Computer Networks

Assignment-1

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Section: A

Q1)

a) Using the ifconfig command on the WSL command prompt:

```
root@LAPTOP-H5BRNDC6:/mnt/c/WINDOWS/system32# ifconfig
eth2: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.56.1  netmask 255.255.255.0  broadcast 192.168.56.255
        inet6 fe80::203c:dcdf:185b:dbc9  prefixlen 64  scopeid 0xfd<compat,link,site,host>
        ether 0a:00:27:00:00:0f  (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

eth3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.40.1  netmask 255.255.255.0  broadcast 192.168.40.255
        inet6 fe80::8176:454:c4a2:5796  prefixlen 64  scopeid 0xfd<compat,link,site,host>
        ether 00:50:56:c0:00:01  (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

eth4: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.45.1  netmask 255.255.255.0  broadcast 192.168.45.255
        inet6 fe80::3c02:dc06:4a90:a6c1  prefixlen 64  scopeid 0xfd<compat,link,site,host>
        ether 00:50:56:c0:00:08  (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 1500
        inet 127.0.0.1  netmask 255.0.0.0
        inet6 ::1  prefixlen 128  scopeid 0xfe<compat,link,site,host>
        loop  (Local Loopback)
        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
```

```
wifi0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.1.6  netmask 255.255.255.0  broadcast 192.168.1.255
        inet6 fe80::71ef:2e24:312:a1c2  prefixlen 64  scopeid 0xfd<compat,link,site,host>
        ether 38:de:ad:24:ac:a2  (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
```

My private IP Address is 192.168.1.6

b) Using the webpage https://www.whatismyip.com, we find this information

What Is My IP?

My Public IPv4 is: 106.215.91.26

My Public IPv6 is: Not Detected

My IP Location is: Azadpur, DL IN

My ISP is: Bharti Airtel Ltd.

My IP Address on this website is 106.215.91.26. Hence my public IP Address is 106.215.91.26

We can see that the IP Addresses are not the same – ifconfig gives the IP Addresses as 192.168.x.x, while whatismyip.com gives the IP Address as 106.215.91.26.

The IP Address in B (106.215.91.26) is the globally assigned public IP Address to the entire network, while

the IP Address in A (192.168.1.6) is the IP Address my
router has assigned to my laptop on the local network.

Q2)

a)


```
root@LAPTOP-H5BRNDC6:/mnt/c/WINDOWS/system32# nslookup google.com
Server:         192.168.1.8
Address:        192.168.1.8#53

Non-authoritative answer:
Name:    google.com
Address: 142.250.66.14
Name:    google.com
Address: 2404:6800:4002:80c::200e
```

We can see that running nslookup google.com
returns only a non-authoritative answer.
We've gotten a non-authoritative answer because
the various nodes in between have cached
information about the server. Thus, running a
simple nslookup will return only information
present with the closest node.
To get authoritative information, we need to use
set query=ns command to tell nslookup that we
want to know which DNS servers are authoritative.
Using this information, we set the domain server
to an authoritative one, from which we can get
authoritative answers.

```
root@LAPTOP-H5BRNDC6:/mnt/c/WINDOWS/system32# nslookup
> set query=ns
> google.com
Server:            192.168.1.8
Address:           192.168.1.8#53

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

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
ns3.google.com  internet address = 216.239.36.10
ns2.google.com  internet address = 216.239.34.10
ns2.google.com  has AAAA address 2001:4860:4802:34::a
ns4.google.com  internet address = 216.239.38.10
```

```
> server ns1.google.com
Default server: ns1.google.com
Address: 216.239.32.10#53
Default server: ns1.google.com
Address: 2001:4860:4802:32::a#53
> set query=any
> google.com
Server:         ns1.google.com
Address:        216.239.32.10#53

Name:   google.com
Address: 142.250.193.238
Name:   google.com
Address: 2404:6800:4002:81d::200e
google.com      text = "apple-domain-verification=30afIBcvSuDV2PLX"
google.com      rdata_65 = \# 13 0001000001000602683202683332
google.com      text = "docusign=1b0a6754-49b1-4db5-8540-d2c12664b289"
google.com      text = "onetrust-domain-verification=de01ed21f2fa4d8781cbc3ffb89cf4ef"
google.com      mail exchanger = 10 smtp.google.com.
google.com      nameserver = ns3.google.com.
google.com      nameserver = ns1.google.com.
google.com      text = "facebook-domain-verification=22rm551cu4k0ab0bxsw536t1ds4h95"
google.com      nameserver = ns2.google.com.
google.com      rdata_257 = 0 issue "pki.goog"
google.com      text = "webexdomainverification.8YX6G=6e6922db-e3e6-4a36-904e-a805c28087fa"
google.com      text = "MS=E4A68B9AB2BB9670BCE15412F62916164C0B20BB"
google.com      nameserver = ns4.google.com.
google.com      text = "atlassian-domain-verification=5YjTmWmjI92ewqkx2oXmBaD60Td9zWon9r6eakvHX6B77zzkFQto8PQ9QsKnbf4I"
google.com      text = "globalsign-smime-dv=CDYX+XFHUw2wml6/Gb8+59BsH31KzUr6c1l2BPvqKX8="
google.com      text = "v=spf1 include:_spf.google.com ~all"
google.com      text = "docusign=05958488-4752-4ef2-95eb-aa7ba8a3bd0e"
google.com      text = "google-site-verification=TV9-DBe4R80X4v0M4U_bd_J9cpOJM0nikft0jAgjmsQ"
google.com      text = "google-site-verification=wD8N7i1JTNTkezJ49swvWW48f8_9xveREV4oB-0Hf5o"
google.com
        origin = ns1.google.com
        mail addr = dns-admin.google.com
        serial = 478064308
        refresh = 900
        retry = 900
        expire = 1800
        minimum = 60
```

b)

```
root@LAPTOP-H5BRNDC6:/mnt/c/WINDOWS/system32# nslookup -debug google.in
Server:         192.168.1.8
Address:        192.168.1.8#53

- - - - - - - - - - -
    QUESTIONS:
        google.in, type = A, class = IN
    ANSWERS:
    ->  google.in
        internet address = 172.217.160.196
        ttl = 300
    AUTHORITY RECORDS:
    ADDITIONAL RECORDS:
- - - - - - - - - - -
Non-authoritative answer:
Name:    google.in
Address: 172.217.160.196
- - - - - - - - - - -
    QUESTIONS:
        google.in, type = AAAA, class = IN
    ANSWERS:
    ->  google.in
        has AAAA address 2404:6800:4009:80a::2004
        ttl = 300
    AUTHORITY RECORDS:
    ADDITIONAL RECORDS:
- - - - - - - - - - -
Name:    google.in
Address: 2404:6800:4009:80a::2004
```

