

CS536 Homework 1

Maksim Lavrenko

Repo: <https://github.com/mxksm/cs536-hw> (latest commit)

Problem 1 From [1] I found how to use the subprocess library in python, from [2] how to get the geolocation, from [3] how to handle csv files, and from [4] how to calculate distance between points represented by latitude and longitude, and [5], [6] for plotting.

- (a) The following is the min, max, and average rtt as well as the geolocation of the ip addresses taken from the provided website. Note that it takes a while, since we were told to ping 100 times for each server.

```
ip = 160.242.19.254
min rtt = 242.601
max rtt = 262.795
avg rtt = 249.045
geolocation = (-8.8368, 13.2343)
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```
ip = 41.110.39.130
min rtt = 141.249
max rtt = 171.893
avg rtt = 148.806
geolocation = (36.7323, 3.0875)
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```
ip = 213.158.175.240
min rtt = 144.574
max rtt = 158.463
avg rtt = 147.137
geolocation = (30.0626, 31.2497)
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```
ip = 102.214.66.39
min rtt = 174.698
max rtt = 200.305
avg rtt = 177.844
geolocation = (5.556, -0.1969)
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ip = 102.214.66.19
min rtt = 199.153
max rtt = 227.464
avg rtt = 203.311
geolocation = (5.556, -0.1969)
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```
ip = 212.60.92.134
min rtt = 157.4
max rtt = 168.683
avg rtt = 160.328
geolocation = (13.4527, -16.578)
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ip = 105.235.237.2
min rtt = 227.75
max rtt = 242.373
avg rtt = 231.175
geolocation = (1.8639, 9.7658)

ip = 102.215.35.132
min rtt = 280.999
max rtt = 297.748
avg rtt = 285.07
geolocation = (-1.2833, 36.8167)

ip = 197.227.12.18
min rtt = 355.925
max rtt = 397.081
avg rtt = 363.261
geolocation = (-20.1619, 57.4989)

ip = 202.123.3.108
min rtt = 346.696
max rtt = 427.241
avg rtt = 368.527
geolocation = (-20.0576, 57.5502)

ip = 41.226.22.119
min rtt = 135.934
max rtt = 171.039
avg rtt = 143.55
geolocation = (36.819, 10.1658)

ip = 41.210.185.162
min rtt = 291.426
max rtt = 307.545
avg rtt = 294.716
geolocation = (0.3163, 32.5822)

ip = 169.150.238.161
min rtt = 241.405
max rtt = 288.251
avg rtt = 249.266
geolocation = (-26.2023, 28.0436)

ip = 69.48.239.124
min rtt = 258.869
max rtt = 550.951
avg rtt = 330.264
geolocation = (-26.2023, 28.0436)

ip = 86.96.154.106
min rtt = 209.205

max rtt = 225.538
avg rtt = 213.227
geolocation = (25.0772, 55.3093)

ip = 23.249.55.42
min rtt = 210.698
max rtt = 229.798
avg rtt = 214.055
geolocation = (25.0772, 55.3093)

ip = 69.48.238.200
min rtt = 218.209
max rtt = 236.953
avg rtt = 222.211
geolocation = (25.0772, 55.3093)

ip = 84.17.57.129
min rtt = 224.702
max rtt = 458.919
avg rtt = 261.586
geolocation = (22.2783, 114.1747)

ip = 23.249.58.14
min rtt = 195.181
max rtt = 210.46
avg rtt = 198.845
geolocation = (22.2783, 114.1747)

ip = 64.120.117.34
min rtt = 226.644
max rtt = 273.317
avg rtt = 237.142
geolocation = (22.2783, 114.1747)

ip = 115.85.65.8
min rtt = 239.182
max rtt = 257.856
avg rtt = 244.457
geolocation = (-6.2146, 106.8451)

ip = 169.150.202.193
min rtt = 160.602
max rtt = 191.231
