Project 4 - ICMP Ping and Traceroute

Part A: Execution trace of ping output tested against ten (10) different IP addresses

```
PS C:\Users\Helen> & C:/Users/Helen/AppData/Local/Programs/Python/Py
Pinging 192.33.12.201 [192.33.12.201] 3 times using Python:
Ping 1 RTT 0.004043 sec
Ping 2 RTT 0.006039 sec
Ping 3 RTT 0.006727 sec
Pinging 128.2.42.52 [128.2.42.52] 3 times using Python:
Ping 1 RTT 0.023799 sec
Ping 2 RTT 0.025050 sec
Ping 3 RTT 0.022076 sec
Pinging 35.232.19.139 [35.232.19.139] 3 times using Python:
Ping 1 RTT 0.044643 sec
Ping 2 RTT 0.041592 sec
Ping 3 RTT 0.042060 sec
Pinging 66.39.95.22 [66.39.95.22] 3 times using Python:
Ping 1 RTT 0.032576 sec
Ping 2 RTT 0.034478 sec
Ping 3 RTT 0.034914 sec
Pinging 67.225.164.122 [67.225.164.122] 3 times using Python:
Ping 1 RTT 0.038622 sec
Ping 2 RTT 0.038115 sec
Ping 3 RTT 0.038861 sec
Pinging 129.194.6.50 [129.194.6.50] 3 times using Python:
Ping 1 RTT 0.093884 sec
Ping 2 RTT 0.094739 sec
Ping 3 RTT 0.094692 sec
Pinging 34.174.121.15 [34.174.121.15] 3 times using Python:
Ping 1 RTT 0.048968 sec
Ping 2 RTT 0.048440 sec
Ping 3 RTT 0.048810 sec
Pinging 141.20.5.188 [141.20.5.188] 3 times using Python:
Ping 1 RTT 0.119960 sec
Ping 2 RTT 0.123210 sec
Ping 3 RTT 0.117830 sec
Pinging 134.21.80.50 [134.21.80.50] 3 times using Python:
Ping 1 RTT 0.097657 sec
Ping 2 RTT 0.097383 sec
Ping 3 RTT 0.097402 sec
Pinging 128.232.132.8 [128.232.132.8] 3 times using Python:
Ping 1 RTT 0.102845 sec
Ping 2 RTT 0.104357 sec
Ping 3 RTT 0.102256 sec
PS C:\Users\Helen>
```