We've run the **nslookup -debug google.in** to find the Time To Live (ttl). We can see that the ttl is 300 seconds; which means that the cached entry would expire 300 seconds after the server sent back the answer.

To test this, we can run the command multiple times, and see that the ttl goes down every time, until it hits 0, then goes back to 300.

Q3)

```
PS C:\Users\Utkarsh> tracert google.in

Tracing route to google.in [142.250.207.228]
over a maximum of 30 hops:

  1     32 ms     79 ms     14 ms  192.168.48.254
  2      4 ms      3 ms      2 ms  vpn.iiitd.edu.in [192.168.1.99]
  3      3 ms      3 ms      2 ms  103.25.231.1
  4      *         *         *     Request timed out.
  5      7 ms      6 ms     44 ms  10.119.234.162
  6      5 ms      4 ms      4 ms  72.14.195.56
  7     27 ms     27 ms     25 ms  108.170.251.113
  8     27 ms     28 ms     34 ms  142.251.76.175
  9     37 ms     27 ms     27 ms  del12s11-in-f4.1e100.net [142.250.207.228]
```

a) The number of intermediate hosts is 8.

The IP Addresses of the hosts are given in the screenshot.

The average rtts are as follows:

```
1    41.66ms
2    3ms
3    2.66ms
4    -
5    19ms
6    4.33ms
7    26.33ms
8    29.67ms
9    30.33ms
```

The average latencies are the half of these values

```
1    20.83ms
2    1.5ms
3    1.33ms
4    -
5    9.5ms
6    2.165ms
7    13.165ms
8    14.835ms
9    15.165ms
```

b) We send 100 ping messages to google.in using the command **ping -c 100 google.in**


```
root@LAPTOP-H5BRNDC6:/mnt/c/WINDOWS/system32# ping -c 100 google.in
PING google.in (172.217.160.164) 56(84) bytes of data.
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=1 ttl=115 time=171 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=2 ttl=115 time=35.2 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=3 ttl=115 time=40.0 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=4 ttl=115 time=51.3 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=5 ttl=115 time=44.5 ms
```

```
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=66 ttl=115 time=39.9 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=67 ttl=115 time=28.7 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=68 ttl=115 time=26.4 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=69 ttl=115 time=32.2 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=70 ttl=115 time=30.6 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=71 ttl=115 time=39.1 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=72 ttl=115 time=30.2 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=73 ttl=115 time=29.2 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=74 ttl=115 time=34.8 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=75 ttl=115 time=27.5 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=76 ttl=115 time=30.7 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=77 ttl=115 time=26.6 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=78 ttl=115 time=44.7 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=79 ttl=115 time=27.7 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=80 ttl=115 time=36.3 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=81 ttl=115 time=29.6 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=82 ttl=115 time=27.9 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=83 ttl=115 time=30.0 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=84 ttl=115 time=28.3 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=85 ttl=115 time=28.4 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=86 ttl=115 time=29.1 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=87 ttl=115 time=29.4 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=88 ttl=115 time=27.3 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=89 ttl=115 time=28.1 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=90 ttl=115 time=26.1 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=91 ttl=115 time=27.1 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=92 ttl=115 time=31.8 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=93 ttl=115 time=26.3 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=94 ttl=115 time=136 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=95 ttl=115 time=139 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=96 ttl=115 time=37.3 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=97 ttl=115 time=42.1 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=98 ttl=115 time=28.7 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=99 ttl=115 time=60.6 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=100 ttl=115 time=27.5 ms

--- google.in ping statistics ---
100 packets transmitted, 100 received, 0% packet loss, time 99125ms
rtt min/avg/max/mdev = 26.142/39.925/171.136/24.890 ms
root@LAPTOP-H5BRNDC6:/mnt/c/WINDOWS/system32#
```

```
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=97 ttl=115 time=42.1 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=98 ttl=115 time=28.7 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=99 ttl=115 time=60.6 ms
64 bytes from bom05s12-in-f4.1e100.net (172.217.160.164): icmp_seq=100 ttl=115 time=27.5 ms

--- google.in ping statistics ---
100 packets transmitted, 100 received, 0% packet loss, time 99125ms
rtt min/avg/max/mdev = 26.142/39.925/171.136/24.890 ms
```

We can see that the average rtt is **39.925ms**, so the average latency is **19.9625ms**.

c) We send 100 ping messages to columbia.edu using the command **ping -c 100 columbia.edu**

```
root@LAPTOP-H5BRNDC6:/mnt/c/WINDOWS/system32# ping -c 100 columbia.edu
PING columbia.edu (128.59.105.24) 56(84) bytes of data.
64 bytes from www.neurotheory.columbia.edu (128.59.105.24): icmp_seq=1 ttl=241 time=388 ms
64 bytes from www.neurotheory.columbia.edu (128.59.105.24): icmp_seq=2 ttl=241 time=453 ms
64 bytes from www.neurotheory.columbia.edu (128.59.105.24): icmp_seq=3 ttl=241 time=458 ms
64 bytes from www.neurotheory.columbia.edu (128.59.105.24): icmp_seq=4 ttl=241 time=457 ms
64 bytes from www.neurotheory.columbia.edu (128.59.105.24): icmp_seq=5 ttl=241 time=424 ms
```

```
64 bytes from www.neurotheory.columbia.edu (128.59.105.24): icmp_seq=96 ttl=241 time=245 ms
64 bytes from www.neurotheory.columbia.edu (128.59.105.24): icmp_seq=97 ttl=241 time=238 ms
64 bytes from www.neurotheory.columbia.edu (128.59.105.24): icmp_seq=98 ttl=241 time=262 ms
64 bytes from www.neurotheory.columbia.edu (128.59.105.24): icmp_seq=99 ttl=241 time=375 ms
64 bytes from www.neurotheory.columbia.edu (128.59.105.24): icmp_seq=100 ttl=241 time=238 ms

--- columbia.edu ping statistics ---
100 packets transmitted, 100 received, 0% packet loss, time 102374ms
rtt min/avg/max/mdev = 235.720/284.324/482.737/70.552 ms
```

