

# ASEN 6519: Optimization: Applications and Algorithms

Zachary Sunberg

Fall 2024

## Prerequisites

Basic knowledge of multivariable calculus, linear algebra, and probability. Fluency in a high-level programming language.

## Learning Objectives

1. Obtain a broad understanding of models and algorithms for optimization
2. Understand how to formulate real-world challenges as optimization problems
3. Communicate clearly and precisely about optimization problems and results

## List of Topics

1. Unconstrained local optimization (gradients, Newton's method, quasi-Newton methods)
2. Zeroth-order optimization (derivative-free methods, evolutionary algorithms)
3. Constraints (Lagrange multipliers, penalty methods, augmented Lagrange, interior point)
4. Linear programming (simplex, interior point)
5. Discrete optimization (integer programming)
6. Additional topics as needed by students and time permits

## Textbooks

- **Algorithms for Optimization** by Mykel J. Kochenderfer and Tim A. Wheeler (Free PDF)
- **Numerical Optimization** by Jorge Nocedal and Stephen Wright (PDF access through CU Libraries)

I may also use other books for specific topics.

## Assignments and Grading

All assignments will be submitted through gradescope. Except as noted below, you may consult any resources, including the internet, textbooks, and other students, but the final work you submit must be your own. If you use generative AI such as ChatGPT, you must disclose its use.

- **40% Final Project (Report and Presentation).** (Groups of 2 permitted)
- **5% Final Project Peer Review.**
- **20% Homework.** (Late policy: 10% off for first 72 hours)
- **15% Research Paper Presentation.**
- **15% Online Quizzes.** (Generative artificial intelligence such as ChatGPT is NOT permitted on the quizzes.)
- **5% Participation.**

## Participation Expectations

- **In-person students** must attend class (I may take attendance; occasional absences due to illness or other commitments are OK, and you do not need to notify me).
- **Remote students** must have at least four online interactions during the semester. Interactions include attending zoom office hours, making a presentation in class, asking or answering a question on Ed, or another similar interaction.
- **All students** are encouraged to ask questions, participate in discussions, and engage with other classmates to understand the material.

## Links

- **Ed** ([edstem.org/us/courses/64118](https://edstem.org/us/courses/64118)) will be the main hub for the course. All announcements will be posted there.
- **Gradescope** ([gradescope.com](https://www.gradescope.com)) will host assignments including exact due dates.
- **The Schedule** is located [here](#).

## Instructor Contact

Professor Zachary Sunberg  
AERO 263 [zachary.sunberg@colorado.edu](mailto:zachary.sunberg@colorado.edu)

**Office Hours** will be posted on Ed. I am also happy to meet individually: Please send a calendar invitation for a time not marked busy on my calendar at <https://zachary.sunberg.net/contact#calendar> and indicate whether you would like to meet in my office or provide a videoconference link.

## Meetings

Tuesdays and Thursdays 1:00-2:15 pm  
AERO N240

## University Policies

**Classroom Behavior:** Students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote, or online. Failure to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation, or political philosophy.

For more information, see the classroom behavior policy, the Student Code of Conduct, and the Office of Institutional Equity and Compliance.

**Accommodation for Disabilities, Temporary Medical Conditions, and Medical Isolation:** If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the Disability Services website. Contact Disability Services at 303-492-8671 or [DSinfo@colorado.edu](mailto:DSinfo@colorado.edu) for further assistance. If you have a temporary medical condition, see Temporary Medical Conditions on the Disability Services website.

If you have a temporary medical condition or required medical isolation for which you require adjustment, please notify the instructor as soon as possible so that appropriate accommodations can be made. If you are sick or require isolation please notify the instructor of your absence from in-person

activities and continue in a completely remote mode, as you are able, until you are allowed or able to return to campus. Please note that for health privacy reasons you are not required to disclose to the instructor the nature of your illness or condition, however you are welcome to share information you feel necessary to protect the health and safety of others within the course.

**Preferred Student Names and Pronouns:** CU Boulder recognizes that students' legal information doesn't always align with how they identify. Students may update their preferred names and pronouns via the student portal; those preferred names and pronouns are listed on instructors' class rosters. In the absence of such updates, the name that appears on the class roster is the student's legal name.

**Honor Code:** All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code. Violations of the Honor Code may include but are not limited to: plagiarism (including use of paper writing services or technology [such as essay bots]), cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. Understanding the course's syllabus is a vital part in adhering to the Honor Code.

All incidents of academic misconduct will be reported to Student Conduct & Conflict Resolution: [StudentConduct@colorado.edu](mailto:StudentConduct@colorado.edu). Students found responsible for violating the Honor Code will be assigned resolution outcomes from the Student Conduct & Conflict Resolution as well as be subject to academic sanctions from the faculty member. Visit Honor Code for more information on the academic integrity policy.

**Sexual Misconduct, Discrimination, Harassment and/or Related Retaliation:** CU Boulder is committed to fostering an inclusive and welcoming learning, working, and living environment. University policy prohibits protected-class discrimination and harassment, sexual misconduct (harassment, exploitation, and assault), intimate partner abuse (dating or domestic violence), stalking, and related retaliation by or against members of our community on- and off-campus. The Office of Institutional Equity and Compliance (OIEC) addresses these concerns, and individuals who have been subjected to misconduct can contact OIEC at 303-492-2127 or email [CUreport@colorado.edu](mailto:CUreport@colorado.edu). Information about university policies, reporting options, and support resources including confidential services can be found on the OIEC website.

Please know that faculty and graduate instructors must inform OIEC when they are made aware of incidents related to these policies regardless of when or where something occurred. This is to ensure that individuals impacted receive outreach from OIEC about resolution options and support resources. To learn more about reporting and support for a variety of concerns, visit the Don't Ignore It page.

**Religious Accommodations:** Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, you must let the instructor know of any such conflicts within the first two weeks of the semester so that they can work with you to make reasonable arrangements.

See the campus policy regarding religious observances for full details.

**Mental Health and Wellness:** The University of Colorado Boulder is committed to the well-being of all students. If you are struggling with personal stressors, mental health or substance use concerns that are impacting academic or daily life, please contact Counseling and Psychiatric Services (CAPS) located in C4C or call (303) 492-2277, 24/7.

Free and unlimited telehealth is also available through Academic Live Care. The Academic Live Care site also provides information about additional wellness services on campus that are available to students.