Part B: Execution trace of traceroute output tested against ten (10) different IP addresses

```
The traceroute for 192.33.12.201:

 1 rtt=29 ms 131.229.47.254
 2 rtt=74 ms 131.229.11.142
 3 rtt=25 ms 131.229.10.104
 4 rtt=8 ms 134.241.249.33
 5 rtt=24 ms 134.241.249.28
 6 rtt=14 ms 64.254.160.15
 7 rtt=19 ms 192.33.12.201
 8 rtt=17 ms 192.33.12.201
```

```
The traceroute for 128.2.42.52:

 1 rtt=44 ms 131.229.47.254
 2 rtt=22 ms 131.229.11.142
 3 rtt=25 ms 131.229.10.104
 4 rtt=5 ms 134.241.249.33
 5 rtt=7 ms 69.16.1.33
 6 rtt=5 ms 18.2.8.89
 7 rtt=9 ms 192.5.89.57
 8 rtt=17 ms 192.5.89.222
 9 rtt=16 ms 163.253.1.241
 10 rtt=15 ms 163.253.5.33
 11 rtt=26 ms 162.223.17.79
 12 rtt=25 ms 128.2.255.181
 13 rtt=30 ms 128.2.255.210
 14 rtt=40 ms 128.2.42.52
```

```
The traceroute for 35.232.19.139:

 1 rtt=89 ms 131.229.47.254
 2 rtt=30 ms 131.229.11.142
 3 rtt=25 ms 131.229.10.104
 4 rtt=13 ms 134.241.249.33
 5 rtt=4 ms 69.16.1.33
 6 rtt=8 ms 18.2.136.89
 7 rtt=50 ms 192.5.89.46
 8 rtt=21 ms 18.2.145.18
 9 rtt=43 ms 35.232.19.139
```

```
The traceroute for 141.20.5.188:

 1 rtt=9 ms 131.229.47.254
 2 rtt=13 ms 131.229.11.142
 3 rtt=21 ms 131.229.10.104
 4 rtt=4 ms 134.241.249.33
 5 rtt=5 ms 69.16.1.33
 6 rtt=5 ms 18.2.8.89
 7 rtt=10 ms 192.5.89.57
 8 rtt=16 ms 192.5.89.222
 9 rtt=14 ms 163.253.1.40
 10 rtt=86 ms 198.71.45.237
 11 rtt=114 ms 62.40.98.238
 12 rtt=109 ms 62.40.98.182
 13 rtt=112 ms 62.40.98.69
 14 rtt=125 ms 62.40.125.171
 15 rtt=155 ms 188.1.235.242
 * * * Request timed out.
 * * * Request timed out.
 * * * Request timed out.
 * * * Request timed out.
 * * * Request timed out.
 * * * Request timed out.
 * * * Request timed out.
 * * * Request timed out.
 * * * Request timed out.
 21 rtt=118 ms 141.20.5.188
```

```
The traceroute for 67.225.164.122:

 1 rtt=12 ms 131.229.47.254
 2 rtt=16 ms 131.229.11.142
 3 rtt=18 ms 131.229.10.104
 4 rtt=5 ms 134.241.249.33
 5 rtt=2 ms 69.16.1.33
 6 rtt=9 ms 69.16.0.9
 7 rtt=9 ms 38.104.218.13
 8 rtt=13 ms 154.54.81.229
 9 rtt=22 ms 154.54.26.129
 10 rtt=30 ms 154.54.6.221
 11 rtt=35 ms 154.54.45.18
 12 rtt=44 ms 38.32.98.66
 13 rtt=38 ms 209.59.157.224
 14 rtt=37 ms 209.59.157.59
 15 rtt=38 ms 67.225.164.122
```

```
The traceroute for 129.194.6.50:

 1 rtt=21 ms 131.229.47.254
 2 rtt=29 ms 131.229.11.142
 3 rtt=23 ms 131.229.10.104
 4 rtt=4 ms 134.241.249.33
 5 rtt=5 ms 69.16.1.33
 6 rtt=3 ms 18.2.8.89
 7 rtt=9 ms 192.5.89.57
 8 rtt=17 ms 192.5.89.222
 9 rtt=15 ms 163.253.1.42
 10 rtt=86 ms 198.71.45.237
 11 rtt=94 ms 62.40.98.238
 12 rtt=96 ms 62.40.124.22
 13 rtt=94 ms 130.59.38.194
 14 rtt=95 ms 192.33.214.18
 * * * Request timed out.
 * * * Request timed out.
 * * * Request timed out.
 * * * Request timed out.
 17 rtt=94 ms 129.194.6.1
 18 rtt=92 ms 129.194.6.50
```

```
The traceroute for 34.174.121.15:

 1 rtt=6 ms 131.229.47.254
 2 rtt=31 ms 131.229.11.142
 3 rtt=18 ms 131.229.10.104
 4 rtt=7 ms 134.241.249.33
 5 rtt=4 ms 69.16.1.33
 6 rtt=5 ms 18.2.136.89
 7 rtt=15 ms 192.5.89.42
 8 rtt=13 ms 18.2.145.18
 9 rtt=49 ms 34.174.121.15
```

```
The traceroute for 66.39.95.22:

 1 rtt=12 ms 131.229.47.254
 2 rtt=54 ms 131.229.11.142
 3 rtt=22 ms 131.229.10.104
 4 rtt=7 ms 134.241.249.33
 5 rtt=15 ms 69.16.1.33
 6 rtt=8 ms 65.175.24.205
 7 rtt=33 ms 141.136.108.125
 8 rtt=40 ms 173.205.47.214
 * * * Request timed out.
 * * * Request timed out.
 10 rtt=34 ms 66.39.95.22
```

```
The traceroute for 128.232.132.8:

 1 rtt=6 ms 131.229.47.254
 2 rtt=16 ms 131.229.11.142
 3 rtt=21 ms 131.229.10.104
 4 rtt=4 ms 134.241.249.33
 5 rtt=2 ms 69.16.1.33
 6 rtt=5 ms 18.2.8.89
 7 rtt=7 ms 192.5.89.57
 8 rtt=16 ms 192.5.89.222
 9 rtt=16 ms 163.253.1.40
 10 rtt=122 ms 198.71.45.237
 11 rtt=98 ms 62.40.98.106
 12 rtt=97 ms 62.40.98.64
 13 rtt=99 ms 62.40.124.198
 14 rtt=99 ms 146.97.33.18
 15 rtt=103 ms 146.97.35.246
 16 rtt=104 ms 146.97.41.38
 17 rtt=100 ms 131.111.7.82
 18 rtt=109 ms 193.60.88.6
 19 rtt=105 ms 193.60.88.6
 20 rtt=103 ms 128.232.128.6
 21 rtt=103 ms 128.232.128.10
 22 rtt=102 ms 128.232.132.8
```

