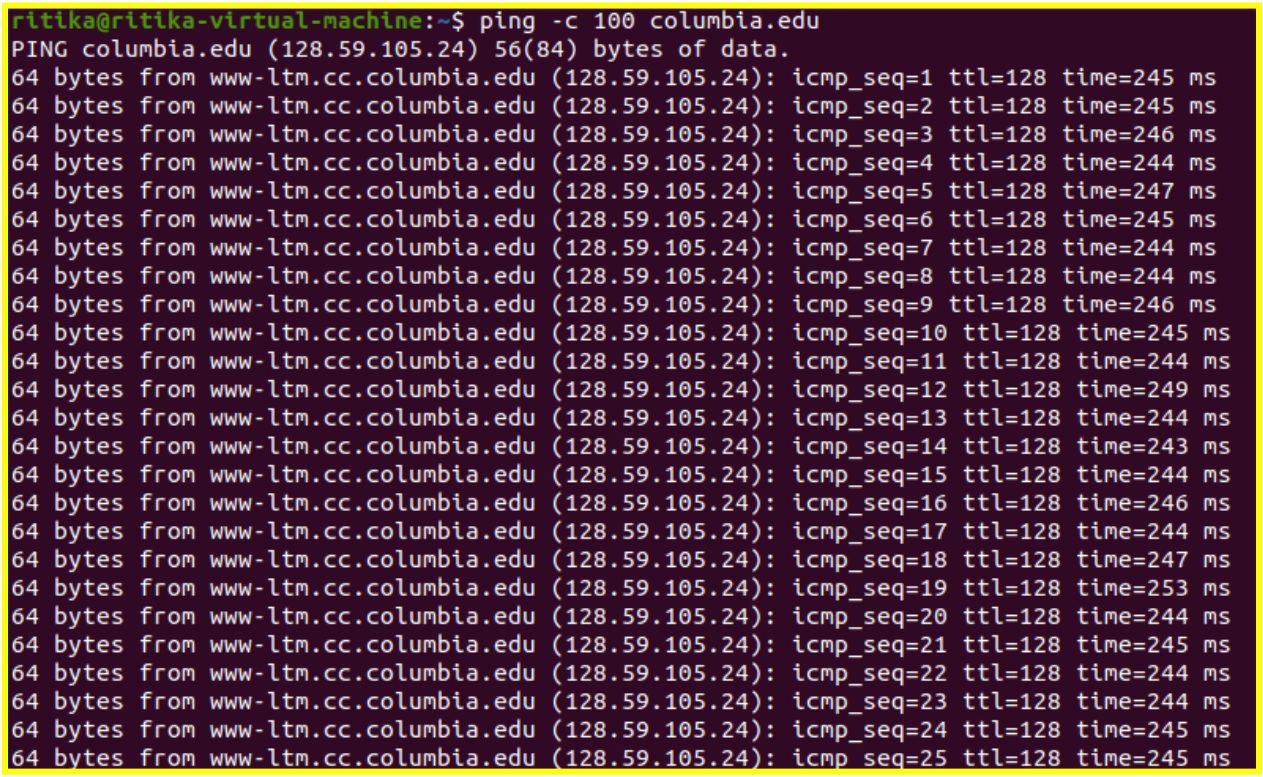
IP Address	Average Latency	Ping Latency
103.212.157.12	3ms	4ms
142.250.160.212	4.66ms	6ms
142.251.78.139	7.33ms	7ms
142.251.54.85	5.66ms	6ms
142.250.193.68	7.33ms	7ms

