

ISyE 4133 (RES/ASY): Advanced Optimization

Summer 2025 (Early summer session).

Days:	Mon-Thu
Place:	College of Computing 52
Time:	3:30pm – 5:40pm
Credit Hours:	3
Website:	https://gatech.instructure.com/courses/486766
Instructor:	Mr. Caleb Ju (he/him/his)
Email:	calebju4@gatech.edu
Office Hours:	Tue 10am-11am, Thu 2pm-3pm (Main 318 + Zoom)
TA:	Mr. Jialin Yu
Email:	yujl1@gatech.edu
Office Hours:	Mon 8pm-9pm (Zoom)

Course summary

Course objective

ISyE 4133 is the second optimization course in the undergraduate ISyE curriculum. This course builds upon ISyE3133 by considering models that are too difficult and/or large to be directly solved. Students will learn basic theoretical knowledge, scalable algorithms, and practical computational skills to solve such challenging problems.

Course outcomes

- Provide a solid mathematical foundation for understanding linear, nonlinear, and combinatorial optimization problems.
- Extend modeling techniques from ISyE3133 and introduce reformulation techniques
- Design and analyze various algorithms for solving difficult and/or large-scale problems
- Practice in applying state-of-the-art software tools to model and solve optimization problems.

Prerequisites

- ISyE 3133 (Engineering Optimization) or equivalent knowledge
- Prior exposure to linear algebra and algorithms. We will review all relevant mathematical concepts as we need them.
- Basic computer programming. We will mostly be using Python, CVXPY, and Gurobi

Course delivery and communication

This course will be delivered hybrid, with in-person lectures that are recorded live (via Zoom) and posted afterwards. While attendance (either in-person or live online) is not mandatory, we highly recommend to participate in class lectures while they are being delivered, for a better learning experience. To incentive participation, there will be extra opportunities for participation. See the *Extra credit* for more details. Incomplete and completes lecture slides will be posted prior and after each class, respectively.

All course material will be hosted on Canvas, as well announcements, grades, Zoom links, and the Piazza link. We will use Piazza for peer-to-peer communication to discuss homeworks, studying, and finding team members. Office hours are posted at the top of syllabus. If no times work, students are encouraged to contact staff to find alternative times.

For direct communication, please use your school email to contact both the instructor and TA. Please give an informative subject and concise email body. **Please include in the subject “ISyE4133 Su25” to ensure the email catches our filter, otherwise we may miss it.**

References

The main material will be lecture notes. For additional material:

- Rardin. *Optimization in Operations Research*. Pearson.
- Luenberger and Ye. *Linear and Nonlinear Programming*. Springer ([access](#) on GT Wi-Fi).

Assignments and grading

Assignments will consist of homework (4 in total), short post-lecture quizzes, a group project, and two midterms. **All online file submissions must given in a pdf format.** Submission details for code will be provided on an ad-hoc basis.

Assignment details

1. **Homeworks** (30%): 3-4 questions, involving either mathematical or coding questions. Students will submit solutions electronically to Canvas (L^AT_EX is recommended). Hand-written submissions must be clearly legible. Solutions will be released after the deadline and grades within a week. The lowest homework will be dropped. In addition, we allow one redo, where students can earn back up to 50% of their missing grade on one homework.
2. **Quizzes** (10%): Bi-weekly (2x a week). Multiple choice and short responses, sometimes involving a coding exercise. Released at the end of lecture on Canvas and due within 48 hours. The three lowest quizzes are dropped.
3. **Group project** (15%): Teams of 2-4. Please use Piazza to find members if you do not have any already. Collaboration only permitted within the team. Three potential project ideas will be released after the first midterm. Students must form groups, select a project, and brainstorm their solution by a “project checkpoint” deadline. Final project and a report are due later. More details to come.
4. **Midterms** (45%): Take-home exam available over a 24hr period. It is open-book and online references are allowed, but the use of generative AI and collaborations is prohibited. First midterm has a 20% weight while second has a 25% weight. Midterm #1 grades will be released by May 29th.

In all assignments, use of online references (e.g., Wikipedia, Stack Overflow, other academic resources) is permitted. In addition, generative AI (GenAI) and collaborations are also allowed unless otherwise stated. Use of online references, collaborations, and GenAI (if permitted) must be properly cited in the submission. Submitted work must be one’s own original work and effort. Failure to follow these guidelines will be considered a violation of the academic honor code. See the section *Responsible use of generative AI tools* for more details.

Regrades and redos

Regrades on homeworks and exams are allowed. Students must provide a written explanation of the suspected grading mistake. A request entails regrading the entire assignment or exam; therefore, the regrade process may result in your submission receiving a higher or a lower score after all of the problems have been reconsidered. Regrade requests must be submitted through Canvas and completed within one week after the grades are reported.

