

CSE232: Programming Assignment 1

Submission by: Swapnil Panigrahi (2022522)

Q1

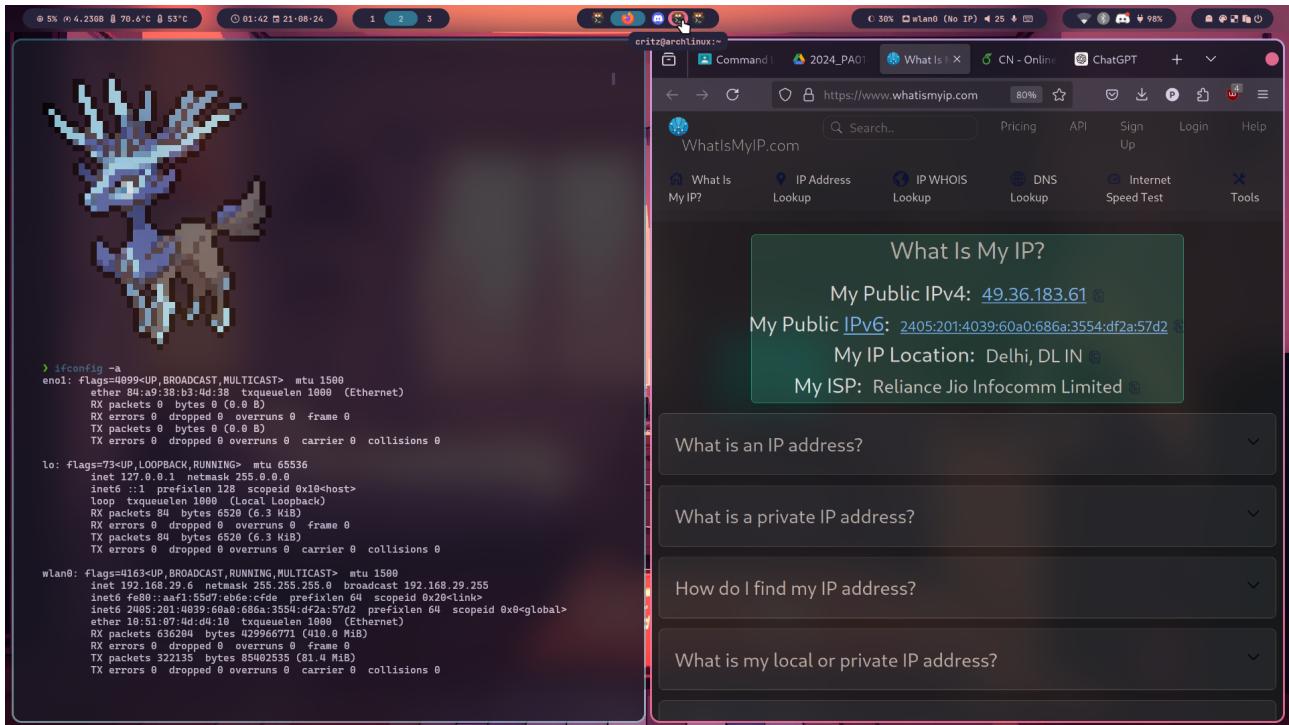


Figure 1: WhatIsMyIP vs. ifconfig command

Commands

1 ifconfig -a

- Clearly, private IP shown by ifconfig is 192.168.29.6 but public IP shown by the website 49.36.183.61
- They aren't identical because the public IP is assigned by the ISP and which is seen as the sender's address by the servers when packets reach them

