6.441 Transmission of Information
Problem Set 8
Spring 2010
Due date: April 22

Problem 1 Binary detection
Consider an AWGN channel $Y_i = X_i + N_i$, with $N_i \sim N(0,\sigma^2)$ and power constraint $rac{1}{n} \sum_i x_i^2 \leq P$.
(a) Use MATLAB, plot the capacity as a function of the signal to noise ratio $P/\sigma^2$
(b) Consider a suboptimal strategy as follows: at each time, transmit $X_i$ as $+\sqrt{P}$ or $-\sqrt{P}$. At the receiver, use maximum likelihood detection to detect whether + or - is transmitted. Compute the probability of detection error $P_e$.
(c) Now each time gives a binary symmetric channel with cross over probability of $P_e$, compute the capacity of this channel. Argue that we can achieve this capacity by using a binary code to choose + or - to be transmitted at each time. Plot the capacity as a function of the signal-to-noise ratio, and compare with the result in part (a).
(d) Use the same binary input at each time, but do not assume a hard decision to be made at each time. Give an expression of the capacity. How would this capacity compare with the results in (a) and (c)?

Problem 2
Problem 9.7 in Cover and Thomas (second edition)

Problem 3
Problem 9.12 in Cover and Thomas (second edition)