Math 6880/7875: Advanced Optimization

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Course overview

Math 6880/7875: Advanced Optimization

- In-person (unless otherwise specified)
- Grading based solely on end-of-term project (presentation)
- Some core topics covered in class ($\sim$10 weeks), some topics based on student interest ($\sim$2-3 weeks)

Most non-technical information here and in what follows is on the syllabus.

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Course topics

A rough outline of what we'll discuss in the "core" topics:

- Background: linear algebra, probability, statistics, basic optimization
- Examples: denoising, inverse problems, inference, machine learning, ...
- First-order descent methods (gradient descent-type algorithms)
- Second-order and quasi-second-order descent algorithms
- Regularization, relaxation, alternation, splitting
- non-negative least squares, non-negative matrix factorization
- convex feasibility, randomized methods
- convex optimization, duality, and algorithms

Throughout, we'll discuss *both* theory and algorithms.

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Grading: Project

Goal: Complete a project that is of interest to you.

This should culminate in a 30-minute presentation at the end of the semester (last few weeks of classes).

Examples:

- Investigate/implement/utilize an algorithm for an application of interest
- Present a research paper on a topic
- Explain the algorithmic backend for a widely-used software package/solver

I will compile potential papers relevant to topics we cover, but any optimization-related topic is fine.

Propose and discuss project with me by mid-semester (say by beginning of spring break).

Ideally, this project will line up well with your current interests.

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Project logistics

1. Now until spring break: consider what you would/could present on
2. I'll disseminate a list of papers that could serve as a project next week
3. I'm happy to discuss offline or in class any potential topics, algorithms, or papers that could be suitable
4. By Spring break: discuss your topic with me (in-person, email, Zoom....)
5. Once topics are all decided, I'll put together a schedule for presentations for the last $\sim$3 weeks of class
6. On presentation day:
   - I'll take $\sim$30 minutes at the beginning of class to discuss broad setup/theory for the project topic
   - You will present following me, discussing your project/paper.
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COVID guidelines

The U encourages

- vaccination + boosting
- routine testing
- masking

We are, unfortunately, still in this pandemic.

- In extenuating circumstances, we'll move class online (Zoom)
- Please keep me informed if you test positive for COVID – I must attend to university guidelines regarding reporting

General class communication: email is the best way to contact me outside of class. I will send any general announcements through email.
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Theme of this class

Advanced Optimization . . . or “Topics in Optimization"

This is a seminar/topics course: curriculum is not necessarily fixed and crystallized.

Major goals (and warnings) for this class:

- To provide an overview/survey of optimization topics
- Not to provide substantial in-depth knowledge of any particular topic
- To give you general exposure of existing tools and formalisms
- To present you with resources where you could find more detailed information
- Not to provide algorithmic minutiae
- To give an elementary understanding of how optimization problems are solved

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