Shixin Song

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Research Interest

My research interest lies in computer architecture and security, with a particular focus on mitigating microarchitectural side-channel attacks. I am especially interested in applying formal methods and programming language principles to advance security analysis and design comprehensive defense mechanisms against microarchitectural vulnerabilities.

Education

Massachusetts Institute of Technology 2022 - Present
Ph.D. Student in Computer Science *Cambridge, MA, USA*
- **Advisor: Prof. Mengjia Yan**

University of Michigan 2020 - 2022
B.S.E. in Computer Science *Ann Arbor, MI, USA*

Shanghai Jiao Tong University 2018 - 2022
B.E. in Electrical and Computer Engineering *Shanghai, China*

Research Experience

Securing Cryptographic Software via Typed Assembly Language 2023 - 2025

Proposed a static program analysis technique that helps transform cryptographic assembly programs so that they split their public and secret data across coarse memory regions

Enabled the Spectre mitigation that tracks secret data flow in the processor and delays insecure speculative operations that leak the secret data

Paper accepted at CCS'25

Protecting ASLR Against Microarchitectural Attacks 2022 - 2024

Systematically analyzed existing microarchitectural attacks that leak the ASLR secret

Presented a software-hardware co-designed mitigation that strengthens ASLR against these attacks and introduces negligible overhead

Paper accepted at NDSS'25

Redesigning the Branch Target Buffer for Data Center Applications 2021

Presented a novel BTB replacement policy that achieves near-ideal front-end processor performance for data center applications

Paper accepted at ISCA'22

Won the first place award at MICRO'21 ACM Student Research Competition

Enabling Early Hardware Development for Futuristic Data Center Applications 2021

Characterized widely-used data center applications (e.g. MySQL, MongoDB, FFmpeg, Nginx) and predicted how these applications might evolve in the future to enable suitable hardware development early on

Peer-Reviewed Conference Publication

Securing Cryptographic Software via Typed Assembly Language 2025
The ACM Conference on Computer and Communications Security (CCS) 2025
Shixin Song*, Tingzhen Dong*, Kosi Nwabueze, Julian Zanders, Andres Erbsen, Adam Chlipala, Mengjia Yan

Oreo: Protecting ASLR Against Microarchitectural Attacks 2025
The Network and Distributed System Security (NDSS) Symposium 2025
Shixin Song, Joseph Zhang, Mengjia Yan

Thermometer: Profile-Guided BTB Replacement for Data Center Applications 2022
International Symposium on Computer Architecture (ISCA) 2022
Shixin Song, Tanvir Ahmed Khan, Sara Mahdizadeh Shahri, Akshitha Sriraman, Niranjan K Soundararajan, Sreenivas Subramoney, Daniel A. Jiménez, Heiner Litz, Baris Kasikci

Awards and Honors

EECS MathWorks Fellowship 2025
Massachusetts Institute of Technology

Ho-Ching and Han-Ching Fund Award 2025
Massachusetts Institute of Technology

Presidential Graduate Fellowship Award 2022
Massachusetts Institute of Technology

CRA Outstanding Undergraduate Researcher Award Honorable Mention 2022
Computing Research Association

ACM Student Research Competition First Place Winner 2021
MICRO'21

Roger King Scholarship 2021
University of Michigan *Ann Arbor, MI, USA*

Dean's List 2020, 2021, 2022
University of Michigan *Ann Arbor, MI, USA*

SJTU Undergraduate Excellence Scholarship 2019, 2020
Shanghai Jiao Tong University *Shanghai, China*

Fuda Scholarship 2019
Shanghai Jiao Tong University *Shanghai, China*

Experience

Teaching Assistant 2025
Massachusetts Institute of Technology *Cambridge, MA, USA*
- Secure Hardware Design (6.5950)

Undergraduate Research Assistant 2021
University of Michigan *Ann Arbor, MI, USA*
- **Advisor**: Prof. Baris Kasikci

Grader 2021 - 2022
University of Michigan *Ann Arbor, MI, USA*
- Introduction to Cryptography (EECS 475)
- Introduction to Computer Organization (EECS 370)

Teaching Assistant 2019 - 2021
Shanghai Jiao Tong University *Shanghai, China*
- Introduction to Computers and Programming (VG 101)
- Introduction to Engineering (VG 100)
- Honors Mathematics II (VV 186)

Student Advisor 2019
Shanghai Jiao Tong University *Shanghai, China*

Volunteer Teaching 2018 - 2019
Sanhe Junior School *Yunnan, China*
- Math classes for grade 7 students

Technical Skills

Languages: C/C++, Python, OCaml, Coq, SystemVerilog
Software Tools: gem5, Linux Perf, Intel VTune, ChampSim, Docker

Course Work

Massachusetts Institute of Technology

* 6.5900: Computer System Architecture, 6.5120: Formal Reasoning about Program, 6.5620: Cryptography & Cryptanalysis, 6.8300: Advances in Computer Vision

University of Michigan

* EECS 470: Computer Architecture, EECS 482: Introduction to Operating System, EECS 475: Introduction to Cryptography

Shanghai Jiao Tong University

* VE 280: Programming and Elementary Data Structures