CMPT 371: Homework 4

Due: April 4, 2007

1. This problem is about the two-dimensional parity check error-correcting codes.

   Assume there was exactly one error in the following message. What was the original, uncorrupted message:

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

   (b) If there was only one error, what was the original message for this message:

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

   (c) We say two messages have distance k if they are the same in all but k positions. Show a 4x4 (corrupted) message that has distance 2 from two different original, uncorrupted messages.

2. This question is about Cyclic Redundancy Checks (CRCs).

   (a) Compute the CRC for the message $M = 10101010$, where $G = 1011$. Compute it as we did in class (not like the book): that is, the CRC should be the remainder (interpreted as a bit string) of the polynomial corresponding to M divided by the polynomial corresponding to G.

   (b) Give a message M' that has distance 4 from M and has the same CRC with respect to G that M does.

3. Consider a channel of rate R bits/second that is shared by N nodes. Assume that $\sqrt{N}$ nodes have data to send.

   (a) What is the throughput of each node that has data to send under TDM?

   (b) Assume we are using a token-ring. That is, the N nodes are arranged in a ring and the token is passed from one node to the next around the ring. When a node that has data to send receives the token, it broadcasts for T seconds. Assume it takes ϵ seconds to forward the token from one node to the next. What is the throughput of each node that has data to send in this scenario? As ϵ tends to 0, what does this throughput approach?

(c) Assume the token from (b) gets lost (because the node that is holding it crashes, for instance) once every 100 times around the ring. It takes K seconds to recover when this happens. Now what is the throughput of each node that has data to send?

(d) What is the throughput of each node that has data to send in pure Aloha (in terms of N and p)? If $p = 1/\sqrt{N}$ and N is very large, how does this compare to (b)?