Introduction:

Summary:

There are two main functions. The first is sendPing which allows the program to send out pings, calculate RTT times and print out summary statistics of these pings. The second is traceRoute sends a series of ICMP echo requests and prints out information about the response for each hop. This function allows the user to see the path the packets take from the computer to the destination host, akin to a traceroute.

To implement these two functions successfully, I have to fulfill the goals of this assignment by improving the echo reply validation, making detailed output to console with detailed error and RTT statistics, and integrating traceroute functionality so that the program traces the path to a destination using incremental TTL values.

How to run:

To run this program, at least on MacOS, one needs python3 and sudo privileges. There are two functions. To run sendPing, first input the domain or input address in the following format:
icmpHelperPing.sendPing("put input here").
Put it under the main function definition. Once that is done, open terminal, ensure terminal is in the same folder as the .py that holds the file, and run sudo python3 _yourFileName_.py.

To run traceRoute, it is the same thing, however the format is the following:
icmpHelperPing.traceRoute("put input here")

Screenshots:

Traceroute with Type 11 & Type 3:

```
Tracing route to 122.56.99.243 [122.56.99.243]. Press Ctrl+C to stop.

TTL=1    RTT=24 ms       Type=11 Code=0   (Time to Live exceeded in transit) 192.168.1.1
TTL=2    RTT=18 ms       Type=11 Code=0   (Time to Live exceeded in transit) 50.34.32.1
TTL=3    RTT=7 ms        Type=11 Code=0   (Time to Live exceeded in transit) 50.46.176.52
TTL=4    RTT=17 ms       Type=3  Code=0   (Host Unreachable) 64.52.96.26

Trace ended: Destination unreachable.
```

Traceroute with Type 11 & Type 0:

```
Tracing route to gaia.cs.umass.edu [128.119.245.12].

TTL=1   RTT=2 ms        Type=11 Code=0  (Time to Live exceeded in transit) 192.168.1.1
TTL=2   RTT=10 ms       Type=11 Code=0  (Time to Live exceeded in transit) 50.34.32.1
TTL=3   RTT=17 ms       Type=11 Code=0  (Time to Live exceeded in transit) 64.52.96.12
TTL=4   *       Request timed out.
TTL=5   RTT=28 ms       Type=11 Code=0  (Time to Live exceeded in transit) 76.74.79.9
TTL=6   RTT=84 ms       Type=11 Code=0  (Time to Live exceeded in transit) 89.149.130.29
TTL=7   RTT=130 ms      Type=11 Code=0  (Time to Live exceeded in transit) 65.175.24.206
TTL=8   RTT=93 ms       Type=11 Code=0  (Time to Live exceeded in transit) 69.16.1.0
TTL=9   RTT=111 ms      Type=11 Code=0  (Time to Live exceeded in transit) 192.80.83.113
TTL=10  RTT=101 ms      Type=11 Code=0  (Time to Live exceeded in transit) 128.119.0.120
TTL=11  RTT=82 ms       Type=11 Code=0  (Time to Live exceeded in transit) 128.119.77.233
TTL=12  *       Request timed out.
```

```
TTL=12  *       Request timed out.
TTL=13  RTT=91 ms       Type=11 Code=0  (Time to Live exceeded in transit) 128.119.0.121
TTL=14  RTT=86 ms       Type=11 Code=0  (Time to Live exceeded in transit) 128.119.3.33
TTL=15  RTT=92 ms       Type=11 Code=0  (Time to Live exceeded in transit) 128.119.3.32
TTL=16  *       Request timed out.
TTL=17  RTT=113 ms      Type=0  Code=0  Destination 128.119.245.12

Trace complete.
```

Traceroute for Cambridge University (Europe):

```
● muhammadakbar@MacBookPro Traceroute % sudo python3 IcmpHelperLibrary-1.py

Tracing route to www.cam.ac.uk [23.185.0.3].

TTL=1   RTT=2 ms        Type=11 Code=0  (Time to Live exceeded in transit) 192.168.1.1
TTL=2   RTT=8 ms        Type=11 Code=0  (Time to Live exceeded in transit) 50.34.32.1
TTL=3   RTT=8 ms        Type=11 Code=0  (Time to Live exceeded in transit) 64.52.96.12
TTL=4   RTT=6 ms        Type=11 Code=0  (Time to Live exceeded in transit) 137.83.80.40
TTL=5   *       Request timed out.
TTL=6   *       Request timed out.
TTL=7   RTT=26 ms       Type=0  Code=0  Destination 23.185.0.3

Trace complete.
```

Traceroute for University of Indonesia (Asia):

```
Trace complete.
⊗ muhammadakbar@MacBookPro Traceroute % sudo python3 IcmpHelperLibrary-1.py

Tracing route to www.ui.ac.id [152.118.147.93].

TTL=1   RTT=1 ms        Type=11 Code=0  (Time to Live exceeded in transit) 192.168.1.1
TTL=2   RTT=6 ms        Type=11 Code=0  (Time to Live exceeded in transit) 50.34.32.1
TTL=3   RTT=11 ms       Type=11 Code=0  (Time to Live exceeded in transit) 64.52.96.12
TTL=4   RTT=7 ms        Type=11 Code=0  (Time to Live exceeded in transit) 137.83.80.40
TTL=5   *       Request timed out.
TTL=6   *       Request timed out.
TTL=7   RTT=25 ms       Type=11 Code=0  (Time to Live exceeded in transit) 154.54.0.233
TTL=8   RTT=28 ms       Type=11 Code=0  (Time to Live exceeded in transit) 154.54.40.41
TTL=9   RTT=55 ms       Type=11 Code=0  (Time to Live exceeded in transit) 154.54.40.158
TTL=10  RTT=46 ms       Type=11 Code=0  (Time to Live exceeded in transit) 154.54.42.102
```