
Summary

Security researcher with a focus on System Security and Program Analysis. Skilled in LLVM, MLIR, and developing static analysis tools to identify and mitigate security vulnerabilities in large software systems.

Work

- 2022 **Research Intern - Program Analysis, SRI International, Melno Park, CA**
- Developed a graph-based model of code evolution to identify code changes that introduce security vulnerabilities.
 - Applied static analysis techniques to detect security vulnerabilities in software.
 - Working with the Linux Foundation to integrate the approach into the Linux Kernel CI/CD pipeline.
 - Used LLVM, Static Analysis, Neo4j, Mining Software Repositories.
- 2021 **Research Intern - Intelligent Systems Lab, PARC, a Xerox Company, Palo Alto, CA**
- Evaluated neural decompilation methods to locate and isolate software features in binary applications.
 - Designed search-based techniques for software re-synthesis, enabling the automatic reconstruction of software applications from their binary code.
 - Developed methods for evaluating the equivalency of software applications, which can be used to verify the correctness of software transformations and repairs.
 - Used Ghidra, GDB, Python.
- 2014 - 2017 **Software Developer/Founding Team, Simpl, Bangalore, India**
- Developed and maintained a payment platform for online merchants used by over 5 million users.
 - Scaled the service to handle over 10 million requests a day using an event-based/pub-sub microservice.
 - Built the data engineering pipeline to support BI queries.
 - Used Golang, Ruby on Rails, Python, Redis, Kafka, RabbitMQ, Spark, Cassandra, and AWS.

Publication (Selected)

- 2023 **SENSOR: Graph-based Revision History Analysis for Code Evolution Introspection, Akshith Gunasekaran, Huascar Sanchez, Briland Hitaj**
- Developed a graph-based representation to analyze the revision history of large open source projects to identify code changes that introduce security vulnerabilities.
 - Evaluated the approach on a dataset of over millions of code changes and found it to be effective at identifying security vulnerabilities.
- 2023 **In Pursuit of Lean OS Kernels - Examining Benefits and Barriers to Unlocking Aggressive Debloating, Akshith Gunasekaran, Gabriel Ritter, Rakesh Bobba, Yeongjin Jang**
- Conducted a systematic study of OS kernel debloating techniques and developed a framework for evaluating their effectiveness.
 - Proposed new composition techniques that enable more aggressive debloating and evaluated them on the Linux Kernel.
 - The proposed techniques have been evaluated on a variety of Linux kernels images and have shown to be effective at reducing kernel size by at least 20%.
- 2022 **CONSTRUCT: A Program Synthesis Approach for Reconstructing Control Algorithms from Embedded System Binaries in Cyber-Physical Systems, Ali Shokri, Alexandre Perez, Souma Chowdhury, Chen Zeng, Gerald Kaloor, Ion Matei, Peter-Patel Schneider, Akshith Gunasekaran, and Shantanu Rane, arXiv:2308.00250**
- Developed a program synthesis approach to reconstruct control algorithms from embedded system binaries.
 - The approach is based on binary decompilation, static analysis, and evolutionary search.
 - We evaluated on a dataset of real-world embedded systems and was able to reconstruct control algorithms with an accuracy of over 90%.
 - The work is being used by researchers at PARC to develop new tools for securing and improving the reliability of cyber-physical systems.

Education

2017 - 2024 **PhD - Computer Science**, *Oregon State University*, Corvallis OR

- PhD student with a focus on System Security, Program Analysis.
- Co-Advised by: Rakesh Bobba, Yeongjin Jang
- Completed coursework in CS Theory (algorithms, graph theory, distributed systems), Security (operating systems, cryptography), AI (machine learning, reinforcement learning, machine learning security), and PL (Programming Languages, Functional Programming).

Activities

Open Source, *trailofbits/vast*

- An experimental compiler pipeline designed for program analysis of C and C++.
- Provides a tower of IRs as MLIR dialects to choose the best fit representations for a program analysis

CTF Team, *OSUSEC*, Oregon State University, Corvallis OR

- Competed in DEFCON CTF, BSides PDX CTF, NSA Codebreaker.
- Made it to DEFCON 2022 Finals, 16th place.
- Skills: Pwn, Reverse Engineering, Program Analysis

External Reviewer

- IEEE Symposium on Security and Privacy (Oakland), 2022.
- ACM Conference on Computer and Communications Security (CSS), 2021, 2022, 2023, 2024.
- ACM Asia Conference on Computer and Communications Security (ASIACCS) 2023.
- IEEE International Conference on Dependable Systems and Network (DSN), 2019, 2022, 2023.
- IEEE Real-Time Systems Symposium (RTSS), 2021, 2022.
- IEEE Real-Time and Embedded Technology and Applications Symposium (RTAS), 2019.

2021 **Shadow Program Committee**, *IEEE Security and Privacy*

Teaching Assistant

- CS427 Cryptography - Winter 2021
- CS370 Introduction to Security - Fall 2021
- CS290 Web Technologies and Web Security - Fall 2017

Summer 2019 **Instructor**, *Pacific North West Cyber Camp*

- Taught a week-long hands-on educational camp in basic computer/network security hardening and cyber ethics.

Summer 2018 **Volunteer**, *Pacific North West Cyber Camp*