We can see that the average rtt is **284.324ms**, so the average latency is **142.162ms**

d) The average of the ping latencies in part a is
9.81125 ms
The average of the ping latencies in part b is
19.9625 ms
We can see that both these latencies do not match. This is because the ping latencies in traceroute is the round-trip time to each of the hops between the source and the destination. Meanwhile the average latency represents the round-trip time to the destination.

e) The maximum of ping latencies in part a is
20.83ms
The average of ping rtt in part b is **39.925ms**, this the average of ping latencies in part b is
19.9625ms
We can see that the values are very similar. So we can treat them as the same value.
This is because the maximum of the ping latency among the intermediate hosts will be when the packet is at most 1 or 2 hops away from the final destination, which is approximately equal to the final destination average ping latency.
The slight differences that have arrived, these are due to the varying amounts of traffic at the router.

f)

```
PS C:\Users\Utkarsh> tracert columbia.edu

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

  1      3 ms      3 ms     14 ms   192.168.48.254
  2      9 ms      5 ms      3 ms   vpn.iiitd.edu.in [192.168.1.99]
  3      2 ms      3 ms      1 ms   103.25.231.1
  4     28 ms     31 ms     28 ms   10.1.209.201
  5     29 ms     29 ms     30 ms   10.1.200.137
  6    176 ms     35 ms     29 ms   10.255.238.122
  7     28 ms     31 ms     55 ms   180.149.48.18
  8    147 ms    147 ms    151 ms   180.149.48.2
  9    237 ms    238 ms    239 ms   180.149.48.13
 10    240 ms    245 ms    244 ms   nyc-9208-I2-NEWY.nysernet.net [199.109.5.1]
 11    237 ms    241 ms    248 ms   columbia.nyc-9208.nysernet.net [199.109.4.14]
 12    242 ms    248 ms    300 ms   cc-core-1-x-nyser32-gw-1.net.columbia.edu [128.59.255.5]
 13    240 ms    234 ms    235 ms   cc-conc-1-x-cc-core-1.net.columbia.edu [128.59.255.21]
 14    237 ms    235 ms    236 ms   teachtechaward.org [128.59.105.24]
```

We can see that google.in requires 8 hops, while columbia.edu requires 14 hops. This is the most likely reason for the latency difference.
The servers of columbia.edu are farther away than those of google.in. Furthermore, google.in is much more accessed by users, thus the information is more likely to be cached inside intermediate hosts, reducing the overall latency to Google.

Q4) **ping 127.0.0.1** means to ping the localhost; which is the loopback address, which loops back to itself when pinged. In order for ping command to fail with 100% packet loss, we need to disable the network interface 'lo'. To do this, we run the **sudo ifconfig lo down**

We can reverse this by the command **sudo ifconfig lo up**

```
ubcn@ubuntuvm:~$ sudo ifconfig lo down
ubcn@ubuntuvm:~$ ping -c 10 127.0.0.1
PING 127.0.0.1 (127.0.0.1) 56(84) bytes of data.

--- 127.0.0.1 ping statistics ---
10 packets transmitted, 0 received, 100% packet loss, time 9240ms

ubcn@ubuntuvm:~$ sudo ifconfig lo up
```
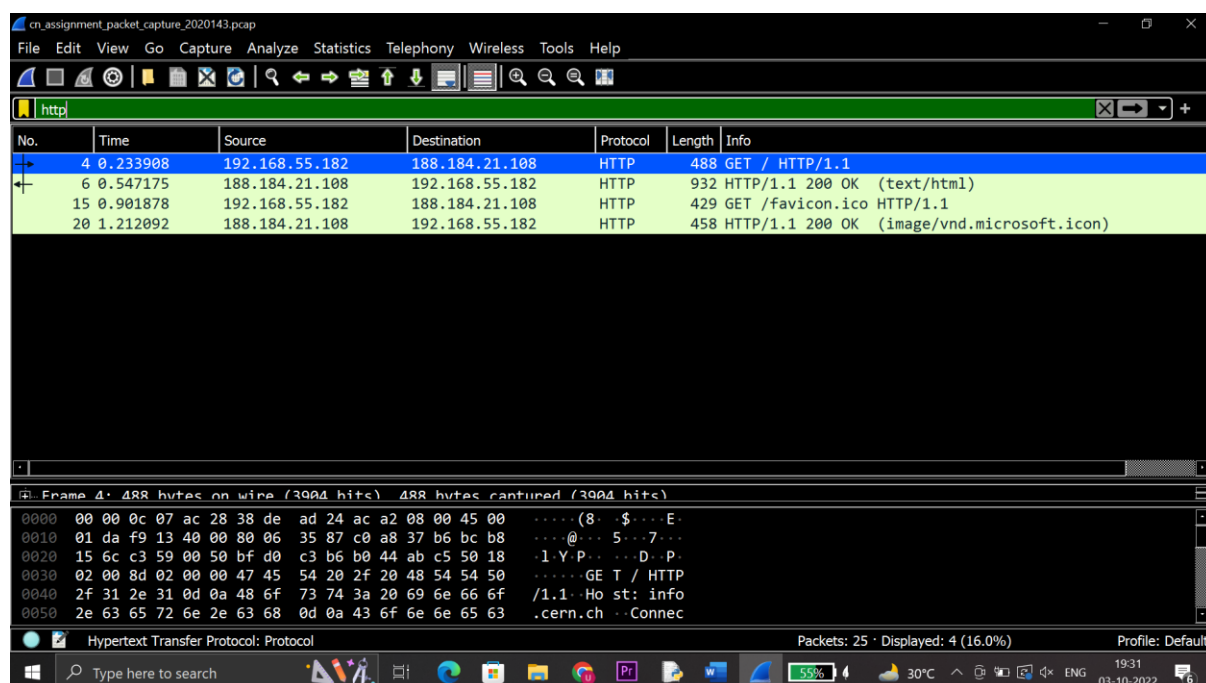
(There was some issue in my VM so this screenshot is taken on someone else's VM)

