Harvard Extension School - Computer Science

Cloud DevOps - Basics and Modern Techniques - CSCI E-91
Fall Semester Syllabus

Part 1: Course Information

Instructor Information

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Course Description

This course covers a deep dive into the DevOps revolution, enabling students to become more efficient and effective in overcoming day-to-day IT infrastructure challenges. We have designed this course keeping in mind what modern DevOps engineers require to fully utilize the resources at hand.

Students can automate and build configurations for infrastructure and servers, addressing areas such as automation, continuous deployment, containerization, and monitoring. The topics in this course are put together in a logical and stepwise manner.

By the end of the course, students will have gained skills in adding resilience into services and infrastructure in the cloud by learning configuration management (Puppet, Ansible), continuous deployment, integration with several DevOps tools and techniques such as cloud APIs and linux skills/scripting towards resource automation and optimization.

Students will explore opportunities with two cloud service providers; AWS (Amazon Web Services) and Google Cloud Platform to achieve rapid application deployment and management across cloud resources.

PREREQUISITES

Understanding of the basic concepts of Linux file system and commands. Windows users are expected to know how to create and run Linux Virtual machine on a virtual environment like VirtualBox. Understanding of the basic concepts of programming, such as variables, control structures, repetition structures (loops), data structures, functions, and syntax. Students should be comfortable writing a simple program in one of their preferred languages, such as C, Java, Bash script, or Python.

Part 2: Topic Outline/Schedule

- **Week 01: Introduction to Cloud and DevOps**

This lecture will be an introduction to the cloud and DevOps. In this lecture, students will learn how to work in a Linux environment, install modules and packages, use Linux commands, and write scripts using bash:

- History of the cloud and the relationship between the cloud and computer virtualization.
- Different cloud platforms: commercial clouds - Amazon Web Services(AWS), Google Cloud, Azure Cloud and private clouds.
- Definition of the term DevOps with an emphasis on why it's important in the modern world.
- Virtual machines.
- Linux basics and commands
- Instructions for creating Google and Amazon AWS account and applying for AWS educational credit.

- **Week 02: Working Environment and Version Control**

In this lecture, students will learn how to use ssh, setup a Python environment and learn basic Python programming techniques. Students will also learn how to use version control systems to store, share, and control changes in their code locally.

- Authentication and Connection to a remote environment: console, ssh, rdp
- Python and IPython Notebook
- Git version control - Git commands with local repository

Assignment 1

- **Week 03: Amazon AWS - Part 1**

The next two lectures will focus on Amazon AWS environment and basic architecture. This lecture will cover the use of the AWS console to build your cloud environment and resources.

- Introduction to the AWS infrastructure and Console
  - Regions
  - Availability Zones
- Computing resources
  - Elastic Compute Cloud - EC2
    - Simple Apache web server setup
- S3 Storage:
  - Simple Storage Service (S3)- Basics
- Networking - *Overview*
  - Virtual Private Cloud (VPC)
  - Subnets
  - Routing tables
  - Address space

Assignment 2

- **Week 04: Amazon AWS - Part 2**

This lecture we will continue with AWS services with the emphasis on the automation part. Students will learn how to use AWS CLI and Python libraries to manage AWS resources.

  - Monitoring and Logging
    - CloudWatch
    - CloudTrail
  - SNS
  - IAM:
    - Users
    - Groups
    - Roles
  - AWS Command Line Interface(CLI)
  - Building AWS resources using AWS SDK for Python

- **Week 05: Infrastructure As Code (IaC)**

One of the pillars of DevOps is the Infrastructure As Code (IaC). IaC is the process of provisioning and managing computation resources using a descriptive language. This lecture will discuss two of the popular IaC tools, CloudFormation and Terraform. Students will learn how to use these tools to provision and manage AWS cloud resources.

  - CloudFormation
  - Terraform

- **Week 06: Configuration Management**

Another pillar of DevOps is the Configuration management used to automate the management and configuration of the server(s) software stack. Students will use configuration management tools to manage AWS cloud servers.

  - Ansible
  - Puppet

Assignment 3

- **Week 07: Continuous Integration / Continuous Delivery (CI/CD) - Part 1**

CI/CD can be considered as the main pillar of DevOps. In this lecture CI/CD will be utilized to automate deployment of different environments. Additionally, version control will be revisited in this lecture.

  - Re-visit Git version control using Gitlab
    - GitLab
    - Git commands with remote repository
  - Continuous delivery
    - Jenkins
    - GitLab

- **Week 08: Continue with CI/CD and Project Management - Part 2**

  In the second part of the lecture 07, we will cover project management as part of CI/CD using different tools.

  - Trello
  - Gitlab project management
  - Github project management

- **Week 09: Continue with CI/CD and Project Management - Part 3**

This lecture will demonstrate how CI/CD and Project Management can be integrated together towards deploying production and testing environments in an automated manner.

Assignment 4

- **Week 10: Microservices & Serverless**

Microservices, Containerization and Serverless are very popular in the DevOps world. We will cover the required details in each topic.

  - Microservices
    - Docker Containers and Container Registry on different platforms
  - Serverless - Overview and demo
    - Lambda
    - API Gateway
    - S3

Assignment 5

- **Week 11: Google Cloud Platform (GCP) - Part 1**

Students will create a Google Cloud account and build a computation environment similar to the one created with the AWS Cloud services.

  - Google Cloud Platform account
  - Build a computing environment
    - Google Computing
    - Google VPC
    - Google Database
    - Google Kubernete Engine

- **Week 12: Google Cloud Platform (GCP) - Part 2**

Students will learn how to use Python to manage their Google Cloud resources using client API, the same way it has been done with Amazon AWS part 1.

  - Python modules for Google Cloud
  - Managing resources and credentials

Assignment 6

- **Week 13: Miscellaneous DevOps and Automation Topics**

We will cover topics and best practices to help DevOps engineers escalate in the work field.

  - Automatic snapshot and disaster recovery.
  - Visualize your cloud environment.
  - Migrating services among different cloud platform
  - Cloud resources cost control

- **Week 14: Projects Presentations**

Part 3: Grading Policy

There will be 6 assignments during the course which will be posted to Canvas. The graded assignments and solutions will also be posted on Canvas.

Points	**Description**
500	6 Assignments (top 5)
100	Participation
400	Final Project and presentation
1000	**Total Points**

- To be able to succeed in this course, students will conduct a pre-evaluation test to assess their readiness to take this course. For those who fairly or did not pass will be provided with some resources to cover their needs and proceed with the course smoothly.
- Out of the 6 assignments, 5 with the top scores will be chosen.
- All assignments must be completed by the assignment due date and time. Late or missing discussion assignments will be accepted but 10% of the total points of the assignment will be deducted every day after the due date.
- Quizzes and Surveys will be posted after each lecture to cover students concerns and questions.
- Accepted format for the submitted assignment will be indicated in each assignment.
- Make sure to inform the instructor and/or the TA(s) when difficulties arise during the semester as needed.