Week 4 Calculation Examples

1. Compute the sum with carry-wraparound (sometimes called the one's complement sum) of the following two numbers. Give answer in 8-bit binary, zero-padded to 8 bits if necessary, with no spaces (e.g. 00101000). Please note this is different than the checksum calculation. NOTE: Canvas will remove any leading zeros from your answer. This will not cause your answer to be marked as incorrect.

   1 0 0 0 0 0 0 0
   1 0 0 0 0 0 0 0

   Solution:

   0 0 0 0 0 0 0 1

   The following guidance is credited to Professor Pfeil:

   To get the 1's complement sum of two binary numbers, you do the following:

   1. Add them
   2. Wrap any overflow bit around and add it to the LSB (least significant bit)
   3. You're done right here if we ask for the 1's complement sum (summary exercises)
   4. To get a checksum to store in your TCP or UDP header, you would take the 1's complement of your answer in #3. That just means you flip all the bits.
   5. Then on the receiving end, you would again calculate the 1's complement sum and add that to the checksum. The result will be all 1's if the data is ok (with a tiny possibility for error).
   6. Modern CPU's can calculate 1's complement sums and 1's complements for 64 bit numbers in one operation. Which is why these checksums are used.
   7. Why are you still reading this? You got the answer back at #3!
   8. So most of the confusion comes from the definition of the checksum, which technically is the "1's complement of the 1's complement sum". Total word salad!
   9. But you don't care about that! The answer was way back at #3 ok? Just do steps 1 and 2.
   10. Here is another good explanation: http://mathforum.org/library/drmath/view/54379.html

2. Assume a TCP sender is continuously sending 1395-byte segments. If a TCP receiver advertises a window size of 8952 bytes, and with a link transmission rate 26 Mbps, an end-to-end propagation delay of 19.7 ms, what is the utilization? Assume no errors, no processing or queueing delay, and ACKs transmit instantly. Also assume the sender will not transmit a non-full

segment. Give answer in percentages, rounded to one decimal place, without units (e.g. for an answer of 10.43% you would enter "10.4" without the quotes).

Solution:

First, determine how many full segments can be sent per window since the problem statement indicates that the sender will not transmit a non-full segment.

$$\frac{8{,}952\ bytes\ per\ window}{1{,}395\ bytes\ per\ segment} = 6.417\ segments\ per\ window = 6\ segments\ per\ window$$

Convert the values for segment size and link transmission rate given in the problem statement to align the units, as needed. The work for this is not shown since it was covered in previous weeks.

Segment size: $1{,}395\ bytes\ per\ segment = 11{,}160\ bits$

Link transmission rate: $26\ Mbps = 26{,}000\ bits\ per\ millisecond$

Calculate the transmission delay.

$$\frac{11{,}160\ bits}{26{,}000\ bits\ per\ ms} = 0.429230769\ ms$$

Calculate the Round Trip Time (RTT) by multiplying the end-to-end propagation delay by 2.

$$19.7\ ms * 2 = 39.4\ ms$$

The delay per packet is the sum of the RTT and the transmission delay.

$$39.4\ ms + 0.429230769\ ms = 39.829230769\ ms$$

Finally, the utilization is calculated as follows:

$$\frac{6\ segments\ per\ window * 0.429230769\ ms}{39.829230769\ ms}(100\%) = \ 0.06466(100\%) = 6.5\%$$