

# IE 511-Spring 2023 Integer Programming

TR 9:30-10:50 am  
Classroom: 112 Transportation Building

**Instructor:** **Rasoul Etesami**, (*etesami1@illinois.edu*)  
Office Hours, 4:00 pm-5:00 pm on Thursdays in 209B TB.

**TA:** **Vincent Leon** (*leon18@illinois.edu*).  
Office Hours: 11am-12pm on Tuesdays in 202 TB.

**Suggested Textbooks:** *Integer Programming* by Laurence A. Wolsey  
*Integer and Combinatorial Optimization* by Nemhauser and Wolsey  
*Theory of Linear and Integer Programming* by Schrijver

**NOTE:** The classes will be in-person. Lecture notes will be posted weekly in the Canvas. However, please feel free to take notes during the lectures as more details may be discussed in the class.

**Canvas Link:** <https://canvas.illinois.edu/courses/34271>

**Course Description:** The course will cover key topics in integer optimization including theory, algorithms and applications at the graduate level. Some specific topics to be covered are: Modeling and Formulations, Polyhedral Theory, Complexity, Lagrangian Relaxation and Duality, Dynamic Programming, Branch & Bound, and Cutting Plane Algorithms.

## TENTATIVE COURSE OUTLINE:

| Topics  | Lectures    |
|---|-------------|
| Introduction to IP, Formulation, and LP Basics            | Weeks 1-2   |
| Polyhedra Theory  | Weeks 3-4   |
| Computational Complexity                                  | Week 5      |
| Theory of Valid and Strong Valid Inequalities             | Weeks 6-7   |
| Lagrangian Duality, Relaxation, Branch&Bound              | Weeks 8-9   |
| Network Basics and Problems on Graphs                     | Weeks 10-11 |
| Applications, Dynamic Programming, Analysis of Heuristics | Weeks 12-13 |
| Matchings   | Week 14     |
| Matroids and Lattice Theory (if time permits)             | Week 15     |

Mathematical maturity at the level of a beginning graduate student will be assumed. Familiarity with reading and writing mathematical proofs and basic knowledge in Linear Algebra are required. Prior coursework in Linear Programming, Linear Algebra and Graph Theory will be helpful.

### Assignments and Exams:

- There will be 4 homework assignments, which will be posted approximately every two/three weeks. Homework assignments and their solutions will be posted in Canvas.
- You should upload your homework solutions in Canvas before the due date. **NO** late homework will be accepted.
- No collaboration or other solution sources are allowed on the problems assigned for homework or exams. It is important to explain your solutions clearly as it may affect your grades.
- There will be one in-class midterm exam. **TENTATIVE DATE: March 23.**
- There will be one take-home final exam in May. The exact date will be determined later.

### Course Grade Composition:

| Item                  | % of grade |
|-----------------------|------------|
| Homework Problem Sets | 60%        |
| Midterm Exam          | 20%        |
| Final Exam            | 20%        |