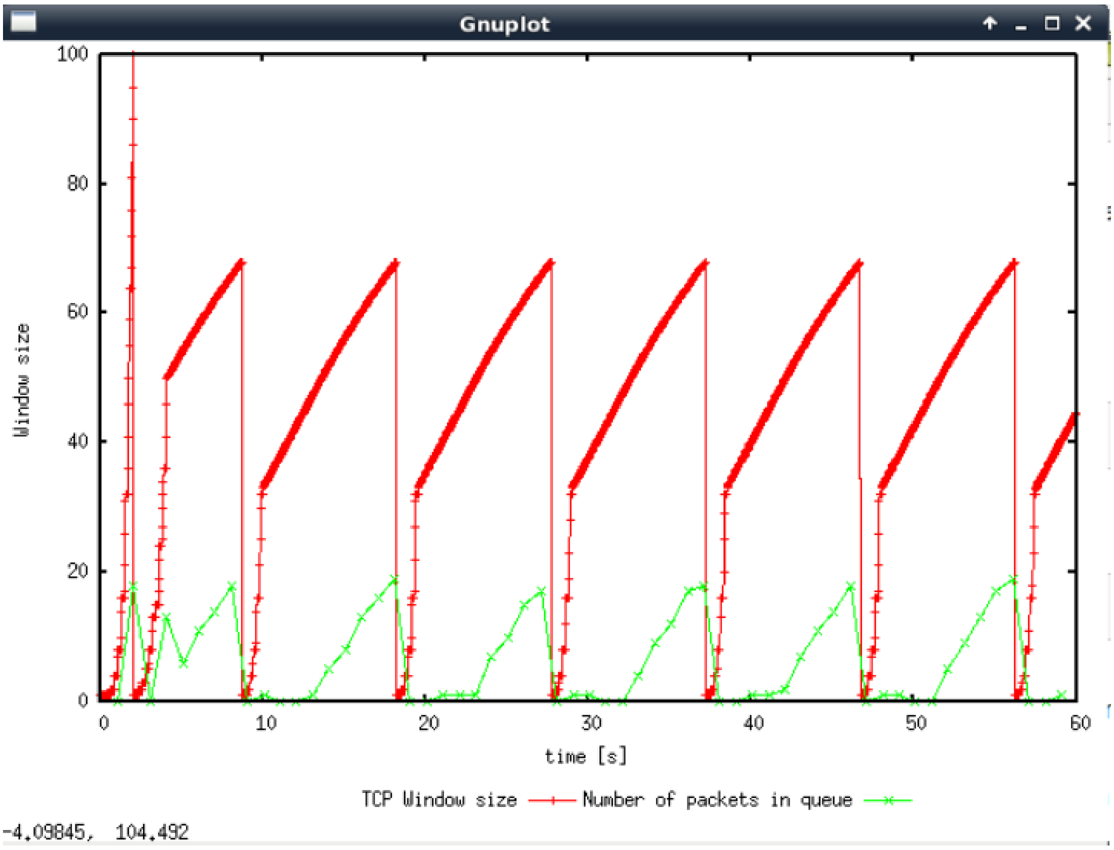
Exercise 1

Q1:

The maximum size of window is 100.

The TCP flow reset the window size from 1 (called slow start), meanwhile, a new ssthresh will be created which is used to control the congestion and its value is half of max window size (50). When new window size reaches the ssthresh, the growing speed will be decreased. Finally, when queue is full, the window size will become 1 again(called slow start). The loop won't end, until the transmission is finished.



