CCSI 3171 Assignment #3

Due date: July 14th, 11:59pm.
Late submissions accepted until July 16th, 11:59pm. (5% off per day)

Hand in: Fill out the assignment cover sheet and attach to your assignment. Submit a hardcopy of your assignment in the 3171 assignment box (*the cabinet near the ladies washroom on the second floor*). Any programming must **also** be submitted using the *submit* software that is described on the webpage.

Notes: Show your calculations for all questions.

Read the programming style guidelines on the course webpage.

Read the Dalhousie Policy on Plagiarism.

Assignment Weight in Course = 9%

(i) [10 marks]: UDP and TCP use 1's complement for their checksums. Suppose you have the following 8-bit bytes: 01010101, 01110000 and 01001100. What is the 1's complement of the sum of these three 8-bit bytes? (TCP and UDP actually use 16-bit integers, but we'll just use these 8-bit bytes). Show all work. Why do the protocols use the 1's complement? If a single bit is corrupted in transit, is it possible that it could go undetected? If so, give an example. Or, could it go undetected if 2 bits are corrupted? If so, give an example.

(ii) [20 marks]: Give two separate traces (similar to those in Figure 3.16) of the operation of protocol rdt3.0 when:

a) data packets are corrupted and,

b) acknowledgement packets are corrupted.

(iii) [20 marks]: Consider the TCP procedure for estimating RTT. Suppose that $\alpha = 0.1$. Let $SampleRTT_1$ be the most recent sample RTT. Let $SampleRTT_2$ be the second most recent sample RTT, and so on…

a) For a given TCP connection, suppose four acknowledgements have been returned with corresponding sample RTTs: $SampleRTT_4$, $SampleRTT_3$, $SampleRTT_2$, $SampleRTT_1$. Express *EstimateRTT* in terms of these four sample RTTs. Simplify the formula.

b) Generalize your formula for *n* sample RTTs.

(iv) [10 marks]: What is the relationship between the variable *SendBase* in Section 3.5.4 of the textbook and *LastByteRcvd* in Section 3.5.5?

(v) [10 marks]: TCP waits until it has received three duplicate ACKs before performing a fast re-transmit. Why do you think the TCP designers chose not to perform a fast re-transmit after the first duplicate ACK for a segment is received?

(vi) [10 marks]: Suppose Host A sends two TCP segments back-to-back over a TCP connection. The first segment has sequence number 75; the second segment has sequence number 111.

a) How much data is in the first segment?

b) Suppose that the first segment is lost but the second segment arrives at Host B. In the acknowledgement that Host B sends to Host A, what will be the acknowledgement number?

(vii) [20 marks]: Answer whether the following statements are TRUE or FALSE. Explain your answers.

a) Host A is sending Host B a large file over TCP. Assume Host B has no data to send Host A. Host B will not send acknowledgements to Host A because Host B cannot piggyback the acknowledgement on a data packet.

b) The size of the TCP *RcvWindow* never changes throughout the duration of the connection.

c) Suppose Host A is sending a large file to Host B over TCP. If the sequence number for a segment of this connection is m, then the sequence number for the subsequent segment will necessarily be $m + 1$.

d) Suppose that the last *SampleRTT* in a TCP connection is equal to 1 second. Then the current value of *TimeOutInterval* for the connection will necessarily be ≥ 1 second.

e) Suppose Host A sends over a TCP connection to Host B one segment with sequence number 38 and 4 bytes of data. In this same segment the acknowledgement number is necessarily 42.