

# Sam Kumar

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|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Research Interests</b>  | System Security, Networked Systems                                                                                                                  |                |
| <b>Academic Experience</b> | <b>University of California, Los Angeles</b><br>Assistant Professor, Computer Science                                                               | 2024 – Present |
|                            | <b>University of Washington</b><br>Postdoctoral Scholar, Computer Science & Engineering                                                             | 2023 – 2024    |
| <b>Education</b>           | <b>University of California, Berkeley</b> (GPA: 4.00/4.00)<br>Ph.D. in Computer Science                                                             | 2017 – 2023    |
|                            | <b>University of California, Berkeley</b> (GPA: 4.00/4.00)<br>M.S. in Computer Science                                                              | 2017 – 2020    |
|                            | <b>University of California, Berkeley</b> (GPA: 4.00/4.00)<br>B.S. in Electrical Engineering and Computer Sciences ( <i>Honors</i> )                | 2013 – 2017    |
| <b>Honors and Awards</b>   | <b>ACM SIGSAC Doctoral Dissertation Award Runner-Up</b>                                                                                             | 2024           |
|                            | <b>David J. Sakrison Memorial Prize, UC Berkeley EECS Department</b><br>• Awarded for completing a truly outstanding piece of research              | 2023           |
|                            | <b>Applied Networking Research Prize, IETF/IRTF</b>                                                                                                 | 2022           |
|                            | <b>Jay Lepreau Best Paper Award, OSDI 2021</b>                                                                                                      | 2021           |
|                            | <b>Outstanding Graduate Student Instructor Award, UC Berkeley</b>                                                                                   | 2020           |
|                            | <b>Best Paper Award Runner-Up, SenSys 2018</b>                                                                                                      | 2018           |
|                            | <b>National Science Foundation Graduate Research Fellowship</b>                                                                                     | 2017           |
|                            | <b>Berkeley Fellowship for Graduate Study, UC Berkeley</b>                                                                                          | 2017           |
|                            | <b>University Medal Runner-Up, UC Berkeley</b><br>• Awarded to the top $\approx 5$ students in a graduating class of $\approx 7,000$ undergraduates | 2017           |
|                            | <b>Departmental Citation, UC Berkeley EECS Department</b><br>• Recognizes outstanding undergraduate achievement in the department                   | 2017           |

- Exceptional academic performance during the first undergraduate semester

**Publications** Peer-Reviewed Papers

- **Breaking the Tradeoff: Elastic and Isolated GPU Sharing with Ghost.**  
(\*Co-primary authors) \*Yicheng Liu, \*Yifan Qiao, Tian Xia, Yi Xu, Tony Hong, Yutong Zhou, David Sun, Shuo Yang, Yilong Zhao, Junyi Shu, Jiarong Xing, Harry Xu, Ion Stoica, Joseph Gonzalez, and Sam Kumar.  
Conditionally accepted to **ASPLOS 2027** (32nd ACM International Conference on Architectural Support for Programming Languages and Operating Systems). *Title may change.*
- **Osprey: Transparent and Efficient Virtual Memory for Secure Computation.**  
Yicheng Liu, Alice Yeh, Harry Xu, Raluca Ada Popa, and Sam Kumar.  
**OSDI 2026** (20th USENIX Symposium on Operating Systems Design and Implementation).
- **Efficient ML Model Updates for Deeply Embedded Microcontrollers.**  
Shishir G. Patil, Sam Kumar, Prabal Dutta, and Joseph E. Gonzalez.  
**EuroSys 2026** (21st European Conference on Computer Systems).
- **Rethinking RPC Communication for Microservices-based Applications**  
Xiangfeng Zhu, Yang Zhou, Yuyao Wang, Xiangyu Gao, Arvind Krishnamurthy, Sam Kumar, Ratul Mahajan, and Danyang Zhuo.  
**HotOS XX (2025)** (ACM SIGOPS 20th Workshop on Hot Topics in Operating Systems).
- **High-level Programming for Application Networks.**  
Xiangfeng Zhu, Yuyao Wang, Banruo Liu, Yongtong Wu, Nikola Bojanic, Jingrong Chen, Gilbert Louis Bernstein, Arvind Krishnamurthy, Sam Kumar, Ratul Mahajan, and Danyang Zhuo.  
**NSDI 2025** (22th USENIX Symposium on Networked Systems Design and Implementation).
- **Skyplane: Optimizing Transfer Cost and Throughput Using Cloud-Aware Overlays.**  
Paras Jain, Sam Kumar, Sarah Wooders, Shishir G. Patil, Joseph E. Gonzalez, and Ion Stoica.  
**NSDI 2023** (20th USENIX Symposium on Networked Systems Design and Implementation).
- **MAGE: Nearly Zero-Cost Virtual Memory for Secure Computation.**  
Sam Kumar, David E. Culler, and Raluca Ada Popa.  
**OSDI 2021** (15th USENIX Symposium on Operating Systems Design and Implementation).  
Received a *Jay Lepreau Best Paper Award* at OSDI 2021.
- **Performant TCP for Low-Power Wireless Networks.**  
Sam Kumar, Michael P Andersen, Hyung-Sin Kim, and David E. Culler.  
**NSDI 2020** (17th USENIX Symposium on Networked Systems Design and Implementation).

