ECE/CS 438 Communication Networks, Fall 2008
Homework 2
Assigned: September 15, 2008
Due: By class time on September 24, 2008

(1) Consider the code specified in the table below.

Data	Codeword
00	0000000
01	1111000
10	0001111
11	1010101

(a) What is the minimum distance between codewords in this code ?
(b) What is the largest value of t such that the code can be used to detect all t-bit errors ?
(c) If we want to use this code to correct all 1-bit errors, what is the largest value of t such that the code can also simultaneously detect all b bit errors, such that $1 < b \leq t$.

(2) Consider the slotted Aloha protocol used by N nodes on a shared link. As discussed in class, if a node transmits in each slot with probability p, the throughput for this protocol is given by $Np(1-p)^{N-1}$ packets/slot. For $N=4$ and $N=20$, plot throughput as a function of p, for p between 0 and 1 (increment p in steps of 0.01).

(3) Consider the slotted Aloha protocol used by 2 nodes on a shared link. As in the class, assume that a collision occurs if two nodes transmit at the same time. Node 1 transmits in each slot with probability p and node 2 transmits in each slot with probability q.

(i) Write an equation for the average throughput achieved by node 1 (in packets/slot).
(ii) Write an equation for the average throughput achieved by node 2 (in packets/slot).
(iii) If $p = 0.1$, what should be the value of q such that the aggregate average throughput of the two nodes is maximized ?
(iv) If $p = 0.1$, what should be the value of q such that node 2 achieves twice the throughput than node 1, on average.

(4) Consider hosts A, B, C and D on a shared link, as shown below. Let d(X,Y) denote distance between hosts X and Y. Assume the following:
d(A,B) = 1000 m, d(B,D) = 2000 m, d(A,D)=3000 m. Let the speed at which signals travel along the link be given by 3×10^8 m/s.
Suppose that host A start transmitting a packet to host B at time 0, and host D starts

transmitting a packet to host C at time 0. Both packets are of an identical size, requiring identical transmission time. Suppose that a collision occurs at a host if multiple transmissions overlap in time (for non-zero duration) when received at that host.
An active transmitter requires 1 microsecond to detect a collision, after a colliding signal arrives at the transmitter.

(a) In each of the cases below, determine whether host A will detect a collision due to the transmission from D. If yes, at what time will the collision be detected?

(i) packet transmission time = 100 microsecond
(ii) packet transmission time = 5 microsecond
(iii) packet transmission time = 1 microsecond

(b) In each of the cases below, determine whether host B will receive the transmission from A reliably, without a collision due to the transmission from D.

(i) packet transmission time = 100 microsecond
(ii) packet transmission time = 5 microsecond
(iii) packet transmission time = 1 microsecond

(5) Show the transmitted signal when 01011 is transmitted using each of the following methods:

(a) NRZ
(b) NRZI

(6)

(a) Specify a reason to prefer a sentinel-based method for framing, when compared to the length-based method.

(b) Specify a reason to prefer a length-based method for framing, when compared to the sentinel-based method.