

# COL334 Assignment - 1

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## 1 Networking Tools

### 1.a *ifconfig*

I identified IP Address of my machine using *ifconfig* command. Here are the IP Addresses of my machine when connected to different service providers:

1. BSNL Wifi: 192.168.1.200
2. Airtel Wifi: 192.168.1.101
3. Jio Hotspot: 192.168.133.190

From these, we can notice that IP Address of my machine is changing if I change the service provider.

```
wlo1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.1.200 netmask 255.255.255.0 broadcast 192.168.1.255
    inet6 fe80::9715:3e33:e3c4:b4fc prefixlen 64 scopeid 0x20<link>
    ether 88:91:33:57:2a:f9 txqueuelen 1000 (Ethernet)
    RX packets 651336 bytes 386683891 (386.6 MB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 239566 bytes 76193974 (76.1 MB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

wlo1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.1.101 netmask 255.255.255.0 broadcast 192.168.1.255
    inet6 fe80::67a7:784:7fcd:4b1a prefixlen 64 scopeid 0x20<link>
    inet6 2401:4908:16b8:d195:e299:a1b3:ed8a:9361 prefixlen 64 scopeid 0x0<global>
    inet6 2401:4908:16b8:d195:c839:f3b1:6752:a866 prefixlen 64 scopeid 0x0<global>
    ether 88:91:33:57:2a:f9 txqueuelen 1000 (Ethernet)
    RX packets 623266 bytes 378553470 (370.5 MB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 209997 bytes 65864915 (65.8 MB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

(a) IP Address of my PC (BSNL)

(b) IP Address of my PC (Airtel)

```
wlo1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.133.190 netmask 255.255.255.0 broadcast 192.168.133.255
    inet6 fe80::51b:c6a3:2290:9aee prefixlen 64 scopeid 0x20<link>
    ether 88:91:33:57:2a:f9 txqueuelen 1000 (Ethernet)
    RX packets 653713 bytes 387395024 (387.3 MB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 242568 bytes 77216291 (77.2 MB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
```

(c) IP Address of my PC (Jio)

## 1.b nslookup

I identified the IP Address associated with `www.google.com` and `www.facebook.com` using `nslookup` command. IP Address of `www.google.com` is 142.250.193.164 and IP Address of `www.facebook.com` is 157.240.228.35.

After changing DNS Server:

1. Google Public DNS (8.8.8.8): IP Address of `www.google.com` is 142.250.196.4 and `www.facebook.com` is 157.240.228.35
2. Cisco OpenDNS (208.67.222.222): IP Address of `www.google.com` is 142.250.182.100 and `www.facebook.com` is 157.240.228.35
3. Quad9 (9.9.9.9): IP Address of `www.google.com` is 142.250.66.132 and `www.facebook.com` is 157.240.235.35
4. Cloudflare (1.1.1.1): IP Address of `www.google.com` is 142.250.183.4 and `www.facebook.com` is 31.13.79.35

We can notice that, IP Address depends on the DNS Server.

```
aditya@aditya-HP-Laptop-15-da1xxx:~$ nslookup www.google.com
Server:      127.0.0.53
Address:      127.0.0.53#53

Non-authoritative answer:
Name:   www.google.com
Address: 142.250.193.164
Name:   www.google.com
Address: 2404:6800:4007:821::2004
```

(a) IP Address associated with google

```
aditya@aditya-HP-Laptop-15-da1xxx:~$ nslookup www.facebook.com
Server:      127.0.0.53
Address:      127.0.0.53#53

Non-authoritative answer:
www.facebook.com canonical name = star-mini.c10r.facebook.com.
Name:   star-mini.c10r.facebook.com
Address: 157.240.228.35
Name:   star-mini.c10r.facebook.com
Address: 2a03:2880:f168:81:face:b00c:0:25de
```

(b) IP Address associated with Facebook

```
aditya@aditya-HP-Laptop-15-da1xxx:~$ nslookup www.google.com 8.8.8.8
Server:      8.8.8.8
Address:      8.8.8.8#53

Non-authoritative answer:
Name:   www.google.com
Address: 142.250.196.4
Name:   www.google.com
Address: 2404:6800:4007:806::2004
```

(a) IP Address of google (Google Public DNS)

