**INFO8995 - Fall 2024 - Section 1**

**Container and Orchestration**

**Assignment 4**

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# **Introduction**

In today's fast-paced software development landscape, the implementation of Continuous Integration and Continuous Deployment (CI/CD) practices is essential for maintaining agility, efficiency, and quality. This document outlines a comprehensive roadmap for integrating CI/CD into our development environment, focusing exclusively on free and open-source solutions. Each phase of the CI/CD pipeline has been meticulously evaluated, with multiple tools considered and the most suitable options selected based on their features, community support, and alignment with our project requirements. This roadmap not only presents the chosen tools but also provides alternative options and detailed justifications for each selection, ensuring a robust and adaptable CI/CD strategy.

Following are the tools and technologies that we are about to implement as part of the solution.

# **1. Version Control**

**Current Tool: Git (GitHub)**

Description: Git is a free and open-source distributed version control system designed to handle everything from small to very large projects with speed and efficiency. It allows multiple developers to work on the same project simultaneously without interfering with each other's work. GitHub and GitLab provide web-based interfaces for Git repositories, offering additional features like issue tracking, CI/CD integration, and project management.

**Alternatives**:

**Mercurial**: A distributed version control system similar to Git, known for its simplicity and performance. It is particularly user-friendly on Windows and offers a straightforward command-line interface. We are avoiding this tool for now because Git has a larger community and more widespread adoption.

**Apache Subversion (SVN)**: A centralized version control system that is also open-source. It is suitable for projects that prefer a centralized repository and provides robust support for versioning and branching. We are avoiding this tool for now because distributed version control systems like Git offer more flexibility for collaborative development.

# **2. Containerization**

**Current Tool: Docker**

Description: Docker is an open-source platform that automates the deployment of applications inside lightweight, portable containers. It ensures consistency across multiple development and release cycles by packaging software with all its dependencies. Docker simplifies the process of managing and scaling applications.

**Alternatives**:

**Podman**: An open-source, daemonless container engine that is compatible with Docker. It offers improved security and performance by eliminating the need for a background daemon. We are avoiding this tool for now because Docker has more extensive documentation and community support.

**LXC (Linux Containers)**: Provides OS-level virtualization for running multiple isolated Linux systems on a single host. It is suitable for more complex software that requires a full operating system. We are avoiding this tool for now because Docker is more widely adopted and easier to use for most containerization needs.

# **3. Continuous Integration/Continuous Deployment (CI/CD)**

**Current Tool: Jenkins**

Description: Jenkins is an open-source automation server that enables developers to build, test, and deploy their software. It supports a wide range of plugins to integrate with various tools and technologies, making it highly customizable and extensible.

**Alternatives**:

**GitLab CI/CD**: Integrated with GitLab, it provides a seamless CI/CD experience and is also open-source. It allows for easy setup and management of pipelines directly within the GitLab interface. We are avoiding this tool for now because Jenkins offers more flexibility with its extensive plugin ecosystem.

**CircleCI**: A CI/CD tool known for its speed and efficiency. It supports parallel testing and integrates well with GitHub and Bitbucket. We are avoiding this tool for now because it is not free.

# **4. Code Quality and Security**

**Current Tool: SonarQube**

Description: SonarQube is an open-source platform for continuous inspection of code quality to perform automatic reviews with static analysis of code. It helps detect bugs, vulnerabilities, and code smells in your codebase.

**Alternatives:**

**Codacy:** An open-source tool that provides automated code reviews and monitors code quality. It supports multiple programming languages and integrates with various CI/CD tools. We are avoiding this tool for now because SonarQube offers more comprehensive analysis and integration options.

**Cppcheck:** An open-source static analysis tool for C/C++ code. It focuses on detecting bugs that compilers typically do not catch. We are avoiding this tool for now because SonarQube supports a wider range of programming languages.

# **5. Testing**

**Current Tool: JUnit**

Description: JUnit is an open-source framework for unit testing in Java. It provides annotations to identify test methods and assertions to test expected results. JUnit is widely used in the Java ecosystem for test-driven development.

**Alternatives:**

**TestNG:** An open-source testing framework inspired by JUnit but with more powerful features. It supports parallel test execution and data-driven testing. We are avoiding this tool for now because JUnit is more widely adopted and has better community support.

**Mockito:** An open-source mocking framework for unit tests in Java. It allows you to create mock objects and define their behavior for testing purposes. We are avoiding this tool for now because JUnit provides sufficient functionality for our current testing needs.

# **6. Artifact Management**

**Current Tool: JFrog OSS Artifactory / S3**

Description: Artifactory is an open-source repository manager that supports various package formats. It helps manage build artifacts and dependencies, providing a central location for storing and retrieving them.

**Alternatives:**

**Sonatype Nexus Repository OSS:** An open-source repository manager that supports many artifact formats, including Docker, Java, and npm. It offers robust features for managing and securing artifacts. We are avoiding this tool for now because Artifactory has a more user-friendly interface.

**Apache Archiva:** An open-source repository management tool that helps manage build artifacts. It supports multiple repository formats and provides a web-based interface for managing artifacts. We are avoiding this tool for now because Artifactory offers better integration with CI/CD tools.

# **7. Monitoring and Alerting**

**Current Tool: Prometheus**

Description: Prometheus is an open-source monitoring and alerting toolkit designed for reliability and scalability. It collects metrics from configured targets at given intervals, evaluates rule expressions, and can trigger alerts if certain conditions are met.

**Alternatives:**

**Zabbix:** An open-source monitoring tool for networks and applications. It provides advanced alerting and visualization features and is known for its reliability in production environments. We are avoiding this tool for now because Prometheus offers better support for modern cloud-native environments.

**InfluxDB + Chronograf:** InfluxDB is a time-series database for collecting and storing metrics, while Chronograf is used for visualizing that data. Together, they provide a powerful solution for monitoring and alerting. We are avoiding these tools for now because Prometheus has a more integrated and cohesive ecosystem.

# **8. Visualization and Dashboarding**

**Current Tool: Grafana**

Description: Grafana is an open-source platform for monitoring and observability. It allows you to query, visualize, alert on, and understand your metrics no matter where they are stored. Grafana supports a wide range of data sources and provides customizable dashboards.

**Alternatives:**

**Kibana:** An open-source data visualization and exploration tool used for log and time-series analytics. It integrates seamlessly with Elasticsearch. We are avoiding this tool for now because Grafana supports more diverse data sources.

**Tableau:** A powerful data visualization tool that, while not open-source, offers extensive features for data analysis and visualization. We are avoiding this tool for now because it is not free.