Syllabus

CSCI 6470 Algorithms (Fall 2024)

School of Computing
The University of Georgia

General Information

Instructor: Dr. Liming Cai
Office: 544 Boyd
Office phone: 542-6081
Email: liming@uga.edu (best way to reach the instructor)

Lecture classrooms and times:

12:40 - 1:30 (Mondays), 328 Boyd (GRSC)
12:45 - 2:00 (Tuesdays and Thursdays), 328 Boyd (GRSC)

Office hours: in-person **10:30 - 11:30** Mondays and **2:00-3:00** Thursdays or by appointment (meeting via Zoom link: https://zoom.us/my/limingcai)

Teaching Assistant: TBA

Course objectives and contents

This course develops indispensable skills to create solutions for computational problems before coding them into computer programs. It introduces a spectrum of algorithmic techniques and related theories, built upon the knowledge in discrete data structures and theory of computing covered in the lower levels of a typical computer science curriculum. Therefore, instead of focusing on usage of logical data structures and their physical implementations, algorithmic techniques covered in this course provide solutions at higher levels to many classical computational problems identified in various real-world situations. The goal of this course is to develop students' vision, creativity, and skills in algorithms, which can be applied to solving problems encountered in their future industrial or academic careers.

This course covers fundamental notations for measuring algorithm complexity, methods to derive time complexity of recursive and iterative algorithms, elementary algorithms on mathematical objects (such as lists, matrices, trees, and graphs), advanced algorithmic techniques (built upon greedy algorithms, dynamic programming, and linear programming), and the notion of computational intractability (NP-completeness theory). The course will briefly touch advanced topics in coping with intractability, namely randomized algorithms and approximation algorithms.

Learning Materials

1. Book manuscript: *Design of Algorithms – A Recursion Perspective*, along with lecture notes.
2. Reference book: S. Dasgupta, C. Papadimitriou, and U. Vazirani, *Algorithms*, McGraw-Hill, 2006.
3. Reference book:

Lecture schedule

Tentatively lectures will be organized and delivered as six portions:

1. **Fundamentals** (1.5 weeks)

   Introduction to worst-case time complexity
   The big-O notation
   Series and recurrence relations
   Time complexity of recursive algorithms .

2. **Power of Divide-and-Conquer** (2.5 weeks)

   Crafting recursive algorithms
   Algorithms for Sorting
   Algorithm for order statistics
   Complexity lower bounds

3. **Averaged complexity** (1 weeks)

   Randomized algorithms with accuracy
   Randomized algorithms with errors
   Las Vegas vs Monte Carlo algorithms

4. **Graph Algorithms** (3 weeks)

   Recursive definitions of graphs
   Depth-first search and applications
   Shortest paths problems

5. **Advanced Algorithmic Techniques** (4 weeks)

   Dynamic programming
   Greedy algorithms
   Algorithms for flow networks
   Tree-decomposition of graphs

6. **NP-Complete Theory** (2 weeks)

   Intractable problems
   Reduction
   Class NP
   NP-complete problems

Final Exam (**Date: Monday, December 9, 12:00 - 3:00 pm**) (closed books/notes, 180 minutes)

Prerequisites

CSCI 2670 Introduction to Theory of Computing, CSCI 2720 Data Structures (or CSCI 2725 Data Structures for Data Sciences)

Grading policy

- Take-home Readings and Exercises: 0%
- Seven to eight (20-mins) Quizzes: 60%
- Midterm Exam: 10%
- Final exam: 30%

Academic Dishonesty

It is expected that the work you submit is your own. Plagiarism and other forms of academic dishonesty will be handled within the guidelines of the Student Handbook. The usual penalty for academic dishonesty is loss of credit for the assignment in question; however, stronger measures may be taken when conditions warrant.

Attendance policy

Regular class attendance is required though class attendance may not be used in the final determination of grades. However, students who do not attend classes with (pop) quizzes, regularly scheduled tests, or the final exam, will lose the corresponding grade unless prior arrangements have been made (e.g., for family emergence or medical reasons).

Covid-19 related information

CSCI 4470/6470 Algorithms is offered in the face-to-face mode in Spring 2022. Given recent guidelines from CDC on Covid-19, attendees to this class are strongly encouraged to get vaccinated and to wear masks during classroom meetings and office hours, as they have proved highly effective against Covid-19. Teaching and learning resources at UGA related to Covid-19 can be found in here. This syllabus has been generated according to the guideline from the Office of Vice President for Instruction.