Q2

```

> ifconfig -a
eth0: flags=4899<UP,BROADCAST,MULTICAST> mtu 1500
ether 84:a9:38:b3:4d:38 txqueuelen 1000  (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 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 84 bytes 6520 (6.3 kB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 84 bytes 6520 (6.3 kB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

wlan0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
  inet 192.168.29.6 brd 255.255.255.255 broadcast 192.168.29.255
    inet6 2005:201:4039:60a0:66a:3554:df2a:57d2 prefixlen 64 scopeid 0x20<link>
      loop txqueuelen 1000  (Ethernet)
    RX packets 80 bytes 6520 (6.3 kB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 80 bytes 6520 (6.3 kB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

> sudo ifconfig wlan0 192.168.22.12
> ifconfig -a
eth0: flags=4899<UP,BROADCAST,MULTICAST> mtu 1500
ether 84:a9:38:b3:4d:38 txqueuelen 1000  (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 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 84 bytes 6520 (6.3 kB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 84 bytes 6520 (6.3 kB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

wlan0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
  inet 192.168.22.12 brd 255.255.255.255 broadcast 192.168.22.255
    inet6 2005:201:4039:60a0:66a:3554:cfe:prefixlen 64 scopeid 0x20<link>
      loop txqueuelen 1000  (Ethernet)
    RX packets 80 bytes 6520 (6.3 kB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 80 bytes 6520 (6.3 kB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

```

Figure 2: Change IP address to 192.168.22.12

Commands

```

1  ifconfig -a
2  sudo ifconfig wlan0 192.168.22.12
3  ifconfig -a
4  sudo ifconfig wlan0 192.168.29.6

```

```

> ifconfig -a
eth0: flags=4899<UP,BROADCAST,MULTICAST> mtu 1500
  inet 192.168.29.6 brd 255.255.255.255 broadcast 192.168.29.255
    inet6 2005:201:4039:60a0:66a:3554:df2a:57d2 prefixlen 64 scopeid 0x20<link>
      loop txqueuelen 1000  (Ethernet)
    RX packets 84 bytes 6520 (6.3 kB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 84 bytes 6520 (6.3 kB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

wlan0: flags=882<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
  inet 192.168.22.12 brd 255.255.255.255 broadcast 192.168.22.255
    inet6 2005:201:4039:60a0:66a:cfe:prefixlen 64 scopeid 0x20<link>
      loop txqueuelen 1000  (Local Loopback)
    RX packets 80 bytes 6520 (6.3 kB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 80 bytes 6520 (6.3 kB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

> sudo ifconfig wlan0 192.168.29.6
SIOCSIFADDR: File exists
> ifconfig -a
eth0: flags=4899<UP,BROADCAST,MULTICAST> mtu 1500
ether 84:a9:38:b3:4d:38 txqueuelen 1000  (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 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 84 bytes 6520 (6.3 kB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 84 bytes 6520 (6.3 kB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

wlan0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
  inet 192.168.29.6 brd 255.255.255.255 broadcast 192.168.29.255
    inet6 2005:201:4039:60a0:66a:3554:cfe:prefixlen 64 scopeid 0x20<link>
      loop txqueuelen 1000  (Ethernet)
    RX packets 614803 bytes 424693308 (405.8 MiB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 79857668 bytes 79857668 (76.1 MiB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

