EE 605: Error Correcting Codes

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Quiz 2 : **10 points** October 28, 2010

1. Construct the standard array for a binary linear block code with the following generator matrix if we want to minimize the average probability of error when the channel is a binary symmetric channel with crossover probability $p < \frac{1}{2}$.

$$G = \begin{bmatrix} 1 & 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 \\ 1 & 1 & 0 & 0 & 1 \end{bmatrix}$$

   Construct the syndrome-error pattern lookup table for this code. [3 points]

2. Find the number of codewords of weight 4 in a binary linear block code with the following generator matrix.

$$G = \begin{bmatrix} 1 & 1 & 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

   [2 points]

3. Consider the (7,4) Hamming code with parity check matrix

$$H = \begin{bmatrix} 1 & 1 & 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 & 1 & 1 \\ 1 & 0 & 0 & 0 & 1 & 1 & 1 \end{bmatrix}$$

   (a) If the syndrome corresponding to a received vector is (1 1 0), what is the estimated error pattern?

   (b) If a transmitted codeword is corrupted by the error pattern (1 0 0 0 0 1 0), what is the syndrome?

   [2 points]

4. Let $g(X) = 1 + g_1(X) + \cdots + g_{r-1}X^{r-1} + X^r$ be the non-zero code polynomial of minimum degree in an (n, k) binary cyclic code C. Prove that a binary polynomial of degree $n-1$ or less is a code polynomial if and only if it is a multiple of $g(X)$.

   [3 points]