

Archisman Dutta

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Research Interests

Verifiable Delay Functions · Pairing-based Cryptography · Zero-knowledge Proof Systems · Secure Messaging · Lattice-based Cryptography · Blockchains · Complexity Theory

Education

Ashoka University

Sonipat, India

B.Sc. (Hons.) in Mathematics and Computer Science

Sep 2021 – May 2024

- CGPA: 3.42/4.00
- *Relevant coursework:* Computer Security and Privacy, Elliptic Curves and Cryptography, Lattice-based Cryptography, Algebra 1, Probability and Statistics, Discrete Mathematics, Statistical Inference, Linear Algebra, Algorithm Design and Analysis, Theory of Computation, Applied Category Theory, Symbolic Logic, Data Structures

University of Zurich

Zurich, Switzerland

Summer abroad

Jul 2023 - Aug 2023

- Participated in the 'Deep Dive into Blockchain' summer school hosted by the UZH Blockchain Center on a full ride and completed a 6 ECTS credit course (**Source**)
- Implemented a privacy-focused CBDC auditing model in Rust using Pedersen commitments and IPFS storage/retrieval, coauthored the final report and gave a technical presentation for the group project

Experience

IIT Bombay Trust Lab

Mumbai, India

Pre-Doctoral Researcher

Aug 2024 – Present

- Conducting research into constructing verifiable delay functions from pairings and coauthored a paper currently in submission
- Contributing to a reading group on proof systems, arguments and zero-knowledge
- Investigating the correspondence between lattices and error-correcting codes with specific focus on the construction of polar codes and the property of secrecy gain for the wiretap channel

Summer Research Intern

May 2024 - Jul 2024

- Investigated the complexity-theoretic hardness of syntactic sub-classes like PPAD, PWPP, PPA and PLS inside TFNP with implications in Karp-reducible problems of cryptographic interest
- Studied and analyzed the security and concrete efficiency of lattice-based verifiable delay functions, time-lock puzzles and proofs of sequential work
- Attended the ACM India Summer School on Theoretical Foundations of Cryptography organized by Trust Lab

Questbook

Remote / Palo Alto, CA

Security Research Intern

Aug 2023 – Mar 2024

- Conducted research into improving the performance of Groth16 zk-SNARK proof generation for the Reclaim Protocol and incorporated optimizations in code
- Benchmarked and tested a number of zero-knowledge proving systems and libraries to integrate with Circom R1CS-based circuits
- Modified and compiled rapidsnark to platform-agnostic WebAssembly for compatibility with Node and browser environments
- Investigated methods to enhance custom AES and ChaCha20 circuits designed for verifiable private key ownership proofs using arkworks and PLONKish arithmetization

Ashoka University

Undergraduate Research Assistant

Sonipat, India

Jun 2023 – Jan 2024

- Contributed to research funded by WhatsApp to design, implement and benchmark a secure originator tracing protocol integrable in end-to-end encrypted messaging platforms without undermining the privacy of intermediate parties in a forwarding chain
- Coauthored a paper currently in submission that proposes, formalizes and compares the protocol against existing alternatives to highlight the feasibility of real-world deployment on thin clients
- Investigated and implemented proof-of-concept algorithmic optimizations for polynomial multiplication using number-theoretic transforms with butterfly interleaving and fast modular operations for efficient lattice-cryptographic operations

Subconscious Compute

System Engineer (Kernel)

Remote / Bengaluru, India

Dec 2022 – Jan 2023

- Created a systems hardening tool for user-defined seccomp-BPF filtering of syscalls spawned by userland applications on Linux to minimize the attack surface of the kernel and enforce the principle of least privilege
- Designed a wrapper around the Linux port of OpenBSD's pledge/unveil sandboxing mechanisms for restricting the operational capabilities of processes while granting access to essential filesystem paths
- Incorporated support for communicating through a Unix IPC socket to facilitate remote code interaction

Papers in submission

- *Verifiable Delay Functions from Bilinear Maps* (with Chethan Kamath, Sruthi Sekar and Hamza Abusalah)
- *ATAVISM: Private Originator Tracing in End-to-End Encrypted Messaging* (with Debayan Gupta and Arup Mondal)

Projects

Applied Cryptography

Mar 2023 – Dec 2023

- Implemented open-source toy variants of numerous cryptosystems and security protocols in Rust as proof-of-concept with minimal use of external libraries to verify correctness and demonstrate intrinsic understanding of their respective functionality

Secure Systems Administration

Jun 2021 – Feb 2023

- Managed multiple hardened server nodes for securely hosting publicly available web services as Docker containers with support for real-time monitoring and Cloudflare tunneling
- Researched various solutions for reducing the exposed attack surface of Unix-based networked systems at the kernel and application layer

Write-ups

- A Privacy-Preserving CBDC Auditing Model using Pedersen Commitments, Filecoin and IPFS ([Source](#))
- On the Foundations of Lattice-based Cryptography ([Source](#))
- CCC: Applying Category Theory to Cryptography ([Source](#))
- seccomp-pledge: Enforce principle of least privilege in Linux kernel ([Source](#))

Volunteering

IITB Trust Lab

Jun 2024

- Coordinated and led a lab session on Fully Homomorphic Encryption at the ACM summer school with specific focus on using OpenFHE's Python bindings for performing rudimentary algebraic operations

Indian Statistical Institute, Kolkata

Oct 2023 – Jun 2024

- Helped a PhD student at ISI Kolkata with implementing a complete simulation of Sybil attacks in blockchain and statistical testing of image classification across ML models and probability distributions as part of their dissertation

Scholarships

- Research Excellence Program for Asia (RExPA) fellowship - *Tel Aviv University* (declined) *Mar 2024*
- Industry scholarship - *UZH International Summer School* *Jul 2023*

Certifications

Cryptography I *Stanford Online*

Skills

Rust · Python · Linux · Shell · Docker · WebAssembly · Typst · BSD · LaTeX · C/C++ · Vim · Nix · Javascript/
Typescript · Circom · JSON

Awards

- Three-time SOF National Cyber Olympiad Gold Medalist and Class Topper *2016 – 2018*
- SOF National Cyber Olympiad International Rank 43, Zonal Rank 4 *2017*