```
aditya@aditya-HP-Laptop-15-da1xxx:~$ nslookup www.facebook.com 8.8.8.8
Server:      8.8.8.8
Address:      8.8.8.8#53

Non-authoritative answer:
www.facebook.com canonical name = star-mini.c10r.facebook.com.
Name:   star-mini.c10r.facebook.com
Address: 157.240.228.35
Name:   star-mini.c10r.facebook.com
Address: 2a03:2880:f168:81:face:b00c:0:25de
```

(b) IP Address of Facebook (Google Public DNS)

```
aditya@aditya-HP-Laptop-15-da1xxx:~$ nslookup www.google.com 208.67.222.222
Server:      208.67.222.222
Address:      208.67.222.222#53

Non-authoritative answer:
Name:   www.google.com
Address: 142.250.182.100
Name:   www.google.com
Address: 2404:6800:4007:81c::2004
```

(a) IP Address of google (Cisco OpenDNS)

```
aditya@aditya-HP-Laptop-15-da1xxx:~$ nslookup www.facebook.com 208.67.222.222
Server:      208.67.222.222
Address:      208.67.222.222#53

Non-authoritative answer:
www.facebook.com canonical name = star-mini.c10r.facebook.com.
Name:   star-mini.c10r.facebook.com
Address: 157.240.228.35
Name:   star-mini.c10r.facebook.com
Address: 2a03:2880:f168:81:face:b00c:0:25de
```

(b) IP Address of Facebook (Cisco OpenDNS)

```
aditya@aditya-HP-Laptop-15-da1xxx:~$ nslookup www.google.com 9.9.9.9
Server:      9.9.9.9
Address:      9.9.9.9#53

Non-authoritative answer:
Name:   www.google.com
Address: 142.250.66.132
Name:   www.google.com
Address: 2404:6800:4005:810::2004
```

(a) IP Address of google (Quad9)

```
aditya@aditya-HP-Laptop-15-da1xxx:~$ nslookup www.facebook.com 9.9.9.9
Server:      9.9.9.9
Address:      9.9.9.9#53

Non-authoritative answer:
www.facebook.com canonical name = star-mini.c10r.facebook.com.
Name:   star-mini.c10r.facebook.com
Address: 157.240.235.35
Name:   star-mini.c10r.facebook.com
Address: 2a03:2880:f16c:83:face:b00c:0:25de
```

(b) IP Address of Facebook (Quad9)

```
aditya@aditya-HP-Laptop-15-da1xxx:~$ nslookup www.google.com 1.1.1.1
Server:      1.1.1.1
Address:      1.1.1.1#53

Non-authoritative answer:
Name:   www.google.com
Address: 142.250.183.4
Name:   www.google.com
Address: 2404:6800:4009:824::2004
```

(a) IP Address of google (CloudFlare)

```
aditya@aditya-HP-Laptop-15-da1xxx:~$ nslookup www.facebook.com 1.1.1.1
Server:      1.1.1.1
Address:      1.1.1.1#53

Non-authoritative answer:
www.facebook.com canonical name = star-mini.c10r.facebook.com.
Name:   star-mini.c10r.facebook.com
Address: 31.13.79.35
Name:   star-mini.c10r.facebook.com
Address: 2a03:2880:f12f:183:face:b00c:0:25de
```

(b) IP Address of Facebook (CloudFlare)

## 1.c ping

Average RTT values for packets with size 56 bytes is 126.248 ms, size 100 bytes is 141.161 ms, size 250 bytes is 135.979 ms. The maximum size of ping packets that I am able to send is 1472(1500) data bytes. From the figure(c), we can see that for 1472(1500), we got response and for 1473(1501) we didn't get reply. It is not same for www.google.com and www.facebook.com. For www.google.com, this value is 68 data bytes and for www.facebook.com, this value is 1452 data bytes.

