Mridu Nanda

mnanda@duke.edu | mridunanda.github.io

Research Interests

I am a fourth-year PhD student at Duke University studying cybersecurity. My research focuses on designing mechanisms that incentivize sharing indicators of compromise to detect credential breaches and other cyber threats. By combining game theory and systems design, I explore how collaborative defense can enhance resilience against evolving attacks.

Education

Duke University 2021 – Present
PhD candidate in Computer Science
Advisor: Michael Reiter

Harvard University 2017 – 2021
Computer Science and Mathematics, B.A.
Advisor: James Mickens

North Carolina School of Science and Math 2015 – 2017
High School Diploma

Publications and Preprints

1. M. Nanda and M.K. Reiter. Strategic Mechanism Design for Cooperative Cyber-Defense. *Submitted*, 2025.
2. M. Nanda and R. Durrett. Genotype Patterns in Growing Solid Tumors. 2018. [arXiv].
3. M. Nanda and R. Durrett. Spatial evolutionary games with weak selection. *Proceedings of the National Academy of Sciences (PNAS)*, 2017. [arXiv].

Research Experience and Projects

Incentivizing Collaborative Security Aug 2021 – Present
Advisor: Michael Reiter, Duke University

- Studying resource allocation strategies for the strategic distribution of security resources among self-interested, rational agents to incentivize collaborative defense mechanisms. Verifying the security of these strategies using formal methods, specifically model checking.

Splicing User Data from Multi-User Applications Dec 2020 – May 2021
Advisor: James Mickens, Harvard University

- Designed an efficient, scalable infrastructure for splicing user data out of complex online services. The infrastructure expands a spreadsheet's computational model to provide developers with deletion-aware storage abstractions. These storage abstractions preserve the semantic integrity of data post-deletion, thus making it easier to create GDPR compliant applications.
- This research was funded by the Hershel Smith Undergraduate Research Fellowship and PRISE (Program for Research in Science and Engineering) Fellowship

Making Trust Explicit in XOS Jan 2021
Mentor: Eddie Kohler, Harvard University

- Proposed XOS, a novel operating system that enforces the principle of least privilege (PoLP) at the application level. Specifically, XOS allows processes to access resources based on their trustworthiness, restricting the default access to system resources (e.g., CPU, memory, ports) for each application.
- This project was completed as part of Eddie Kohler's CS 261: Research Topics in Operating Systems class.

Analyzing Heap Memory for Fun and Profit Jan 2020
Mentor: James Mickens, Harvard University

- Proposed MEMERY, an algorithm that augments memory cartography, a data-oriented attack to siphon sensitive data via inter-region pointers at constant offsets. MEMERY overcomes Address Space Layout Randomization challenges and uses heuristics to reconstruct linked data structures and identify sensitive objects like function pointers, without requiring binary instrumentation or debugging symbols.

- This project was completed as part of James Micken's CS 263: Systems Security class.

Improving Crash Consistency with Symbolic Execution and Fuzzing Jan 2021

Mentor: Eddie Kohler, Harvard University

- Improved record-and-replay tools' ability to find application crash consistency bugs by creating diverse workloads using KLEE and a custom grammar-based fuzzer.
- This project was completed as part of Eddie Kohler's CS 261: Research Topics in Operating Systems class.

Modeling Tumor Dynamics Using Game Theory 2015 - 2018

Advisor: Richard Durrett, Duke University

- Simulated stochastic processes in multiple dimensions with the goal of reproducing qualitative features of tumor growth dynamics. The study relied on simulations as there is no mathematical framework which captures tumor dynamics in three dimensions.
- Designed a mathematical framework to analyze the effect of space on a large class of three-strategy games. Implemented Python simulations to verify the predictions made by the replicator equation and discovered that space can play a stabilizing role in the outcome of certain games.
- This research was funded by NSF grant DMS 1614978 from the math biology program.

Fellowships and Honors

Duke Graduate Summer Research Fellowship 2021, 2022

Harvard Certificate of Distinction in Teaching 2021

Herchel Smith Undergraduate Research Fellowship: $5K grant supporting research on splicing user data from multi-user applications. 2020

Program for Research in Science and Engineering Fellowship: Summer research program at Harvard that supported research on splicing user data from multi-user applications. 2020

Teaching and Service

Graduate Teaching Assistant at Duke University

- Cryptography. *Instructor: Michael Reiter* Jan 2023, 2025
- Introduction to Computer Security. *Instructor: Kartik Nayak* Jan 2021

Undergraduate Teaching Assistant at Harvard University

- Graduate-level Systems Security. *Instructor: James Mickens* Aug 2020
- Systems Programming & Machine Organization. *Instructor: Eddie Kohler* Aug 2019
- Programming Languages. *Instructor: Stephen Chong* Jan 2019

Veritas AI May 2022

- Taught high school students foundational concepts in machine learning, providing hands-on guidance through coding exercises and real-world applications.

Mentor at TheoryPrep May 2020

- Helped design curriculum and problem sets for 8-week discrete math course to prepare Harvard undergraduates for theoretical computer science classes
- Conducted weekly problem sessions and provided feedback on student assignments.

Faculty Search Coordinator Jan 2021

- Graduate student liaison for coordinating faculty search. Assisted in evaluating candidates by attending job talks and coordinating discussion sessions.

Internships

Bridgewater Associates May 2019

- Researched the existence of risk premiums in developed market FX volatility.

Relevant Coursework

Computer Security and Systems: Cryptography, Systems Security, Operating Systems, Database Systems, Research Topics in Operating Systems
Algorithms and Theory: Artificial Intelligence, Algorithmic Game Theory, Probability Theory, Design and Analysis of Algorithms, Introduction to Theoretical Computer Science, Programming Languages, Honors Linear Algebra, Theory and Algorithms for Machine Learning, Fairness and Privacy

Technical Skills

Languages:: Python, C/C++, Java
Other: Bash/Shell scripting, git, LaTeX, QEMU+KVM, gdb, PRISM, STORM