Q5) I retrieved the web page http://info.cern.ch on my Mozilla Firefox browser, and used Wireshark to record the communication between my machine and the web server. I've saved this packet capture as well, and attached it in the zip.

a) Request packets
    a. HTTP request type- GET
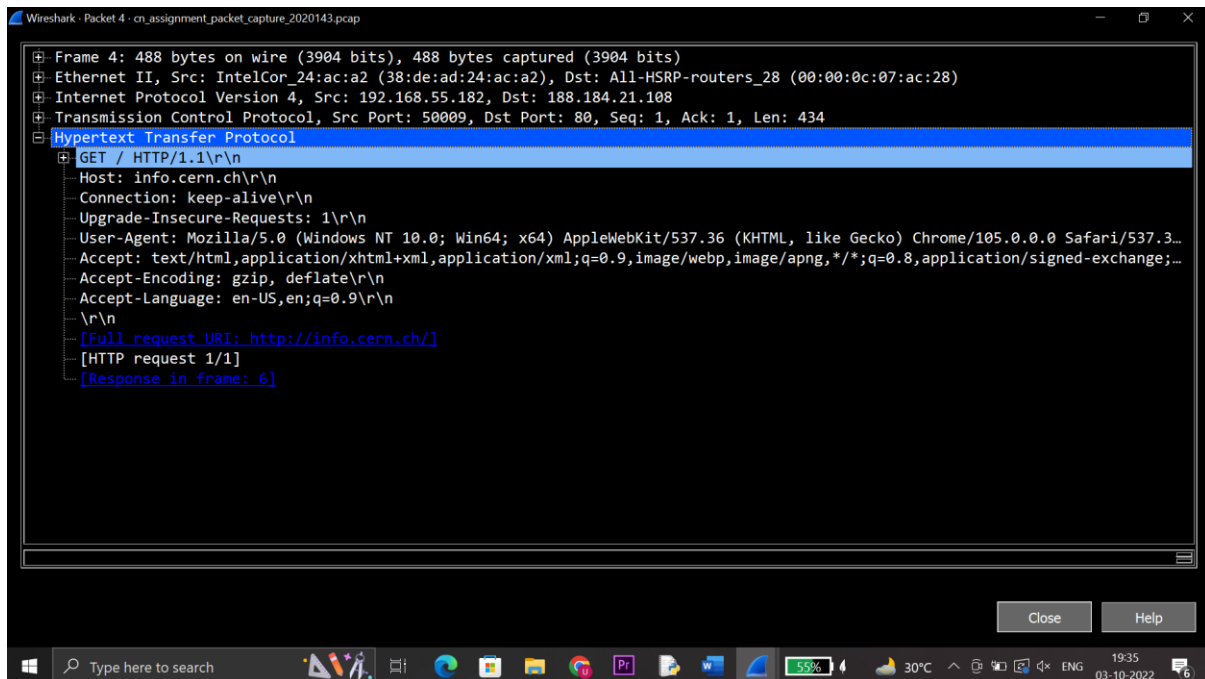
User agent type- Mozilla/5.0

HTTP request packet's URL-

http://info.cern.ch

b. HTTP request type- GET

User agent type- Mozilla/5.0

HTTP request packet's URL-

http://info.cern.ch/favicon.ico
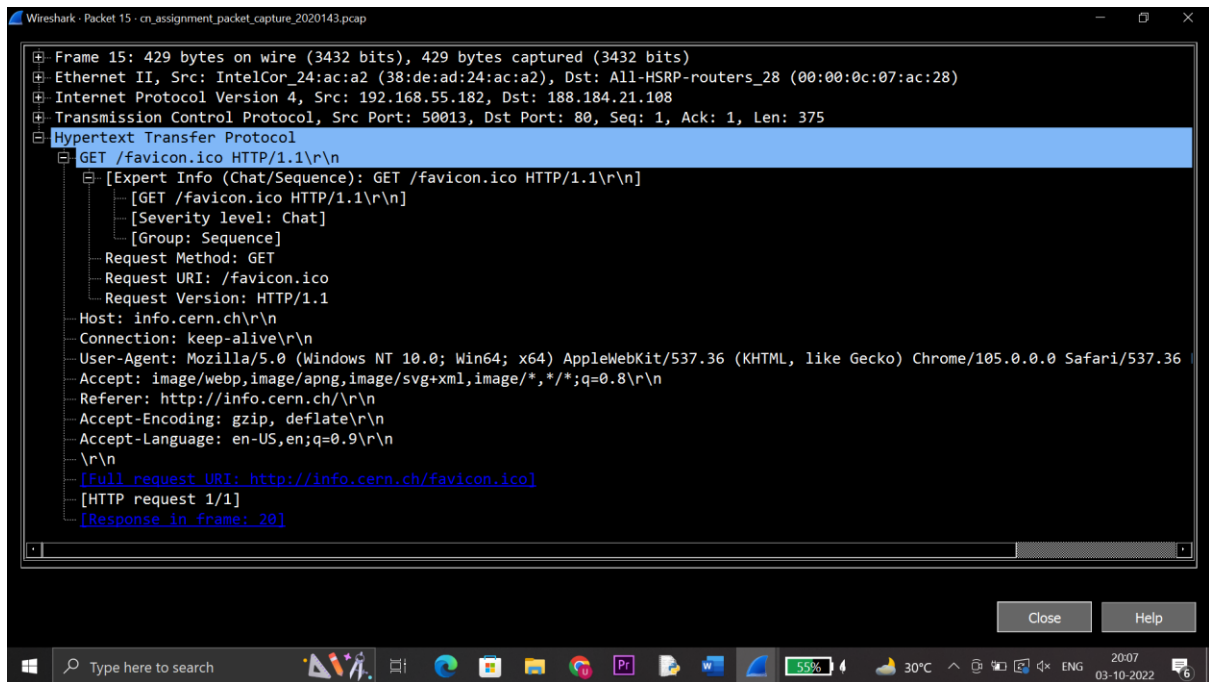
b) Response Packets

