# EE 121: Introduction to Digital Communication Systems

## Problem Set for Discussion Section 7

Wed 3/12/2008 and Mon 3/17/2008

**1.** Consider the two-dimensional communication channel $\mathbf{Y} = \mathbf{X} + \mathbf{W}$, where $\mathbf{W}$ is white Gaussian noise with zero mean and covariance matrix $\sigma^2 \mathbf{I}_{2\times 2}$. We wish to send a string of $n$ binary data symbols over this channel (assume the string has an entropy of $n$ bits). The energy constraint is $\mathbb{E}X(1)^2 + \mathbb{E}X(2)^2 \leq 2E$.

(a) If we are constrained to use a repetition code where $X(1) = X(2)$, what is the best probability of error we can achieve as a function of $n$?

(b) Suppose no such constraint exists. Suggest a better communication scheme and compute the probability of error as a function of $n$. You may assume $n = 2m$ for some integer $m$.

(c) Comment on the difference between your answers to part (a) and (b) when $n$ is large.