```
aditya@aditya-HP-Laptop-15-da1xxx:~$ ping -c 3 -s 68 www.google.com
PING www.google.com(maa03s31-lin-x04.1e100.net (2404:6800:4007:812::2004)) 68 data bytes
68 bytes from maa03s31-lin-x04.1e100.net (2404:6800:4007:812::2004): icmp_seq=1 ttl=115 time=98.7 ms
68 bytes from maa03s31-lin-x04.1e100.net (2404:6800:4007:812::2004): icmp_seq=2 ttl=115 time=95.3 ms
68 bytes from maa03s31-lin-x04.1e100.net (2404:6800:4007:812::2004): icmp_seq=3 ttl=115 time=143 ms
--- www.google.com ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2003ms
rtt min/avg/max/mdev = 95.330/112.391/143.147/21.796 ms

aditya@aditya-HP-Laptop-15-da1xxx:~$ ping -c 3 -s 1452 www.facebook.com
PING www.facebook.com(edge-star-mnl0-shv-01-tir2.facebook.com (2a03:2880:f108:81:face:b00c:0:25de)) 1452 data bytes
1452 bytes from edge-star-mnl0-shv-01-tir2.facebook.com (2a03:2880:f108:81:face:b00c:0:25de): icmp_seq=1 ttl=55 time=181 ms
1452 bytes from edge-star-mnl0-shv-01-tir2.facebook.com (2a03:2880:f108:81:face:b00c:0:25de): icmp_seq=2 ttl=55 time=123 ms
1452 bytes from edge-star-mnl0-shv-01-tir2.facebook.com (2a03:2880:f108:81:face:b00c:0:25de): icmp_seq=3 ttl=55 time=146 ms
--- www.facebook.com ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2003ms
rtt min/avg/max/mdev = 100.840/123.160/145.610/18.275 ms
```

(a) Maximum packet size for www.google.com (b) Maximum packet size for www.facebook.com

```
aditya@aditya-HP-Laptop-15-da1xxx:~$ ping -c 3 -s 1472 www.iitd.ac.in
PING www.iitd.ac.in (103.27.9.24) 1472(1500) bytes of data.
1480 bytes from 103.27.9.24 (103.27.9.24): icmp_seq=1 ttl=50 time=200 ms
1480 bytes from 103.27.9.24 (103.27.9.24): icmp_seq=2 ttl=50 time=223 ms
1480 bytes from 103.27.9.24 (103.27.9.24): icmp_seq=3 ttl=50 time=143 ms
--- www.iitd.ac.in ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2003ms
rtt min/avg/max/mdev = 142.696/188.340/222.522/33.581 ms

aditya@aditya-HP-Laptop-15-da1xxx:~$ ping -c 3 -s 1473 www.iitd.ac.in
PING www.iitd.ac.in (103.27.9.24) 1473(1501) bytes of data.
--- www.iitd.ac.in ping statistics ---
3 packets transmitted, 0 received, 100% packet loss, time 2037ms
```

(c) Maximum packet size for www.iitd.ac.in

## 1.d traceroute

Traceroute for www.google.com via different service providers:

1. BSNL Wifi: No of hops - 10, No of routers responded - 9, No of routers didn't respond - 1
2. Airtel Wifi: No of hops - 12, No of routers responded - 11, No of routers didn't respond - 1
3. Jio Hotspot: No of hops - 14, No of routers responded - 12, No of routers didn't respond - 2

```
aditya@aditya-HP-Laptop-15-da1xxx:~$ traceroute www.google.com
traceroute to www.google.com (172.217.31.196), 64 hops max
 1 192.168.1.1 1.979ms 7.490ms 2.123ms
 2 10.209.0.1 16.645ms 12.764ms 11.585ms
 3 218.248.120.118 13.449ms 13.622ms 13.853ms
 4 * * *
 5 * 117.216.207.222 118.933ms
 6 72.14.218.250 25.895ms 76.305ms 102.410ms
 7 10.252.186.158 102.075ms 102.885ms 102.253ms
 8 74.125.242.129 102.094ms 101.832ms 102.340ms
 9 74.125.253.13 102.179ms 92.621ms 27.872ms
10 172.217.31.196 83.915ms 102.098ms 102.400ms

