

MATH 588: OPTIMIZATION IN NETWORKS

Section E1 , CRN 38194: 1:00-1:50pm MWF, 347 Altgeld Hall

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Office Hours: MW 3-4:30pm

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TOPICS: This is a rigorous introduction to linear programming, network flows and related topics of combinatorial optimization. There is some overlap with Math 482 and Math 412, but the basic material from these classes will be presented more quickly and concisely. Network flow theory is a subject that lies at the cusp among several fields of inquiry, including applied mathematics, engineering, and management.

The topics are selected from:

- Simplex algorithm: Geometry of Linear Programs, Interpretation of the Dual Simplex Algorithm, Computational Aspects, Dantzig-Wolfe Decomposition, Interior point method, the Ellipsoid Algorithm.
- Minimum Spanning Trees: Greedy Algorithm, Kruskal's, Prim's and Sollins's Algorithms, Relation between Spanning Trees and Matroids.
- Maximum flows: Basic ideas, Max-Flow Min-Cut Theorem, Preflow-Push algorithm, Polymatroidal Network Flow.
- Minimum cost flows: Primal-Dual Algorithm, Out-of-Kilter Algorithm, Relaxation Algorithm, Polynomial Algorithms, Repeated and Enhanced Capacity Scaling Algorithms.
- Branch-and-Bound and Dynamic Programming: Integer Linear Programming, Application to a Flowshop Scheduling Problem.

TEXT: Selected chapters from *Combinatorial Optimization*, Papadimitriou, Christos H.; Steiglitz, Kenneth *Combinatorial optimization: algorithms and complexity*. Corrected reprint of the 1982 original. Dover Publications, Inc., Mineola, NY, 1998. xvi+496 pp. ISBN: 0-486-40258-4(required), and *Network Flows*, R. K. Ahuja, T. L. Magnati, J. B. Orlin, (Prentice Hall). Some material may be used from *The Art of Combinatorics, Vol. III*, D. B. West.

REQUIREMENTS: There are roughly 5 homework assignments. A typical homework assignment consists of 5 – 6 exercises. There may be make up-possibilities, e.g. type a high quality solution to some selected homework, or give a presentation on a selected topics. You must consult with the instructor about any make-up work. There are no exams.

The grading scale: 80% : *A*, 75% : *A*⁻, 65% : *B*⁺, 60% : *B*, 55% : *B*⁻, 50% : *C*⁺ etc.

RESOURCES: Electronic mail is a medium for announcements and questions.

PREREQUISITES: There are no official prerequisites, but students need the mathematical maturity and background for graduate-level mathematics. For example, basics of linear algebra and graph theory are assumed to be known.