

Course Outline — SPRING 2014

MATH 482

COMBINATORIAL OPTIMIZATION

Sections B13 B14, 9AM MWF, Room 343 Altgeld Hall

Instructor: Theo Molla, 226 Illini Hall, molla@illinois.edu

Office hours: 1:30–2:30 MWF (tentatively) or by appointment

Webpage: <http://www.math.uiuc.edu/~molla/math482>

Final exam: 1:30–4:30 PM, Wednesday, May 14

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 is based on the book *Combinatorial optimization. Algorithms and complexity* by C. Papadimitriou and K. Steiglitz.

We start by describing and analyzing the simplex algorithm for linear programming. Next we 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. Then we discuss some applications of the above material to matrix games and combinatorial min-max theorems. After that, we 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 introduce some ideas of dynamic programming and branch-and-bound.

Requirements: At least 11 problem sets (the ten highest homework grades count), several short quizzes, three tests and a final examination. There will be one make-up test for all three tests in the semester, and no other make-ups.

Weighting: Problem sets $20 \times 10 = 200$ points, tests $100 \times 3 = 300$ points, final exam 200 points, quizzes 25 points, total 725 points. There will be one make-up test for all three tests in the semester, and no other make-ups. The grading scale is: $A \geq 640$ points, $A^- \geq 600$ points, $B^+ \geq 550$ points, $B \geq 500$ points, $B^- \geq 450$ points, $C^+ \geq 400$ points, $C \geq 350$ points, $C^- \geq 300$ points, $D^+ \geq 266$ points, $D \geq 233$ points, $D^- \geq 200$ points. For graduate students who needs a 4-hour credit, the requirements are different.

Prerequisite: Math 415 or equivalent