avg rtt = 171.633
geolocation = (32.0809, 34.7806)

ip = 23.249.61.122
min rtt = 275.379
max rtt = 335.425
avg rtt = 294.916

geolocation = (12.9719, 77.5937)

ip = 69.48.236.198
min rtt = 288.524
max rtt = 306.341
avg rtt = 291.861
geolocation = (18.5196, 73.8554)

ip = 89.187.160.1
min rtt = 157.374
max rtt = 173.916
avg rtt = 161.352
geolocation = (35.6895, 139.6917)

ip = 23.249.60.154
min rtt = 130.986
max rtt = 158.532
avg rtt = 135.183
geolocation = (35.6895, 139.6917)

ip = 66.35.31.81
min rtt = 133.164
max rtt = 154.664
avg rtt = 138.584
geolocation = (35.6895, 139.6917)

ip = 23.106.226.75
min rtt = 166.278
max rtt = 182.787
avg rtt = 169.681
geolocation = (35.6769, 139.652)

ip = 89.187.162.1
min rtt = 249.396
max rtt = 264.329
avg rtt = 251.908
geolocation = (1.2897, 103.8501)

ip = 96.45.38.22
min rtt = 197.104
max rtt = 216.646
avg rtt = 201.454
geolocation = (1.2897, 103.8501)

ip = 23.108.99.54
min rtt = 378.504
max rtt = 400.851
avg rtt = 384.242
geolocation = (1.3557, 103.8237)

ip = 15.235.182.181
min rtt = 241.453
max rtt = 263.159
avg rtt = 245.475
geolocation = (1.2897, 103.8501)

ip = 165.21.70.1
min rtt = 206.189
max rtt = 225.393
avg rtt = 210.024
geolocation = (1.2897, 103.8501)

ip = 156.146.52.1
min rtt = 141.852
max rtt = 160.047
avg rtt = 145.754
geolocation = (41.004, 28.9788)

ip = 69.48.237.66
min rtt = 143.098
max rtt = 159.0
avg rtt = 146.302
geolocation = (41.0138, 28.9497)

ip = 195.69.189.215
min rtt = 203.159
max rtt = 222.256
avg rtt = 206.216
geolocation = (41.2647, 69.2163)

ip = 185.180.12.40
min rtt = 122.746
max rtt = 145.334
avg rtt = 127.77
geolocation = (48.2085, 16.3721)

ip = 86.106.182.189
min rtt = 122.838
max rtt = 152.884
avg rtt = 128.126
geolocation = (48.3043, 16.3614)

ip = 207.211.214.65
min rtt = 99.948
max rtt = 118.605
avg rtt = 103.356
geolocation = (50.8505, 4.3488)

ip = 37.19.203.1
min rtt = 135.36

max rtt = 242.518
avg rtt = 161.025
geolocation = (42.6975, 23.3241)

ip = 148.187.129.10
min rtt = 118.344
max rtt = 143.241
avg rtt = 121.848
geolocation = (46.0101, 8.96)

ip = 89.187.165.1
min rtt = 124.63
max rtt = 229.51
avg rtt = 146.952
geolocation = (47.3667, 8.55)

ip = 82.197.188.129
min rtt = 114.868
max rtt = 127.254
avg rtt = 116.729
geolocation = (47.3667, 8.55)

ip = 212.60.47.34
min rtt = 121.41
max rtt = 138.6
avg rtt = 124.144
geolocation = (47.1371, 7.2461)

ip = 88.213.191.212
min rtt = 112.047
max rtt = 136.965
avg rtt = 117.623
geolocation = (47.7148, 8.625)

ip = 95.143.54.63
min rtt = 112.746
max rtt = 126.981
avg rtt = 118.19
geolocation = (47.3667, 8.55)

ip = 185.152.65.113
min rtt = 118.183
max rtt = 140.904
avg rtt = 123.055
geolocation = (50.088, 14.4208)

ip = 85.163.71.241
min rtt = 126.735
max rtt = 159.017
avg rtt = 130.328

geolocation = (50.088, 14.4208)

ip = 91.199.118.184
min rtt = 111.983
max rtt = 123.785
avg rtt = 114.456
geolocation = (50.0979, 8.5999)

ip = 185.102.219.93
min rtt = 110.0
max rtt = 135.308
avg rtt = 113.872
geolocation = (50.1155, 8.6842)

ip = 178.215.228.109
min rtt = 106.736
max rtt = 120.806
avg rtt = 109.273
geolocation = (50.1155, 8.6842)

ip = 96.45.39.38
min rtt = 109.422
max rtt = 131.928
avg rtt = 114.195
geolocation = (50.1155, 8.6842)