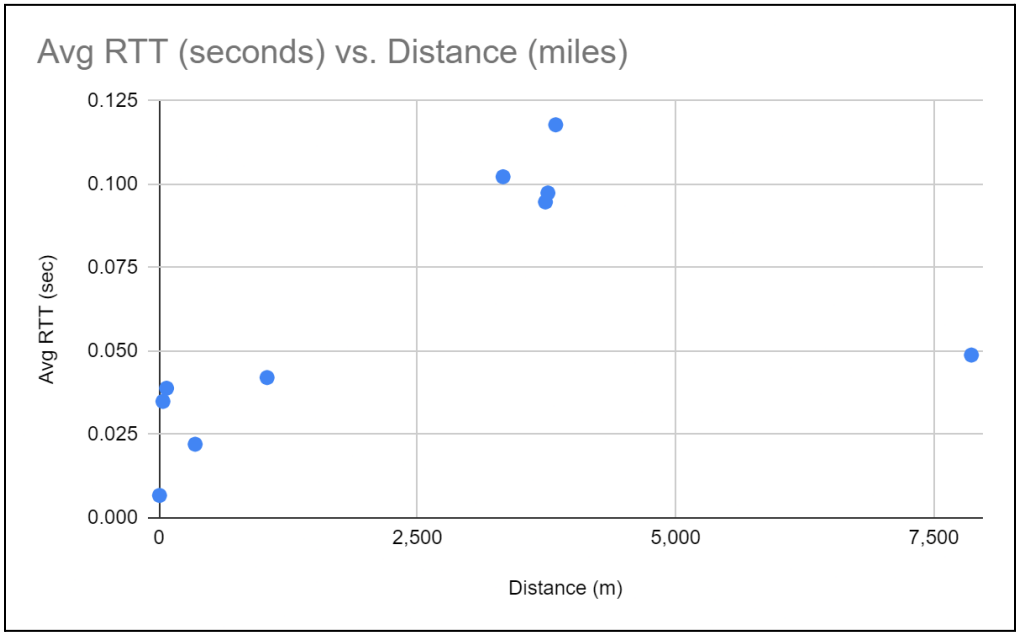
```
The traceroute for 134.21.80.50:

 1 rtt=10 ms 131.229.47.254
 2 rtt=23 ms 131.229.11.142
 3 rtt=23 ms 131.229.10.104
 4 rtt=7 ms 134.241.249.33
 5 rtt=5 ms 69.16.1.33
 6 rtt=6 ms 18.2.8.89
 7 rtt=9 ms 192.5.89.57
 8 rtt=16 ms 192.5.89.222
 9 rtt=15 ms 163.253.1.40
 10 rtt=86 ms 198.71.45.237
 11 rtt=94 ms 62.40.98.238
 12 rtt=97 ms 62.40.124.22
 13 rtt=93 ms 130.59.36.70
 14 rtt=96 ms 130.59.37.154
 15 rtt=95 ms 130.59.37.145
 16 rtt=97 ms 192.47.245.25
 * * * Request timed out.
 * * * Request timed out.
 * * * Request timed out.
 * * * Request timed out.
 * * * Request timed out.
 * * * Request timed out.
 * * * Request timed out.
 * * * Request timed out.
 21 rtt=99 ms 134.21.80.50
```

Note:

To find the IP addresses, I used a combination of the suggested IP Location Finder and Google Maps. For each address, I would first use the Location Finder, but if it gave back coordinates not in the proximity of its supposed location, I used Google Maps.

Scatterplot A:

Scatterplot with the Average RTT in milliseconds on the Y-axis, and the geographic distance in miles on the X-axis.



