CSC-452: Parallel & Distributed Computing-Cloud

General Information

Course Number	CSC-452
Credit Hours	3 (Theory Credit Hour = 3, Lab Credit Hours = 0)
Prerequisite	N/A
Course Coordinator	

Course Objectives

In this course students learn fundamental concepts of parallel and distributed computing methods, including threaded applications, GPU parallel programming, and datacenter-scale distributed methods such as MapReduce and distributed graph algorithms & the types of algorithms which work well with these techniques, and have the opportunity to implement some of these algorithms also the types of hardware architectures which have been developed along with these computing methods. This course will provide high-level understanding of virtualization, containerization and dockerization in computing environments. The main objective of this course is to provide with the comprehensive and in-depth knowledge of parallel and distributed computing concepts, technologies, architecture and applications by introducing state-of-theart in parallel and distributed computing fundamental issues, technologies, applications and implementations. Another objective is to expose the students to frontier areas of Computing and information systems, while providing sufficient foundations to enable further study and research.

Course Content

Week	*Topics*	*Readings*

Week 01	• History of Computing
	• Fundamentals Of Parallel & Distributed Computing
	• **Computing Types**
	  • Traditional Computing Environment
	  • Cloud Computing
	  • Grid Computing
	  • Distributed Computing
	  • Cluster Computing
	  • Personal Computing
	  • Time-Sharing Computing
	  • Client-Server Computing
	  • Peer-to-Peer Computing
	  • Mobile Computing
	• Pros & Cons of Parallel & Distributed Computing
		Instructor Handouts
		Text Books

Week 02	• Flynn's Taxonomy. • Introduction to Multi-Threading • Parallel algorithms & architectures • Parallel I/O • Parallel Programming models (data-parallel, task-parallel, process-centric, shared/distributed memory)	Instructor Handouts Text Books

Week 03	• Asynchronous/synchronous computation/communication, • Concurrency control • Fault tolerance • Case Studies: From problem specification to a parallelized solution	Instructor Handouts Text Books
Week 04	• GPU architecture and programming, • Heterogeneity • Introduction to OpenCL • Message passing interface (MPI)	Instructor Handouts Text Books
Week 05	• Full Virtualization vs Para Virtualization • Device Virtualization (Pass-through, Hypervisor-Direct, and Split Device Driver) • Network and Storage Virtualization • Software Defined Networks (SDN) and Software Defined Storage (SDS);	Instructor Handouts Text Books
Week 06	**Midterm Exam**	
Week 7-8	• Containerization Technology? • Containers vs Virtual Machines in Cloud Computing • Docker containers • Container Management Platform (Kubernetes) • Working with Kubernetes in Azure cloud	Instructor Handouts Text Books
Week 9-10	• Overview of OpenStack • Deployments Models of OpenStack • OpenStack Architecture • Working with OpenStack components • Deploying OpenStack based private Cloud	Instructor Handouts Text Books
Week 11	• Explain the fundamental aspects of parallel and distributed programming models. • Big Data and Cloud Computing • Apache Hadoop framework on cloud	Instructor Handouts Text Books
Week 12	• Hadoop Cluster on Azure Cloud • Different cloud programming models (MapReduce, Spark, GraphLab and Spark Streaming). • Apache Spark and Cloud computing	Instructor Handouts Text Books
Week 13	Understand Internet of Things. IoT Infrastructure in Cloud Computing Connecting IoT devices to Azure Cloud Working with Azure Cloud IoT Suite. Understand IoT Hub in Azure Cloud	Instructor Handouts
Week 14	Cloud security challenges Cloud security approaches: encryption, tokenization/obfuscation, cloud security alliance standards, cloud security models and related patterns Cloud security in mainstream vendor solutions	Text Books

	Mainstream Cloud security offerings: security assessment, secure Cloud architecture design Presentations and Revision QA Session	
Week 17	Final Exam	Online Course Completion Certificate Research Articles

Evaluation

1.	Online Course Completion Certificate (related to Parallel & Distributed Computing)	5%
2.	Assignments and Quizzes	5%
3.	(Research Article) + Presentation	5%
4.	Midterm Exam I	20%
5.	Midterm Exam II	20%
6.	class participation (Weekly Q&A Sessions)	5%
7.	Final Exam	40%

Text Book

1. K. Hwang, G. Fox, and J. Dongarra, Distributed and Cloud Computing: from Parallel Processing to the Internet of Things

Reference Book

1. R. Buyya, J. Broberg, and A. Goscinski (eds), Cloud Computing: Principles and Paradigms

1	Define and explain the fundamental ideas behind Parallel & Distributed Computing, the evolution of the paradigm, its applicability; and benefits; Also understand how to use different Computing Services, deployment models, SLAs and SLOs.
2	Understand the importance of Virtualization and containerization technologies in cloud. Describe and implement open source private cloud platform using OpenStack. Also understand the working of different cloud storage services and distributed cloud programming models
3	Learn and implement different Parallel & distributed applications and cloud evaluation platforms such as Big Data, Data science and Machine learning using cloud infrastructures

CLO-SO Map

	SO IDs											
CLO ID	**GA1**	**GA2**	**GA3**	**GA4**	**GA5**	**GA6**	**GA7**	**GA8**	**GA9**	**GA10**	**GA11**	**GA12**
CLO 1	1	0	0	0	0	0	0	0	0	0	0	0
CLO 2	0	0	0	0	0	1	0	0	0	0	0	0
CLO 3	0	0	0	0	0	0	0	0	0	0	0	1

Approvals

Prepared By	
Approved By	Not Specified
Last Update	