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# Lab5

**The graph required are all included under each question, therefore there is no attached files**

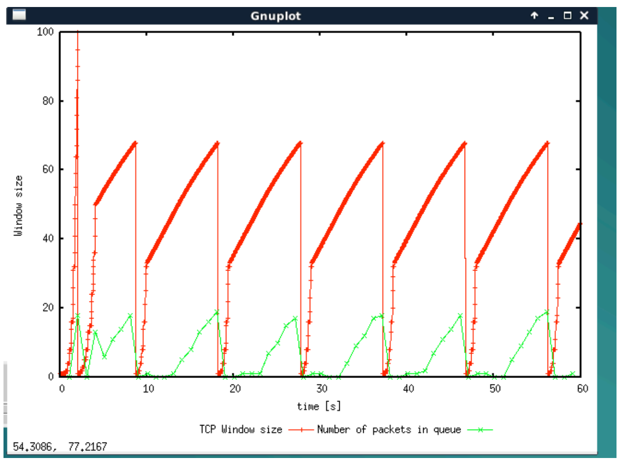
## Exercise 1

Q1、

the maximum size of the congestion window that the TCP flow reaches in this case is 100.

TCP flow drop some packets, because the size of packet congestion(100) larger than the size of the queue(20).

After that the size of window go back to 1, and increase in slow start and reach the half of last congestion window and additive increase until there is packet loss again.

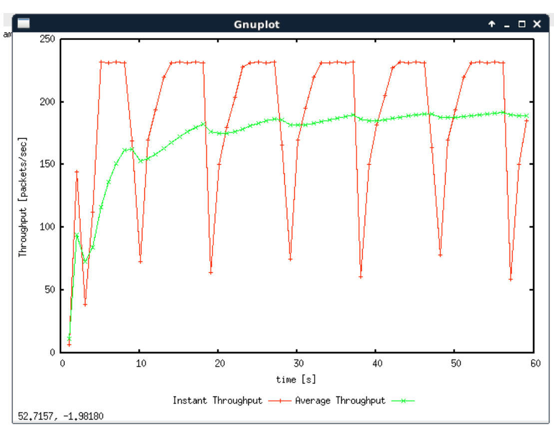



Q2.

From the graph below, we know the average of the throughout(packet/seconds) = 190

The payload = 500bytes.

The average throughput of TCP = (500 + 40) * 8 bits * 180packets = 802800bps



Q3.
When the maximum congestion window size grow larger than the maximum queen size, some of packets will be dropped, and the throughout will go back to 1 and slow start again.

When we set the initial maximum congestion window as 50 packets, TCP grow at first and keep stability and stops oscillating.

The average packet is 225 packets
The average throughput is 225 * (500 +40) * 8 = 972000bps, which is almost equal to the link capacity(1Mbps)

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$gnuplot Window.plot
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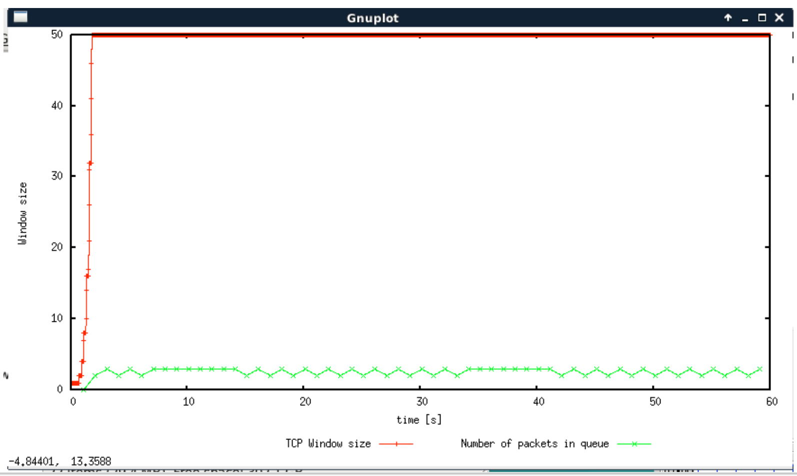


