MATH 482: Linear Programming and Combinatorial Optimization

Spring 2006 — Course Outline — University of Illinois

Sections X13/X14: 12:00pm–12:50pm MWF, 441 Altgeld Hall
Stephen Hartke, 227A Illini Hall, 265-6760, hartke@math.uiuc.edu
Web page: http://www.math.uiuc.edu/~hartke/teaching/math482
Tests: The weeks of Feb 13-17, Mar 13-17, and Apr 17-21 in the evening
Final Exam: 7:00-10:00pm Tue, May 9

TEXT: *Combinatorial Optimization: Algorithms and Complexity* by C. Papadimitriou and K. Steiglitz, Dover Publications, 1998.

OVERVIEW: In this course, we study mathematical aspects of problems in linear and integral optimization that are relevant in computer science and operation research. The course will follow the textbook, with supplemental material provided by the instructor.

We will begin by describing and analyzing the simplex algorithm for linear programming. We will next discuss the geometric concepts underlying the algorithm and start the main theme of the course: duality. Using this idea we give some modifications of the simplex method and analyze their computational aspects. We introduce the primal-dual algorithm and show what its variations can do for basic problems of combinatorial optimization: the shortest path problem, the max-flow problem, the min-cost flow problem. We will then discuss some applications of the above material to matrix games and combinatorial min-max theorems. After that, we will describe what can be done for integer linear programs (such as Traveling Salesman Problem or scheduling problems). We will also discuss matroids—a notion important in combinatorial optimization. If time permits, we will mention some ideas of dynamic programming and branch-and-bound.

PREREQUISITE: Math 415 Linear Algebra or equivalent.

REQUIREMENTS: Weekly problem sets (20 points each, only the ten highest count), three tests (100 points each), and one cumulative final exam (200 points each). The tests and final exam are written and closed-book.

The homework provides practice employing techniques learned in class and finding and writing proofs; writing up the solutions is among the most effective ways of keeping up with the material in the course. Students are encouraged to discuss the problems with each other, but all students are expected to *individually* write their own solutions.

All students are expected to be aware of and abide by the University's policies on student conduct and academic integrity and honesty.

RESOURCES: Email and web pages will be used for announcements and questions.

Students should discuss with the instructor any class conflicts or other problems as soon as possible. Late homework and makeups for missed tests and the final exam will only be allowed in extreme situations.