CS5282: PRACTICAL OPTIMIZATION ALGORITHMS AND TECHNIQUES

Effective Term
Semester A 2025/26

Part I Course Overview

Course Title
Practical Optimization Algorithms and Techniques

Subject Code
CS - Computer Science
Course Number
5282

Academic Unit
Computer Science (CS)

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
CS2310 Computer Programming or equivalent
AND CS4335 Design and Analysis of Algorithms

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

This course aims to offer practical techniques to solve hard optimization problems by the latest computing technology. These problems can be found in a variety of applications in ecommerce, networking, and cloud computing, such as combinatorial auction, group buying, network virtualization, and resource allocation. Upon completing the course, students will be familiar with applied optimization techniques and able to use optimization to formulate and solve large-scale problems.

The course includes two parts. In the first part, we introduce fundamentals of optimization formulation and the usage of modern Solvers (such as Cplex and Gurobi). In the second part, we investigate some typical optimization problems, in particular, in e-commerce and telecommunication, and study how to design tailor-made algorithms to solve them. Students will be required to do projects of implementing their designs.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Formulate optimization problems and interpret the optimization solutions.	20	x	x	
2	Use common optimization solvers.	20	x	x	
3	Identify and explain the typical optimization problems in ecommerce, networking, and cloud computing.	10	x	x	
4	Apply the formulation and practical techniques to solve some optimization problems in ecommerce, networking, and cloud computing.	30	x	x	x
5	Implement algorithms to solve some optimization problems in ecommerce, networking, and cloud computing.	20	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 engage in lectures about the basic concepts of various optimization technologies and the optimization problems in e-commerce and telecommunication.	1, 2, 3, 4, 5	2

2	Lab	Students will see demonstrations on using solvers, and students will practice the optimization technologies.	1, 2, 3, 4, 5	1
3	Homework	Students will test their understanding on the knowledge learned in lectures, and students will train their independent thinking.	1, 2, 3, 4, 5	0.5
4	Group project	Students will create practical and innovative optimization solutions to problems in ecommerce.	2, 3, 4, 5	0.5

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Homework	1, 2, 3, 4, 5	10	-	Yes
2	Quiz	1, 2, 3, 4, 5	15	-	No
3	Group project	2, 3, 4, 5	25	-	Yes

Continuous Assessment (%)

50

Examination (%)

50

Examination Duration (Hours)

2

Minimum Examination Passing Requirement (%)

30

Additional Information for ATs

For a student to pass the course, at least 30% of the maximum mark for the examination must be obtained.

Assessment Rubrics (AR)

Assessment Task

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

Criterion

The ability to solve problems using the knowledge learned in lectures

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

Criterion
The ability to solve problems using the knowledge learned in lectures

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

Criterion
The ability to innovatively solve practical problems in e-commerce and telecommunication

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

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

Criterion
The ability to solve problems using the knowledge learned in lectures

Excellent
(A+, A, A-) The answer is correct and written in a clear manner.

Good
(B+, B) The answer is mostly correct, with some minor mistakes.

Marginal
(B-, C+, C) The answer is large correct with some mistakes.

Failure
(F) Below the marginal level

Assessment Task
Quiz & Final Exam (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
The ability to solve problems using the knowledge learned in lectures

Excellent
(A+, A, A-) The answer is correct and written in a clear manner.

Good
(B+, B) The answer is mostly correct, with some minor mistakes.

Marginal
(B-, C+, C) The answer is large correct with some mistakes.

Failure
(F) Below the marginal level

Assessment Task
Group project (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
The ability to innovatively solve practical problems in e-commerce and telecommunication

Excellent
(A+, A, A-) The topic of study is interesting. The analysis is thorough and creative, with a research component. The presentation is clear.

Good
(B+, B) The topic of study is interesting. The analysis is mostly thorough. The presentation is clear.

Marginal
(B-, C+, C) The topic of study is conventional, and the study does not require to take efforts. The analysis is superficial. The presentation is alright.

Failure

(F) Below the marginal level

Part III Other Information

Keyword Syllabus

Fundamentals of linear programming, combinatorial optimization, optimization solvers, heuristics, algorithm design, combinatorial auction, logistics, group buying, sharing economy, game theory
Syllabus:
An overview of various optimization technologies and optimization problems will be presented during the lectures, with discussion of the following issues and the related techniques/algorithms:
1. Basic concepts of optimization formulation, solution and interpretation.
2. Usage of common optimization solvers.
3. Optimizations problems that exist in ecommerce and telecommunication, and practical solution approaches.
4. Implementation of optimization to solve problems.

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Saul I. Gass (2010). Linear Programming: Methods and Applications. Dover Publications, 5th edition.
2	Gurobi Reference Manual, http://www.gurobi.com