MATH 523: INTRODUCTION TO COMBINATORIAL OPTIMIZATION

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TEXT:

Combinatorial Optimization: Algorithms and Complexity by Papadimitriou and Steiglitz , Dover reprint available at reasonable cost.

Some References:

Combinatorial Optimization: Networks and Matroids by Lawler
Theory of Linear and Integer Programming by Schrijver
Combinatorial Optimization by Schrijver

OUTLINE: The course follows the philosophy of studying a few basic topics deeply. Student requests can influence the topics covered:

Introduction.

Formulation of decision, recognition, and optimization problems. Basics of complexity (without many details) including NP-completeness versus polynomial.

Linear Programming.

The ellipsoid algorithm (of Khachian 1979) is given as a true polynomial algorithm for LP. Its value as a separation algorithm is discussed. On the way, we show that Gaussian Elimination is in P when done as exact rational arithmetic.

Minimum Cost Flows.

A strongly polynomial algorithm presented (Orlin).

Matchings.

Cardinality and weighted matching algorithms for general graphs using the primal-dual approach.

Matroids.

Definitions including the definition via the greedy algorithm. Cardinality and weighted matroid intersection algorithms (Orlin).

Approximation Algorithms.

We explore approximation algorithms to an NP-complete problem and bounds on how close you can get.

Possible additional topics.
Totally Dual Integral polyhedra.
Integer programming: Facets
Submodular Flows

GRADING The assessments in the course will include assignments, an in class presentation (if the class is small), and an oral final. The grading scheme of the department is followed so a strict numerical grading scheme is not relevant.