ip = 185.84.224.68
min rtt = 112.281
max rtt = 127.178
avg rtt = 115.255
geolocation = (50.1155, 8.6842)

ip = 185.245.99.75
min rtt = 108.121
max rtt = 125.0
avg rtt = 111.983
geolocation = (50.1155, 8.6842)

ip = 178.162.226.176
min rtt = 107.932
max rtt = 127.406
avg rtt = 111.806
geolocation = (50.1155, 8.6842)

ip = 62.176.246.73
min rtt = 123.867
max rtt = 137.717
avg rtt = 126.627
geolocation = (52.5244, 13.4105)

ip = 62.176.246.39
min rtt = 121.516
max rtt = 151.662
avg rtt = 128.471
geolocation = (52.4245, 10.7815)

ip = 62.176.246.102
min rtt = 120.619
max rtt = 132.547
avg rtt = 124.148
geolocation = (51.4566, 7.0123)

ip = 62.176.246.8
min rtt = 118.251
max rtt = 133.077
avg rtt = 122.693
geolocation = (50.1155, 8.6842)

ip = 62.176.246.197
min rtt = 117.84
max rtt = 135.645
avg rtt = 120.756
geolocation = (50.1155, 8.6842)

ip = 62.176.224.217
min rtt = 121.427
max rtt = 147.884
avg rtt = 125.52
geolocation = (52.4245, 10.7815)

ip = 62.176.246.171
min rtt = 122.306
max rtt = 138.844
avg rtt = 125.426
geolocation = (52.4245, 10.7815)

ip = 213.209.106.95
min rtt = 112.749
max rtt = 125.06
avg rtt = 116.212
geolocation = (53.7018, 9.9933)

ip = 121.127.45.65
min rtt = 104.032
max rtt = 125.003
avg rtt = 107.89
geolocation = (55.6759, 12.5655)

ip = 193.106.164.10
min rtt = 117.841

max rtt = 129.459
avg rtt = 120.004
geolocation = (55.6755, 12.594)

ip = 193.106.166.153
min rtt = 115.263
max rtt = 130.03
avg rtt = 117.614
geolocation = (55.6755, 12.594)

ip = 185.118.248.162
min rtt = 147.869
max rtt = 169.83
avg rtt = 155.461
geolocation = (55.6759, 12.5655)

ip = 185.93.3.50
min rtt = 194.389
max rtt = 372.751
avg rtt = 293.22
geolocation = (40.4165, -3.7026)

ip = 148.230.45.213
min rtt = 169.447
max rtt = 358.95
avg rtt = 271.789
geolocation = (40.4165, -3.7026)

ip = 212.237.217.41
min rtt = 139.264
max rtt = 153.957
avg rtt = 142.245
geolocation = (60.1695, 24.9354)

ip = 138.199.14.66
min rtt = 122.412
max rtt = 150.934
avg rtt = 128.176
geolocation = (43.2966, 5.3703)

ip = 185.93.2.193
min rtt = 103.161
max rtt = 117.25
avg rtt = 105.783
geolocation = (48.8534, 2.3488)

ip = 96.45.42.156
min rtt = 99.637
max rtt = 121.783
avg rtt = 105.055

geolocation = (48.8534, 2.3488)

ip = 96.45.41.167
min rtt = 113.351
max rtt = 138.579
avg rtt = 117.688
geolocation = (43.6329, 6.9991)

ip = 51.158.1.19
min rtt = 191.233
max rtt = 203.779
avg rtt = 194.007
geolocation = (48.8534, 2.3488)

ip = 51.158.1.21
min rtt = 103.275
max rtt = 119.717
avg rtt = 107.649
geolocation = (48.8534, 2.3488)

ip = 62.210.156.7
min rtt = 103.584
max rtt = 116.547
avg rtt = 105.911
geolocation = (48.8534, 2.3488)

ip = 51.158.1.21
min rtt = 103.444
max rtt = 119.509
avg rtt = 107.286
geolocation = (48.8534, 2.3488)

ip = 45.147.210.189
min rtt = 103.164
max rtt = 113.994
avg rtt = 105.065
geolocation = (48.8534, 2.3488)

ip = 5.180.211.133
min rtt = 95.448
max rtt = 106.304
avg rtt = 97.217
geolocation = (51.5085, -0.1257)

ip = 185.59.221.51
min rtt = 102.679
max rtt = 119.419
avg rtt = 105.195
geolocation = (51.5085, -0.1257)

ip = 96.45.40.45
min rtt = 97.392
max rtt = 112.926
avg rtt = 100.835
geolocation = (51.5085, -0.1257)

ip = 23.106.58.162
min rtt = 98.131
