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Automated Vulnerability Scanner for the Cyber Resilience Act

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Cyber Resilience Act (CRA)

- Introduces new mandatory cybersecurity requirements for hardware and software products throughout the whole lifecycle
- Regulation focuses on products with digital elements
- Classification of products into different classes + exclusion criteria

4 Objectives

1. Improve security throughout the whole lifecycle
2. Ensure coherent framework for cybersecurity
3. Increase transparency of security features of products
4. Enable companies/ consumers to use digital products safely

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Challenges for manufacturers of IoT products

- How to define requirements for a software that could assists manufacturers with complying with the CRA?
- Additional overhead for manufacturers to proof compliance
- How can compliance be proven to a third party?

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Presented Solutions

- Research Question: How could a software prototype look like, that assists manufacturers with vulnerability detection to comply with the CRA?

- Idea: Introducing Software that performs compliance checks for IoT devices

☑ CRA Compliance Checklist

☑ Vulnerability Scanner

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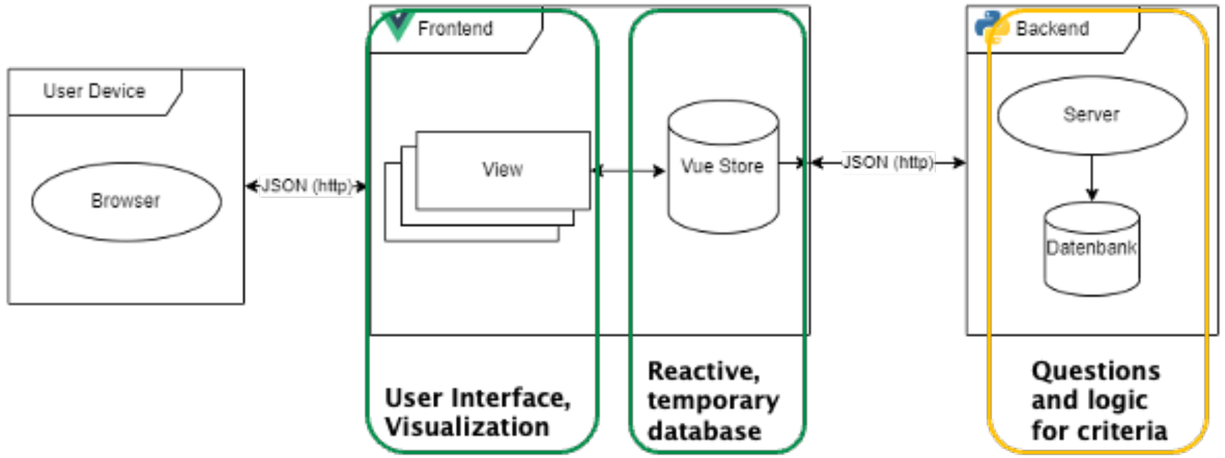
CRA Compliance Checklist

- A tool to determine the current cyber security standard and to monitor compliance with the requirements of the Cyber Resiliance Act
- Documentation on the current status and the degree of compliance with the regulation
- Tips and information on compliance with the requirements



