Using command-line utilities for network debugging

Question 1

a.

```
kamper@VED-LAPPY: ~

kamper@VED-LAPPY:~$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1280
        inet 172.29.219.205  netmask 255.255.240.0  broadcast 172.29.223.255
        inet6 fe80::215:5dff:fe40:f7d4  prefixlen 64  scopeid 0x20<link>
        ether 00:15:5d:40:f7:d4  txqueuelen 1000  (Ethernet)
        RX packets 464  bytes 557604 (557.6 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 222  bytes 16678 (16.6 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 18  bytes 1971 (1.9 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 18  bytes 1971 (1.9 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

kamper@VED-LAPPY:~$
```

b. The IP address on the website https://whatismyip.com is different. This is because the IP addres shown in ifconfig is the private IP address provided by LAN and the IP address on the website is the public IP address that is used to identify the device on the internet.

Question 2

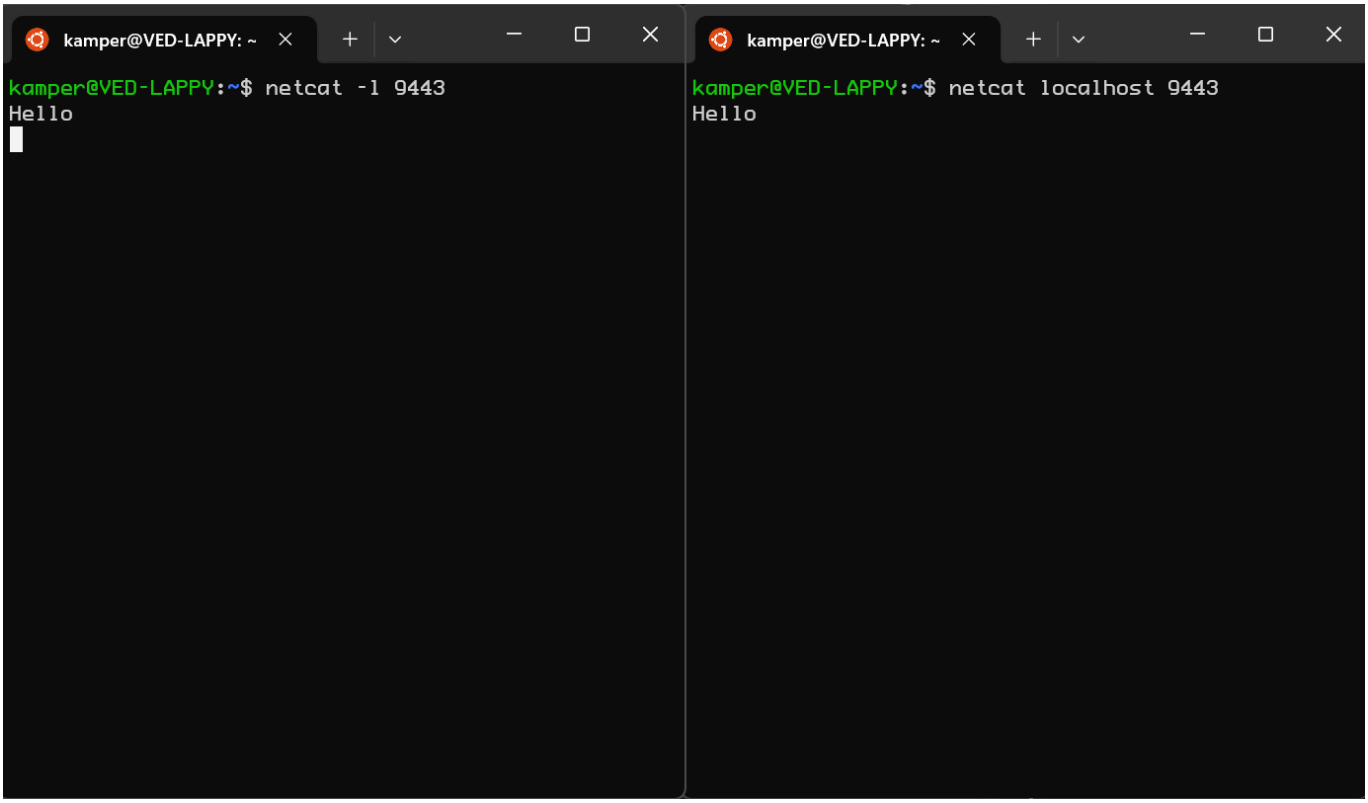
```
kamper@VED-LAPPY: ~

kamper@VED-LAPPY:~$ sudo ifconfig eth0 172.29.219.204
kamper@VED-LAPPY:~$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1280
        inet 172.29.219.204  netmask 255.255.0.0  broadcast 172.29.255.255
        inet6 fe80::215:5dff:fe40:f794  prefixlen 64  scopeid 0x20<link>
        ether 00:15:5d:40:f7:94  txqueuelen 1000  (Ethernet)
        RX packets 2350  bytes 3800562 (3.8 MB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 1176  bytes 83964 (83.9 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 34  bytes 3994 (3.9 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 34  bytes 3994 (3.9 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

kamper@VED-LAPPY:~$
```

you can revert back to the IP address by using the same command and use the original IP address.

