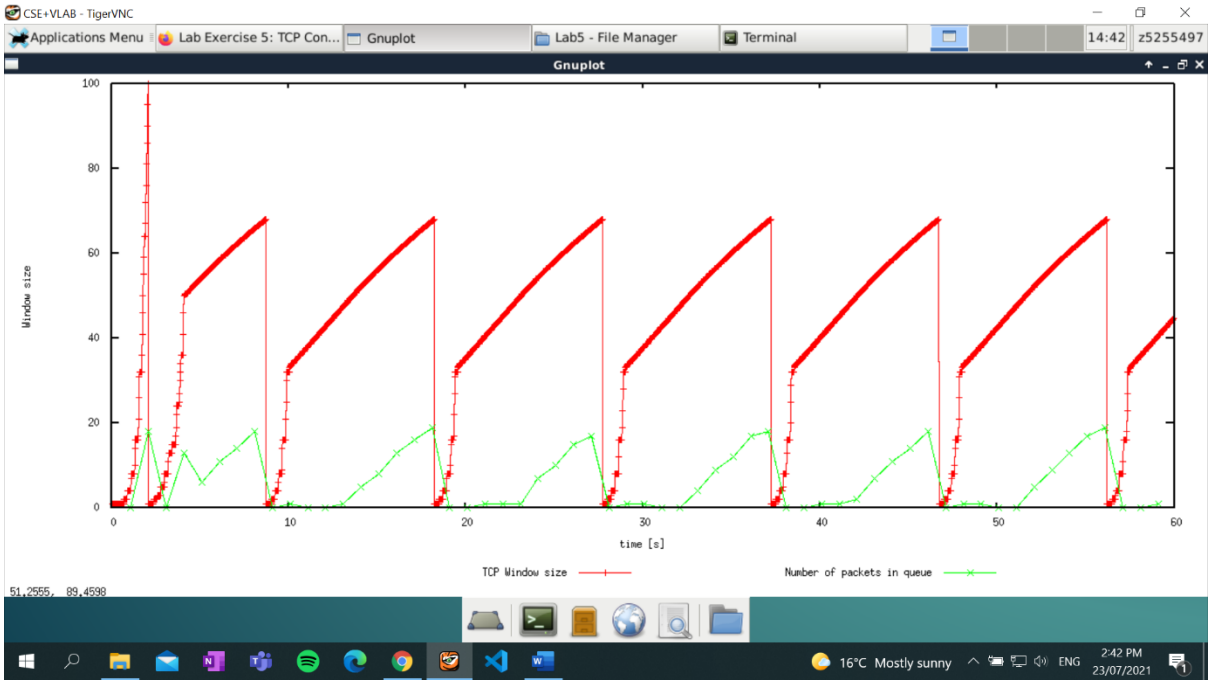
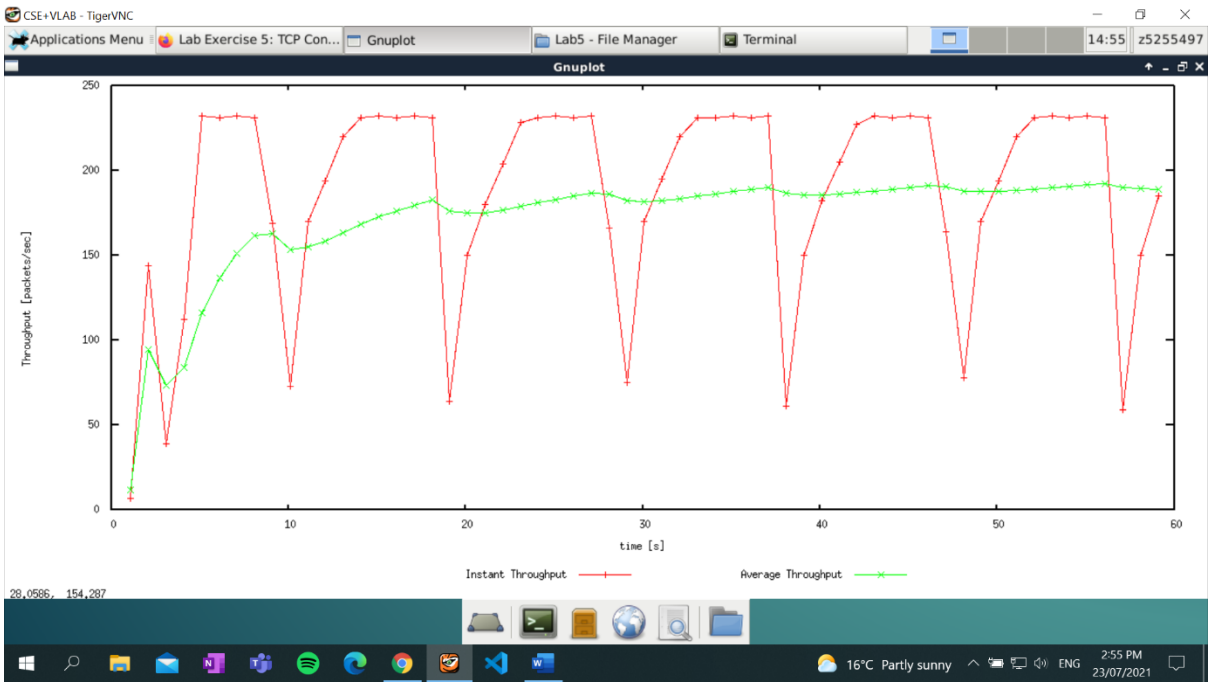
Question 1.1