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$gnuplot WindowTPut.plot
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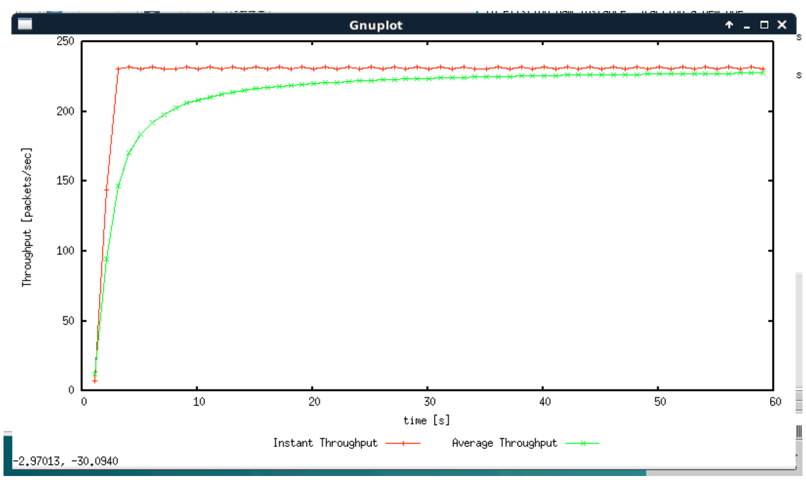


Q4.

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$gnuplot Window.plot
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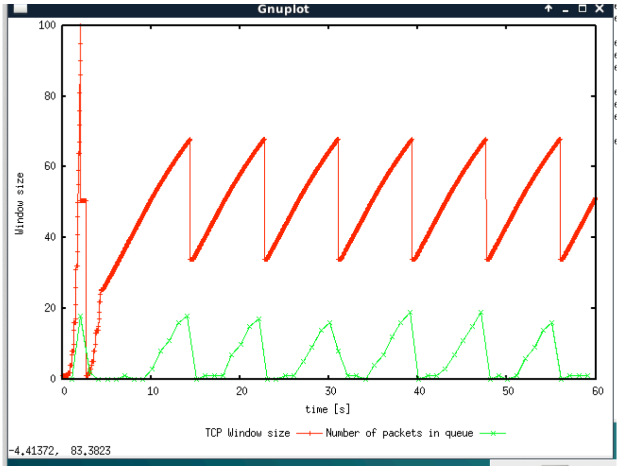


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$gnuplot WindowTPut.plot
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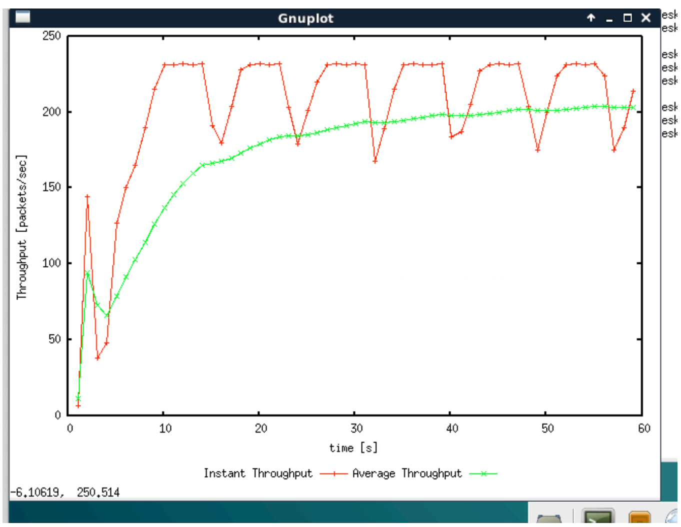
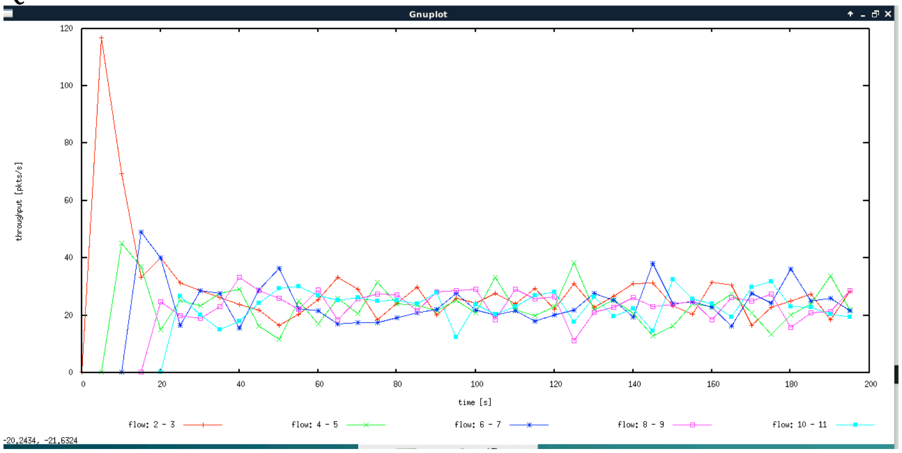



