

# Prg-Assignment-1-My TCP/UDP Pinger

## UDPPingerServer.py

I have made a few changes to show the output on terminal when messages are received and sent, apart from it the logic is the same as given in the question.

## UDPPingerModifiedServer.py

- I have made a few changes to show the output on the terminal when messages are received and sent.
- Apart from it the logic is the same except the random generator is removed and all the messages are sent.
- The 33% loss is simulated at the NIC card using the given below command

**sudo tc qdisc add dev eth0 root netem loss 33%**

```
root@bob1:~/akshay# sudo tc qdisc add dev eth0 root netem loss 33%
root@bob1:~/akshay# sudo tc qdisc show dev eth0
qdisc netem 8004: root refcnt 2 limit 1000 loss 33%
root@bob1:~/akshay#
```

## UDPPingerClient.py

I have created a client code for the given UDP server which receives the messages from the server and print details using the below functionalities

- Time module is imported to record time to save the time of message sent and received to calculate rtt.

- Also, the timeout is set to the socket to find the message not received from the server. The code is placed in the try block and if the socket does not receive a message in a given time then it raises an exception. The exception block catches it and prints the corresponding message to the server.
- Also, a counter is initialized which keeps itself incrementing inside except blocks to count the number of packets lost.
- Finally RTT is calculated and two variables keep checking all the RTT to find minimum and maximum RTT.
- Also, packet loss percentage calculated to check whether theoretically considered percentage is same to the simulation or not.
- **I have observed that it is nearly the same as the theoretical calculation when the number of ping messages are large.**

**Screenshot of UDPPingerClient.py and UDPPingerServer.py**

```
root@trudy1: ~/akshay
SeSent: ping 2497 1694453710.8775382
tReceived: PING 2497 1694453710.8775382, RTT: 0.000296 sec
Reonds
fSent: ping 2498 1694453710.8778646
SeReceived: PING 2498 1694453710.8778646, RTT: 0.000289 sec
tonds
ReSent: ping 2499 1694453710.878183
fReceived: PING 2499 1694453710.878183, RTT: 0.000286 sec
Sends
tSent: ping 2500 1694453710.8784976
ReReceived: PING 2500 1694453710.8784976, RTT: 0.000283 sec
fonds
Se
tAll transmission of ping messages completed
Re
fPing statistics:
SeNumber of packets sent : 2500
tNumber of Packets received: 2500
ReNumber of Packets lost: 0
fPackets lost rate: 0.00% loss
SeMinimum RTT: 0.000073 seconds
tMaximum RTT: 0.018698 seconds
ReAverage RTT: 0.000259 seconds
froot@trudy1:~/akshay#

root@alice1: ~/akshay
Average RTT: 0.000139 seconds
root@alice1:~/akshay# python3 TCPPingerClient.py
Enter the number of pings message to be sent: 2500

-----Welcome to UDP Ping simulator-----

Details of ping messages sent and received

Sent: ping 1 1694453710.5842223
Received: PING 1 1694453710.5842223, RTT: 0.000597 seconds
Sent: ping 2 1694453710.5848906
Received: PING 2 1694453710.5848906, RTT: 0.000096 seconds
Sent: ping 3 1694453710.5850065
Received: PING 3 1694453710.5850065, RTT: 0.000080 seconds
Sent: ping 4 1694453710.5851042
Received: PING 4 1694453710.5851042, RTT: 0.000189 seconds
Sent: ping 5 1694453710.585321
Received: PING 5 1694453710.585321, RTT: 0.000102 seconds
Sent: ping 6 1694453710.5854416
Received: PING 6 1694453710.5854416, RTT: 0.000081 seconds
Sent: ping 7 1694453710.5855405
Received: PING 7 1694453710.5855405, RTT: 0.000079 seconds
Sent: ping 8 1694453710.585637
Received: PING 8 1694453710.585637, RTT: 0.000079 seconds
```

```
root@alice1:~/akshay# python3 UDPPingerClient.py
Enter the number of pings message to be sent: 7

-----Welcome to UDP Ping simulator-----

Details of ping messages sent and received

Sent: ping 1 1694449909.8880177
Received: PING 1 1694449909.8880177, RTT: 0.000561 seconds
Sent: ping 2 1694449909.88867
Received: PING 2 1694449909.88867, RTT: 0.000117 seconds
Sent: ping 3 1694449909.8888342
Received: PING 3 1694449909.8888342, RTT: 0.000102 seconds
Sent: ping 4 1694449909.8889933
Received: PING 4 1694449909.8889933, RTT: 0.000090 seconds
Sent: ping 5 1694449909.8891265
Request timed out
Sent: ping 6 1694449910.890348
Received: PING 6 1694449910.890348, RTT: 0.000278 seconds
Sent: ping 7 1694449910.8907053
Request timed out

Transmission of ping messages are completed

Ping statistics:
Number of packets sent      : 7
Number of Packets received: 5
Number of Packets lost:     2
Packets lost rate:          28.57% loss
Minimum RTT:                 0.000090 seconds
Maximum RTT:                 0.000561 seconds
Average RTT:                 0.000230 seconds
```

```
root@bob1:~/akshay# python3 UDPPingerServer.py
The server is ready to receive
Received message: ping 1 1694449909.8880177 from ('172.31.0.2', 34340)
Sent message: b'PING 1 1694449909.8880177' to ('172.31.0.2', 34340)
Received message: ping 2 1694449909.88867 from ('172.31.0.2', 34340)
Sent message: b'PING 2 1694449909.88867' to ('172.31.0.2', 34340)
Received message: ping 3 1694449909.8888342 from ('172.31.0.2', 34340)
Sent message: b'PING 3 1694449909.8888342' to ('172.31.0.2', 34340)
Received message: ping 4 1694449909.8889933 from ('172.31.0.2', 34340)
Sent message: b'PING 4 1694449909.8889933' to ('172.31.0.2', 34340)
Received message: ping 5 1694449909.8891265 from ('172.31.0.2', 34340)
Packet dropped
Received message: ping 6 1694449910.890348 from ('172.31.0.2', 34340)
Sent message: b'PING 6 1694449910.890348' to ('172.31.0.2', 34340)
Received message: ping 7 1694449910.8907053 from ('172.31.0.2', 34340)
Packet dropped
```