The maximum size of the congestion window is 100.

The loss happens and the windows size is reduced to 1.

Question 1.2

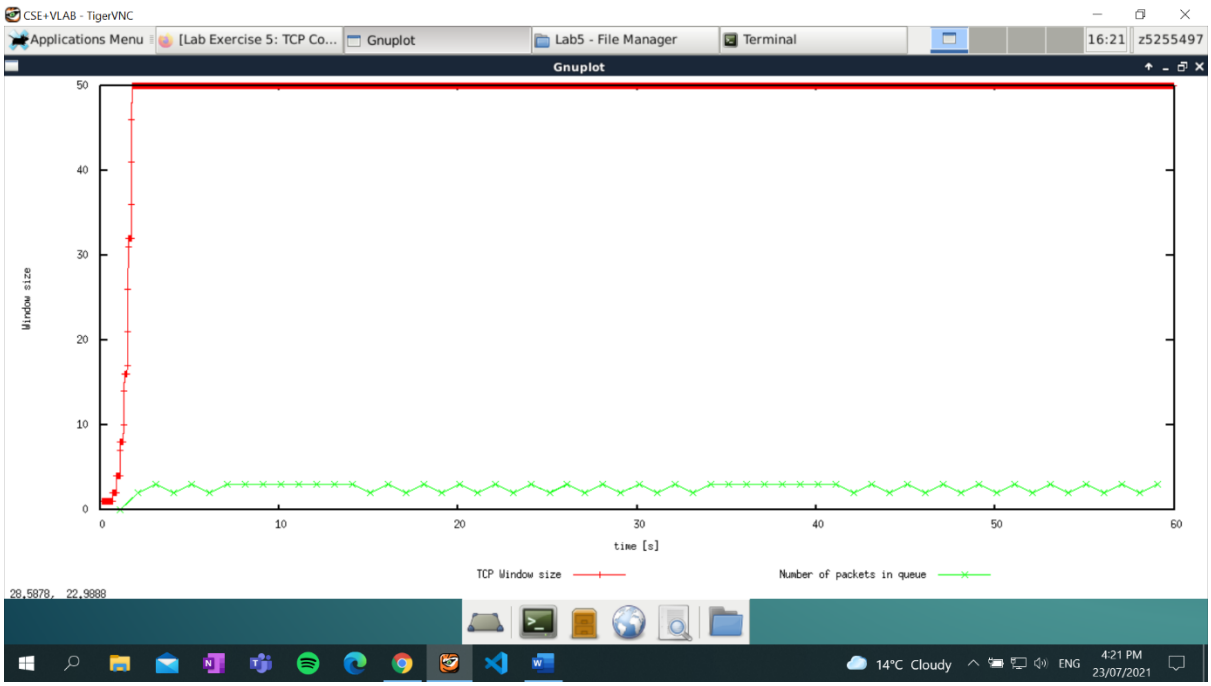


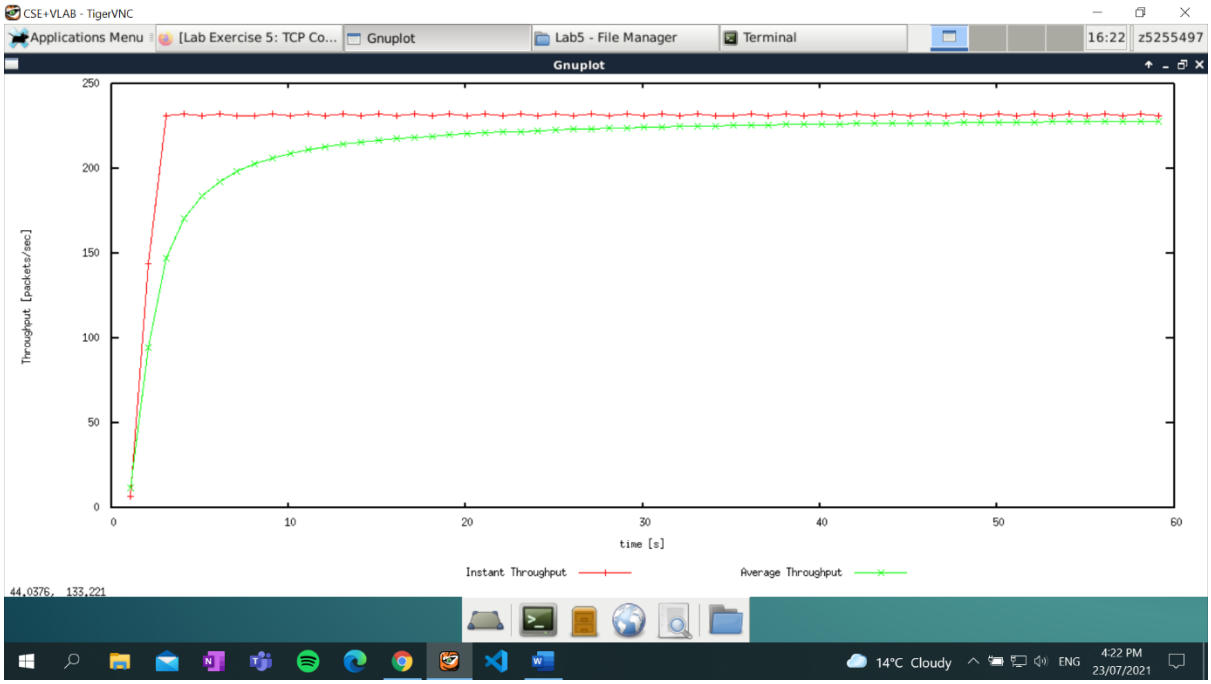
