澳門理工大學
Universidade Politécnica de Macau
Macao Polytechnic University

FACULTY OF APPLIED SCIENCES

DOCTOR OF PHILOSOPHY IN COMPUTER APPLIED TECHNOLOGY

LEARNING MODULE OUTLINE

Academic Year	2025/2026	Semester	1
Module Code	COMP8123		
Learning Module	Advanced Topics in Computer Applied Technology		
Pre-requisite(s)	Nil		
Medium of Instruction	English		
Credits	3	Contact Hours	45 hrs
Instructor	Jie Zhang	Email	jpeter.zhang@mpu.edu.mo
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MODULE DESCRIPTION

This module is designed to provide students with an in-depth exploration of a specific area within the field of machine learning and data analysis. This module caters to students who have already acquired a solid foundation in computer programming, machine learning and data analysis and are eager to delve into advanced concepts and emerging trends in a specialized topic area. By engaging in this module, students will have the opportunity to deepen their knowledge, develop practical skills, and engage in critical analysis of cutting-edge topics.

MODULE INTENDED LEARNING OUTCOMES (ILOS)

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

M1.	Summarize and utilize foundational and advanced algorithms and methods in the context of computer applied technologies. (AHEP4-M3, AHEP4-M4)
M2.	Evaluate and compare diverse computer applied technologies in practical scenarios. (AHEP4-M4, AHEP4-M5)
M3.	Apply essential and advanced computer applied technologies to transform and resolve real-world problems. (AHEP4-M1, AHEP4-M5)
M4.	Illustrate and analyze the broader considerations and challenges associated with computer applied technologies. (AHEP4-M2, AHEP4-M5)
M5.	Visualize the results using the advanced data visualization technologies and communicate with the audience (AHEP4-M3, AHEP4-M4)
M6.	Design and implement computer applied technologies to address real-world problem-solving tasks. (AHEP4-M16, AHEP4-M17)

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

PILOs		M1	M2	M3	M4	M5	M6
Knowledge and Understanding							
P1.	Critically evaluate scientific methodologies and mathematical models in Computing.		✓				
P2.	Demonstrate the mastery of a body of knowledge spanning a wide range of Computing-related topics.	✓			✓		✓
P3.	Identify, assess, analyse complex problems and relevant issues in information-related phenomena.			✓	✓		
P4.	Utilize and synthesize a host of Computing-related methodologies to produce innovative solutions over diverse range of settings.						
Skills and Attributes							
P5.	Create new knowledge or original research in Computing, both individually and collaboratively in a team.						✓
P6.	Plan, design, execute and manage a scholarly research project with professional integrity and risk awareness.						✓
P7.	Communicate research findings, both orally to diverse audiences and in writing through publishing research papers of scholarly values.						
P8.	Gather and disseminate knowledge at the postgraduate level and beyond.	✓					✓
P9.	Demonstrate advanced knowledge, research capability and enthusiasm in high-quality research and development.			✓		✓	
P10.	Develop a global vision on knowledge advancement and dissemination.	✓	✓				✓
P11.	Advocate of professionalism in workplaces and the society at-large.						
P12.	Communicate technically and effectively both in oral and written form.			✓		✓	

MODULE SCHEDULE, COVERAGE AND STUDY LOAD

Week	Content Coverage	Contact Hours
1-3	1. Advanced Data Analysis Methods	9
	1.1 Overview of Data Analysis Methods	
	1.2 Data Analysis Packages: *Statsmodels* and *Pingouin*	
	1.3 Descriptive Analysis	
	1.4 Hypothesis Testing	
4-6	2. Advanced Data Visualization Methods	9
	2.1 Overview of Data Visualization Methods	

	2.2. Data Visualization with Matplotlib Package	
	2.3. Data Visualization with Seaborn Package	
	2.4. Data Visualization with Plotnine Package	
7-10	4. Advanced Unsupervised Learning Algorithms	12
	4.1 Foundations of Unsupervised Learning	
	4.2 Unsupervised Learning Package: *scikit-learn, Pytorch*	
	4.3 Clustering: From Classical to Deep Learning	
	4.4 Dimensionality Reduction: Evolution of Techniques	
	4.5 Model Construction and Evaluation Methods	
11-14	5. Advanced Supervised Learning Algorithms	12
	5.1 Foundations of Supervised Learning	
	5.2 Supervised Learning Package: *scikit-learn, Pytorch*	
	5.3 Prediction: From Linear to Neural	
	5.4 Classification: From Traditional to Modern	
	5.5 Model Training and Evaluation Methods	
15	6. Advanced Computer Applied Technology in Human Data	3
	6.1 Human Image-Related Computer Applied Technologies	
	6.2 Human Signal-Related Computer Applied Technologies	
	6.3 Applications Scenarios	

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**	**M6**
T1. Lectures	✓	✓	✓			
T2. Case studies	✓			✓	✓	✓
T3. In-class practice				✓	✓	✓

ATTENDANCE

Attendance requirements are governed by the Academic Regulations Governing Doctoral 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. Individual Assignment (AI Programming)	20	AHEP4-M3, AHEP4-M4, AHEP4-M5	M1, M2, M5
A2. Individual Assignment (AI Programming)	20	AHEP4-M3, AHEP4-M4, AHEP4-M5	M1, M2, M5
A3. Individual Assignment (AI Technologies)	20	AHEP4-M1, AHEP4-M2, AHEP4-M3, AHEP4-M4, AHEP4-M5,	M1, M3, M4
A4. Group Assignment (AI Technologies)	40	AHEP4-M1, AHEP4-M2, AHEP4-M3, AHEP4-M4, AHEP4-M5, AHEP4-M16, AHEP4-M17	M3, M4, M5, M6

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

1. Aurélien Géron. (2022). Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow (2nd ed.) O'Reilly Media, Inc.

REFERENCES

1. Vallat, R. (2018). Pingouin: statistics in Python. J. Open Source Softw., 3(31), 1026.
2. Seabold, S., & Perktold, J. (2010). Statsmodels: econometric and statistical modeling with python. SciPy, 7(1).
3. Pedregosa, F., Varoquaux, G., Gramfort, A., Michel, V., Thirion, B., Grisel, O., ... & Duchesnay, É. (2011). Scikit-learn: Machine learning in Python. the Journal of machine Learning research, 12, 2825-2830.

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/.