Optimization and Complexity: Course Description

Prof. Ramras Mathematics G234 Spring, 2006

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Office Hours: Wednesday TBA, and at other times by appointment
Time of class: Wednesdays, 5:50:00−8:50:00 (with a 15 minute break around 7:30pm)
Room: TBA

Required Text:
Combinatorial Optimization: Algorithms and Complexity, by Papadimitriou and Steiglitz, Dover.

This course deals with theory and methods of maximizing and minimizing solutions to various types of problems. We begin with examples of combinatorial probems of the following types: mixed integer programming problems (MIP); pure integer programming problems (IP); Boolean programming problems; linear programming problems (LP). We start with a very general class of function, continuous functions, and quickly specialize to differentiable functions, and finally to linear functions. We also specialize from arbitrary subsets of $\mathcal{R}^n$ (n-space) as domains to convex subsets and then to polyhedral subsets. At the end of this process, we are in the realm of Linear Programming (LP). We'll discuss the relationship between an LP problem and its dual LP problem, and prove the Duality Theorem.

We will discuss the Simplex Algorithm, but it will be assumed that students have some prior experience with using it. We will also study the Kuhn-Tucker conditions for optimality for non-linear functions.

We will discuss network problems such as Minimum Cost and Maximumum Flow- Minimum Cut.

In the last 3 or 4 weeks of the course we discuss complexity of algorithms. We focus on the problem classes P (problems with polynomial-time algorithms) and NP (problems with non-deterministic polynomial-time algorithms), and discuss Turing machines. We develop the notion of NP completeness, and establish that certain well-known problems are NP-complete.

There will be no exams. Your grade will be based on a number of problem sets.