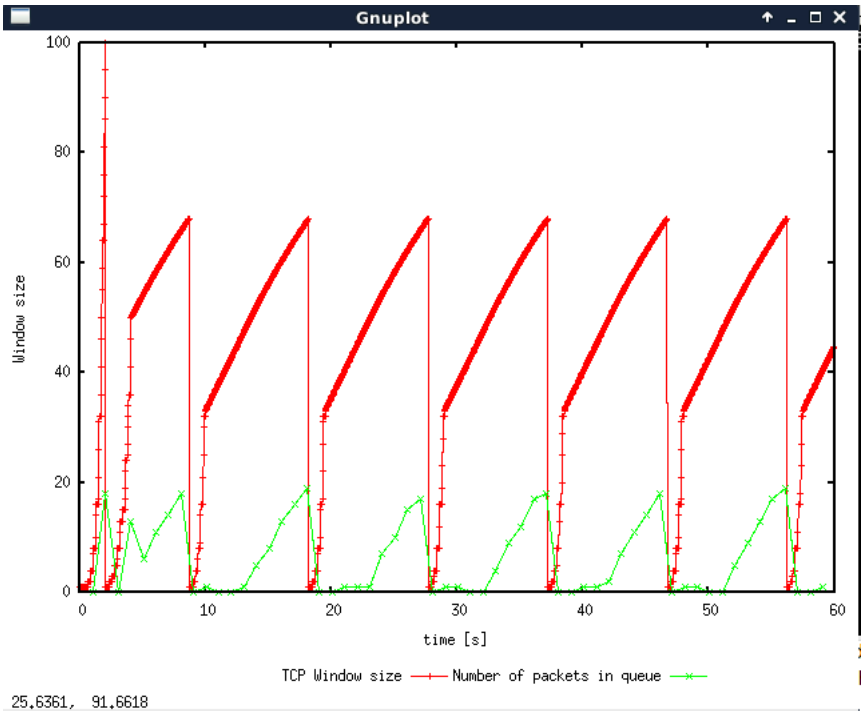
# Lab 5

## Exercise 1

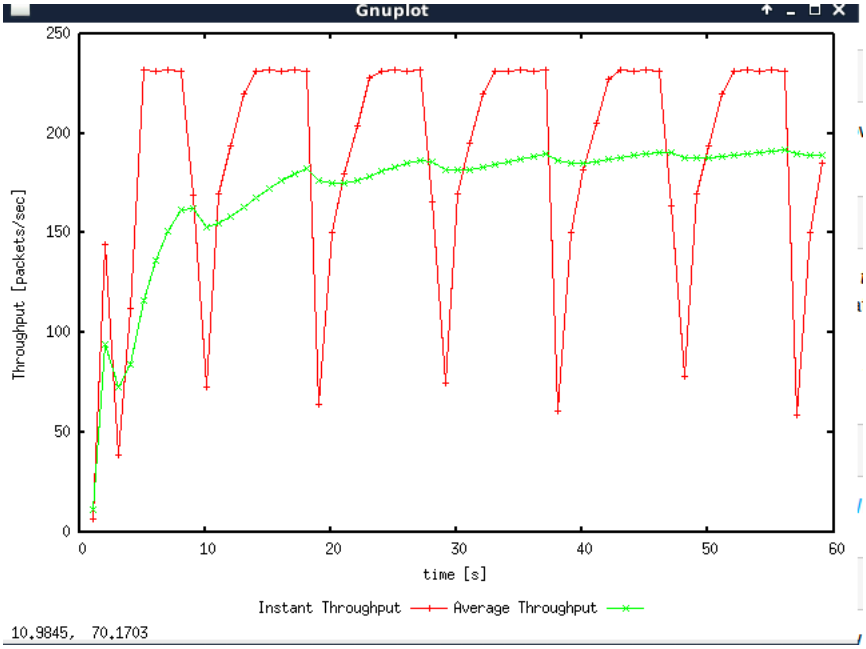
Question 1:
What is the maximum size of the congestion window that the TCP flow reaches in this case? What does the TCP flow do when the congestion window reaches this value? Why? What happens next? Include the graph in your submission report.

Answer:




Maximum size: 100
After reaching this value, congestion window decreases to value 1.
The threshold is set to 1/2 size of window, and the value of window size increases by the slow start way. After reaching the threshold, it starts to increase by AIMD way.