aditya@aditya-HP-Laptop-15-da1xxx:~$ traceroute www.google.com
traceroute to www.google.com (142.250.193.104), 64 hops max
 1 192.168.1.1 2.460ms 1.614ms 1.660ms
 2 * * *
 3 10.40.24.125 139.013ms 101.963ms 102.622ms
 4 10.50.135.97 102.610ms 101.823ms 102.096ms
 5 125.16.100.109 102.375ms 101.888ms 102.649ms
 6 116.119.57.102 102.465ms 101.232ms 102.881ms
 7 72.14.216.192 102.250ms 102.967ms 46.724ms
 8 * 115.255.253.237 123.999ms *
 9 74.125.252.208 171.349ms 101.331ms 103.206ms
10 142.251.55.235 101.156ms 102.843ms 102.851ms
11 74.125.242.129 102.452ms 50.828ms 153.649ms
12 142.250.193.104 102.272ms 102.224ms 102.302ms
```

(a) Traceroute of Google (BSNL)

(b) Traceroute of Google (Airtel)

```
aditya@aditya-HP-Laptop-15-da1xxx:~$ traceroute www.google.com
traceroute to www.google.com (142.250.193.228), 64 hops max
 1 192.168.133.6 3.521ms 3.408ms 3.382ms
 2 * * *
 3 10.72.212.49 193.750ms 205.472ms 10.72.212.65 203.800ms
 4 172.25.124.212 204.427ms 172.25.124.210 204.561ms 172.25.124.212 205.017ms
 5 172.25.124.209 80.217ms 172.25.124.213 95.475ms 172.25.124.209 233.546ms
 6 172.26.100.72 204.366ms 204.748ms 204.664ms
 7 172.26.100.63 170.197ms 233.576ms 204.303ms
 8 192.168.59.116 204.320ms 192.168.59.114 189.304ms 192.168.59.116 220.505ms
 9 192.168.59.111 204.361ms 204.725ms 204.730ms
10 172.31.2.71 204.595ms 204.631ms 204.701ms
11 209.85.175.48 204.686ms 204.670ms 204.519ms
12 * * *
13 108.170.253.97 206.370ms 204.673ms 204.498ms
14 142.250.193.228 204.876ms 105.395ms 99.104ms
```

(c) Traceroute of Google (Jio)

Traceroute for www.facebook.com via different service providers:

1. BSNL Wifi: No of hops - 15, No of routers responded - 10, No of routers didn't respond - 5
2. Airtel Wifi: No of hops - 10, No of routers responded - 9, No of routers didn't respond - 1
3. Jio Hotspot: No of hops - 14, No of routers responded - 13, No of routers didn't respond - 1

