USCViterbi

CSCI-570 – Analysis of Algorithms
Units: 4 units
Summer 2023

Lecture and Discussion:
Lectures : 4:00-6:50pm MWTh OHE122
Discussions: 11:00 to 1:00 pm F OHE100B

Instructor: Shawn Shamsian
Office Hours: By Appointment

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Course Information

- **Course Outline:** The course is intended as a first graduate course in the design and analysis of algorithms. The main focus is on developing an understanding for the major algorithm design techniques. Algorithmic techniques covered include divide and conquer, greedy, and dynamic programming. Other topics also include network flow, NP-completeness, approximation algorithms, and linear programming. At times, the practical side of algorithm design and implementation is also explored with interesting examples of their usage in solving industry problems.

At the end of this course, students should have:

- A good understanding of major algorithm design and analysis techniques
- Ability to design, analyze complexity of, and prove correctness of moderately difficult problems
- A good understanding of the NP, NP-complete, and NP-hard classifications and ability to demonstrate hardness of NP-complete problems
- Ability to solve problems through reduction such as reduction to network flow problems (max flow, min cut, feasible circulation) or linear programming
- An understanding of different methods to solving problems approximately
- Overall better problem-solving skills

- **Textbook:**
  *** Algorithm Design**
  Jon Kleinberg/Eva Tardos
  The class will be relying mostly on this textbook, but additional material will occasionally be drawn from the following:
  * Introduction to Algorithms (second Edition)
  Thomas H Cormen, Charles E. Leiserson, Ronald L. Rivest and Cliff Stein published by MIT Press and McGraw-Hill.

Students in the class are expected to have a reasonable degree of mathematical sophistication, and to be familiar with the basic notions of algorithms and data structures, discrete mathematics, and probability. More specifically the knowledge of the following prerequisite topics is a must:

- Mathematical induction from discrete math
- Graph basics (directed, undirected, DAG, trees, adjacency list, cycles, BFS, DFS, etc.)
- Asymptotic notation (Big O, etc.)
- Sorting methods
- Basic data structures (arrays, linked lists, stacks, queues)

The following textbook is one possible resource on prerequisite topics:
Mathematics for Computer Science, by Eric Lehman, Thomson Leighton and Albert Meyer.

Grading Breakdown

Exams	% of Grade	Date
Exam 1	45%	July 24
Exam 2	45%	August 7
Homework	10%	Weekly
Total	100%	

Exam 1 covers the material corresponding to lectures 1 through 10.
Exam 2 is comprehensive and covers all topics from lectures 7 through 16.

Assignment Submission Policy

Homework assignments are assigned on a weekly basis. Homework assignments are collected, graded and returned to students but homework grades do not count towards final grades as indicated in the grading breakdown. Students are highly encouraged to submit homework assignments for grading since this provides them an opportunity to receive feedback on their work before exams. Also, homework assignments contain questions from previous exams and help familiarize students with the types of questions they can expect on exams.

Additional Policies

Exam dates will be announced by first week of classes. Students need to make sure they can take exams on those dates and times. No alternate exam dates or times will be provided.

Course Schedule: Breakdown by Session

	Topics/Daily Activities	**Readings and Homework**
Lecture 1 June 28	Intro, Stable Matching	Reading: chapter 1
Lecture 2 June 29	Asymptotic Notation, BFS, DFS, Greedy Algorithms	Reading: chapters 2, 3, 4 Home assignment 1
July 3	University Holiday	
Lecture 3 July 5	Greedy Algorithms	Reading: chapter 4, supplemental text chapters 6,19
Lecture 4 July 6	Heaps, Amortized Cost	Reading: chapter 4, 5 Home assignment 2
Lecture 5 July 10	MST, Shortest Path	Reading: chapter 4, 5 Home assignment 3
Lecture 6 July 12	Divide and Conquer	Reading: chapter 5
Lecture 7 July 13	Dynamic Programming	Reading: chapter 6 Home assignment 4
Lecture 8 July 17	Dynamic Programming	Reading: chapter 6 Home assignment 5
Lecture 9 July 19	Dynamic Programming	Reading: chapter 6
Lecture 10 July 20	Review	
July 24	**Exam I**	
Lecture 11 July 26	Network Flow – Max Flow	Reading: chapter 7
Lecture 12 July 27	Network Flow – Circulation	Reading: chapter 7 Home assignment 6
Lecture 13 July 31	NP-Completeness	Reading: chapter 8 Home assignment 7
Lecture 14 August 2	NP-Completeness	Reading: chapter 8
Lecture 15 August 3	Approximation Algorithms, Linear Programming	Reading: chapter 8, supplemental text chapter 34 Home assignment 8
Lecture 16 August 4	Review. Time and location TBD	
August 7	**Exam II**	

Statement on Academic Conduct and Support Systems

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Academic Conduct

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of Academic Integrity on the Viterbi website: https://viterbischool.usc.edu/academic-integrity/.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the *Office of Equity and Diversity* http://equity.usc.edu or to the *Department of Public Safety* https://dps.usc.edu/contact/. This is important for the safety of the whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person.

Support Systems

A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the *American Language Institute* http://dornsife.usc.edu/ali, which sponsors courses and workshops specifically for international graduate students. *The Office of Student Accessibility Services https://osas.usc.edu/* provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information http://emergency.usc.edu* will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.