Q2:

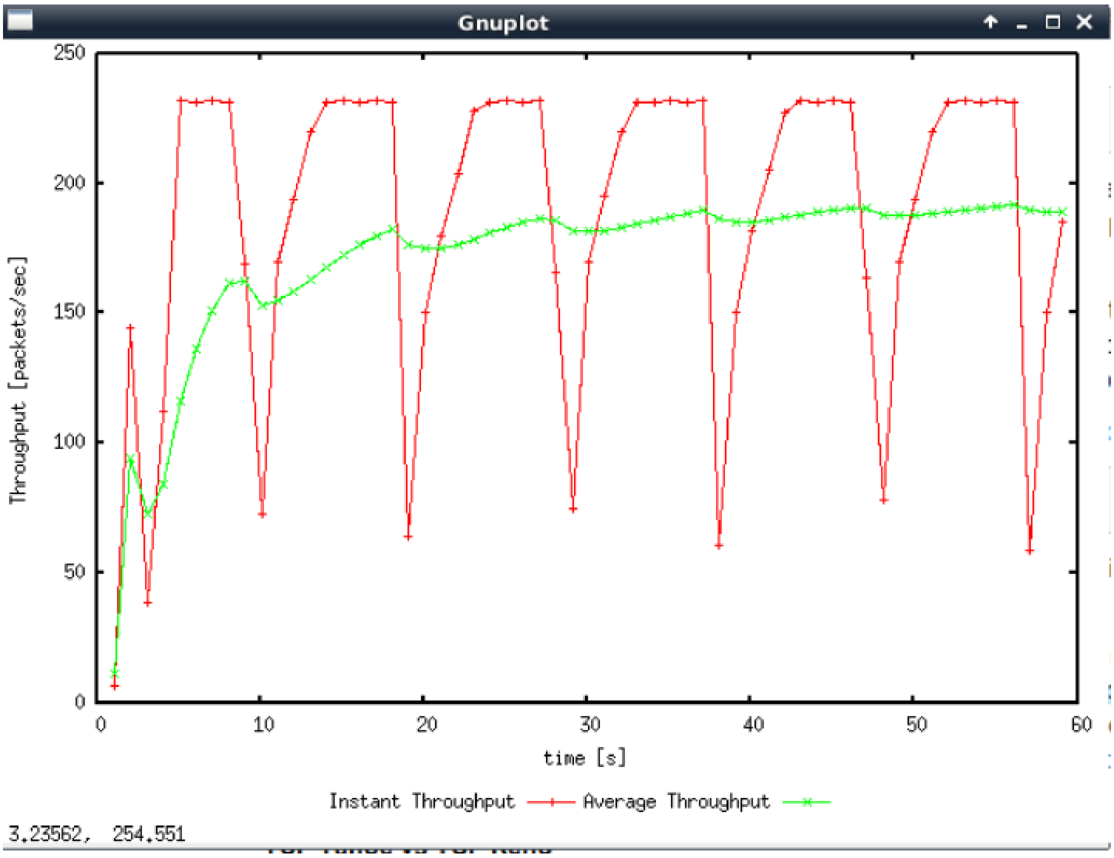
in numbers of packets per second:

The average throughput of TCP is 190 pps.

In bps:

= (500 + 20 + 20) x 190 x 8 = 820,800 bps

The average throughput of TCP is 820.8 Kbps.



