CO 739-2 Topics in Combinatorics
Information theory and applications
University of Waterloo, Winter 2020

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QNC 1201, Tue-Thu 10:00--11:20 am

Although it was originally developed as a mathematical theory of communication, information theory has found a growing number of applications in seemingly unrelated domains. Through this course, we will study basic concepts from information theory, properties of entropic quantities, their operational interpretations, and applications in discrete mathematics and computer science. A tentative list of topics includes:

- Shannon entropy, divergence, and mutual information
- basic properties of entropic quantities
- Chain Rule, Pinsker Inequality, Data Processing Inequality
- one-shot and asymptotic compression
- compression of interactive protocols
- Noisy Coding Theorem and error-correction codes
- Bregman theorem, Shearer lemma and applications
- communication complexity of Set Disjointness
- applications of error-correction codes
- Lovasz Local Lemma
- extended linear programming formulations

Prerequisites for the course include knowledge of elementary discrete probability theory and mathematical maturity. Familiarity with discrete mathematics and theoretical computer science will be helpful, but may be substituted by sufficient enthusiasm for these subjects.

This course may be used towards satisfying some of the requirements of the C&O undegraduate degree. Interested students must obtain a course override form signed by the C&O undergrad advisor and the instructor of the course.

Evaluation for graduate students will be based on assignments and a project. Evaluation for undergraduate students will be based on assignments, a midterm and a final exam.

The assignments are intended to supplement the lectures and help the students get a more complete appreciation of the topics covered. The project consists of studying further topics in information theory or one or more research articles related to the course, making a presentation to the class, and writing a report.

Details of the Winter 2018 and 2016 offerings are available at:
http://www.math.uwaterloo.ca/~anayak/Site/Information_Theory.html