max rtt = 113.787
avg rtt = 100.859
geolocation = (51.5085, -0.1257)

ip = 81.17.61.145
min rtt = 101.012
max rtt = 117.402
avg rtt = 105.418
geolocation = (51.5085, -0.1257)

ip = 194.24.162.86
min rtt = 97.739
max rtt = 109.193
avg rtt = 99.876
geolocation = (50.8622, 0.2577)

ip = 31.132.7.130
min rtt = 99.783
max rtt = 118.975
avg rtt = 103.075
geolocation = (51.5085, -0.1257)

ip = 169.150.252.2
min rtt = 149.116
max rtt = 166.761
avg rtt = 153.279
geolocation = (37.9838, 23.7278)

ip = 169.150.242.129
min rtt = 124.757
max rtt = 149.514
avg rtt = 130.243
geolocation = (45.8144, 15.978)

ip = 87.249.137.8
min rtt = 117.982
max rtt = 142.908
avg rtt = 123.836
geolocation = (53.3331, -6.2489)

ip = 195.162.68.38
min rtt = 203.386

max rtt = 384.211
avg rtt = 299.793
geolocation = (64.1355, -21.8954)

ip = 31.14.130.68
min rtt = 125.925
max rtt = 151.92
avg rtt = 131.562
geolocation = (43.4628, 11.8807)

ip = 217.61.40.96
min rtt = 122.872
max rtt = 139.335
avg rtt = 127.694
geolocation = (45.706, 9.5905)

ip = 84.17.59.129
min rtt = 131.503
max rtt = 148.567
avg rtt = 136.838
geolocation = (45.4643, 9.1895)

ip = 104.244.76.191
min rtt = 115.552
max rtt = 134.088
avg rtt = 120.706
geolocation = (47.3667, 8.55)

ip = 23.136.20.236
min rtt = 113.145
max rtt = 209.456
avg rtt = 134.834
geolocation = (52.374, 4.8897)

ip = 194.127.172.176
min rtt = 99.601
max rtt = 128.719
avg rtt = 103.858
geolocation = (52.374, 4.8897)

ip = 185.102.218.1
min rtt = 104.689
max rtt = 148.816
avg rtt = 111.533
geolocation = (52.374, 4.8897)

ip = 217.18.95.142
min rtt = 102.108
max rtt = 170.725
avg rtt = 123.438

geolocation = (52.5083, 5.475)

ip = 95.211.20.80
min rtt = 101.249
max rtt = 118.697
avg rtt = 104.191
geolocation = (52.374, 4.8897)

ip = 178.162.166.76
min rtt = 111.112
max rtt = 129.571
avg rtt = 115.076
geolocation = (52.374, 4.8897)

ip = 185.15.210.116
min rtt = 105.56
max rtt = 120.869
avg rtt = 108.385
geolocation = (52.5083, 5.475)

ip = 195.95.177.10
min rtt = 102.829
max rtt = 119.669
avg rtt = 106.188
geolocation = (52.5083, 5.475)

ip = 185.216.141.19
min rtt = 102.29
max rtt = 116.759
avg rtt = 104.944
geolocation = (52.5083, 5.475)

ip = 163.172.208.7
min rtt = 101.27
max rtt = 119.294
avg rtt = 104.217
geolocation = (52.374, 4.8897)

ip = 45.88.200.26
min rtt = 104.038
max rtt = 116.696
avg rtt = 105.924
geolocation = (52.374, 4.8897)

ip = 62.176.247.4
min rtt = 121.605
max rtt = 139.13
avg rtt = 125.014
geolocation = (52.374, 4.8897)

ip = 185.125.168.212
min rtt = 120.106
max rtt = 139.533
avg rtt = 123.846
geolocation = (59.1729, 10.2149)

ip = 185.125.168.212
min rtt = 119.878
max rtt = 137.957
avg rtt = 122.907
geolocation = (59.1729, 10.2149)

ip = 185.246.208.67
min rtt = 119.611
max rtt = 134.308
avg rtt = 121.749
geolocation = (52.2298, 21.0118)

ip = 109.61.94.65
min rtt = 134.029
max rtt = 153.487
avg rtt = 137.664
geolocation = (38.7251, -9.1498)

ip = 95.95.252.87
min rtt = 127.117
max rtt = 136.944
avg rtt = 128.678
geolocation = (38.7167, -9.1333)

ip = 95.95.252.95
min rtt = 143.628
max rtt = 157.346
avg rtt = 146.373
geolocation = (38.7167, -9.1333)

ip = 185.102.217.170
min rtt = 135.594
max rtt = 158.072
avg rtt = 139.417