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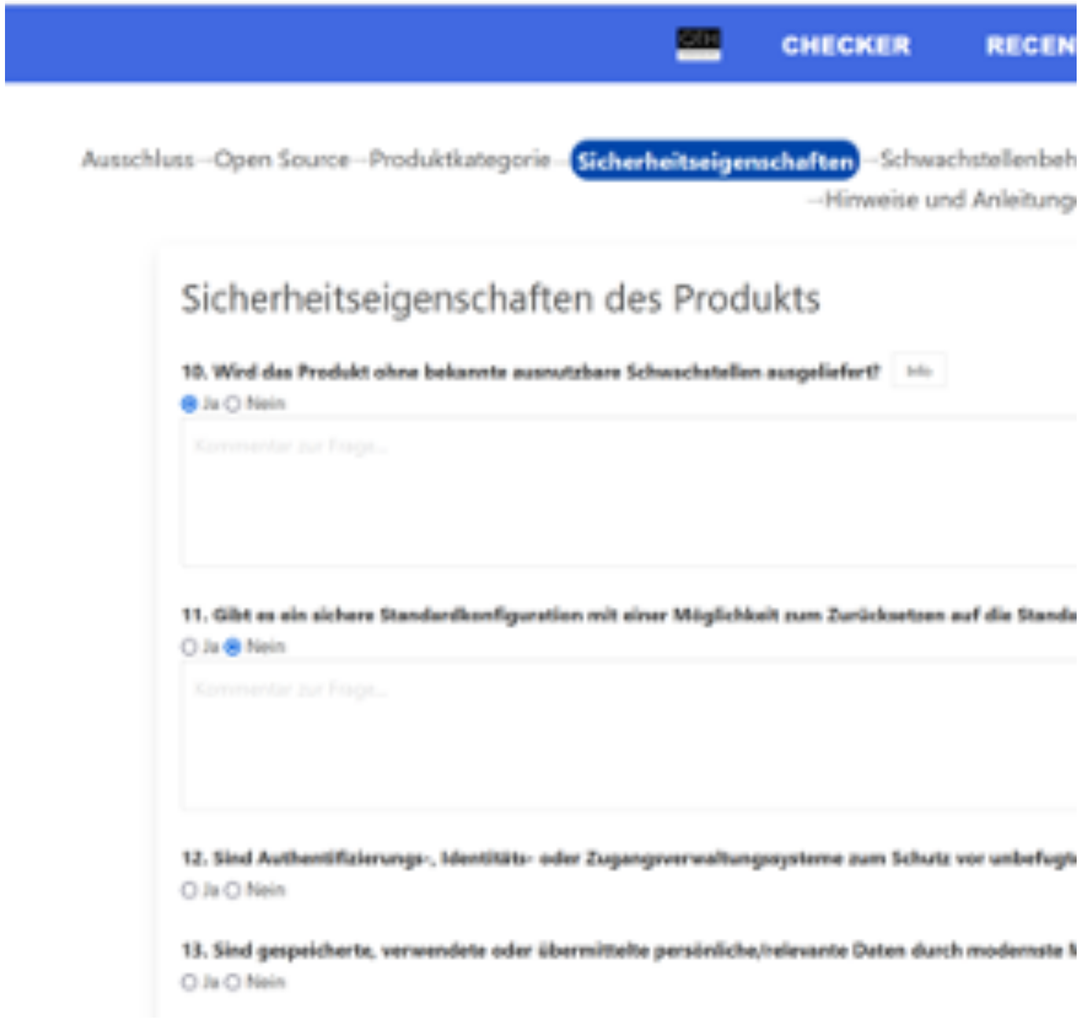
CRA Compliance Checklist

e.g. Checklist:

- Is the product delivered without known exploitable weak points?
- Yes / No
- Comments (for documentation)
- Further Information



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Vulnerability Scanner

Functional Requirements	Non-Functional Requirements
Vulnerability Reporting	**Usability:** Should enable non-developers, like project managers, to track the security status of the project
Software Bills of Materials	**Deployment:** Easy installation procedure, ability to deploy on all platforms
Languages: C, C++ and Python	**Development Process:** Should be integrated into the development process

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Vulnerability Scanner

Architecture: Microservice Architecture + REST Interface

Backend: Python + FAST API

Frontend: Vue.js

Vulnerability Scanning: SBOMs (Syft + OSS Index), Static Application Security Testing (SAST) Tools (e.g Semgrep)