1. **Are RTT and geographic distance correlated positively, negatively, or not at all? If applicable, also comment on the strength of correlation (weak vs. strong).**

There is a slight positive correlation between the distance in miles and average RTT in seconds of these 10 IP addresses. Given that the data points are more spread out, the strength of the correlation is weak, with an outlier from Africa University's IP address.

We can also see on the graph that some of the calculated IP addresses close to Smith College (i.e. Hampshire Franklin Pierce University) are very below 2,500; they have a short distance to travel.

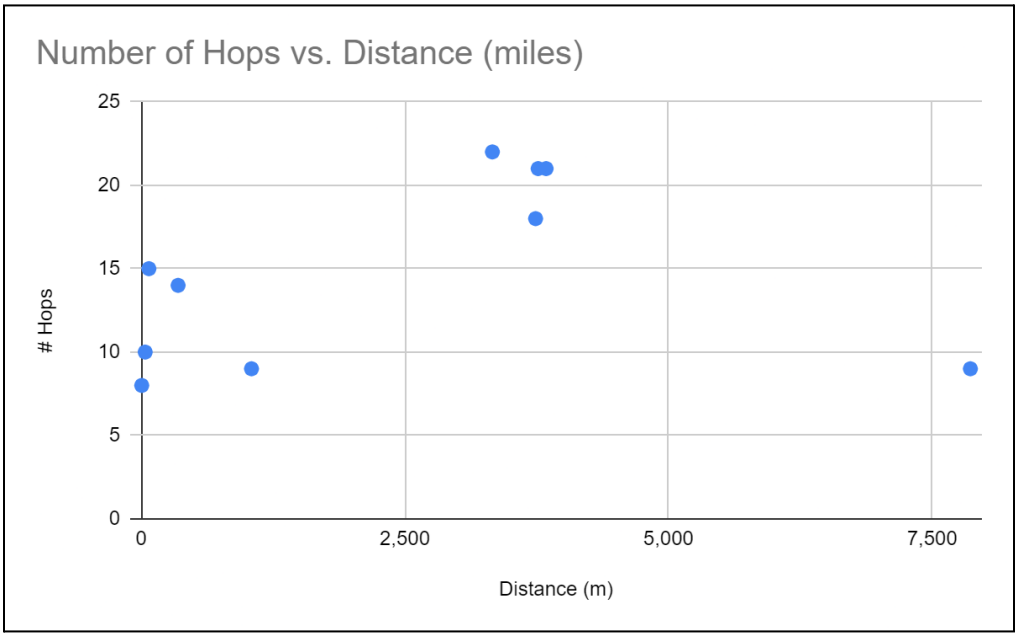
Future testing should include collecting more data and testing during the same day.

2. **Why do you think you observe this trend (or lack thereof)?**

Given that the data includes IP addresses from within and outside of the United States, a positive correlation is expected with increased geographic distance. This leads to increased RTT with more routers that the data has to traverse to get to its location. As such, on average, longer geographic distances can be associated with longer RTTs.

Scatterplot B:

Scatterplot mapping # Hops to Target on the Y-axis, and the geographic distance in miles on the X-axis.



1. **Are # hops and geographic distance correlated positively, negatively, or not at all? If applicable, also comment on the strength of correlation (weak vs. strong).**

There is a slight positive correlation between the distance in miles and number of hops of these 10 IP addresses. This means generally, the farther away the IP address is, the more hops are needed as the data travels from router to router. As such, locations like Hampshire College had the shortest distance (5 m) and hops needed (8) while Humboldt University of Berlin had the second largest distance (3,840 m) and the most amount of hops (118). The strength of the correlation is weak and Africa University is an outlier with two times the amount of distance traveled compared to all the others (7,863), but the second shortest number of hops (9).

Similar to scatterplot 2, we can also see on this graph that some of the calculated IP addresses close to Smith College (i.e. Hampshire Franklin Pierce University) are very below 2,500 miles and as such, have less amount of hops to travel.

2. Why do you think you observe this trend (or lack thereof)?

Given that there is a positive correlation, this means as the distance increases, the number of hops tends to increase too. This is due to longer distances requiring more routing nodes to reach the destination. The correlation is weak because the IP addresses chosen were not very spread out across the globe; a few U.S. addresses were close to Smith and many international addresses were in Europe. Europe was chosen given that its internet is mostly accessible.