This is a test from 2013. Note that

1) Different material may have been covered or empasized

2) This year's test will be different: It will have two parts

   Part A: Multiple Choice
   Part B: Regular Questions/Answers

3) Study all the material covered in class up the last lecture before the test.

Evangelos
2018-10-04

PRINCIPLES OF COMPUTER NETWORKS
COMP 3203
TEST 1

Evangelos Kranakis

Name:	
ID #:	
Department:	

1. Put your name and ID at the bottom of every page.
2. Duration: 60 minutes. (in fact it was 70 min)
3. Answer all questions on the exam paper and in the space provided.
4. Show your work but be precise, concise and clear.
5. Closed books, No notes, No calculating devices of any kind.
6. Use the back pages for scratch.
7. You are not allowed to talk/whisper or look at somebody else's test during the exam.
8. Use alternate seating, if space permits.

1 [10 pts]

Answer the following questions in concise manner (2 pts per question).

1. What are four important factors that led to the development of computer networks?

2. The lowest frequency of a signal is 20 MHz and the highest 60 MHz. What is the bandwidth?

3. What is the bandwidth of a periodic signal decomposed into eight sine waves having frequencies $5, 10, 15, 20, 25, 30, 35, 40$, respectively?

4. What is the redundancy of the 2 dimensional parity check algorithm on $n \times n$ bit words? Give the formula!

5. What is the duration of 100 bits in seconds of a signal with bit-rate 500 $KBps$?

ID#:	Name:

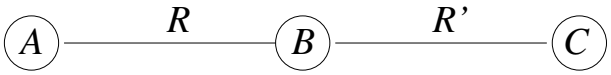
2 [4 pts]

1. Given the delay and bandwidth of a pipe, what metric can define the capacity (of the pipe)?

2. A transcontinental channel has one way latency of 50 ms and bandwidth 45 $Mbps$. What is the maximum number of bits that can be in transit in this channel? (Put another way, how many bits can the channel hold?)

3 [6 pts]

Assume two channels connect hosts A, B, C as in the figure below.



The bit rate from A to B is R and the propagation time is T, Similarly, the bit rate from B to C is R' and the propagation time is T'. Derive a formula for the efficiency of transmitting a packet of length L (in bits) from A to C (assume that processing delay at A, B, C is negligible).

ID#:	Name:

4 [6 pts]

Assume a 128 *Kbps* point-to-point link between Earth and a Mars rover. The closest distance between the two planets is approximately 55 *Gm* and data travels over the link at the speed of light (3×10^8 *m/sec*).

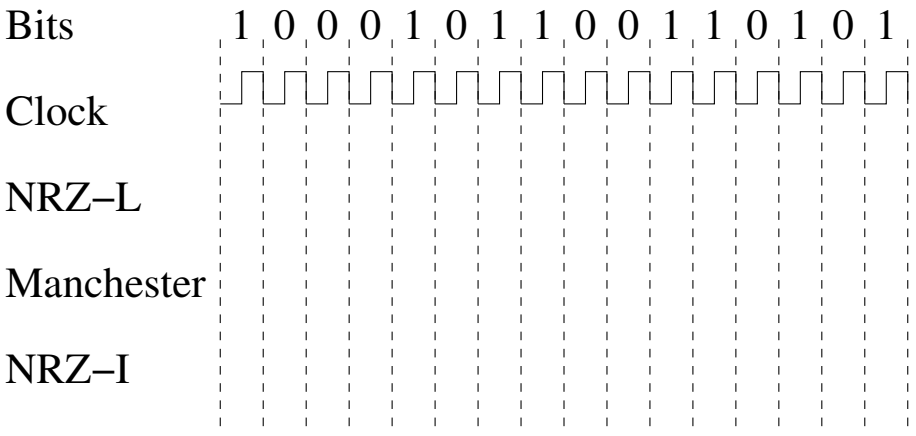
1. Calculate the minimum RTT for the link.

2. Calculate the *delay* × *bandwidth* product.

3. How quickly can a picture of size 5 *MB* taken from the rover be transmitted to earth?
   Hint: Calculate Transmit delay plus propagation delay.

5 [4 pts]

Draw the NRZ-L, Manchester and NRZ-I encodings for the bit string depicted below. Assume the NRZ-I signal starts low.



not covered this year

ID#:	Name:

6 [10 pts]

1. [**2 pts**] Locate the errors (if any) in the following LRC code by circling the wrong bits:

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

2. [**2 pts**] Give the checksum of the sequence

   0001011 0101100 1001000 1110111

   assuming 7-bit block size. (Recall in a 7-bit checksum operations are mod$(2^7 - 1)$.) Your answer should be a 7-bit block.

3. [**3 pts**] Give the Hamming Code bits of the sequence 1101100 by filling out the spaces:

   $- \; - \; 1 \; - \; 101 \; - \; 100$

   not covered this year

4. [**3 pts**] Assume m data bits, r redundancy bits, and that $m + r$ bits are being transmitted. What is the max number of data bits that can be transmitted by any error correction code? Explain!

ID#:	Name:

7 [7 pts]

1. **[3 pts]** A transmission medium used by two hosts has Bit Error Rate p. Given that packets are n bits long, what is the probability that a packet has at least one bit in error?

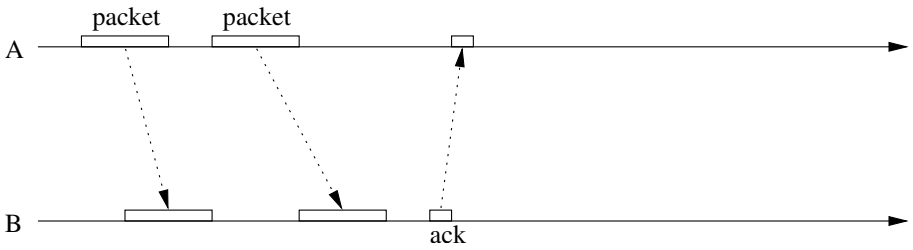
2. **[2 pts]** What is the expected number of errors in a packet of length n?

3. **[2 pts]** A wireless medium has bit error rata 10^{-6}, If a protocol uses packets of size $10,000$ bit long what is the expected rate of packets having at least one bit in error?

ID#:	Name:

8 [6 pts]

Host A sends packets to host B using an ARQ protocol. Assume that transmission takes one time unit per packet regardless of the size of the packet and that no error occurs. *Ignore all other types of delay.*



1. **[3 pts]** How many time units does it take (as a function of n) to transmit (and acknowledge) n packets when using the Stop-and-Wait protocol?

2. **[3 pts]** How many time units does it take (as a function of n and w) to transmit n packets when using the Sliding-Window protocol with window size w packets? *Assume that w packets can "fit" in the transmission line and no errors are reported.*

ID#:	Name: