CSC 310S
Spring, 2003

April 14, 2003
Final Exam: April 29, 2003

Information Theory

Information about the Final Exam

General

Here are some general points:

- Open books and notes.
- Use of calculators is permitted.
- Write all answers in the space provided on the examination paper.
- Show your work where appropriate.
- Attempt all parts of the test before dwelling on any one part.

Overall

The final exam is designed to test your understanding and intuition and insight about the material of the course, much more than testing your knowledge of details of proofs or intricate variations of algorithms. A good strategy would be to try to go through the test once without looking at texts or notes and filling in provisional answers to at least 75% of the questions. (You can go back and check them later as time permits.) Only after that should you devote significant time to looking things up in notes and books.

Types of Questions

About 3/4ths of the questions on the test are either "multiple choice" (circle the right answer), or "short answer" (fill an answer into a box). The other 1/4th includes "true / false", "short written answer" (one or two or three sentences), "order by quality" (rank several alternatives according to a specified criterion), and "provide an expression" (state and expression in terms of variables without evaluating it).

Range of Material

The material on the final exam will be drawn from what was covered in lectures, on the midterm exam, and on the three assignments. Most (but not quite all) of this material is also covered in one or both of the two course texts.

[See next page.]

Specific Topics

Because the exam is (undeniably) long, I have decided to give you a lot of inforomation about the structure and the subject matter of the exam. Below are the six parts and nineteen subparts on the exam, along with the topic of the question and the associated number of marks.

I.

- A. [6 marks] Implications of Theorems
- B. [4 marks] Ideal (average) codeword lengths
- C. [6 marks] Classification of Codes (ambig., uniq. decod., instant., Huffman)
- D. [8 marks] Entropy and Mutual Information Calculations

II.

- A. [2 marks] Relative Entropy
- B. [6 marks] Huffman and Arithmetic Coding
- C. [4 marks] Adaptive Versions of Huffman and Arithmetic Coding
- D. [5 marks] Simplified Lempel-Ziv-Welch Coding

III.

- A. [6 marks] Coding Based on Markov Chains and PPM
- B. [8 marks] Entropies and Entropy Rates in Markov Chains

IV.

- A. [8 marks] Characteristics of a Noisy Channel
  (Channel Matrix, Joint Prob. Matrix, Backward Probs., Output Probs.)
- B. [3 marks] Asymptotic Transmission Rates and Error Probabilities
  for various Error Correcting Codes
- C. [8 marks] Decoding Error Correcting Codes by (i) Maximum
  Likelihood vs. (ii) Ideal Observer

V.

- A. [4 marks] Differential Entropy
- B. [2 marks] Types of Quantization
- C. [5 marks] Scalar and Vector Quantization for a Specific Distribution

VI.

- A. [8 marks] Simplified (as in lecture) Wavelet Transforms
- B. [3 marks] Sampling and Quantization of Sound
- C. [4 marks] Approaches to Compressing Images