OR 642: Integer Optimization

GEORGE MASON UNIVERSITY

Systems Engineering and Operations Research Department

Spring, 2011

Time: Mondays, 4:30-7:10p.m; Robinson Hall B208
Professor: Karla Hoffman
Phone: (703) 993-1679
(703) 993-1521 (fax) indicate that it is for Karla Hoffman

email: khoffman@gmu.edu
Office hours: Mondays 1:00pm-3:00pm and by appointment
With notice, I am available after class on Mondays

Text: Applied Integer Programming
Authors: Der-San Chen, Robert G. Batson, and Yu Dang
Publisher: Wiley 2010

Software: The course requires that you use a modeling language to complete your project. MPL is the preferred language, but you can use AMPL, GAMS or AIMMS if you feel that you are sufficiently proficient in that language to debug any problems without my help. MPL is available free of charge for student use from Maximal Software. Go to Maximal Software (www.maximal-usa.com) to download the latest version of the software. More detailed instructions on downloading the software and getting the license set up will be provided in class.

Course Description: This course is designed to introduce discrete optimization models and to provide the mathematical foundations of integer and combinatorial optimization models along with the algorithms that can be used to solve such problems. The course will combine modeling, algorithmic developments and the use of commercial software. The problem areas discussed will include both planning models such as capital budgeting, facility location and portfolio selection, and design problems such as telecommunication and transportation network design, VLSI circuit design and the design of automated production systems. Examples from statistics, economics, politics and mathematics will also be presented. Heuristic algorithms, cutting-plane methods, decompositions and tree search will be covered in detail. A tentative outline of the topics is provided below. This outline can change based on time limitations and the interests of the students.

Goals for the Course: By the end 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 design a solver for a specific problem class.

WebCt: Lecture notes, presentations, and assignments will be found on blackboard. The url for blackboard is blackboard.gmu.edu. This site is password protected, and uses the same identification as your gmu email account.

EMAIL: I will communicate with the class through email, so please make sure that your gmu account is current and working!

Course Outline
Lesson 1 (Jan 24th): Introduction and Model Formulation I *(Read textbook, Chapters 2 and 3)*
Lesson 2 (Jan 31st): Model Formulation II *(Read textbook, Chapter 5 &6)*
Lesson 3 (Feb 7th): Preprocessing of Integer Programming Models (*Read textbook, Chapter* 4)
Lesson 4 (Feb 15th): Review of Linear Programming (*Read textbook, Chapter 9)*
Lesson 5 (Feb 21st) Relaxations and Branch and Bound *(Read Wolsey, Chapter 11)*
Lesson 6 (Feb 31st): Using MPL (ensure MPL is downloaded on your laptop and working)
Spring Break (Mar 7th): No Class
Lesson 7 (Mar 14th): Mid-term Exam
Lesson 8 (Mar 21st): Introduction to the geometry of integer problems and polyhedral theory (*Read textbook, Chapter 8)*
Lesson 9 (Mar 28nd): Cutting Planes I *(Read textbook, Chapter 12)*
Lesson 10 (Apr 4th): Cutting Planes II *(Read textbook, Chapter 11)*
Lesson 11 (Apr 11th): Heuristics *(Read textbook Chapter 14 and handout)*
Lesson 14 (Apr 18th): Column Generation *(Read Wolsey, Chapter 11* ***NOTE:*** *Projects Due Today)*
Lesson 11 (Apr 25th): Benders Decomposition (*Read handout)*
Lesson 12 (May 2nd): Review *(Read Wolsey, Chapter 11)*
FINAL EXAM: TAKE HOME. DUE May 9th.

Grading Scheme:
Homework: 20%
Midterm Exam: 25%
Project: 20%
Final Exam: 35%

Additional Notes:
Mid-term exam will be an in-class exam. The final exam will be a take-home exam. In class exams will be open book and open notes.

There will be a class project. Students may work in pairs or individually.
Best way to contact the professor is by email.