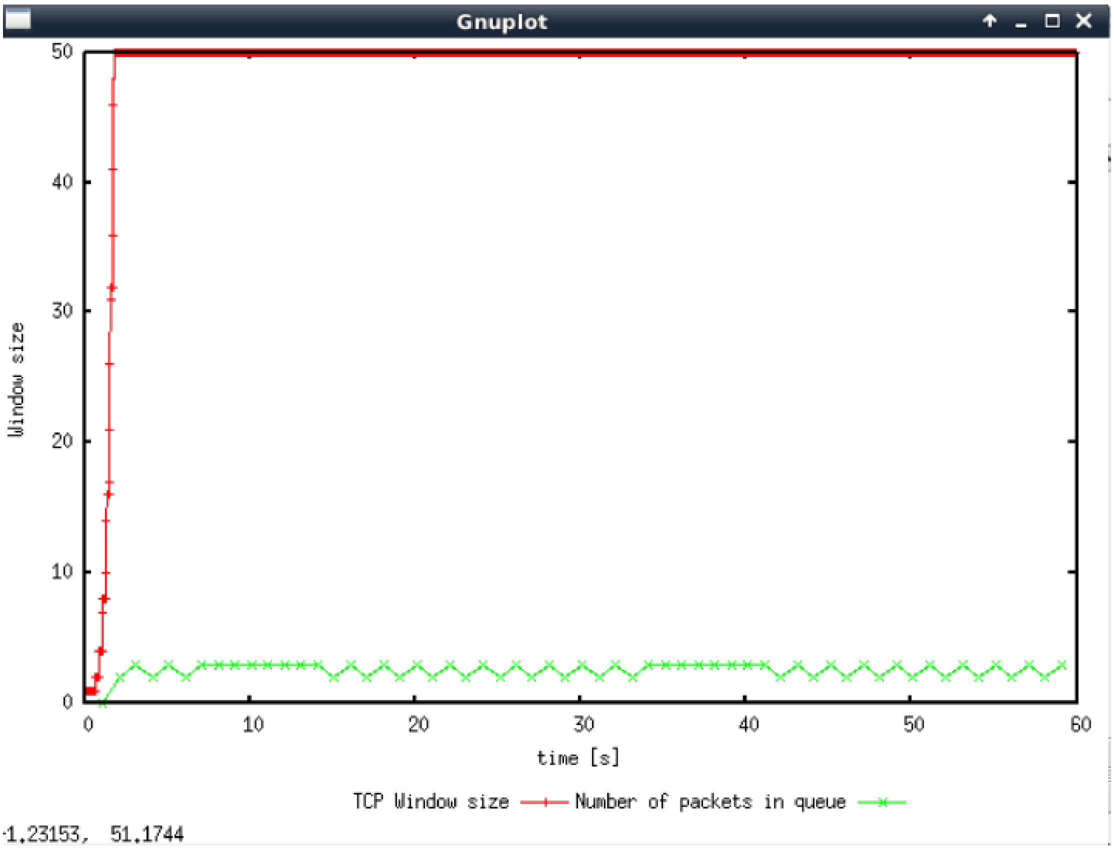
Q3:

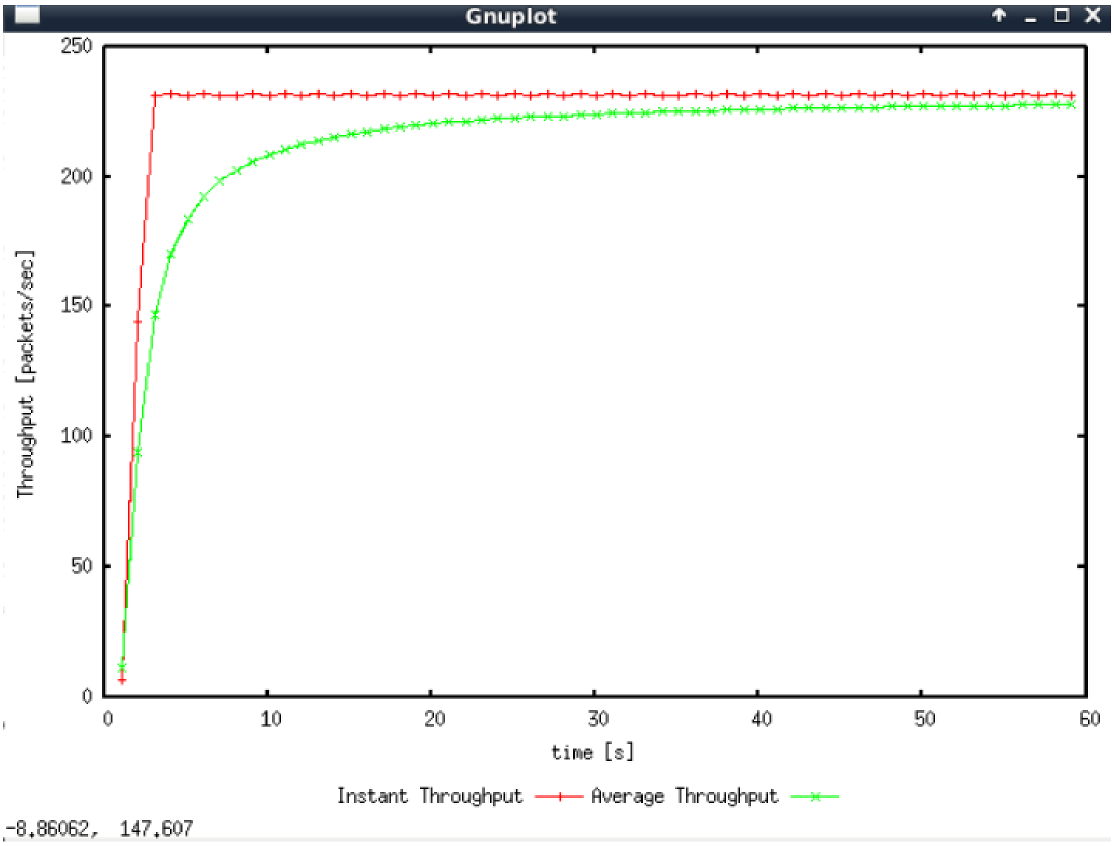
As the graph shows, when the initial maximum congestion window is set to 50, TCP stops oscillating and reach a stable behavior, so the maximum congestion window is **50.**

