

# **Machine Learning Techniques for Predictive Bug Detection and Software Error Prevention in IT Systems**

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**Abstract:** *Ensuring software reliability has become increasingly challenging as modern IT systems grow in complexity and scale, leading to a rising number of defects that can disrupt functionality, compromise security, and increase maintenance costs. Traditional testing and debugging techniques are often reactive, detecting issues only after they have surfaced during execution. To address this limitation, machine learning (ML) introduces a proactive approach by leveraging historical data, code metrics, and development patterns to predict bug-prone components before deployment. This paper provides an analytical study of various ML techniques—including supervised and deep learning models—for accurately identifying potential defects and preventing software failures. The framework emphasizes early detection, automated risk assessment, and continuous learning to support decision-making throughout the Software Development Life Cycle (SDLC). By integrating intelligent predictive models into software engineering workflows, organizations can significantly reduce debugging efforts, improve code quality, and enhance overall system reliability. The findings highlight the transformative potential of ML-based prediction tools in shifting from corrective measures to preventive software engineering practices, ultimately ensuring secure and high-performance IT environments.*

**Keywords:** Machine Learning, Predictive Bug Detection, Software Error Prevention, Software Reliability, Defect Prediction Models, Software Quality Assurance, SDLC, Intelligent Analytics