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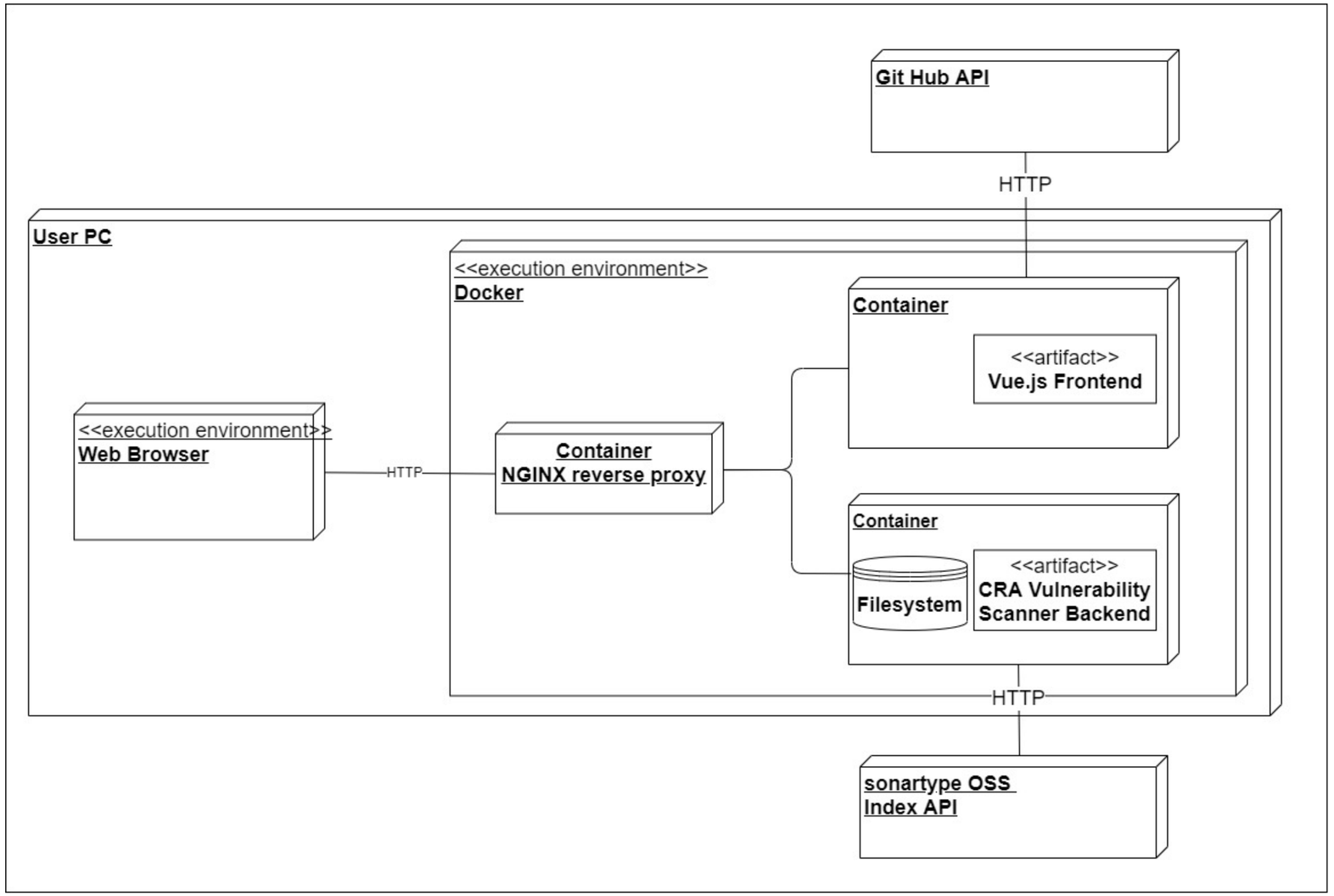
Vulnerability Scanner



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Vulnerability Scanner

Variety of different scanners exit on the market

Scanners
Sonar Qube
Frama-C
CppCheck
Flawfinder
…

Preselection based on criteria

Criteria
Must support C, C++, Python
Open Source
Can handle nested file structures
Can run without library dependencies
Project still maintained

