Midterm

Instructor: Ali Sharifian

44 points possible

Questions: 8

Points Possible: 44

For all questions, your answers must be based on what was taught in class this semester. Anything else will get you points deducted, up to and including zero credit. You must complete this exam individually.

Show as much work as possible to attempt to get partial credit. No work = no credit.

The expectation is that you show your work similar to how the sample midterm was done. Failure to do so will result in massive point deductions, up to and including receiving zero credit.

If you are writing out your answers, I recommend you give yourself about 15 minutes of buffer time to scan your exam and upload/submit it to Canvas. Otherwise, if typing in your answer to the word document, you should still give yourself enough time to save the document and upload/submit it to Canvas.

First question starts on the next page.

Name: Lixing Chen

1. (4 points)
   A transcontinental channel with a one-way latency of 100 ms and a bandwidth of 25 Mbps can hold how many Megabits (Mb) at a given instant? Do not round your answer.

   Volume of the pipe = delay * bandwidth

   0.1 s * 25 Mb/s = 2.5 Mb

2. (4 points)
   Let's say you have a sender, a receiver, a one-way latency of 68 ms, and the bandwidth is 225 Mbps. Let's say the receiver tells the sender to stop transmitting. The receiver may receive up to how many megabits (Mb) of data from the sender before the sender stops transmitting? Do not round your answer.

   Roundtrip time (RTT) = 2 * 0.068 s = 0.136 s

   0.136s *225 Mb/s = 306 Mb

3. (4 points)
   What is the wavelength, in kilometers (km), when a 53 Hz wave travels through copper? Assume speed of light through copper is $\frac{2}{3} * 3 * 10^8\ m/s$. Round your answer to one decimal place.

   Wavelength = Speed of light in Copper / frequency (2/3) * 3 * 10^8 m/s / 53 = 3.77 * 10 ^6 m = 3.8 km

4. (8 points)
   What is the NRZ encoding of the below stream?

11010001010

For questions 5 to 7, consider a 105 Mbps link with a 33 ms round trip time (RTT). The three questions are related to each other.

5. (4 points)
   What is the delay x bandwidth product? Provide your answer in megabits (Mb), and rounded to three decimal places.

   delay x bandwidth = 0.033 second * 105 Mbps = 3.465 Mb

6. (4 points)
   Assuming a frame size of 2 KB and the network uses the Stop and Wait Protocol, what is the maximum sending rate? Assume 2 KB = 2*1,000 bytes = 2,000 bytes. Provide your answer in bps and round to the nearest whole number.

   Frame Size = 2,000 bytes * 8 bits/byte = 16,000bits

   Maximum sending rate = Frame Size / RTT = 16,000 bits/0.033s = 484,848 bps

7. (4 points)
   Continuing from question 6, what fraction of the link's total capacity is being used in this network using the Stop and Wait Protocol?

   Provide your answer as a percentage, rounded to three decimal places.

484,848 bps / 105,000,000 * 100% = 0.461%

8. Suppose you are designing a sliding window protocol for a 40 Mbps point-to-point link to the stationary satellite revolving around the Earth at an altitude of 90 km. Assuming that each frame carries 0.9 KB of data, what is the minimum number of bits you need for the sequence number in the following cases?

   Assume the speed of light is $3 * 10^8\ m/s$ and assume 0.9 KB = 900 bytes.

   RWS stands for receiving window size.

   SWS stands for sending window size.

   a. (6 points)
   RWS=1
   To find the roundtrip time:
   Delay = Distance / Speed
   90 km = 90,000 m
   90,000 m / $3 * 10^8$ m / s = 0.0003 s
   Round trip is double that 2* 0.0003 s = 0.0006 s

   Number of packets the link can hold at a given roundtrip time:
   Frame size is 900 bytes * 8 = 7,200 bits
   0.0006 s * 40,000,000 bps / 7200 bits = 3.33 or 4 packets

   If RWS = 1, SWS + RWS= 4 + 1 = 5
   Minimum bits = log 2 (5) = 3 bits

   b. (6 points)
   RWS=SWS

   SWS < (MaxSeqNum + 1)/2

   2*SWS < MaxSeqNum + 1

   2*SWS-1 < MaxSeqNum

   2*4 -1 < MaxSeqNum

   So at a minimum, MaxSeqNum needs to be (2*4-1)+1 =8

   log2(8)=3 bits.So it would require 3 bits