ISyE 6661 Syllabus

Linear Optimization, three credits

Spring 2027

Instructor Information

Instructor: Alejandro Toriello

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General Course Information

Description

This course is intended to introduce ISyE doctoral students to the theoretical fundamentals, modeling techniques and algorithmic methodologies of linear programming. The main methodological focus is polyhedral theory, duality and the simplex algorithm, but will also include broader topics.

Tentative course outline:

1. Introduction to and modeling with LP
2. Polyhedral theory
3. The simplex algorithm
4. Duality
5. Large-scale methods
6. Advanced topics, time permitting

Course Learning Outcomes

- Modeling OR problems with linear programming.
- Understanding the basics of polyhedral theory.
- Understand how duality is used to benchmark and prove optimality.
- Learn the mechanics of the simplex method and apply it in large-scale contexts.

Required Course Materials

The recommended text is *Introduction to Linear Optimization*, by Bertsimas and Tsitsiklis (Athena Scientific). We will mostly follow this book's progression with a few exceptions. Linear optimization is a mature subject, and there are many references available, including some for free:

- *A First Course in Linear Optimization*, by Jon Lee; available for free at https://github.com/jon77lee/JLee_LinearOptimizationBook/blob/master/JLee.4.08.7z
- *Introduction to Linear Optimization*, lecture notes by Arkadi Nemirovski; available for free at https://www2.isye.gatech.edu/~nemirovs/OPTILN2023Spring.pdf

Pre-Requisites

- This is a PhD course that heavily relies on mathematical proofs. You should be comfortable with proof techniques, e.g. contradiction, the contrapositive, induction, etc.
- Linear algebra at the advanced undergraduate level. You should be familiar with concepts such as matrix rank, determinants, linear independence, span, null space, Gaussian elimination, etc., and should be comfortable doing proofs with them.
- Some familiarity with real analysis, including open versus closed sets, convergence, continuity, etc.

Device-Free Lecture

Lectures will be device-free. This includes cell phones, laptops and any other electronic device that has a screen, makes sounds, or both. The only possible exception is a tablet used exclusively for note taking, under the following conditions: the tablet lies flat on your desk, no other application besides note-taking is open/active, the volume is muted and the internet is disabled. The intent is to provide an environment as free of distractions as possible, to encourage attention and participation. Please consult with me if you have questions or need special accommodations according to ODS.

Grading Policy and Description:

Homeworks (30\%): I expect to assign five or six homeworks. Each assignment will be posted online on Canvas and due roughly a week later at the start of lecture. You must turn

in handwritten answers, stapled and clearly legible. I encourage you to work with classmates in groups on the assignments, and you may also consult outside sources (including AI sources), but your answers must be your own, written by yourself.

Midterms (2 x 20\%): The midterm exams will be in class, tentatively scheduled for February 16 and April 1. For each test, you may reference your handwritten class notes, but no other outside sources are allowed. If you use a tablet for notes, its internet must be disabled, and only your notes may be open.

Final (30\%): The final exam will also be in class and will be comprehensive. It is scheduled for Wednesday, May 6, starting at 2:40, and will last no more than two hours. The format will be identical to the midterms.

Grading Scale

Your letter grade will be assigned based on the following rubric:

A: [90%, 100%]

B: [80%, 90%)

C: [70%, 80%)

D: [60%, 70%)

F: below

At my discretion, this rubric may be adjusted, but only down (in your favor).

Course Policies

Attendance and/or Participation

Attendance is not mandatory except for tests.

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. Review Georgia Tech's Honor Code and the student Code of Conduct.

Any student suspected of cheating or plagiarism on an exam or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services (404-894-2563) as soon as possible to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Student-Faculty Expectations Agreement

At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. The Student-Faculty Expectations articulate some basic expectations that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.