

THE CHINESE UNIVERSITY OF HONG KONG
Department of Systems Engineering & Engineering Management
2021-22
2nd Term

Course Code & Title (in English and Chinese):

SEEM 5380: Optimization Methods for High-Dimensional Statistics 高維統計最優化方法

Teaching Venue:	
Website: (Demonstrate in class)	http://www.se.cuhk.edu.hk/~manchoso/2122/seem5380/
Other information:	

Instructors and Teaching Assistants

Instructor	
Name	SO, Man Cho Anthony
Office	ERB 604
Telephone	3943-8477
Email	manchoso@se.cuhk.edu.hk

TA	
Name	
Office	
Telephone	
Email	

Course Description & Content

The prevalence of high-dimensional data has motivated active research on efficient methods for tackling optimization problems that arise in statistical analysis. In this course, we will give an introduction to this exciting area of research, with emphasis on the theory of structured regularizers for high-dimensional statistics and the design and analysis of statistically and computationally efficient optimization algorithms. Applications in various areas of science and engineering, such as machine learning, signal processing, and statistics, will also be discussed. Prerequisite: ENGG 5501 or equivalent.

Learning Outcomes

Upon completion of the course, students should understand

- the structures of different classes of statistical estimation problems;
- some of the recent algorithmic techniques used to tackle statistical estimation problems;
- the key techniques used to analyze the statistical and convergence performance of optimization methods for statistical estimation problems.

Learning Activities

Activities	Number of Hours		Nature of Activities
Lecture	In class	3	M
	Outside class		M; O
Interactive Tutorial	In class		M; O
	Outside class		M; O
Laboratory Work	In class		M; O
	Outside class		M; O
Group Discussion	In class		M; O
	Outside class		M; O
Field Trip	In class		M; O
	Outside class		M; O
Project	In class		M; O
	Outside class		M; O
Assignment	In class		M; O
	Outside class	3	M
Reading	In class		M; O
	Outside class	6	O
Other	In class		M; O
	Outside class		M; O

M: Mandatory activity in the course

O: Optional activity

Learning Resources

Research papers and general references will be posted
at <http://www.se.cuhk.edu.hk/~manchoso/2122/seem5380/>

Assessment Scheme

Task nature	Weight
Homework sets	60%
Take-home final examination	40%
OR	
Solution to any open problem introduced in class	100%

Course Syllabus

Topic	Contents/fundamental concepts
Statistical estimation problems: Convex formulations and structures	Decomposable regularizer, restricted strong convexity
Statistical estimation problems: Non-convex formulations and structures	Non-convex loss functions and regularizers, weak convexity

Numerical methods for statistical estimation problems	Design and analysis of first-order methods, regularity properties of optimization problems
---	--

Course Schedule

Class/Week	Topic	Requirements
1	Introduction / Overview	Relevant research papers and lecture notes
2-3	Convex formulations of statistical estimation problems: Part I – Design and analysis of optimization algorithms	
4	Convex formulations of statistical estimation problems: Part II – Statistical analysis	
5	Advanced optimization algorithms for statistical estimation problems	
6-7	Analysis of non-convex formulations: Part I – Statistical estimation problems	
8-9	Analysis of non-convex formulations: Part II – Phase Retrieval	
10-11	Analysis of non-convex formulations: Part III – Matrix completion / factorization problems	
12	Open directions	

Feedback for evaluation

<ul style="list-style-type: none"> - Office hours - Course evaluation

Academic Honesty

Academic honesty and plagiarism

Attention is drawn to University policy and regulations on honesty in academic work, and to the disciplinary guidelines and procedures applicable to breaches of such policy and regulations. Details may be found at <http://www.cuhk.edu.hk/policy/academichonesty/>.

With each assignment, students will be required to submit a signed declaration that they are aware of these policies, regulations, guidelines and procedures. For group projects, all students of the same group should be asked to sign the declaration.

For assignments in the form of a computer-generated document that is principally text-based and submitted via VeriGuide, the statement, in the form of a receipt, will be issued by the system upon students' uploading of the soft copy of the assignment. Assignments without the receipt will not be graded by teachers. Only the final version of the assignment should be submitted via VeriGuide.