    a. HTTP response code- 200

       HTTP response description- OK

       Name and version of the web server- Apache
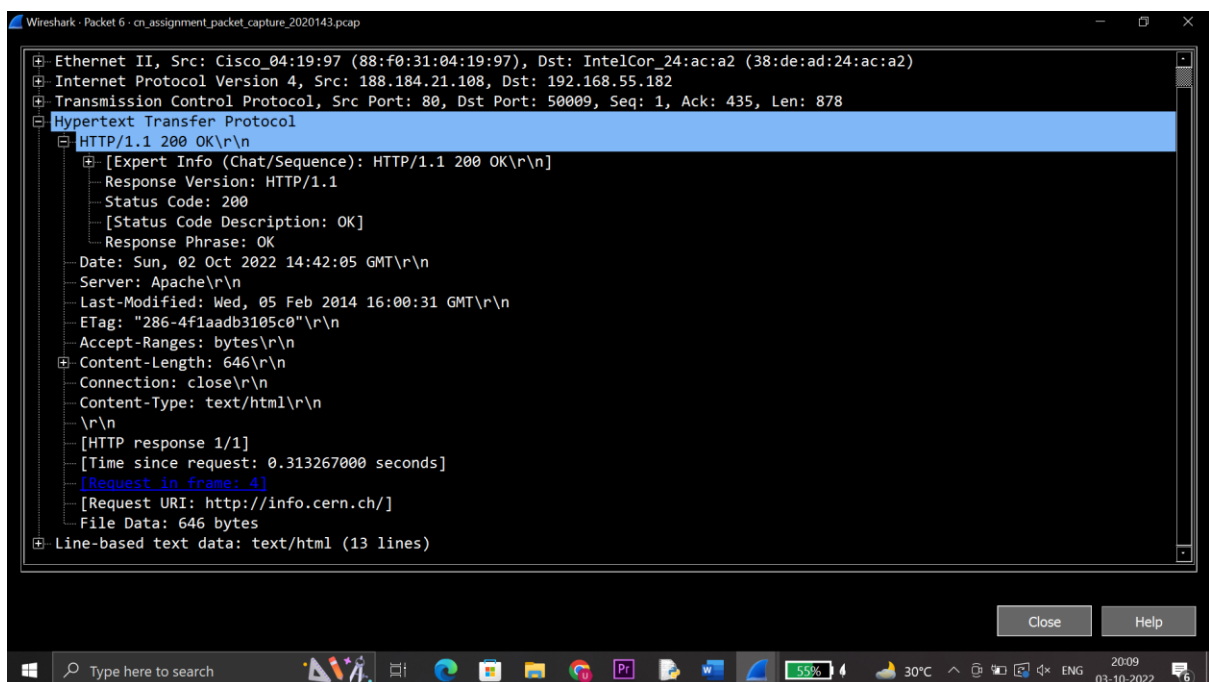
    b. HTTP response code- 200