**Screenshot of UDPPingerClient.py and UDPPingerModifiedServer.py**

```
root@bob1:~/akshay# python3 UDPPingerModifiedServer.py
The server is ready to receive
Received message: ping 1 1694451980.1368349 from ('172.31.0.2', 52877)
Sent message: b'PING 1 1694451980.1368349' to ('172.31.0.2', 52877)
Received message: ping 2 1694451980.1394353 from ('172.31.0.2', 52877)
Sent message: b'PING 2 1694451980.1394353' to ('172.31.0.2', 52877)
Received message: ping 3 1694451980.1405873 from ('172.31.0.2', 52877)
Sent message: b'PING 3 1694451980.1405873' to ('172.31.0.2', 52877)
Received message: ping 4 1694451980.1415875 from ('172.31.0.2', 52877)
Sent message: b'PING 4 1694451980.1415875' to ('172.31.0.2', 52877)
Received message: ping 5 1694451980.1423745 from ('172.31.0.2', 52877)
Sent message: b'PING 5 1694451980.1423745' to ('172.31.0.2', 52877)
Received message: ping 6 1694451980.142987 from ('172.31.0.2', 52877)
Sent message: b'PING 6 1694451980.142987' to ('172.31.0.2', 52877)
Received message: ping 7 1694451981.1446695 from ('172.31.0.2', 52877)
Sent message: b'PING 7 1694451981.1446695' to ('172.31.0.2', 52877)
Received message: ping 8 1694451981.1454399 from ('172.31.0.2', 52877)
Sent message: b'PING 8 1694451981.1454399' to ('172.31.0.2', 52877)
Received message: ping 9 1694451981.146052 from ('172.31.0.2', 52877)
Sent message: b'PING 9 1694451981.146052' to ('172.31.0.2', 52877)
Received message: ping 10 1694451981.146619 from ('172.31.0.2', 52877)
Sent message: b'PING 10 1694451981.146619' to ('172.31.0.2', 52877)
Received message: ping 1 1694451986.8427799 from ('172.31.0.2', 44820)
Sent message: b'PING 1 1694451986.8427799' to ('172.31.0.2', 44820)
Received message: ping 2 1694451986.84472 from ('172.31.0.2', 44820)
Sent message: b'PING 2 1694451986.84472' to ('172.31.0.2', 44820)
Received message: ping 3 1694451986.8450913 from ('172.31.0.2', 44820)
Sent message: b'PING 3 1694451986.8450913' to ('172.31.0.2', 44820)
Received message: ping 4 1694451986.845395 from ('172.31.0.2', 44820)
Sent message: b'PING 4 1694451986.845395' to ('172.31.0.2', 44820)
Received message: ping 5 1694451986.846324 from ('172.31.0.2', 44820)
Sent message: b'PING 5 1694451986.846324' to ('172.31.0.2', 44820)
Received message: ping 6 1694451987.8478408 from ('172.31.0.2', 44820)
Sent message: b'PING 6 1694451987.8478408' to ('172.31.0.2', 44820)
Received message: ping 7 1694451987.8505564 from ('172.31.0.2', 44820)
Sent message: b'PING 7 1694451987.8505564' to ('172.31.0.2', 44820)
```

```
-----Welcome to UDP Ping simulator-----  
  
Details of ping messages sent and received  
  
Sent: ping 1 1694451986.8427799  
Received: PING 1 1694451986.8427799, RTT: 0.001566 seconds  
Sent: ping 2 1694451986.84472  
Received: PING 2 1694451986.84472, RTT: 0.000271 seconds  
Sent: ping 3 1694451986.8450913  
Received: PING 3 1694451986.8450913, RTT: 0.000212 seconds  
Sent: ping 4 1694451986.845395  
Received: PING 4 1694451986.845395, RTT: 0.000204 seconds  
Sent: ping 5 1694451986.846324  
Request timed out  
Sent: ping 6 1694451987.8478408  
Received: PING 6 1694451987.8478408, RTT: 0.002556 seconds  
Sent: ping 7 1694451987.8505564  
Request timed out  
Sent: ping 8 1694451988.851994  
Received: PING 8 1694451988.851994, RTT: 0.000492 seconds  
Sent: ping 9 1694451988.852594  
Request timed out  
Sent: ping 10 1694451989.8539345  
Received: PING 10 1694451989.8539345, RTT: 0.001166 seconds  
  
Transmission of ping messages are completed  
  
Ping statistics:  
Number of packets sent      : 10  
Number of Packets received: 7  
Number of Packets lost:     3  
Packets lost rate:          30.00% loss  
Minimum RTT:                0.000204 seconds  
Maximum RTT:                0.002556 seconds  
Average RTT:                0.000924 seconds  
root@alice1:~/akshay#
```

