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

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	COMP6113		
Learning Module	Cloud Computing		
Pre-requisite(s)	Nil		
Medium of Instruction	English		
Credits	3	Contact Hours	45 hrs
Instructor	K. L. Eddie Law	Email	eddielaw@mpu.edu.mo
Office	M509, Meng Tak Building	Office Phone	8599-3287

MODULE DESCRIPTION

Cloud Computing is an important technological facilitator. Data can be stored, managed, executed somewhere on the Internet or within an enterprise network. Cloud Computing is a technology adopted by any businesses nowadays. Technology for Cloud Computing evolves continuously with data redundancy and availability across geographical locations. Cloud Computing transforms the ways how services, applications, and solutions are delivered without the need to own any physical infrastructure. With the rises of virtualization and container technologies, new programming paradigms enable the deliveries of applications rapidly. Furthermore, with its flexible elasticity and scalability, Cloud Computing offers low-cost solutions to the needs of companies of any sizes. It is the perfect operating platform for housing Big Data systems and analysing collected IoT sensing data. In this module, the main characteristics and enabling technologies of Cloud Computing, including virtualization, containerization, nodal orchestrations, and the latest service paradigms, will be covered. Other underpinning issues such as security, privacy, and ethical concerns are also discussed.

MODULE INTENDED LEARNING OUTCOMES (ILOS)

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

M1.	Identify and contrast the characteristics and tradeoffs of key approaches to emerging Cloud computing system design (AHEP4-M2, AHEP4-M4)
M2.	Analyse the architectures of different Cloud models and determine suitable models for complex business requirements (AHEP4-M5)
M3.	Develop Cloud applications using popular technologies in a range of complex application domains (AHEP4-M3, AHEP4-M16)
M4.	Evaluate critically emerging issues related to Cloud computing, including security, privacy and ethical concerns (AHEP4-M2, AHEP4-M4)

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. What is Cloud computing?	3
	1.1 NIST definition and evolution of Cloud computing paradigm	
	1.2 Cloud computing resources – CPUs, memory, I/O resources	
	1.3 Business models, economics models and service level agreements (SLAs)	
	1.4 About security	
2	2. Service and deployment models	3
	2.1 Starting from three basic servicing models: IaaS, PaaS, SaaS	

	2.2 Popular Cloud stacks, use cases, and commercial Cloud service providers	
	2.3 New service models – FaaS, microservices, serverless	
3-5	3.Virtualization	9
	3.1 Hardware-assisted virtualisation – full and para-virtualisation	
	3.2 Hypervisors (virtual machine monitors) – KVM, and VirtualBox	
6-8	4. Containerisation	9
	4.1 Containers – LXC (LXD), Docker, etc.	
	4.2 Namespace, cgroup, networking, and storage	
9-11	5. Introduction to orchestration and configuration	9
	5.1 Docker swarm	
	5.2 Kubernetes	
12-13	6. Data lake and data mesh	6
	6.1 Introduction to data storage	
	6.2 NoSQL – CAP theorem and secure hash	
	6.3 Basically Available, Soft State, Eventual Consistency (BASE)	
14-15	7. Advanced Topics	6
	7.1 Network virtualisation (SDN) and network function virtualisation (NFV)	
	7.2 Cloud security and Cloud ethics, etc.	

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 (lectures)	✓	✓	✓	✓
T2. Literature review and presentation		✓		✓
T3. Project		✓	✓	

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	35%	AHEP4-M4, AHEP4-M16	P1, P2, P3, P4, P5, P6, P8, P9, P10
A2. Test	25%	AHEP4-M2	P1, P8, P9, P10
A3. Group project	40%	AHEP4-M2, AHEP4-M3, AHEP4-M4, AHEP4-M5, AHEP4-M16	P1, P2, P3, P4, P5, P8, P9, P10, P11

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

REFERENCES

1. C. Surianarayanan, P. R. Chelliah (2019) Essentials of Cloud Computing - A Holistic Perspective. Springer Nature Switzerland.
2. R. Vitillo (March 2022) Understanding Distributed Systems, v2.0.0. Online.
3. R. Lezsko (2022) Continuous Delivery with Docker and Jenkins, Third Edition, Packt Publishing.
4. J. Buelta (2019). Hands-On Docker for Microservices with Python. Packt Publishing.
5. J. Vyas, C. Love (2022) Core Kubernetes. Manning Publications Co.
6. D. Kapexhiu (2024) Building Microservices with Node.js. Packt Publishing.
7. K. N. Billimoria (2024). Linux Kernel Programming. Second Edition. Packt Publishing.

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/.