```

Figure 3: Change IP address back to 192.168.29.6

Q3

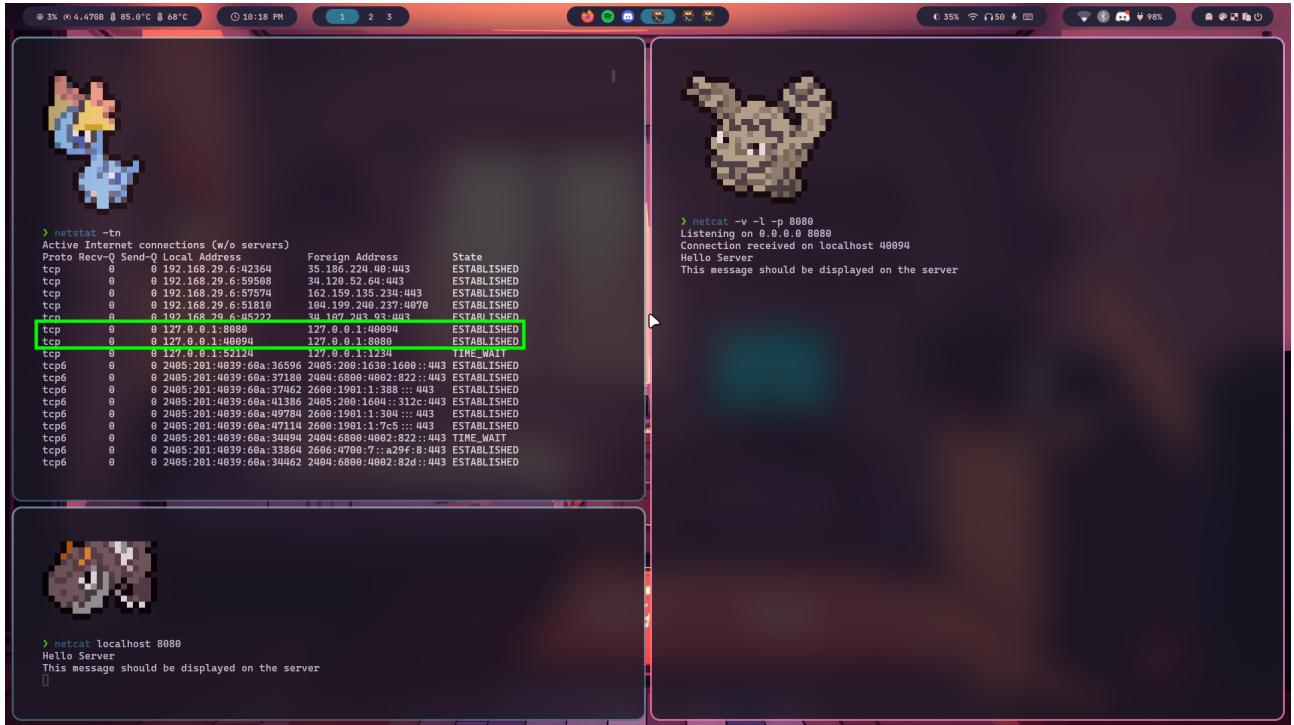


Figure 4: Setting up connection with localhost, and checking state of TCP connection

Commands

```
1 # Open server terminal
2 netcat -v -l -p 8080

1 # Open client terminal
2 netcat localhost 8080
3 Hello Server
4 This message should be displayed on server

1 # Open monitor terminal
2 netstat -tn
```

Q4

- References: ServerFault Article

The image shows two side-by-side terminal windows on a Mac OS X desktop. Both windows have a dark theme with a blue icon in the top-left corner.

Left Terminal:

```
> nslookup
> google.in
Server:      192.168.29.1
Address:     192.168.29.1#53

Non-authoritative answer:
Name:  google.in
Address: 216.58.196.100
Name:  google.in
Address: 2404:4800:4002:825::2084
> set type=ns
> google.in
Server:      192.168.29.1
Address:     192.168.29.1#53

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

Authoritative answers can be found from:
> server ns1.google.com
Default server: ns1.google.com
Address: 216.239.32.10#53
> google.in
Server:      ns1.google.com
Address:     2001:4860:4802:32::#53

google.in    nameserver = ns1.google.com.
google.in    nameserver = ns2.google.com.
google.in    nameserver = ns4.google.com.
google.in    nameserver = ns3.google.com.
>
```

Right Terminal:

```
> nslookup -debug alibaba.com
Server:      192.168.29.1
Address:     192.168.29.1#53

QUESTIONS:
alibaba.com, type = A, class = IN
ANSWERS:
→ alibaba.com
internet address = 47.246.131.30
ttl = 84
→ alibaba.com
internet address = 47.246.131.55
ttl = 84
AUTHORITY RECORDS:
ADDITIONAL RECORDS:

Non-authoritative answer:
Name:  alibaba.com
Address: 47.246.131.30
Name:  alibaba.com
Address: 47.246.131.55

QUESTIONS:
alibaba.com, type = AAAA, class = IN
ANSWERS:
AUTHORITY RECORDS:
→ alibaba.com
origin = ns1.alibabadns.com
mail = hostmaster.alibabadns.com
serial = 2018091909
refresh = 3600
retry = 1200
expire = 86400
minimum = 3600
ttl = 231
ADDITIONAL RECORDS:
```

Figure 5: Authoritative answer for google.in & TTL for alibaba.in

Commands

```
1 nslookup
2 google.in
3 set type=ns
4 google.in
5 server ns1.google.com
6 google.in

1 nslookup -debug alibaba.com
```

1. nslookup starts an interactive version of the nslookup
2. google.in gives the non-authoritative answer from local DNS server
3. set type=ns helps us lookup the "name servers" for google.in
4. server ns1.google.com changes the DNS server to an authoritative server for google.in
5. Querying google.in again returns an authoritative answer from server ns1.google.com

