Introduction to Graduate Algorithms

General Information

- Course prefix: CS
- Course number: 4540
- Section: A
- CRN: 89595
- Instructor: Sahil Singla
- Semester: Fall
- Academic year: 2026

Course Description

This course is a graduate-level course in the design and analysis of algorithms. We study techniques for the design of algorithms to solve fundamental problems. In addition, we study algorithmic strategies to deal with hard problems, specifically, does labeled as NP-hard. The main topics covered in the course include: advanced dynamic programming, divide and conquer, graph algorithms, approximation algorithms, and randomized algorithms.

Required Material

The course have no required material. We recommended several textbooks that will supplement the material covered in lectures.

- `Algorithms` by S. Dasgupta, C. Papadimitriou, and U. Vazirani.
- `Algorithm Design` by J. Kleinberg and E. Tardos.
- `Probability and Computing` by M. Mitzenmacher and E. Upfal.
- `Algorithms` by Jeff Erikson.
- `Introduction to algorithms` by T.H. Cormen, C.E. Leiserson, R.L. Rivest, and C. Stein.
- `Markov Chains and mixing times` by D.A. Levin, Y. Peres and E.L. Wilmer.

Learning Outcomes

By the end of the semester, you will be able to:

- use big-O notation to describe the growth rates of runtimes of algorithms and compare them based on their theoretical performance rather than just execution time on a specific computer.
- master specific strategies for building new algorithms, using Algorithm Design Paradigms such as Divide & Conquer; Dynamic Programming, and Graph Algorithms.
- prove the correctness of your designs rigorously.
- model real-world problems as concrete problems you can solve algorithmically.
- recognize *hard* problems and apply strategies to handle their intractability.
- use randomization techniques to approach problems from an average case point of view, in comparison with the worst case performance.

Attendance Policy

Attendance is mandatory. Any known absences should be communicated by email to both the instructor and TAs. Any unknown absences should be communicated in the same manner as soon as safely possible. When asked for documentation, please provide the event, time, and name of a person to contact to verify the event. Do not provide any personal or health information in screenshots.

Two unexcused absences are provided to you at the beginning of the semester, as we understand sickness and career fair interviews can overlap the class. Based on the circumstances of your absence, the instructor may let you make up any missed assignments. Only absences that are pre-emptively notified with an institute approved absence (IAA) form or religious holiday are immediately counted as excused absences.

To make up work for an unexcused absence after the first two, you need explicit authorization from the instructor. Only under very special circumstances such make up will be granted.

Grading policy and weighting

- Homework: 25% total.
- Three exams: 25% each

Letter grades are computed according to the usual brackets: $A[90, 100]$; $B[80, 90)$; $C[70, 80)$; $D[60, 70)$; $F[0, 60)$. These brackets may change, but only to your benefit.

Use of AI tools

AI tools are an important addition to our learning spaces. We assume you will use them — but in ways that improve your own judgment instead of replacing it.

Across the course we use one simple protocol:
I. Baseline first (your own thinking before AI). You must write your own answers.

II. AI second (critique and structure, not source of reality). You may then ask AI to:

- reorganize or label notes you already wrote,
- suggest missing arguments or perspectives,
- help with phrasing, formatting, or other structures.

AI is welcome as a coach and organizer, not as a replacement for solving assignments or designing your algorithms.

Academic Integrity and Student Conduct

Students must adhere to Georgia Tech Student Code and Academic Honor Code. When uncovered, violations will be reported to the Office of Student Integrity and the assignment grade becomes 0. Violations will be reported to the Office of Student Integrity (OSI) for review.

An AI policy is in the works for this course. For now, please defer to your instructors approved use and expectations on using AI for this course. Any AI use should be meet institute policies listed on this Office of Information and Technology pageLinks to an external site. AND the Student Code of Conduct. Instructors have the ability to adjust their AI policies within courses for future assignments if issues arise by clearly announcing them in writing to the students. Instructors may not retroactively change policies for former assignments.

All submissions and projects will be monitored for compliance. For any questions or concerns, please consult the instructor.

Accommodations for Disabilities

If you have accommodations from the Office of Disability Services, please notify your instructor as soon as possible to discuss your course needs. Accommodations will take effect only after you provide the necessary documentation.

If you need accommodations but haven't set them up yet, contact Disability Services at 404-894-2563, dsinfo@gatech.edu, or visit http://disabilityservices.gatech.edu. They help coordinate reasonable accommodations for students with disabilities or temporary health conditions.

Accommodations are established through collaboration between you, your instructor, and Disability Services.