Final Selection
Cppcheck
Flawfinder
Horusec
Semgrep

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Vulnerability Scanner

Ground Truth Data

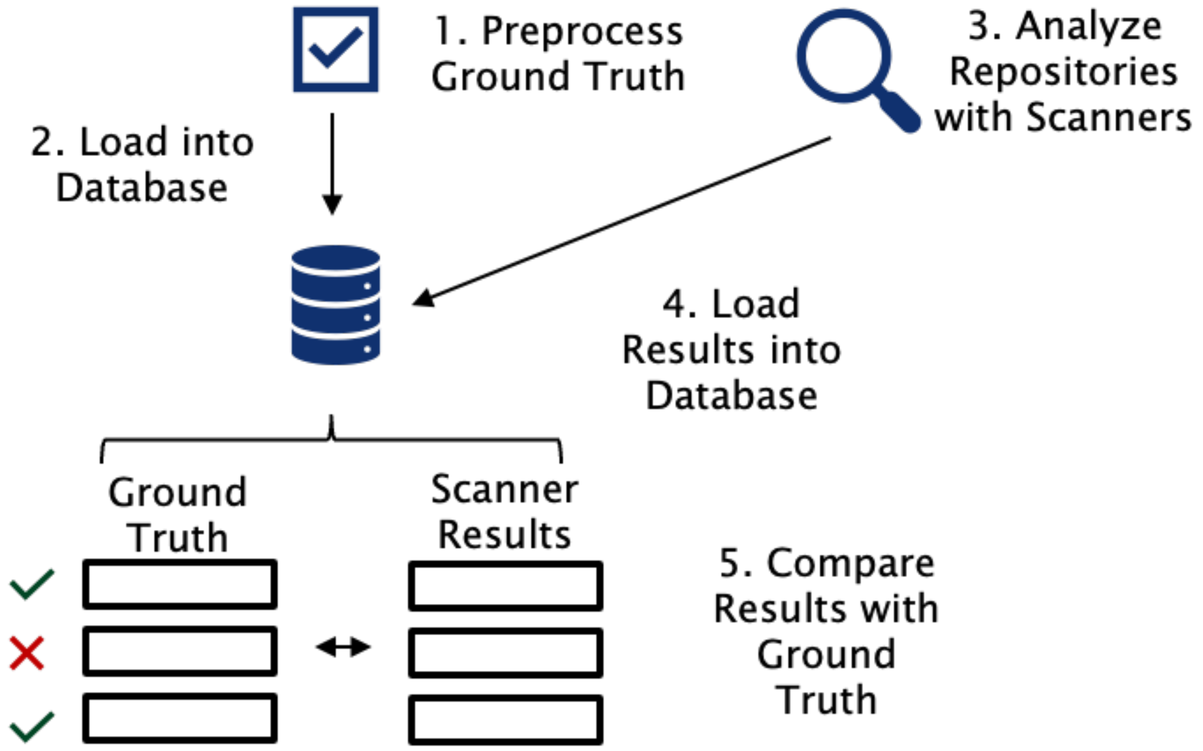
Juliet Test Suite for C++ 1.3.0

- **synthetic** test data
- 64099 Test Cases
- Published by National Institute of Standards and Technology (NIST)

Wireshark 1.8.0

- **real** project
- 127 test cases

Methodology



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Vulnerability Scanner

Problem

Scanners: have different **output formats**, include different information (e.g Severity, CWE-Mapping)

Assumption: If a hit of scanner matches the exact **file and line** of a flaw in the ground truth data, then this is considered a **true positive**