```

root@tysa-HP-Laptop-15-d41xxx:~# traceroute www.facebook.com
traceroute to star-min1.c10r.facebook.com (157.240.16.35), 64 hops max
 1  192.168.1.1  2.180ms  1.966ms  1.673ms
 2  * * *
 3  10.40.24.125  143.170ms  102.220ms  101.678ms
 4  10.50.135.97  102.280ms  102.395ms  102.356ms
 5  125.16.100.109  101.937ms  102.169ms  101.911ms
 6  182.79.152.88  102.529ms  102.246ms  102.708ms
 7  157.240.67.48  101.510ms  102.909ms  204.443ms
 8  157.240.53.69  102.114ms  102.628ms  102.493ms
 9  157.240.38.159  101.667ms  102.173ms  102.399ms
10  157.240.16.35  90.318ms  114.285ms  101.627ms

```

(b) Traceroute of Facebook (Airtel)

(c) Traceroute of Facebook (Jio)

Changes to *traceroute* request for some of the missing routers to reply:

1. We can use ICMP packets instead of UDP Packets by using -I in command, because UDP Packets are not reliable
2. We can increase the wait time of response by using -w <wait time>in command

Using wireshark, I grabbed all packets on your interface while visiting the website <http://apache.org> from the browser

I applied DNS filter on the grabbed packets. The time stamp for DNS request is 5.9032 s and time stamp for DNS response is 5.9894. So, the time taken for DNS request - response is 86.2 ms. In the below figure, the DNS request is in No 223 and response is in No 242.

(b) DNS Response

I applied http filter and the number of http requests generated are 28. From this we can say that web page consists of different objects (these can be images, HTML files, audio files) which are

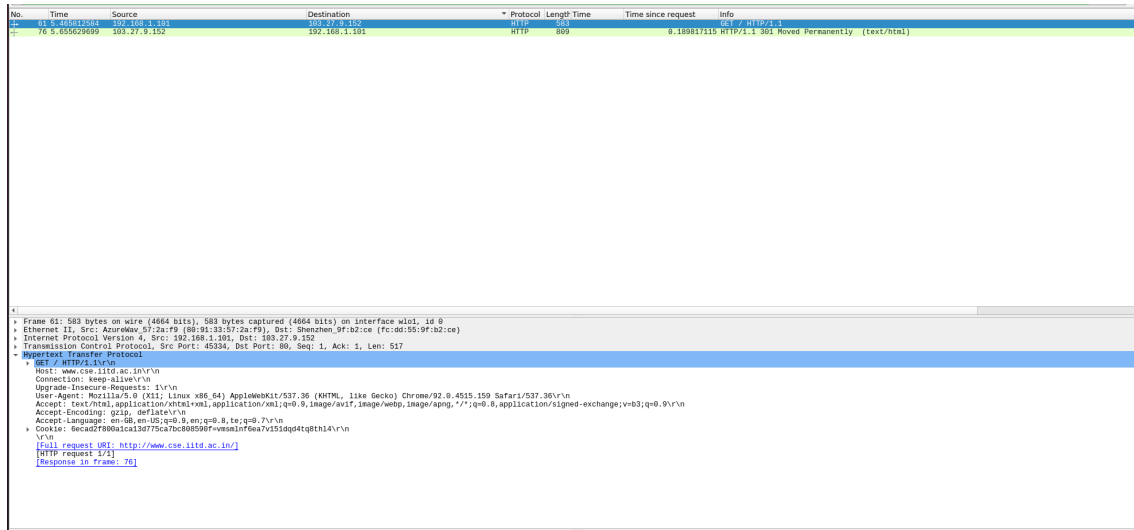
No.	Time	Source	Destination	Protocol	Length	Time	Time since request	Info
257	6.867916917	2401:4000:1600:d195:8126:3310:5f:7e12	2a04:4e42::644	HTTP	526			GET / HTTP/1.1
320	6.135459521	2401:4000:1600:d195:8126:3310:5f:7e12	2a04:4e42::644	HTTP	429			GET /css/min/bootstrap.css HTTP/1.1
321	6.135501193	2401:4000:1600:d195:8126:3310:5f:7e12	2a04:4e42::644	HTTP	422			GET /css/styles.css HTTP/1.1
343	6.187192139	2401:4000:1600:d195:8126:3310:5f:7e12	2a04:4e42::644	HTTP	415			GET /js/jquery-2.1.1.min.js HTTP/1.1
376	6.246232211	2401:4000:1600:d195:8126:3310:5f:7e12	2a04:4e42::644	HTTP	408			GET /js/bootstrap.js HTTP/1.1
422	6.249148556	2401:4000:1600:d195:8126:3310:5f:7e12	2a04:4e42::644	HTTP	408			GET /js/slideshow.js HTTP/1.1
469	6.319029220	2401:4000:1600:d195:8126:3310:5f:7e12	2a04:4e42::644	HTTP	480			GET /img/asf-estd-1999-logo.jpg HTTP/1.1
657	6.546271752	2401:4000:1600:d195:8126:3310:5f:7e12	2a04:4e42::644	HTTP	481			GET /fonts/glyphicons-halflings-regular.woff2 HTTP/1.1
