University of Illinois at Urbana-Champaign
Department of Industrial and Enterprise Systems Engineering

IE411 Optimization of Large-Scale Linear Systems

Fall 2015

Lectures: 153 MEB TR 2-3:20pm

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Course website: Illinois Compass 2g (https://compass2g.illinois.edu/)

Overview: This course is about large-scale linear optimization, which is an important discipline to modeling and solving engineering and business problems. We will cover both the theory and computation of linear optimization and touch upon some important applications. Some important topics are: a variety of applications; LP geometry; the simplex method; the interior point method; the decomposition principle and column generation; numerical implementation issues; duality theory and applications; and sensitivity analysis.

Objectives: The main objective is for you to gain a good understanding of theory and computation of linear optimization, in particular, the theory and computational issues related to the simplex method and the interior point method.

Textbook: 1. Bertsimas and Tsitsiklis, *Introduction to Linear Optimization*, Athena Scientific (1997). (required)
2. Bazaraa, Jarvis and Sherali, *Linear Programming and Network Flows (fourth edition)*, John Wiley and Sons (2010). (*ebook free from the library*, required)
3. Vanderbei, *Linear Programming: Foundations and Extensions (fourth edition)*, Springer (2014). *(ebook free from the library*, optional*)*

Lecture Notes: Lecture notes will be posted on Illinois Compass 2g before the lectures. Caution: Lecture notes are only used to facilitate your understanding of the lectures and will be supplemented by additional notes/explanations on blackboard.

Software: Excel Solver and Matlab will be the main tools used for this course. We will also use NEOS Solver http://neos.mcs.anl.gov/neos/**,** which allows you to submit your optimization problems to the Solver and returns optimal solutions to you.

Grading Policies: There will be an individual homework every other week (roughly). Most of the exercises are going to be from the textbook. Some homework assignments will be computational. You are encouraged to discuss homework problems in groups. However, you have to write your own solutions. ***No late homework is allowed without my permission.*** We will selectively grade homework problems.

We will have one project on coding the simplex method, one midterm and the final exam.

The homework will form 30% of the grade. The project 10%, the midterm 25% and the final exam will contribute 25%. Course participation will contribute 10%.

Additional homework problems will be assigned to students registered for 4 credit hours.

Tentative Schedule (Chapters based on BT95)

Week 1 (August 25 & 27): Chapter 1 and Chapter 2.1-2.4
Introduction, LP Models, mathematical preliminaries and LP applications I
Homework 1 Assigned on August 25

Week 2 (September 1 & 3): Chapter 2
LP applications II

Week 3 (September 8 & 10): Chapter 2
Geometry of LP I
Homework 1 Due on September 8
Homework 2 Assigned on September 8

Week 4 (September 15 & 17): Chapter 2
Geometry of LP II

Week 5 (September 22 & 24):
Geometry of LP III
Homework 2 due date delayed to September 22
Homework 3 assigned September 22

Week 6 (September 29 & October 1): Chapter 3
Simplex method, the revised simplex method

Week 7 (October 6 & 8): Chapters 3 & 4
the Big-M method/two-phase method, the bounded simplex method
Homework 3 due on October 6
Homework 4 assigned on October 6

Week 8 (October 13 & 15):
Homework 4 due on October 13
Coding project assigned October 13
October 13& 15: TA Q&A (to be confirmed)
Midterm Exam: October 15 6pm-8:50pm

Week 9 (October 20 & 22): Chapter 4
Duality Theory

Homework 5 assigned on October 22

Week 10 (October 27 & 29): Chapter 4
Applications of duality theory

Week 11 (November 3 & 5): Chapter 5
November 3: No Class (informs)
November 5: Dual simplex method
Homework 5 due on November 5
Homework 6 assigned on November 5

Week 12 (November 10 & 12): Chapters 5& 6
Sensitivity analysis, parametric analysis, Column generation method, Lagrangian relaxation

Week 13 (November 17 & 19): Chapter 7
Complexity of Simplex Method & Ellipsoid method
Homework 6 due on November 19
Homework 7 assigned on November 19

Week 14 (Thanksgiving Break):
No Class

Week 15 (December 1 & 3):
Interior point method

Week 16 (December 8):
Homework 7 due on December 8
Coding project due
Review

Final Exam: December 8 6pm-8:30pm

Emergency Planning

In an emergency in this building, we'll have three choices: **RUN**(get out), **HIDE** (find a safe place to stay inside), or **FIGHT** (with anything available to increase our odds for survival).

First, take a few minutes this week and learn the different ways to leave this building. If there's ever a fire alarm or something like that, you'll know how to get out, and you'll be able to help others get out too.

Second, if there's severe weather and leaving isn't a good option, go to a low level in the middle of the building, away from windows.

If there's a security threat, such as an active shooter, we'll **RUN**out of the building if we can do it safely or we will **HIDE** by finding a safe place where the threat cannot see us. We will lock or barricade the door and we will be as quiet as possible, which includes placing our cell phones on silent. We will not leave our area of safety until we receive an Illini-Alert that advises us it is safe to do so. If we cannot run out of the building safely or we cannot find a place to hide, we must be prepared to fight with anything we have available in order to survive. **Remember, RUN away or HIDE if you can, FIGHT if you have no other option.**

Finally, if you sign up for emergency text messages atemergency.illinois.edu, you'll receive information from the police and administration during these types of situations.

If you have any questions, go to police.illinois.edu, or call 217-333-1216.