geolocation = (44.4323, 26.1063)

ip = 88.218.137.64
min rtt = 141.427
max rtt = 156.551
avg rtt = 144.41
geolocation = (44.8718, 20.6417)

ip = 185.76.9.135
min rtt = 112.729

max rtt = 131.572
avg rtt = 115.371
geolocation = (59.3294, 18.0687)

ip = 93.177.80.27
min rtt = 114.164
max rtt = 135.141
avg rtt = 117.304
geolocation = (59.3294, 18.0687)

ip = 45.154.255.51
min rtt = 116.795
max rtt = 133.584
avg rtt = 121.996
geolocation = (59.3294, 18.0687)

ip = 156.146.40.65
min rtt = 124.679
max rtt = 139.683
avg rtt = 128.803
geolocation = (48.1482, 17.1067)

ip = 37.19.218.65
min rtt = 134.825
max rtt = 148.884
avg rtt = 137.694
geolocation = (50.4547, 30.5238)

ip = 138.199.4.1
min rtt = 137.757
max rtt = 156.769
avg rtt = 140.757
geolocation = (-23.5475, -46.6361)

ip = 148.230.60.200
min rtt = 141.529
max rtt = 159.939
avg rtt = 144.541
geolocation = (-23.5475, -46.6361)

ip = 146.19.95.34
min rtt = 140.84
max rtt = 154.235
avg rtt = 142.974
geolocation = (-23.5475, -46.6361)

ip = 79.127.209.1
min rtt = 140.673
max rtt = 162.139
avg rtt = 144.904

geolocation = (-33.4569, -70.6483)

ip = 170.254.229.178
min rtt = 101.919
max rtt = 121.048
avg rtt = 105.754
geolocation = (5.0668, -75.5068)

ip = 169.150.228.129
min rtt = 96.98
max rtt = 116.43
avg rtt = 99.564
geolocation = (4.6097, -74.0817)

ip = 152.204.128.194
min rtt = 103.326
max rtt = 120.878
avg rtt = 106.362
geolocation = (4.6097, -74.0817)

ip = 156.146.53.53
min rtt = 59.561
max rtt = 78.953
avg rtt = 63.15
geolocation = (37.3394, -121.895)

ip = 170.83.216.19
min rtt = 124.677
max rtt = 140.176
avg rtt = 127.242
geolocation = (-1.2078, -80.3706)

ip = 69.79.207.214
min rtt = 75.356
max rtt = 88.674
avg rtt = 77.621
geolocation = (17.997, -76.7936)

ip = 121.127.43.65
min rtt = 51.106
max rtt = 62.89
avg rtt = 53.617
geolocation = (20.5881, -100.3881)

ip = 201.225.207.2
min rtt = 85.73
max rtt = 103.738
avg rtt = 89.107
geolocation = (8.9936, -79.5197)

ip = 201.225.207.3
min rtt = 87.648
max rtt = 104.896
avg rtt = 92.318
geolocation = (8.9936, -79.5197)

ip = 138.199.57.129
min rtt = 22.476
max rtt = 39.225
avg rtt = 26.157
geolocation = (43.7064, -79.3986)

ip = 173.243.131.29
min rtt = 25.034
max rtt = 39.865
avg rtt = 28.072
geolocation = (45.4112, -75.6981)

ip = 96.45.43.6
min rtt = 20.623
max rtt = 44.5
avg rtt = 24.628
geolocation = (43.7064, -79.3986)

ip = 66.35.30.9
min rtt = 53.098
max rtt = 70.669
avg rtt = 56.869
geolocation = (49.2497, -123.1193)

ip = 70.38.95.143
min rtt = 28.81
max rtt = 53.567
avg rtt = 36.282
geolocation = (45.5088, -73.5878)

ip = 69.168.185.43
min rtt = 40.446
max rtt = 71.129
avg rtt = 44.866
geolocation = (51.0501, -114.0853)

ip = 74.49.158.20
min rtt = 37.36
max rtt = 65.369
avg rtt = 42.956
geolocation = (45.5088, -73.5878)

ip = 104.245.79.230
min rtt = 38.342

max rtt = 51.624
avg rtt = 40.907
geolocation = (35.222, -101.8313)

ip = 45.250.25.133
min rtt = 35.731
max rtt = 55.287
avg rtt = 41.872
geolocation = (39.0437, -77.4875)

ip = 92.119.16.139
min rtt = 39.106
max rtt = 56.256
avg rtt = 43.51
geolocation = (33.749, -84.388)

ip = 2.56.188.136
min rtt = 28.692
max rtt = 41.006
avg rtt = 31.14
geolocation = (32.7831, -96.8067)

ip = 77.247.126.223
