



Department of Combinatorics and
Optimization, University of Waterloo

CO 367 Nonlinear Optimization

Fall 2021

Instructor:	Fei Wang	Time:	Tuesday and Thursday 14:30 - 15:50
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Teaching Assistants:	Tyler Weames Maria Sobchuk	Email:	tweames@uwaterloo.ca msobchuk@uwaterloo.ca

Course description: An introductory course to the mathematics of nonlinear optimization. Necessary and sufficient optimality conditions for unconstrained and constrained problems. Convexity and its applications. Computational algorithms and their analysis. Application to machine learning.

Mixed-mode teaching:

- There are two sections of this course: on-campus (section 001) and online (section 002). The lectures in the classroom will be streamed simultaneously on zoom and the students in the online section will join the zoom meeting (students in the zoom meeting can also ask questions during the class, instructor can hear the questions through a headphone).
- Recordings of livestreamed lectures will typically but not always be posted on LEARN. Since these lectures are delivered synchronously, it is expected that students make every effort to attend and participate in the live session. If you cannot attend a lecture, it is your responsibility to make up for the material — regardless of whether or not the lecture video is posted on LEARN.

- Lecture notes, assignments and solutions will be posted on LEARN.
- Students from both sections will have to upload their assignment solutions to Crowdmark.
- Students can use Piazza to post questions and have discussions with other students. The Piazza sign-up link is piazza.com/uwaterloo.ca/fall2021/co367
- Both midterm and final tests will be delivered online and on-campus synchronously.

Requirements: Prerequisites: (One of CO 250/350, 352, 255/355) and MATH 128 with a grade of at least 70% or MATH 138 or 148.

Textbooks: There is no required textbook for this course. Suggested readings and lecture notes will be posted on LEARN weekly. The following textbooks will be used to suggest readings:

- Nocedal and S. J. Wright, Numerical Optimization, Springer-Verlag, New York, 2006.(Available online.)
- S. Boyd, L. Vandenberghe, Convex optimization, 2009. (Available online.)

Office hours:

- In-person office hours: Wednesday 2:00 pm - 3:00 pm.
- Online office hours: Wednesday 10:00 am - 11:00 am. (Via Zoom.)

Topics:

1. Introduction and Unconstrained optimization
2. Convex sets and convex functions.
3. Duality theory
4. Algorithms for unconstrained optimization.
5. Trust region methods.
6. Least squares optimization.
7. Constrained Optimization.
8. Algorithms for constrained optimization.
9. Application to Deep Learning

Grading

- The final grades will be computed as follows: Assignments 40 %, mid term 20 %, final test 40 %
- There will be 5 assignments, each assignments is worth 8 %
- Midterm will be held on **Wednesday October 27, 2021. Time: 10:00 am - 12:30 pm**
- A missed assignment or midterm will be treated the same as a mark of zero unless the cause is illness (a medical note is necessary), or some other serious reason given promptly in writing with convincing evidence, in which case the corresponding weight will normally be transferred to the final exam
- Final test date is still to be determined

Important dates (tentative):

1. Assignment 1, posted on September 16, due September 24.
2. Assignment 2, posted on September 24, due October 8.
3. Assignment 3, posted on October 9, due October 23.
4. Mid term: October 27, 2021. Time: 10:00 am-12:30 pm
5. Assignment 4: posted on November 5, due November 19.

6. Assignment 5: Posted On November 20, due December 4.
7. Final: TBA.

Academic integrity: In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. [Check the [Office of Academic Integrity](#) for more information.]

Grievance: A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read [Policy 70, Student Petitions and Grievances, Section 4](#). When in doubt, please be certain to contact the departments administrative assistant who will provide further assistance.

Discipline: A student is expected to know what constitutes academic integrity to avoid committing an academic offence, and to take responsibility for his/her actions. [Check the [Office of Academic Integrity](#) for more information.] A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about rules for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate associate dean. For information on categories of offences and types of penalties, students should refer to [Policy 71, Student Discipline](#). For typical penalties, check [Guidelines for the Assessment of Penalties](#).

Appeals: A decision made or penalty imposed under [Policy 70, Student Petitions and Grievances](#) (other than a petition) or [Policy 71, Student Discipline](#) may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to [Policy 72, Student Appeals](#).

Note for students with disabilities: [Access Ability Services](#), located in Needles Hall, Room 1401, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with AccessAbility Services at the beginning of each academic term.