Networks and Distributed Systems **Homework 4**
CS3700 Fall 2022

This homework is due at 11:59:59 PM on October 31, 2022 and is worth 3% of your grade.

Name: _____

NUID (with leading zeros): _____

Problem	Possible	Score
1	9	
2	10	
3	15	
4	25	
5	20	
6	10	
7	25	
Total	114	

1a. TCP packets are being sent from a client to a server. The MSS is equal to 1460 bytes, and each TCP packet is sent with the maximum capacity. How many TCP packets can be sent before the sequence number field in the TCP header will wrap around to where it began? (5 pts)

1b. How much time (in seconds) will this take on a 1 Mbit/s link? (2 pts)

1c. How much time (in seconds) will this take on a 1 Gbit/s link? (2 pts)

2. Host A is transferring a file of size S to host B using TCP. A sends the file data in fixed size packets equal to the Maximum Segment Size (MSS), a predetermined value. B sends an acknowledgement immediately upon receiving a data segment. Let R be the round trip delay between A and B. The advertised receiver window size of host B is W. In this problem, we assume the TCP connection is already established and that the transmission time is negligable. TCP performs the slow start and congestion avoidance mechanisms, and there is no error or packet loss during transmission.

2a. Given $W = 3 * \text{MSS}$, $S = 10 * \text{MSS}$, how long does it take for the file to be sent and acknowledged? Your answer should be in terms of R. Show your work. (5 pts)

2b. Given $W = 5 * \text{MSS}$, $S = 15 * \text{MSS}$, how long does it take for the file to be sent and acknowledged? Your answer should be in terms of R. Show your work. (5 pts)

3a. Recall that we discussed two TCP variants in class: TCP Tahoe and TCP Reno. However, in practice, most machines use TCP Reno. What is the primary reason why people have moved away from TCP Tahoe? (5 pts)

3b. Give an example of a case where the fast retransmit in TCP Reno would result in unnecessary packets being sent. (5 pts)

3c. What sequence of events would lead to TCP Reno *re-entering* the slow start phase after being in the congestion avoidance phase? Give a concrete example. (5 pts)

4a. What Are ***three*** Major Differences Between UDP and TCP Protocols? (10 pts)

4b. Which protocol is faster: UDP or TCP? Why? (5 pts)

4c. What is a Denial of Service (DoS) attack? Why would these attacks be useful to an attacker? (5 pts)

4d. What are the advantages when using SYN Cookies? Are there any disadvantages? (Make sure to give examples) (5 pts)

5a. If we generalize from the stop-and-wait protocol to a sliding window protocol, where k packets can be sent but unacknowledged, what is the minimum number of distinct sequence numbers that we would need for this protocol to work correctly? Why? (10 pts)

5b. Suppose we are using a sliding window protocol with a window size of 128 KB and a round-trip time of 100 milliseconds. What is the expected sending rate of this protocol in units per second (e.g., bytes per second, kilobytes per second, etc.)? (10 pts)

6a. Suppose that a TCP connection at a sender has a receiver's advertised window of r and a congestion window of c. What is the value of the sender's window? (5 pts)

6b. Suppose that we design a variant of TCP that uses MIAD (multiplicative increase, additive decrease) as the congestion control mechanism for updating the congestion window. What would happen if two of our TCP flows compete at a bottleneck router? (5 pts)

7a. Recall that TCP has two phases: *slow start* and *congestion avoidance*. What is the primary purpose of the slow start phase? (10 pts)

7b. What about the primary purpose of congestion control? (5 pts)

7c. Explain the TCP Handshake process and explain its ***two*** important functions. (10 pts)