HTTP response description- OK
Name and version of the web server- Apache
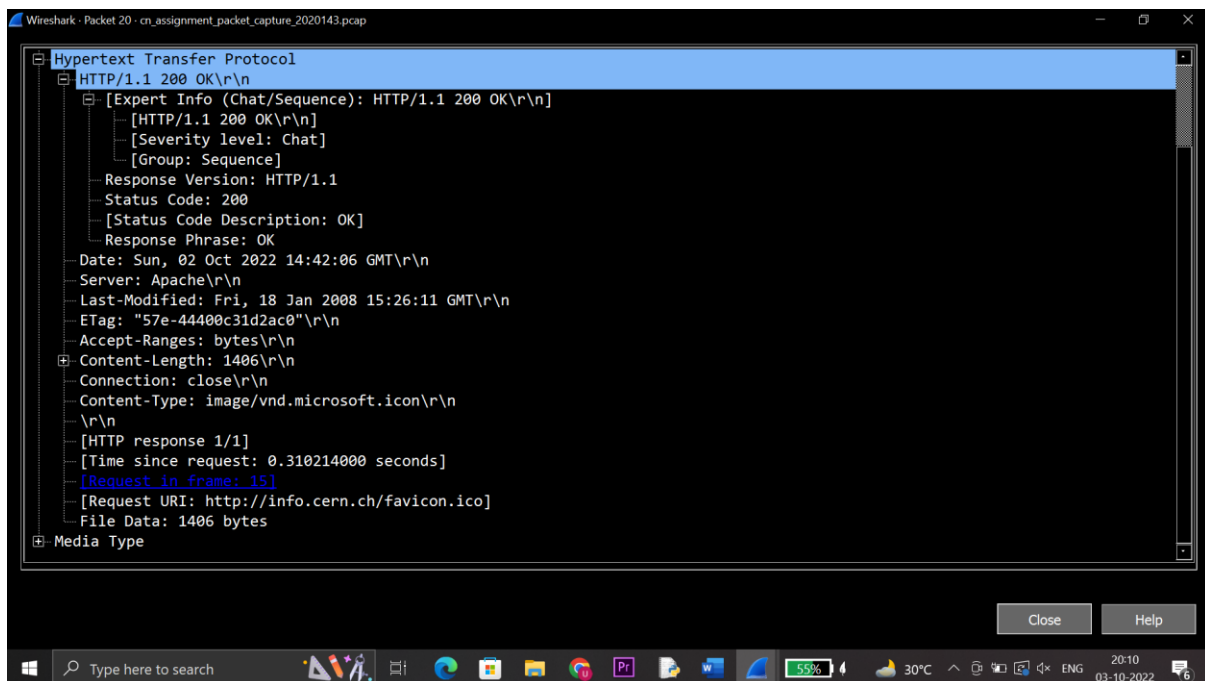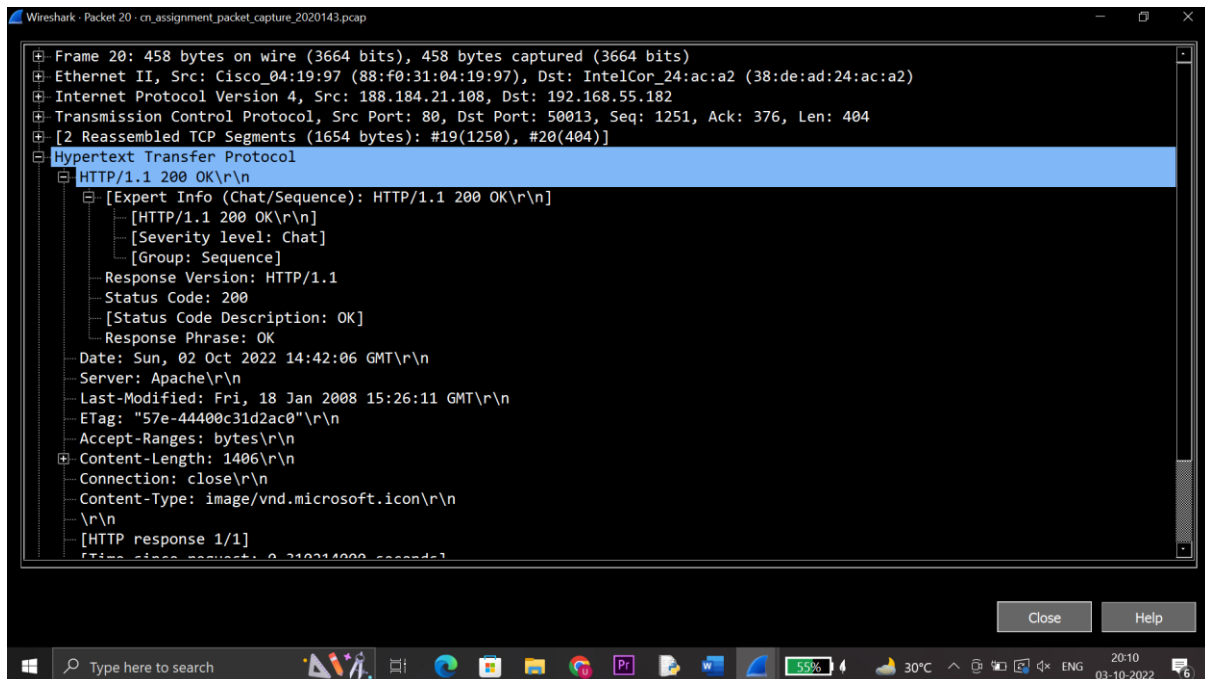
c) 2 web objects got downloaded (Web Page and Favicon) and were over multiple TCP connections.

d) Because the downloaded web objects were from different TCP connections, this means that it is non-persistent.

Q6)