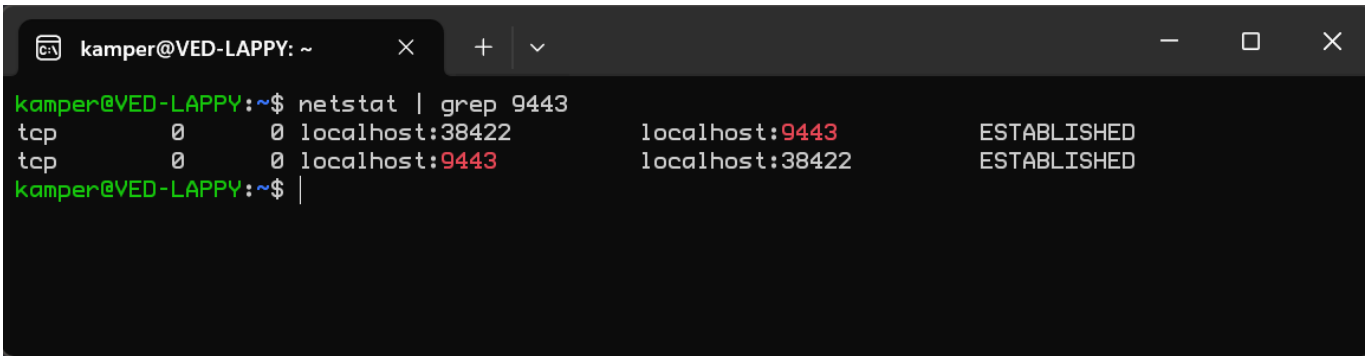
Alternatively, if you don't know the original IP address, you can reboot the system to revert to the original IP address.

Question 3

a.



b.



Question 4

a.

```
kamper@VED-LAPPY:~$ nslookup
> set querytype=soa
> google.in
Server:         10.255.255.254
Address:        10.255.255.254#53

Non-authoritative answer:
google.in
        origin = ns1.google.com
        mail addr = dns-admin.google.com
        serial = 668858537
        refresh = 900
        retry = 900
        expire = 1800
        minimum = 60

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
> exit

kamper@VED-LAPPY:~$ nslookup google.in ns1.google.com
Server:         ns1.google.com
Address:        216.239.32.10#53

Name:   google.in
Address: 142.250.207.196
Name:   google.in
Address: 2404:6800:4002:82e::2004

kamper@VED-LAPPY:~$
```

The query type soa shows where the authorative answers can be found from.

b.

```
kamper@VED-LAPPY:~$ dig +ttlid youtube.com

; <<>> DiG 9.18.28-0ubuntu0.22.04.1-Ubuntu <<>> +ttlid youtube.com
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 16565
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 4000
;; QUESTION SECTION:
;youtube.com.                   IN      A

;; ANSWER SECTION:
youtube.com.            184     IN      A       142.250.194.174

;; Query time: 0 msec
;; SERVER: 10.255.255.254#53(10.255.255.254) (UDP)
;; WHEN: Fri Aug 30 21:16:33 IST 2024
;; MSG SIZE  rcvd: 56

kamper@VED-LAPPY:~$
```

This entry would expire from the local DNS server in 184 seconds which means the cache for this will be cleared from the server every 184 seconds.

Question 5

a.

```
kamper@VED-LAPPY:~$ traceroute google.in
traceroute to google.in (142.250.193.4), 30 hops max, 60 byte packets
 1  VED-LAPPY.mshome.net (172.29.208.1)  0.289 ms  0.257 ms  0.246 ms
 2  192.168.224.254 (192.168.224.254)  1.323 ms  1.631 ms  1.513 ms
 3  auth.iiitd.edu.in (192.168.1.99)  0.329 ms  0.320 ms  0.520 ms
 4  103.25.231.1 (103.25.231.1)  0.644 ms  0.634 ms  0.623 ms
 5  * * *
 6  10.119.234.162 (10.119.234.162)  5.213 ms *  5.719 ms
 7  72.14.195.56 (72.14.195.56)  5.582 ms 72.14.194.160 (72.14.194.160)  3.415 ms  3.401 ms
 8  192.178.80.159 (192.178.80.159)  26.744 ms 142.251.54.111 (142.251.54.111)  27.557 ms 192.178.80.159 (192.
178.80.159)  27.024 ms
 9  142.251.54.87 (142.251.54.87)  24.374 ms 142.251.54.89 (142.251.54.89)  33.143 ms  33.136 ms
10  del11s14-in-f4.1e100.net (142.250.193.4)  29.794 ms  29.848 ms  29.610 ms
kamper@VED-LAPPY:~$
```

