ECE 695C, Homework #3, due date: 2/16/2012

https://engineering.purdue.edu/∼chihw/12ECE695C/12ECE695C.html

Question 1: Implement MATLAB programs that performs the following tasks.

1. Take any generating matrix as input and output the set of all legitimate codewords.
2. Take the following two inputs: The conditional probabilities $p_{0\to 0}$, $p_{0\to 1}$, $p_{1\to 0}$, and $p_{1\to 1}$ of an i.i.d. binary-input/binary-output channel; The observation vector $\overrightarrow{y}$. Implement the codeword-wise ML decoder that outputs the most likely codeword.
3. Take a generating matrix as input, plot the frame error rate (FER) and the bit error rate (BER) of the corresponding code assuming that we use the codeword-wise ML decoder.

Use your program to compare the BER and FER of the following two codes described by their *parity-check* matrices. We assume the channel model being a binary symmetric channel with cross over probability p. (That is, $p_{0\to 0} = 1 - p$, $p_{0\to 1} = p$, $p_{1\to 0} = p$, and $p_{1\to 1} = 1 - p$.)

The Hamming code with the following parity-check matrix:

$$H_1 = \begin{pmatrix} 1 & 0 & 0 & 0 & 1 & 1 & 1 \\ 0 & 1 & 0 & 1 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 & 1 & 0 & 1 \end{pmatrix}. \tag{1}$$

The Reed-Muller code with the following parity-check matrix:

$$H_2 = \begin{pmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 \\ 0 & 0 & 1 & 1 & 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 & 0 & 1 & 0 & 1 \end{pmatrix}. \tag{2}$$

Specifically, please plot the FER and BER curves of the above two codes for the range $p = 0.01$ to $p = 0.5$.

Question 2: Repeat the previous question by focusing on the bit-wise ML decoder instead.