ECS 452: In-Class Exercise # 11

Date: **0 4** / **0 4** / 2017

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1. Consider a linear block code that uses parity checking on a square array:

b_1	b_2	$p_1 = b_1 \oplus b_2$
b_3	b_4	$p_2 = b_3 \oplus b_4$
$b_1 \oplus b_3 = p_3$	$p_4 = b_2 \oplus b_4$	
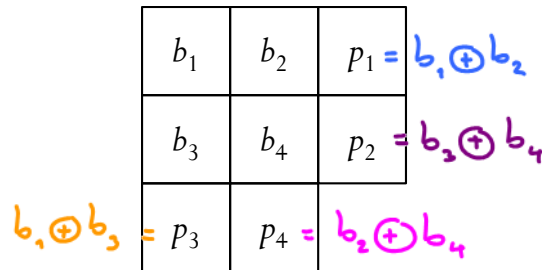
Each parity bit p_i is calculated such that the corresponding row or column has even parity.

Suppose the following bits arrangement is used in the codeword:

$$\underline{\mathbf{x}} = \begin{pmatrix} b_1 & b_2 & b_3 & b_4 & p_1 & p_2 & p_3 & p_4 \end{pmatrix}.$$

a. Find the generator matrix $\mathbf{G}$.

$$\begin{bmatrix} 1 0 0 0 1 0 1 0 \\ 0 1 0 0 1 0 0 1 \\ 0 0 1 0 0 1 1 0 \\ 0 0 0 1 0 1 0 1 \end{bmatrix}$$

b. Find the codeword for the message $\underline{\mathbf{b}} = \begin{bmatrix} 0 & 1 & 1 & 0 \end{bmatrix}$.

$$\underline{x} = [0\ 1\ 1\ 0\ 1\ 1\ 1\ 1]$$

$$\begin{array}{ccc} 0 & 1 & \to 1 \\ 1 & 0 & \to 1 \\ \downarrow & \downarrow & \\ 1 & 1 & \end{array}$$
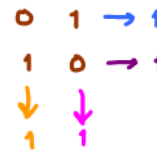
c. Find the parity-check matrix $\mathbf{H}$.

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