Question 2:
What is the average throughput of TCP in this case? (both in number of packets per second and bps)



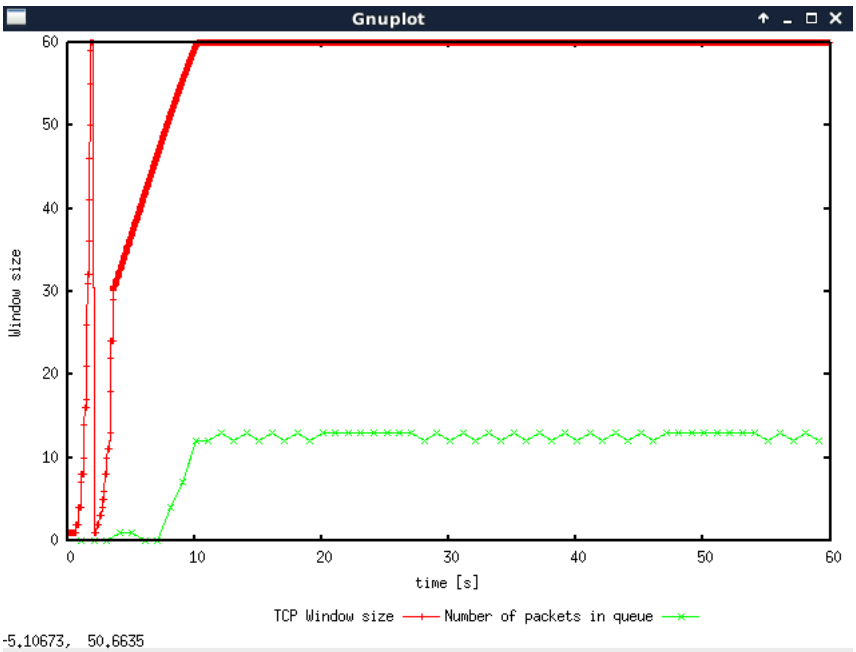

Answer:

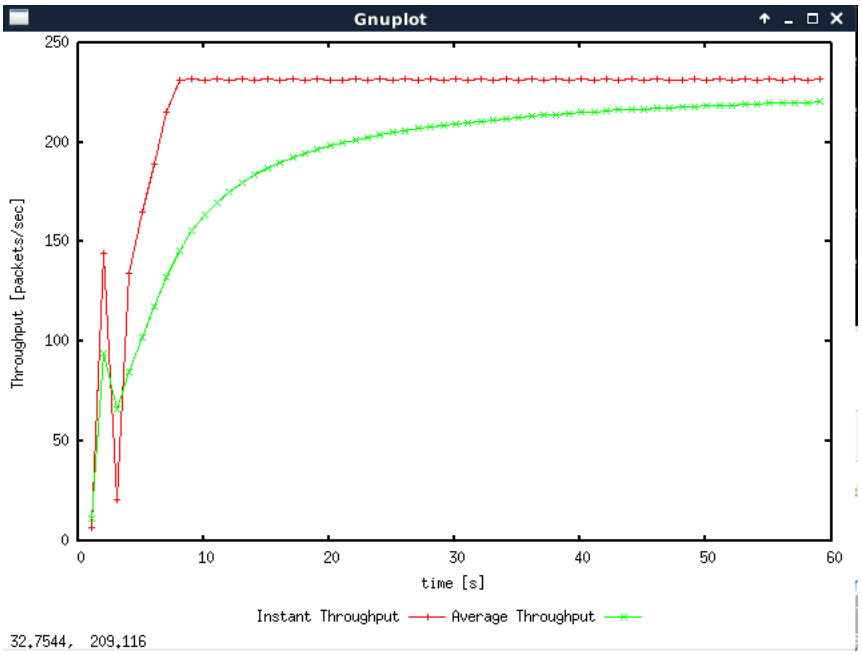
The average throughput is 190 packets/s
190 * 500 * 8 = 760000 bps

Question 3:
Rerun the above script, each time with different values for the max congestion window size but the same RTT (i.e. 100ms). How does TCP respond to the variation of this parameter? Find the value of the maximum congestion window at which TCP stops oscillating (i.e., does not move up and down again) to reach a stable behaviour. What is the average throughput (in packets and bps) at this point? How does the actual average throughput compare to the link capacity (1Mbps)?

