15.093/6.215 Optimization Methods
Syllabus - Fall 2020

1 General Information

This edition of the class will be fully online and hosted via the Canvas website `https://canvas.mit.edu/courses/5686`.

Instructor:	Bart Van Parys (`http://www.mit.edu/~vanparys/`) e-mail: vanparys@mit.edu Office hours: Wednesday 3-4pm
Teaching Assistants:	Mohammed Amine Bennouna e-mail: amineben@mit.edu Shuvomoy Das Gupta e-mail: sdgupta@mit.edu office hours: Monday 10:30-11:30am
Class Times:	Monday & Wednesday 5:00-6:30pm
Recitations:	Monday 9:30-10:30pm, Friday 11:00am-12:00pm and Saturday 11:00am-12:00pm

Prerequisites: Calculus, Linear Algebra, and some familiarity with computational tools (e.g, Julia).
Required Book: Dimitris Bertsimas and John Tsitsiklis, Introduction to Linear Optimization, Athena Scientific, Belmont, Mass, 1997. ISBN 1886529191

2 Expectations from the course

Course Description and Objectives: The course offers a unified view of mathematical optimization, covering the main areas of application as well as the core optimization algorithms. It includes the following topics:

1. Linear Optimization
2. Robust Optimization
3. Network Flows
4. Discrete Optimization
5. Dynamic Optimization
6. Nonlinear Optimization

At the end of the course you should be able to

1. Understand in detail the different classes of optimization problems discussed in class, as well as the relative advantages among different formulations.
2. Be able to identify what optimization methodologies are the most appropriate when faced with a concrete problem.

3. Be familiar with the geometric, algebraic, and computational aspects of linear optimization problems, and their associated duality and sensitivity properties.

Tentative plan:

1. Sep 2: Introduction to Optimization. (Chapter 1)
2. Sep 7: Labor Day
3. Sep 9: Geometry of Linear Optimization (Chapter 2)
4. Sep 14: Simplex Method 1 (Chapter 3)
5. Sep 16: Simplex Method 2 (Chapter 3)
6. Sep 21: Duality Theory 1 (Chapter 4)
7. Sep 23: Duality Theory 2 (Chapter 4)
8. Sep 28: Sensitivity Analysis (Chapter 5)
9. Sep 30: Large Scale Optimization (Chapter 6)
10. Oct 5: Robust Optimization 1
11. Oct 7: Robust Optimization 2
12. Oct 13: Columbus Day (Review)
13. Oct 14: Mid term
14. Oct 19: Network Flows 1 (Chapter 7)
15. Oct 21: Network Flows 2 (Chapter 7)
16. Oct 26: Discrete Optimization 1 (Chapter 10)
17. Oct 28: Discrete Optimization 2 (Chapter 11)
18. Nov 2: Lagrangean Methods (Chapter 11)
19. Nov 4: Heuristic and Approximation Algorithms (Chapter 11)
20. Nov 9: Dynamic Programming (Chapter 11)
21. Nov 11: Applications of Nonlinear Optimization
22. Nov 16: Optimality Conditions for Nonlinear Optimization
23. Nov 18: First Order Methods
24. Nov 23: Thanksgiving Vacation
25. Nov 25: Thanksgiving Vacation
26. Nov 30: BONUS: Ellipsoid Method (Chapter 8)
27. Dec 2: BONUS: Interior Point Methods (Chapter 9)

28. Dec 7: BONUS: Semidefinite Optimization
29. Dec 9: Review
30. Dec 14 - Dec 18 : Final Exam (TBA)

3 Course Policy

Lecture notes: The lectures notes will be posted on the course website before each lecture. *Students are also responsible to take their own notes,* as well as read the assigned portions of the textbook before class. All handouts, including homework solutions will be posted on the course website.

Requirements: Homework 30%, Midterm Exam 30%, Final Exam 40%.

Homework: Problem sets will be handed out in an approximately bi-weekly basis, and will be due in two weeks, at the beginning of the lecture on their respective due dates. We expect you to turn in all completed problem sets on time. Late homework will not be accepted, unless there is a prior arrangement with the instructor.

Policy on Team Work: In the case of written homework assignments, your assignment write-up may be done in pairs. If you can not find a team mate the TAs will be happy to help you along. During the midterm and the final examination, any student who either receives or knowingly gives assistance or information concerning the examination will be in violation of the policy on individual work.