HW2 Report: Ping and Traceroute

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Course: Computer Networks
Assignment: HW2

1. Overview

This assignment implements ICMP Ping and Traceroute utilities using raw sockets in Python. The goal was to replicate the functionality of the system `ping` and `traceroute` commands while handling packet construction, TTL manipulation, RTT calculation, and ICMP message parsing manually.

2. my_ping.py

Features Implemented

- ICMP Echo Request packet creation
- Checksum calculation
- ICMP Echo Reply handling
- Round Trip Time (RTT) calculation
- Support for command-line flags:
    - `-c` (number of packets)
    - `-t` (timeout)

Screenshot my_ping.py

```
siddhi221@Siddhis-MacBook-Air ASSIGN02 % sudo python3 my_ping.py google.com -c 5 -t 1
Password:
PING google.com (142.250.217.238) 56 data bytes
sent icmp_seq=1 at 1772215018.463826
received packet from 142.250.217.238 in 15.57 ms
Overall timeout reached. Exiting.
siddhi221@Siddhis-MacBook-Air ASSIGN02 %
```

3. my_traceroute.py

Features Implemented

- Increment TTL for each hop
- Detect ICMP Time Exceeded messages
- Display hop IP address
- Display RTT for each probe
- Support for command-line flags:
    - -n (numeric output only)
    - -q (number of queries per hop)
    - -S (custom flag implemented)

Screenshots my_traceroute.py

```
siddhi221@Siddhis-MacBook-Air ASSIGN02 % sudo python3 my_traceroute.py -S google.com
traceroute to google.com (142.250.217.238), 30 hops max
 1  10.3.46.1  102.591 ms  4.610 ms  4.335 ms
 2  168.92.252.17  4.339 ms  4.010 ms  3.955 ms
 3  168.92.252.1  15.001 ms  15.167 ms  15.227 ms
 4  et-6-0-9.edge2.newyork6.level3.net (4.68.11.221)  15.929 ms  15.527 ms  15.520 ms
 5  15169-3356-nyc.sp.lumen.tech (4.68.68.146)  15.815 ms  20.355 ms  15.911 ms
 6  *  *  *  (3/3 probes unanswered)
 7  108.170.236.90  19.451 ms  17.119 ms  15.513 ms
 8  192.178.106.18  18.135 ms  17.399 ms  104.753 ms
 9  *  *  *  (3/3 probes unanswered)
10  pnlgaa-ay-in-f14.1e100.net (142.250.217.238)  19.384 ms  17.010 ms  16.025 ms
siddhi221@Siddhis-MacBook-Air ASSIGN02 %
```

```
siddhi221@Siddhis-MacBook-Air ASSIGN02 % sudo python3 my_traceroute.py -S -q 3 google.com
traceroute to google.com (142.250.217.238), 30 hops max
 1  10.3.46.1  7.153 ms  3.998 ms  3.145 ms
 2  168.92.252.17  4.211 ms  3.363 ms  3.271 ms
 3  168.92.252.1  15.039 ms  15.283 ms  15.172 ms
 4  et-6-0-9.edge2.newyork6.level3.net (4.68.11.221)  17.585 ms  15.536 ms  15.473 ms
 5  15169-3356-nyc.sp.lumen.tech (4.68.68.146)  15.272 ms  15.045 ms  16.835 ms
 6  *  *  *  (3/3 probes unanswered)
 7  142.251.60.232  70.060 ms  16.775 ms  16.746 ms
siddhi221@Siddhis-MacBook-Air ASSIGN02 %
```

```
siddhi221@Siddhis-MacBook-Air ASSIGN02 % sudo python3 my_traceroute.py -q 5 google.com
traceroute to google.com (142.250.217.238), 30 hops max
 1  10.3.46.1  2.742 ms  2.634 ms  2.932 ms  3.151 ms  4.184 ms
 2  168.92.252.17  3.201 ms  3.439 ms  3.185 ms  3.255 ms  92.042 ms
 3  168.92.252.1  15.114 ms  15.133 ms  15.098 ms  16.019 ms  15.914 ms
 4  et-6-0-9.edge2.newyork6.level3.net (4.68.11.221)  15.675 ms  16.311 ms  22.715 ms  17.230 ms  15.629 ms
 5  15169-3356-nyc.sp.lumen.tech (4.68.68.146)  16.450 ms  15.909 ms  16.070 ms  15.965 ms  15.839 ms
 6  * * * * *
 7  pnlgaa-ay-in-f14.1e100.net (142.250.217.238)  19.412 ms  16.551 ms  15.946 ms  18.428 ms  15.998 ms
siddhi221@Siddhis-MacBook-Air ASSIGN02 %
```

```
siddhi221@Siddhis-MacBook-Air ASSIGN02 % sudo python3 my_traceroute.py -n google.com
traceroute to google.com (142.250.217.238), 30 hops max
 1  10.3.46.1  6.893 ms  3.385 ms  3.185 ms
 2  168.92.252.17  3.301 ms  3.205 ms  91.594 ms
 3  168.92.252.1  15.060 ms  14.975 ms  15.283 ms
 4  4.68.11.221  16.539 ms  15.539 ms  16.079 ms
 5  4.68.68.146  16.996 ms  16.064 ms  16.057 ms
 6  * * *
 7  142.251.65.102  19.694 ms  16.422 ms  17.193 ms
 8  142.250.224.247  17.203 ms  16.591 ms  16.773 ms
 9  216.239.62.196  19.279 ms  16.194 ms  16.635 ms
```

4. Notes

- Raw sockets require administrative privileges.
- Some hops may display * if no response is received.
- Results may vary depending on network configuration and firewall policies.

5. Conclusion

This project provided hands-on experience with ICMP packet construction, TTL-based routing discovery, and low-level network programming using Python raw sockets.