Received an *Applied Networking Research Prize* from the IETF/IRTF in 2022.

- **Ghostor: Toward a Secure Data-Sharing System from Decentralized Trust.**  
(\*Co-primary authors) \*Yuncong Hu, \*Sam Kumar, and Raluca Ada Popa.  
**NSDI 2020** (17th USENIX Symposium on Networked Systems Design and Implementation).  
Extended paper published as Cryptology ePrint Archive, Report 2020/648.
- **JEDI: Many-to-Many End-to-End Encryption and Key Delegation for IoT.**  
Sam Kumar, Yuncong Hu, Michael P Andersen, Raluca Ada Popa, and David E. Culler.  
**USENIX Security 2019** (28th USENIX Security Symposium).  
Extended paper published as Technical Report No. arXiv:1905.13369 [cs.CR].
- **WAVE: A Decentralized Authorization Framework with Transitive Delegation.**  
Michael P Andersen, Sam Kumar, Moustafa AbdelBaky, Gabe Fierro, John Kolb, Hyung-Sin Kim, David E. Culler, and Raluca Ada Popa.  
**USENIX Security 2019** (28th USENIX Security Symposium).
- **Thread/OpenThread: A Compromise in Low-Power Wireless Multihop Network Architecture for the Internet of Things.**  
Hyung-Sin Kim, Sam Kumar, and David E. Culler.  
**ComMag July 2019** (IEEE Communications Magazine, Vol. 57, No. 7).
- **System Architecture Directions for Post-SoC/32-bit Networked Sensors.**  
Hyung-Sin Kim, Michael P Andersen, Kaifei Chen, Sam Kumar, William J. Zhao, Kevin Ma, and David E. Culler.  
**SenSys 2018** (16th ACM Conference on Embedded Networked Sensor Systems).  
Received a *Best Paper Runner-Up Award* at SenSys 2018.
- **Well-Connected Microzones for Increased Building Efficiency and Occupant Comfort.**  
Michael P Andersen, Gabe Fierro, Sam Kumar, Joyce Kim, Edward A. Arens, Hui Zhang, Paul Raftery, and David E. Culler.  
**SSB 2016** (ACEEE Summer Study on Energy Efficiency in Buildings, also known as the 19th Biennial ACEEE Conference on Energy Efficiency in Buildings).
- **DISTIL: Design and Implementation of a Scalable Synchrophasor Data Processing System.**  
Michael P Andersen, Sam Kumar, Connor Brooks, Alexandra von Meier, and David E. Culler.  
**SmartGridComm 2015** (IEEE International Conference on Smart Grid Communications).