The average packet throughput is nearly 230 pps

The average throughput is 230x500x8=920 Kbps

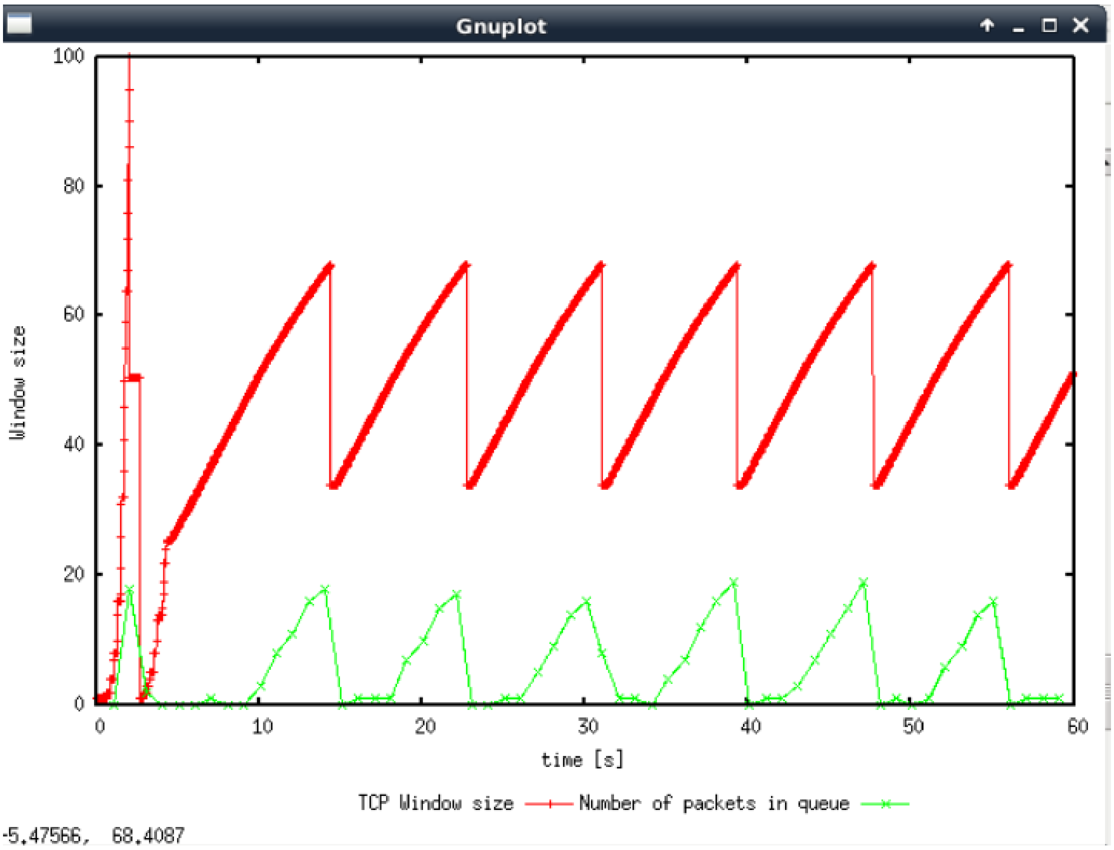
Which is approximately equal to the link capacity (1Mbps).