b)

```
ritika@ritika-virtual-machine:~$ ping -c 100 google.in
PING google.in (142.250.194.228) 56(84) bytes of data.
64 bytes from del12s08-in-f4.1e100.net (142.250.194.228): icmp_seq=1 ttl=128 time=9.67 ms
64 bytes from del12s08-in-f4.1e100.net (142.250.194.228): icmp_seq=2 ttl=128 time=7.32 ms
64 bytes from del12s08-in-f4.1e100.net (142.250.194.228): icmp_seq=3 ttl=128 time=8.08 ms
64 bytes from del12s08-in-f4.1e100.net (142.250.194.228): icmp_seq=4 ttl=128 time=7.71 ms
64 bytes from del12s08-in-f4.1e100.net (142.250.194.228): icmp_seq=5 ttl=128 time=6.64 ms
64 bytes from del12s08-in-f4.1e100.net (142.250.194.228): icmp_seq=6 ttl=128 time=7.03 ms
64 bytes from del12s08-in-f4.1e100.net (142.250.194.228): icmp_seq=7 ttl=128 time=8.07 ms
64 bytes from del12s08-in-f4.1e100.net (142.250.194.228): icmp_seq=8 ttl=128 time=6.35 ms
64 bytes from del12s08-in-f4.1e100.net (142.250.194.228): icmp_seq=9 ttl=128 time=7.03 ms
64 bytes from del12s08-in-f4.1e100.net (142.250.194.228): icmp_seq=10 ttl=128 time=12.1 ms
64 bytes from del12s08-in-f4.1e100.net (142.250.194.228): icmp_seq=11 ttl=128 time=9.12 ms
64 bytes from del12s08-in-f4.1e100.net (142.250.194.228): icmp_seq=12 ttl=128 time=7.33 ms
64 bytes from del12s08-in-f4.1e100.net (142.250.194.228): icmp_seq=13 ttl=128 time=7.30 ms
64 bytes from del12s08-in-f4.1e100.net (142.250.194.228): icmp_seq=14 ttl=128 time=6.70 ms
64 bytes from del12s08-in-f4.1e100.net (142.250.194.228): icmp_seq=15 ttl=128 time=6.97 ms
64 bytes from del12s08-in-f4.1e100.net (142.250.194.228): icmp_seq=16 ttl=128 time=6.44 ms
64 bytes from del12s08-in-f4.1e100.net (142.250.194.228): icmp_seq=17 ttl=128 time=8.00 ms
64 bytes from del12s08-in-f4.1e100.net (142.250.194.228): icmp_seq=18 ttl=128 time=8.27 ms
64 bytes from del12s08-in-f4.1e100.net (142.250.194.228): icmp_seq=19 ttl=128 time=7.55 ms
64 bytes from del12s08-in-f4.1e100.net (142.250.194.228): icmp_seq=20 ttl=128 time=6.01 ms
64 bytes from del12s08-in-f4.1e100.net (142.250.194.228): icmp_seq=21 ttl=128 time=7.01 ms
64 bytes from del12s08-in-f4.1e100.net (142.250.194.228): icmp_seq=22 ttl=128 time=5.67 ms
64 bytes from del12s08-in-f4.1e100.net (142.250.194.228): icmp_seq=23 ttl=128 time=8.18 ms
64 bytes from del12s08-in-f4.1e100.net (142.250.194.228): icmp_seq=24 ttl=128 time=10.8 ms
64 bytes from del12s08-in-f4.1e100.net (142.250.194.228): icmp_seq=25 ttl=128 time=6.95 ms
64 bytes from del12s08-in-f4.1e100.net (142.250.194.228): icmp_seq=26 ttl=128 time=6.68 ms
64 bytes from del12s08-in-f4.1e100.net (142.250.194.228): icmp_seq=27 ttl=128 time=6.91 ms
64 bytes from del12s08-in-f4.1e100.net (142.250.194.228): icmp_seq=28 ttl=128 time=6.29 ms
64 bytes from del12s08-in-f4.1e100.net (142.250.194.228): icmp_seq=29 ttl=128 time=7.20 ms
64 bytes from del12s08-in-f4.1e100.net (142.250.194.228): icmp_seq=30 ttl=128 time=8.26 ms
```

Average Latency: 7.369 ms

c)



Average Latency: 254.180 ms

d) From table 1 on page4: Adding up the ping latencies of all intermediate hosts is 30ms which is not equal to the average latency which is 7.39 ms. This can be concluded by the fact that ping gives a direct path from source to destination. ping is essentially point-to-point traffic. Whereas, tracert is the time taken for a packet to get to each point in its route from point to point.

e) Maximum ping latency amongst the intermediate hosts is 7 ms which is somehow equal to the average latency. Here also we have the same reasons from the above point. These both are not exactly equal because we can take into account network congestion and noises in the case of tracert command.