min rtt = 56.551
max rtt = 72.812
avg rtt = 59.194
geolocation = (34.0522, -118.2437)

ip = 194.33.45.192
min rtt = 26.976
max rtt = 51.601
avg rtt = 31.764
geolocation = (40.7143, -74.006)

ip = 37.19.206.20
min rtt = 32.977
max rtt = 46.831
avg rtt = 35.915
geolocation = (39.0437, -77.4875)

ip = 185.152.66.67
min rtt = 41.54
max rtt = 52.617
avg rtt = 44.154
geolocation = (33.749, -84.388)

ip = 109.61.86.65
min rtt = 34.236
max rtt = 52.904
avg rtt = 37.804

geolocation = (42.3584, -71.0598)

ip = 185.93.1.65
min rtt = 10.038
max rtt = 32.565
avg rtt = 14.535
geolocation = (41.85, -87.65)

ip = 89.187.164.1
min rtt = 28.433
max rtt = 41.145
avg rtt = 31.25
geolocation = (32.7831, -96.8067)

ip = 37.19.216.1
min rtt = 32.0
max rtt = 49.275
avg rtt = 34.852
geolocation = (29.7633, -95.3633)

ip = 185.152.67.2
min rtt = 60.789
max rtt = 75.512
avg rtt = 64.022
geolocation = (34.0522, -118.2437)

ip = 195.181.162.195
min rtt = 60.497
max rtt = 79.003
avg rtt = 62.696
geolocation = (25.7743, -80.1937)

ip = 185.59.223.8
min rtt = 28.513
max rtt = 50.692
avg rtt = 31.584
geolocation = (40.7143, -74.006)

ip = 84.17.41.11
min rtt = 51.652
max rtt = 69.191
avg rtt = 56.198
geolocation = (47.6062, -122.3321)

ip = 66.35.22.79
min rtt = 27.665
max rtt = 43.548
avg rtt = 30.553
geolocation = (39.0437, -77.4875)

ip = 66.35.27.207
min rtt = 29.684
max rtt = 46.296
avg rtt = 33.038
geolocation = (32.7831, -96.8067)

ip = 23.249.54.234
min rtt = 37.48
max rtt = 54.312
avg rtt = 41.023
geolocation = (25.7743, -80.1937)

ip = 209.40.123.215
min rtt = 28.642
max rtt = 46.847
avg rtt = 32.349
geolocation = (32.7831, -96.8067)

ip = 66.35.20.123
min rtt = 63.411
max rtt = 100.156
avg rtt = 69.671
geolocation = (37.3394, -121.895)

ip = 148.230.59.38
min rtt = 63.561
max rtt = 81.856
avg rtt = 67.328
geolocation = (37.3394, -121.895)

ip = 139.60.160.88
min rtt = 32.591
max rtt = 41.404
avg rtt = 34.487
geolocation = (40.7143, -74.006)

ip = 64.112.186.242
min rtt = 44.506
max rtt = 64.645
avg rtt = 47.382
geolocation = (32.7831, -96.8067)

ip = 157.250.201.61
min rtt = 41.314
max rtt = 55.451
avg rtt = 43.95
geolocation = (32.8371, -97.082)

ip = 23.19.208.9
min rtt = 13.271

max rtt = 39.446
avg rtt = 17.891
geolocation = (41.85, -87.65)

ip = 209.58.159.68
min rtt = 42.947
max rtt = 61.921
avg rtt = 45.292
geolocation = (32.7831, -96.8067)

ip = 23.105.41.222
min rtt = 59.165
max rtt = 74.725
avg rtt = 62.419
geolocation = (34.0522, -118.2437)

ip = 23.82.138.78
min rtt = 47.543
max rtt = 250.513
avg rtt = 164.336
geolocation = (25.7623, -80.3162)

ip = 108.62.52.129
min rtt = 24.524
max rtt = 43.859
avg rtt = 28.111
geolocation = (40.7143, -74.006)

ip = 23.81.207.31
min rtt = 51.173
max rtt = 65.389
avg rtt = 53.598
geolocation = (33.4484, -112.074)

ip = 23.81.166.99
min rtt = 56.11
max rtt = 85.182
avg rtt = 59.996
geolocation = (37.3394, -121.895)

ip = 23.82.193.66
min rtt = 60.162
max rtt = 81.661
avg rtt = 64.606
geolocation = (47.6062, -122.3321)

ip = 23.105.9.80
min rtt = 32.849
max rtt = 56.219
avg rtt = 37.992

geolocation = (38.8951, -77.0364)

ip = 208.110.65.2
min rtt = 19.245
max rtt = 38.299
avg rtt = 21.71
geolocation = (39.0997, -94.5786)

ip = 146.112.61.104
