OR 642: Integer Optimization

GEORGE MASON UNIVERSITY

Systems Engineering and
Operations Research Department

Spring, 2017

Professor: Karla Hoffman

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

Location: Robinson Hall B208

Phone: (703) 993-1679

Email: khoffman@gmu.edu

Backup email: orprofessor@gmail.com

Webpage: http://seor.vse.gmu.edu/~khoffman

Office hours: Mondays and Thursdays: 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 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.

Software: The course requires that you use a modeling language to complete for homework, project and the exams. You will have your choice of providing your models to GUROBI or CPLEX via MPL (Maximal Software), Python, or JuMP (Julia for Mathematical

Programming). 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 model integer linear model
- Understand the basic mathematical structure of the problem
- Understand the techniques that could be used to solve the problem
- Understand how to use a modelling language and a commercial software package to solve the model
- Understand the limitations of "off the shelf" software and understand how to tune parameters to improve the software performance

Blackboard:
Lecture notes, presentations, 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!)**

1/23 **Lesson 1:** *Introduction and Model Formulation I* (Read textbook, Chapters 2 and 3)

1/30 **Lesson 2:** *Model Formulation II* (Read textbook Chapters 5 and 6)

2/6 **Lesson 3:** *Preprocessing of Inte*ger Programming Models (Read textbook, Chapter 4)

2/13 **Lesson 4:** *Review of Linear Pr*ogramming (Read textbook, Chapter 9)

2/20 **Lesson 5:** *Relaxations and Branch* and Bound (Read Handout provided)

2/27 **Lesson 6:** *Using software to solve large optimization problems* (Please bring laptop to class)

3/6 **Lesson 7:** In class midterm

3/13 **No Class – Spring Break**

3/20 **Lesson 8:** *Heuristics* (read Chapter 14 and Handout)

3/27 **Lesson 9:** *Heuristics* – using optimization software to obtain good feasible solutions quickly

4/3 **Lesson 10:** *Overview of column generation*

4/10 **Lesson 11:** *Understanding the parameters within an optimization code and Review of graphs and networks*

4/17 **Lesson 12:** *Column generation*

4/24 **Lesson 13:** *Decompositions*

5/1 **Lesson 14:** *Decompositions continued*

5/8 Reading period

5/15 **Final Exam due**

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

George Mason University 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 as well as email 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 will be made through the Office of Disability Services. http://ods.gmu.edu

Other University Policies:

University Library services: One can reach the university catalog via: http://catalog.gmu.edu. This is the central repository for university policies affecting student, faculty and staff conduct in university affairs.

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