a) I have used the command **netstat -to**

```
PS C:\Users\Utkarsh> netstat -to

Active Connections

  Proto  Local Address          Foreign Address        State           PID     Offload State

  TCP    127.0.0.1:49674        LAPTOP-H5BRNDC6:49675  ESTABLISHED     6204    InHost
  TCP    127.0.0.1:49675        LAPTOP-H5BRNDC6:49674  ESTABLISHED     6204    InHost
  TCP    127.0.0.1:49676        LAPTOP-H5BRNDC6:49677  ESTABLISHED     6204    InHost
  TCP    127.0.0.1:49677        LAPTOP-H5BRNDC6:49676  ESTABLISHED     6204    InHost
  TCP    127.0.0.1:49678        LAPTOP-H5BRNDC6:49679  ESTABLISHED     4872    InHost
  TCP    127.0.0.1:49679        LAPTOP-H5BRNDC6:49678  ESTABLISHED     4872    InHost
  TCP    127.0.0.1:49686        LAPTOP-H5BRNDC6:54022  ESTABLISHED     4872    InHost
  TCP    127.0.0.1:49686        LAPTOP-H5BRNDC6:54024  ESTABLISHED     4872    InHost
  TCP    127.0.0.1:49686        LAPTOP-H5BRNDC6:54089  ESTABLISHED     4872    InHost
  TCP    127.0.0.1:49686        LAPTOP-H5BRNDC6:54091  ESTABLISHED     4872    InHost
  TCP    127.0.0.1:49686        LAPTOP-H5BRNDC6:54117  ESTABLISHED     4872    InHost
  TCP    127.0.0.1:49686        LAPTOP-H5BRNDC6:54133  ESTABLISHED     4872    InHost
  TCP    127.0.0.1:49686        LAPTOP-H5BRNDC6:54340  ESTABLISHED     4872    InHost
  TCP    127.0.0.1:49686        LAPTOP-H5BRNDC6:54370  ESTABLISHED     4872    InHost
  TCP    127.0.0.1:49686        LAPTOP-H5BRNDC6:54379  ESTABLISHED     4872    InHost
  TCP    127.0.0.1:49686        LAPTOP-H5BRNDC6:54381  ESTABLISHED     4872    InHost
  TCP    127.0.0.1:49686        LAPTOP-H5BRNDC6:54389  ESTABLISHED     4872    InHost
  TCP    127.0.0.1:49686        LAPTOP-H5BRNDC6:54390  ESTABLISHED     4872    InHost
  TCP    127.0.0.1:49686        LAPTOP-H5BRNDC6:54391  ESTABLISHED     4872    InHost
  TCP    127.0.0.1:49686        LAPTOP-H5BRNDC6:54392  ESTABLISHED     4872    InHost
  TCP    127.0.0.1:49686        LAPTOP-H5BRNDC6:54404  ESTABLISHED     4872    InHost
  TCP    127.0.0.1:49686        LAPTOP-H5BRNDC6:54406  ESTABLISHED     4872    InHost
  TCP    127.0.0.1:49686        LAPTOP-H5BRNDC6:54407  ESTABLISHED     4872    InHost
  TCP    127.0.0.1:49686        LAPTOP-H5BRNDC6:54409  ESTABLISHED     4872    InHost
  TCP    127.0.0.1:49686        LAPTOP-H5BRNDC6:54411  ESTABLISHED     4872    InHost
  TCP    127.0.0.1:49686        LAPTOP-H5BRNDC6:54412  ESTABLISHED     4872    InHost
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TCP    127.0.0.1:49686          LAPTOP-H5BRNDC6:54440   ESTABLISHED    4872     InHost
TCP    127.0.0.1:49686          LAPTOP-H5BRNDC6:54443   ESTABLISHED    4872     InHost
TCP    127.0.0.1:49696          LAPTOP-H5BRNDC6:49697   ESTABLISHED    4872     InHost
TCP    127.0.0.1:49697          LAPTOP-H5BRNDC6:49696   ESTABLISHED    4872     InHost
TCP    127.0.0.1:54004          LAPTOP-H5BRNDC6:54005   ESTABLISHED    4872     InHost
TCP    127.0.0.1:54005          LAPTOP-H5BRNDC6:54004   ESTABLISHED    4872     InHost
TCP    127.0.0.1:54022          LAPTOP-H5BRNDC6:49686   ESTABLISHED    14928    InHost
TCP    127.0.0.1:54024          LAPTOP-H5BRNDC6:49686   ESTABLISHED    14928    InHost
TCP    127.0.0.1:54053          LAPTOP-H5BRNDC6:54060   ESTABLISHED    8832     InHost
TCP    127.0.0.1:54060          LAPTOP-H5BRNDC6:54053   ESTABLISHED    4684     InHost
TCP    127.0.0.1:54089          LAPTOP-H5BRNDC6:49686   ESTABLISHED    14928    InHost
TCP    127.0.0.1:54090          LAPTOP-H5BRNDC6:49686   TIME_WAIT      0        InHost
TCP    127.0.0.1:54091          LAPTOP-H5BRNDC6:49686   ESTABLISHED    14928    InHost
TCP    127.0.0.1:54117          LAPTOP-H5BRNDC6:49686   ESTABLISHED    14928    InHost
TCP    127.0.0.1:54133          LAPTOP-H5BRNDC6:49686   ESTABLISHED    14928    InHost
TCP    127.0.0.1:54340          LAPTOP-H5BRNDC6:49686   ESTABLISHED    14928    InHost
TCP    127.0.0.1:54359          LAPTOP-H5BRNDC6:49686   TIME_WAIT      0        InHost
TCP    127.0.0.1:54360          LAPTOP-H5BRNDC6:49686   TIME_WAIT      0        InHost
TCP    127.0.0.1:54370          LAPTOP-H5BRNDC6:49686   ESTABLISHED    14928    InHost
TCP    127.0.0.1:54379          LAPTOP-H5BRNDC6:49686   ESTABLISHED    14928    InHost
TCP    127.0.0.1:54381          LAPTOP-H5BRNDC6:49686   ESTABLISHED    14928    InHost
TCP    127.0.0.1:54389          LAPTOP-H5BRNDC6:49686   ESTABLISHED    14928    InHost
TCP    127.0.0.1:54390          LAPTOP-H5BRNDC6:49686   ESTABLISHED    14928    InHost
TCP    127.0.0.1:54391          LAPTOP-H5BRNDC6:49686   ESTABLISHED    14928    InHost
TCP    127.0.0.1:54392          LAPTOP-H5BRNDC6:49686   ESTABLISHED    14928    InHost
TCP    127.0.0.1:54404          LAPTOP-H5BRNDC6:49686   ESTABLISHED    14928    InHost
TCP    127.0.0.1:54406          LAPTOP-H5BRNDC6:49686   ESTABLISHED    14928    InHost
TCP    127.0.0.1:54407          LAPTOP-H5BRNDC6:49686   ESTABLISHED    14928    InHost
TCP    127.0.0.1:54409          LAPTOP-H5BRNDC6:49686   ESTABLISHED    14928    InHost
TCP    127.0.0.1:54411          LAPTOP-H5BRNDC6:49686   ESTABLISHED    14928    InHost
TCP    127.0.0.1:54412          LAPTOP-H5BRNDC6:49686   ESTABLISHED    14928    InHost
TCP    127.0.0.1:54440          LAPTOP-H5BRNDC6:49686   ESTABLISHED    14928    InHost
```