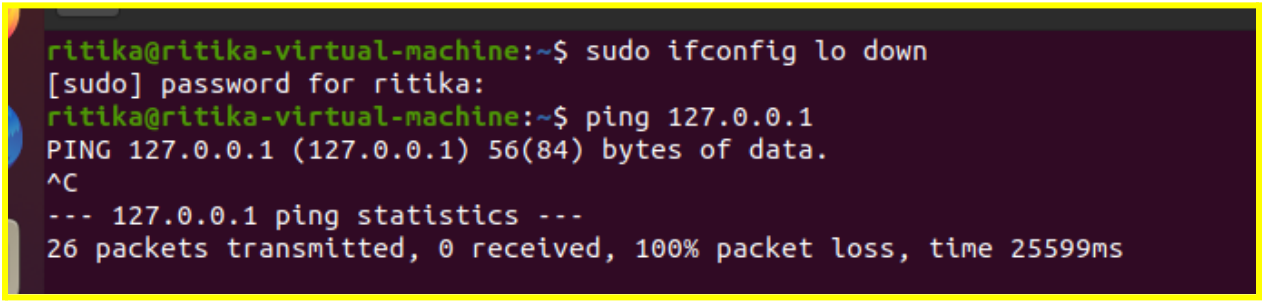
f)

```
C:\Users\ritik>tracert columbia.edu

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

  1     2 ms     2 ms     1 ms  MYGROUP [192.168.1.1]
  2    11 ms     3 ms     4 ms  103.212.157.12
  3     *        *        *     Request timed out.
  4     5 ms     6 ms     7 ms  115.113.240.105.static-delhi.vsnl.net.in [115.113.240.105]
  5    28 ms    27 ms    29 ms  172.23.183.134
  6    30 ms    27 ms    27 ms  ix-ae-0-100.tcore1.mlv-mumbai.as6453.net [180.87.38.5]
  7     *      150 ms     *     if-be-6-2.ecore1.emrs2-marseille.as6453.net [195.219.174.16]
  8     *        *        *     Request timed out.
  9   150 ms   147 ms   160 ms  if-ae-55-4.tcore1.pvu-paris.as6453.net [80.231.153.168]
 10   149 ms   149 ms   149 ms  be6453.agr21.par04.atlas.cogentco.com [130.117.15.69]
 11   151 ms   150 ms   147 ms  be2151.ccr32.par04.atlas.cogentco.com [154.54.61.33]
 12   144 ms   145 ms   145 ms  be2103.ccr42.par01.atlas.cogentco.com [154.54.61.21]
 13   249 ms   256 ms   244 ms  be3628.ccr42.jfk02.atlas.cogentco.com [154.54.27.169]
 14   247 ms   244 ms   243 ms  be2897.rcr24.jfk01.atlas.cogentco.com [154.54.84.214]
 15   244 ms   282 ms   241 ms  38.122.8.210
 16   242 ms   243 ms   243 ms  cc-core-1-x-nyser32-gw-1.net.columbia.edu [128.59.255.5]
 17   244 ms   244 ms   243 ms  cc-conc-1-x-cc-core-1.net.columbia.edu [128.59.255.21]
 18   249 ms   246 ms   242 ms  neurotheory.columbia.edu [128.59.105.24]
```

Number of hops in google.in: 8
Number of hops in columbia.edu: 18

Every domain name on the internet contains a top-level domain label, known as a TLD. (.in) is TLD which belongs to India and (.edu) is TLD which is associated with an American institution.
We know our latency depends upon the distance; in the case of columbia.edu there are more hops that data need to make to reach its destination. Every hop introduces extra latency. The greater the distance, the greater latency.

