Assignment 1

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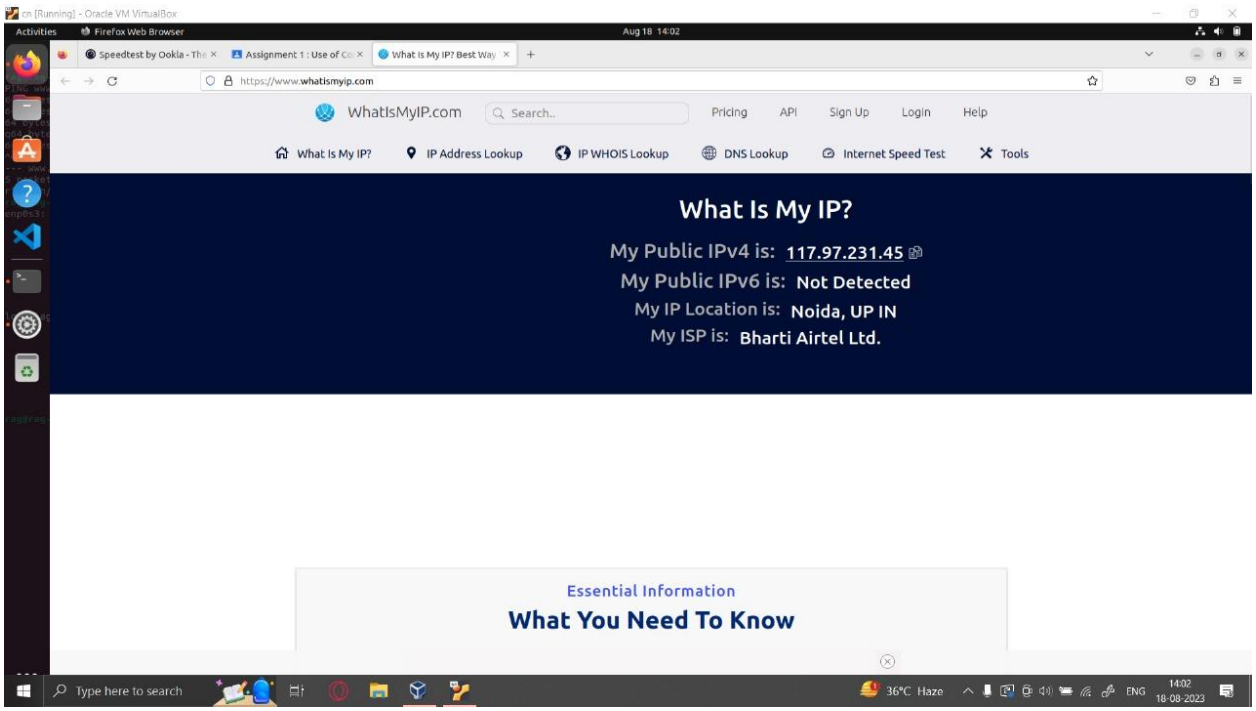
1)

