# Final Year Project

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Computing with Games Development

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# "**AI-Driven CI/CD Pipeline: Automating Code Quality and Unit Testing with GitHub Actions"**

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# Introduction

Introduction will be re written at the end of the project.

In the constant growing field of software development, automation and continuous improvement are critical to maintain efficiency, code quality, and rapid delivery. As modern development teams shift towards Agile and DevOps methodologies, Continuous Integration and Continuous Delivery (CI/CD) pipelines have become foundational elements in software development processes. These pipelines allow for the automatic integration and testing of code, ensuring that new features and updates are integrated to our software without manual work. However, maintaining high code quality and comprehensive test coverage remains a challenge, especially as the complexity of codebases increase.

Integrating AI into CI/CD pipelines is a promising solution to these challenges. AI can improve processes by automating code quality analysis, detect code smells and recommend or create unit tests. This is especially useful in environments where junior developers are involved, as AI can help identify potential problems early on the development cycle, provide solutions and facilitate faster feedback

This project focuses on the development of an AI-Driven CI/CD Pipeline, leveraging GitHub Actions as the primary automation tool for pipeline management. The pipeline will incorporate AI capabilities to automate key quality assurance tasks such as code scanning, detecting code smells, generating unit tests, and ensuring high code coverage. The AI will be triggered during the pull request process, reviewing the code submitted by developers, offering improvements and suggestions.

The main goal of this project is to explore integrating AI into GitHub workflows to create automation that improves code quality. By creating AI-powered automation in the CI/CD process, the project seeks to provide innovative solutions to improve code flexibility and developer productivity. So, it sets the modern standard for DevOps with tools like SonarQube for code quality scanning and GitHub Actions for automated workflows. Using these software tools, this project will provide practical insights into how AI can help streamline the CI/CD lifecycle.

# Chapter 1: Literature Review

## AI in Software Development

### 1.1.1 Overview of AI

Artificial Intelligence (AI) has grown from a theoretical concept in the past to a practical tool that is now spreading in various fields, including software development. AI in this sector refers to the application of intelligent systems that can process data, learn from it, make decisions and problem-solve to improve software creation and maintenance. AI is rapidly being implemented across various stages of the development lifecycle, from code generation, optimization to testing and deployment. These systems or machines are programmed to help automate repetitive and time-consuming tasks such as bug detection, code review etc. thus improve the efficiency of developers and “reduce their cognitive load and eliminating human error Ozkaya, I. (2023).” Also, he increased machine learning algorithms and natural language processing tools enable AI to expand its potential to understand more complex codebases and leading to more innovation and better code.

### AI in DevOps

DevOps is the communication and collaboration between development and operations teams. DevOps is all about helping shorten the development lifecycle while still delivering high-quality software continuously. It involves teams focusing on agile methodologies, automating processes, improving deployment iterations and ensuring more reliable software releases. AI in DevOps according to GitLab (2023), refers to “the use of machine learning (ML) and other artificial intelligence technologies to automate and optimize the software development and delivery process”. By integrating AI into DevOps, companies can make software development processes more efficient, accurate and dependable. Also, as AI-driven systems can be programmed to detect anomalies, predict points of system failure and suggest possible optimizations, this leads to enhancing system stability. Furthermore, AI can automate important DevOps tasks such as infrastructure management, security checks, and system behavior analysis. Overall, combining AI with DevOps processes “amplifies the effectiveness of feedback loops” increasing collaboration across the operations and development teams.

## Investigating AI in Continuous Integration and Continuous Development (CI/CD)

### Automation of Code Quality Assurance

Maintaining code quality in CI/CD pipelines in the past relied on manual code reviews and static analysis tools. However, now with the implementation of AI, these processes can be automated. This provides real-time code analysis to detect issues like bugs, security vulnerabilities and code smells. To add on this the use of tools such as SonarQube give efficient code analyzation and offer immediate feedback for developers. These Code Quality Assurance tools are rapidly being integrated into CI/CD pipelines, enhancing productivity by automating repetitive quality assurance tasks (Shahin et al., 2017). Furthermore, as stated by (Zencoder, 2023) AI-Driven code review systems not only analyze the source code, but they are also capable of automatically constructing the related test cases and improving overall code quality by using the knowledge obtained from past reviews, thus, ensuring there is complete test coverage. As a result, reducing human error caused by manual intervention in the code review process.

### Automated Testing and Deployment

## Tools for Enhancing CI/CD Pipeline

### GitHub Actions an AI Integration

### SonarQube for Automated Code Quality Analysis

# Chapter 2: Methodology

## 2.1 Research Question

How can AI-driven automation enhance the code review process in CI/CD pipelines, specifically through the integration of GitHub Actions and SonarQube for improving code quality and developer efficiency?

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