

SDSC6011: OPTIMIZATION FOR DATA SCIENCE

Effective Term

Semester A 2025/26

Part I Course Overview

Course Title

Optimization for Data Science

Subject Code

SDSC - Data Science

Course Number

6011

Academic Unit

Data Science (DS)

College/School

College of Computing (CC)

Course Duration

One Semester

Credit Units

3

Level

P5, P6 - Postgraduate Degree

Medium of Instruction

English

Medium of Assessment

English

Prerequisites

Nil

Precursors

Nil

Equivalent Courses

Nil

Exclusive Courses

Nil

Part II Course Details

Abstract

This course offers an introduction to optimization methods with applications in data science. A basic understanding of Calculus and Linear Algebra are assumed. We will introduce the theoretical foundation and the fundamental algorithms

for optimization and advanced optimization methods for practical problems arising in data science and machine learning applications. Course content includes convex analysis, Lagrangian duality theory, linear and nonlinear programming, conic programming, etc.

Course Intended Learning Outcomes (CILOs)

CILOs		Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Explain methodologies and the underlying mathematical structures in optimization	20	x	x	
2	Apply basic concepts of mathematics to formulate an optimization problem	25	x	x	
3	Derive optimal solutions for optimization models	25	x	x	
4	Apply commonly used optimization algorithms	20	x	x	
5	Implement optimization programs to solve practical problems	10	x	x	x

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 real-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.

Learning and Teaching Activities (LTAs)

LTAs	Brief Description	CILO No.	Hours/week (if applicable)	
1	Lecture	Students will gain knowledge points of optimization methods covered in this course	1, 2, 3, 4	39 hours/semester

Assessment Tasks / Activities (ATs)

ATs	CILO No.	Weighting (%)	Remarks ("- for nil entry)	Allow Use of GenAI?	
1	Test	2, 3, 4, 5	40	-	No
2	Assignments	1, 2, 3, 4	20	-	Yes

Continuous Assessment (%)

60

Examination (%)

40

Examination Duration (Hours)

2

Minimum Examination Passing Requirement (%)

30

Assessment Rubrics (AR)

Assessment Task

Test (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

40%

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task

Assignments (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

20%

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task

Examination (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

40%

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(A+, A, A-) High

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(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task

Test (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion

40%

Excellent

(A+, A, A-) High

Good

(B+, B) Significant

Marginal

(B-, C+, C) Moderate/basic

Failure

(F) Not even reaching marginal levels

Assessment Task

Assignments (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion

20%

Excellent

(A+, A, A-) High

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Assessment Task

Examination (for students admitted from Semester A 2022/23 to Summer Term 2024)

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Failure

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Part III Other Information**Keyword Syllabus**

- Convex analysis
- Lagrangian duality theory
- Linear and conic programming
- Nonlinear programming
- Gradient descent, subgradient descent, proximal gradient descent
- Barrier methods
- Interior-point methods

Reading List**Compulsory Readings**

Title	
1	Convex Optimization (3rd edition), Stephen Boyd and Lieven Vandenberghe © 2004 Cambridge University Press.
2	Lecture Notes

Additional Readings

Title	
1	Lectures on Modern Convex Optimization: Analysis, Algorithms, and Engineering Applications, Aharon Ben-Tal, Arkadi Nemirovski, © 2001 SIAM Press.
2	Linear and Nonlinear Programming (3rd edition), David G. Luenberger and Yinyu Ye © 2008 Springer