Problem Set 6
Due Thursday, February 24.

Reading: Chapter 3, begin 4.2 on Noisy Channels

1. (2 from last week)
2. (3 from last week). A first order Markov source is as shown below. (Compare prob. 3.5 van der Lubbe)

![Markov Source Diagram]

a) Determine the steady state probabilities for the source
b) Calculate the entropy of the source.
c) What is the 0-th order approximation for the source?
d) Calculate the entropy of the 0-th order approximation and compare to b)
e) Give a state-dependent binary encoding of the source. What is the average code length per source symbol?

3. a) For the source of problem 2, give the diagram for the second extension of the source, in which states are labeled by pairs of symbols and two symbols are emitted at each transition.
b) Using the steady state distribution for the source of problem 2, give the best estimate you can of the steady state distribution for the second extension. (If you know Matlab, it can give you the true steady state distribution.)
c) Give a state-dependent binary encoding of the source for the 3 states ending in "a"; aa, ba, ac. Is this encoding the same as the encoding that would be realized by the encoding of the previous problem 2e)? How does it differ? Is it more efficient or less efficient?

4. For the "Erasure Channel" below and the probability distribution on the inputs shown, give an expression for the mutual information I(Y;X) as function of $p$ and $q$. For a fixed value of $q$, what value of $p$ maximizes the mutual information? What is the maximum?

![Erasure Channel Diagram]