

MATH 588: OPTIMIZATION IN NETWORKS

Section X1, CRN 38194: 12:00-12:50pm MWF, 441 Altgeld Hall

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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, 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*, C. H. Papadimitriou, K. Steiglitz (Dover edition), 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 5 homework assignments, each worth 50 points, so the maximum possible score is 250. A typical homework assignment consists of 5 – 6 exercises.

Make up possibilities: - to type in a “proper way” some selected homework. - Give some presentation on selected topics. Must consult in advance with the instructor. There are no exams.

The gradings: 75%– : A , 66%– : A^- , 60%– : B^+ , 50%– : B , etc.

Collaborative work is encouraged, working groups should submit only one copy of solutions, providing all the names from the group. Note that the score for an exercise depends on the number of good solutions. Note that the writings of the solutions must have a high quality, if the argument is messy or the handwriting is not readable then even if the solution is correct it could be returned without grading with 0 points. There will be homework discussions classes, where students getting high scores (in particular from groups) will be selected in advance to present the solutions.

Late homework policy: In case the homework is not submitted on time, it could be submitted within a week, with losing 10% of the score.

Class attendance is required: each missed class after two absences means 5 points deductions from the total homework score. Late arrival (after the bell rings) is counted as a half miss.

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.