Computational Integer Programming
Syllabus
Universidad de los Andes

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1 Miscellaneous Course Information

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2 Description of Course

In this short course, we'll give an overview of the theory and practice of integer programming. The first part of the course will focus on the mathematical foundations of modern solution methods, including polyhedral theory, disjunctive programming, and duality. In the second part of the course, we'll build on this foundation in describing the primary computational components of a modern solver: methods for bounding, branching, and search. In the final part, we'll discuss software: what's available and how to use it. The focus will be on open source, especially the software available in the COIN-OR repository.

3 Course Objectives

The goals of this course are for students to:

1. Understand how integer variables are used for formulating complex mathematical models.
2. Understand and be able to use common methodology for the solution of integer programs.
3. Understand the basic concepts of polyhedral theory and how they apply to integer programming.
4. Understand the theory of valid inequalities and how it applies to the solution of integer programs.
5. Be familiar with various software packages for solving integer programs.
6. Be able to apply course concepts in practice to solve integer programs.

4 Prerequisites

All students should have completed a course in linear programming and should have a good undergraduate mathematics background, especially in linear algebra. I also expect a basic knowledge of computer programming and mathematical modeling systems.

5 Reading

There will be suggested readings associated with each lecture. The readings will be from a combination of texts and research papers available on-line. Links to suggested supplementary reading material can be accessed from the course page.

5.1 Blocks

Block 1: Introduction. In the first block, we will discuss the basic precept of integer programming: what is an integer program, how do we describe the feasible region mathematically and how are integer programs generally solved.

Block 2: Bounding. In the second block, we will discuss methods for obtaining bounds on the optimal value of an integer program by means of basic relaxations and duality. We'll also cover the principle of decomposition and cutting plane methods.

Block 3: Branching and Search. In the third block, we will consider the basic computation framework used to solve integer programs.

5.2 Tentative Schedule of Topics

Lecture	Block	Topic
1	Introduction	What is Integer Programming?
2		Describing Polyhedra
3		Introduction to Branch and Bound
4	Bounding	Duality and Relaxation
5		Decomposition Methods
6		Cutting Plane Methods
7	Branching and Search	Branching Methods
8		Disjunctive Methods
8		Search Strategies
10	Wrap-up	Branch and Cut Methods