Integer Programming
IE418

Introduction

Dr. Ted Ralphs
Introductory Stuff

• Welcome Back!

• Class Meeting Time
  – TR 6:00-7:15

• Office Hours
  – WR 1-2
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

• 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 basic graph theory
  – Familiarity with modeling languages
  – 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

• 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.