CSE 6140 / CX 4140
Computational Science & Engineering (CSE) Algorithms

Fall 2025

1 General Information

1.1 Lectures

Classroom:	Paper Tricentennial 109
Time:	Monday 11:00am - 12:15pm; Wednesday 11:00am - 12:15pm.

1.2 Instructor

Nabil Imam

Email:	nimam6@gatech.edu
Office Hours:	Monday 1:15pm - 2:00pm on Zoom (link available on Canvas) and by appointment

1.3 Teaching Assistants

	Email
Sudarshan Anand	sanand315@gatech.edu
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TA Office Hours will be posted on Canvas.

2 Course Description

This course will introduce students to designing scalable and effective algorithms for computational science and engineering applications. The course focuses on algorithm design, complexity analysis, experimentation, and optimization. Students will develop knowledge and skills concerning:

- the design and analysis of real-world algorithms employed in computational science and engineering applications
- analyzing problem complexity, algorithm correctness and time/space requirements
- experimental performance analysis and optimization

2.1 Topics

- Analysis of algorithms: proof of correctness, asymptotic order of growth

- Graphs: connectivity, traversal, shortest paths, spanning trees, topological ordering, applications
- Greedy algorithms: scheduling problems, optimal caching, clustering, Huffman codes
- Divide and Conquer: recurrence relations, mergesort, convolutions and FFT.
- Dynamic Programming: scheduling problems, subset sums and knapsacks, RNA secondary structure, sequence alignment
- Network Flow: max-flow, min-cuts
- NP Completeness: polynomial-time reductions, NP-complete problems: sequencing problems, partitioning problems, graph coloring, SAT, numerical problems
- Approximation algorithms: set cover, vertex cover, knapsack problem
- Heuristics / Local Search

Topics may change over the course of the semester.

2.2 Recommended Textbook

We will follow material in the following textbook:

- (KT) J. Kleinberg and E. Tardos, *Algorithm Design*, Pearson, 2005.

2.3 Optional Textbooks

The following two textbooks are also great references:

- (CLRS) T. Cormen, C. Leiserson, R. Rivest, and C. Stein, *Introduction to Algorithms*, Fourth edition, MIT Press, 2022.
- (DP) S. Dasgupta, C. Papadimitriou, and U Vazirani, *Algorithms*, McGraw-Hill Education 2006.

2.4 Pre-requisites

Familiarity with a programming language (e.g. Python or C) is required. A minimum grade of C in one of the following courses: CS 1331 or CS 1372 or CS 2316 or ECE 2035 or ECE 2036 or CX 4010.

Recommended: design and analysis of algorithms (GT CS 3510 or equivalent), some background in discrete math, and graphs. If you do not know what a Depth First Search is, you are most likely not ready to take this course. Students (from the Sciences, Engineering, and Computing) interested in algorithmic applications in science and engineering are encouraged to take this course.

This course can be taken for satisfying the theory breadth requirement by computer science graduate students (M.S. and non-theory Ph.D. students). This course cannot be taken by ACO students to satisfy their core requirement and by theory Ph.D. students in computer science to satisfy the theory breadth requirement.

Some of the homeworks will involve proofs. Some programming questions and possibly your project will require coding in your choice of language.

2.5 Grading

Homework	30%
Midterm	20%
Project	20%
Final Exam	30%

There will be five homeworks throughout the semester. By default all lectures will be conducted in person.

Letter grade cutoff
A: 90-100% B: 80-90% C: 70-80% D: 60-70% F: 0-60%

2.6 Important Dates

- Aug 18: First class
- Aug 22: Drop deadline without W
- Oct 6: Fall Break
- Oct 8: Midterm
- Oct 27: Deadline to change grade mode from letter grade to pass/fail (and vice versa), or drop with a W
- Nov 26: Student Recess/Official School Holiday
- Dec 1: Last class
- Dec 10: Final exam (11:20am - 2:10pm)

3 CLASS POLICIES

1. Class announcements will be sent to the Georgia Tech Canvas mailing list, see http://canvas.gatech.edu/. It will be used for posting and submitting homeworks and programming assignments.
2. All homework must be submitted through Canvas. Each homework gets a grace period of 24h. There will be no penalty for homework submitted within the grace period, but no submission will be accepted beyond the grace period without a legitimate excuse and approval from the instructor.
3. Each student must read and abide by the Georgia Tech Academic Honor Code, see www.honor.gatech.edu.
4. Plagiarizing is defined by Webster's as "to steal and pass off (the ideas or words of another) as one's own: use (another's production) without crediting the source." If caught plagiarizing, you will be subjected to GT Academic Honor Code.

5. When working on homework, you may work with other students in the class. However, each student must write homework solutions in their own words independently, and upload their own homework solutions to Canvas with the collaborators names annotated on every copy of the submission.

6. No collaboration is permitted on exams. The midterm and final exams will be online, via Honorlock on Canvas. You will be allowed to use a "cheat sheet" (double-sided 8.5 x 11 sheet of paper). No other resources are allowed.