Integer Programming
ISE 418

Introduction

Dr. Ted Ralphs

Introductory Stuff

- Welcome Back!
- Class Meeting Time
  - TR 1:15-2:25
- Office Hours
  - T 12-1, R 11-12 and by appointment

What will this class be about?

- Introduction: Modeling With Integer Variables
- Enumerative Methods and Disjunction
  - Branch and Bound
  - Bounding Methods
  - Branching Methods
- Polyhedral Theory and Convexification
  - Polyhedra and Dimension
  - Theory of Valid Inequalities
  - Cutting Planne Methods
- Advanced Computational Methods
  - Decomposition
  - Branch and Cut/Price
  - Numerics
  - Computational Methods
- Complexity

- Classifying Integer Programs
- Complexity Theory

What won't this class be about?

- Dynamic Programming (well, maybe a little)
- Heuristic Methods (well, maybe a little)

Prerequisites

- This class requires substantial background and is targeted students studying optimization in the Ph.D program.
- Expected background
  - Linear algebra
  - Linear programming (406)
  - Familiarity with modeling languages
  - Familiarity with basic graph theory
  - Familiarity with Linux will be helpful
  - Familiarity with C++/Python will be helpful

Goals for the course

After this course, you should be able to:

- Given an optimization problem, formulate an appropriate integer linear model.
- Understand the basic mathematical structure of the model.
- Understand the techniques that could be used to solve the model.
- Understand how to use a modeling language and/or commercial solver to solve the model.
- Understand the limitations of "off the shelf" solvers and how to tune their parameters to improve performance.
- Understand how to build a solver for a specific problem class.

Course Requirements

- Attending Lectures
- Attending Seminars
- Reading
- Homework
- Exams

Homework

- Homework will be due approximately every two weeks.
- Homework is due at the beginning of class.
- Lateness policy is in the syllabus.
- I encourage working together, but you must write up the homework yourself.
- Please reference the work of others.
- There will also be a computational project at the end of the course.

Grading

Grading Scheme:

- 10% Homework
- 20% Exams (each)
- 25% Final Exam
- 15% Project
- 10% Class Participation

Class Web Site

- The class Web site will be at

  `http://coral.ie.lehigh.edu/~ted/teaching/ie418/`

- I will post lecture slides before class so you can use them to take notes.
- The slides will be in PDF format.
- All handouts for the class will also be available.
- There will also be links to other relevant sites and reference materials.

COR@L Account

- For some of the computational experiments in the class, it will be useful to have access to the COR@L Lab.
- Please let me know if you do not already have an account on COR@L.

Textbook and Other References

- **I am developing a textbook and will attempt to keep up with the material**.
- The primary text for the course is *Integer Programming* by Conforti, Cornuéjols, and Zambelli.
- A secondary text is *Integer and Combinatorial Optimization* by Nemhauser and Wolsey.
- A more concise summary text you may find useful is *Integer Programming* by Wolsey.
- Marlow is a concise summary of the mathematical background needed for the course (and cheap too).
- Parker and Rardin and Bertsimas and Weismantel are also good books on discrete optimization.
- We will also be reading a number of papers to supplement the main text.
- Please let me know if you want supplementary material.

My Approach to Lectures

- I want to make lectures as interactive as possible.
- You will get more out of this course if you ask questions during lecture.
- The pace and structure of the lectures can be adjusted.
- I need feedback from you to adjust appropriately.