EE 605: Error Correcting Codes
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Quiz 1 : 20 points August 21, 2014

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1. (5 points) Let C be a binary linear block code given by the vectors

$$
\begin{aligned}
&[0,0,0,0,0,0,0],[1,0,0,0,0,0,1],[0,1,0,0,1,0,0],[1,1,0,0,1,0,1],\\
&[0,0,1,0,0,1,0],[1,0,1,0,0,1,1],[0,1,1,0,1,1,0],[1,1,1,0,1,1,1],\\
&[0,0,0,1,0,0,1],[1,0,0,1,0,0,0],[0,1,0,1,1,0,1],[1,1,0,1,1,0,0],\\
&[0,0,1,1,0,1,1],[1,0,1,1,0,1,0],[0,1,1,1,1,1,1],[1,1,1,1,1,1,0]
\end{aligned}
$$

   (a) What is the dimension of $C^\perp$?

   (b) What is the minimum distance of $C^\perp$?

2. (5 points) The first row of a standard array is given below where the last four entries are missing. It is known that this standard array has 8 columns.

$$000000 \quad 110001 \quad 101010 \quad 000111 \quad * \quad * \quad * \quad *$$

   (a) Complete the standard array by giving all the remaining columns and rows.

   (b) If the code corresponding to this standard array is used over a binary symmetric channel with crossover probability p, what is the probability of decoding error?

3. (5 points) Consider a binary linear code with generator matrix

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

   Suppose a codeword from this code is sent over a binary symmetric channel with crossover probability p. What is the probability that the received vector is a codeword?

4. (5 points) Let C_1, C_2 be binary linear block codes of same length n and dimensions k_1, k_2 respectively. Let d_i be the minimum distance of C_i for $i = 1, 2$. Consider the set of vectors

$$C_3 = \left\{ \begin{bmatrix} \mathbf{u} & \mathbf{v} \end{bmatrix} \,\middle|\, \mathbf{u} \in C_1, \mathbf{v} \in C_2 \right\}$$

   (a) Show that C_3 is a linear block code.

   (b) What is the dimension of C_3?

   (c) What is the minimum distance of C_3?