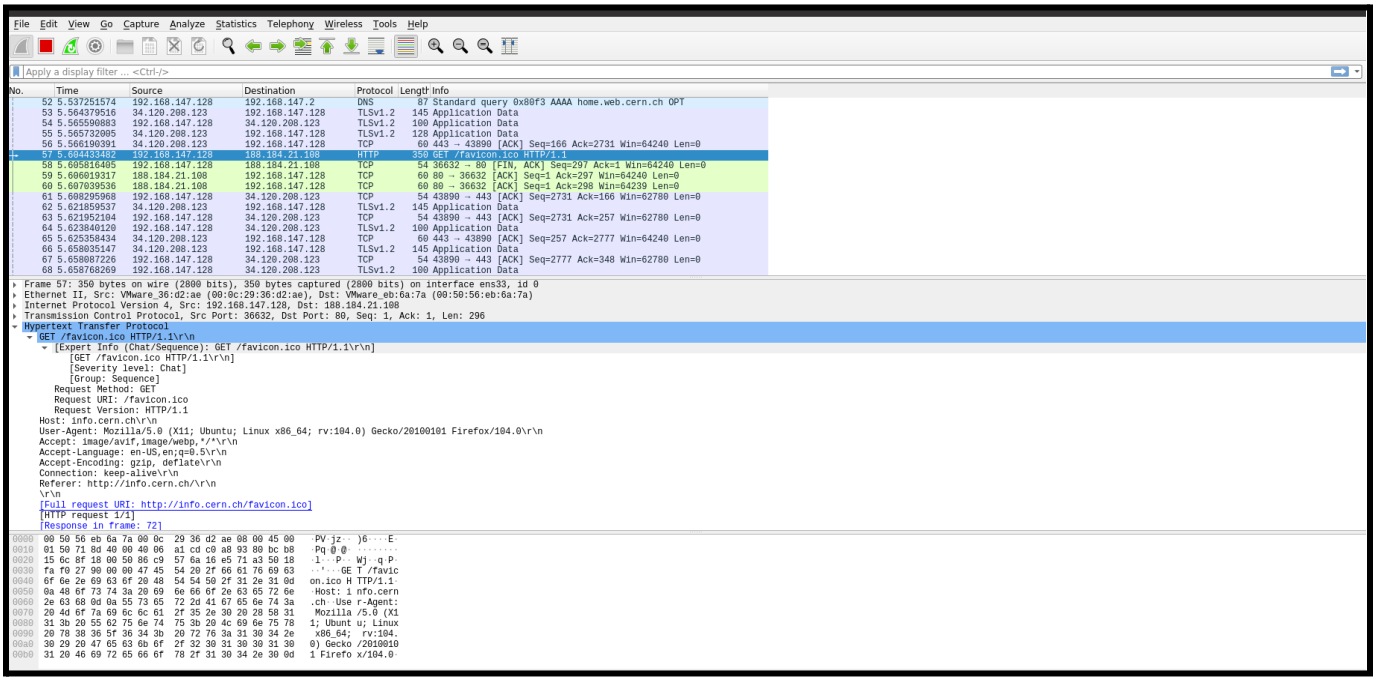
Q4)



We can make the ping command fail, by making out interface down using the command ifconfig lo down. If a system's only network interface is down, we will not be able to access it except on the console. The ping command will report 100% lost packers and all other network commands will fail. Because of this, the ping command will not be able to send requests over the network to a specific device.