### Technical Reports

- **An AI Agent Execution Environment to Safeguard User Data.**  
Robert Stanley, Avi Verma, Lillian Tsai, Konstantinos Kallas, and Sam Kumar.  
Technical Report No. arXiv:2604.19657 [cs.CR].
- **NaSh: Guardrails for an LLM-Powered Natural Language Shell.**  
Bimal Raj Gyawali, Saikrishna Achalla, Konstantinos Kallas, and Sam Kumar.  
Technical Report No. arXiv:2506.13028 [cs.OS].
- **3PO: Programmed Far-Memory Prefetching for Oblivious Applications.**  
Christopher Branner-Augmon, Narek Galstyan, Sam Kumar, Emmanuel Amaro, Amy Ousterhout, Aurojit Panda, Sylvia Ratnasamy, and Scott Shenker.  
Technical Report No. arXiv:2207.07688 [cs.OS].
- **Mr. Plotter: Unifying Data Reduction Techniques in Storage and Visualization Systems.**  
Sam Kumar, Michael P Andersen, and David E. Culler.  
Technical Report No. UCB/EECS-2018-85.
- **Efficient Data Retrieval from a Secure, Durable, Append-Only Log.**  
Sam Kumar, Andrew M. Chen, Paul R. Bramsen, and John D. Kubiatowicz.  
CS 262A Class Project Report, May 2016.

#### Poster and Demo Abstracts

- **Demo Abstract: Bringing Full-Scale TCP to Low-Power Networks.**  
Sam Kumar, Michael P Andersen, Hyung-Sin Kim, and David E. Culler.  
**SenSys 2018** (16th ACM Conference on Embedded Networked Sensor Systems).
- **Poster Abstract: Well-Connected Microzones for Increased Building Efficiency and Occupant Comfort.**  
Michael P Andersen, Gabe Fierro, Sam Kumar, Michael Chen, Leonard Truong, Joyce Kim, Edward A. Arens, Hui Zhang, Paul Raftery, and David E. Culler.  
**BuildSys 2015** (2nd ACM International Conference on Embedded Systems for Energy-Efficient Built Environments).

#### **Open Source *TCPlp***

**and Adoption** Code (for reproducibility): <https://github.com/ucbrise/tcplp>  
Code (OpenThread adoption): <https://github.com/openthread/openthread>

- *TCPlp* has been adopted as the TCP stack in [OpenThread](#), an open-source network stack used in smart home products sold by companies including Amazon/Eero and Google/Nest.
- I continue to be involved in this open-source effort, to add features to and maintain OpenThread's TCP stack.
- The conclusions of the *TCPlp* research project significantly influenced the [Thread network standard](#), developed by a consortium of [companies](#) in the smart home/IoT

space, including Google/Nest, Apple, Qualcomm, and others.

## JEDI

JEDI protocol: <https://github.com/ucbrise/jedi-protocol-go>

JEDI cryptography library: <https://github.com/ucbrise/jedi-pairing>

- **WAVEMQ** is a publish-subscribe system for IoT that uses WAVE for authorization. It was used to collect sensor data from IoT devices (lighting, thermostats, electric meters, etc.) from over 20 buildings in California as part of the XBOS research project. We integrated JEDI into WAVE and WAVEMQ and it was used for end-to-end encryption to collect some of the data.

## Mr. Plotter

Code (web application): <https://github.com/BTrDB/mr-plotter>

Code (desktop application): <https://github.com/samkumar/mr-plotter-app>,  
<https://github.com/samkumar/mr-plotter-qml>

- **Power Standards Lab (now Powerside)** sells micro-synchrophasors and software tools to store and process their data, based on DISTIL. Some of their products use Mr. Plotter (e.g., the **MicroPMU Quick Start Kit**; the **setup guide** refers to Mr. Plotter in §3 as uPMU Plotter, an earlier name for the same system).
- **PingThings** provides a platform for smart grid data analytics targeted at utility companies. Mr. Plotter's design significantly influenced their data visualization tool.
- The XBOS project, which provides an extensible operating system for smart buildings, also uses Mr. Plotter.

## MAGE

Open-source code: <https://github.com/ucbrise/mage>

Scripts for experiments: <https://github.com/ucbrise/mage-scripts>

## Teaching Experience

### University of California, Los Angeles

**Instructor**, *CS 239: Secure and Privacy-Preserving Systems* Spring 2026

- Pilot offering of a new lecture-based graduate course that I am creating

**Instructor**, *CS 239: Topics in Datacenter Systems Research* Winter 2026

- Graduate seminar course

**Instructor**, *CS 111: Operating Systems Principles* Spring 2025, Fall 2025

- Undergraduate course with  $\approx 130$  students
- Required course for Computer Science, Computer Science and Engineering, and Computer Engineering majors

