

A Special Topics Course – Information Theory, Inference, and Learning Algorithms

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In recent years many problems of applied science problems can be addressed using a blend of mathematical and computational tools spanning several disciplines. This includes information theory, probability and computer science. The topics covered will include:

1. Introduction to Data Compression
2. Noisy-Channel Coding
3. Topics in Information Theory
4. Selected topics of Probability including Monte Carlo methods
5. Neural Networks
6. Sparse Graph Codes.

Much of the mathematics presented in this course has been developed in engineering departments, government and industrial labs. Thus, the approach is deeply rooted in the underlying applications: data compression, learning, pattern recognition, error correction and others. Moreover, deep connections between these seemingly disjoint subjects will play an important role.

The book “Information Theory, Inference, and Learning Algorithms” by David J.C. MacKay, a Professor of Natural Philosophy at Cavendish Laboratory, University of Cambridge, provides in one volume a fascinating overview of the mathematical theory, algorithms which will be the valuable resource for this class. The book can be downloaded from the author’s website:

<http://www.inference.phy.cam.ac.uk/mackay/>

Note: Marek Rychlik joined the Department of Mathematics in 1989 and he is a Professor of Mathematics and member of the Applied Math Program. He is a recipient of the 4th Monroe Martin Prize for best paper in applied mathematics, and the author of the solution of the Equichordal Point Problem. He specializes in dynamical systems, algorithm development and software development. Between 2004 and 2008 he was on leave from the University working in industry on data compression. He held positions of a Research Senior Mathematician and as a Chief Science Officer he led the technology division of Qbit Corporation, a data compression company operating in Washington DC area and Los Angeles, CA.