

# Macao Polytechnic University

## Faculty of Applied Sciences

### Master of Science in Big Data and Internet of Things

#### Module Outline

Academic Year 2022 / 2023 Semester 2

<b>Learning Module</b>	Cloud Computing		<b>Class Code</b>	COMP6103	
<b>Pre-requisite(s)</b>	Nil				
<b>Medium of Instruction</b>	English		<b>Credit</b>	3	
<b>Lecture Hours</b>	45 hrs	<b>Lab/Practice Hours</b>	0 hrs	<b>Total Hours</b>	45 hrs
<b>Instructor</b>	K. L. Eddie Law		<b>E-mail</b>	eddielaw@mpu.edu.mo	
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#### Description

Cloud Computing is one important technological innovation, and being adopted across industries at a rapid pace. With improved data redundancy and availability across different geographical locations, Cloud Computing transforms the ways how services, applications, and solutions are delivered. With the rises of novel virtualization technologies and new programming paradigms, applications can be delivered quickly to customers, without the need to own any physical infrastructure. Furthermore, with its rapid 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 orchestration of compute nodes, and different service paradigms, will be discussed. Other underpinning issues such as security, privacy, and ethical concerns are also covered.

## **Learning Outcomes**

After completing the learning module, students will be able to:

1. Identify and contrast the characteristics and tradeoffs of key approaches to emerging Cloud Computing system design (SM2fl, EA2fl)
2. Analyse the architecture of different Cloud models and determine suitable models for complex business requirements (ET3fl, ET6fl)
3. Develop Cloud applications using popular technologies in a range of complex application domains (D2fl)
4. Critically evaluate emerging issues related to Cloud Computing, including security, privacy and ethical concerns (ET1fl)

## **Content**

1. What is Cloud Computing? (6 hours)
  - 1.1 NIST Definition and Evolution of Cloud Computing Paradigm
  - 1.2 Enabling Technologies, Software and Hardware Virtualisation Concepts
  - 1.3 Resource Characteristics (CPU, Memory, I/O Resources)
  - 1.4 Business Models and Service Providers
  - 1.5 Economics Models and Service Level Agreements (SLAs)
  - 1.6 About Cloud Security
2. Service and Deployment Models (3 hours)
  - 2.1 Three Basic Servicing Models: IaaS, PaaS, SaaS
  - 2.2 Popular Cloud Stacks and Use Cases
  - 2.3 Commercial Cloud Service Providers (CSPs)
  - 2.4 Function as a Service (FaaS) and Serverless Architecture
3. Virtualisation (6 hours)
  - 3.1 Hardware-Assisted Virtualisation: Full and Para-Virtualisation
  - 3.2 Virtual Machine Monitors / Hypervisors: VirtualBox, Xen and KVM
4. Containerisation (9 hours)
  - 4.1 Containers: LXC (LXD) and Docker, etc.
  - 4.2 Namespace and cgroup
  - 4.3 Networking and Storage
5. Orchestration and Configuration (6 hours)
  - 5.1 Docker Swarm
  - 5.2 Kubernetes
  - 5.3 Service Meshes

6. Data Stores and NoSQL (6 hours)
  - 6.1 Concepts of Data Stores and Data Lakes
  - 6.2 NoSQL and CAP Theorem
  - 6.3 Secure Hash for NoSQL Designs
  - 6.4 Distributed Transactions and Synchronisation – BASE
  - 6.5 Evaluation of Two-Phase Commit and Concurrency Control
  
7. Network Virtualisation (3 hours)
  - 7.1 Software Defined Networking (SDN)
  - 7.2 Network Function Virtualisation (NFV)
  
8. Advanced Topic Investigation (6 hours)
  - 8.1 Apache Projects
  - 8.2 Design Review of OpenStack
  - 8.3 Other Topics: Security, Privacy, and Ethics on Cloud Data

### **Teaching Method**

Lectures, demonstration, presentations and group discussion.

### **Attendance**

Attendance requirements are governed by the “Academic Regulations Governing Master’s Degree Programmes” of Macao Polytechnic University. Students who do not meet the attendance requirements for the module will not be permitted to sit the final examination and shall be awarded an ‘F’ grade.

### **Assessment**

The learning module is graded on a 100 point scale, with 100 being the highest possible score and 50 being the passing score.

<b>Item</b>	<b>Description</b>	<b>AHEP3 LO</b>	<b>Percentage</b>
1. Assignments	Knowledge investigation & expansion	SM2fl, D2fl	35%
2. Test	Knowledge assessment	SM2fl, D2fl	25%
3. Project	Knowledge expansion	SM2fl, D2fl, EA2fl, ET1fl, ET3fl, ET6fl	40%
<b>Total Percentage:</b>			<b>100%</b>

## **Teaching Material(s)**

### **Textbook(s)**

There is no textbook.

## **Reference**

### **Reference book(s)**

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. K. Jackson, C. Bunch, E. Sigler, J. Denton. (2018). OpenStack Cloud Computing Cookbook. Fourth Edition. Packt Publishing.
7. M. A. Calles (2020) Serverless Security: Understand, Assess, and Implement Secure and Reliable Applications in AWS, Microsoft Azure, and Google Cloud. APress.
8. D. Abts, J. Kim (2011). High Performance Datacenter Networks - Architectures, Algorithms, and Opportunities. Morgan & Claypool Publishers.