

CS261

Optimization and Algorithmic Paradigms

Tuesday, January 8, 2008

Overview

The course can be viewed as a continuation of CS161, and its goal is to cover basic algorithmic techniques that are not covered in CS161. In particular, we will discuss approximation algorithms for NP-hard problems, online algorithms, network flow techniques, and basic ideas in Linear Programming.

The course is geared towards beginning graduate and advanced undergraduate students in all areas and the only prerequisites are an introductory algorithms course, such as cs161, and basic knowledge of linear algebra and probability.

Topics

- *Approximation algorithms:* Many of the problem that one encounters in practice are NP-hard. We will present several ways to approach these problems. In particular, we will discuss polynomial-time approximation algorithms with provable performance guarantees and heuristics that run in worst case exponential time but work well in practice.
- *Tools for designing fast poly-time algorithms:* Often, a small change in the formulation of the problem makes it possible to solve the problem in polynomial time. We will discuss several tools that help us recognize polynomial-time problems, and solve them in practically efficient ways. In particular, we will present linear programming and network flow techniques.
- *Online algorithms:* One new important set of tools helps us deal with situations where we cannot afford to wait until all the data arrives and have to start making decisions based on partial information. We will introduce the notion of online algorithms and discuss several basic examples.

The people

- **Instructor: Prof. Serge Plotkin**
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Brief Tentative Syllabus

- Lectures 1-6: Approximation algorithms.
- Lectures 7-10: Network Flow.
- Lectures 11-12: Matching and related problems.
- Lectures 13-15: Introduction to Linear Programming.
- Lectures 16-17: Online algorithms.

Requirements

- **Homework (70%)** 3-4 homework assignments, on which you are to work alone. “Alone” means that you may discuss general strategies for solving a problem with other students, but the details and write-up must be entirely your own work. If you do discuss the homework, please note on the front page whom you talked to.

Try to be as clear and precise as possible in your presentations. Understandability of the solution is as desirable as correctness. Sloppy answers will be at a disadvantage, i.e. likely to receive fewer or no points, even if they are correct. Succinct answers are always more desirable than wordy answers.
- **Final (30%)** The final will be a take-home exam. It will be handed out during the last week of classes. Exact dates will be determined later.

Online Information

Web Page: <http://cs261.stanford.edu/>

We will attempt to keep all online information related to the course up-to-date. Announcements regarding homework problems, common questions, etc. will be posted to the web site.

Textbooks

There are no required textbooks for the class. Some of the material will be taken from *Introduction to Algorithms* by Cormen, Leiserson, and Rivest and from *Algorithm Design* by Kleinberg and Tardos. Network flow material will be taken from the book *Network Flows* by Ahuja, Magnanti, and Orlin. Other material will be taken from recent papers.