MATH 597 / COMP 554: Submodular Optimization (Winter 2017)

Times: Monday: 2:35 - 3:55, Burnside 1205. Wednesday: 1:35 - 2:55, Burnside 1205.

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Office Hours: Tuesday 3:00-4:30. And also by appointment.

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Office Hours: TBA Or by email appointment.

Topics: Submodular set functions have played a central role in the development of combinatorial optimization and could be viewed as the discrete analogue of convex functions. Submodularity has also been a useful model in areas such as economics, supply chain management and recently algorithmic game theory and machine learning. There has been a huge amount of work recently in approximation algorithms for various constrained submodular optimization models arising in practice, perhaps most prominently the social welfare maximization problem. We develop the basic properties of submodular functions and then present both classical methods and recent trends. Topics include: algorithms for unconstrained submodular maximization and minimization, polymatroids, local greedy algorithms, multilinear extensions and pipage rounding, Lovasz Extension and convex minimization, matroid constraints, multi-agent optimization, and many applications.

Textbooks:

There is no course textbook. The following may be of interest as supporting references.

(1) A good introduction to linear programming: *Understanding and using linear programming* by Matoušek and Gärtner.
(2) *Linear Programming* by V. Chvátal is also a classic.
(3) The most comprehensive handling of polyhedral combinatorics is *The theory of linear and integer programming*, by A. Schrijver. A more circumscribed introduction is *A course in convexity* by A. Barvinok.
(4) *Numerical Optimization* by Nocedal and Wright.
(5) *Convex optimization:* by Boyd and Vandenberghe.
(6) *Combinatorial Optimization; a polyhedral perspective* by A. Schrijver.
(7) For integer programming: *Integer Programming* by L. Wolsey.
(8) *Submodular Functions and Optimization*, by Satoru Fujishige.

Prerequisites:

Students should know the basics from Calculus, Linear Algebra and have taken a course in Algorithms.

Grading:

In-class Quiz: Best 4 of 5. 20%
Homework: $4 \times 10\% = 40\%$
Scribing: 10%
Take-Home Final: 30 %

Policy on homework:

You may (and are encouraged to) work with other students in the class on the assignments, however, the work you submit must be your own. No copying. List the names of fellow students with whom you worked. You **must** also cite any reference materials used to complete your work.

Statement:

By direction of the Senate all course outlines have to include the following statements:

McGill University values academic integrity. Therefore all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the Code of Student Conduct and Disciplinary Procedures (see http://www.mcgill.ca/integrity for more information).

In accord with McGill Universitys Charter of Students Rights, students in this course have the right to submit in English or in French any written work that is to be graded. This right applies to all written work that is to be graded, from one-word answers to dissertations.

In the event of extraordinary circumstances beyond the Universitys control, the content and/or evaluation scheme in this course is subject to change.