# ECE 499/599 Data Compression/Information Theory
# Spring 06

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## Homework 2
## Due 04/27/06 at the beginning of the class

**Problem 1:** Do problem 4 in chapter 3 of the textbook. (6pts)

**Problem 2:** Suppose you are given a task of compressing a Klingon text consisting of 10,000 letters. To your surprise, the Klingon alphabet consists of only five different letters: k1, k2, k3, k4, and k5. Furthermore, you notice that there are 4000 k1's, 3000 k2's, 2000 k3's, 500 k4's and 500 k5's. (6pts)

(a) Develop the Huffman codes for these Klingon letters.
(b) What is the average code rate?
(c) Interestingly, you notice that the letters k4 and k5 always appear together as "k4k5". Can you use this information to improve the compression ratio? If so, what are the new codes and corresponding average coding rate?

**Problem 3:** By now, you are an expert at compressing alien's languages, the U.S. government assigns you the task of compressing Krypton language. Kryptonite are very smart (or stupid) beings, as such their entire language can be represented by sequences consisting of only three letters k1, k2, and k3. Being a compression expert that you are, you exam the krypton text, and notice there are 7000 k1's, 2000 k2's, and 1000 k3's out of the given Krypton text containing 10,000 letters. (6pts)

(a) What is the entropy rate of this Krypton text?
(b) If Huffman code is used to code the letters, what is the average code rate?
(c) Due to the bandwidth limitation of inter-star communication, the US government wants you to improve your basic Huffman compression scheme. Can you modify Huffman coding to compress the Krypton text further? If so, provide an example of the new codes.

**Problem 4: (bonus)** Suppose you are at Las Vegas, and you notice this one peculiar game. The game is described as follows. A guy throws a perculiar dice with three faces: 1, 2, and 3. However, he would not let you know the outcome of the dice. Your job is to guess the outcome of the dice. Suppose you guess an outcome, then he would tell you *which number is not the outcome*, and gives you a second chance to guess your number again (he won't throw the dice again). If you guess wrong the second time, you have to give him $5, on other hand if you guess right, he has to give you $4. (2pts)

(a) What is the amount of uncertainty regarding your guesses.
(b) Would you play the game (I assume you like to win some money)?