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TCP    127.0.0.1:54443          LAPTOP-H5BRNDC6:49686        ESTABLISHED    14928    InHost
TCP    192.168.55.182:7680      Jai:59428                    TIME_WAIT      0        InHost
TCP    192.168.55.182:7680      192.168.52.110:51114         TIME_WAIT      0        InHost
TCP    192.168.55.182:54000     52.163.231.110:https         ESTABLISHED    17068    InHost
TCP    192.168.55.182:54003     20.198.118.190:https         ESTABLISHED    5552     InHost
TCP    192.168.55.182:54020     195.27.253.108:https         ESTABLISHED    4872     InHost
TCP    192.168.55.182:54065     whatsapp-cdn-shv-01-del1:https   ESTABLISHED    14928    InHost
TCP    192.168.55.182:54171     bom12s16-in-f10:https        TIME_WAIT      0        InHost
TCP    192.168.55.182:54219     4.1.82.146:https             ESTABLISHED    4872     InHost
TCP    192.168.55.182:54271     40.99.9.50:https             ESTABLISHED    15548    InHost
TCP    192.168.55.182:54325     77.74.181.34:https           ESTABLISHED    4872     InHost
TCP    192.168.55.182:54345     202.163.7.42:https           ESTABLISHED    4252     InHost
TCP    192.168.55.182:54348     sd-in-f188:5228              ESTABLISHED    14928    InHost
TCP    192.168.55.182:54349     del12s04-in-f10:https        TIME_WAIT      0        InHost
TCP    192.168.55.182:54350     bom12s08-in-f10:https        TIME_WAIT      0        InHost
TCP    192.168.55.182:54351     bom12s08-in-f10:https        ESTABLISHED    14928    InHost
TCP    192.168.55.182:54354     13.83.65.43:https            ESTABLISHED    16956    InHost
TCP    192.168.55.182:54355     13.83.65.43:https            TIME_WAIT      0        InHost
TCP    192.168.55.182:54361     del11s12-in-f3:https         TIME_WAIT      0        InHost
TCP    192.168.55.182:54363     bom12s14-in-f4:https         TIME_WAIT      0        InHost
TCP    192.168.55.182:54364     del11s20-in-f14:https        TIME_WAIT      0        InHost
TCP    192.168.55.182:54365     se-in-f113:https             TIME_WAIT      0        InHost
TCP    192.168.55.182:54366     hkg12s10-in-f5:https         ESTABLISHED    14928    InHost
TCP    192.168.55.182:54367     bom12s19-in-f3:https         TIME_WAIT      0        InHost
TCP    192.168.55.182:54368     bom07s33-in-f3:https         TIME_WAIT      0        InHost
TCP    192.168.55.182:54369     del11s22-in-f1:https         TIME_WAIT      0        InHost
TCP    192.168.55.182:54371     bom12s21-in-f10:https        TIME_WAIT      0        InHost
TCP    192.168.55.182:54372     200:https                    TIME_WAIT      0        InHost
TCP    192.168.55.182:54373     bom12s16-in-f17:https        TIME_WAIT      0        InHost
TCP    192.168.55.182:54375     bom07s33-in-f3:https         TIME_WAIT      0        InHost
TCP    192.168.55.182:54376     bom07s15-in-f14:https        ESTABLISHED    14928    InHost
TCP    192.168.55.182:54377     bom12s19-in-f3:https         TIME_WAIT      0        InHost
```

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TCP     192.168.55.182:54413    bom12s03-in-f1:https    ESTABLISHED    14928    InHost
TCP     192.168.55.182:54414    bom05s12-in-f14:https   ESTABLISHED    14928    InHost
TCP     192.168.55.182:54415    bom05s12-in-f14:https   ESTABLISHED    14928    InHost
TCP     192.168.55.182:54416    bom12s14-in-f10:https   ESTABLISHED    14928    InHost
TCP     192.168.55.182:54419    del11s12-in-f3:https    ESTABLISHED    14928    InHost
TCP     192.168.55.182:54420    del11s12-in-f3:https    ESTABLISHED    14928    InHost
TCP     192.168.55.182:54421    bom07s25-in-f3:https    ESTABLISHED    14928    InHost
TCP     192.168.55.182:54424    180.87.4.161:https      TIME_WAIT      0        InHost
TCP     192.168.55.182:54425    del12s05-in-f14:https   ESTABLISHED    14928    InHost
TCP     192.168.55.182:54426    del12s05-in-f14:https   ESTABLISHED    14928    InHost
TCP     192.168.55.182:54429    13.83.65.43:https       ESTABLISHED    16956    InHost
TCP     192.168.55.182:54430    bom12s12-in-f19:https   ESTABLISHED    14928    InHost
TCP     192.168.55.182:54431    bom12s16-in-f17:https   ESTABLISHED    14928    InHost
TCP     192.168.55.182:54432    bom12s03-in-f3:https    ESTABLISHED    14928    InHost
TCP     192.168.55.182:54433    bom12s17-in-f14:https   ESTABLISHED    14928    InHost
TCP     192.168.55.182:54434    180.87.4.157:https      TIME_WAIT      0        InHost
TCP     192.168.55.182:54435    del12s03-in-f14:https   ESTABLISHED    14928    InHost
TCP     192.168.55.182:54436    bom07s31-in-f5:https    ESTABLISHED    14928    InHost
TCP     192.168.55.182:54437    bom12s14-in-f4:https    ESTABLISHED    14928    InHost
TCP     192.168.55.182:54438    del11s21-in-f14:https   ESTABLISHED    14928    InHost
TCP     192.168.55.182:54439    51.104.167.186:https    ESTABLISHED    13804    InHost
TCP     192.168.55.182:54441    webafs706:http          ESTABLISHED    14928    InHost
TCP     192.168.55.182:54444    bom12s14-in-f4:https    CLOSE_WAIT     14928    InHost
TCP     192.168.55.182:54445    a-0001:https            ESTABLISHED    15548    InHost
TCP     192.168.55.182:54446    52.98.58.34:https       ESTABLISHED    15548    InHost
TCP     192.168.55.182:54447    180.87.4.161:https      TIME_WAIT      0        InHost
TCP     192.168.55.182:54448    52.168.117.170:https    ESTABLISHED    11132    InHost
TCP     192.168.55.182:54449    52.113.196.254:https    ESTABLISHED    15548    InHost
TCP     192.168.55.182:54450    20.141.10.208:https     ESTABLISHED    15548    InHost
TCP     192.168.55.182:54451    a104-71-61-42:https     ESTABLISHED    15548    InHost
TCP     192.168.55.182:54452    204.79.197.222:https    ESTABLISHED    15548    InHost
PS C:\Users\Utkarsh>
```

b) On loading the website info.cern.ch, a TCP connection has been made. When the website is completely loaded, the TCP connection is closed. Thus no TCP connections remain when the specified website is completely loaded.

As we can see from the screenshots in part (a), Connection State is **Estabilished**