# Part A

For Sequence numbers, I passed in $rtt\_cnt + 1$ for ID in $sendOnePing()$. $rtt\_cnt$ increments in $doOnePing()$ whenever a ping is successfully sent (the else condition). The checksum is precomputed with $checksum()$. The time is calculated by taking the difference in time between sending the packet and receiving the packet. The packet is composed of the ICMP header and the data (the time it was sent). After unpacking the time data, take the difference by the later $time.time()$ yielded the time needed for the packet to be sent and received. Multiplying the result by 3 gives the time in milliseconds.

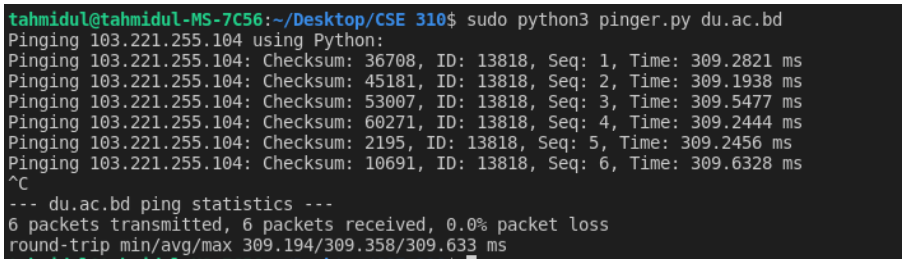
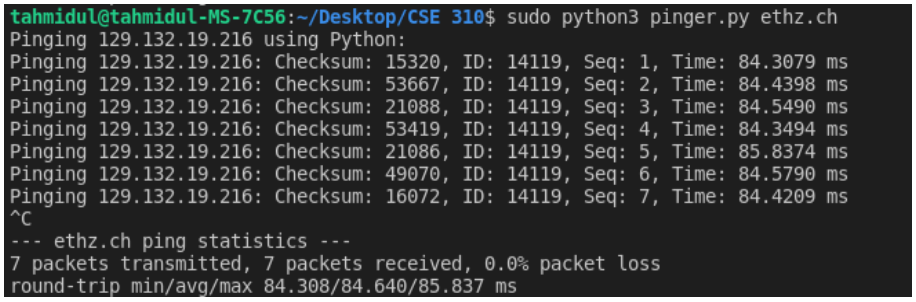
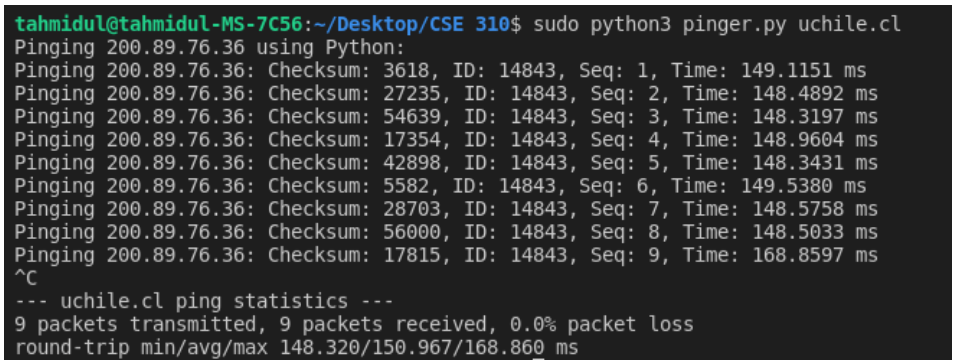
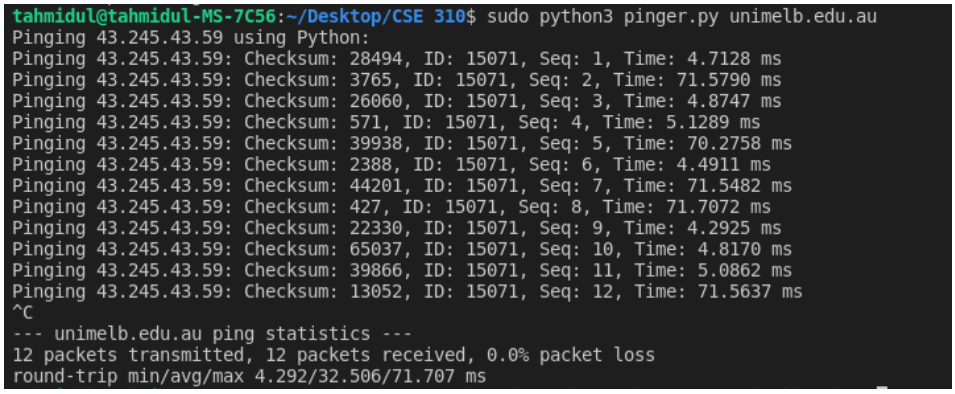
```
tahmidul@tahmidul-MS-7C56:~/Desktop/CSE 310$ sudo python3 pinger.py 127.0.0.1
Pinging 127.0.0.1 using Python:
Pinging 127.0.0.1: Checksum: 2130, ID: 15471, Seq: 1, Time: 0.0343 ms
Pinging 127.0.0.1: Checksum: 1163, ID: 15471, Seq: 2, Time: 0.0477 ms
Pinging 127.0.0.1: Checksum: 60531, ID: 15471, Seq: 3, Time: 0.0622 ms
Pinging 127.0.0.1: Checksum: 55295, ID: 15471, Seq: 4, Time: 0.0582 ms
Pinging 127.0.0.1: Checksum: 49001, ID: 15471, Seq: 5, Time: 0.0689 ms
Pinging 127.0.0.1: Checksum: 41708, ID: 15471, Seq: 6, Time: 0.0651 ms
Pinging 127.0.0.1: Checksum: 36031, ID: 15471, Seq: 7, Time: 0.0625 ms
Pinging 127.0.0.1: Checksum: 30738, ID: 15471, Seq: 8, Time: 0.0622 ms
Pinging 127.0.0.1: Checksum: 24444, ID: 15471, Seq: 9, Time: 0.0625 ms
Pinging 127.0.0.1: Checksum: 17906, ID: 15471, Seq: 10, Time: 0.0637 ms
^C
--- 127.0.0.1 ping statistics ---
10 packets transmitted, 10 packets received, 0.0% packet loss
round-trip min/avg/max 0.034/0.059/0.069 ms
```