Gnuplot
Window size
time [s]
TCP Window size
Number of packets in queue
-1.23153, 51.1744

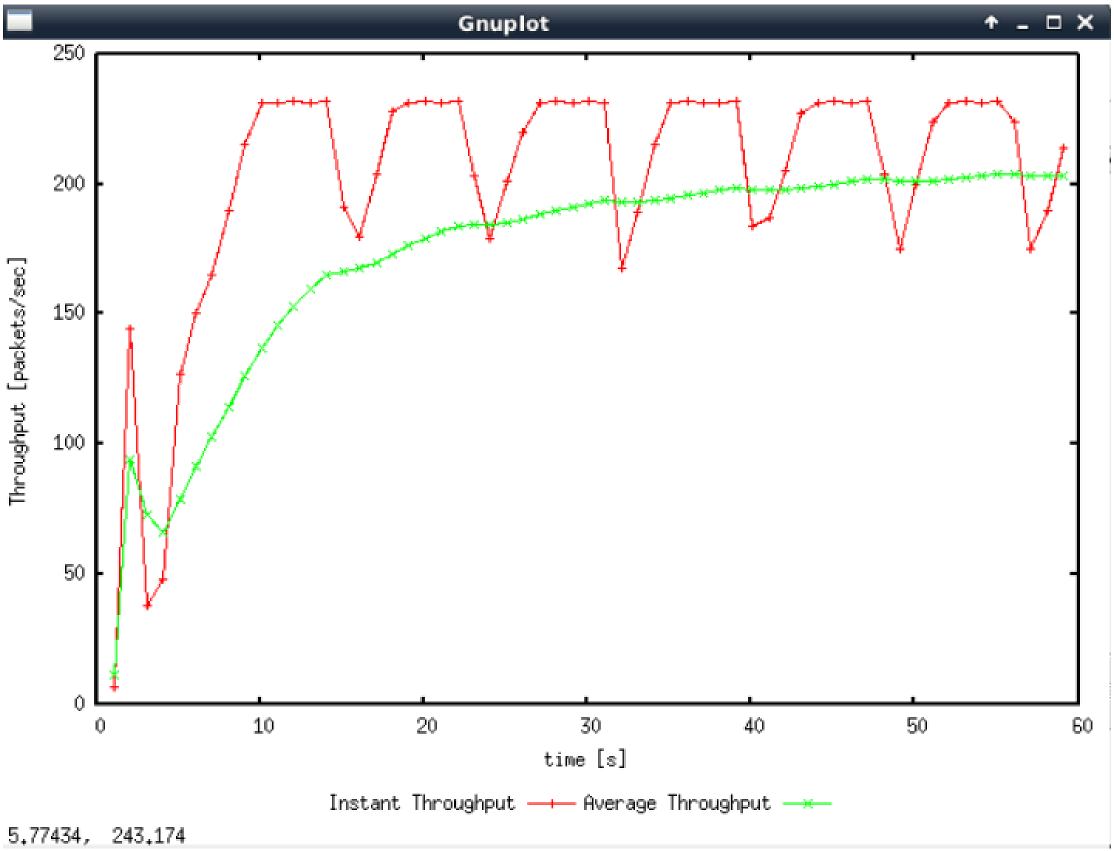

Gnuplot
Throughput [packets/sec]
time [s]
Instant Throughput
Average Throughput
-8.86062, 147.607

Q4:

The TCP flow does not reset the window size from 1, the slow start doesn't happen and the ssthresh is 1/4 of the max window size, and then, when it reach the ssthresh, it just set the ssthresh to the half of congestion window size and the congestion window size will restart from it.