**Instructor**, *CS 239: Efficient Cryptography-Based Systems* Fall 2024

- Graduate seminar course

### University of California, Berkeley

**Instructor**, *CS 162: Operating Systems and System Programming* Summer 2020

- Taught all lectures, decided the course content and syllabus, and wrote all exams
- Reorganized the course content to begin with a new “Abstractions” unit; some later offerings of CS 162 have retained these organizational changes
- Helped transition the course to a fully online format, for the COVID-19 pandemic
- Hired a team of GSIs (teaching assistants) to help run the class

**Head GSI, CS 162: Operating Systems and System Programming** Fall 2019

- Together with the other Head GSI, I helped manage a team of 11 GSIs (teaching assistants) for a class of 500+ students
- Taught weekly discussion sections; guided students in my section as they worked on significant programming tasks in the Pintos kernel in groups of four
- Created new assignments, including (1) a gentle introduction to kernel programming/debugging in Pintos, (2) programming tasks for Linux userspace and Pintos, and (3) an optional tutorial encouraging students to run their projects outside of the test cases; later offerings of CS 162 reused several of these assignments
- Taught a lecture when Prof. Culler was away
- Updated the course’s technical infrastructure
- Helped design and grade exam questions
- Received the university-level Outstanding GSI Award

**Peer Tutor, Eta Kappa Nu (HKN), UC Berkeley** 2015 – 2017

- HKN is the national Electrical and Computer Engineering honor society
- I offered free one-on-one tutoring as part of HKN’s drop-in tutoring program, and led review sessions to help students prepare for exams for their CS classes

**Talks**

**Scaling Encrypted Data Analytics Beyond Main Memory**

Science of Security Talk Series, Amazon

June 2026

**Rethinking System Design for Expressive Cryptography**

Faculty Candidate Talk, Cornell University

January 2023

Faculty Candidate Talk, University of Michigan

February 2023

Faculty Candidate Talk, UCLA

February 2023

Faculty Candidate Talk, University of Pennsylvania

February 2023

Faculty Candidate Talk, UMD College Park

February 2023

Faculty Candidate Talk, Brown University

March 2023

Faculty Candidate Talk, UNC Chapel Hill

March 2023

Faculty Candidate Talk, Columbia University

March 2023

Dissertation Talk, UC Berkeley

April 2023

Postdoc Candidate Talk, University of Washington

May 2023

**MAGE: Nearly Zero-Cost Virtual Memory for Secure Computation**

SDI Seminar, Carnegie Mellon University

October 2022

SysNet Seminar, UC San Diego

October 2022

SRG Seminar, University of Michigan

May 2022

Systems Lunch, Princeton University

March 2022

|                                                         |                |
|---------------------------------------------------------|----------------|
| RISE End-of-Project Retreat, UC Berkeley                | January 2022   |
| Security Lunch, Stanford University                     | December 2021  |
| Systems Seminar, UC Berkeley                            | November 2021  |
| Cryptography and Privacy Colloquium, MSR Redmond        | October 2021   |
| Security Seminar, Massachusetts Institute of Technology | September 2021 |
| Conference Talk, OSDI                                   | July 2021      |
| Systems Infrastructure Group, Google                    | June 2021      |
| RISELab Retreat, UC Berkeley                            | May 2021       |

**Performant TCP for Low-Power Wireless Networks**

|                                                     |                |
|-----------------------------------------------------|----------------|
| RIOT Summit, Hamburg University of Applied Sciences | September 2022 |
| IRTF Open Meeting, IETF 114                         | July 2022      |
| Core Networking Team Meeting, Apple                 | February 2021  |
| Thread Members Meeting, Thread Group                | November 2020  |
| Conference Talk, NSDI                               | February 2020  |
| RISELab Retreat, UC Berkeley                        | January 2019   |

**Building Systems that Efficiently and Cryptographically Protect User Privacy**

|                   |           |
|-------------------|-----------|
| Tech Talk, Soroco | June 2022 |
|-------------------|-----------|

**Ghostor: Toward a Secure Data-Sharing System from Decentralized Trust**

|                                     |               |
|-------------------------------------|---------------|
| Conference Talk, NSDI               | February 2020 |
| Bay Area Crypto Day, UC Berkeley    | November 2019 |
| RISELab Retreat, UC Berkeley        | May 2019      |
| RISE All Hands Meeting, UC Berkeley | February 2019 |

