Combinatorial Optimization

MATH 3802 A, Winter 2021

School of Mathematics and Statistics, Carleton University

Instructor: Dr. Kevin Cheung **E-mail:** kevin.cheung@carleton.ca

Course description: Network flow problems, network simplex method, max-flow min-cut problem, integral polyhedra, minimum-weight spanning tree problem, maximum matching problem, maximum stable set problem, introduction to approximation algorithms.

Prerequisite: MATH 3801 or permission of the School

Textbook: Course notes and supplementary videos are available for free in cuLearn.

Lectures: Web-based + synchronous sessions (Fri 10:05—11:25)

Online tutorials: Fri 14:35—15:25

Instructor's online office hours: TBA **Teaching assistant:** TBA

Evaluation scheme:

MATH 3801 review quiz (maximum 5 marks)

Assignments (maximum 55 marks):

- Eleven in total. The ***i***-th highest scoring quiz is worth **11-*i*** marks. For example, the highest scoring assignment is worth 10 marks, the second highest 9 marks, and the lowest 0 mark.

Midterm test (maximum 20 marks)

Project (maximum 10 marks)

Tutorial work (maximum 10 marks):

- Ten in total. One mark each.

Important dates:

Midterm test: Feb 26 10:05—11:25
Project: Apr 14
Assignment due dates: Jan 19, 26, Feb 2, 9, 23, Mar 2, 9, 16, 23, 30, Apr 6
Tutorial dates: Jan 22, 29, Feb 5, 12, Mar 5, 12, 19, 26, Apr 2, 9

Policies for review quiz and assignments

- **Posting review quiz or assignment questions to websites outside cuLearn such as chegg.com is strictly prohibited.**
- Solutions to each assignment **must be submitted in cuLearn by the posted deadline** following all submission requirements. Failure to follow these requirements and the instructions given in each problem set will result in a deduction or even a complete rejection of the submission. Note that **up to two** late assignments no more than 24 hours late each are accepted.

System requirements: Students must have reliable internet access. A webcam for e-proctoring during the midterm test is required. Students are **fully responsible for resolving their own computer/connection issues and creating proper files for assignment submissions.** The course content has been tested on Firefox version 83 with Javascript enabled on Windows 10 and macOS 10.15. Students having **technical issues** with cuLearn should contact the **ITS service desk.**

Communication: Announcements on course-related issues are made in cuLearn. In case of cuLearn system malfunction, communication may be made through Carleton's email system. It is each student's responsibility to **check for messages on cuLearn and their Carleton email account every business day.** Communication between students and the instructor is through electronic means only except for PMC students with a letter requesting accommodation for other available means of communication. **All email to instructors and TAs must be made from students' Carleton email accounts**.

Additional policies: If you miss any term work due to illness or other conditions recognized by the University, you will need to provide appropriate supporting documentation for the missed work within three days of your return to study so that arrangements for make-up work can be made.

Students may request to have any evaluated term work regraded if it has been incorrectly graded. Such a request must be submitted to the instructor in writing no later than two business days after the work is first returned. All regrades are final.

Students must conform to the University's Academic Integrity Policy. Failure to be informed of the expectations regarding academic integrity is not a valid excuse for violations of the policy.

Pregnancy/Religious Accommodation: Write to the instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, visit the Equity services website.

Students with disabilities requiring academic accommodations in this course must register with the Paul Menton Centre for Students with Disabilities (PMC) for a formal evaluation of disability-related needs. Documented disabilities could include but are not limited to mobility/ physical impairments, specific Learning Disabilities (LD), psychiatric/psychological disabilities, sensory disabilities, Attention Deficit Hyperactivity Disorder (ADHD), and chronic medical conditions. Registered PMC students are required to contact the PMC, 613-520-6608, every term to ensure that I receive your Letter of Accommodation, no later than two weeks before the first assignment is due or the first in-class test/midterm requiring accommodations. If you only require accommodations for your formally scheduled exam(s) in this course, please submit your request for accommodations to PMC by the deadlines published on the PMC website.

Course schedule

Week	Dates	Topic
1	Jan 13, 15	self-directed review of MATH 3801 material
2	Jan 20, 22	total unimodularity, integral polyhedra, directed graphs
3	Jan 27, 29	minimum-cost flow problem, integral flow, network simplex method
4	Feb 3, 5	finite termination of network simplex method
5	Feb 10, 12	maximum s-t flow, max-flow min-cut theorem
6	Feb 24, 26	applications of max-flow min-cut theorem, **midterm**
7	Mar 3, 5	undirected graphs, trees, forests, matchings
8	Mar 10, 12	minimum-weight spanning tree
9	Mar 17, 19	maximum-cardinality matching for bipartite graphs
10	Mar 24, 26	maximum-cardinality matching in general
11	Mar 31, Apr 2	maximum-cardinality stable set, stable set polytope
12	Apr 7, 9	approximation algorithms
13	Apr 14	**projects due**