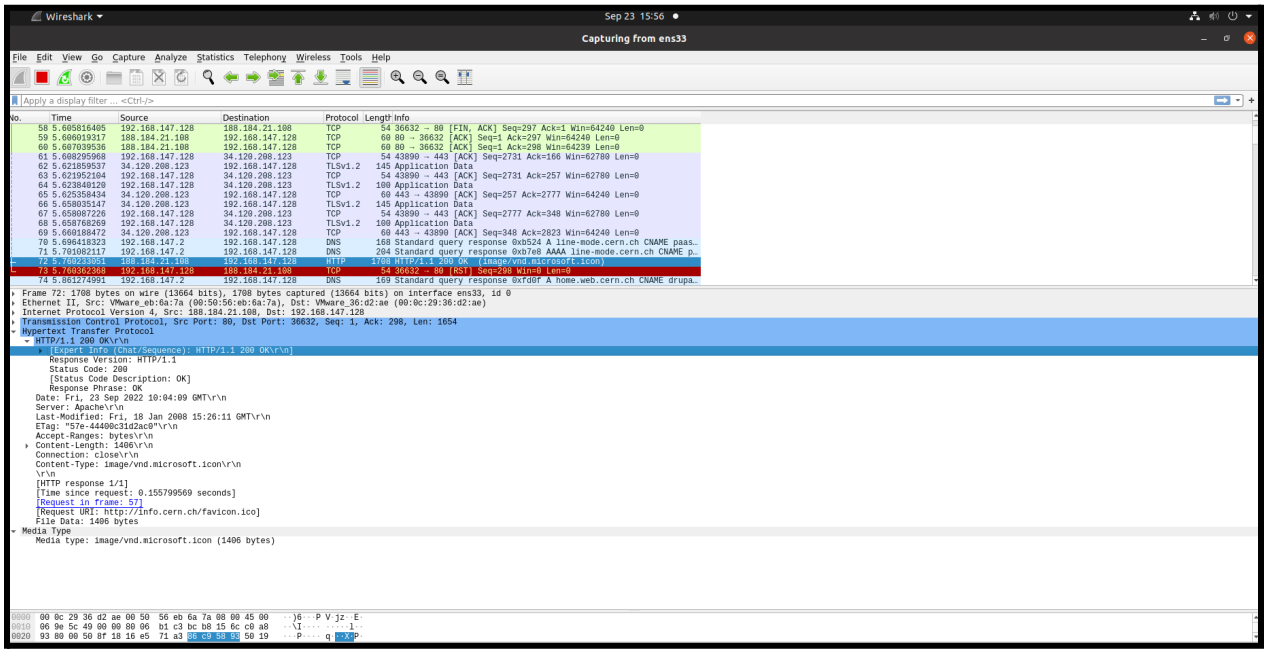
Q5):

- For HTTP request packets



- HTTP Request Type: Get
- User-agent Type: Mozzila Firefox
- HTTP request packet's URL: http://info.cern.ch/favicon.ico

- For HTTP response packets



- HTTP response code : 200
- HTTP response description: OK
- Name and version of the web server: Apache\r\n

Topic / Item	Count	Average	Min val	Max val	Rate (ms)	Percent	Burst rate	Burst start
Total HTTP Packets	51				0.0001	100%	0.0300	50.989
Other HTTP Packets	0				0.0000	0.00%	-	-
HTTP Response Packets	9				0.0000	17.65%	0.0200	51.041
???: broken	0				0.0000	0.00%	-	-
5xx: Server Error	0				0.0000	0.00%	-	-
4xx: Client Error	0				0.0000	0.00%	-	-
3xx: Redirection	0				0.0000	0.00%	-	-
2xx: Success	9				0.0000	100.00%	0.0200	51.041
204 No Content	6				0.0000	66.67%	0.0100	138.998
200 OK	3				0.0000	33.33%	0.0200	51.041
1xx: Informational	0				0.0000	0.00%	-	-
HTTP Request Packets	42				0.0001	82.35%	0.0200	50.989
SEARCH	32				0.0001	76.19%	0.0100	43.127
GET	10				0.0000	23.81%	0.0200	50.989

There have 3 web objects downloaded over the same TCP connection. Therefore this is a persistent HTTP connection. Also, we can verify this, since HTTP/1.1 connections are persistent.

Q6):

a) netstat -no -p TCP

b) State for all TCP connection(s) is LISTEN.

```
ritika@ritika-virtual-machine:~$ netstat -at info.cern.ch
Active Internet connections (servers and established)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
tcp        0      0 localhost:ipp           0.0.0.0:*               LISTEN
tcp        0      0 127.0.0.53:domain       0.0.0.0:*               LISTEN
tcp6       0      0 ip6-localhost:ipp       [::]:*                  LISTEN
```