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END OF STUDY THESIS

To obtain a **state engineer's** diploma
Stream: **Computer Science**
Speciality: **Information Systems Engineering (ISI)**

STATIC ANALYSIS FOR EARLY DETECTION OF VULNERABILITIES IN SOURCE CODE BASED ON ARTIFICIAL INTELLIGENCE

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Abstract

Software security has become a critical concern as modern applications grow increasingly complex and interconnected. Traditional static analysis tools, while widely adopted for detecting vulnerabilities in source code, often suffer from high false-positive rates and limited ability to capture deep semantic relationships in programs. To address these limitations, this project replicates and adapts a deep learning architecture from a state-of-art Research paper which achieved a great results relatively to other reseach papers for classifying Java functions as safe or vulnerable. The model leverages program representations to learn semantic and structural patterns in source code, enabling more accurate vulnerability detection.

Beyond model development, this work focuses on practical integration. A web application was implemented to provide an accessible interface for testing and analyzing Java code, while a dedicated Visual Studio Code extension was developed to bring vulnerability detection directly into the developer workflow. Together, these tools demonstrate how deep learning can be effectively applied in real-world development environments to assist programmers in identifying and mitigating security risks.

This project highlights the potential of combining deep learning with engineering solutions to advance automated vulnerability detection, bridging the gap between research prototypes and practical software security tools.

Keywords: Static Code Analysis, Vulnerability Detection, AST, DFG, CFG, DL, ML, Software Vulnerability Detection, Graph Neural Networks (GNNs), Java Security, Web Application, VS Code Extension.