Answer:

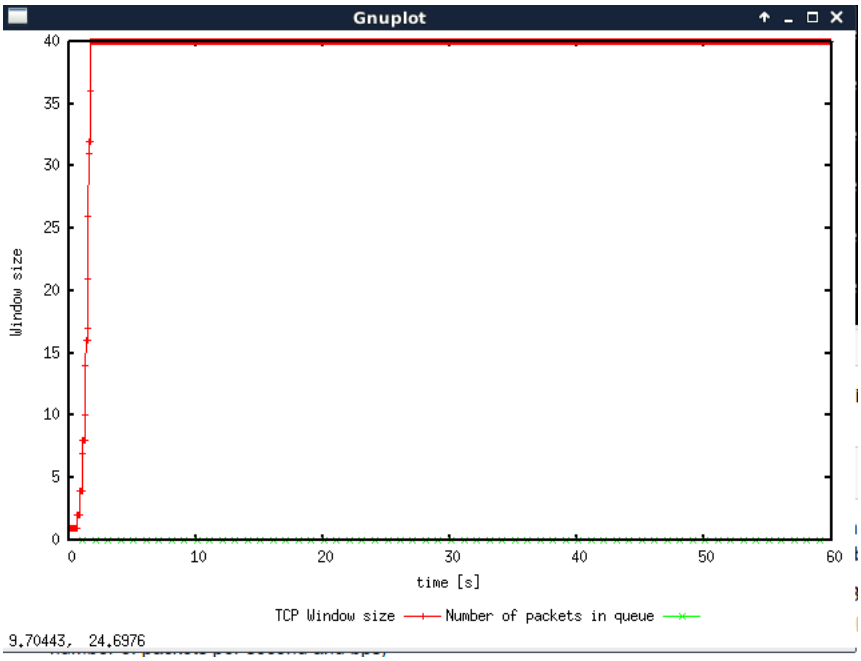
When the max window size is equal to 60

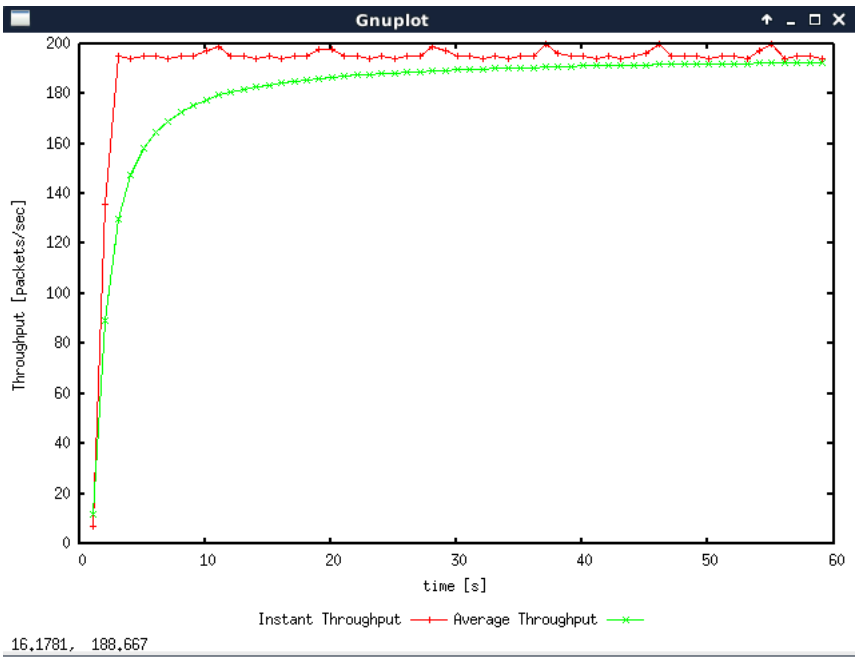



the maximum congestion window at which TCP stops oscillating is 60
average throughput is 215
215 * 500 * 8 = 860000 bps
It is approximately equal to 1Mbps