For one choice of homework, students can redo a homework. In a redo, students supplement each incorrect solution with the following: why their submitted solution was incorrect and what changes are needed to make it correct. Additionally, redos can be combined with regrades. Students can use the same resources as with the homework plus the solution guide. Redos are subject to the same academic honor code, and similar to regrades, redos have the same one week deadline and entail regrading the entire homework. Questions that are correctly “redone” can earn back up to 50% of the missing grade. More precise scoring details will be available after the first homework grade is released. To discourage misuse, redos are only allowed on homeworks where the student has put a nontrivial amount of effort. As a baseline requirement, we will use the rule of a homework score of at least 50% to allow redos. If students believed they put sufficient effort but received under 50% (e.g., due to grading errors or difficulty with the homework), students can discuss with the instructor to allow a redo. In this case, the instructor reserves the right to permit redos.

Letter grades

Letter grades’ minimum scores will be tentatively set at

A: 90%; B: 80%; C: 70%; D: 60%; F: <60%.

The instructor reserves the right to adjust the minimum average to avoid certain extreme cases. It will only result in grades being adjusted higher for all students. For example, a student with a score 90% is guaranteed an A. The weight of each grade follows Georgia Tech’s grading system (<https://catalog.gatech.edu/rules/5/>)

Extra credit

There are two opportunities for extra credit, dispersed at the discretion of the staff:

1. (Up to 1%): A first-week “prerequisite quiz”. Extra credit based on effort/correctness.
2. (Up to 5%): Participation (e.g., lecture participation, asking/answering questions on Piazza or over email, attending office hours).

Course expectations and guidelines

Special accommodations

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services at (404) 894-2563 or <http://disabilityservices.gatech.edu/>, as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodations letter. Please contact the instructor as soon as possible to discuss your learning needs.

Late assignments

Due to provided dropping policy, condensed nature of the class, and logistics for grading and releasing solutions, late assignments generally will not be accepted. Late assignments will be accepted only and make-up exams will be given only for documented reasons of illness, family emergency, or participation in approved Institute activities (see <http://catalog.gatech.edu/rules/12/> for more information).

Academic honor code

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. While collaboration and outside academic resources are permitted in this course, they must be responsibly used and cited as outlined in this syllabus. Any student suspected of cheating, plagiarizing, or irresponsibly using outside academic resources will be reported to the Office of Student Integrity, which will investigate the incident and identify the appropriate penalty for violations. **Students who violate the academic honor code may receive an automatic F in the course.** For more information on the Honor Code, visit the OSI website <https://osi.gatech.edu/students/honor-code>.

Responsible use of generative AI tools

Given the prevalence of generative artificial intelligence (GenAI), this course permits its use for all assignments excluding midterms, under appropriate usage. The goal is to use GenAI as a tool and not a substitute for applying the material. Appropriate uses of GenAI include (but are not limited to):

- generating approaches on how to solve a problem.
- developing boiler plate code.
- editing/formatting text or writing code for visualization (e.g., plots and tables).

Inappropriate uses include (but are not limited to):

- directly using and presenting GenAI content as one's own original work.
- failing to acknowledge the use of GenAI.

Most importantly, students must properly cite the use of GenAI and how it is used. Inappropriate use of GenAI will be deemed a violation of the honor code. If you have uncertainty about the use of GenAI, please reach out to staff. For more details, see Georgia Tech's guidelines at <https://oit.gatech.edu/ai/guidance>.

Tentative course schedule

Tentative schedule. Subject to change after class survey on the first week. Lectures (denoted with "L") with an asterisk indicate a quiz will be released afterwards.

MONDAY	TUESDAY	WEDNESDAY	THURSDAY
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MONDAY	TUESDAY	WEDNESDAY	THURSDAY
May 12th HW #1 released L: Introduction and LP formulations	13th L: LP formulations and Geometry of LPs*	14th HW #2 released L: Geometry of LPs and duality	15th L: Duality*
19th Due: HW #1 L: Sensitivity analysis*	20th Due: HW #2 L: Simplex method*	21st L: Review	22nd Test: Midterm #1
26th No Class Memorial Day	27th HW #3 released L: Nonlinear formulations*	28th L: Convexity	29th Due: Project checkpoint (Fri May 30) L: Descent methods*
June 2nd L: Newton methods	3rd Due: HW #3 HW #4 released L: MIP formulations and B&B	4th L: MIP formulations and B&B	5th L: Decomposition methods*
9th L: Cutting Plane & Lagrangian methods*	10th Due: HW #4 L: ADMM and progressive hedging*	11th Due: Project deadline L: Review	12th Test: Midterm #2