a. The ip-address of my vm is 192.168.160.174

```
rag@rag-VirtualBox:~$ ifconfig
enp0s3: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.160.174  netmask 255.255.255.0  broadcast 192.168.160.255
        inet6 fe80::3ab9:f3a8:93a3:a31e  prefixlen 64  scopeid 0x20<link>
        ether 08:00:27:01:27:57  txqueuelen 1000  (Ethernet)
        RX packets 608  bytes 270141 (270.1 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 533  bytes 58269 (58.2 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 366  bytes 39436 (39.4 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 366  bytes 39436 (39.4 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

b. No the IP address is not the same. This is because when using ifconfig we viewing the local IP addresses assigned to your network interfaces which is not directly accessible from the internet. Meanwhile the website ‘WhatisMyip” displays the public ip address.



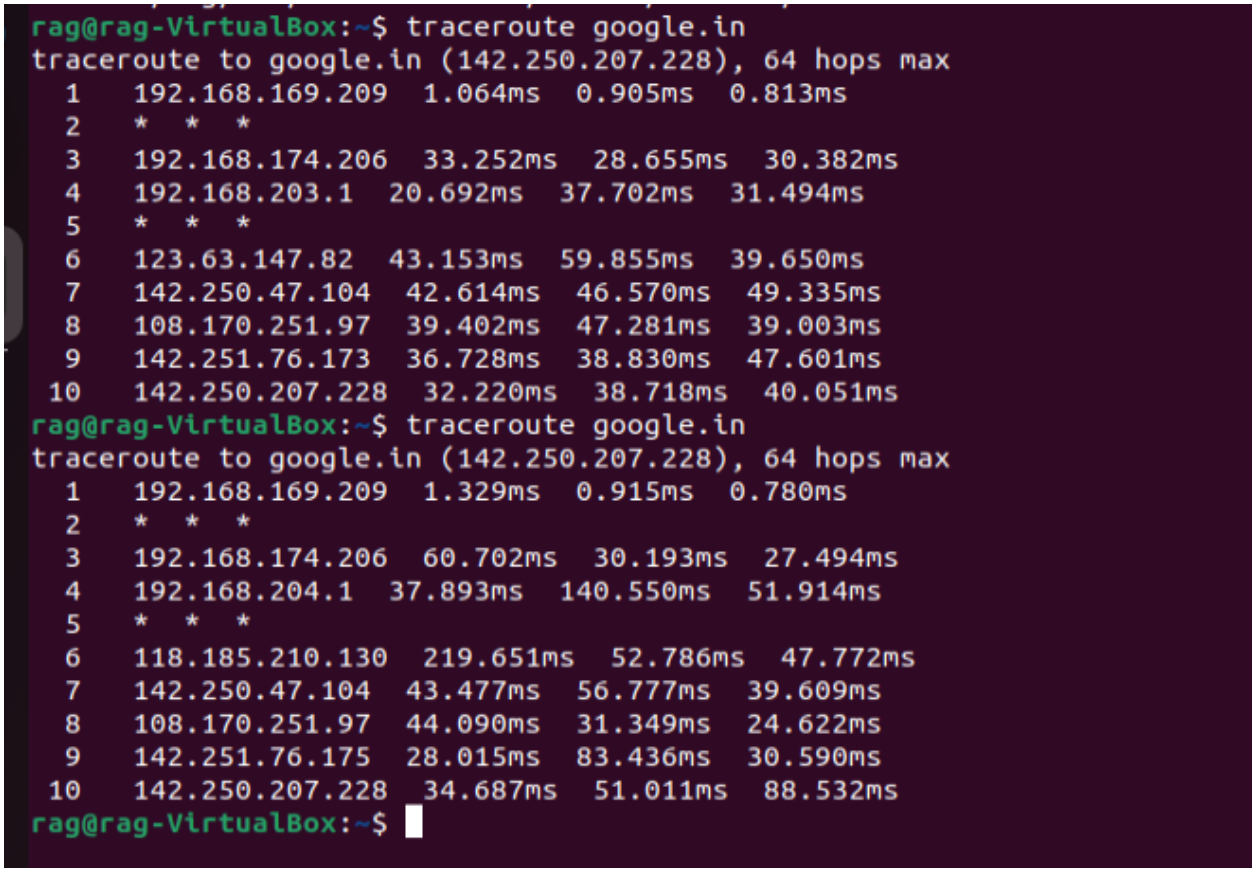
2)

a. To get an authoritative response from the DNS server, I used nslookup with type=ns. This allowed me to find the addresses from where I can get authoritative response. Then querying these addresses allowed me to get an authoritative response.

```
rag@rag-VirtualBox:~$ nslookup
> google.in
Server:         127.0.0.53
Address:        127.0.0.53#53

Non-authoritative answer:
Name:   google.in
Address: 142.250.194.164
Name:   google.in
Address: 2404:6800:4002:823::2004
> set type=ns
> google.in
;; communications error to 127.0.0.53#53: timed out
Server:         127.0.0.53
Address:        127.0.0.53#53

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

Authoritative answers can be found from:
ns3.google.com  internet address = 216.239.36.10
ns3.google.com  has AAAA address 2001:4860:4802:36::a
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
ns4.google.com  has AAAA address 2001:4860:4802:38::a
ns1.google.com  internet address = 216.239.32.10
ns1.google.com  has AAAA address 2001:4860:4802:32::a
> ns3.google.com
;; communications error to 127.0.0.53#53: timed out
Server:         127.0.0.53
Address:        127.0.0.53#53

