



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

Academic Year	2024/2025	Semester	1
Module Code	MATH1111		
Learning Module	Linear Algebra		
Pre-requisite(s)	Nil		
Medium of Instruction	English		
Credits	3	Contact Hours	45 hrs
Instructor	Dr. Charles Lam	Email	cklamsta@mpu.edu.mo
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**MODULE DESCRIPTION**

This module introduces basic concepts and techniques from linear algebra that will be required in later computer science areas such as machine learning and computer graphics. Topics include systems of linear equations, matrices, determinants, vectors and vector spaces, linear in(dependence), multi-dimensional linear transformations, eigenvalues and eigenvectors.

**MODULE INTENDED LEARNING OUTCOMES (ILOS)**

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

M1.	Describe the various methods in solving systems of linear equations; (C2)
M2.	Explain matrix operations; (C1)
M3.	Explain the concepts of vectors and vector spaces; (C1)
M4.	Discuss linear independence and dependence; (C1)
M5.	Extend the principles of matrix algebra to linear transformations; (C1)
M6.	Demonstrate an understanding of eigenvalues and eigenvectors. (C2)

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

PILOs	M1	M2	M3	M4	M5	M6
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
1-2	1. Matrices and Vectors	6
	1.1 Matrix addition and scalar multiplication	
	1.2 Matrix multiplication	
	1.3 Special Matrices	
	1.4 Transpose of a matrix	
	1.5 Matrix Algebra	
	1.6 Magnitude and direction of vectors	
	1.7 Unit vectors	
	1.8 Vector operations	
	1.9 Inner product	



3-4	2. Systems of Linear Equations	6
	2.1 Augmented matrix	
	2.2 Elementary row operations	
	2.3 Gaussian elimination method	
	2.4 Gauss-Jordan elimination method	
	2.5 Homogeneous system of linear equations	
	2.6 Null space, rank and nullity	
5-7	3. Matrix Inversion and Determinants	9
	3.1 Determinant of a matrix	
	3.2 Properties of determinants	
	3.3 Matrix inversion using determinant	
	3.4 Matrix inversion using adjoint method	
	3.5 Matrix inversion using Gauss-Jordan elimination	
8-10	4. Vector Spaces	9
	4.1 Property of vector spaces	
	4.2 Subspace	
	4.3 Linear combinations of vectors	
	4.4 Span and Spanning Set	
	4.5 Linear independence and dependence	
	4.6 Basis and dimension	
11-13	5. Linear Transformations	9
	5.1 Introduction to linear transformations	
	5.2 Domain and codomain	
	5.3 Range and null space	
	5.4 Matrix representations of linear transformations	
	5.5 Reflection, projection, rotation, and scaling	
	5.6 Composition of linear transformations	
	5.7 One-to-one linear transformations	
	5.8 Onto linear transformations	



14-15	6. Eigenvalues and Eigenvectors	6
	6.1 Introduction to eigenvalues and eigenvectors	
	6.2 Characteristic polynomial	
	6.3 Characteristic equation	
	6.4 Computing eigenvalues and eigenvectors	

### 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. In-class tutorials and exercises	✓	✓	✓	✓	✓	✓

### 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/Classwork	10%	C1, C2	M1, M2, M3, M4, M5, M6
A2. Test	40%	C1, C2	M1, M2, M3, M4, M5, M6
A3. Examination	50%	C1, C2	M1, M2, 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](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 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

1. Strang, G. (2016). Introduction to Linear Algebra (5th ed.). MIT Press.

## REFERENCES

1. Lay, D., Lay, S., and McDonald, J. (2015). Linear Algebra and Its Applications (4th ed.). Pearson Education.

## 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/).