Evaluation Procedure – Matching Lines

✓ True Positive

Ground Truth		Scanner Result
File x line 12	↔	File x line 12

✗ False Positive

Ground Truth		Scanner Result
File x line 12	↔	File x line 13

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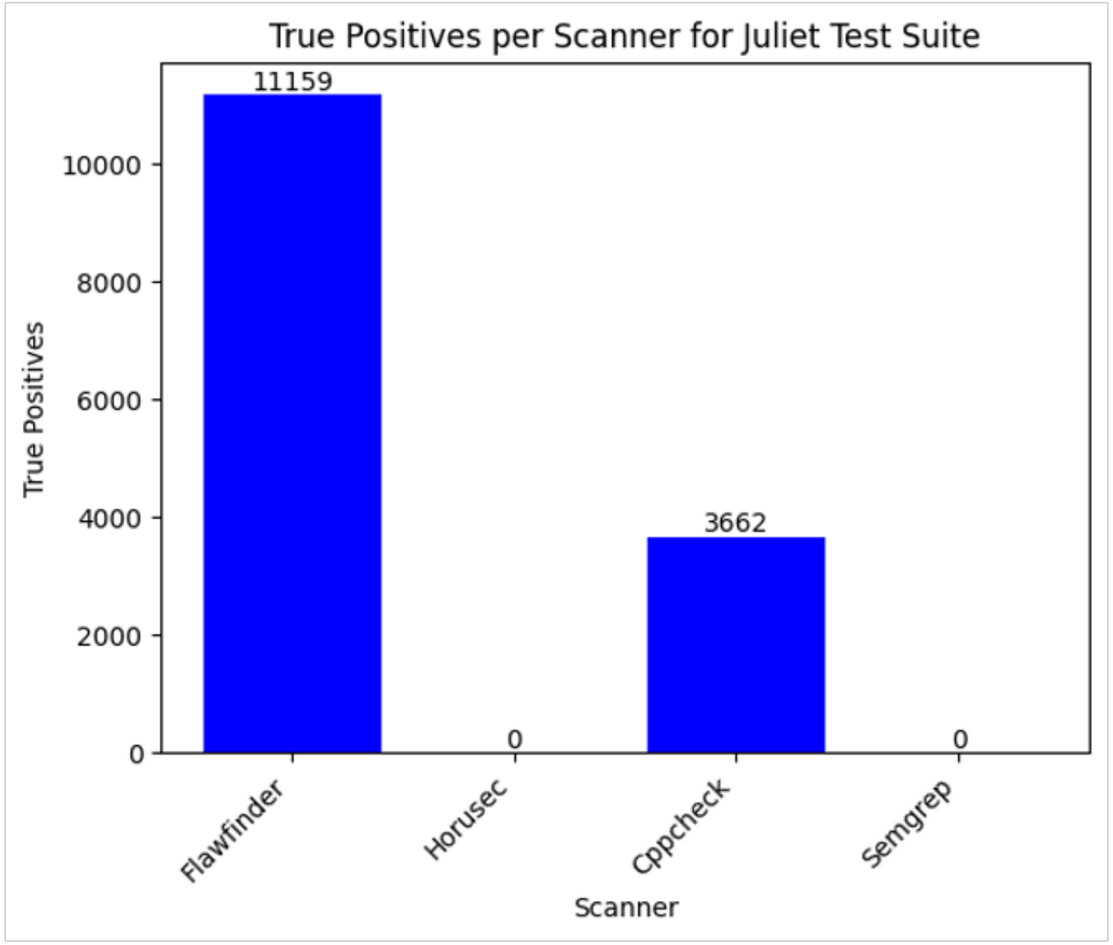
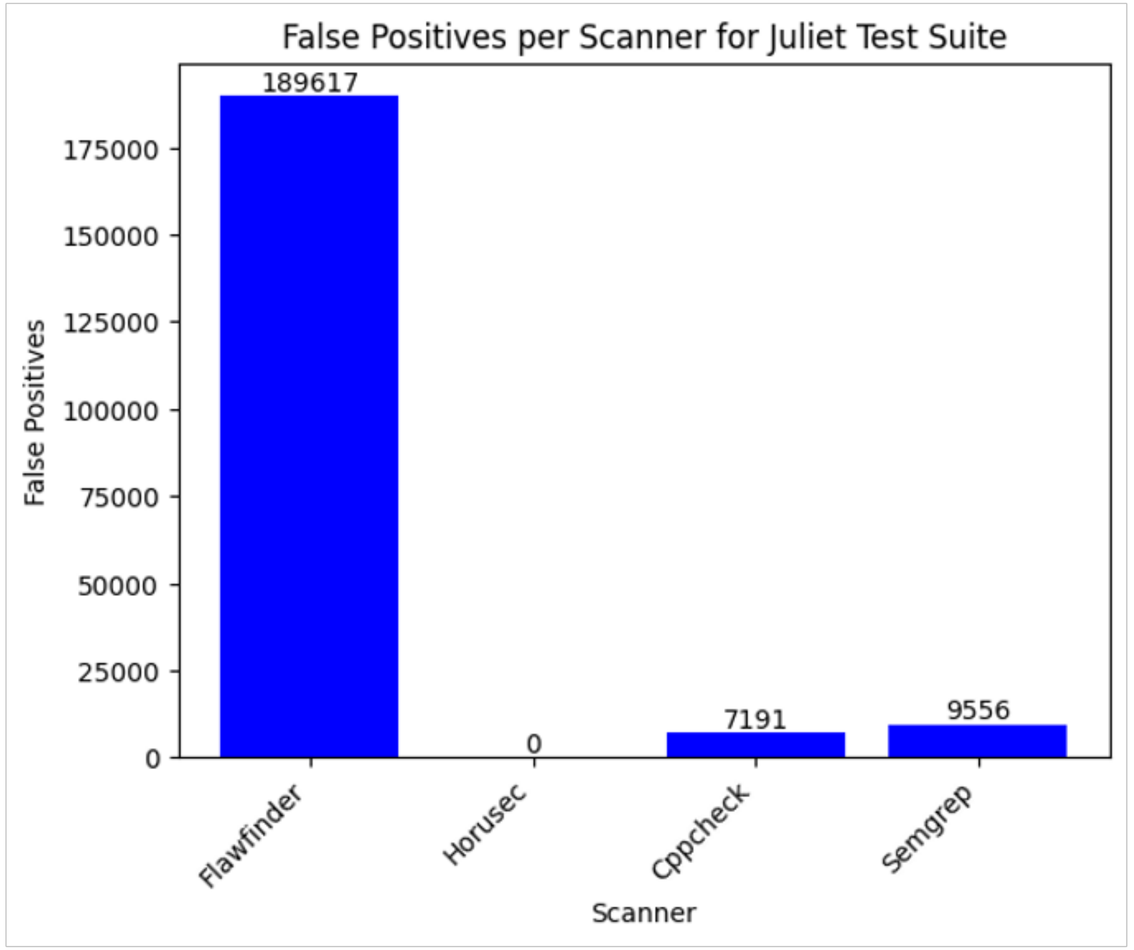
Vulnerability Scanner

