SIE 644: Integer and Combinatorial Optimization

Spring 2017

Course Description: (3 units) Modeling and solving problems where the decisions form a discrete set. Topics include model development, branch and bound methods, cutting plane methods, relaxations, computational complexity, and solving well-structured problems.

Course Objective: Students are expected to develop a working knowledge of integer programming in these directions: using integer variables and modeling tricks to formulate complex optimization problems in industrial engineering, management science and other areas; learning the solutions approaches for well-known combinatorial optimization problems; using various software to solve integer programming problems; being familiar in the complexity theory and polyhedral theory for integer programming; and studying basic solutions approaches and developing advanced decomposition methods to solve complex/large-scale integer programming problems.

Prerequisites: SIE 544 – Linear Programming, or equivalent. Knowledge of linear programming.

Time and Location: TuTh 12:30PM-1:45PM, ENGR 301

Instructor: Dr. Neng Fan
Office: ENGR 312
Office Hours: TuTh 11:00AM-12:30PM
Email: nfan@email.arizona.edu

Course Website: We'll be using D2L. All class materials, including HW, lecture notes, supplemental readings, etc, will be distributed from D2L. You must check the announcements in D2L at least twice a week.

Reference:

Lecture notes and papers distributed through D2L.

Laurence A. Wolsey , George L. Nemhauser, Integer and Combinatorial Optimization. 1999 ISBN-13: 978-0471359432 .Wiley-Interscience.

Course Outline:

1. Introduction to Integer Programming
   1.1 What is integer programming?
   1.2 Classification of integer programming problems
   1.3 Optimization modeling tricks
   1.4 Introduction to CPLEX
2. Combinatorial Optimization Problems
   2.1 Formulations and methods for combinatorial problems
   2.2 Relations among many well-known combinatorial problems
3. Integer Programming Theory

    3.1 Complexity theory
    3.2 Polyhedral theory and valid inequalities
4. Methods for Integer Programming
    4.1 Branch and bound methods
    4.2 Cutting plane methods
    4.3 Branch and cut methods
    4.4 Lagrangian relaxation and decomposition
    4.5 Benders decomposition and Dantzig-Wolfe decomposition
5. Special problems: general integer linear and binary quadratic programming

Course Policies:

Two homework assignments/take-home exams: 25%*2

A comprehensive project: 50% (literature review 10%, modeling 10%, algorithm design 15%, numerical experiments 10%, other 5%). In this project, students are expected to use modeling techniques to formulate a complex problem from industrial engineering, management science, transportation engineering, etc; or make progress in some well-known combinatorial optimization problems; develop algorithms to solve the problem, and analyze the numerical results. Software with CPLEX solver will be used for numerical experiments (more detailed requirements will be given in class).

1. Topics: will be given/decided for each student during the first month of class
2. Policy: schedule a meet with the instructor every two weeks to discuss progress, and also present your results in the end of this semester

You are encouraged to make recommendations to improve the class and my teaching skills.