The average throughput is about 188 packets/second.

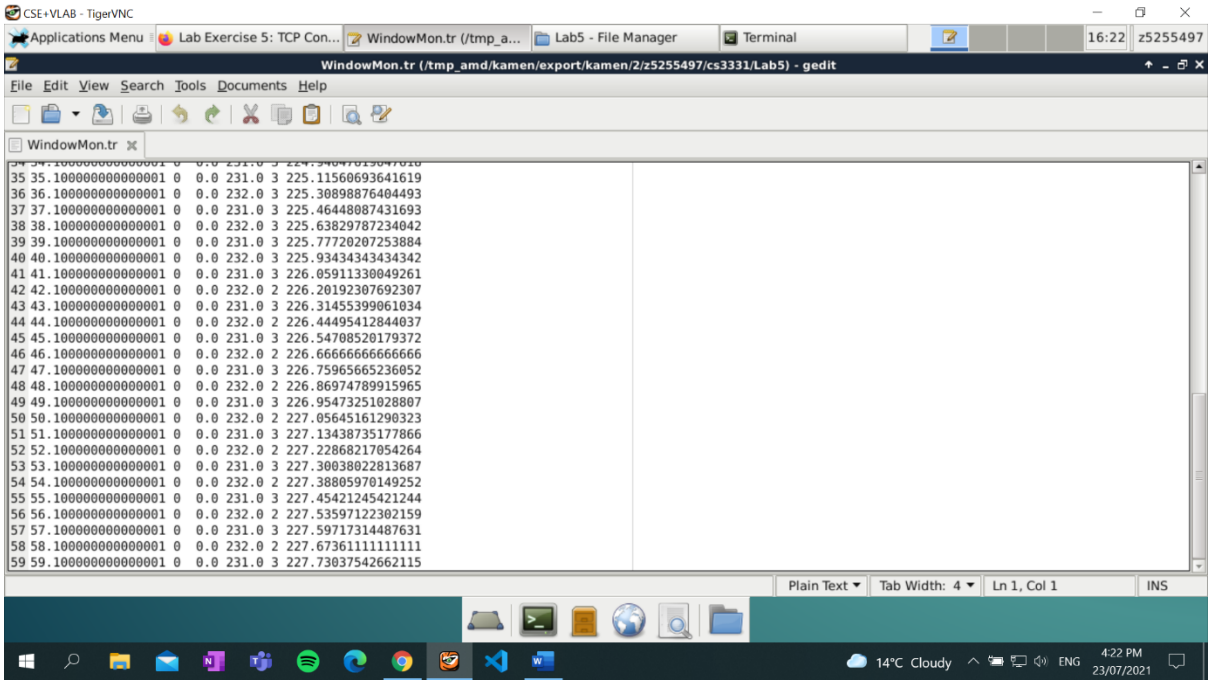
Without headers: each packet has 500 bytes of data. The average throughput is 188 * 500 = 9400 bytes/second.

