Assignment (5)

Linear Block codes

1. The generator matrix for a linear binary code is

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

a) Express **G** in systematic **[I|P]** form.
b) Determine the parity check matrix **H** for the code.
c) Construct the table of syndromes for the code.
d) Determine the minimum distance of the code.
e) Demonstrate that the code word corresponding to the information sequence 101 is orthogonal to **H**.

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2. Consider a (7, 4) code whose generator matrix is

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

(a) Find all the codewords of the code.
(b) Find **H**, the parity-check matrix of the code.
(c) Compute the syndrome for the received vector 1 1 0 1 1 0 1. Is this a valid code vector?
(d) What is the error-correcting capability of the code?
(e) What is the error-detecting capability of the code?

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3. Consider a systematic block code whose parity-check equations are

$$p_1 = m_1 + m_2 + m_4$$
$$p_2 = m_1 + m_3 + m_4$$
$$p_3 = m_1 + m_2 + m_3$$
$$p_4 = m_2 + m_3 + m_4$$

where m_i are message digits and p_i are check digits.
(a) Find the generator matrix and the parity-check matrix for this code.
(b) How many errors can the code correct?
(c) Is the vector 10101010 a codeword?
(d) Is the vector 01011100 a codeword?

Convolutional codes

Q4. Convolution encoder has the following parameter:

Connection vectors g1=[1 0 1] (up), g2=[0 1 1] (down), Rate of the encoder=1/2,

constraint length K=3;

a. Draw the convolutional encoder.
b. How many states the state diagram will have? How many transitions per state?
c. Draw the state diagram of the encoder.
d. Determine the encoder output produced by the message sequence 110 (add tail bits to clear encoder's memory)
e. Flip the third and the fifth bit of the output of part d and show the process of decoding using the trellis diagram.