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

Academic Year	2025/2026	Semester	1
Module Code	COMP6133		
Learning Module	Machine Learning		
Pre-requisite(s)	Nil		
Medium of Instruction	English		
Credits	3	Contact Hours	45 hrs
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MODULE DESCRIPTION

Artificial Intelligence (AI) is so pervasive today that possibly you are using it in one way or the other and you don't even know about it. One of the popular applications of AI is Machine Learning (ML), which is the science of getting computers to learn without being explicitly programmed. In the past decade, machine learning has given us many amazing applications, such as self-driving cars, speech recognition, image recognition, financial trading, machine translation, AlphaGo etc. This module covers some of the most important methods for machine learning, including neural networks, deep learning, reinforcement learning, etc. The aim of the module is to give students the theoretical underpinnings of machine learning techniques, and to allow them to apply such methods in a range of areas, such as classification, regression, language models etc. by practice.

MODULE INTENDED LEARNING OUTCOMES (ILOS)

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

M1.	Apply the theoretical knowledge and mathematics to solve machine learning problems. (AHEP4-M1)
M2.	Design machine learning neural networks and conduct proper training procedures. (AHEP4-M2, AHEP4-M3)
M3.	Critically evaluate and select proper machine learning strategies and be able to use them to perform a range of computational tasks using proper machine learning frameworks. (AHEP4-M4)
M4.	Work in a team for a complete machine learning project, design and evaluate machine learning solutions for a real-world problem, and finally present it in class. (AHEP4-M5, AHEP4-M7, AHEP4-M16, AHEP4-M17)

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 to machine learning	3
	1.1 Machine learning applications	
	1.2 What constitutes a learning algorithm?	
	1.3 Supervised learning & unsupervised learning	
	1.4 Polynomial fitting	
	1.5 K-nearest neighbours	
2-3	2. Fundamental statistics and optimization	6
	2.1 Fundamentals of probability	

	2.2	Maximum likelihood	
	2.3	Decision theory	
	2.4	Information theory	
	2.5	Fundamentals of optimization	
4	3.	Decision tree and ensemble learning	3
	3.1	ID3, C4.5, and CART	
	3.2	Bagging and random forest	
	3.3	Boosting, AdaBoost, and Boosting tree	
5	4.	Regression algorithms	3
	4.1	Linear regression model	
	4.2	Linear basis function regression	
	4.3	Geometry of linear regression	
	4.4	Stochastic gradient descent	
6-10	5.	Neural network and deep learning	15
	5.1	Multi-layer perceptron	
	5.2	Feed-forward neural network	
	5.3	Universal approximation theorem	
	5.4	Network training	
	5.5	Error backpropagation	
	5.6	Activation functions	
	5.7	Convolutional neural network	
	5.8	Recurrent neural networks	
	5.9	Long short-term memory	
	5.10	Gate recurrent unit	
11-12	6.	Reinforcement learning	6
	6.1	Markov decision process	
	6.2	Bellman equations	
	6.3	Dynamic programming	
	6.4	Monte-Carlo reinforcement learning	

	6.5	Temporal-difference learning	
	6.6	Q-learning	
13-15	7.	Student presentation	9

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. Lectures	✓	✓	✓	
T2. Lab practice	✓	✓	✓	✓
T3. Assignments	✓	✓	✓	✓

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. Assignments x3	45%	AHEP4-M1, AHEP4-M2, AHEP4-M3, AHEP4-M4	M1, M2, M3
A2. Test	20%	AHEP4-M1, AHEP4-M2, AHEP4-M3	M1, M2
A3. Project	35%	AHEP4-M5, AHEP4-M7, AHEP4-M16, AHEP4-M17	M4

The assessment will be conducted following the University's Assessment Strategy (see 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.

REQUIRED READINGS

NA

REFERENCES

Reference book(s)

1. Shai Shalev-Shwartz and Shai Ben-David (2014). *Understanding Machine Learning: From Theory to Algorithms.* Cambridge University Press.
2. Ian Goodfellow, Yoshua Bengio and Aaron Courville (2016). *Deep Learning.* An MIT Press book, http://www.deeplearningbook.org.
3. Richard S. Sutton and Andrew G. Barto (2018). *Reinforcement Learning: An Introduction (2rd ed).* MIT Press, Cambridge, MA, 2018. http://incompleteideas.net/book/the-book-2nd.html

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/.