With headers: each packet has 500 + 2*20 = 540 bytes of data. The average throughput is 188 * 540 = 101520 bytes/second.

Question 1.3







I noticed when the maximum window size is 50, the TCP did not oscillate and reached a stable behaviour.

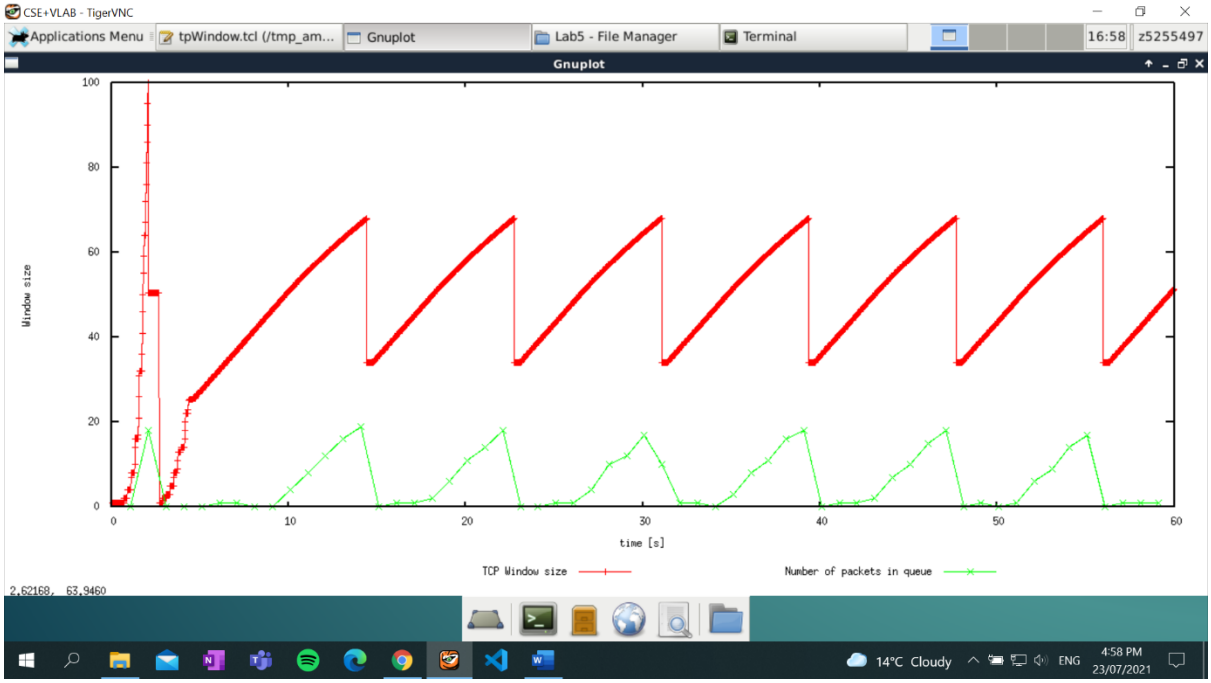
When the maximum windows size is 50, the average throughput size is about 227 packets/second.

