



**FACULTY OF APPLIED SCIENCES**  
**MASTER OF SCIENCE IN BIG DATA AND INTERNET OF THINGS**  
**LEARNING MODULE OUTLINE**

Academic Year	2024/2025	Semester	2
Module Code	COMP6111		
Learning Module	Optimization Methods		
Pre-requisite(s)	Nil		
Medium of Instruction	English		
Credits	3	Contact Hours	45 hrs
Instructor	Dr. Yanming Zhang	Email	ymzhang@mpu.edu.mo
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**MODULE DESCRIPTION**

This module introduces the principal algorithms for linear, network, discrete, stochastic, system and process optimizations. Emphasis is on methodology and the underlying mathematical structures. Topics include the calculus, optimization basics, Linear Programming (LP), first-order methods, duality and optimality, and support vector machine (SVM).

**MODULE INTENDED LEARNING OUTCOMES (ILOS)**

On completion of this learning module, students will be able to:

M1.	Choose the mathematical cores for optimization and apply the related mathematical models for various optimization techniques. (AHEP4-M1, AHEP4-M2)
M2.	Determine the problems typically encountered in each aspect of operations research and optimizations in various perspectives. (AHEP-M3)
M3.	Interpret various optimization methods to solve real-world situations. (AHEP4-M3, AHEP4-M16)
M4.	Recommend the practical solutions for various optimization matters and the importance to the profession of applying mathematical and statistical tools with programming implementations. (AHEP-M5)

These ILOs aims to enable students to attain the following Programme Intended Learning Outcomes (PILOs):

PILOs	M1	M2	M3	M4
P1. Master the principles of system engineering and relevant enabling technologies for building of IoT solutions				
P2. Critically evaluate scientific methodologies and mathematical models for Big Data and its applications	✓			



P3.	Master the advanced software and programming tools and techniques for IoT solutions and Big Data				
P4.	Explain the processes involved in IoT solutions and Big Data analytics in a typical business setting				
P5.	Explain different application domains and analyze their requirements for IoT and Big Data				
P6.	Apply knowledge in advanced communication and multimedia technologies for the design and implementation of IoT solutions				
P7.	Apply knowledge in applied statistics, machine learning, leading-edge technologies and programming techniques for Big Data	✓	✓		
P8.	Design and carry out an advanced project following an ethical and professional methodology			✓	
P9.	To demonstrate advanced knowledge and R&D techniques in Big Data and IoT				✓
P10.	To investigate and develop new, emerging ICT technology for Big Data and IoT				
P11.	To develop a global vision on the critical development and new application of Big Data and IoT				
P12.	To communicate technically and effectively in both speaking and writing				✓
P13.	To have a positive attitude towards society and the environment.			✓	
P14.	To adhere to high moral standards and commit to excellence in life-long learning.				

#### MODULE SCHEDULE, COVERAGE AND STUDY LOAD

Week	Content Coverage	Contact Hours
1	1. Introduction and Calculus	3
	1.1. Module introduction	
	1.2. Calculus basics	
	1.3. Calculus optimization	
2-4	2. Fundamentals of optimization	9
	2.1. Sets and functions	
	2.2. Optimization basics	
	2.3. Canonical problem forms	
5-7	3. Linear Programming (LP)	9
	3.1. Linear programming basics	
	3.2. Simplex method	
	3.3. Network flow	



8-10	4. First-order methods	9
	4.1. Gradient descent	
	4.2. Subgradient method	
	4.3. Other gradient descent	
11-13	5. Duality	9
	5.1. Duality in linear programs	
	5.2. Duality in general programs	
	5.3. KKT conditions	
14-15	6. Support vector machine	6
	6.1. Introduction	
	6.2. SVM Problem formulation	
	6.3. Examples	
	6.4. SVM implementation	

### TEACHING AND LEARNING ACTIVITIES

In this learning module, students will work towards attaining the ILOs through the following teaching and learning activities:

Teaching and Learning Activities	M1	M2	M3	M4
T1. Module teaching and lecture	✓	✓		✓
T2. Group activity			✓	
T3. Literature review				✓
T4. Tests	✓	✓	✓	

### ATTENDANCE

Attendance requirements are governed by the Academic Regulations Governing Master's Degree Programmes of the Macao Polytechnic University. Students who do not meet the attendance requirements for the learning module shall be awarded an 'F' grade.

### ASSESSMENT

In this learning module, students are required to complete the following assessment activities:



Assessment Activities	Weighting (%)	AHEP4 LOs	ILOs to be Assessed
A1. Popup quizzes	10%	AHEP4-M1, AHEP4-M3,	P2, P7, P8, P9
A2. Group projects	50%	AHEP4-M5, AHEP4-M16,	P13
A3. Assignments (x2)	40%	AHEP4-M1, AHEP4-M2, AHEP4-M3	P12

The assessment will be conducted following the University's Assessment Strategy (see [www.mpu.edu.mo/teaching\\_learning/en/assessment\\_strategy.php](http://www.mpu.edu.mo/teaching_learning/en/assessment_strategy.php)). Passing this learning module indicates that students will have attained the ILOs of this learning module and thus acquired its credits. Students with an overall score of less than 35 in the coursework will fail the module even if the overall score for the module is 50 or above.

Students with a score of less than 35 in the final examination will fail the module even if the overall score for the module is 50 or above.

#### REQUIRED READINGS

1. Boyd, S., & Vandenberghe, L. (2004). Convex optimization. Cambridge university press.

#### REFERENCES

1. George B. Thomas, Ross L. Finney (1998). Calculus and Analytic Geometry, 9th Ed. Addison Wesley, 978-0201531749
2. Cristianini, N., & Shawe-Taylor, J. (2000). An introduction to support vector machines and other kernel-based learning methods. Cambridge university press.
3. L. Mark (2013). Learning Python 5th Ed, O'Reilly Media. 978-1449355739

#### STUDENT FEEDBACK

At the end of every semester, students are invited to provide feedback on the learning module and the teaching arrangement through questionnaires. Your feedback is valuable for instructors to enhance the module and its delivery for future students. The instructor and programme coordinators will consider all feedback and respond with actions formally in the annual programme review.

#### ACADEMIC INTEGRITY

The Macao Polytechnic University requires students to have full commitment to academic integrity when engaging in research and academic activities. Violations of academic integrity, which include but are not limited to plagiarism, collusion, fabrication or falsification, repeated use of assignments and cheating in examinations, are considered as serious academic offenses and may lead to disciplinary actions. Students should read the relevant regulations and guidelines in the Student Handbook which is distributed upon the admission into the University, a copy of which can also be found at [www.mpu.edu.mo/student\\_handbook/](http://www.mpu.edu.mo/student_handbook/).