# Part B

```
tahmidul@tahmidul-MS-7C56:~/Desktop/CSE 310$ sudo python3 pinger.py stonybrook.edu
Pinging 129.49.2.176 using Python:
Pinging 129.49.2.176: Checksum: 33670, ID: 13646, Seq: 1, Time: 1.6100 ms
Pinging 129.49.2.176: Checksum: 21668, ID: 13646, Seq: 2, Time: 1.4622 ms
Pinging 129.49.2.176: Checksum: 10192, ID: 13646, Seq: 3, Time: 1.7209 ms
Pinging 129.49.2.176: Checksum: 62563, ID: 13646, Seq: 4, Time: 1.9431 ms
Pinging 129.49.2.176: Checksum: 48552, ID: 13646, Seq: 5, Time: 1.8342 ms
Pinging 129.49.2.176: Checksum: 35837, ID: 13646, Seq: 6, Time: 1.5788 ms
Pinging 129.49.2.176: Checksum: 28366, ID: 13646, Seq: 7, Time: 1.6649 ms
Pinging 129.49.2.176: Checksum: 16092, ID: 13646, Seq: 8, Time: 1.7405 ms
Pinging 129.49.2.176: Checksum: 3409, ID: 13646, Seq: 9, Time: 1.4822 ms
^C
--- stonybrook.edu ping statistics ---
9 packets transmitted, 9 packets received, 0.0% packet loss
round-trip min/avg/max 1.462/1.671/1.943 ms
```

```
tahmidul@tahmidul-MS-7C56:~/Desktop/CSE 310$ sudo python3 pinger.py cs.stonybrook.edu
Pinging 130.245.27.3 using Python:
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Request timed out.
^C
--- cs.stonybrook.edu ping statistics ---
6 packets transmitted, 0 packets received, 100.0% packet loss
```

# Part C

| | |
|---|---|
| Dhaka University (Asia, Bangladesh) |  |
| ETH Zürich (Europe, Switzerland) |  |
| University of Chile (South America, Chile) |  |
| University of Melbourne (Australia, Australia) |  |

# Part D

In part A, we are pinging our local server from our local machine, so the RTT is expected to be faster than pinging stonybrook.edu and pinging servers in different continents. The stonybrook.edu server is closer (dorm internet connection is closer to stonybrook.edu) and is closer to the client (the computer running the program) than the servers in different continents. Similarly, the RTT in different continents tends to be larger and vary due to the distance from the client (closer to the client, the smaller the RTT). Since the code is making a new socket every time a request is made, the time required to process the request (the CPU clock, other time factors in calling functions from other libraries, etc.) tends to vary. The “major” impact is the distance between the client and server that the ping is being sent to (echo request/reply pair). Some of the servers in different continents may have been cached so the RTT can be much smaller than expected.

# Parts E and F

The codes for printing out the Ping statistics are already given. The changes that were incorporated to yield accurate results are (seen in RTT Calculation in $receiveOnePing()$ function):

- Incrementing $rtt\_cnt$ by 1 (since the destination address matches with the response)
- Adding $rtt\_sum$ by the difference in time (time received - time sent)
- Changing $rtt\_min$ and $rtt\_max$ whenever the RTT was the minimum or the maximum value