# ORI 391Q.4 - Integer Programming
# Fall 2006
# Syllabus

**Professor**
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**Office Hours**
TTh, 10:00 a.m. – 11:30 a.m., (or, stop by anytime, I'll meet with you if I am not busy)

**Class Meetings**
Times: TTh, 3:30 p.m. – 5:00 p.m., Room: ETC 4.150

**Course Web Page**
Blackboard: `courses.utexas.edu`

**(Official) Course Description**
*Subject Matter Description*: Mathematical optimization techniques with applications to engineering and industrial problems. *Topic Description*: Models, theory, and computational methods for problems with discrete decision alternatives. Greedy algorithms, branch and bound, cutting plane methods, Lagrangian relaxation, and heuristics. *Meeting Information*: Three lecture hours a week for one semester. *Degree Plan Information*: May be repeated for credit when the topics vary. *Prerequisite*: Graduate standing and a course in operations research methods.

**Other Prerequisites**
ME 366M (OR Methods) or equivalent; a working knowledge of at least one computer programming language (e.g., C++, VBA, Java).

**Objectives**
Many problems that arise in industrial and socio-economic systems, such as machine scheduling, vehicle routing, resource management, and telecommunications network design, can be modeled as integer or mixed-integer programs. Generic models that make up the field of combinatorial optimization also fit the integer programming (IP) format. The aim of this course is to present the theory and exact and approximate techniques that have been developed to solve related models. These techniques include branch and bound, cutting planes, Lagrangian relaxation, and column generation. However, it is rare that any one technique can be applied successfully in solving IPs of realistic size. In most cases, it is necessary to identify and exploit a familiar underlying structure in the model. Polyhedral theory will play an active role in this regard and will be discussed at some length. In addition, students will be required to program a number of the algorithms.

**Text**
Laurence A. Wolsey, *Integer Programming*, John Wiley and Sons, 1998.
Check corrections at `www.core.ucl.ac.be/wolsey/correcti.htm`

**Other references**

- G.L. Nemhauser and L.A. Wolsey, *Integer and Combinatorial Optimization*, Wiley, 1988.
- H.A. Taha, *Integer Programming: Theory, Applications, and Computations*, Academic Press, 1975.
- A. Schrijver, *Theory of Linear and Integer Programming*, Wiley, 1986.
- C.H. Papadimitriou and K. Stiglitz, *Combinatorial Optimization: Algorithms and Complexity*, Prentice-Hall, 1982.

**Software**

- Modeling languages: AMPL (`www.ampl.com`), GAMS (`www.gams.com`), or XPRESS-MP (`www.dash.com`)
- Solvers and callable libraries: CPLEX (`www.ilog.com`)
- MS Excel Solver
- Jensen Add-ins: `www.ormm.net`

**Web Sites**

- The Institute for Operations Research and Management Sciences (INFORMS) (`www.informs.org`), including OR/MS Resources Collection (`www.informs.org/Resources/`)
- Mathematical Programming Glossary by H. Greenberg (`http://carbon.cudenver.edu/~hgreenbe/glossary/index.php`).
- Integer programming and recreational mathematics (puzzles) (`http://www.chlond.demon.co.uk/academic/puzzles.html`)

**(Tentative) Outline**

- Introduction, Formulations and Illustrative Examples (Chapter 1).
- From Theory to Solutions (Chapter 13)
- Optimality, Relaxation, and Bounds (Chapter 2)
- Branch and Bound (Chapter 7)
- Cutting Plane Algorithms (Chapter 8)
- Strong Valid Inequalities (Chapter 9)
- Lagrangian Duality (Chapter 10)
- Column Generation Algorithms (Chapter 11)
- Heuristic Algorithms (Chapter 12)

**Grading**
The grading will be based on the following weights:

- Homework and Computer Programming Assignments: 25%
- Term Project (Interim report due October 7, Final report due December 2): 25%
- Midterm Exam (Thursday, October 20): 25%
- Final (Tuesday, December 20, 9:00 am – 12:00 noon): 25%

I expect that each assignment (homework, project, and exams) be neat and professional. You will not be allowed to make up exams unless there is a documented emergency. Homework is graded according to the following scale:

- 5 Outstanding. Especially elegant solution, or exceptionally clear justification and writeup.
- 4 Good. The answer is basically correct and clearly presented.
- 3 OK. Got the basic idea, but either some details are wrong or the presentation is not clear.
- 2 Poor. Something of value, but below the standard that I expect.
- 1 You tried, but this is not passing work.

Homework assignment that is one class late will be penalized with a grade level reduction; it will not be accepted after that date.

**Academic Dishonesty**
Students who violate University rules on scholastic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and dismissal from the University. Since dishonesty harms the individual, fellow students, and the integrity of the University, policies on scholastic dishonesty will be strictly enforced. Cheating will not be tolerated, and incidents of dishonesty will be reported. For more information, and for what constitutes "cheating," see:
`http://www.utexas.edu/student/registrar/catalogs/gi06-07/app/appc11.html`.

**Students with Disabilities**
The University of Texas at Austin provides, upon request, appropriate academic adjustments for qualified students with disabilities. For more information, contact the Office of the Dean of Students at 471-6259, 471-4241 TDD, or the College of Engineering Director of Students with Disabilities at 471-4321.

**Course Evaluation**
Near the end of the semester, you will have an opportunity to anonymously evaluate the course and instructor using the standard College of Engineering evaluation form.

**Dropping the Course**
An engineering student must have the Dean's approval to add or drop a course after the fourth class day of the semester. A student may not drop a class after the fourth class day except for good cause (health or serious personal problems). A student seeking to drop a class after the fourth class day should go the College of Engineering Office of Student Affairs (ECJ 2.200).

**Web Site and Privacy**
Web-based, password-protected class sites are associated with all academic courses taught at The University. The syllabus, handouts, assignments and other resources are types of information that may be available within these sites. Site activities could include exchanging e-mail, engaging in class discussions and chats, and exchanging files. In addition, a class e-mail roster will be a component of the sites. Students who do not want their names included in this electronic class roster must restrict their directory information in the Office of the Registrar, Main Building, Room 1. For information on restricting directory information, see:
`http://www.utexas.edu/student/registrar/catalogs/gi06-07/app/appc09.html`.

**Changes to the syllabus**
You are responsible for any changes to this syllabus announced in class during the semester.