Juliet Test Suite: LoC – 28 394 004, 40 626 Flaws





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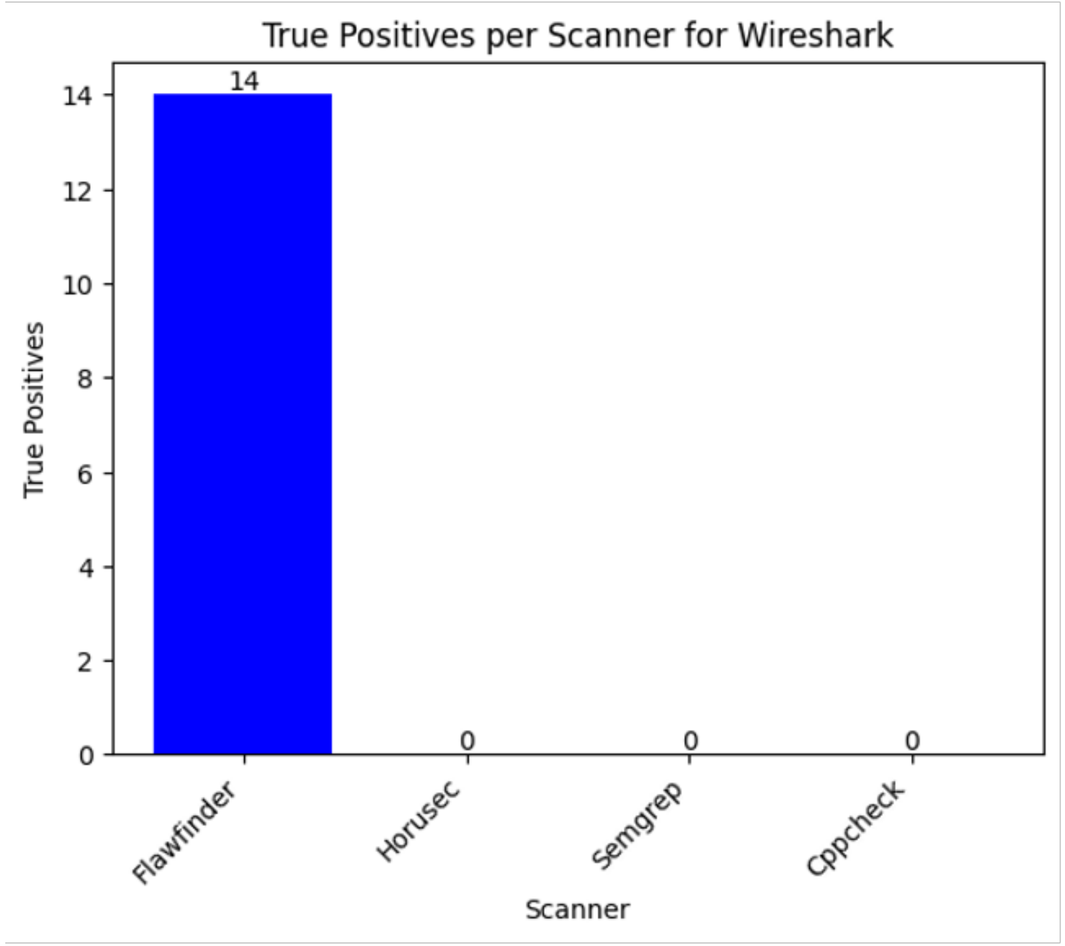
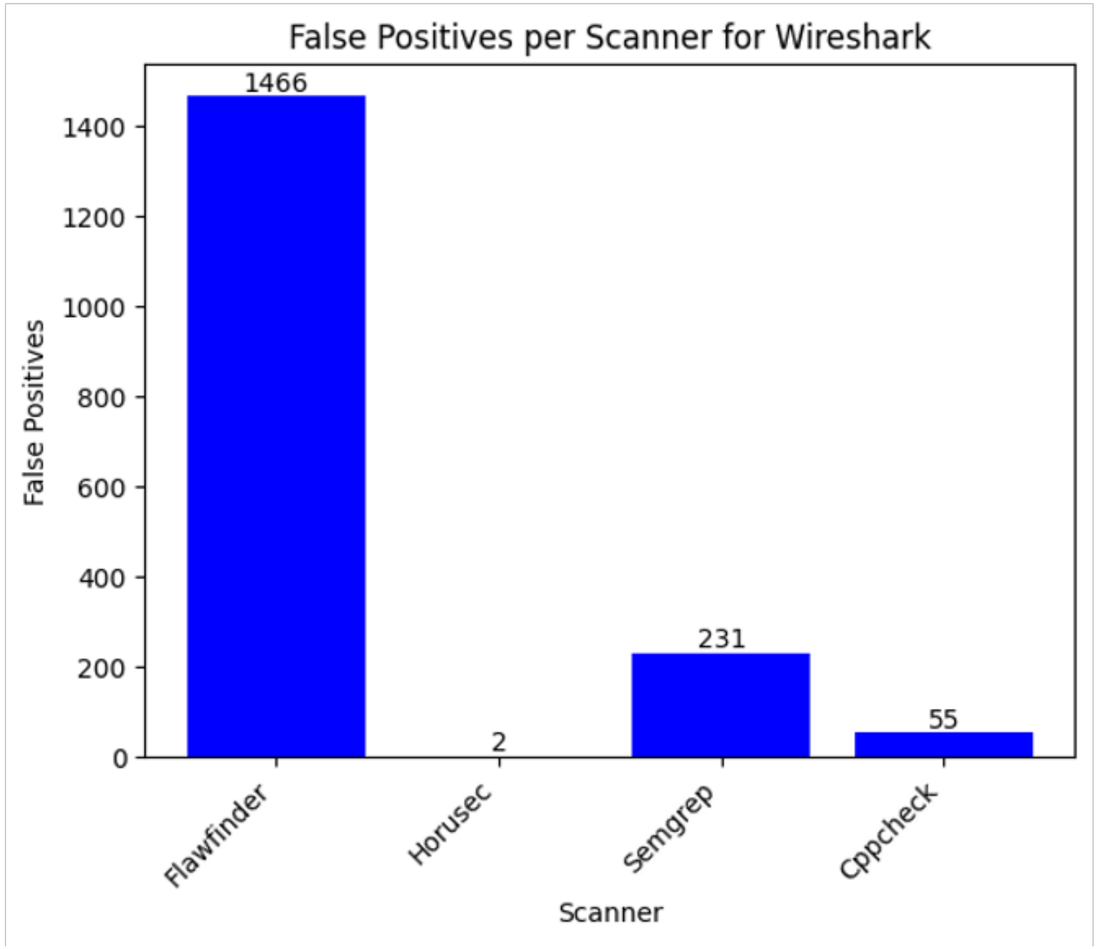
Wireshark: LoC – 1 007 501, 767 Flaws