735	6.63119194193	2401:4000:1600:d195:8126:3310:5f:7e12	2a04:4e42::644	HTTP	476			GET /img/support-apache.jpg HTTP/1.1
765	6.670894419	2401:4000:1600:d195:8126:3310:5f:7e12	2a04:4e42::644	HTTP	505			GET /img/trillions-and-trillions/why-apache-thumbnail.jpg HTTP/1.1
766	6.670896890	2401:4000:1600:d195:8126:3310:5f:7e12	2a04:4e42::644	HTTP	513			GET /img/trillions-and-trillions/apache-everywhere-thumbnail.jpg HTTP/1.1
806	6.696591956	2401:4000:1600:d195:8126:3310:5f:7e12	2a04:4e42::644	HTTP	519			GET /img/trillions-and-trillions/trillions-and-trillions-thumbnail.jpg HTTP/1.1
817	6.712474484	2401:4000:1600:d195:8126:3310:5f:7e12	2a04:4e42::644	HTTP	513			GET /img/trillions-and-trillions/apache-innovation-thumbnail.jpg HTTP/1.1
824	6.7232434515	2401:4000:1600:d195:8126:3310:5f:7e12	2a04:4e42::644	HTTP	473			GET /img/2028-report.jpg HTTP/1.1
835	6.7329214081	2401:4000:1600:d195:8126:3310:5f:7e12	2a04:4e42::644	HTTP	471			GET /img/community.jpg HTTP/1.1
862	6.741257313	2401:4000:1600:d195:8126:3310:5f:7e12	2a04:6800:4007:80a::200e	HTTP	440			GET /css.js?c=06570343832241170421:5mgshgrx2u HTTP/1.1
905	6.756154092	2401:4000:1600:d195:8126:3310:5f:7e12	2a04:4e42::644	HTTP	476			GET /img/the-apache-way.jpg HTTP/1.1
974	6.772703169	2401:4000:1600:d195:8126:3310:5f:7e12	2a04:4e42::644	HTTP	471			GET /img/ApacheCon.jpg HTTP/1.1
986	6.774935880	2401:4000:1600:d195:8126:3310:5f:7e12	2a04:4e42::644	HTTP	483			GET /logos/res/archiva/default.png HTTP/1.1
1060	6.784511973	2401:4000:1600:d195:8126:3310:5f:7e12	2a04:4e42::644	HTTP	486			GET /logos/res/serviceux/default.png HTTP/1.1
1197	6.806553414	2401:4000:1600:d195:8126:3310:5f:7e12	2a04:4e42::644	HTTP	486			GET /logos/res/jackrabbit/default.png HTTP/1.1
1416	6.880443242	2401:4000:1600:d195:8126:3310:5f:7e12	2a04:4e42::644	HTTP	485			GET /logos/res/incubator/default.png HTTP/1.1
1505	6.875552668	2401:4000:1600:d195:8126:3310:5f:7e12	2a04:4e42::644	HTTP	485			GET /logos/res/pagespeed/default.png HTTP/1.1
1733	6.920330868	2401:4000:1600:d195:8126:3310:5f:7e12	2a04:4e42::644	HTTP	493			GET /logos/res/datalab/default.png HTTP/1.1
1990	7.020706500	2401:4000:1600:d195:8126:3310:5f:7e12	2a04:6800:4007:80a::200e	HTTP	424			GET /adsense/search/async-ads.js HTTP/1.1
2358	7.148990497	2401:4000:1600:d195:8126:3310:5f:7e12	2a04:6800:4007:81f::200e	HTTP	475			GET /generate_204 HTTP/1.1
2766	8.226924282	2401:4000:1600:d195:8126:3310:5f:7e12	2a04:4e42::644	HTTP	474			GET /favicons/favicon.ico HTTP/1.1
