

About The Course

IE 601, Optimization Techniques

July 29, 2019

Course Website	Moodle
Class Hours	Slot 6 (WF 11-12:30PM) and 4A (M 11:30-12:30 – May be changed)
Class Room	LT203
Tutorial	LT204
Teaching Assistants	Akul Bansal, akul.bansal@iitb.ac.in Mustafa Vora, mustafa.vora@iitb.ac.in Mayur Zadbuke, mayurzadbuke@iitb.ac.in Aanchal Panwar, aanchal@iitb.ac.in
Instructor	Ashutosh Mahajan, amahajan@iitb.ac.in, Ph: x-9418, Room 104, IEOR Building

Objectives

Main objectives of the course are

1. To learn algorithms for solving linear and nonlinear mathematical optimization problems
2. To understand the theory of when and why these techniques work, i.e., they find a provably optimal solution
3. To understand main difficulties in solving these problems

Main Topics To Be Covered

Following topics will be covered in the lectures

1. Introduction to Linear Optimization and Revision of Mathematical Background
2. The Simplex Method for Solving Linear Optimization Problems
3. Duality and Sensitivity Analysis
4. Nonlinear Unconstrained Optimization: Line Search, Quadratic Models, Newton's Method, etc
5. Theory of Nonlinear Constrained Optimization
6. Quadratic Programming

7. Barrier Functions and SQP

Following topics will be not covered in this course:

1. Applications of optimization
2. Use of modeling and solving software
3. Optimization under uncertainty
4. Discrete optimization

Prerequisites Students are expected to have prior exposure to modeling and solving optimization problems (linear programs or network flows or combinatorial optimization etc.). Students should also be comfortable in writing mathematics and analysis.

Books

The following two text-books will be followed extensively. Can be easily procured and are not too expensive. Buying them is highly recommended.

- Linear Programming and Network Flows, Bazaraa, Jarvis and Sherali (2nd Edition) (<https://www.amazon.in/Linear-Programming-Network-Flows-2ed/dp/8126518928>)
- Practical Methods of Optimization, R. Fletcher (2nd Edition) (<https://www.amazon.in/Practical-Methods-Optimization-2nd-Fletcher/dp/8126567902>) or (<https://www.amazon.in/Practical-Methods-Optimization-2ed-Fletcher/dp/8126524251>)

Other References Many other good books are available, but are expensive or not so easy to procure.

1. Robert J. Vanderbei, *Linear Programming: Foundations and Extensions*, Springer, 2014.
2. Dimitris Bertsimas and John N. Tsitsiklis. *Introduction to Linear Optimization*. Athena Scientific.
3. George B. Dantzig and Mukund N. Thapa. *Linear Programming 2: Theory and Extensions*. Springer, 2003.
4. Jorge Nocedal and Stephen Wright. *Numerical Optimization*. 2nd Edition. Springer, 2006.

Attendance

Attendance is necessary (as per institute rules) in the first week. Please sign the attendance sheet circulated in the class.

Attendance will **not** be taken in lectures after the first week. Still, the students are required to attend the classes.

Lectures

Please come on time and take notes. Try to clear all your doubts or unclear concepts in the lecture itself. It will save time and effort. I would like the lectures to be as interactive as possible. So please ask questions or make comments whenever necessary.

Assignments and Tutorials

We will have tutorials every week. These will be used for practice and problem solving. There may also be quizzes in the tutorials. Regular assignments will be given. Students are expected to attempt these assignments before the tutorial. Some assignments may be graded.

Students are required to attempt the assignment problems on their own. They are allowed to discuss amongst themselves and with others the problems in the assignments. Any help must be mentioned clearly in the assignment. If two or more students solve a problem together, each should mention all the names in the report. **The solutions must be written by students themselves in their own words and using their own notation, without copying from anyone else. Students should not write assignments sitting together.**

Clarity of expression should not be sacrificed for the sake of space. Remember that instructors and graders can only grade assignments based on what is written and not what is in student's thoughts.

Exams

There will be a mid-semester exam, and an end-semester exam. If a student is unavailable because of an exigency, a makeup exam will be conducted. The student should inform me directly (in person or over email) or through someone before the exam.

Grading

The following is the breakup of the final score.

Tutorials	25%
Mid-semester Exam	30%
Final Exam	45%

Outside Class

Students are encouraged to interact with the instructors and TAs during the office-hours and otherwise also. Feel free to ask any questions, discuss difficulties and provide feedback regarding the course. We are usually open to meeting if we are in office and not in another meeting. Fixing an appointment through email is recommended.