**JEDI: Many-to-Many End-to-End Encryption and Key Delegation for IoT**

|                                                                |             |
|----------------------------------------------------------------|-------------|
| Conference Talk, USENIX Security                               | August 2019 |
| Secure Internet of Things Project Retreat, Stanford University | June 2019   |
| RISELab Retreat, UC Berkeley                                   | May 2019    |

**WAVE: A Decentralized Authorization Framework with Transitive Delegation**

|                                                                |           |
|----------------------------------------------------------------|-----------|
| Secure Internet of Things Project Retreat, Stanford University | July 2018 |
|----------------------------------------------------------------|-----------|

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| <b>Service</b> | <b>Program Committee Member for USENIX Security 2027</b>     | 2026–2027 |
|                | <b>Program Committee Member for OSDI 2026</b>                | 2025–2026 |
|                | <b>Program Committee Member for IEEE S&amp;P 2026</b>        | 2025      |
|                | <b>Program Committee Member for NSDI 2026</b>                | 2025      |
|                | <b>External Review Committee Member for ASPLOS 2026</b>      | 2025      |
|                | <b>MS Admissions Committee Member, UCLA Computer Science</b> | 2024–2025 |
|                | <b>Program Committee Member for NSDI 2025</b>                | 2024      |

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|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
|                            | <b>Co-Organizer of Systems Reading Group, UC Berkeley EECS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                       | 2021-2022           |
|                            | <b>Organizer of DARE Research Workshop</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 2021                |
|                            | <ul style="list-style-type: none"> <li>• DARE stands for <b>D</b>iversifying Access to <b>R</b>esearch in <b>E</b>ngineering. It is a program in the EECS department at UC Berkeley to promote access to undergraduate research, particularly for underrepresented groups.</li> <li>• As part of DARE, I designed and ran the first-ever Research Workshop, which aims to introduce undergraduates to the research process in preparation for getting involved in undergraduate research.</li> </ul> |                     |
|                            | <b>Subreviewer for SOSP 2021</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2021                |
|                            | <b>Subreviewer for IEEE S&amp;P 2020</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 2019                |
|                            | <b>Subreviewer for SOSP 2019</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2019                |
|                            | <b>Graduate Admissions Reader, UC Berkeley EECS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 2018–2019           |
|                            | <b>Subreviewer for NSDI 2019</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2018                |
|                            | <b>Subreviewer for OSDI 2018</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2018                |
| <b>Industry Experience</b> | <b>Consultant, Thread Group</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Jun 2021 – Oct 2025 |
|                            | <ul style="list-style-type: none"> <li>• Invited by the Thread Group to contribute my expertise from the <i>TCPlp</i> project to help define and shepherd the transport-layer standard for Thread networks</li> </ul>                                                                                                                                                                                                                                                                                |                     |
|                            | <b>PhD Intern, Apple</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Feb 2021 – Apr 2021 |
|                            | <ul style="list-style-type: none"> <li>• Engaged in discussions with Thread Group members, using my expertise from the <i>TCPlp</i> project to help define a transport-layer standard for Thread networks</li> <li>• Helped define an API for TCP in OpenThread, an open-source implementation of Thread, in collaboration with the OpenThread open-source community</li> </ul>                                                                                                                      |                     |
|                            | <b>Software Engineering Intern, Google</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                           | May 2017 – Aug 2017 |
|                            | <ul style="list-style-type: none"> <li>• Interned on the Ad Spam Infrastructure team, which provides the software systems Google uses to identify spam in its Ads traffic</li> <li>• Worked on the Real-Time Spam Filter, which filters clicks and impressions in real-time, acting as Google’s first line of defense against spammy Ads traffic</li> </ul>                                                                                                                                          |                     |
|                            | <b>Backend Software Engineer (Intern), Nest Labs, Google</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         | Jun 2015 – Aug 2015 |
|                            | <ul style="list-style-type: none"> <li>• Interned on the Real-Time Services team, which provides and maintains collections of API endpoints to support Nest’s products</li> <li>• Worked on backend scheduling infrastructure to support time-based algorithms for Nest’s products</li> </ul>                                                                                                                                                                                                        |                     |