



FACULTY OF APPLIED SCIENCES
BACHELOR OF SCIENCE IN ARTIFICIAL INTELLIGENCE
LEARNING MODULE OUTLINE

Academic Year	2025/2026	Semester	1
Module Code	CSAI3121		
Learning Module	Machine Learning and Intelligent Data Analysis		
Pre-requisite(s)	MATH1111 Linear Algebra, CSAI2121 Probability and Statistics		
Medium of Instruction	English		
Credits	3	Contact Hours	45 hrs
Instructor	Shirley Siu	Email	shirleysiu@mpu.edu.mo
Office	Room P333, 3/F, Pearl Jubilee Building, Taipa Campus	Office Phone	8399-8620

MODULE DESCRIPTION

This module will provide a comprehensive introduction to the core concepts in machine learning, emphasizing theoretical foundations and practical implementation. Fundamental paradigms, including supervised learning (linear regression, logistic regression), unsupervised learning (clustering, dimensionality reduction), and essential techniques (loss functions, hyperparameter tuning, etc.) will be discussed. The introduction to machine learning and its applications is taught using the Python library Scikit-learn. Students will learn about the different types of machine learning algorithms, their applications and limitations, and how they can be implemented using Scikit-learn. The module covers data pre-processing, model selection, evaluation and tuning techniques.

Some popular machine learning algorithms, including Support Vector Machines, K Nearest Neighbours, Decision Trees will be covered. Students will learn these concepts with practices. Additionally, advanced topics such as reinforcement learning, and explainable ML will be introduced. There will be a group project for students to work on. Students will work together for a complete machine learning task involving problem analysis, data processing, model selection and evaluation, solution design, system integration and final presentation.

MODULE INTENDED LEARNING OUTCOMES (ILOS)

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

M1.	Analyse problem and apply basic Scikit-learn library to solve machine learning problems in Python; (C3, C12)
M2.	Evaluate different machine learning techniques, identify real-world problem and which ML algorithm can solve such problem; (C3)
M3.	Apply linear regression, logistic regression, clustering algorithms, etc. to solve machine learning problems; (C1, C3)



M4.	Work in the team to complete a real-world machine learning project; (C5, C16)
M5.	Identify the professional and ethical responsibilities associated with the use of AI and ML in engineering and technology, including issues related to privacy and fairness. (C7, C8)

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

PILOs	M1	M2	M3	M4	M5
P1. Select and apply proven methods, tools and techniques to the effective and efficient implementation of information systems on common platforms, including the Internet platform;	✓	✓	✓		
P2. Acquire essential knowledge in specific fields of artificial intelligence, including machine learning, computer vision and natural language processing;	✓	✓	✓		
P3. Apply necessary mathematical techniques to model, analyse and devise solutions to complex problems;	✓	✓	✓		
P4. Work independently to develop an understanding of, and the knowledge and skills associated with the general support and mitigation of security risks of computer systems and networks;					
P5. Design and implement both relational and non-relational data stores, with an emphasis on how to organise, maintain, retrieve and analyse information;					
P6. Distinguish the fundamental and operational issues of computer systems and artificial intelligence applications, with considerations of user, business, ethical, societal and environmental needs;		✓			✓
P7. Evaluate, prepare and communicate effectively on technical information to both technical and non-technical audience;				✓	✓
P8. Work as an effective member of a team in the analysis, design and development of software systems, with recognition of requirement to support equality, diversity and inclusion;				✓	
P9. Use project planning, risk management and quality management techniques in solutions to complex problems;				✓	
P10. Build the capacity and desire for lifelong learning and to learn advanced and emerging technologies on one's own.					✓

MODULE SCHEDULE, COVERAGE AND STUDY LOAD

Week	Content Coverage	Contact Hours
1	1. Introduction to Machine Learning	3
	1.1 ML applications	
	1.2 What constitutes an ML algorithm?	



	1.3 Supervised learning & unsupervised learning	
	1.4 Introduction to Scikit-learn library	
	1.5 Ethical and societal implications of ML	
2	2. Linear Regression	3
	2.1 Linear regression with one variable	
	2.2 Linear regression with multiple variables	
	2.3 Advanced optimization	
3-5	3. Classification	9
	3.1 Logistic Regression (LR)	
	3.2 k-Nearest Neighbors (kNN)	
	3.2 Support Vector Machines (SVM)	
	3.3 Decision Trees (DT)	
	3.4 Random Forests (RF)	
6-8	4. Clustering	9
	4.1 K-Means clustering	
	4.2 Hierarchical clustering	
	4.3 DBSCAN	
9-10	5. Dimensionality Reduction	6
	5.1 Principal Component Analysis (PCA)	
	5.2 t-distributed Stochastic Neighbor Embedding (t-SNE)	
11-12	6. Model Selection and Evaluation	6
	6.1 Cross-Validation	
	6.2 Bias-variance tradeoff	
13-14	7. Advanced Topics	6
	7.1 Reinforcement Learning (RL)	
	7.2 Explainable ML (SHAP, LIME)	
15	Project presentation	3

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	M5
T1. Lectures	✓	✓	✓		✓
T2. In-class exercises and labs	✓		✓		
T3. Assignment and project	✓	✓	✓	✓	✓

ATTENDANCE

Attendance requirements are governed by the Academic Regulations Governing Bachelor'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 and Project	35	C1, C3, C5, C7, C8, C16	M1, M2, M3, M4, M5
A2. Lab Exercises	10	C12	M1
A3. Test	15	C1, C3	M1, M2, M3
A4. Examination	40	C1, C3	M1, M2, M3

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.

Students with an overall score of less than 35 in the coursework must take the re-sit examination even if the overall score for the module is 50 or above.

Students with a score of less than 35 in the final examination must take the re-sit examination even if the overall score for the module is 50 or above.

Students with an overall final grade of less than 35 are NOT allowed to take the re-sit examination.

REQUIRED READINGS

There is no official text for this module. Module notes are distributed in the class.

REFERENCES

1. Aurélien Géron (2019). *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems (2nd Edition)*, O'Reilly
2. John D. Kelleher (2020). *Fundamentals of Machine Learning for Predictive Data Analytics, second edition: Algorithms, Worked Examples, and Case Studies (2nd Edition)*, The MIT Press



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/.