1. TTL for alibaba.com on local DNS server is 84 seconds
2. TTL for the same on the authoritative server is 231 seconds

Q5



```

> traceroute google.in
traceroute to google.in (142.250.66.4), 30 hops max, 60 byte packets
  1 reliance.reliance (192.168.29.1) 1.696 ms 1.665 ms 1.643 ms
  2 10.232.136.1 (10.232.136.1) 7.744 ms 7.721 ms 7.709 ms
  3 172.16.18.29 (172.16.18.29) 7.676 ms 7.655 ms 172.16.18.5 (172.16.18.5) 10.532 ms
  4 192.168.96.236 (192.168.96.236) 10.513 ms 192.168.96.234 (192.168.96.234) 10.489 ms 192.168.96.236 (192.168.96.236) 10.468 ms
  5 172.26.111.117 (172.26.111.117) 10.463 ms 10.442 ms 10.419 ms
  6 172.26.111.131 (172.26.111.131) 10.388 ms 5.669 ms 5.624 ms
  7 192.168.44.44 (192.168.44.44) 5.599 ms 192.168.44.48 (192.168.44.48) 3.296 ms 192.168.44.44 (192.168.44.44) 4.520 ms
  8 * * *
  9 * * *
  10 *
  11 142.250.169.176 (142.250.169.176) 10.070 ms 74.125.147.192 (74.125.147.192) 10.028 ms 142.251.71.163 (142.251.71.163) 10.004 ms
  12 * 142.251.71.163 (142.251.71.163) 7.839 ms
  13 142.251.49.120 (142.251.49.120) 7.808 ms 192.178.83.224 (192.178.83.224) 7.745 ms 142.251.54.94 (142.251.54.94) 10.287 ms
  14 192.178.82.236 (192.178.82.236) 7.732 ms 142.250.63.116 (142.250.63.116) 11.368 ms 142.256.238.116 (142.256.238.116) 37.242 ms
  15 209.85.250.56 (209.85.250.56) 12.299 ms 142.250.234.126 (142.250.234.126) 34.093 ms 142.250.208.227 (142.250.208.227) 34.812 ms
  16 142.250.46.171 (142.250.46.171) 30.849 ms 142.250.234.126 (142.250.234.126) 31.535 ms 142.250.226.135 (142.250.226.135) 32.127 ms
  17 142.250.209.71 (142.250.209.71) 33.144 ms 142.250.226.67 (142.250.226.67) 31.291 ms 72.14.236.219 (72.14.236.219) 28.143 ms
  18 bom07s35-in-f4.1e100.net (142.250.66.4) 29.813 ms 72.14.236.219 (72.14.236.219) 27.963 ms bom07s35-in-f4.1e100.net (142.250.66.4) 29.568 ms

```

Figure 6: traceroute to google.in

Commands

```

1 traceroute google.in
2 ping -c 50 google.in
3 ping -c 50 stanford.edu
4 traceroute stanford.edu

```

- There are 15 intermediate hosts with the following IP addresses (taking the first host at each hop):

