City University of Hong Kong
Course Syllabus

offered by School of Data Science
with effect from Semester A 2024/25

Part I Course Overview

Course Title:	Optimization
Course Code:	SDSC8005
Course Duration:	One semester
Credit Units:	3
Level:	R8
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	Nil
Precursors: *(Course Code and Title)*	Nil
Equivalent Courses: *(Course Code and Title)*	Nil
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

In this course we will learn how to formulate, analyze and solve various optimization problems. Topics include convex analysis, classifying different types of optimization problems, optimality conditions, duality, unconstrainted optimization, and optimization under uncertainty. No prior optimization background is required for this class. However, students should have workable knowledge in multivariable calculus, linear algebra and matrix theory.

2. Course Intended Learning Outcomes (CILOs)

No.	CILOs	Weighting* (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Explain the fundamentals and principles of optimization	20%	✓	✓	
2.	Explain the theory for different types of optimization problems	50%		✓	✓
3.	Use/apply software packages or existing algorithms to formulate and solve various optimization problems	15%		✓	
4.	Model different applications of optimization	15%	✓	✓	✓
		100%			

A1: *Attitude*
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: *Ability*
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to self-life problems.

A3: *Accomplishments*
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

3. Learning and Teaching Activities (LTAs)

LTA	Brief Description	CILO No.					Hours/week (if applicable)
		1	2	3	4	5	
Class Activities	Students will engage in lectures, which introduce the understanding and applications of various concepts and methods.	✓	✓	✓	✓		32 hours/sem
Tutorial Sessions	Students will participate tutorial sessions that have explanation and exercises to familiarize themselves with the methods learnt during the lectures.	✓	✓	✓	✓		7 hours/sem

4. Assessment Tasks/Activities (ATs)

Assessment Tasks/Activities	CILO No.					Weighting*	Remarks
	1	2	3	4			
Continuous Assessment: 100 %							
Assignments Students are required to explain knowledge and apply methodologies learned from the course in solving some problems.	✓	✓	✓	✓		20%	
Midterm/in-lab/take-home exam Students will be assessed via the examination in their ability to explain concepts and apply methodologies in solving optimization problems	✓	✓	✓	✓		50%	
Course project Students will be assessed via course projects in demonstrating their ability in solving real optimization problems		✓	✓	✓		30%	
						100%	

5. Assessment Rubrics

Applicable to students admitted from Semester A 2022/23 to Summer Term 2024

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B)	Marginal (B-, C+, C)	Failure (F)
1. Assignments	Train students' ability to theorize and solve various types of optimization problems.	High	Moderate	Basic	Not even reaching marginal levels
2. Midterm/in-lab/take-home exam	It assesses students' ability to theorize and solve various types of optimization problems.	High	Moderate	Basic	Not even reaching marginal levels
3. Course project(s)	Nurture students' ability in solving real optimization problems.	High	Moderate	Basic	Not even reaching marginal levels

Applicable to students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Assignments	Train students' ability to theorize and solve various types of optimization problems.	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Midterm/in-lab/take-home exam	It assesses students' ability to theorize and solve various types of optimization problems.	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Course project	Nurture students' ability in solving real optimization problems.	High	Significant	Moderate	Basic	Not even reaching marginal levels

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

Convex analysis, optimality conditions, duality, unconstrainted optimization, optimization under uncertainty

2. Reading List

2.1 Compulsory Readings

1.	S. Boyd and L. Vandenberghe. *Convex Optimization*. Cambridge University Press, Cambridge, 2004. Available online at http://www.stanford.edu/~boyd/cvxbook/.
2.	Lecture Notes and Slides

2.2 Additional Readings

1.	A. Ben-Tal and A. Nemirovski. *Lectures on Modern Convex Optimization: Analysis, Algorithms, and Engineering Applications*, volume 2 of *MPS{SIAM Series on Optimization*. Society for Industrial and Applied Mathematics, Philadelphia, Pennsylvania, 2001.
2.	M. S. Bazaraa, H. D. Sherali, and C. M. Shetty. *Nonlinear Programming: Theory and Algorithms*. Wiley{Interscience Series in Discrete Mathematics and Optimization. John Wiley & Sons, Inc., New York, second edition, 1993.
3.	D. P. Bertsekas. *Nonlinear Programming*. Athena Scienti_c, Belmont, Massachusetts, second edition, 1999.
4.	D. G. Luenberger and Y. Ye. *Linear and Nonlinear Programming*, volume 116 of *International Series in Operations Research and Management Science*. Springer Science+Business Media, LLC, New York, third edition, 2008.