min rtt = 8.241
max rtt = 32.999
avg rtt = 12.897
geolocation = (37.7621, -122.3971)

ip = 107.1.167.50
min rtt = 64.448
max rtt = 79.609
avg rtt = 66.887
geolocation = (47.6062, -122.3321)

ip = 198.60.22.18
min rtt = 65.045
max rtt = 76.333
avg rtt = 67.028
geolocation = (40.6681, -111.9083)

ip = 103.31.113.244
min rtt = 210.737
max rtt = 227.543
avg rtt = 213.298
geolocation = (-37.814, 144.9633)

ip = 143.244.63.144
min rtt = 195.374
max rtt = 208.811
avg rtt = 197.402
geolocation = (-33.8678, 151.2073)

ip = 96.45.44.87
min rtt = 189.475
max rtt = 204.554
avg rtt = 192.146
geolocation = (-33.8678, 151.2073)

ip = 23.106.244.70
min rtt = 202.385
max rtt = 220.637
avg rtt = 205.76
geolocation = (-33.8678, 151.2073)

ip = 51.161.209.134
min rtt = 309.949
max rtt = 325.948
avg rtt = 312.594
geolocation = (-33.8678, 151.2073)

ip = 202.22.159.9
min rtt = 239.696
max rtt = 255.076
avg rtt = 243.049
geolocation = (-22.2741, 166.4488)

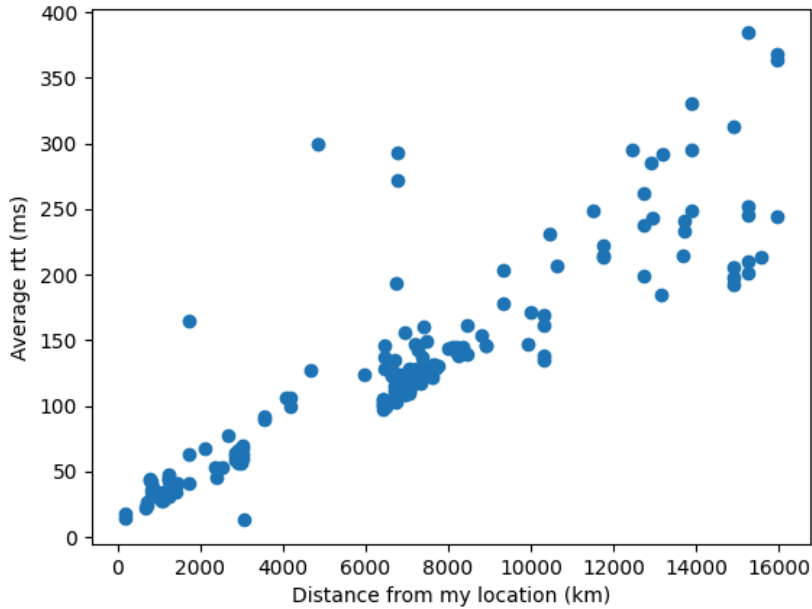
ip = 101.98.9.197
min rtt = 181.13
max rtt = 196.637
avg rtt = 184.184
geolocation = (-36.8485, 174.7635)

ip = 101.98.9.201
min rtt = 207.622
max rtt = 241.782
avg rtt = 214.713
geolocation = (-43.5333, 172.6333)

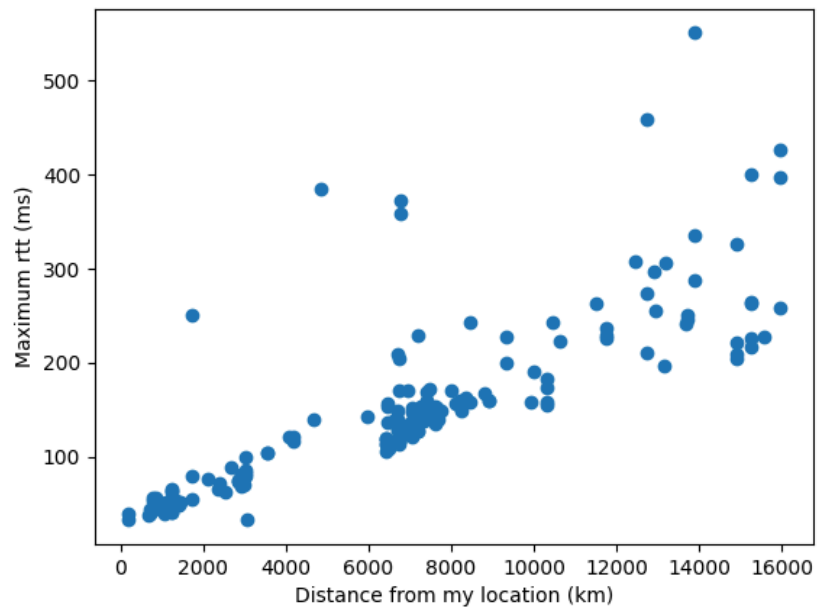
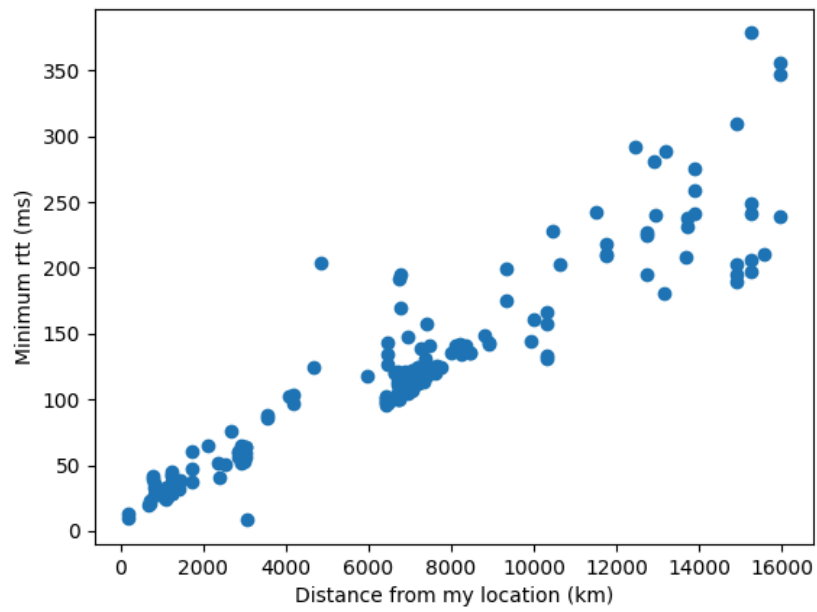
ip = 154.81.51.4
min rtt = 231.153
max rtt = 245.912
avg rtt = 233.528
geolocation = (-9.4772, 147.1509)

ip = 103.146.200.98
min rtt = 238.271
max rtt = 250.917
avg rtt = 240.857
geolocation = (-9.4772, 147.1509)

- (b) Since the question doesn't specify which rtt to use, minimum, maximum or average, I went with average.



- (c) From the plot of average rrt to distance in part (b), we see a mostly linear relationship with a positive slope, i.e., the farther the geolocation of the ip address is from my geolocation, the larger (slower) the round-trip time. This makes sense because the speed at which we can transmit data is bottlenecked, at the very least by the speed of light (some of the data may be sent along even slower paths), so even if the network was a complete graph, farther hosts would take more time to reach. But besides just the speed of light being a bottleneck, the network graph itself can have bottlenecks, which can make geographically farther hosts reachable faster. For example, if host A is farther away from my computer than host B is, but there are many different paths to A but very few to B , it's possible that the rrt to A is smaller, because having very few paths to a host means a greater chance that they are all busy. This is likely what's happening to the few outliers show in [Figure 1](#), at distances of 12000 and 16000 km from my computer. That point at 12000 km away has rrt greater than some points at 16000 km away, possibly because of the topology of the network, i.e., perhaps a small number of paths to that node. As for max and min rrt, the graphs look pretty much the same as for the average case, except that the max rrt has more outliers, which suggests that congestion happens in the network, but is irregular.



◆

Problem 2

(a) I filtered out the non-responsive hops.

Question 2

Running part a

The 5 random ip addresses = 37.19.218.65 66.35.27.207 194.127.172.176 148.230.45.213 195.69.189.215