For TCP Reno, when there occurs a loss, the throughout won't go back to 1 and start a slow-start phase, instead, it will decrease to the half of the current congestion window and additive increase until there is a loss again. And in this TCP, most of losses are due to the triple duplicate ACKs instead of timeout.

The TCP reno throughout = 200pps (approximately )
The average throughput of TCP = (500 + 40) * 8 bits * 200 packets = 864000bps
Compare to the TCP Tahoe (802800bps), the throughout of TCP Reno increased 7%,
The Reno performs a little bit better. The reason is that Reno don't have to initiate from 1 to slow-start when there is a loss occurred.

# Exercise2.

Q1.




After the start phase, each of the connection get an equal share of the capacity of the common link, because we can see that each of the throughout vary in a certain range(20-40packet/s).

Q2.

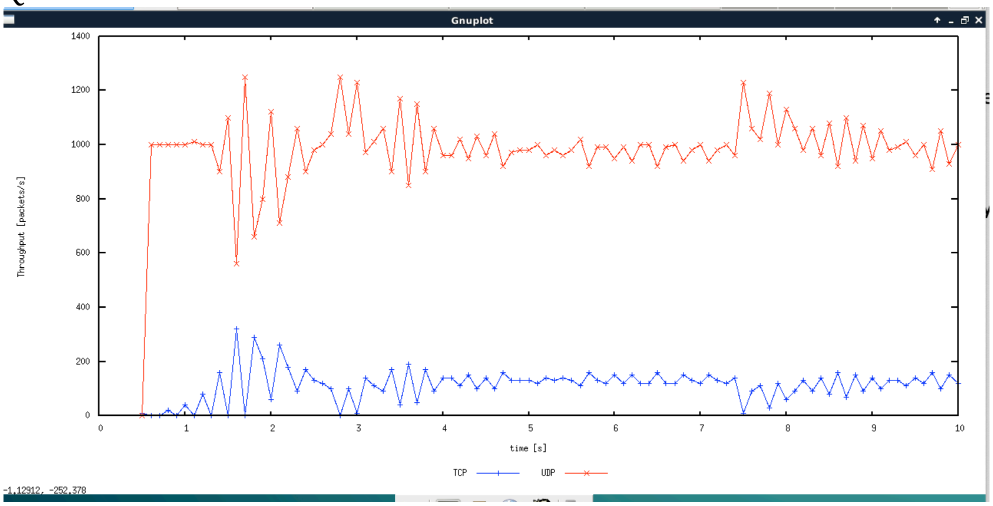
when a new flow is created, the throughput of the existing flow decreases significantly, then it varies in a certain range as other flow.

Due to the congestion control mechanisms, when there is a new flow join, it will ramp up its congestion window and caused the congestion in the link, therefore the TCP will slow down the exist flow to avoid more serious congestion.

In this problem, this behavior is fair enough, because all the flow trans one file at the same time, which means each flow download at same speed(average), however, if there is a flow which have many parallel connections compare to others, it will occupy more bandwidths.

# Exercise3.

Q1.




Ignoring the hint shown under the graph, the red line is UDP, whereas the blue line is TCP, because the throughout of UDP should be much larger than TCP and the UDP will not control its transmission rate when there is a congestion.

Q2.

As we known, the UDP don't have congestion control mechanism, therefore even the Internet is already congestion or the packets are dropped, the server will not adjust the speed of sending UDP packet, and it also lead to the decrease of the TCP packet at a low transmission speed at the same time.

Q3.

The advantage of using UDP in this question is the speed of transmission is much faster than the TCP, In contrast, the disadvantage of using UDP for file transfer is the stability and reliable, the sender don't know the receiver get the file successfully, if there is a serious congestion in the link, there may a lot of packet loss, which contribute the file not reliable.

If everyone using UDP to transfer the file, it will lead a serious congestion at first, and finally the network may collapse.