

High Level Overview of the code :

First I have taken separate lists for all the sequence numbers, acknowledgement numbers, source ports and destinations ports. I have also stored the throughput values, timestamps and scaling factors in dictionaries. As I iterate through various packets I store the corresponding values in the dictionaries and lists which would later be handy in the calculation of required parameters.

Answers to the Questions :

1) Number of flows is 3

The number of flows is calculated by the number of unique source ports other than the given destination port.

2)

a) First two transactions are :

\*\*\*\*\* Transaction 1 \*\*\*\*\*

Source Port : 43502    Destination Port : 80  
Sequence Number : 2558634630    Acknowledgement Number : 3429921723  
Window Size : 49152

Source Port : 80    Destination Port : 43502  
Sequence Number : 3429921723    Acknowledgement Number : 2558634654  
Window Size : 49152

\*\*\*\*\* Transaction 2 \*\*\*\*\*

Source Port : 43502    Destination Port : 80  
Sequence Number : 2558634654    Acknowledgement Number : 3429921723  
Window Size : 49152

Source Port : 80    Destination Port : 43502  
Sequence Number : 3429921723    Acknowledgement Number : 2558636102  
Window Size : 49152

\*\*\*\*\* Transaction 1 \*\*\*\*\*

Source Port : 43498    Destination Port : 80  
Sequence Number : 705669103    Acknowledgement Number : 1921750144  
Window Size : 49152

Source Port : 80    Destination Port : 43498  
Sequence Number : 1921750144    Acknowledgement Number : 705669127  
Window Size : 49152

\*\*\*\*\* Transaction 2 \*\*\*\*\*

Source Port : 43498    Destination Port : 80  
Sequence Number : 705669127    Acknowledgement Number : 1921750144  
Window Size : 49152

Source Port : 80    Destination Port : 43498  
Sequence Number : 1921750144    Acknowledgement Number : 705670575  
Window Size : 49152

\*\*\*\*\* Transaction 1 \*\*\*\*\*

Source Port : 43500    Destination Port : 80  
Sequence Number : 3636173852    Acknowledgement Number : 2335809728  
Window Size : 49152

Source Port : 80    Destination Port : 43500  
Sequence Number : 2335809728    Acknowledgement Number : 3636173876  
Window Size : 49152

\*\*\*\*\* Transaction 2 \*\*\*\*\*

Source Port : 43500    Destination Port : 80  
Sequence Number : 3636173876    Acknowledgement Number : 2335809728  
Window Size : 49152

Source Port : 80    Destination Port : 43500  
Sequence Number : 2335809728    Acknowledgement Number : 3636175324  
Window Size : 49152

After the connection has established I have picked the first two packets having the ack bit set in them and to get the corresponding items I have taken them from the previous lists and dictionaries I have given in the above overview

b) Throughput:

Throughput of : 43498 is 5251440.93545 bytes/sec

Throughput of : 43500 is 1285424.88902 bytes/sec

Throughput of : 43502 is 1481548.3748 bytes/sec

While parsing the packets I have calculated the total number of bytes for each port and also the timestamps. Now the Throughput is the (total number of bytes)/(e\_time - s\_time)

c) Loss Rate:

Loss rate of 43498 is 0.000430230890578

Loss rate of 43500 is 0.013444664591

Loss rate of 43502 is 0.00137551581843

While parsing the packets, I have stored all the sequence numbers in a list and then took the unique sequence numbers from it. It gives the number of loss packets and that divided by the total length of sequence list gives the loss rate

d) Average RTT:

Average RTT for 43502 is 0.0283540049686

Average RTT for 43498 is 0.02951331197

Average RTT for 43500 is 0.130448618893

While parsing the packets I have taken the ack\_pkt and sent\_pkt lists and stored the corresponding values in them. Then for each of the pair I have calculated the sum of the e\_time - s\_time. Now the total rtt is divided by the sum of length of ack\_pkt and sent\_pkt.

Theoretical Throughput:

Theoretical Throughput of 43502 is 694185.686127

Theoretical Throughput of 43498 is 1192488.27286

Theoretical Throughput of 43500 is 48262.3415271

It is calculated using the formula:

$$(MSS * (\sqrt{3/2})) / (avg\_rtt * \sqrt{loss\_rate})$$

Where mss = 1460

