Homework 5

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EE 140: Introduction to Communication Systems

Due Time: Jun. 7, 2018

Problem 1 (20 points)

Consider the linear block code with the codeword defined by

$$U = m_1 + m_2 + m_4 + m_5, m_1 + m_3 + m_4 + m_5, m_1 + m_2 + m_3 + m_5,$$

$$m_1 + m_2 + m_3 + m_4, m_1, m_2, m_3, m_4, m_5$$

(a) Find the generator matrix.
(b) Find the parity check matrix.
(c) Find n, k, and d_{min}.

Problem 2 (40 points)

Consider a (7, 4) Hamming code with the following matrix as the parity check matrix:

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

(a) Provide the systematic form of generator matrix G_{sys}.
(b) Provide a table for the systematic (7, 4) Hamming code which contains all syndromes and the corresponding coset leaders (error pattern).
(c) The sequence $r = [1\ 1\ 0\ 1\ 0\ 0\ 1]$ is found at the receiver. Determine which sequence u was sent with the greatest probability.

Problem 3 (40 points)

Given a convolutional code with $g_0(D) = 1+D+D^2$ and $g_1(D) = 1+D^2$, where a terminated sequence ([0 0]) shall be used.
(a) Sketch the realization of this rate 1/2 convolutional code and find the recursive systematic (RSC) G(D).
(b) Generate the corresponding convolutional code given the information sequence $u = [0\ 1\ 0\ 1\ 1]$.
(c) Conduct the Viterbi-decoding for the received sequence $r = [1\ 1\ 1\ 1\ 0\ 1\ 0\ 1\ 1\ 0\ 1\ 1]$.