## TCPPingServer.py

I have created the code exactly similar to **UDPPingerServer.py** with using the TCP socket to send and receive the message.

## **TCPPingerModifiedServer.py**

- I have created the code exactly similar to **TCPPingerServer.py** with using the TCP socket to send and receive the message.
- Apart from it the logic is the same except the random generator is removed and all the messages are sent.

The 33% loss is simulated at the NIC card using the given below command

**sudo tc qdisc add dev eth0 root netem loss 33%**

```
root@bob1:~/akshay# sudo tc qdisc add dev eth0 root netem loss 33%
root@bob1:~/akshay# sudo tc qdisc show dev eth0
qdisc netem 8004: root refcnt 2 limit 1000 loss 33%
root@bob1:~/akshay#
```

## **TCPPingerConcurrentServer.py**

I have created a function that works similar to **TCPPingerServer.py** and then used the concept of threading to execute multiple clients simultaneously.

## **UDPPingerClient.py**

I have created a client code for the given TCP server which receives the messages from the server and print details using the below functionalities

- Time module is imported to record time to save the time of message sent and received to calculate rtt.
- Also, the timeout is set to the socket to find the message not received from the server. The code is placed in the try block and if the socket does not receive a message in a given time then it raises an exception. The exception block catches it and prints the corresponding message to the server.



