CO 367: NONLINEAR OPTIMIZATION
(FALL 2020)

General Information

Instructor: Nargiz Kalantarova, email: n2kalant@uwaterloo.ca
Class Times, Place: Video lectures and notes will be posted online on LEARN every Tuesday and Thursday by 10am (ET).
Instructor's Office Hours: Wednesday 4-6 p.m. (ET) via MS Team.
Teaching Assistants:

1. Elvis Iam, email: hciam@uwaterloo.ca

2. Lise Turner, email: lise.turner@uwaterloo.ca

LEARN: https://learn.uwaterloo.ca [link]
• Lecture notes, videos, assignments and their solutions will be posted on LEARN.
Piazza: http://piazza.com/uwaterloo.ca/fall2020/co367 [link]
• Students may post their questions about the course material and assignments on Piazza. Please read the guidelines for posting.
• Announcements will be posted by the instructor and TAs on Piazza.
Crowdmark: Students are expected to submit their assignment solutions via Crowdmark. For typesetting LaTeX is recommended.

Course Description: A first course in the mathematics of nonlinear optimization. Necessary and sufficient optimality conditions for unconstrained and constrained problems. Convexity and its applications. Computational techniques and their analysis.

Required Background and Materials

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

- **[NW]** J. Nocedal and S. J. Wright, *Numerical Optimization*, Springer-Verlag, New York, 2006. (Available as an online resource at the library.)

- **[BV]** S. Boyd, L. Vandenberghe, *Convex optimization*, 2009. (Available online.)

Topics

1. *Unconstrained optimization based on calculus and linear algebra*

2. *Convex sets and convex functions*

3. *Algorithms for unconstrained optimization*

4. *Trust region methods*

5. *Least squares optimization*

6. *Constrained Optimization*

7. *Algorithms for constrained optimization*

8. *Deep learning from an applied mathematics perspective*

Grading

The final grade will be computed as follows:

Assignments	45 %
Midterm Exam	20 %
Final Exam	35%

- There will be 5 assignments. Each assignment is 10% except the first assignment which is 5%. Assignments will be posted on LEARN and must be submitted via Crowdmark.

- **Computational problems:** Some assignments will include a computational problem. We will be using MATLAB (or Python) to implement certain algorithms for nonlinear optimization problems. MATLAB is developed by MathWorks. A good tutorial for MATLAB can be found in [link] .

- Midterm will be held on **Wednesday, October 28, 2020, Time: TBA**

- 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, in which case the corresponding weight will normally be transferred to the final exam.

Important Dates (tentative)

- Assignment #1: posted on September 10, <u>due September 22</u>.

- Assignment #2: posted on September 23, <u>due October 8</u>.

- Assignment #3: posted on October 9, <u>due October 23</u>.

- **Midterm:** held on **October 28, 2020, Time: TBA**

- Assignment #4: posted on November 6, <u>due November 20</u>.

- Assignment #5: posted on November 20, <u>due December 4</u>.

- **Final Exam:** December 14, 9:00 a.m. (2.5 hour exam in 24 hour window)

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: AccessAbility 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.