Hops for ip = 37.19.218.65

Time to hop 0 is 14.037
Time to hop 1 is 16.355
Time to hop 2 is 11.851
Time to hop 3 is 15.868
Time to hop 4 is 7.735
Time to hop 5 is 20.438
Time to hop 6 is 14.248
Time to hop 7 is 13.213
Time to hop 8 is 26.425
Time to hop 9 is 19.46
Time to hop 10 is 22.559
Time to hop 11 is 42.342
Time to hop 12 is 103.486
Time to hop 13 is 139.034
Time to hop 14 is 135.363
Time to hop 15 is 149.367
Time to hop 16 is 143.034
Time to hop 17 is 153.091
Time to hop 18 is 151.977

Hops for ip = 66.35.27.207

Time to hop 0 is 45.127
Time to hop 1 is 17.456
Time to hop 2 is 13.186
Time to hop 3 is 22.181
Time to hop 4 is 6.862
Time to hop 5 is 12.373
Time to hop 6 is 9.201
Time to hop 7 is 9.861
Time to hop 8 is 14.204
Time to hop 9 is 27.516
Time to hop 10 is 51.888
Time to hop 11 is 54.207
Time to hop 12 is 47.607
Time to hop 13 is 39.558

Hops for ip = 194.127.172.176

Time to hop 0 is 37.546
Time to hop 1 is 9.83
Time to hop 2 is 22.937
Time to hop 3 is 16.635
Time to hop 4 is 12.272
Time to hop 5 is 7.674

Time to hop 6 is 7.62
Time to hop 7 is 7.424
Time to hop 8 is 8.343
Time to hop 9 is 25.696
Time to hop 10 is 50.753
Time to hop 11 is 132.979
Time to hop 12 is 136.189
Time to hop 13 is 115.712
Time to hop 14 is 112.346
Time to hop 15 is 118.472
Time to hop 16 is 105.96

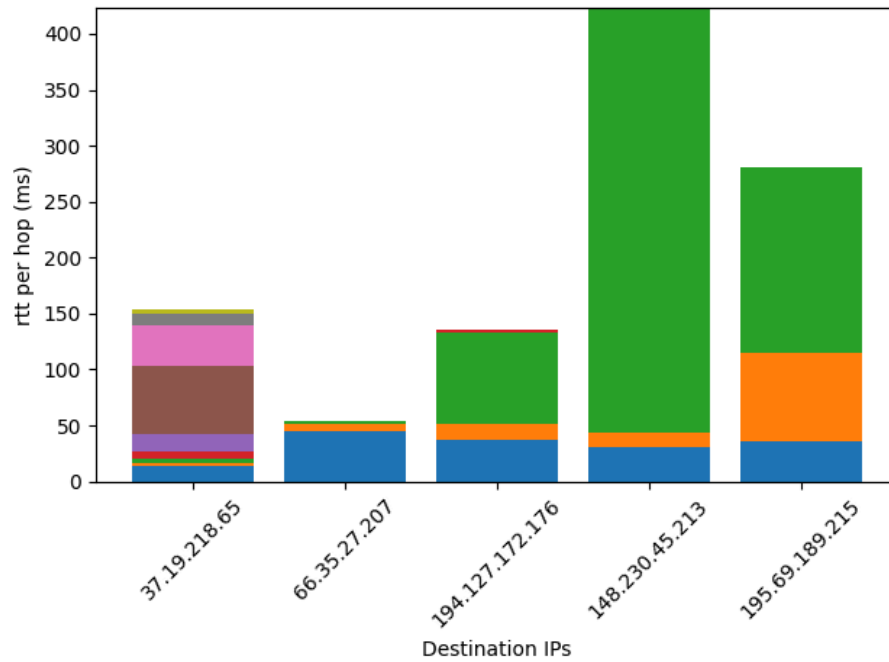
Hops for ip = 148.230.45.213

Time to hop 0 is 30.913
Time to hop 1 is 10.52
Time to hop 2 is 18.989
Time to hop 3 is 11.856
Time to hop 4 is 9.319
Time to hop 5 is 9.94
Time to hop 6 is 9.061
Time to hop 7 is 8.229
Time to hop 8 is 19.481
Time to hop 9 is 43.221
Time to hop 10 is 423.316
Time to hop 11 is 122.437
Time to hop 12 is 126.344
Time to hop 13 is 120.602

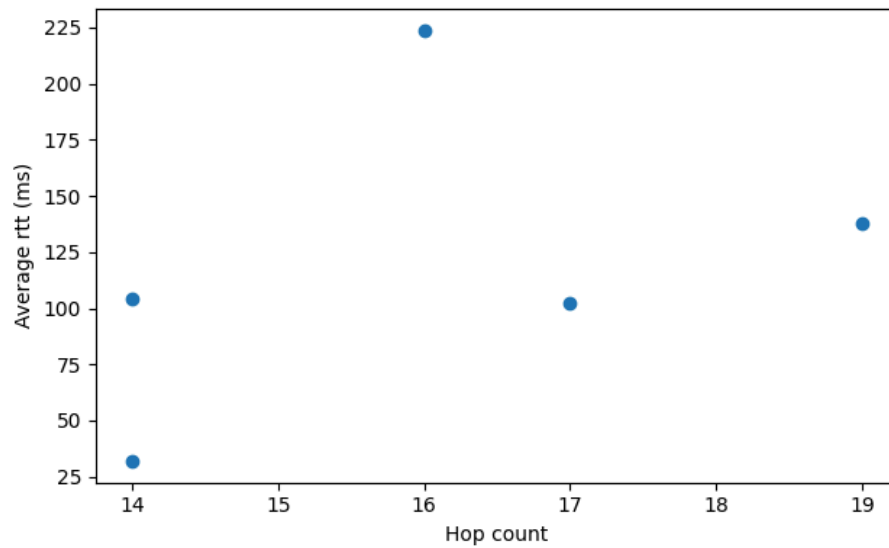
Hops for ip = 195.69.189.215

Time to hop 0 is 35.461
Time to hop 1 is 6.973
Time to hop 2 is 10.269
Time to hop 3 is 11.051
Time to hop 4 is 20.139
Time to hop 5 is 11.957
Time to hop 6 is 12.298
Time to hop 7 is 9.09
Time to hop 8 is 11.793
Time to hop 9 is 114.241
Time to hop 10 is 280.991
Time to hop 11 is 200.923
Time to hop 12 is 210.621
Time to hop 13 is 210.004
Time to hop 14 is 223.794
Time to hop 15 is 206.898

(b)



(c)



(d) I expected that higher hop count would lead to lesser average rtt, but that doesn't seem to be the case according to the plot in the previous part. This could be an artifact of picking a very small sample of just 5 ips, or some congested links, but it's hard to say from just this result.

◆

Bibliography

- [1] [Online]. Available: <https://www.datacamp.com/tutorial/python-subprocess>
- [2] [Online]. Available: https://www.reddit.com/r/commandline/comments/uguewp/a_cli_tool_for_getting_the_longitude_and_latitude/
- [3] [Online]. Available: <https://www.geeksforgeeks.org/computer-science-fundamentals/reading-rows-from-a-csv-file-in-python/>
- [4] [Online]. Available: <https://stackoverflow.com/questions/19412462/getting-distance-between-two-points-based-on-latitude-longitude>
- [5] [Online]. Available: https://www.w3schools.com/python/matplotlib_scatter.asp
- [6] [Online]. Available: <https://www.geeksforgeeks.org/python/create-a-stacked-bar-plot-in-matplotlib/>