IP Address	Average Latency (ms)
192.168.29.1	1.668
10.232.136.1	7.721
172.16.18.29	7.665
192.168.96.236	10.495
172.26.111.117	10.441
172.26.111.131	7.221
192.168.44.44	5.059
142.250.169.176	10.070
142.251.71.163	7.839
142.251.49.120	7.808
192.178.82.236	7.732
209.85.250.56	12.299
142.250.46.171	30.849
142.250.209.71	33.144
142.250.66.4	29.690
Total Latency	189.701 ms

```

64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=6 ttl=60 time=4.88 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=7 ttl=60 time=5.65 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=8 ttl=60 time=5.13 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=9 ttl=60 time=6.00 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=10 ttl=60 time=5.49 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=11 ttl=60 time=5.37 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=12 ttl=60 time=5.13 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=13 ttl=60 time=6.53 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=14 ttl=60 time=2.28 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=15 ttl=60 time=4.81 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=16 ttl=60 time=9.61 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=17 ttl=60 time=5.46 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=18 ttl=60 time=6.16 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=19 ttl=60 time=6.39 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=20 ttl=60 time=5.89 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=21 ttl=60 time=6.65 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=22 ttl=60 time=12.5 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=23 ttl=60 time=8.09 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=24 ttl=60 time=5.56 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=25 ttl=60 time=6.01 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=26 ttl=60 time=7.78 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=27 ttl=60 time=6.02 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=28 ttl=60 time=6.08 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=29 ttl=60 time=9.28 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=30 ttl=60 time=5.57 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=31 ttl=60 time=6.55 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=32 ttl=60 time=6.56 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=33 ttl=60 time=8.17 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=34 ttl=60 time=7.73 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=35 ttl=60 time=5.58 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=36 ttl=60 time=8.97 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=37 ttl=60 time=8.95 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=38 ttl=60 time=7.04 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=39 ttl=60 time=5.90 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=40 ttl=60 time=5.90 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=41 ttl=60 time=5.69 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=42 ttl=60 time=6.94 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=43 ttl=60 time=6.04 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=44 ttl=60 time=4.61 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=45 ttl=60 time=5.39 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=46 ttl=60 time=3.32 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=47 ttl=60 time=5.04 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=48 ttl=60 time=11.7 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=49 ttl=60 time=4.55 ms
64 bytes from dell2s08-in-x84.le100.net (2404:6800:4002:825::2004): icmp_seq=50 ttl=60 time=5.33 ms

--- google.in ping statistics ---
50 packets transmitted, 50 received, 0% packet loss, time 49066ms
rtt min/avg/max/mdev = 4.547/6.965/23.936/3.037 ms

```

Figure 7: ping command to google.in

- b. The average latency is 6.965 ms
- c.
 - i. The average latency for ping command is 6.965 (RTT) while the total latency for traceroute command is 189.7 ms
 - ii. traceroute command gives us the latency to ping each hop, which adding up won't necessarily give us the correct RTT to our final hop ping
- d.
 - i. The highest latency for traceroute is 34.812 ms while the average for ping command is 6.965 ms.
 - ii. The highest latency of traceroute is the latency to that host and not to the destination address i.e. the slowest hop, while for ping command, the latency is to the destination address.
- e. We see multiple IPs for each hop as routers distribute traffic across multiple paths to next hop for load balancing purposes

```

64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=6 ttl=50 time=516 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=7 ttl=50 time=698 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=8 ttl=50 time=267 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=9 ttl=50 time=756 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=10 ttl=50 time=357 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=11 ttl=50 time=171 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=12 ttl=50 time=266 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=13 ttl=50 time=1028 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=14 ttl=50 time=994 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=15 ttl=50 time=1083 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=16 ttl=50 time=486 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=17 ttl=50 time=1047 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=18 ttl=50 time=1804 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=19 ttl=50 time=1083 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=20 ttl=50 time=1064 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=21 ttl=50 time=1014 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=22 ttl=50 time=759 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=23 ttl=50 time=1024 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=24 ttl=50 time=1010 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=25 ttl=50 time=1086 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=26 ttl=50 time=558 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=27 ttl=50 time=800 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=28 ttl=50 time=342 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=29 ttl=50 time=1028 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=30 ttl=50 time=855 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=31 ttl=50 time=1033 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=32 ttl=50 time=843 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=33 ttl=50 time=577 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=34 ttl=50 time=269 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=35 ttl=50 time=579 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=36 ttl=50 time=453 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=37 ttl=50 time=1087 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=38 ttl=50 time=215 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=39 ttl=50 time=1036 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=40 ttl=50 time=1045 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=42 ttl=50 time=687 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=43 ttl=50 time=1028 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=44 ttl=50 time=1086 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=45 ttl=50 time=1085 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=46 ttl=50 time=1038 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=47 ttl=50 time=1076 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=48 ttl=50 time=788 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=49 ttl=50 time=1029 ms
64 bytes from web.stanford.edu (2607:f6d0:8:925a::ab43:d7c8): icmp_seq=50 ttl=50 time=1416 ms
--- stanford.edu ping statistics ---
50 packets transmitted, 50 received, 0% packet loss, time 51135ms
rtt min/avg/max/mdev = 266.281/773.053/1415.849/279.522 ms, pipe 2

