Nonlinear Optimization

CSC / DSCC / MATH 294 Spring 2025

Meeting Information

Tuesday/Thursday 2:00-3:15 pm
Harkness Hall 210

Instructor

Jiaming Liang
Email: jiaming.liang@rochester.edu
Office: Wegmans Hall 2403

Teaching Assistant

Youwei Wang
Email: ywang464@ur.rochester.edu

Office Hours

4:00-5:00 pm, Wednesday, Wegmans Hall 2403 (Jiaming Liang)
4:00-5:00 pm, Friday, Wegmans Hall 1219 (Youwei Wang)

Prerequisites

The course is intended for advanced undergraduate students with mathematical maturity in multivariate calculus (MATH 164) and linear algebra (MATH 165). Prior knowledge of optimization (MATH 208) is helpful but not required. Students should have good MATLAB or Python programming skills.

Course Description

This course serves as a modern introduction to the field of optimization. It covers important topics such as convexity, optimality conditions, duality, gradient methods, and Newton's method. The objective is to provide the foundations of theory and algorithms of nonlinear optimization, as well as to present a variety of applications from diverse areas.

Topics (subject to change)

1. Mathematical Preliminaries
2. Unconstrained Optimization
3. Least Squares
4. The Gradient Method
5. Newton's Method
6. Convex Sets
7. Convex Functions
8. Convex Optimization

9. Optimization over a Convex Set
10. Linearly Constrained Problems
11. The Karush-Kuhn-Tucker Conditions
12. Duality

Textbooks

Amir Beck. *Introduction to Nonlinear Optimization, Second Edition*. SIAM, 2023.

Recommended Readings

1. Dimitri P. Bertsekas. *Nonlinear Programming, Third Edition*. Athena Scientific, 2016.
2. Stephen Boyd and Lieven Vandenberghe. *Convex Optimization*. Cambridge University Press, 2004.
3. David G. Luenberger and Yinyu Ye. *Linear and Nonlinear Programming, Third Edition.* Springer, 2008.
4. Fatma Kilinc-Karzan and Arkadi Nemirovski. *Mathematical Essentials for Convex Optimization*. Cambridge University Press, 2024+.

Assessments & Grading

- 30% homework (6 problem sets x 5% each)
- 35% midterm exam (March 6)
- 35% final exam (May 10)

The final grade will be assigned as a letter grade according to the following scale:

A	90-100%
B	80-89%
C	70-79%
D	60-69%
F	0-59%

Programming Languages

MATLAB, Python, or Julia

Academic Integrity

Academic integrity is a core value of the University of Rochester. Students are strongly encouraged to discuss homework problems with one another. However, each student must write up and turn in their own solutions, written in their own words/consisting of their own code. All assignments and activities associated with this course must be performed in accordance with the University of Rochester's Academic Honesty Policy. More information is available at: http://www.rochester.edu/college/honesty.

Absences/Late Submissions

Out of fairness to the entire class, late submission of homework will not be accepted in the absence of a prior agreement between the student and instructor. In particular, excused absences include illnesses, religious observations, career fairs and job interviews. In the event than an excused absence such as above prevents a student from submitting an assignment, their homework grade will be calculated on a prorated basis.

Diversity, Equity, Inclusion, & Belonging

Instructors, teaching assistants, and students should work together to ensure that our class is a welcoming, inclusive, respectful, and vibrant place for all of its members to share, learn, and grow. Our class will not tolerate discrimination, prejudice, or harassment of any kind. More resources can be found at: https://www.rochester.edu/diversity/.

Accessibility

Students needing academic adjustments or accommodations because of a documented disability must contact the Disability Resource Coordinator for the school in which they are enrolled. I am happy to accommodate any and all accommodations, so long as they are documented with the Office of Disability Resources. I am glad to meet to discuss your specific situation or to help ensure you have the support you need. For additional information, please see: https://www.rochester.edu/college/disability/.