When the max window size is equal to 40

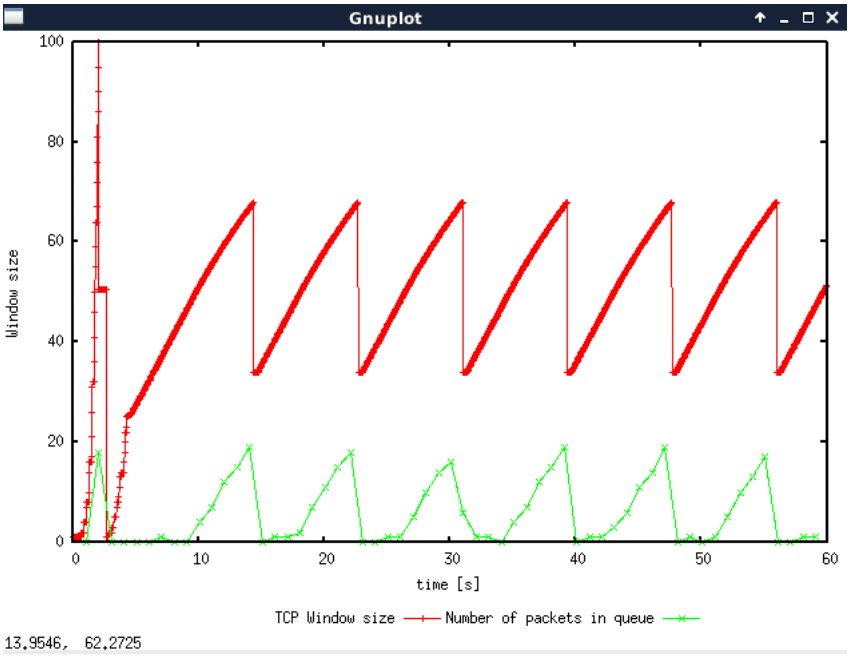


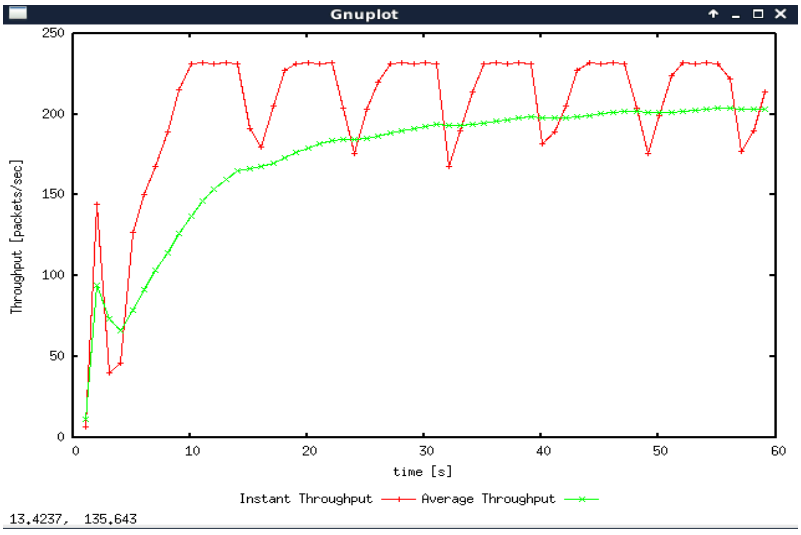

the maximum congestion window at which TCP stops oscillating is 40
average throughput is 190
190 * 500 * 8 = 760000 bps
It is smaller than 1Mbps

Question 4:
Repeat the steps outlined in Question 1 and 2 (NOT Question 3) but for TCP Reno. Compare the graphs for the two implementations and explain the differences. (Hint: compare the number of times the congestion window goes back to zero in each case). How does the average throughput differ in both implementations?

Answer:




In terms of Tahoe, every time when the window size reaches the maximum value, it decreases to value 1.
But for Reno, when the timeout, the value decreases to value 1, while the value decreases to the half of window size when the triple duplicate ACK.

