CSE 6140 / CX 4140
Computational Science & Engineering (CSE) Algorithms
Fall 2020

General Information

Instructor

Xiuwei Zhang
Email : xiuwei.zhang@gatech.edu
Office Hours : Monday & Wednesday 2pm-3pm, and by appointment

This course will be given in Remote Asynchronous mode. Every week there will be two lectures: the lecture video of the first lecture will be uploaded every Monday before noon; that of the second lecture will be uploaded every Tuesday before noon (time for uploading the 2nd lecture can be subject to small changes).

Teaching Assistants:

	Email
Shahrokh Shahi	shahi@gatech.edu
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Schedules and BlueJeans links of all office hour can be found in Canvas → Calendar.

Course Description

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

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

Fall 2020 Tentative Topics

- Analysis: big O notation, recurrences, models of computation
- Review: graph algorithms and data structures
- Greedy algorithms: e.g., interval scheduling, minimum spanning tree
- Divide and Conquer: e.g., sort, matrix multiplication
- Dynamic Programming: e.g., weighted interval scheduling, longest common subsequence, string alignment, edit distance
- NP-completeness: decision vs optimization, reductions, hierarchy
- NP-completeness: e.g., subset sum, clique, SAT, vertex cover, Steiner Tree
- Backtracking and Intelligent Search
- Approximation algorithms: e.g., vertex cover, set cover, knapsack, max cut, k-center clustering
- Heuristics / Local Search

Recommended Textbooks:

- (KT) J. Kleinberg and E. Tardos, *Algorithm Design*, Addison Wesley, 1st ed., 2005. (strongly recommended - main textbook, in bookstore)
- (CLRS) T. Cormen, C. Leiserson, R. Rivest, and C. Stein. *Introduction to Algorithms*, Third edition, MIT Press, 2010. (in bookstore)
- (BRV) A. Benoit, Y. Robert, F. Vivien. A guide to algorithm design: Paradigms, methods, and complexity analysis. Chapman and Hall/CRC Press 2013. (in bookstore)

Pre-requisites: Undergraduate Semester level CS 1331 Minimum Grade of C or Undergraduate Semester level CS 1372 Minimum Grade of C or Undergraduate Semester level CS 2316 Minimum Grade of C or Undergraduate Semester level CX 4010 Minimum Grade of C or Undergraduate Semester level ECE 2035 Minimum Grade of C or Undergraduate Semester level ECE 2036 Minimum Grade of C.

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.

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

Grading:

Homework	—	25%
Test 1	—	15%
Test 2	—	20%
Test 3	—	20%
Project	—	20%

There will be four assignments, three tests and one final project throughout the semester.

The tests will be proctored through Honorlock. The tests are timed, but one is given a time window of 15 hours (9am-11:59pm on the test day). One can launch the test anytime during this time window but must submit the solutions within the duration of the test and before 23:59pm.

The following are required of students in order to use Honorlock:

- Meet the Honorlock technical requirements: https://honorlock.kb.help/-students-starting-exam/minimum-system-requirements/.
- Students must have a webcam and microphone.
- Students must have a secure private location to take an exam.
- Students will be asked to provide a picture ID and take a picture of themselves via a webcam as part of the exam process.

At the end of the semester, I hope to have at least 70% of the students getting B or above, but this may change depending on the overall performance of the class.

Important Dates

- Aug 17: Start of semester
- Aug 21: Drop deadline without W
- Sep 4: hw1 due
- Sep 18: Test 1
- Oct 2: hw2 due
- Oct 16: hw3 due
- Oct 24: Withdrawal deadline to change grade mode from letter grade to pass/fail (and vice verse), or drop with a W
- Oct 28: Test 2
- Nov 13: hw4 due
- Dec 2: Test 3
- Dec 4: Project due

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 class notes, slides, homeworks, and programming assignments. It will also be used for electronically submitting homework and programming assignments. Please check the site frequently for additional useful information pertaining to the class and announcements for upcoming deadlines.

2. We will be using Piazza for class discussion. The Piazza site for the course can be directly accessed at piazza.com/gatech/fall2020/cse6140qacx4140a, or via a link made available from the course Canvas site. The Piazza system is highly catered to getting you help fast and efficiently from classmates, the TA, and myself. Rather than emailing questions to the teaching staff, we encourage you to post your questions on Piazza. If you have any problems or feedback for the developers, email team@piazza.com.

3. Please let me know as soon as possible if you will need to re-schedule an exam, or have any special needs during the semester.

4. Each student must read and abide by the Georgia Tech Academic Honor Code, see https://osi.gatech.edu/content/honor-code.

5. 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 dealt with according to the GT Academic Honor Code.

6. All homework must be submitted through Canvas. Each homework gets a grace period of 48h. 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.

7. 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.

8. The tests are open-book and no collaboration is permitted. There should be no discussion between students on the tests until the end of the test day.

9. Unauthorized use of any previous semester course materials, such as tests, quizzes, homework, projects, and any other coursework, is prohibited in this course. Using these materials will be considered a direct violation of academic policy and will be dealt with according to the GT Academic Honor Code.