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Machine Learning Applications for Code Smell Detection and Automated Software Refactoring Recommendations

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Abstract: *Software quality and maintainability are critical challenges in modern software development. Code smells—subtle indicators of poor design or implementation choices—can lead to increased technical debt, higher defect rates, and reduced system performance if left unaddressed. Traditional manual detection of code smells is time-consuming, error-prone, and heavily dependent on developer expertise. This project explores the application of machine learning (ML) techniques to automatically detect code smells in software systems and provide intelligent, context-aware refactoring recommendations. By analyzing software metrics such as cyclomatic complexity, lines of code, coupling, and cohesion, ML models can classify code segments as smelly or clean. Furthermore, the system suggests appropriate refactoring actions, like Extract Method or Move Class, to improve code quality without altering its functionality. The proposed approach aims to reduce manual effort, lower technical debt, and enhance overall software maintainability. Experimental results demonstrate that ML-based detection outperforms traditional rule-based techniques, offering accurate, scalable, and proactive solutions for software improvement.*

Keywords: Code Smell, Software Refactoring, Machine Learning, Automated Detection, Software Maintainability

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