Industrial Engineering & Operations Research, UC Berkeley

IEOR269 Integer Programming and Combinatorial Optimization

Semester: Spring 2009 *Instructor: Alper Atamtürk*

Prerequisite: A good understanding of linear programming.

Instructor: Alper Atamtürk (email: `atamturk@berkeley.edu`)
Lectures: Tue Thr 12:30–2 PM (1174B Etcheverry)
Office hrs: Tue 2–3 PM (4175 Etcheverry)

Textbook: G.L. Nemhauser and L.A. Wolsey, *Integer and Combinatorial Optimization*, Wiley, 1999 (paperback).

Other recommended texts:

1. A. Schrijver, *Theory of Linear and Integer Programming*, Wiley, 1998.
2. A. Schrijver, *Combinatorial Optimization: Polyhedra and Efficiency*, Springer, 2003.
3. M. Grötschel, L. Lovázs, A. Schrijver, *Geometric Algorithms and Combinatorial Optimization*, Springer, 1993.
4. W.J. Cook, W.H. Cunningham, W.R. Pulleyblank, A. Schrijver, *Combinatorial Optimization*, Wiley, 1998.

Course web page: `http://www.ieor.berkeley.edu/~atamturk/ieor269`

Course description

This is a graduate course on discrete optimization. The course will survey a selection of fundamental topics in the area, with an emphasis on polyhedral combinatorics. The topics of the course include the Euclidean algorithm, lattices and integral basis methods, the ellipsoid algorithm and its consequences, polarity, integral polyhedra, matching, covering and packing, matroids and submodular function minimization, and elements of discrete convex analysis.

IEOR269 complements IEOR264, which is mainly concerned with practical and computational aspects of solving integer programs, and IEOR266, which is on graphs, network flows, and approximation algorithms.

Grading is based on problem sets given during the semester.

Outline

1. Introduction to computational complexity
2. The Euclidean algorithm and linear diophantine equations
3. Lattices and Lovász basis reduction
4. Integer programming in fixed dimension
5. Integer hull of polyhedra and Chvátal–Gomory rank
6. The ellipsoid algorithm for linear programming
7. Elements of polyhedral theory
8. Equivalence of optimization and separation for polyhedra
9. Unimodularity, total unimodularity
10. Total dual integrality and Hilbert bases
11. Balanced matrices
12. Perfect graphs
13. Polarity, clutters, blocking, antiblocking
14. Nonbipartite matching
15. Matroids and the greedy algorithm
16. Matroid intersection
17. Polymatroids and submodular function minimization
18. Conjugacy and duality in discrete optimization

This syllabus may be modified as time and interests dictate.