EE 121 – Intro to Digital Communication Spring 2016

Homework 6

Assigned: Tue, 3/29/16 Due: Tue, 4/5/16

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1 Inter-symbol Interference Channel

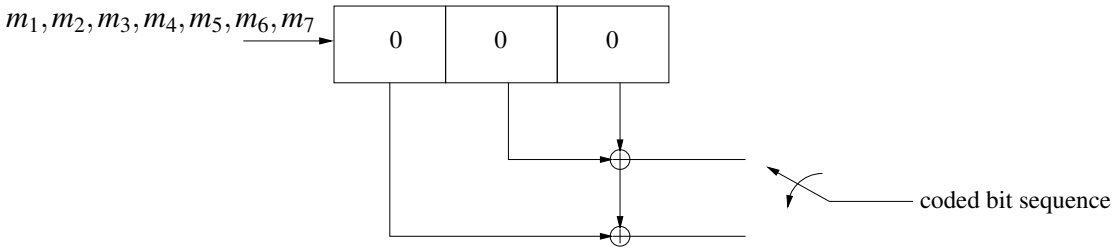
Consider the following inter-symbol interference channel:

$$y_i = x_i + 0.5x_{i-1} + n_i$$

where n_i is i.i.d. zero mean unit variance Gaussian noise. Assume that x_i are i.i.d. with equal probability over the set $\{-1, 1\}$. Let the received sequence be $y_1 = 1.3$, $y_2 = 0.3$, $y_3 = -1$, $y_4 = 2.1$, $y_5 = 1.5$ and $y_6 = -0.3$. Take $x_0 = 0$. Use Viterbi algorithm to determine the MAP estimate $\hat{x}_1, \hat{x}_2, \hat{x}_3, \hat{x}_4, \hat{x}_5, \hat{x}_6$.

2 A Convolutional Code

Consider the following convolutional code over the usual binary field $\mathbb{F}_2$.



(a) Show that this is a linear code. What are n, k parameters for this code. Determine the generator matrix in systematic form and an upper bound on the minimum distance using the generator matrix.

(b) Assume the coded bit sequence is passed through a binary symmetric channel and the received sequence is 01101111010001. What is the most likely message sequence $m_1, m_2, m_3, m_4, m_5, m_6, m_7$ that might have been sent? To get the answer, use dynamic programming principle and resulting Viterbi decoding algorithm. What are the state and action for this scenario?