Non-authoritative answer:
*** Can't find ns3.google.com: No answer

Authoritative answers can be found from:
google.com
        origin = ns1.google.com
        mail addr = dns-admin.google.com
        serial = 556730683
        refresh = 900
        retry = 900
        expire = 1800
        minimum = 60
> ns1.google.com
;; communications error to 127.0.0.53#53: timed out
Server:         127.0.0.53
Address:        127.0.0.53#53
```

b) For TTL, I have nslookup -debug queries the DNS to provide the details. Here the ttl was 72ms.

3)
a)



For the first set of responses:

Average for Hop 1: (1.064 + 0.905 + 0.813) / 3 = 0.927 ms
Average for Hop 3: (33.252 + 28.655 + 30.382) / 3 = 30.430 ms
Average for Hop 4: (20.692 + 37.702 + 31.494) / 3 = 29.963 ms
Average for Hop 6: (43.153 + 59.855 + 39.650) / 3 = 47.219 ms
Average for Hop 7: (42.614 + 46.570 + 49.335) / 3 = 46.840 ms
Average for Hop 8: (39.402 + 47.281 + 39.003) / 3 = 41.562 ms
Average for Hop 9: (36.728 + 38.830 + 47.601) / 3 = 41.720 ms
Average for Hop 10: (32.220 + 38.718 + 40.051) / 3 = 37.663 ms

For the second set of responses:

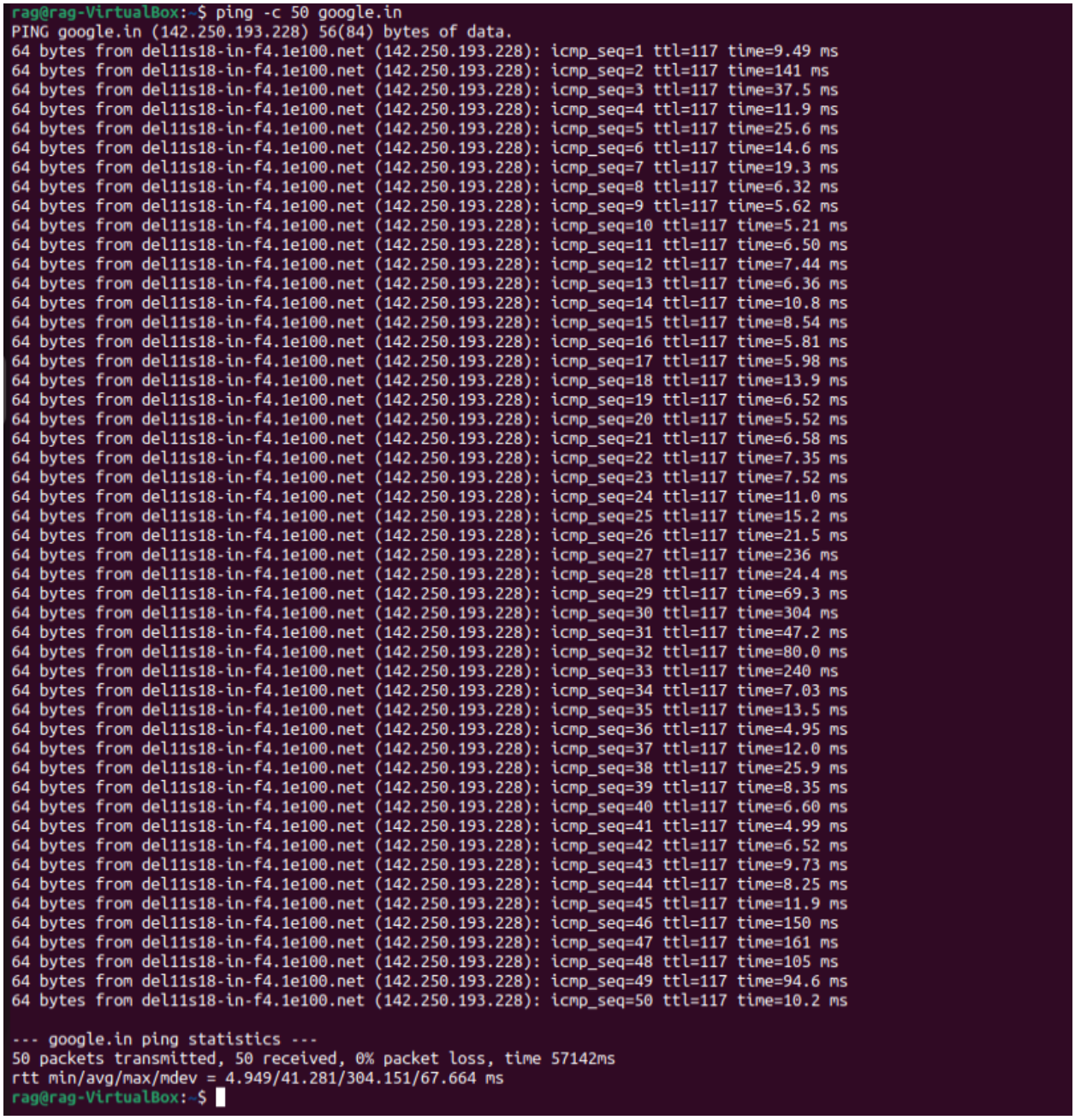
Average for Hop 1: (1.329 + 0.915 + 0.780) / 3 = 1.008 ms
Average for Hop 3: (60.702 + 30.193 + 27.494) / 3 = 39.463 ms
Average for Hop 4: (37.893 + 140.550 + 51.914) / 3 = 76.786 ms
Average for Hop 6: (219.651 + 52.786 + 47.772) / 3 = 106.736 ms
Average for Hop 7: (43.477 + 56.777 + 39.609) / 3 = 46.288 ms
Average for Hop 8: (44.090 + 31.349 + 24.622) / 3 = 33.687 ms

Average for Hop 9: (28.015 + 83.436 + 30.590) / 3 = 47.013 ms
Average for Hop 10: (34.687 + 51.011 + 88.532) / 3 = 58.743 ms

For the first set of responses:
Total Time = 0.927 + 30.430 + 29.963 + 47.219 + 46.840 + 41.562 + 41.720 + 37.663 = 276.324 ms

For the second set of responses:
Total Time = 1.008 + 39.463 + 76.786 + 106.736 + 46.288 + 33.687 + 47.013 + 58.743 = 409.724 ms

b)



