

CMPSCI 611: Advanced Algorithms

Course information: Fall 2001

Lecture: Monday and Wednesday, 2:05-3:20 in CMPS 142.

Lecturer: Professor Micah Adler

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Teaching Assistant: TBD

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- Office hours: TBD

Description: This course provides a graduate-level introduction to the principles underlying the design and analysis of efficient algorithms for some of the most frequently encountered combinatorial problems. The algorithms and techniques to be covered in the course have been chosen for their generality, elegance, and practical relevance. The emphasis will be on obtaining a broad introduction to as many topics as possible, but references will also be provided for those who want to obtain a more in-depth understanding of the topics covered.

Textbook: Cormen, Leiserson and Rivest, *Introduction to Algorithms*, MIT Press, 1990.

Additional reading:

- Papadimitriou and Steiglitz, *Combinatorial Optimization: Algorithms and Complexity*. Prentice-Hall 1982, Dover Publications 1998.
- Motwani and Raghavan, *Randomized Algorithms*. Cambridge University Press, 1995.
- M. Garey and D. Johnson, *Computers and Intractability: A Guide to the Theory of NP-Completeness*. Freeman, 1979.

Prerequisites: The equivalent of an undergraduate algorithms course, as well as general mathematical maturity will be assumed, but no specific prior knowledge is necessary.

Web page: Problem sets, scribe notes, and the like will be available from:

<http://www.cs.umass.edu/~micah/cs611/index.html>.

Syllabus: The following list is tentative. Items may be added and/or removed, depending on interest and available time.

- Divide-and-conquer algorithms: matrix multiplication; closest pair of points; fast Fourier transforms.
- Graph algorithms: review of basic algorithms; network flow; bipartite matchings.
- Matroids and greedy algorithms: minimum spanning trees; matroids and generalized greedy algorithms; union-find data structures; intersection of matroids.
- Dynamic Programming.

- Randomized algorithms: Quicksort and median finding; min-cut algorithm; polynomial zero testing; perfect matchings; primality testing; Markov, Chebyshev and Chernoff inequalities.
- Linear programming: simplex algorithm; duality; reducing problems to linear programming.
- NP-completeness: theory; Cook's Theorem; reductions.
- Approximation algorithms: classical examples; hardness results; PCP techniques; linear programming relaxation; heuristics.

Assessment:

- **Homeworks.** There will be approximately 5 assignments that contribute 40% to your overall grade. You will have 1 week for each assignment.
- **Exams.** There will be two exams for this course. They will both be evening exams: the first one on October 24, and the second on December 14. The second exam will cover only the second half of the course. Each of these exams counts for 25% of your grade.
- **Scribe Notes.** The presentation of the material will in many cases differ from that in the textbook, and some of the material does not appear at all in the textbook. Thus, an important component of the course will be a set of scribe notes. Each (on campus) participant is required to contribute to the preparation of scribe notes for one lecture in the course. Scribe notes for a Monday lecture are due the following Friday at 12:00 Noon. Scribe notes for a Wednesday lecture are due the following Monday at 12:00 Noon. They will then be edited in consultation with the writers, and then distributed two lectures after the one covered. These notes should be written in Latex (a template will be provided), and should convey the technical ideas covered in the lecture clearly and concisely.

To aid in the preparation of these scribe notes, the scribe notes from last year's offering of the course will be made available to students.

These notes contribute 10% to your grade. If a version that only needs routine editing is submitted, then each contributor to the notes will receive full credit. However, credit will drop VERY QUICKLY with any additional time that is required for editing. Students who are enrolled in the course remotely (i.e., VIP or NTU students) are not required to contribute to the scribe notes. Their grades will be based 55% on exams, and 45% on homework.