- Also, a counter is initialized which keeps itself incrementing inside except blocks to count the number of packets lost.
- Finally RTT is calculated and two variables keep checking all the RTT to find minimum and maximum RTT.
- Also, packet loss percentage calculated to check whether theoretically considered percentage is same to the simulation or not.
- **I have observed that it is nearly the same as the theoretical calculation when the number of ping messages are large.**

**Note:** In this client code we have a problem that TCP is a reliable protocol hence In the case of NIC card packet loss changes it keeps retransmitting the message hence I have set the timeout as 0.3 after observing the retransmitted packets are taking longer time.

Also, the lost packet is retransmitted along with another packet which is removed while printing on the client side with a logic to remove those duplicate packets.

**Screenshot of TCPPingerClient.py and TCPPingerServer.py**

```
root@trudy1: ~/akshay
SeSent: ping 2497 1694453710.8775382
tReceived: PING 2497 1694453710.8775382, RTT: 0.000296 sec
Reonds
fSent: ping 2498 1694453710.8778646
SeReceived: PING 2498 1694453710.8778646, RTT: 0.000289 sec
tonds
ReSent: ping 2499 1694453710.878183
fReceived: PING 2499 1694453710.878183, RTT: 0.000286 sec
Sends
tSent: ping 2500 1694453710.8784976
ReReceived: PING 2500 1694453710.8784976, RTT: 0.000283 sec
fonds
Se
tAll transmission of ping messages completed
Re
fPing statistics:
SeNumber of packets sent : 2500
tNumber of Packets received: 2500
ReNumber of Packets lost: 0
fPackets lost rate: 0.00% loss
SeMinimum RTT: 0.000073 seconds
tMaximum RTT: 0.018698 seconds
ReAverage RTT: 0.000259 seconds
froot@trudy1:~/akshay#

root@alice1: ~/akshay
Average RTT: 0.000139 seconds
root@alice1:~/akshay# python3 TCPPingerClient.py
Enter the number of pings message to be sent: 2500

-----Welcome to UDP Ping simulator-----

Details of ping messages sent and received

Sent: ping 1 1694453710.5842223
Received: PING 1 1694453710.5842223, RTT: 0.000597 seconds
Sent: ping 2 1694453710.5848906
Received: PING 2 1694453710.5848906, RTT: 0.000096 seconds
Sent: ping 3 1694453710.5850065
Received: PING 3 1694453710.5850065, RTT: 0.000080 seconds
Sent: ping 4 1694453710.5851042
Received: PING 4 1694453710.5851042, RTT: 0.000189 seconds
Sent: ping 5 1694453710.585321
Received: PING 5 1694453710.585321, RTT: 0.000102 seconds
Sent: ping 6 1694453710.5854416
Received: PING 6 1694453710.5854416, RTT: 0.000081 seconds
Sent: ping 7 1694453710.5855405
Received: PING 7 1694453710.5855405, RTT: 0.000079 seconds
Sent: ping 8 1694453710.585637
Received: PING 8 1694453710.585637, RTT: 0.000079 seconds
```

```
root@alice1:~/akshay# python3 ICPPingerClient.py
Enter the number of pings message to be sent: 10
```

```
-----Welcome to UDP Ping simulator-----
```

### Details of ping messages sent and received

```
Sent: ping 1 1694451558.0149004
Request timed out
Sent: ping 2 1694451559.0165493
Sent: ping 3 1694451559.0177298
Received: PING 3 1694451559.0177298, RTT: 0.001560 seconds
Sent: ping 4 1694451559.0194001
Received: PING 4 1694451559.0194001, RTT: 0.001350 seconds
Sent: ping 5 1694451559.0208578
Received: PING 5 1694451559.0208578, RTT: 0.000282 seconds
Sent: ping 6 1694451559.0212414
Received: PING 6 1694451559.0212414, RTT: 0.000229 seconds
Sent: ping 7 1694451559.0215683
Received: PING 7 1694451559.0215683, RTT: 0.000254 seconds
Sent: ping 8 1694451559.0223095
Received: PING 8 1694451559.0223095, RTT: 0.000347 seconds
Sent: ping 9 1694451559.02277
Request timed out
Sent: ping 10 1694451560.0248256
```