```
rag@rag-VirtualBox:~$ ping -c 50 google.in
PING google.in (142.250.193.228) 56(84) bytes of data.
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=1 ttl=117 time=9.49 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=2 ttl=117 time=141 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=3 ttl=117 time=37.5 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=4 ttl=117 time=11.9 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=5 ttl=117 time=25.6 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=6 ttl=117 time=14.6 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=7 ttl=117 time=19.3 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=8 ttl=117 time=6.32 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=9 ttl=117 time=5.62 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=10 ttl=117 time=5.21 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=11 ttl=117 time=6.50 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=12 ttl=117 time=7.44 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=13 ttl=117 time=6.36 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=14 ttl=117 time=10.8 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=15 ttl=117 time=8.54 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=16 ttl=117 time=5.81 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=17 ttl=117 time=5.98 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=18 ttl=117 time=13.9 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=19 ttl=117 time=6.52 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=20 ttl=117 time=5.52 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=21 ttl=117 time=6.58 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=22 ttl=117 time=7.35 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=23 ttl=117 time=7.52 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=24 ttl=117 time=11.0 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=25 ttl=117 time=15.2 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=26 ttl=117 time=21.5 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=27 ttl=117 time=236 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=28 ttl=117 time=24.4 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=29 ttl=117 time=69.3 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=30 ttl=117 time=304 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=31 ttl=117 time=47.2 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=32 ttl=117 time=80.0 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=33 ttl=117 time=240 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=34 ttl=117 time=7.03 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=35 ttl=117 time=13.5 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=36 ttl=117 time=4.95 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=37 ttl=117 time=12.0 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=38 ttl=117 time=25.9 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=39 ttl=117 time=8.35 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=40 ttl=117 time=6.60 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=41 ttl=117 time=4.99 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=42 ttl=117 time=6.52 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=43 ttl=117 time=9.73 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=44 ttl=117 time=8.25 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=45 ttl=117 time=11.9 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=46 ttl=117 time=150 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=47 ttl=117 time=161 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=48 ttl=117 time=105 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=49 ttl=117 time=94.6 ms
64 bytes from del11s18-in-f4.1e100.net (142.250.193.228): icmp_seq=50 ttl=117 time=10.2 ms

