

CLOUD & DATA APPLICATIONS

OVERALL COURSE OBJECTIVES:

Develop a comprehensive understanding of cloud computing, covering a wide range of tools, practices, and systems. This includes developing cloud-based solutions, managing big data, applying data engineering and machine learning in a cloud context, and creating efficient and effective cloud-native systems. These skills will equip learners to address real-world problems in cloud computing and adapt to evolving technologies and frameworks in the field of cloud computing.

LEARNING OUTCOMES: On successful completion of the course the students shall be able to:

1. Design and implement cloud computing infrastructure using core techniques, distributed systems, and algorithms.
2. Perform data analytics to handle big data solutions in both static and real-time environments using tools such as MapReduce, Hadoop, and Spark.
3. Incorporate machine learning engineering and automated learning solutions to solve complex problems in the cloud environment.
4. Implement agile software development techniques and apply them to projects involving microservices, serverless technology, and data engineering.
5. Develop cloud computing applications for machine learning, data science, and data engineering encompassing key areas like containers, virtual machines, and APIs.
6. Comprehend and apply the principles of cloud data engineering, encompassing the construction of data processing systems and databases.

Cloud Computing - I	Cloud Computing Concepts, Part 1
	Cloud Computing Concepts: Part 2
Cloud Computing - II	Cloud Computing Applications, Part 1: Cloud Systems and Infrastructure
	Cloud Computing Applications, Part 2: Big Data and Applications in the Cloud
	Cloud Networking
Cloud Applications - I	Cloud Computing Project
	Introduction to Cloud Computing
Cloud Applications - II	Application Development using Microservices and Serverless
	Cloud Computing Foundations
Cloud & Data Engineering	Cloud Data Engineering
	Cloud Virtualization, Containers and APIs
	Cloud Machine Learning Engineering and MLOps

COURSE CONTENT:

Module 1 : [Cloud Computing Concepts, Part 1](#) [23 Hours]

Cloud computing systems today, whether open-source or used inside companies, are built using a common set of core techniques, algorithms, and design philosophies – all centered around distributed systems. Learn about such fundamental distributed computing "concepts" for cloud computing. Some of these concepts include: clouds, MapReduce, key-value/NoSQL stores, classical distributed algorithms, widely-used distributed algorithms, scalability, trending areas, and much, much more!

Know how these systems work from the inside out. Get your hands dirty using these concepts with provided homework exercises. In the programming assignments, implement some of these concepts in template code (programs) provided in the C++ programming language. Prior experience with C++ is required. The course also features interviews with leading researchers and managers, from both industry and academia.

Sub-Topics

Orientation, Introduction to Clouds, MapReduce
Gossip, Membership, and Grids
P2P Systems
Key-Value Stores, Time, and Ordering
Classical Distributed Algorithms

Formative Assessments:

1 Programming Assignment & 2 Graded Quizzes

Module 2 : [Cloud Computing Concepts: Part 2](#) [20 Hours]

This course builds on the material covered in the Cloud Computing Concepts, Part 1 course. Cloud computing systems today, whether open-source or used inside companies, are built using a common set of core techniques, algorithms, and design philosophies – all centered around distributed systems. Learn about such fundamental distributed computing "concepts" for cloud computing. Some of these concepts include: clouds, MapReduce, key-value/NoSQL stores, classical distributed algorithms, widely-used distributed algorithms, scalability, trending areas, and much, much more!

Sub-Topics

Course Orientation and Classical Distributed Algorithms Continued
Concurrency and Replication Control
Emerging Paradigms
Classical Systems
Real-Life Behaviors

Formative Assessments:

1 Programming Assignment & 6 Graded Quizzes

Module 3 : [Cloud Computing Applications, Part 1: Cloud Systems and Infrastructure](#) [15 Hours]

Welcome to the Cloud Computing Applications course, the first part of a two-course series designed to give you a comprehensive view on the world of Cloud Computing and Big Data!

This course explores key cloud computing concepts, starting with big data, software-defined architectures, and virtualization. It delves into various service offerings by major providers like Amazon, Google, and Microsoft. Higher cloud offerings, including serverless architectures and middleware technologies, are also addressed. The course highlights the use of physical machines in the cloud environment and focuses on cloud storage services, with notable discussions on virtual archival storage options.

Sub-Topics

Introduction to Cloud Computing

Foundations: Containers, Virtual Machine, JVM

MAAS, PAAS, Web Services

Storage: Ceph, SWIFT, HDFS, NAAS, SAN, Zookeeper

Formative Assessments:

4 Graded Quizzes

Module 4 : [Cloud Computing Applications, Part 2: Big Data and Applications in the Cloud](#) [20 Hours]

The Cloud Computing Applications course delves into the transformative aspect of cloud computing, exploring data analytics on large, varied data sets. It looks at key systems for data analysis, such as Spark, and discusses data storage challenges in massive stores. The course introduces concepts like eventual consistency, ACID, BASE, and different consensus algorithms. It sheds light on distributed storage solutions, NOSQL databases, and real-time data streaming. The latter weeks focus on graph processing, machine learning, and deep learning, imparting practical knowledge through examples and introducing various tools used in these processes. The course ends with a deep dive into deep learning technologies used in the cloud.