```

Figure 8: ping command to stanford.edu

f. The average latency is 773.053 ms

```

traceroute to stanford.edu (171.67.215.200), 30 hops max, 60 byte packets
1  reliance.reliance (192.168.29.1) 5.123 ms 5.193 ms 5.328 ms
2  16.232.136.1 (16.232.136.1) 5.731 ms 5.717 ms 5.791 ms
3  172.16.18.29 (172.16.18.29) 5.647 ms 172.16.18.5 (172.16.18.5) 6.184 ms 6.168 ms
4  192.168.96.236 (192.168.96.236) 8.508 ms 192.168.96.234 (192.168.96.234) 8.505 ms 192.168.96.240 (192.168.96.240) 8.589 ms
5  172.26.111.117 (172.26.111.117) 8.455 ms 8.555 ms 8.427 ms
6  172.26.111.131 (172.26.111.131) 8.422 ms 8.468 ms 8.386 ms
7  192.168.44.44 (192.168.44.44) 4.297 ms 192.168.44.48 (192.168.44.48) 5.558 ms 5.527 ms
8 * *
9 * *
10 * *
11 * * 103.198.140.174 (103.198.140.174) 31.829 ms
12 103.198.140.174 (103.198.140.174) 27.886 ms *
13 103.198.140.176 (103.198.140.176) 31.755 ms 103.198.140.298 30.123 ms
14 * 103.198.140.56 (103.198.140.56) 291.315 ms 49.45.4.64 (49.45.4.64) 270.133 ms *
15 * 103.198.140.56 (103.198.140.56) 601.792 ms 103.198.140.213 (103.198.140.213) 601.773 ms
16 * *
17 * *
18 * *
19 stanford-university.e0-62.core2.pao1.he.net (184.105.177.238) 601.581 ms *
20 stanford-university.e0-62.core2.pao1.he.net (184.105.177.238) 727.267 ms campus-nw-rtr-v1102.SUNet (171.64.255.196) 723.844 ms stanford-university.e0-62.core2.pao1.he.net (184.105.177.238)
21 723.867 ms
22 * *
23 stanford-university.e0-62.core2.pao1.he.net (184.105.177.238) 723.793 ms * campus-nw-rtr-v1102.SUNet (171.64.255.196) 288.462 ms
24 * *
25 web.stanford.edu (171.67.215.200) 1129.062 ms 2062.517 ms 774.629 ms

```

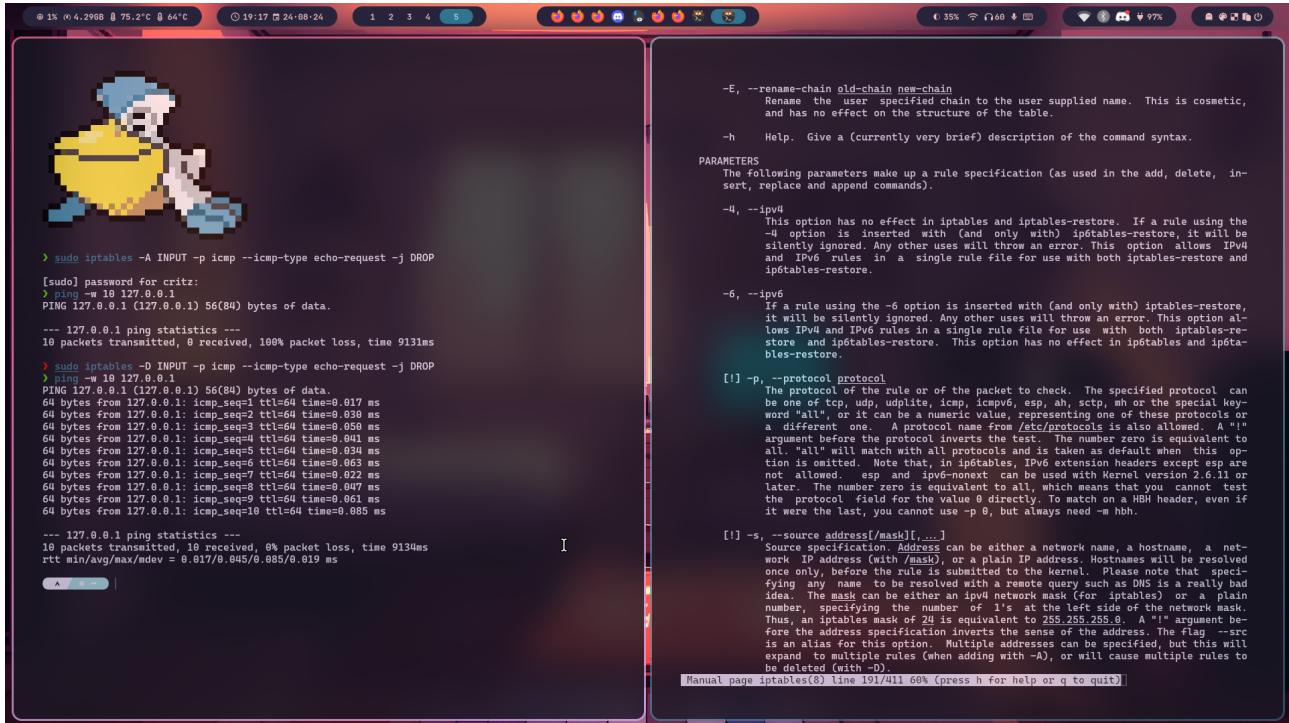
Figure 9: traceroute command to stanford.edu