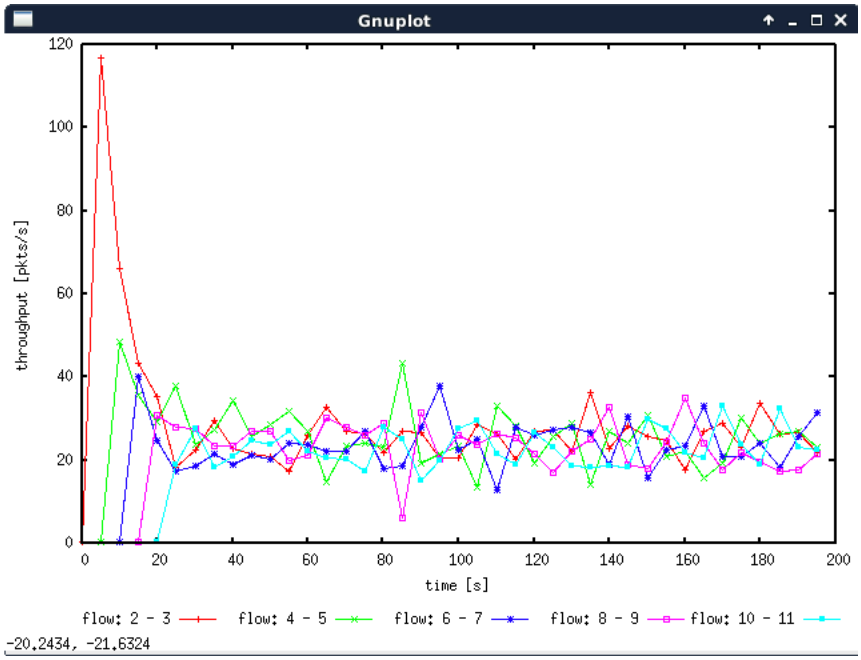


The average throughput is equal to 200, which is slightly higher than the value of TCP Tahoe.

# Exercise 2

Question 1: Does each flow get an equal share of the capacity of the common link (i.e., is TCP fair) ? Explain which observations lead you to this conclusion.

Answer:




Yes. It is obvious in the image that every flow is approximately equal for the throughout value when it reaches to stable behavior.

Question 2. What happens to the throughput of the pre-existing TCP flows when a new flow is created? Explain the mechanisms of TCP which contribute to this behaviour. Argue about whether you consider this behaviour to be fair or unfair.

Answer:

This behavior is fair:

At the first, when there is only one flow, its throughput is equal to 120. But when the second one comes, it decreases to as much as the second one, and so on.

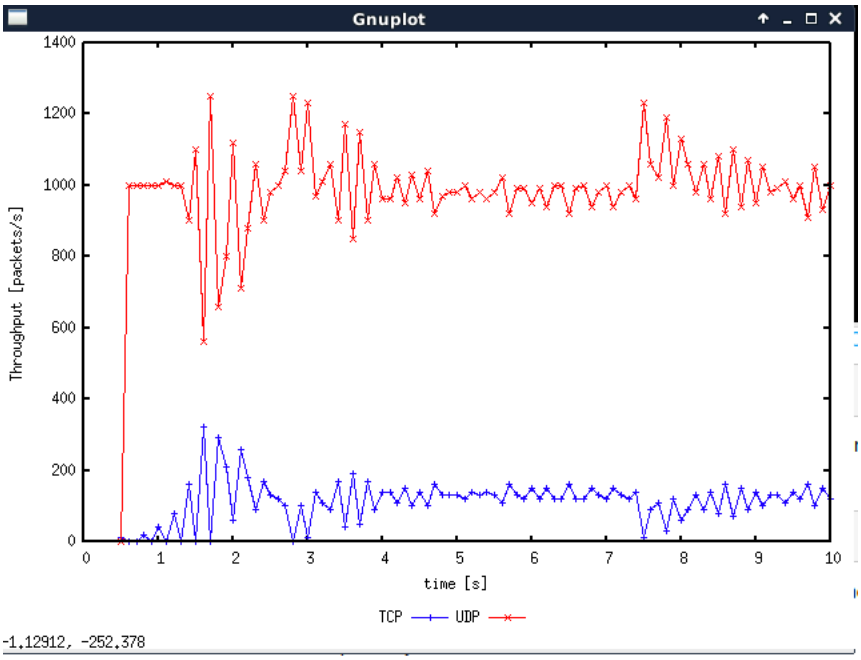
So every time when a new flow comes, pre-existing TCP flows will decrease their throughout values to ensure fair.

# Exercise 3

Question 1: How do you expect the TCP flow and the UDP flow to behave if the capacity of the link is 5 Mbps ?

Answer:

UDP throughput is much higher than TCP.




Red one is UDP while blue one is TCP

Question 2: Why does one flow achieve higher throughput than the other? Try to explain what mechanisms force the two flows to stabilise to the observed throughput.

Answer:

There is no congestion control and flow control in the UDP while TCP has congestion control and flow control. So the transformation speed of UDP is faster than TCP. So the throughput is higher.

Question 3: List the advantages and the disadvantages of using UDP instead of TCP for a file transfer, when our connection has to compete with other flows for the same link. What would happen if everybody started using UDP instead of TCP for that same reason

Answer:

For the file transfer:

Advantages: fast

Disadvantages: data loss, unreliable

If everybody started using UDP, it will cause the congestion collapse.