The average throughput is nearly 200 which is higher than before. As no slow start anymore.



Exercise2

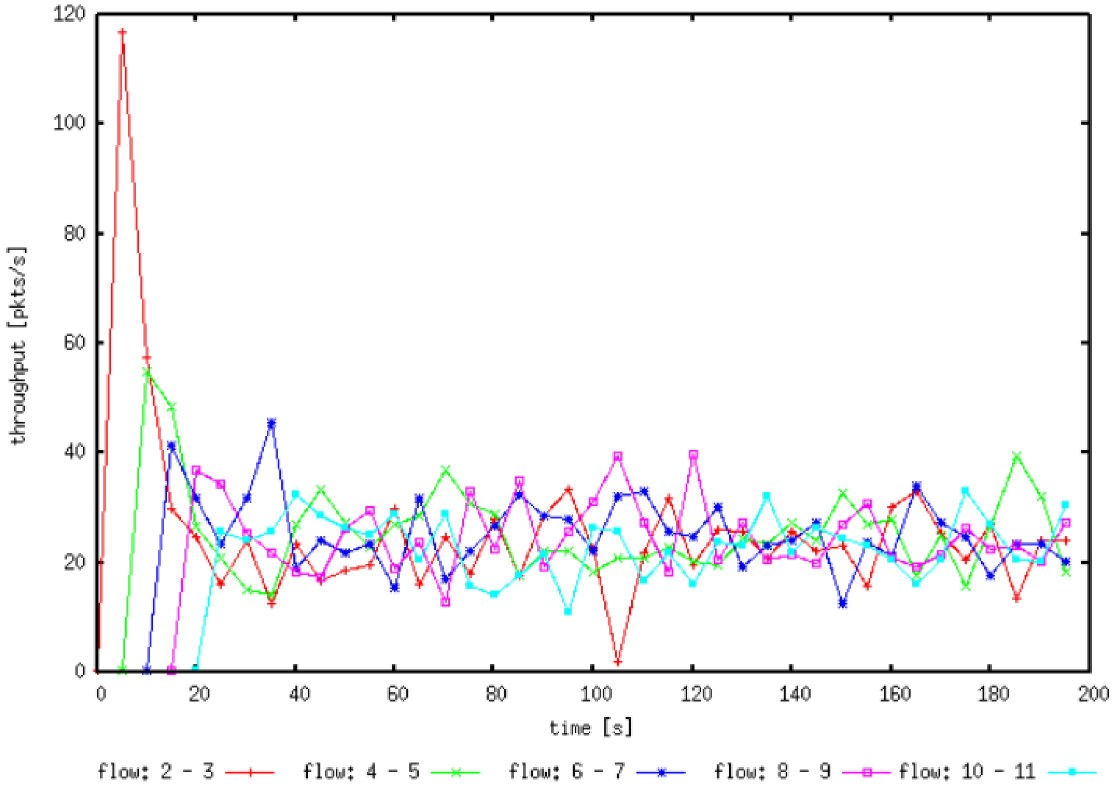
Q1:

Almost equal share, from the graph you can see, sometimes one flow is higher than others and sometimes it is lower than others, the throughput is oscillating. Because of the congestion control strategy, the throughput of each flow cannot be same at the same time , but the TCP is fair, they equally share the link.

Q2:

When a new flow is created all pre-existing flows reduces. This is because the new one creates its own congestion window on the link. And other flows adapt their congestion windows to avoid running out of the network.

The behavior is fair, when a new flow added, other pre-existing flows share the link with the new one by reducing their congestion windows.



