MATH/MTHE 477/877 - Data Compression and Source Coding

Winter 2012

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 3 (Monday 10:30 am, Wednesday 9:30 am, Friday 8:30 am) Jeffery Hall 115
Office Hours:	Tuesday 2:30 – 3:30 pm, or by appointment
Text:	Class notes and posted lecture slides
Recommended Text:	A. Gersho and R. M. Gray, *Vector Quantization and Signal Compression*, Kluwer, Boston, 1992. T. Cover and J. Thomas, *Elements of Information Theory*, 2nd Ed., Wiley, 2006.
Grading:	Undergraduate students: 25% homework, 25% + 25% + 25% mid-term quizzes Graduate students: 25% homework, 15% + 15% + 15% mid-term quizzes, 30% final project
Prerequisite:	Information Theory (MATH/MTHE 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 data compression will be studied. 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.
- *Lossless Coding:* Arithmetic coding, lossless universal coding, Kolmogorov complexity, Lempel-Ziv coding.
- *Scalar Quantization:* Uniform and nonuniform quantization, companding quantization, predictive quantization, speech coding fundamentals, CELP.
- *Frequency Domain Coding:* Transform coding, bit allocation, subband coding, wavelet coding, image coding fundamentals, JPEG, JPEG2000.

- *Vector Quantization and High Resolution Theory:* Optimality conditions and design algorithms (Lloyd-Max and related methods), lattice quantization, Bennett's integral, the Zador-Gersho formula.