

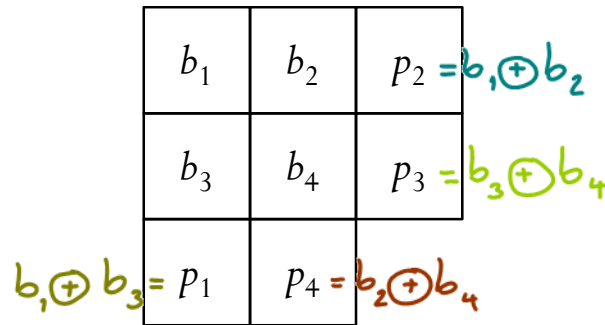
ECS 452: In-Class Exercise #13

Instructions

1. Separate into groups of no more than three persons.
2. The group cannot be the same as your former group.
3. Only one submission is needed for each group.
4. **Write down all the steps** that you have done to obtain your answers. You may not get full credit even when your answer is correct without showing how you get your answer.
5. **Do not panic.**

Date: 03/04 / 2017			
Name			ID (last 3 digits)
Prapun			5 5 5

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



Each parity bit p_i is calculated such that the corresponding row or column has even parity.

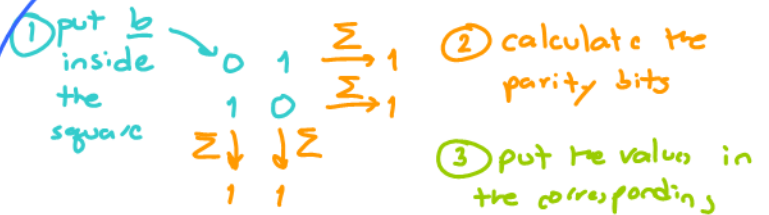
Suppose the following bits arrangement is used in the codeword:

$$\underline{x} = (b_1 \ p_1 \ p_2 \ b_2 \ b_3 \ b_4 \ p_3 \ p_4)$$

- a. Find the generator matrix G .

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

Alternatively, use the square array:



- b. Find the codeword for the message $\underline{b} = [0 \ 1 \ 1 \ 0]$.

$$\underline{x} = \underline{b}G = [0 \ 1 \ 1 \ 0] \begin{bmatrix} g^{(1)} \\ g^{(2)} \\ g^{(3)} \\ g^{(4)} \end{bmatrix} = g^{(2)} \oplus g^{(3)} = \begin{array}{cccccccc} 0 & 0 & 1 & 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 & 0 & 1 & 0 \\ \hline 0 & 1 & 1 & 1 & 0 & 1 & 1 & 1 \end{array}$$

- c. Find the parity-check matrix H .

Identity matrix in the data positions becomes identity matrix in the parity positions

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

Bit values in the parity positions are transposed and put in the data positions