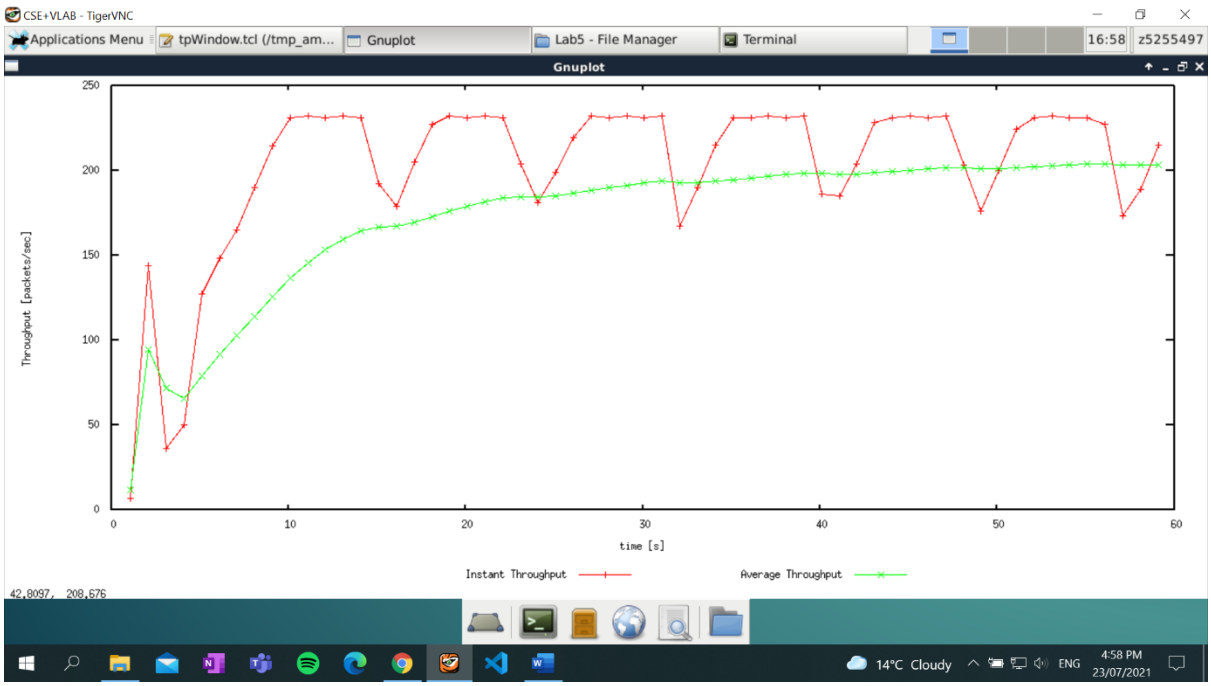
Without headers: each packet has 500 bytes of data. The average throughput is 227 * 500 = 113500 bytes/second.

With headers: each packet has 500 + 2*20 = 540 bytes of data. The average throughput is 227 * 540 = 122580 bytes/second.

Compare to the actual capacity 1 Mbps, its capacity rate is 122580/125000 = 98%.

