Math 477/877 - Source Coding and Quantization

Winter 2009

Instructor:	Tamas Linder - Jeffery Hall 401 Phone: 533-2417, Email: linder@mast.queensu.ca
Course Web Site:	http://www.mast.queensu.ca/~math477 All important announcements will be posted here.
Time/Place:	Slot 5 (Tuesday 9:30, Thursday 8:30, Friday 10:30) Jeffery Hall 110
Office Hours:	Tuesday 10:45 – 11:45 am (tentative)
Text:	Class notes (posted on the course web site) A. Gersho and R. M. Gray, *Vector Quantization and Signal Compression* Kluwer, Boston, 1992.
Grading:	20% homework, 15% + 15% mid-term tests, 50% final project. Undergraduate students will receive a reduced load.
Prerequisite:	Information Theory (Math 474/874)

Course Outline

Efficient transmission and storage of information is of critical importance in many branches of science and engineering. The means by which to achieve this is *source coding* (a.k.a. data compression), a discipline that studies the compact representation of information bearing signals (such as text, speech, still image, and video) for the purpose of storage or transmission. Source coding is part of the general theory of communication, and is closely related to and information theory, signal processing, as well as probability and random processes.

In this course the fundamentals of the theory and practice of source coding will be studied, with main emphasis on lossy source coding. The following is a list of topics that will be covered in more or less detail.

- *Fundamentals of Rate-Distortion Theory:* The rate-distortion function and its properties, the lossy source coding theorem.
- *Scalar Quantization:* uniform and nonuniform quantization, predictive quantization, speech coding fundamentals, CELP.
- *Lossless Coding:* Arithmetic coding, lossless universal coding, the Burrows-Wheeler transform.
- *Frequency Domain Coding:* Transform coding, bit allocation, subband coding, wavelet coding, image coding fundamentals, JPEG, JPEG2000.
- *Vector Quantization:* Optimality conditions, geometric structure, design algorithms (Lloyd-Max and related methods).
- *High Resolution Theory:* Companding quantization, Bennett's integral, the Zador-Gersho formula.
- *Structured Vector Quantization:* Lattice quantization, multistage and tree-structured vector quantization, trellis coded quantization.
- *Variable Rate Quantization:* Entropy coded quantization, greedy growing and pruning of tree structured vector quantizers.