--- google.in ping statistics ---
50 packets transmitted, 50 received, 0% packet loss, time 57142ms
rtt min/avg/max/mdev = 4.949/41.281/304.151/67.664 ms
rag@rag-VirtualBox:~$
```

c)

Total Time(Traceroute) = 0.927 + 30.430 + 29.963 + 47.219 + 46.840 + 41.562 + 41.720 + 37.663 = 276.324 ms

Total Time(Ping) =41.281ms

No, the latencies do not match as traceroute measures the time it takes for packets to reach each intermediate host and return, while ping measures the round-trip time to the final destination. Traceroute involves more hops and intermediate hosts, potentially encountering different network conditions at each hop.

Traceroute and ping also might take slightly different paths through the network, potentially encountering different network equipment and conditions.

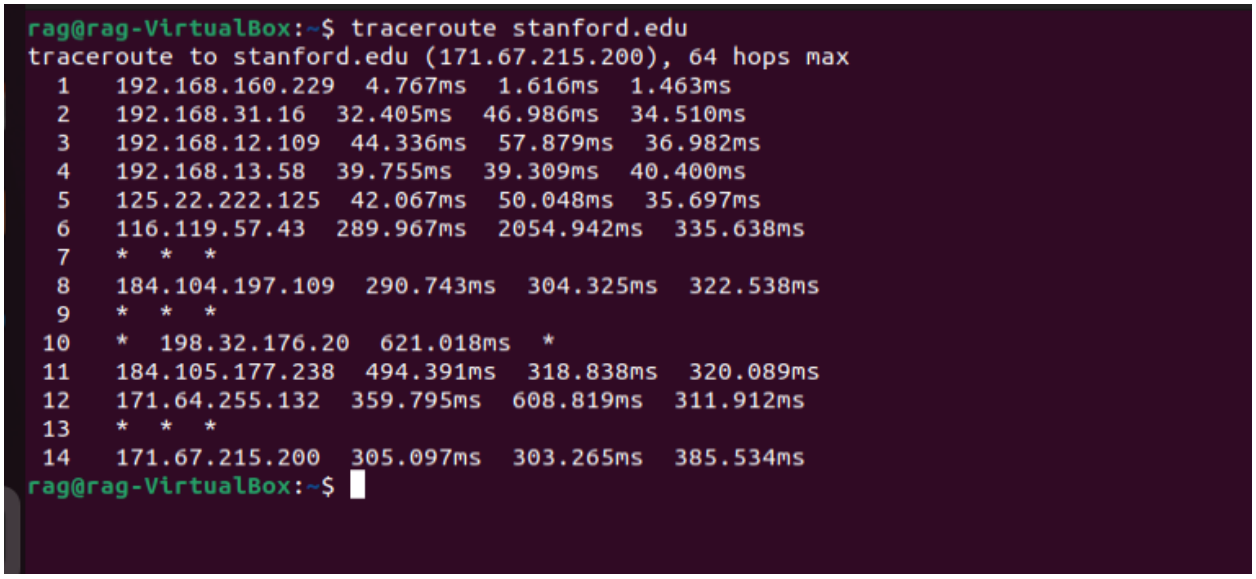
d) They do not match, as the latency in traceroute represents the traffic in that host being high during each jump. On the other hand ping is the rtt, and represents the traffic in the connection.

e) Even though, i did not get any multiple entries, it can happen while using tracereoute. It is usually due to the fact that traceroute shows you multiple paths with equal cost through which the destination is possible to reach. Another reason for this could be that due to higher traffic, packets are transferred through multiple paths.

f)

```
rag@rag-VirtualBox:~$ ping -c 50 stanford.edu
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=231 time=318 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=2 ttl=231 time=349 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=3 ttl=231 time=349 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=4 ttl=231 time=607 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=5 ttl=231 time=300 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=6 ttl=231 time=504 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=7 ttl=231 time=686 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=8 ttl=231 time=649 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=9 ttl=231 time=611 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=10 ttl=231 time=550 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=11 ttl=231 time=529 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=12 ttl=231 time=580 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=13 ttl=231 time=511 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=14 ttl=231 time=779 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=15 ttl=231 time=833 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=16 ttl=231 time=313 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=17 ttl=231 time=302 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=18 ttl=231 time=338 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=19 ttl=231 time=319 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=20 ttl=231 time=295 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=21 ttl=231 time=338 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=22 ttl=231 time=344 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=23 ttl=231 time=312 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=24 ttl=231 time=321 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=25 ttl=231 time=438 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=26 ttl=231 time=330 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=27 ttl=231 time=318 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=28 ttl=231 time=575 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=29 ttl=231 time=423 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=30 ttl=231 time=301 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=31 ttl=231 time=451 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=32 ttl=231 time=350 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=33 ttl=231 time=367 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=34 ttl=231 time=323 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=35 ttl=231 time=314 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=36 ttl=231 time=565 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=37 ttl=231 time=379 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=38 ttl=231 time=309 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=39 ttl=231 time=437 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=40 ttl=231 time=343 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=41 ttl=231 time=323 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=42 ttl=231 time=388 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=43 ttl=231 time=591 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=44 ttl=231 time=343 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=45 ttl=231 time=369 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=46 ttl=231 time=310 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=47 ttl=231 time=396 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=48 ttl=231 time=388 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=49 ttl=231 time=348 ms
64 bytes from web.stanford.edu (171.67.215.200): icmp_seq=50 ttl=231 time=341 ms

