University of Toronto
Dept. of Electrical & Computer Engineering

ECE1502F—2007
Course Outline

Information Theory

Instructor: Prof. F. R. Kschischang
Office: BA 4132
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Lectures: Tuesdays and Fridays, 10:30 a.m. – 12:00 p.m., GB221, GB244, respectively

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This course is an introduction to information theory. As stated by Cover and Thomas, the authors of the recommended text,

> Information theory answers two fundamental questions in communication theory: what is the ultimate data compression (answer: the entropy H), and what is the ultimate transmission rate of communication (answer: the channel capacity C).

As many of the following topics as permitted by the time available will be covered.

- Entropy: entropy, relative entropy, mutual information, the asymptotic equipartition property, entropy rates for stochastic processes.
- Data Compression: the Kraft inequality, Shannon-Fano codes, Huffman codes, arithmetic coding.
- Channel Capacity: discrete channels, the random coding bound and its converse, Gaussian channels, coloured Gaussian noise and "water-filling."
- Rate Distortion Theory: the rate-distortion function, parallel Gaussian sources and reverse "water-filling."
- Network Information Theory: multiple user channels, broadcast channels.

Main Reference: Thomas M. Cover and Joy A. Thomas, *Elements of Information Theory*, Second Edition, John Wiley & Sons, Inc., 2006.

Other References: Robert G. Gallager, *Information Theory and Reliable Communication*, John Wiley & Sons, Inc., 1968.

Richard E. Blahut, *Principles and Practice of Information Theory*, Addison-Wesley, 1987.

Raymond W. Yeung, *A First Course in Information Theory*, Kluwer, 2002.

David J. C. MacKay, *Information Theory, Inference, and Learning Algorithms*, Cambridge University Press, 2003 and www.inference.phy.cam.ac.uk/mackay/itila/book.html.

IEEE Transactions on Information Theory, Commemorative Issue, Vol. 44, October 1998.

Grading: Final grades will be determined on the basis of midterm (40%) and final (60%) examinations.