Macao Polytechnic Institute

School of Applied Sciences

Master of Science in Big Data and Internet of Things

Module Outline

Academic Year 2020 / 2021 Semester 2

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

Cloud Computing has transformed how services and applications are delivered. With the rise of virtualization technology and new programming paradigms, applications can quickly be delivered to a growing audience, without the need to physically own and configure the infrastructure. With its rapid elasticity and scalability, Cloud Computing easily offers low-cost solutions to the needs of small companies, and enables elastic solutions to the needs of large firms. Today, Cloud Computing is the foundation technology for processing of big data and IoT sensor data. This module covers the main characteristics of Cloud Computing, including the enabling technologies, main software and service paradigms underpinning it, as well as related aspects, namely security, privacy, and ethical concerns.

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. Analyze 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 the Evolution of Cloud Computing Paradigm
   - 1.2 Enabling Technologies, Software and Hardware Virtualization 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 Server-less Architecture
3. Virtualization (6 hours)
   - 3.1 Hardware-Assisted Virtualization: Full and Para-Virtualization
   - 3.2 Virtual Machine Monitors / Hypervisors: VirtualBox, Xen and KVM
4. Containerization (9 hours)
   - 4.1 Containers: LXC (LXD) and Docker
   - 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 Ansible
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 Synchronization – BASE
   - 6.5 Evaluation of Two-Phase Commit and Concurrency Control
7. Network Virtualization (3 hours)
   - 7.1 Software Defined Networking (SDN)
   - 7.2 Network Function Virtualization (NFV)
8. Advanced Topic Investigation (3 hours)
   - 8.1 Apache Projects

8.2 Design Review of OpenStack

9. Other Topics (3 hours)

9.1 Security, Privacy and Ethics on Cloud Data

Teaching Method

Lectures, demonstrations and presentations.

Attendance

Attendance requirements are governed by the "Academic Regulations Governing Master's Degree Programmes of Macao Polytechnic Institute." Students who do not meet the attendance requirements for the learning module shall be awarded an 'F' grade.

Assessment

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

	Item	Description	AHEP3 LO	Percentage
1.	Assignments	Knowledge investigation and expansion	EA2p, EP4p	40%
2.	Test	Knowledge assessment	EA1p, EP1p, EP2p, EP3p	20%
3.	Project	Knowledge expansion	EA1p, EA2p, SM2p, EP1p, EP2p	40%
			Total Percentage:	100%

Reference

Reference book(s)

1. I. Foster and D. B. Gannon (2017). *Cloud Computing for Science and Engineering*. The MIT Press.
2. C. Surianarayanan, P. R. Chelliah (2019) *Essentials of Cloud Computing - A Holistic Perspective*. Springer Nature Switzerland.
3. B. Scholl, T. Swanson, P. Jausovec (2019) *Cloud Native - Using Containers, Functions, and Data to Build Next-Generation Applications*. O'Reilly Media, Inc.
4. J. Buelta (2019). *Hands-On Docker for Microservices with Python*. Packt Publishing.
5. K. Jackson, C. Bunch, E. Sigler, J. Denton. (2018). *OpenStack Cloud Computing Cookbook, Fourth Edition*. Packt Publishing.
6. D. Abts, J. Kim (2011). *High Performance Datacenter Networks - Architectures, Algorithms, and Opportunities*. Morgan & Claypool Publishers.