COMSATS UNIVERSITY, ISLAMABAD
Department of Computer Science
Midterm Examination, Fall 2025

Class: BDS VII
Instructor: Mr. Qasim Malik
Subject: DSC413 – Topics in Data Science (DevOps)

Date: 29-10-2025
Time Allowed: 90 Minutes
Marks: 25

CLO-1: Characterize the fundamentals of cloud computing along with its service models

Question 1: The DevOps team wants to deploy an e-commerce web application built with *Node.js*, *React*, and *MongoDB* in AWS cloud. The app should run on highly available, scalable infrastructure using EC2 instances running Linux but managed automatically through Elastic Beanstalk The database (MongoDB) will remain on-premises, while all product images and user uploads will be stored securely in Amazon S3. [3]

a) Identify which cloud service models are involved in this setup and justify your choice.
b) Which cloud deployment model best fits this setup? Justify your answer.
c) Explain how AWS Elastic Beanstalk ensures scalability and high availability for the deployed e-commerce web application.

CLO-2: Enumerate virtualization and containerization techniques used in cloud computing

Question 2: You are provided with a single physical server having 8 GB RAM and 4 vCPUs. You are required to host three separate web applications on it:

App1: Node.js with MongoDB
App2: Django with PostgreSQL
App3: PHP with MySQL

Due to limited system resources, only one application can remain active at a time while the others must stay stopped to conserve memory and CPU. Additionally, there is a web-based control panel (a lightweight fourth application) that allows a user to start or stop any one of the three applications through a simple web interface (no terminal or SSH usage)

a) Propose a complete design or architecture that can achieve the above requirements. **[2]**
b) Explain how your system will start, stop, and switch between applications behind the scenes and comment on the startup time. **[2]**
c) Describe how you would preserve application data (e.g., databases) even when an app is stopped. **[1]**

Question 3: The RARE25 Challenge requires participants to submit their trained AI models as a Grand Challenge (GC) inference container. The container is Docker-based and encapsulate the following:

- The trained AI model (*model.pth*)
- The inference script that loads input data, performs prediction, and writes results (*inference.py*)
- All dependencies and environment setup needed for reproducibility (*requirements.txt*)
- *inference.py* wants test images to be placed in */input/images* inside the container and stores predictions (*results.csv*) in */output* folder

a) Write a *Dockerfile* that can package the whole application including installing dependencies using *pip install*. Use the *pytorch/pytorch:2.2.0-cuda12.1-cudnn8-runtime* as base image. **[3]**
b) Write a series of commands to build the image and push it to *DockerHub*. **[2]**
c) RARE25 Challenge wants you to submit *docker-compose* file that can mount the host folder *./test_cases/* to provide test images and automatically start the container to run inference. Write such a *docker-compose* file. **[2]**

CLO-3: Compare centralized and distributed types of source control management techniques

Question 4: While working on a project, developers located in different offices connect to a main repository hosted on a cloud server. Each developer's workstation maintains a local working copy of the project files. Developers modify their local copies and, when ready, push their changes to the main repository. However, local changes are not versioned or tracked until they are pushed to the server. All official branches (such as main, testing, and release) exist only on that server. Based on this description, determine whether this setup represents a centralized or distributed version control system. Justify your reasoning with two strong arguments. **[2]**

Question 5: While collaborating on a project, a teammate mistakenly commits directly to the main branch. Write down the Git command sequence you would use to safely move that commit to a new branch, ensuring that no work is lost and the main branch remains stable. **[3]**

CLO-4: Apply DevOps pipeline automation techniques for code deployment

Question 6: ShopEasy, an online retail company, wants to automate its CI/CD workflow using Jenkins.

a) Differentiate between a Freestyle job and a Pipeline job in Jenkins. [1]
b) Apply build stage automation by writing a Jenkins pipeline script that pulls code from GitHub and launch build environment in a containerized way. [3]
c) Demonstrate how Jenkins can be integrated with GitHub to automatically trigger the pipeline when new code is pushed. [1]