-20.2434, -21.6324

Exercise3

Q1:

UDP will still transmit packets at a constant speed, meanwhile, the throughput of TCP will be increase, as there are more link capacities that TCP can use.

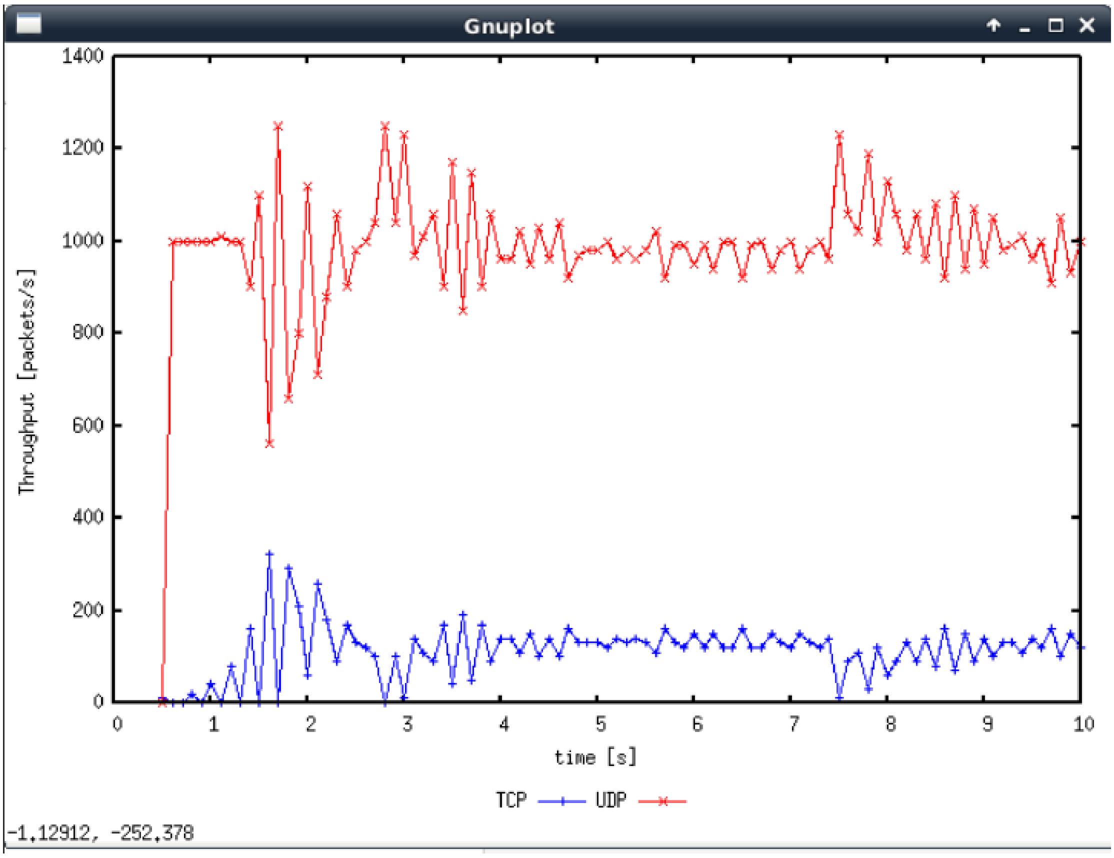
Q2:

UDP is higher than TCP,

The UDP doesn't have congestion control, so it will transmit packets at a constant speed, even meets congestion, it won't reduce its transmit spend.

TCP has congestion control, so when meeting congestion, it will adapt its transmit speed to meet the congestion condition.

When UDP transit packets in a constant rate, the link is in congestion condition, so TCP have to adapt its transmit speed to meet the congestion condition.



Q3:

TCP:

Advantages: reliable, stable.

Disadvantage: too many constrain, transmission speed.

UDP:

Advantages: fast.

Disadvantage: easily been influence , cannot ensure the integrity.

When everybody use UDP, there are no congestion control anymore, the speed of entire internet will decrease even collapse.