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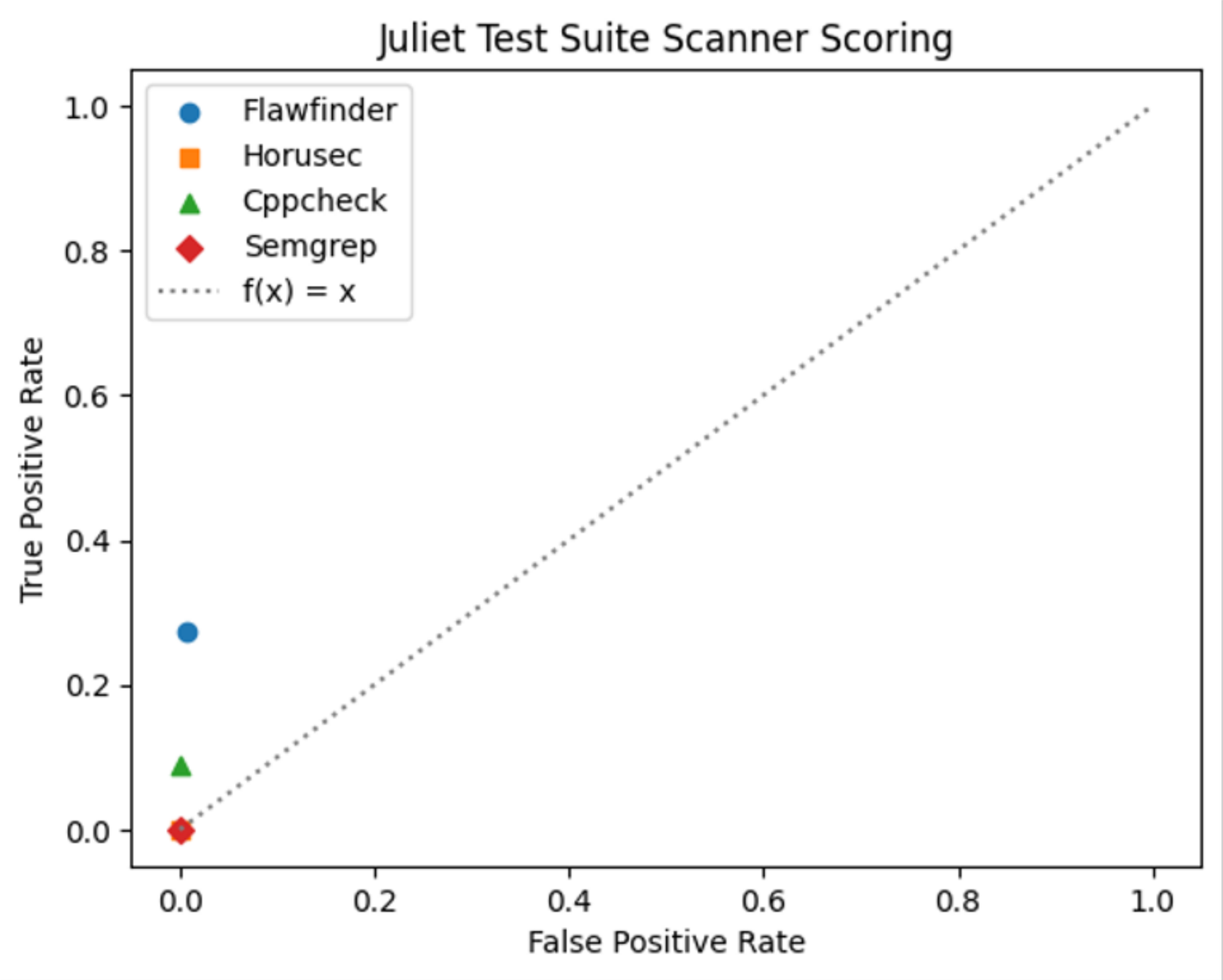
Vulnerability Scanner



Results:
- Flawfinder performed best
- followed by CppCheck

In general:
- SAST Scanners have problems finding most of the vulnerabilities, especially with non-synthetic data

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Vulnerability Scanner

- SAST Scanners like Semgrep, Flawfinder perform pattern matching
- Quality of the scan depends on variety, number and quality of the patterns
- Certain vulnerabilities cannot be expressed with simple patterns

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Conclusion / Outlook

Summary:

- ✓ Summarizing the **CRA** and deriving **requirements** for a vulnerability scanning tool
- ✓ Creating a **proof-of-concept** that implements and **visualizes** vulnerabilities
- ✓ Creating a methodology to verify performance of the tool
- ✓ Comparing the performance of multiple SAST scanners

Future Directions:

SAST Tools are very helpful early in the design stage to find vulnerabilities in the code

- Implement new rulesets to detect more severe vulnerabilities
- New approaches: deep learning-based pattern matching

Reverse Engineering:

- often, customers don't have access to the respective code – enable vulnerability detection by reverse engineering the code

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Future Directions:

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- New approaches: deep learning-based pattern matching

-> Toolkit for the CRA

Reverse Engineering:

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