ORF 523, Spring 2021

Convex and Conic Optimization

Course description

A mathematical introduction to convex, conic, and nonlinear optimization. Topics include convex analysis, duality, theorems of alternatives and infeasibility certificates, semidefinite programming, polynomial optimization, sum of squares relaxation, robust optimization, computational complexity in numerical optimization, and convex relaxations in combinatorial optimization. Applications drawn from operations research, dynamical systems, statistics, and economics.

Course website

- http://aaa.princeton.edu/orf523
- Includes Zoom links to lectures and office hours (password has been emailed to registered students)
- Can register for Piazza via the course website
- The course will also be on Blackboard

Class schedule and location

T, Th 1:30 pm-2:50 pm EST.

Instructor

Amir Ali Ahmadi, Professor at ORFE. Web: http://aaa.princeton.edu/ Email: aaa@p...
Office hours: Wed, 3-5 PM EST.

TAs

- Abraar Chaudhry (1/2 AI)
- Email: azc@p...
- Office hours: Wed, 5-7 PM EST

- Cemil Dibek (1/2 AI)
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- Cole Becker (UCA)
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- Office hours: Tue, 5-7 PM EST

- Kathryn Leung (UCA)
- Email: kl22@p...
- Office hours: Tue, 5-7 PM EST

Prerequisites

- Linear optimization (e.g., at the level of ORF 522).
- Mathematical maturity, familiarity with MATLAB or similar software, and comfort with linear algebra and multivariate calculus.

Tentative set of topics

- Optimality conditions
- Convex analysis and convex optimization
- Duality and infeasibility certificates
- Computational complexity
    - Focus on complexity in numerical optimization
- Conic programming
- More in depth coverage of semidefinite programming
- A module on combinatorial optimization
- Selected topics:
    - Robust optimization
    - The ellipsoid method or interior point methods
    - Polynomial optimization
    - Sum of squares programming
    - Optimization in dynamical systems
    - Optimal control
- Various applications of convex and conic optimization

References

- A. Ben-Tal and A. Nemirovski, Lecture Notes on Modern Convex Optimization [link]
- S. Boyd and L. Vandenberghe, Convex Optimization [link]
- M. Laurent and F. Vallentin, Semidefinite Optimization [link]
- R. Vanderbei, Linear Programming and Extentions [link]

Course grade

- 50% homework (5-6 problem sets; will drop the lowest score)
- 20% midterm exam (about 2 hours in length; one page of cheat sheet allowed)
- 30% final exam/assignment (take-home)

Homework

Homework will be due at the beginning of lecture (1:30 PM EST). Unless there is a *valid* reason, requests for extension on homework will not be accepted. To help stick with this policy, we drop your lowest homework score.

Midterm exam

There will be a midterm exam (date TBA), which will be about two hours long. This exam is closed-book and closed-notes. However, you can have a single sheet of A4 paper with you (double-sided) with anything you want written or typed on it. There will be no computer exercises on the midterm exams.

Final exam/assignment

You can think of the final exam as a longer, cumulative problem set that needs to be done individually. It will be given out after the last week of class. Exact dates are to be announced.

In rare cases, we may allow the final assignment to be replaced with a final independent project, which will be graded to high standards. A solution to any of the open problems of the class can also replace the final exam (and all other exams and assignments).

Collaboration policy

Homework: You are allowed and in fact encouraged to collaborate on the homework. You have to turn in your individual assignment and you have to write the name of the students with whom you worked with on the first page of your homework. Full credit will be given to all members of the team.

Midterm and final exams: No collaboration allowed.

Honor code

We strictly adhere to Princeton University's Honor System.