CSE489: Homework #2

Due on March 8, 2016 at 2:00pm

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Statement of Academic Integrity

I have read and understood the course academic integrity policy located under this link: `http://www.cse.buffalo.edu/faculty/dimitrio/courses/cse4589_s16/index.html#integrity`

Problem 1

UDP and TCP checksum

(a) The sum $00001001_2 + 01100101_2 = 01101110_2$. The one's complement of this result is 10010001_2.

(b) The sum $01101001_2 + 11101101_2 = 01010111_2$ with $c_{out} = 1_2$ (addition overflow occurred, c_{out} was "wrapped around" in this case). The one's complement of this result is 10101000_2.

(c) Using the two bytes from (a) with bit b_7 in each byte flipped: $00001001_2 \implies 0\mathbf{1}001001_2$, and $01100101_2 \implies 0\mathbf{0}100101_2$.

The resulting one's complement of the sum of these two "new" bytes does not change:

$01001001_2 + 00100101_2 = 01101110_2 \underset{\text{flip bits}}{\implies} 10010001_2$

Problem 2

Simple synchronized message exchange protocol
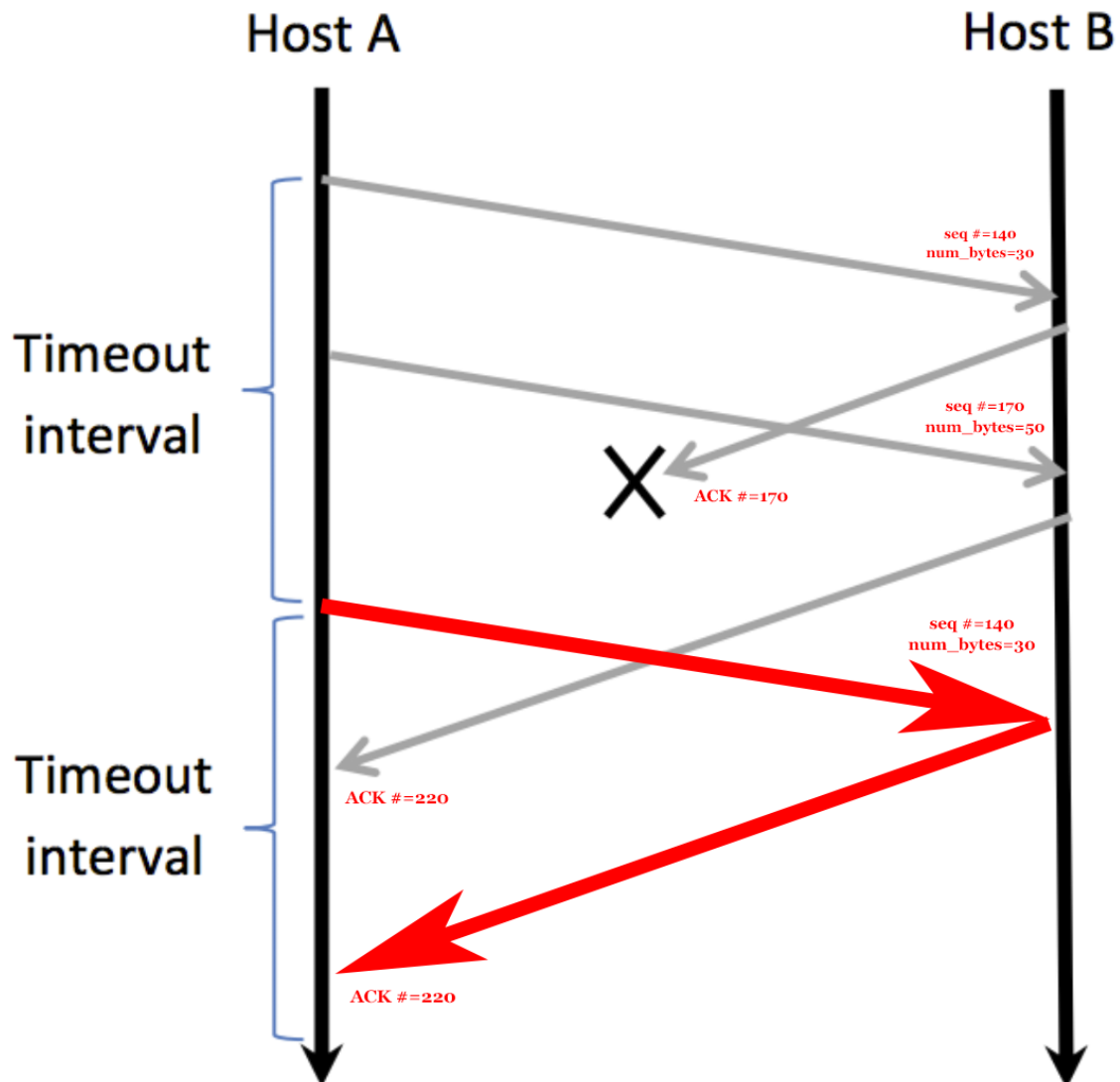
Problem 3

Can a window size be too large for a sequence number space?

Yes. Suppose the sequence number space and window size is $N = 2$ for simplicity, with a client actively sending data to a server. Furthermore, suppose that the client has sent 2 segments whose corresponding ACKs from the server were both lost. As a result, the client resends the two segments to the server after a certain timeout period. But, since the window size is equal to the sequence number space, the server processes the resent segments as NEW segments when they are in fact OLD segments. It is in this scenario that Go Back N fails because the window size is too large for the sequence number space. This can be remedied by restricting the window size to be at most one half of the sequence number space.

Problem 4

TCP sequence numbers

(a) The sequence number is 170, source port 543, and destination port 80.

(b) The ACK number is 170, source port 80, and destination port 543.

(c) The ACK number is 140, source port 80, and destination port 543.

(d) Diagram below.

Problem 5

TCP sequence numbers

(a) $2^{32} = 4294967296$ possible sequence numbers

4294967296 segments $* 536 \frac{\text{bytes}}{\text{segment}} = 2.3021025 * 10^{12}$ bytes $= 2.302$ TB

(b) $f_{size} = 2.302$ TB

$h_{size} = 66 \frac{\text{bytes}}{\text{segment}} * 4294967296$ segments $= 0.2835$ TB

total size $= 2.302$ TB $+ 0.2835$ TB $= 2.586$ TB

$t_{transfer} = \frac{L}{R} = \frac{2.586 \text{ TB}}{155 \text{ Mbps}} = \frac{2{,}586{,}000 \text{ MB}}{19.375 \text{ MBps}} = 133471$ seconds $= 37$ hours and 5 minutes

Problem 6

Compare GBN, SR, TCP (no delayed ACK, no SACK)