LLM-Driven Fuzzing

Automatic Harness Generation for Crypto Libraries

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July, 2025

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Preface

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1 Introduction

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1.1 Motivation

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1.2 Preview of following sections (rename)

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2 Background

2.1 Fuzzing

What is fuzzing [1].

Why fuzz?

2.1.1 Fuzzing examples

Heartbleed [2], shellshock [3].

2.1.2 Fuzzer engines

C/C++: AFL [4] & AFL++ [4, pp. ++]. LibFuzzer [5].

Python: Atheris [6].

Java, Rust etc...

An example of a fuzz target/harness can be seen in Listing 2.1 [5].

Listing 2.1 A simple function that does something interesting if it receives the input "HI!".

```
cat << EOF > test_fuzzer.cc
#include <stdint.h>
#include <stddef.h>
extern "C" int LLVMFuzzerTestOneInput(const uint8_t *data, size_t size) {
  if (size > 0 && data[0] == 'H')
    if (size > 1 && data[1] == 'I')
       if (size > 2 && data[2] == '!')
       __builtin_trap();
  return 0;
}
EOF
# Build test_fuzzer.cc with asan and link against libFuzzer.
clang++ -fsanitize=address,fuzzer test_fuzzer.cc
# Run the fuzzer with no corpus.
./a.out
```

2.2 Large Language Models (LLMs)

Transformers [7], 2017–2025. ChatGPT/OpenAI history & context. Claude, Llama (1–3) etc.

2.2.1 Prompting

Prompting techniques.

1. Zero-shot.
2. One-shot.
3. Chain of Thought [8].
4. ReACt [9].
5. Tree of Thoughts [10].

Comparison, strengths weaknesses etc. [11].

2.2.2 LLM Programming Libraries (?)

Langchain & LangGraph, LlamaIndex [12]–[14]. DSPy [15].

Comparison, relevance to our usecase.

2.3 Neurosymbolic AI

TODO [16]–[21].

3 Related work

3.1 Automatic Harnesses

Where we are right now. SOTA projects. Similar projects using LLMs in the fuzzing space [22]–[24].

TODO

3.2 Google

FuzzGen, FUDGE, OSS-Fuzz-Gen [25]–[28].

3.2.1 OSS-Fuzz-Gen

Features/caveats. `from_scratch` branch[1].

[1] commit 171aac2

4 Overview

1. How is it different?
2. What does it offer?
3. Example uses
4. Scope of Usage
    1. In what contexts does it work?
    2. Prerequisites

4.1 Architecture

- System diagram
- Main Library Architecture/Structure
- LLM usage
    - Prompting techniques used (callback to Section 2.2.1).
- Static analysis
- Code localization(?)
- Fuzzers
- GitHub Workflow/Usage

5 Implementation

- Tools
- Libraries

6 Evaluation

6.1 Benchmarks

Results from integration with 10/100 open-source C/C++ projects.

6.2 Performance

6.3 Issues

6.4 Future work

6.4.1 Technical future work

6.4.2 Architectural future work/extensions

1. Build system
2. More (static) analysis tolls integrations
3. General *localization* problem

7 Conclusion

Recap

7.1 Acknowledgements

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A Failed Techniques

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