2772	8.178565262	2401:4000:1600:d195:8126:3310:5f:7e12	2a04:4e42::644	HTTP	480			GET /favicons/favicon-32x32.jpg HTTP/1.1

## 2.c Total Time

[illegible]

(b) Last Content response

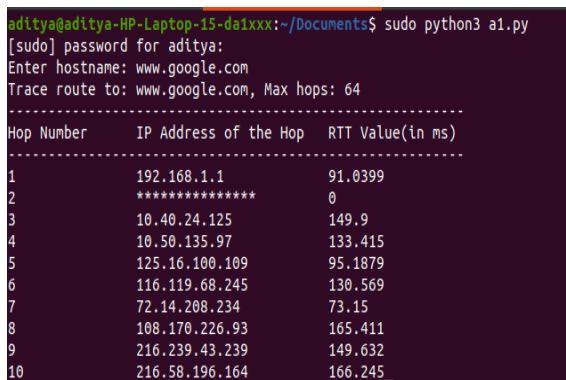
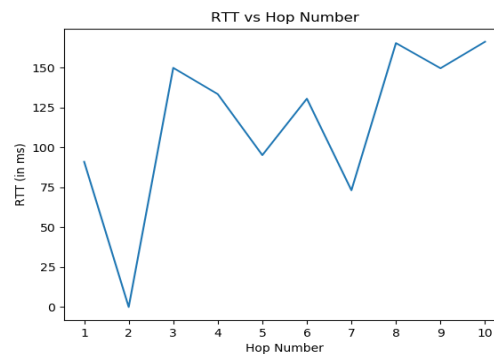
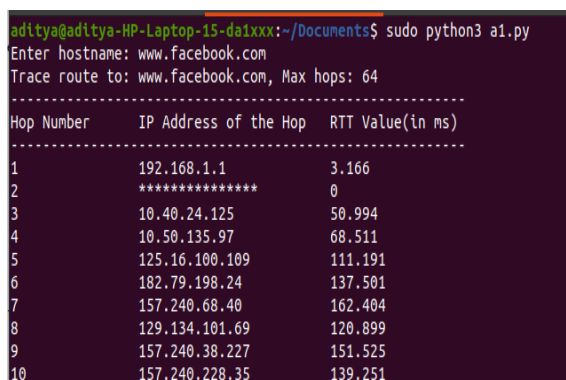
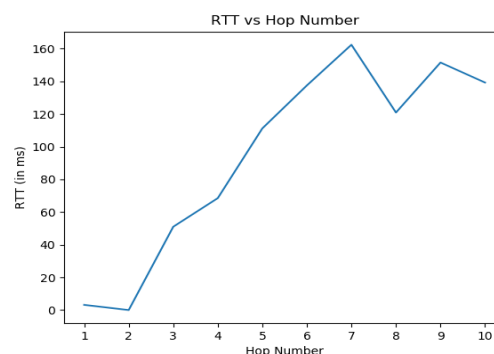
There is no http traffic when I visit <http://www.cse.iitd.ac.in/>. The reason is that, this webpage is secure. So, it follows https protocol and we can't find http traffic. But <http://apache.org/> follows http protocol, so we can find http traffic easily.

Figure 13: No http Traffic when we visit <http://www.cse.iitd.ac.in/>

### 3 Implementing Traceroute

I Implemented Trace route using scapy library. The program sends ICMP Packets with varying TTL values to get the IP Address of the hops in between and then calculates RTT values for these hops. Using matplotlib library, the graph of RTT vs hop number is plotted.

The following are the screenshots of output showing IP addresses of all the hops and RTT values for all these hops:

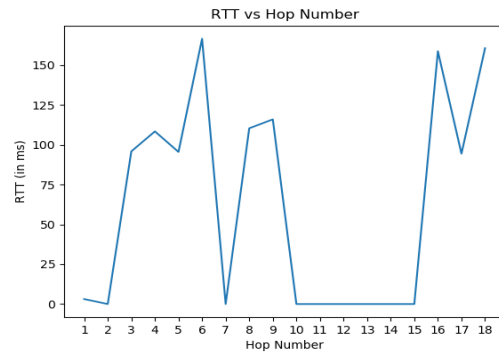
(a) Hops on the way to [www.google.com](http://www.google.com)(b) RTT vs Hop Number for [www.google.com](http://www.google.com)(a) Hops on the way to [www.facebook.com](http://www.facebook.com)(b) RTT vs Hop Number for [www.facebook.com](http://www.facebook.com)

```

Enter hostname: www.iitd.ac.in
Trace route to: www.iitd.ac.in, Max hops: 64
-----
Hop Number      IP Address of the Hop      RTT Value(in ms)
-----
1                192.168.1.1                3.117
2                *****                   0
3                10.40.24.125               95.8669
4                10.50.135.97               108.404
5                125.16.100.109             95.503
6                116.119.68.108             166.575
7                *****                   0
8                115.255.253.237            110.345
9                115.249.198.97             115.941
10               10.255.222.3               0
11               *****                   0
12               *****                   0
13               *****                   0
14               *****                   0
15               *****                   0
16               103.27.9.24                158.743
17               103.27.9.24                94.417
18               103.27.9.24                160.656

```

(a) Hops on the way to www.iitd.ac.in



(b) RTT vs Hop Number for www.iitd.ac.in

## 4 Appendix

1. Operating System: Linux (Ubuntu)