All transmission of ping messages completed

```
Ping statistics:
Number of packets sent      : 10
Number of Packets received: 8
Number of Packets lost:    2
Packets lost rate:         20.00% loss
Minimum RTT:                0.000229 seconds
Maximum RTT:                0.001560 seconds
Average RTT:                0.000503 seconds
```

root@alice1:~/akshay#

```
Received message: ping 2 1694451559.0165493
  from ('172.31.0.2', 53550)
Sent message: PING 2 1694451559.0165493
  to ('172.31.0.2', 53550)
Received message: ping 3 1694451559.0177298
  from ('172.31.0.2', 53550)
Sent message: PING 3 1694451559.0177298
  to ('172.31.0.2', 53550)
Received message: ping 4 1694451559.0194001
  from ('172.31.0.2', 53550)
Sent message: PING 4 1694451559.0194001
  to ('172.31.0.2', 53550)
Received message: ping 5 1694451559.0208578
  from ('172.31.0.2', 53550)
Sent message: PING 5 1694451559.0208578
  to ('172.31.0.2', 53550)
Received message: ping 6 1694451559.0212414
  from ('172.31.0.2', 53550)
Sent message: PING 6 1694451559.0212414
  to ('172.31.0.2', 53550)
Received message: ping 7 1694451559.0215683
  from ('172.31.0.2', 53550)
Sent message: PING 7 1694451559.0215683
  to ('172.31.0.2', 53550)
Received message: ping 8 1694451559.0223095
  from ('172.31.0.2', 53550)
Sent message: PING 8 1694451559.0223095
  to ('172.31.0.2', 53550)
Received message: ping 9 1694451559.02277
  from ('172.31.0.2', 53550)
Received message: ping 10 1694451560.0248256
  from ('172.31.0.2', 53550)
Sent message: PING 10 1694451560.0248256
  to ('172.31.0.2', 53550)
Connection with ('172.31.0.2', 53550) closed.
```

**Screenshot of TCPPingerClient.py and TCPPingerModifiedServer.py**

```

root@alice1:~/akshay# python3 TCPPingerClient.py
Enter the number of pings message to be sent: 8

-----Welcome to UDP Ping simulator-----

Details of ping messages sent and received

Sent: ping 1 1694452482.863143
Received: PING 1 1694452482.863143, RTT: 0.204329 seconds
Sent: ping 2 1694452483.067617
Request timed out
Sent: ping 3 1694452483.3683126
Request timed out
Sent: ping 4 1694452483.6689842
Sent: ping 5 1694452483.7074163
Received: PING 4 1694452483.6689842, RTT: 0.000105 seconds
Sent: ping 6 1694452483.7076187
Received: PING 5 1694452483.7074163, RTT: 0.000276 seconds
Received: PING 6 1694452483.7076187, RTT: 0.000276 seconds
Sent: ping 7 1694452483.7080128
Received: PING 7 1694452483.7080128, RTT: 0.207399 seconds
Sent: ping 8 1694452483.9155354
Received: PING 8 1694452483.9155354, RTT: 0.000441 seconds

All transmission of ping messages completed

Ping statistics:
Number of packets sent      : 8
Number of Packets received: 6
Number of Packets lost:    2
Packets lost rate:         25.00% loss
Minimum RTT:               0.000105 seconds
Maximum RTT:               0.207399 seconds
Average RTT:               0.068804 seconds
root@alice1:~/akshay#

```

```
Received message: ping 1 1694452482.863143
  from ('172.31.0.2', 53388)
Sent message: PING 1 1694452482.863143
  to ('172.31.0.2', 53388)
Received message: ping 2 1694452483.067617
  from ('172.31.0.2', 53388)
Sent message: PING 2 1694452483.067617
  to ('172.31.0.2', 53388)
Received message: ping 3 1694452483.3683126
  from ('172.31.0.2', 53388)
Sent message: PING 3 1694452483.3683126
  to ('172.31.0.2', 53388)
Received message: ping 4 1694452483.6689842
  from ('172.31.0.2', 53388)
Sent message: PING 4 1694452483.6689842
  to ('172.31.0.2', 53388)
Received message: ping 5 1694452483.7074163
ping 6 1694452483.7076187
  from ('172.31.0.2', 53388)
Sent message: PING 5 1694452483.7074163
PING 6 1694452483.7076187
  to ('172.31.0.2', 53388)
Received message: ping 7 1694452483.7080128
  from ('172.31.0.2', 53388)
Sent message: PING 7 1694452483.7080128
  to ('172.31.0.2', 53388)
Received message: ping 8 1694452483.9155354
  from ('172.31.0.2', 53388)
Sent message: PING 8 1694452483.9155354
  to ('172.31.0.2', 53388)
Connection with ('172.31.0.2', 53388) closed.
```

