CMPT 371 Summer 2019: Homework Assignment 3 (25 Points)
Available: June 4, 2019
Due Date: June 18, 2019

Q1. **Window Size and Sequence Number.** Consider the GBN and SR protocols. Suppose the sequence number space is of size k. What is the largest allowable sender window that will avoid the occurrence of problems for each of these protocols?

Q2. TCP Throughput. Considering the macroscopic description of TCP throughput, in the period of time from when the connection's rate varies from $W/(2 \cdot RTT)$ to W/RTT, only one packet is lost (at the very end of the period). Show that the loss rate (fraction of packets lost) is equal to L= loss rate = $1 / (3/8 \ W^2 + 3/4 \ W)$.

Q3. ACK & NAK. Consider a reliable data transfer protocol that uses only negative acknowledgments. Suppose the sender sends data only infrequently. Would a NAK-only protocol be preferable to a protocol that uses ACKs? Why? Now suppose the sender has a lot of data to send and the end-to-end connection experiences few losses. In this second case, would a NAK-only protocol be preferable to a protocol that uses ACKs? Why?

Q4. Application Control. We have said that an application may choose UDP for a transport protocol because UDP offers finer application control (than TCP) of what data is sent in a segment and when. Why does an application have more control of what data is sent in a segment? Why does an application have more control on when the segment is sent?

Q5. TCP Congestion Control. Why does TCP need a window-based congestion-control mechanism in addition to doubling-timeout-interval mechanism?

Please submit your answers in pdf format, before the midnight on June 18, 2019 on the canvas system HW3 activity.