Advanced Discrete Optimization & Networks

Prerequisites: CS 4414 or CS 5433 or permission of instructor
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Discrete optimization problems abound in every day life. This course will focus on those discrete optimization techniques and methodologies which have served as powerful tools in the solution of problems in a variety of applications: telecommunications and transport network design, VLSI circuit design, data analysis, etc. The first part of this course will focus on techniques and methodologies and the second part on special topics and recent advances in the networking area. The course will help students gain an in-depth training in modern trends in discrete optimization as well as offer opportunities to identify and explore new directions of research. The topics to be covered will depend on the students’ needs and preparation. The following outline will serve as a guideline:

- Review of Shortest Paths Algorithms
- Min cost-flow problems
  - Optimality Criterion
  - Network simplex Method
  - Primal-dual and relaxation methods
- Maximum flow problem
  - Max-Flow Min Cut Theorem
  - Dinic-MPM algorithm
  - Goldberg-Tarjan Preflow Push Algorithm
  - Maximum Flows in 0-1 networks and computational complexity
- Connectivity
  - Menger’s theorems
  - Vertex and Edge connectivity algorithms
- Matching:
  - Bipartite matching
  - Optimum assignment problems
- Eulerian Graphs and Postman Tours
- Integer Programming Formulations for Discrete Optimization Problems
- Coping with NP-Completeness:
  - Constrained Shortest Paths
  - Disjoint Paths
- More Advanced Topics, if time permits.

References:
- Class Notes

Course Assessment
2 Tests: 60%
Project: 40%

Project: Each student must submit a topic of study and have it approved by the instructor before February 6, 2016. A report on the study must be submitted before April 15, 2016. Oral presentation of the report will be scheduled in the last of April.