ECE 499/599 Data Compression/Information Theory
Spring 06

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Homework 3
Due 05/04/06 at the beginning of the class

Problem 1: For an alphabet A = {a1, a2, a3} with probabilities P(a1) = 0.6, P(a2) = 0.3, and P(a3) = 0.1. (3pts)

(a) Design a 3-bit Tunstall code for this alphabet.
(b) Find the redundancy (code rate – entropy rate).

Problem 2: Suppose you saw this one game in which, a guy repeatedly tosses a fair coin (at least he claims that it is a fair coin, and hence with probability P(head) = 1/2) until either (a) the outcome is head or (b) the number of consecutive tail outcomes reaches 4. (8pts)

(a) Code these outcomes using Golomb code with m = 4. What is average code rate? (note that the uncoded outcomes have the forms: 1, 01, 001, 0001, 0000, with 1 representing head and 0 representing tail.)
(b) Being a very observant person, you notice that the guy is actually cheating his audiences by using a biased coin, in which the probability of head P(head) is not 1/2. Using m = 4, can you derive the equation for the average Golomb code rate as a function of P(head)?
(c) If you are going to code these outcomes using runlength code, what is the average code rate as a function of probability P(head), assuming you always code the run-lengths of tails using 2-bit fixed-lengh code?

Problem 3: Do problem 7 in chapter 4. This problem refers to integer arithmetic coding with scaling. Show steps by steps during encoding and decoding. (8pts)

Problem 4: (bonus) Show that the remainder bits in Golomb code can be viewed as a prefix code (1pt).