### **Screenshot of TCPPingerClient.py and TCPPingerConcurrentServer.py**

Here two clients are shown running concurrently.

```
root@trudy1: ~/akshay
SeSent: ping 2497 1694453710.8775382
tReceived: PING 2497 1694453710.8775382, RTT: 0.000296 sec
Reonds
fSent: ping 2498 1694453710.8778646
SeReceived: PING 2498 1694453710.8778646, RTT: 0.000289 sec
tonds
ReSent: ping 2499 1694453710.878183
fReceived: PING 2499 1694453710.878183, RTT: 0.000286 sec
Sends
tSent: ping 2500 1694453710.8784976
ReReceived: PING 2500 1694453710.8784976, RTT: 0.000283 sec
fonds
Se
tAll transmission of ping messages completed
Re
fPing statistics:
SeNumber of packets sent : 2500
tNumber of Packets received: 2500
ReNumber of Packets lost: 0
fPackets lost rate: 0.00% loss
SeMinimum RTT: 0.000073 seconds
tMaximum RTT: 0.018698 seconds
ReAverage RTT: 0.000259 seconds
froot@trudy1:~/akshay#

root@alice1: ~/akshay
Average RTT: 0.000139 seconds
root@alice1:~/akshay# python3 TCPPingerClient.py
Enter the number of pings message to be sent: 2500

-----Welcome to UDP Ping simulator-----

Details of ping messages sent and received

Sent: ping 1 1694453710.5842223
Received: PING 1 1694453710.5842223, RTT: 0.000597 seconds
Sent: ping 2 1694453710.5848906
Received: PING 2 1694453710.5848906, RTT: 0.000096 seconds
Sent: ping 3 1694453710.5850065
Received: PING 3 1694453710.5850065, RTT: 0.000080 seconds
Sent: ping 4 1694453710.5851042
Received: PING 4 1694453710.5851042, RTT: 0.000189 seconds
Sent: ping 5 1694453710.585321
Received: PING 5 1694453710.585321, RTT: 0.000102 seconds
Sent: ping 6 1694453710.5854416
Received: PING 6 1694453710.5854416, RTT: 0.000081 seconds
Sent: ping 7 1694453710.5855405
Received: PING 7 1694453710.5855405, RTT: 0.000079 seconds
Sent: ping 8 1694453710.585637
Received: PING 8 1694453710.585637, RTT: 0.000079 seconds
```



```
Sent message: PING 2493 1694453711.3273838
to ('172.31.0.2', 38712)
Received message: ping 2494 1694453711.3274891
from ('172.31.0.2', 38712)
Sent message: PING 2494 1694453711.3274891
to ('172.31.0.2', 38712)
Received message: ping 2495 1694453711.3275938
from ('172.31.0.2', 38712)
Sent message: PING 2495 1694453711.3275938
to ('172.31.0.2', 38712)
Received message: ping 2496 1694453711.3276985
from ('172.31.0.2', 38712)
Sent message: PING 2496 1694453711.3276985
to ('172.31.0.2', 38712)
Received message: ping 2497 1694453711.3278034
from ('172.31.0.2', 38712)
Sent message: PING 2497 1694453711.3278034
to ('172.31.0.2', 38712)
Received message: ping 2498 1694453711.3279076
from ('172.31.0.2', 38712)
Sent message: PING 2498 1694453711.3279076
to ('172.31.0.2', 38712)
Received message: ping 2499 1694453711.3280125
from ('172.31.0.2', 38712)
Sent message: PING 2499 1694453711.3280125
to ('172.31.0.2', 38712)
Received message: ping 2500 1694453711.3281171
from ('172.31.0.2', 38712)
Sent message: PING 2500 1694453711.3281171
to ('172.31.0.2', 38712)
Connection with ('172.31.0.2', 38712) closed.
```