CMSC 442 Fall 2001
Homework 2

- READING ASSIGNMENT: Peterson & Weldon, **"Error-Correcting Codes,"** MIT Press, (Second Edition), (1986), Chapter 2, Section 2.6
- READING ASSIGNMENT: Peterson & Weldon, **"Error-Correcting Codes,"** MIT Press, (Second Edition), (1986), Chapter 3.
- OPTIONAL READING ASSIGNMENT: MacWilliams & Sloane, **"The Theory of Error-Correcting Codes,"** North-Holland (Second Edition), (1983), Chapter 1.

1. Consider the following matrix over $GF(2)$

$$M = \begin{pmatrix} 0 & 1 & 1 & 0 & 1 \\ 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 & 1 \\ 1 & 1 & 0 & 0 & 1 \end{pmatrix}$$

   a) Prove that the rows of M are linearly dependent.

   b) Prove that the first three rowd M form a basis for the row space of M.

   c) What is the dimension of the row space of M? Explain your answer.

2. Consider the following matrix S over $GF(3)$

$$S = \begin{pmatrix} 0 & 0 & 2 & 2 & 0 & 2 \\ 2 & 2 & 0 & 2 & 1 & 2 \\ 1 & 1 & 2 & 0 & 2 & 2 \\ 1 & 1 & 0 & 1 & 2 & 1 \end{pmatrix}$$

   a) Put the matrix S into echelon canonical form. (**Hint**. See section 2.6 of text)

   b) Use the resulting echelon canonical form to find a basis for the row space of S. Explain your answer.

   c) What is the dimension of the row space of S? Explain how you found your answer.

3. Let V be a binary linear code given by the generator matrix

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

a) Find a parity check matrix H of V .

b) Construct a maximum likelihood decoding table for V .

c) Use H to reduce the maximum likelihood decoding table of **b)** to an error/syndrome table.

d) Demonstrate how your error/syndrome table can be used to decode the received vector

$$r = 111101.$$

e) Use the generator matrix to create a list of all code vectors of V. Then use this list to determine the minimum distance of V.