OR 642: Integer Optimization

GEORGE MASON UNIVERSITY

Systems Engineering and Operations Research Department

Spring, 2016

Professor: Karla Hoffman

Time: Mondays, 4:30-7:10p.m

Location: ENGR 1107

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Office hours: Mondays and Thurdays: 2:00pm-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

Course Description:

This course is d**e**signed 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.

Software: The cours**e 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.

GOALS:

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.

Blackboard:

Lecture notes, p**resentations**, and assignments will be found on Blackboard. The location for Blackboard is http://mymason.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! This is especially important since Blackboard will only function if you have a working email account and are registered for the course.

Course Outline (This is a tentative schedule and is likely to change as the course progresses!)

1/25 **Lesson 1:** *Introduction and Model Formulation I* (Read textbook, Chapters 2 and 3)

2/1 **Lesson 2:** *Model Formulation II*   (Read textbook, Chapter 5 &6)

2/8 **Lesson 3:** *Preprocessing of Inte*ger Programming Models (Read textbook, Chapter 4)

2/15 **Lesson 4:** *Review of Linear Pr*ogramming (Read textbook, Chapter 9)

2/22 Class is cancelled. Professor is at meeting in Europe so may have little email access.

2/29 **Lesson 5:** *Relaxations and Branch* and Bound (Read Handout provided)

3/7 *NO CLASS – Spring Break*

3/14 **Lesson 6:** Using MPL (ensure MPL is downloaded on your laptop and working)

3/21 **In Class Midterm Exam**

3/28 **Lesson 7:** Introduction to the geometry of integer problems and polyhedral theory (Read textbook, Chapter 8)

4/4 **Lesson 8:** Cut*ting Planes (Read textbook*, Chapter 11 and 12)

4/11 **Lesson 9:** *Heuristics (Read textbook Chapt*er 14 and handout)

4/18 **Lesson 10:** *More on heuristics and understanding the parameter se*ttings in an integer programming package

4/25 **Lesson 11:** *Decompositions I: Column Generation* (Handout provided)

5/2 **Lesson 12:** *Decompositions II: Bender's Decomposition* (Handout provided)

5/9 TAKE HOME FINAL EXAM DUE BY 7:30pm

Grading Scheme:

- Homework: 20%
- Midterm Exam: 25%
- Project: 20%
- Final Exam: 35%

Additional Notes:

The midterm exam is scheduled to be an in-class exam, but may be a take-home exam if students prefer**.** All exams will be open book and open notes. The final exam will be a take-home exam. There will be a class project. Students may work in pairs or individually on the project.

University Policies

Academic Integrity

Mason is an Honor Code university; please see the University Catalog for a full description of the code and the honor committee process. The principle of academic integrity is taken very seriously and violations are treated gravely. What does academic integrity mean in this course? Essentially this: when you are responsible for a task, you will perform that task. When you rely on someone else's work in an aspect of the performance of that task, you will give full credit in the proper, accepted form. Another aspect of academic integrity is the free play of ideas. Vigorous discussion and debate are encouraged in this course, with the firm expectation that all aspects of the class will be conducted with civility and respect for differing ideas, perspectives, and traditions. When in doubt (of any kind) please ask for guidance and clarification.

Mason Email Accounts

Students must use their MasonLive email account to receive important University information, including messages related to this class. See http://masonlive.gmu.edu for more information.

Office of Disability Services

If you are a student with a disability and you need academic accommodations, please see me and contact the Office of Disability Services (ODS) at 993-2474. All academic accommodations must be arranged through the ODS. (http://ods.gmu.edu)

Other Useful Campus Resources

WRITING CENTER: A114 Robinson Hall; (703) 993-1200; http://writingcenter.gmu.edu

UNIVERSITY LIBRARIES "Ask a Librarian" http://library.gmu.edu/mudge/IM/IMRef.html

COUNSELING AND PSYCHOLOGICAL SERVICES (CAPS): (703) 993-2380; http://caps.gmu.edu

University Policies:

The University Catalog, http://catalog.gmu.edu, is the central resource for university policies affecting student, faculty, and staff conduct in university academic affairs.

Other policies are available at http://universitypolicy.gmu.edu. All members of the university community are responsible for knowing and following established policies.