average latency

1 0.264ms

2 1.489ms

3 0.390ms

4 0.634ms

5 NA

6 5.466ms

7 4.132ms

8 27.115ms

9 30.218ms

10 29.751ms

b.

```
kamper@VED-LAPPY:~$ ping google.in -c 50 > ping.txt
kamper@VED-LAPPY:~$
```

```
PING google.in (142.250.193.4) 56(84) bytes of data.
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=1 ttl=54
```

```
time=30.1 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=2 ttl=54
time=30.1 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=3 ttl=54
time=30.0 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=4 ttl=54
time=30.8 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=5 ttl=54
time=30.2 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=6 ttl=54
time=30.1 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=7 ttl=54
time=30.3 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=8 ttl=54
time=30.2 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=9 ttl=54
time=30.3 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=10 ttl=54
time=30.2 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=11 ttl=54
time=30.6 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=12 ttl=54
time=30.1 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=13 ttl=54
time=30.2 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=14 ttl=54
time=30.6 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=15 ttl=54
time=30.6 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=16 ttl=54
time=30.2 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=17 ttl=54
time=30.1 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=18 ttl=54
time=30.4 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=19 ttl=54
time=30.8 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=20 ttl=54
time=30.2 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=21 ttl=54
time=30.0 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=22 ttl=54
time=30.2 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=23 ttl=54
time=30.6 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=24 ttl=54
time=30.1 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=25 ttl=54
time=30.4 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=26 ttl=54
time=31.2 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=27 ttl=54
time=30.7 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=28 ttl=54
```

```
time=30.2 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=29 ttl=54
time=30.2 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=30 ttl=54
time=30.3 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=31 ttl=54
time=30.1 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=32 ttl=54
time=30.2 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=33 ttl=54
time=31.3 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=34 ttl=54
time=30.3 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=35 ttl=54
time=30.4 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=36 ttl=54
time=30.0 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=37 ttl=54
time=30.2 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=38 ttl=54
time=30.3 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=39 ttl=54
time=30.2 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=40 ttl=54
time=30.2 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=41 ttl=54
time=30.2 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=42 ttl=54
time=30.1 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=43 ttl=54
time=31.2 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=44 ttl=54
time=31.2 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=45 ttl=54
time=30.2 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=46 ttl=54
time=30.1 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=47 ttl=54
time=30.0 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=48 ttl=54
time=30.4 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=49 ttl=54
time=30.3 ms
64 bytes from del11s14-in-f4.1e100.net (142.250.193.4): icmp_seq=50 ttl=54
time=30.1 ms

--- google.in ping statistics ---
50 packets transmitted, 50 received, 0% packet loss, time 49089ms
rtt min/avg/max/mdev = 30.003/30.338/31.261/0.327 ms
```

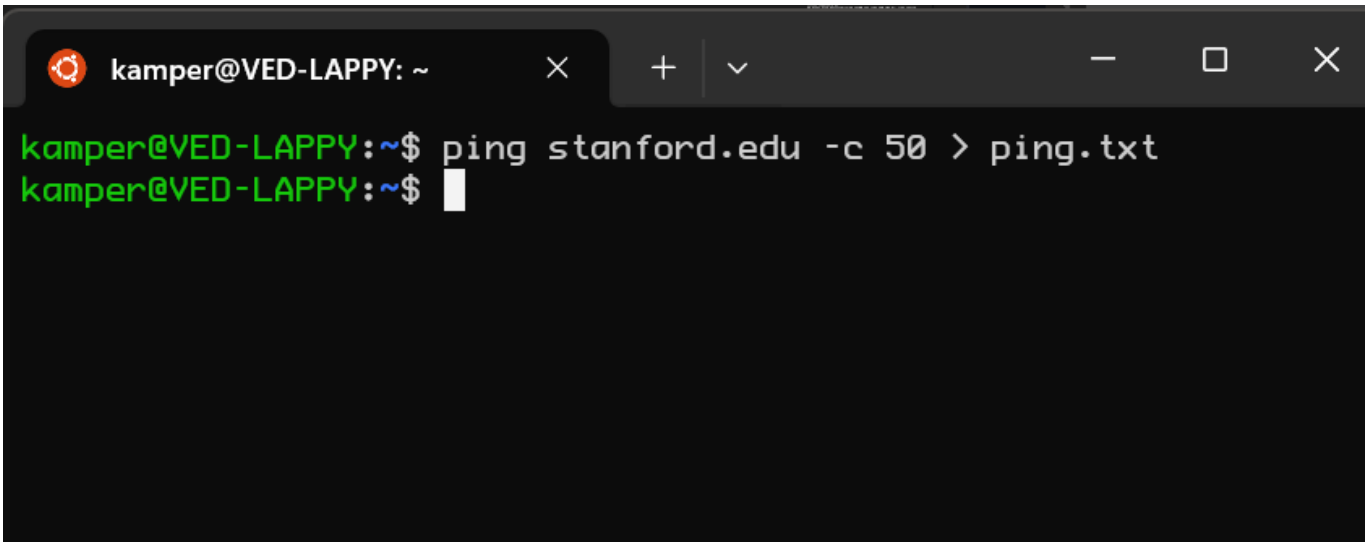
the average ping is 30.338ms. (NOTE: I decided to take text output because screenshot wouldn't fit the entire contents)

