6.891 Approximation Algorithms

Course Information

February 4, 2000

1 Instructor Information

Instructor:	David Williamson
Office:	NE43-328 (using Tom Leighton's office)
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I am a lecturer and will only be spending Fridays at MIT on a regular basis. Otherwise, I work at the IBM T.J. Watson Research Center at Yorktown Heights and can be contacted there.

2 Lectures

Lectures will be held in 31-161 on Fridays from 1-4, with a five-minute break around 2 and another around 3.

3 Prerequisites

The formal requirements are 6.046 and 6.045. In practice, I will be assuming a basic knowledge of linear programming, and some previous exposure either to algorithms or combinatorial optimization. I will be giving out a handout on the first day with basic background information in linear programming for those who have not studied it. Please talk to me if you have questions about whether you have the necessary background.

4 Textbooks

As there is not yet a text in this area, I am not able to recommend a book. I will be distributing class notes from a previous version of the course, and we will follow them relatively closely with some departures. David Shmoys of Cornell University and I are in the process of coauthoring a textbook on approximation algorithms; I will distribute drafts of chapters on occasion. Of course, any feedback on the chapters will be appreciated.

In addition, Professor Vijay Vazirani of Georgia Tech is preparing a monograph on approximation algorithms. A version of this monograph is available from his web page (`http://www.cc.gatech.edu/fac/Vijay.Vazirani/`).

The following two surveys are easy to obtain and may be helpful:

- David B. Shmoys, "Computing near-optimal solutions to combinatorial optimization problems," Technical Report ORIE TR-1120, Cornell University, 1994. Available on `http://www.orie.cornell.edu/~shmoys/`.
- Rajeev Motwani, "Lecture Notes on Approximation Algorithms," Technical Report STAN-CS-92-1435, Stanford University, 1992.
Available on `http://theory.stanford.edu/people/rajeev/books.html`.

The following book also contains surveys of advanced material in the area:

- Dorit S. Hochbaum, editor, "Approximation Algorithms for NP-hard Problems," PWS Publishing Company, Boston, 1997.

A copy of this book on reserve in the Engineering Library (Barker).

5 Requirements

There will be 4 problem sets, handed out and collected on a biweekly basis. In addition, there may be a take-home final, which will count for somewhat more than a problem set.

Furthermore, because there is no text, we will try a system to which I was subjected to in graduate school and which worked reasonably well. Each week an official "scribe" will be appointed to take notes for that day's class. The scribe will then get to me a clearly written version of the notes (preferably in LaTeX) by the next Thursday, so that I can hand out copies of these notes on Friday. Producing scribe notes will be either a requirement of the course or extra credit, depending on the ratio of students to lectures. Scribe notes already exist for most lectures, so it will usually be a matter of modifying the previous version of the notes.

6 Collaboration

You may collaborate with other students on the solution of problem sets. However, you must write up solutions on your own independently, and acknowledge your collaborators. If you use papers or books to help obtain your solution, you must cite those sources.

No collaboration will be allowed for the take-home final.

7 Schedule

Here is a rough schedule for the course, which will is subject to change without notice. This may be a bit ambitious; we will probably cover less material than is listed here.

Feb	4	Introduction to approximation algorithms. Set cover.
Feb	11	Dynamic programming and deterministic rounding: bin packing. Problem set 1 out.
Feb	18	Randomization: MAX SAT.
Feb	25	Deterministic and randomized rounding: scheduling, prize-collecting Steiner trees. Problem set 1 due. Problem set 2 out.
March	3	Randomization and semidefinite programming: MAX CUT.
March	10	Semidefinite programming: quadratic programming, graph coloring. Problem set 2 due. Problem set 3 out.
March	17	Dynamic programming: Arora/Mitchell PTAS for Euclidean problems.
March	24	No class (Spring break).
March	31	Primal-dual methods: feedback vertex sets, generalized Steiner trees. Problem set 3 due. Problem set 4 out.
April	7	Primal-dual methods: uncapacitated facility location, k-median.
April	14	Metrics: multicuts, separators. Problem set 4 due.
April	21	Metrics: sparsest cuts and low-distortion embeddings. Take-home exam out (tentative)
April	28	Deterministic rounding: Jain's technique for network design. Take-home exam due (tentative).
May	5	TBA.

8 Your information

Please fill out the information below and return it by the end of the lecture.

Name ____

Phone Number ____________________ Email address ____________________

Major ____________________ Year ____________________

Are you taking this class for credit? ____

I have studied the following subjects:

____ Linear programming
____ Algorithms
____ Combinatorial optimization
____ Complexity theory (including NP-completeness)
____ Linear algebra
____ Combinatorics and/or graph theory