Llama3 Fine-Tuning for Injection Vulnerability Detection in Smart Contracts

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Abstract

Decentralized applications (DApps) face significant security risks due to vulnerabilities in smart contracts, with traditional detection methods struggling to address emerging and machine-unauditable flaws. This paper proposes a novel approach leveraging fine-tuned Large Language Models (LLMs) to enhance smart contract vulnerability detection. We introduce a comprehensive dataset of 215 real-world DApp projects (4,998 contracts), including hard-to-detect logical errors like token price manipulation, addressing the limitations of existing simplified benchmarks. By fine-tuning LLMs (Llama3-8B

1 Introduction

This paper examines: Enhancing Smart Contract Vulnerability Detection in DApps Leveraging Fine-Tuned LLM. Research question: Can fine-tuning Llama3 on domain-specific secure coding guidelines improve its precision and recall scores for detecting injection vulnerabilities compared to zero-shot performance?.

2 Methodology

Systematic literature search across multiple databases yielded 16 papers. Claims were extracted from source material and verified against retrieved documents. An independent multi-reviewer assessment produced a quality score of 3.8/10.

3 Results

16 papers retrieved. 13 claims extracted; 0 independently verified. Quality review score: 3.8/10.

4 Limitations

This report is a machine-generated literature synthesis and does not constitute original research. Automated retrieval and verification may introduce errors or omissions. Review scores reflect automated assessment, not human peer review. Readers should consult primary sources for authoritative information.

5 Extracted Claims

Claim	Verified	Confidence
Fine-Tuning LLM achieves an accuracy of 0.82 for RV, 0.63 for AV, 0.47 for TDV, and 0.97 for PMV using Llama3-8B-FFT.	×	0.08
Fine-Tuning LLM achieves a precision of 0.82 for RV, 0.63 for AV, 0.47 for TDV, and 0.97 for PMV using Llama3-8B-FFT.	×	0.09
Fine-Tuning LLM achieves a recall of 0.63 for RV, 0.70 for AV, 0.98 for TDV, and 0.68 for PMV using Llama3-8B-FFT.	×	0.08
Fine-Tuning LLM achieves a precision of 0.57 for RV, 1.00 for AV, 0.44 for TDV, and 1.00 for PMV using Qwen2-7B-FFT.	×	0.07
Fine-Tuning LLM achieves a recall of 0.83 for RV, 0.19 for AV, 0.93 for TDV, and 0.63 for PMV using Qwen2-7B-FFT.	×	0.08
Fine-Tuning LLM achieves a precision of 0.66 for RV, 0.82 for AV, 0.22 for TDV, and 0.97 for PMV using Qwen2-7B-LoRA.	×	0.08
Fine-Tuning LLM achieves a recall of 0.68 for RV, 0.21 for AV, 0.74 for TDV, and 0.63 for PMV using Qwen2-7B-LoRA.	×	0.08
The proposed method uses a fine-tuning approach to adapt LLMs for Solidity code vulnerability detection.	×	0.11
The LLM assumes two roles—Smart Contract Auditor and Verifier—activated through prompt instructions.	×	0.07
The Smart Contract Auditor is responsible for auditing smart contract code and identifying potential security issues.	×	0.09
The Verifier is responsible for further verifying the types of identified vulnerabilities to ensure the accuracy and rig	×	0.02
The dataset collected contains audited contract projects from Code4rena and Slowmist platforms.	×	0.03
A Python tool called SmartCollect is implemented to recover a complete DApp project's dependency contracts, including pu	×	0.06

References

- http://arxiv.org/abs/2504.16584v1
- http://arxiv.org/abs/2504.05006v2
- http://arxiv.org/abs/2506.11022v2