c. The total traceroute latency is 99.459ms which doesn't much the latency of 30.338ms from ping. Traceroute sends packets to each node and waits for the timeout response on each node. The traceroute shows the time it takes for each of those nodes to respond.

d. The maximum latency in (a) is very close to the average ping latency in (b). This is because the latency to get to the final destination should be the same.

e. There are more than one entries in intermediate hosts because there is more than one path from the machine to the final destination.

f.




```
PING stanford.edu (171.67.215.200) 56(84) bytes of data.
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=1 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=2 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=3 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=4 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=5 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=6 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=7 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=8 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=9 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=10 ttl=235 time=270 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=11 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=12 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=13 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=14 ttl=235 time=272 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=15 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=16 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=17 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=18 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=19 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=20 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=21 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=22 ttl=235 time=271 ms
```

```
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=23 ttl=235 time=274 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=24 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=25 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=26 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=27 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=28 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=29 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=30 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=31 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=32 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=33 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=34 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=35 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=36 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=37 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=38 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=39 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=40 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=41 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=42 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=43 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=44 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=45 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=46 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=47 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=48 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=49 ttl=235 time=271 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=50 ttl=235 time=271 ms

--- stanford.edu ping statistics ---
50 packets transmitted, 50 received, 0% packet loss, time 49063ms
rtt min/avg/max/mdev = 270.380/270.999/274.375/0.556 ms
```

The average latency for stanford.edu is 270.999ms

g.

```
kamper@VED-LAPPY: ~
kamper@VED-LAPPY:~$ traceroute stanford.edu
traceroute to stanford.edu (171.67.215.200), 30 hops max, 60 byte packets
 1  VED-LAPPY.mshome.net (172.29.208.1)  0.246 ms  0.215 ms  0.328 ms
 2  192.168.224.254 (192.168.224.254)  2.356 ms  2.488 ms  2.600 ms
 3  vpn.iiitd.edu.in (192.168.1.99)  0.231 ms  0.208 ms  0.201 ms
 4  103.25.231.1 (103.25.231.1)  0.587 ms  0.476 ms  0.574 ms
 5  10.1.209.201 (10.1.209.201)  23.704 ms  23.511 ms  23.678 ms
 6  10.1.200.137 (10.1.200.137)  44.162 ms  44.045 ms  43.729 ms
 7  10.255.238.254 (10.255.238.254)  24.943 ms  24.919 ms 10.255.238.122 (10.255.238.122)  23.407 ms
 8  180.149.48.18 (180.149.48.18)  27.456 ms  27.713 ms  27.809 ms
 9  * * *
10  * * *
11  * * *
12  * * *
13  * * *
14  * * *
15  * * *
16  * * *
17  * * *
18  * * *
19  * * *
20  * * *
21  * * *
22  * * *
23  * * *
24  campus-ial-nets-b-vl1104.SUNet (171.66.255.200)  273.401 ms campus-east-rtr-vl1120.SUNet (171.66.255.232)  278.63
1 ms campus-east-rtr-vl1020.SUNet (171.64.255.232)  269.697 ms
25  campus-ial-nets-b-vl1120.SUNet (171.66.255.232)  278.831 ms *  278.723 ms
26  web.stanford.edu (171.67.215.200)  270.727 ms  270.580 ms *
kamper@VED-LAPPY:~$
```

there are 26 intermeidate hosts in stanford.edu compared to 10 intermediate hosts in google.in

h. The main reason for higher latency in stanford.edu compared to google.in is due to the distance of the machines being different. stanford.edu probably has its node in america while google.in is probably in India. Latency of communication increases as distance increases.

Question 6

```
kamper@VED-LAPPY: ~
kamper@VED-LAPPY:~$ sudo ifconfig lo down
kamper@VED-LAPPY:~$ ping 127.0.0.1
PING 127.0.0.1 (127.0.0.1) 56(84) bytes of data.
^C
--- 127.0.0.1 ping statistics ---
2 packets transmitted, 0 received, 100% packet loss, time 1034ms

kamper@VED-LAPPY:~$
```

Just remove the loopback and you can have 100% packet loss.