g. The number of hops (ignoring "***") is 16, compared to 15 hops for google.in

h. Latency is different for both which could be due to geographical difference in the server locations. A part of the reason could also be network congestion.

Q6

- References: AskUbuntu Article



The screenshot shows a Linux desktop environment with a terminal window open. The terminal displays the following sequence of commands and their results:

```
> sudo iptables -A INPUT -p icmp --icmp-type echo-request -j DROP
[sudo] password for critz:
> ping -w 10 127.0.0.1
PING 127.0.0.1 (127.0.0.1) 56(84) bytes of data.
10 packets transmitted, 0 received, 100% packet loss, time 913ms
--- 127.0.0.1 ping statistics ---
10 packets transmitted, 0 received, 100% packet loss, time 913ms

> sudo iptables -D INPUT -p icmp --icmp-type echo-request -j DROP
> ping -w 10 127.0.0.1
PING 127.0.0.1 (127.0.0.1) 56(84) bytes of data.
64 bytes from 127.0.0.1: icmp_seq=1 ttl=64 time=0.017 ms
64 bytes from 127.0.0.1: icmp_seq=2 ttl=64 time=0.030 ms
64 bytes from 127.0.0.1: icmp_seq=3 ttl=64 time=0.050 ms
64 bytes from 127.0.0.1: icmp_seq=4 ttl=64 time=0.041 ms
64 bytes from 127.0.0.1: icmp_seq=5 ttl=64 time=0.034 ms
64 bytes from 127.0.0.1: icmp_seq=6 ttl=64 time=0.038 ms
64 bytes from 127.0.0.1: icmp_seq=7 ttl=64 time=0.072 ms
64 bytes from 127.0.0.1: icmp_seq=8 ttl=64 time=0.047 ms
64 bytes from 127.0.0.1: icmp_seq=9 ttl=64 time=0.061 ms
64 bytes from 127.0.0.1: icmp_seq=10 ttl=64 time=0.085 ms
--- 127.0.0.1 ping statistics ---
10 packets transmitted, 0 received, 100% packet loss, time 913ms
rtt min/avg/max/mdev = 0.017/0.045/0.085/0.019 ms
```

On the right side of the terminal window, the man page for `iptables` is visible, specifically the section for the `-E` option.

Figure 10: ping command with 100% packet loss

Commands

```
1 sudo iptables -A INPUT -p icmp --icmp-type echo-request -j DROP
2 ping -w 10 127.0.0.1
3 sudo iptables -D INPUT -p icmp --icmp-type echo-request -j DROP
4 ping -w 10 127.0.0.1
```

1. `iptables` is the command-line utility that allows us to configure the firewall
2. `-A INPUT` appends a rule to the incoming traffic to the machine1
3. Since ping command uses ICMP protocol, we silently discard ICMP echo requests, without sending anything back
4. Simply running the command with `-D` instead, deletes the rule and we can ping localhost again