DS 211: Numerical Optimization 3:0:0

Where: CDS 202
When: TTh 11:30 AM – 1 PM [First Class on 8/8/19 Thu, Attendance Mandatory]

Syllabus Outline

Introduces numerical optimization with emphasis on convergence and numerical analysis of algorithms as well as applying them in problems of practical interest. Topics include: Methods for solving matrix problems and linear systems that arise in the context of optimization algorithms. Major algorithms in unconstrained optimization (e.g., modified Newton, quasi-Newton, steepest descent, nonlinear conjugate gradient, trust-region methods, line search methods), constrained optimization (e.g., simplex, barrier, penalty, sequential gradient, augmented Lagrangian, sequential linear constrained, interior point methods), derivative-free methods (e.g., simulated annealing, Bayesian optimization, Surrogate-assisted optimization), dynamic programming, and optimal control.

Pre-requisites

Basic knowledge of Numerical Methods, linear algebra, and consent from the advisor

Text Books

*Practical Optimization by Philip E. Gill, Walter Murray, Margaret H. Wright, Emerald Group Publishing Limited (1982).

*Numerical Optimization, J. Nocedal and S. Wright, Springer Series in Operations Research and Financial Engineering, 2006.

*Practical Methods of Optimization by R. Fletcher 2nd edition, Wiley, 1987.

*Introduction to Linear Optimization by Bertsimas, Tsitsiklis. MIT Press (1997)

*Linear Programming with MATLAB, M. Ferris, O. Mangasarian, and S. Wright, MPS-SIAM Series on Optimization, 2007.

Discussion

This term we will be using Piazza for class discussion. The system is highly catered to getting you help fast and efficiently from classmates, the TA, and myself. Rather than emailing questions to the teaching staff, I encourage you to post your questions on Piazza. If you have any problems or feedback for the developers, email team@piazza.com.

Find our class page at: https://piazza.com/iisc.ernet.in/fall2019/ds211/home

Instructor

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Webpage

http://cds.iisc.ac.in/courses/ds211/

Class Schedule

8-Aug-19	Thu	Introduction	
13-Aug-19	Tue	Review of Foundation	Assignment 0 due
15-Aug-19	Thu	Independence Day – No Class	
20-Aug-19	Tue	Unconstrained Optimization	
22-Aug-19	Thu	Unconstrained Optimization	
27-Aug-19	Tue	Unconstrained Optimization	Mini-Project (MP) 1 due
29-Aug-19	Thu	Unconstrained Optimization	
3-Sep-19	Tue	Unconstrained Optimization	
5-Sep-19	Thu	Unconstrained Optimization	
10-Sep-19	Tue	Muharram – No Class	
12-Sep-19	Thu	Unconstrained Optimization	MP 2 due
17-Sep-19	Tue	**Quiz 1**	
19-Sep-19	Thu	Constrained Optimization	
24-Sep-19	Tue	Constrained Optimization	
26-Sep-19	Thu	Constrained Optimization	MP 3 due
1-Oct-19	Tue	Constrained Optimization	
3-Oct-19	Thu	Constrained Optimization	
8-Oct-19	Tue	Dussehra – No Class	
10-Oct-19	Thu	Constrained Optimization	
15-Oct-19	Tue	Constrained Optimization	MP 4 due
17-Oct-19	Thu	**Quiz 2**	
22-Oct-19	Tue	Derivative Free Methods	
24-Oct-19	Thu	Derivative Free Methods	
29-Oct-19	Tue	Derivative Free Methods	
31-Oct-19	Thu	No Class/Reserve Day	MP 5 due
5-Nov-19	Tue	Dynamic Programming	
7-Nov-19	Thu	Dynamic Programming	
12-Nov-19	Tue	Guru Nanak Jayanti – No Class	
14-Nov-19	Thu	Advanced Topics/Reserve Day	MP 6 due
19-Nov-19	Tue	Advanced Topics/Reserve Day	
21-Nov-19	Thu	Concluding Lecture - Last Day	
TBD		**Final Exam**	

Grading Scheme

Quiz 1	15%
Quiz 2	15%
Mini-Projects	30%
Scribe and Class Participation	10%
Final	30%

Mini-Project Rules

- Projects will be completed in groups
- Projects are to be submitted as a soft copy via email before 10:30 am on the day it is due
- Each member's contribution must be clearly written in the report
- There will be a viva with a random member of a group, and scores will be assigned to all members based on the report and viva
- Assignment 0 must be completed individually, and students must meet the instructor to continue in the course
- Project 1 and 2 will have the same group of students
- Project 3 and 4 will have the same group of students, different from the previous groups
- Project 5 and 6 will have the same group of students, different from the previous groups
- The best group will get a special reward at the end of the class
- We have decided to do away with individual assignments and assign group mini-projects so that you can collaborate and have an honourable system of group learning. As such, you are all expected to follow your conscience's honour code.

Exam Rules

- Quizzes will be in class, closed book written exams. You are allowed one A4 sheet of hand-written notes for reference. No photocopies shall be allowed.
- Final dates will be announced in due course. You are allowed three A4 sheets (ideally the ones from the quizzes and one for the topics after quizzes)

Scribe Rules

- Two students would be assigned as scribes for each class.
- The job of a scribe is to write notes in each class and prepare a summary in uniform latex PDF format.
- The scribe is expected to add information from the textbook (or other sources), not covered in the class and prepare the notes to be a reference for the future.
- The collection of scribe notes is meant to be a quick reference for you in your future careers. For example, if you are in an industry and faced with an optimization task, this collection must be the first place that you refer. As such, prepare the scribe notes for this goal.
- The scribe roster will be prepared by the instructor before 20-Aug-19. If a scribe is planning to be absent on their “duty day”, they must arrange to exchange their “duty day” and inform the instructor before the lecture.
- The scribe notes will be placed for comments by the entire class on Piazza, and the scribe may be required to edit the contents in case revisions are requested either by the class or the instructor.