Sub-Topics

Spark, Hortonworks, HDFS, CAP

Large Scale Data Storage

Streaming Systems

Graph Processing and Machine Learning

Formative Assessments:

4 Graded Quizzes

Module 5 : [Cloud Networking](#) [23 Hours]

In the cloud networking course, we will see what the network needs to do to enable cloud computing. We will explore current practice by talking to leading industry experts, as well as looking into interesting new research that might shape the cloud network's future.

This course will allow us to explore in-depth the challenges for cloud networking—how do we build a network infrastructure that provides the agility to deploy virtual networks on a shared infrastructure, that enables both efficient transfer of big data and low latency communication, and that enables applications to be federated across countries and continents? Examining how these objectives are met will set the stage for the rest of the course.

This course places an emphasis on both operations and design rationale—i.e., how things work and why they were designed this way. We're excited to start the course with you and take a look inside what has become the critical communications infrastructure for many applications today.

Sub-Topics

Application and Traffic Patterns

Host Virtualization

Congestion Control

Formative Assessments:

3 Programming Assignments & 5 Graded Quizzes

Module 6 : [Cloud Computing Project](#) [21 Hours]

This six-week long Project course of the Cloud Computing Specialization will allow you to apply the learned theories and techniques for cloud computing from the previous courses in the Specialization, including Cloud Computing Concepts, Part 1, Cloud Computing Concepts, Part 2, Cloud Computing Applications, Part 1, Cloud Computing Concepts, Part 2, and Cloud Networking.

Sub-Topics

Cloud Computing

Formative Assessments:

2 Peer Review Assignments

Module 7 : [Introduction to Cloud Computing](#) [24 Hours]

In this course you'll learn about essential characteristics of cloud computing and emerging technologies supported by cloud. You'll explore cloud service models, including Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS), and Public, Private, and Hybrid deployment models.

You will learn about the many components of cloud computing architecture including datacenters, availability zones, virtual machines, containers, and bare metal servers. You will also familiarize yourself with different types of cloud storage options, such as Object Storage.

Sub-Topics

Cloud Computing Models

Cloud Security and Monitoring, Case Studies, and Jobs

Components of Cloud Computing

Emergent Trends and Practices

Formative Assessments:

1 Peer Review Assignment & 5 Graded Quizzes

Module 8 : [Application Development using Microservices and Serverless](#) [24 Hours]

In this course, you will create microservices using various methodologies. You will create REST APIs using Python and Flask. Next, you will learn the basics of Serverless applications, and how to run your applications on the IBM Cloud Code Engine.

The course contains several hands-on labs which allow you to practice and apply the content you learn in the course.

Sub-Topics

Introduction to MicroServices

Introduction to Serverless

OpenShift Essentials/Working with OpenShift and Istio

ORM: MicroServices w/ Serverless

Formative Assessments:

1 Peer Review Assignment & 4 Graded Quizzes

Module 9 : [Cloud Computing Foundations](#) [19 Hours]

In this course, you will learn how to build foundational Cloud computing infrastructure, including websites involving serverless technology and virtual machines. You will also learn how to apply Agile software development techniques to projects which will be useful in building portfolio projects and global-scale Cloud infrastructures.

Sub-Topics

Applying DevOps Principles

Developing Effective Technical Communication

Evaluating the Cloud Service Model

Exploring Cloud Onboarding

Getting Started with Cloud Computing Foundations

Formative Assessments:

4 Graded Quizzes

Module 10 : [Cloud Data Engineering](#) [17 Hours]

In this course, you will learn how to apply Data Engineering to real-world projects using the Cloud computing concepts introduced in the first two courses of this series. By the end of this course, you will be able to develop Data Engineering applications and use software development best practices to create data engineering applications. These will include continuous deployment, code quality tools, logging, instrumentation and monitoring. Finally, you will use Cloud-native technologies to tackle complex data engineering solutions.

Sub-Topics:

Applying Key Data Engineering Tasks

Building Data Engineering Pipelines
Examining Principles of Data Engineering
Getting Started with Cloud Data Engineering

Formative Assessments:

4 Graded Quizzes

Module 11 : [Cloud Virtualization, Containers and APIs](#) [14 Hours]

In this course, you will learn to design Cloud-native systems with the fundamental building blocks of Cloud computing. These building blocks include virtual machines and containers. You will also learn how to build effective Microservices using technologies like Flask and Kubernetes. Finally, you will analyze successful patterns in Operations including: Effective alerts, load testing and Kaizen.

Sub-Topics

Getting Started with Cloud Building Blocks
Microservices
Operations
Virtualization and Containers

Formative Assessments:

3 Graded Quizzes

Module 12 : [Cloud Machine Learning Engineering and MLOps](#) [12 Hours]

In this course, you will build upon the Cloud computing and data engineering concepts introduced in the first three courses to apply Machine Learning Engineering to real-world projects. First, you will develop Machine Learning Engineering applications and use software development best practices to create Machine Learning Engineering applications. Then, you will learn to use AutoML to solve problems more efficiently than traditional machine learning approaches alone. Finally, you will dive into emerging topics in Machine Learning including MLOps, Edge Machine Learning and AI APIs.

Sub-Topics

Emerging Topics in Machine Learning
Getting Started with Machine Learning Engineering
Using AutoML

Formative Assessments:

3 Graded Quizzes

ASSESSMENT:

For summative assessments, Coursera will provide question banks for which exams can be conducted on the Coursera platform or the faculty will create their own assessments.

Note: If a Course or Specialization becomes unavailable prior to the end of the Term, Coursera may replace such Course or Specialization with a reasonable alternative Course or Specialization.