Algorithms in the Real World
Assignment #1 Due Date: 26 Sept 00

Problem 1: (10pt) Given the following conditional probabilities for a two state Markov Chain what factor would one save by using the conditional entropy instead of the unconditional entropy?

$$p(w|w) = .9 \quad p(b|w) = .1$$
$$p(w|b) = .4 \quad p(b|b) = .6$$

Problem 2: (10pt) Given the following probability model:

Letter	$p(a_i)$	$f(a_i)$
a_1	.1	0
a_2	.2	.1
a_3	.7	.2

Decode the 4 letter message given by `01010100` assuming it was coded using arithmetic coding. Why is this message longer than if we simply had used a fixed-length code of 2 bits per letter?

Problem 3: (30pt) Prove the Kraft-McMillan inequality for Prefix Codes. Note that this is somewhat easier than for general uniquely decodable codes.
You will be graded on the clarity as well as the correctness of your proof. Remember that making the proof longer does not necessarily increase the information content.