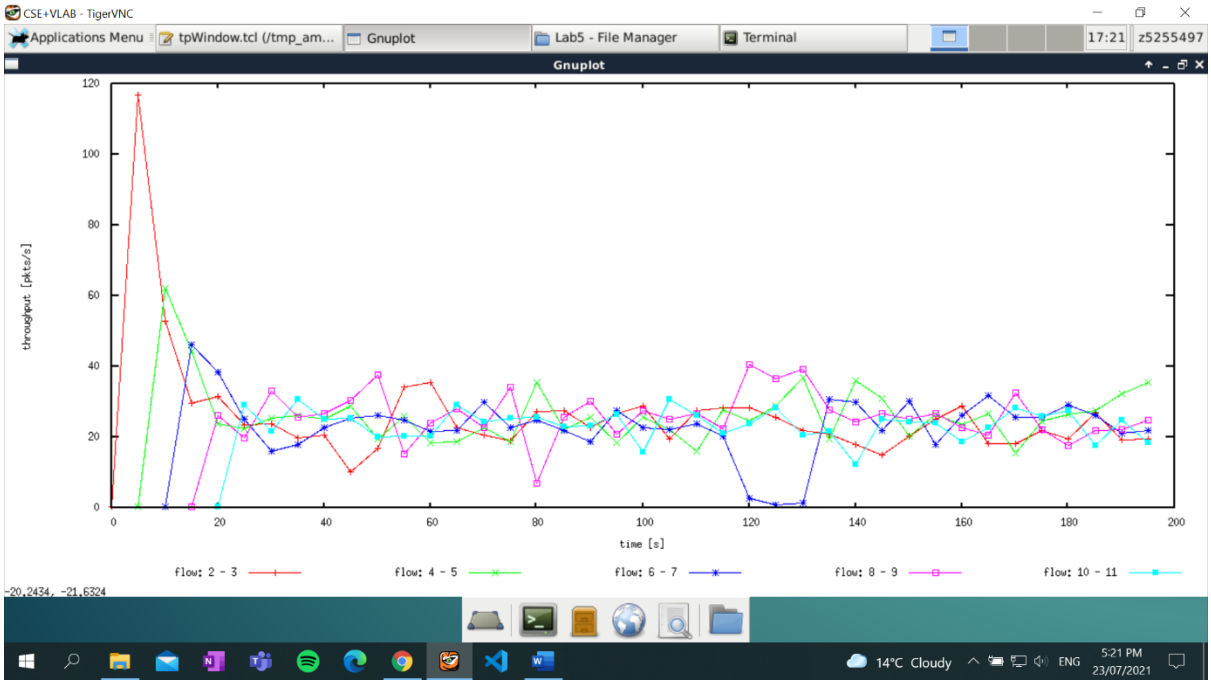
Question 1.4





The congestion window size only back to zero once because TCP Reno only reduce it to zero when its timeout. The average throughput is around 200 for TCP Reno and is around 188 for TCP Tahoe.

Question 2.1

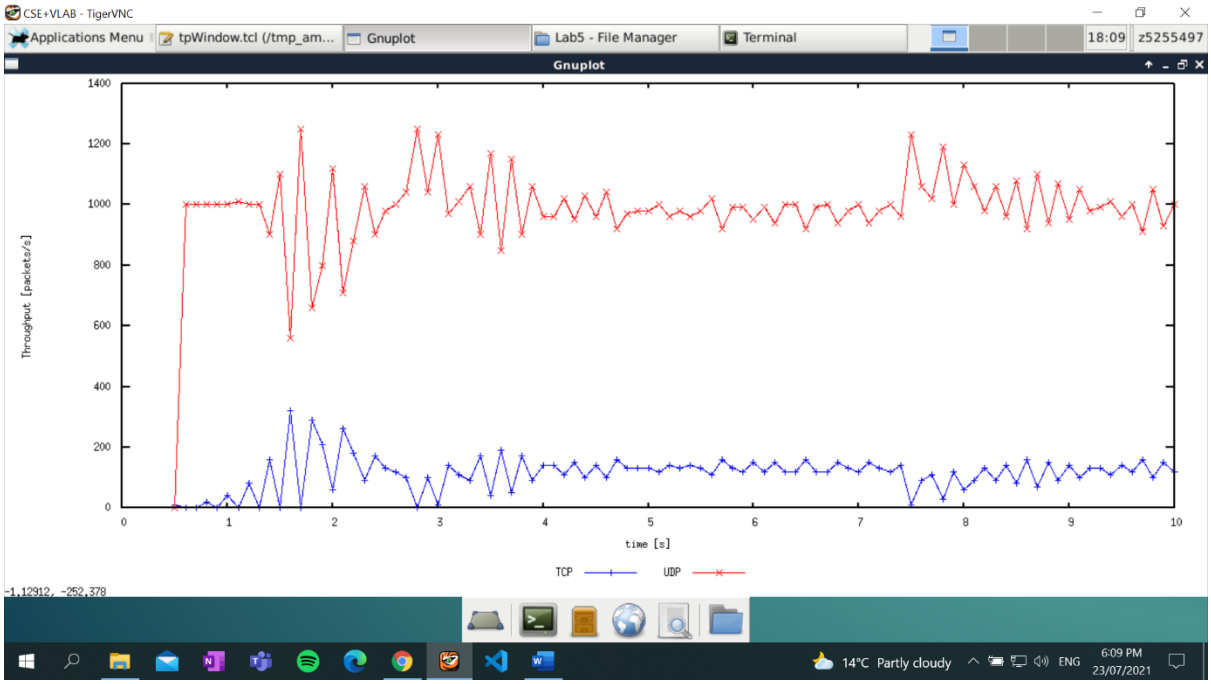


Yes, it does. Each flow starts at different time but as time passes, the throughput for each flow coverages to around 20-40 packets/second.

Question 2.2

After a new flow is created, the throughput of all existing flow will decrease. The mechanism is timeout and it is fair because the earlier flow should adjust its flow when other flow join the network.

Question 3.1



TCP has congestion control but UDP does not have congestion control. UDP will maintain a higher throughput rate than TCP.

Question 3.2

UDP does not have congestion control. It takes most of the link for itself and does not care about the package loss. TCP has congestion control. It will try to maintain a stable connection and not overload the link by adjusting the window size.

Question 3.3

Advantage of UDP: Higher throughput, faster transmission speed, .

Disadvantage of UDP: No congestion control, packet loss and corruptions, no retransmission of lost packets.

If everyone starts using UDP, there will be a network congestion because UDP has no congestion control. There will also be a lot of packet loss, and difficult to detect corrupted packages.