COMP/MATH 552 Combinatorial Optimization

McGill University, Winter 2018

Course Information:

Session: Winter 2018 Time: Tuesdays and Thursdays 08:35 - 09:55 am

Room: McConnell 103 Course webpage: `http://www.cs.mcgill.ca/~yli252/co.html`

Instructor:

Instructor: Yaqiao Li Email: yaqiao.li@mail.mcgill.ca

Office: McConnell 303 Office Hours: Monday 3:00 - 4:00 pm, or by appointment

Teaching Assistant: TBD.

1 Prerequisites

Math 350 (Graph theory and Combinatorics) or COMP 362 or equivalent.

This course is intended for graduate students and senior undergraduate students in math or computer science. The main prerequisite is mathematical maturity, with basic knowledge in graphs and linear algebra. The exposure to some algorithms (e.g. shortest path, minimal spanning tree, bipartite matching, max flow - min cut) is preferable, though not essentially required. It is important that you feel comfortable or are ready to work with rigorous mathematical reasoning.

2 Course description

Combinatorial optimization is a branch of mathematics that studies optimization over a finite set that usually can be described by a graph or other combinatorial object. It has wide application in sciences and engineering.

This is an introductory course on combinatorial optimization. Our focus will NOT be on modelling practical problems, but on structure and theory behind those problems and algorithms. The course mainly consists of: polyhedral combinatorics and application in general matching theory; matroids; equivalence of optimization and separation; and submodular optimization. A recurring theme in this course is to see individual problems are unified in general theory.

See tentative topics for things that are planned to be covered. Topics (certainly also interesting and important!) that won't be covered include but not limited to: heuristic algorithms, approximation algorithms, semidefinite programming, complexity, etc.

3 Textbook

There is no one single text book. The main references will be the following (increasing level) together with other materials that will be issued with the lectures.

- A Course in Combinatorial Optimization by A. Schrijver.
- Combinatorial Optimization by W. Cook, W. Cunningham, W. Pulleyblank and A. Schrijver.

- Combinatorial Optimization by B. Korte and J. Vygen.
- Geometric algorithms and combinatorial optimization by by M. Grotschel, L. Lovasz, and Alexander Schrijver

4 Tentative topics

Here is a list of planned topics:

- Polyhedra combinatorics and LP duality, integral polytopes, total unimodularity. (5-6 Lectures)
- General matching and matching polytopes. T-joins. (8 Lectures)
- Matroid theory: greedy and matroid intersection. (2-3 Lectures)
- Ellipsoid method, separation and optimization. (3 Lectures)
- Submodular optimization. (5 Lectures)

It should be noted that the topics are subject to change depending on the interest of the audience, and longer or shorter treatment of specific topics.

5 Evaluation

There are no formal mid-term or final exams. Evaluation will be made through assignments, in-class tests and a final group project.

Assignments: 30%. (Three assignments, each worth 10%)
In-class Tests: 40%. (Two tests, each worth 20%)
Project: 30%.

6 Academic Integrity

McGill University values academic integrity. Therefore all students must understand the meaning and consequences of cheating, plagiarism and other academic offenses under the Code of Student Conduct and Disciplinary Procedures (see `http://www.mcgill.ca/integrity` for more information). Most importantly, work submitted for this course must represent your own efforts. Copying assignments or tests from any source, completely or partially, allowing others to copy your work, will not be tolerated.

7 Submission of written work in French

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.