--- stanford.edu ping statistics ---
50 packets transmitted, 50 received, 0% packet loss, time 49931ms
rtt min/avg/max/mdev = 295.460/421.103/832.615/133.515 ms
```

g) The route to Stanford had a higher number of hops.



Hop 1: Average latency: (4.767 + 1.616 + 1.463) / 3 = 2.948ms
Hop 2: Average latency: (32.405 + 46.986 + 34.510) / 3 = 37.634ms
Hop 3: Average latency: (44.336 + 57.879 + 36.982) / 3 = 46.732ms
Hop 4: Average latency: (39.755 + 39.309 + 40.400) / 3 = 39.488ms
Hop 5: Average latency: (42.067 + 50.048 + 35.697) / 3 = 42.937ms
Hop 6: Average latency: (289.967 + 2054.942 + 335.638) / 3 = 893.849ms
Hop 8: Average latency: (290.743 + 304.325 + 322.538) / 3 = 305.869ms
Hop 10: Average latency: 621.018ms (only one value)
Hop 11: Average latency: (494.391 + 318.838 + 320.089) / 3 = 377.773ms
Hop 12: Average latency: (359.795 + 608.819 + 311.912) / 3 = 426.842ms
Hop 14: Average latency: (305.097 + 303.265 + 385.534) / 3 = 331.632ms

Sum of all averages: 3765.719ms

h) The latency of stanford.edu is much higher than that of google.in. This could be due to many reasons like the google having its servers in india resulting in less rtt. Also as the number of hops in stanford.edu were more than that of in google.in resulting in an increased latency. Another reason could be that I had ran the commands on different times, and this could mean there was different traffic in the network at that point in time.

4) I have used sudo ifconfig lo down. This would result in the loopback interface being disabled temporarily, meaning that any network communication that relies on the loopback interface (such as accessing localhost or 127.0.0.1) won't work

```
rag@rag-VirtualBox:~$ sudo ifconfig lo down
[sudo] password for rag:
rag@rag-VirtualBox:~$ 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 ---
6 packets transmitted, 0 received, 100% packet loss, time 5119ms

rag@rag-VirtualBox:~$
```

5)

```
rag@rag-VirtualBox:~$ telnet 192.168.24.12 9900
Trying 192.168.24.12...
Connected to 192.168.24.12.
Escape character is '^]'.
GET /secret HTTP/1.1
Host: 192.168.24.12

HTTP/1.1 200 OK
Content-Type: text/plain
ip: 192.168.1.99
X-secret: U2FsdGVkX1/71l7CgWMpxxQ+VRtHcuIsLAhP2PC5UsXNuI78WsEotPg2vS+9rg06
Date: Thu, 24 Aug 2023 17:43:30 GMT
Connection: keep-alive
Keep-Alive: timeout=5
Content-Length: 8

Success
```

6)

```
rag@rag-VirtualBox:~$ telnet 192.168.24.12 smtp
Trying 192.168.24.12...
Connected to 192.168.24.12.
Escape character is '^]'.
220 Welcome to CSE232 Mail Server
helo cse232.com
250 xeon01-rs-iiitd.iiitd.edu.in
MAIL FROM: 21274@cse232.com
250 2.1.0 Ok
RCPT TO: 21286@cse232.com
250 2.1.5 Ok
DATA
354 End data with <CR><LF>.<CR><LF>
Subject: SMPT

mail using smtp proto
.
250 2.0.0 Ok: queued as B0FDD6F643AC
quit
221 2.0.0 Bye
Connection closed by foreign host.
rag@rag-VirtualBox:~$
```

```
From 21274@cse232.com  Thu Aug 24 23:22:52 2023
Return-Path: <21274@cse232.com>
X-Original-To: 21286@cse232.com
Delivered-To: 21286@cse232.com
Received: from cse232.com (vpn.iiitd.edu.in [192.168.1.99])
        by xeon01-rs-iiitd.iiitd.edu.in (Postfix) with SMTP id B0FDD6F643AC
        for <21286@cse232.com>; Thu, 24 Aug 2023 23:19:00 +0530 (IST)
Subject: SMPT

mail using smtp proto
```