Ronghui Gu

http://www.ronghuigu.com

Associate Professor, Department of Computer Science, Columbia University
500 West 120 Street, 515 CSB, New York, NY 10027
Email: ronghui.gu@columbia.edu   Phone: +1 (212) 939-7111   Fax: +1 (212) 666-0140

Prepared February 8, 2024

RESEARCH INTERESTS

Programming languages and operating systems, with a focus on systems verification and proof automation.

EDUCATION

Ph.D. in Computer Science, **Yale University**, New Haven, CT, December 2016.
- Thesis title: An Extensible Architecture for Building Certified Sequential and Concurrent OS Kernels.
- Advisor: Prof. Zhong Shao.
- Distinguished Dissertation of Yale Graduate School of Art and Science.

M.S. in Computer Science, **Yale University**, New Haven, CT, May 2013.

M.Phil. in Computer Science, **Yale University**, New Haven, CT, May 2013.

B.S. in Computer Science with Highest Distinction, **Tsinghua University**, Beijing, China, June 2011
- Graduation with Highest Distinction (3 out of 140).

EMPLOYMENT

Associate Professor of Computer Science, **Columbia University**, New York, NY, since 2024.

Tang Family Assistant Professor, **Columbia University**, New York, NY, January 2021-December 2023.

Assistant Professor, **Columbia University**, New York, NY, January 2018-December 2020.

Co-Founder, **CertiK**, New York, NY, since 2018.

Software Engineer, **Google**, Mountain View, CA, September 2016-September 2017.

Research Assistant, **Yale University**, New Haven, CT, August 2012-August 2016.

AWARDS

VMware Systems Research Award, VMware, January 2023.

NSF CAREER Award, National Science Foundation, January 2023.

Builders and Innovators, Goldman Sachs, May 2022.

Amazon Research Award, April 2022.

Amazon Research Award (co-PI), July 2021.

OSDI Jay Lepreau Best Paper Award, July 2021.

Amazon Research Award, April 2021.

Named the inaugural Tang Family Assistant Professor, January 2021.

SOSP Best Paper Award, October 2019

Communications of the ACM (CACM) Research Highlights, October 2019.

Distinguished Dissertation Award, Yale University, December 2016.

Robert Willets Carle Scholarship, Yale University, February 2016.

Graduation with Highest Distinction (3 out of 140), Tsinghua University, July 2011.

PUBLICATIONS

Advisees are listed in **bold**. Ronghui Gu is <u>underlined</u>. Co-student leads are marked by *.

REFEREED AWARD PAPERS

[1] **J. Yao**, **R. Tao**, <u>R. Gu</u>, J. Nieh, S. Jana, and G. Ryan, "DistAI: Data-Driven Automated Invariant Learning for Distributed Protocols." *Proceedings of the 15th USENIX Symposium on Operating Systems Design and Implementation (**OSDI 2021**)*, Santa Clara, CA, July 14-16, 2021, pp. 405-421.
(Acceptance rate: 18.8%, 31 out of 165. Impact factor: 4.79)
Jay Lepreau Best Paper Award.

[2] <u>R. Gu</u>, Z. Shao, H. Chen, J. Kim, J. Koenig, X. Wu, V. Sjöberg, and D. Costanzo, "Building Certified Concurrent OS Kernels." *Communications of ACM (**CACM**)*, 62(10), pp. 89-99, 2019.
(Invited paper. Impact factor: 6.99)
Research Highlights.

[3] L. Nelson, J. Bornholt, <u>R. Gu</u>, A. Baumann, E. Torlak, and X. Wang. "Scaling Symbolic Evaluation for Automated Verification of Systems Code with Serval." *Proceedings of the 27th ACM Symposium on Operating Systems Principles (**SOSP 2019**)*, Ontario, Canada, October 27-30, 2019, pp. 225-242.
(Acceptance rate: 13.7%, 28 out of 276. Impact factor: 6.11)
Best Paper Award.

SELECTED REFEREED JOURNAL ARTICLES

[4] **J. Yao**, **R. Tao**, <u>R. Gu</u>, and J. Nieh, "Mostly Automated Verification of Liveness Properties for Distributed Protocols with Ranking Functions." *Proceedings of the ACM on Programming Languages (PACMPL) 4, **POPL***, Article 35, 32 pages, January 2024.
(Impact factor: 7.42)

[5] M. Liu, L. Rieg, Z. Shao, <u>R. Gu</u>, D. Costanzo, J. Kim, and M. Yoon, "Virtual Timeline: A Formal Abstraction for Verifying Preemptive Schedulers with Temporal Isolation." *Proceedings of the ACM on Programming Languages (PACMPL) 4, **POPL***, Article 20, 31 pages, January 2020.
(Acceptance rate: 27.5%, 68 out of 247. Impact factor: 7.42)

[6] E. Zhai, R. Piskac, <u>R. Gu</u>, X. Lao, and X. Wang, "An Auditing Language for Preventing Correlated Failures in the Cloud." *Proceedings of the ACM on Programming Languages (PACMPL) 1, **OOPSLA***, Article 97, 27 pages, October 2017.
(Acceptance rate: 30.7%, 66 out of 215. Impact factor: 4.79)

SELECTED REFEREED CONFERENCE PAPERS

[7] Z. Dai, S. Liu, V. Sjoberg, **X. Li**, Y. Chen, W. Wang, Y. Jia, S. Anderson, L. Elbeheiry, S. Sondhi, Y.Zhang, Z. Ni, S. Yan, <u>R. Gu</u>, and Z. He, "Verifying Rust Implementation of Page Tables in a Software Enclave Hypervisor." *Proceedings of the 29th International Conference on Architectural Support for Programming Languages and Operating Systems. (**ASPLOS 2024**)*, San Diego, CA, April 27-May 1, 2024.

[8] **X. Li**, **X. Li**, **Q. Wei**, <u>R. Gu</u>, and J. Nieh, "Spoq: Scaling Machine-Checkable Systems Verification in Coq."

*Proceedings of the 17th USENIX Symposium on Operating Systems Design and Implementation (**OSDI 2023**)*, Boston, MA, July 10-12, 2023.
(Acceptance rate: 19.6%, 50 out of 255. Impact factor: 4.79)
Media coverage: New Tool Automates the Formal Verification of Systems Software.

[9] **J. Yao**, R. Tao, R. Gu, and J. Nieh, "DuoAI: Fast, Automated Inference of Inductive Invariants for Verifying Distributed Protocols." *Proceedings of the 16th USENIX Symposium on Operating Systems Design and Implementation (**OSDI 2022**)*, Carlsbad, CA, July 11-13, 2022.
(Acceptance rate: 19.4%, 49 out of 253. Impact factor: 4.79)

[10] **X. Li**, **X. Li**, C. Dall, R. Gu, J. Nieh, Y. Sait, and G. Stockwell, "Design and Verification of the Arm Confidential Compute Architecture." *Proceedings of the 16th USENIX Symposium on Operating Systems Design and Implementation (**OSDI 2022**)*, Carlsbad, CA, July 11-13, 2022.
(Acceptance rate: 19.4%, 49 out of 253. Impact factor: 4.79)
Media coverage: New Computing Architecture Protects Sensitive Private Data.

[11] Y. Dabid, X. Sun, A. Senthilnathan, **R. Sofaer**, J. Yang, Z. Zuo, G. Xu, J. Nieh, and R. Gu, "UPGRADVISOR: Early Adopting Dependency Updates Using Hybrid Program Analysis and Hardware Tracing." *Proceedings of the 16th USENIX Symposium on Operating Systems Design and Implementation (**OSDI 2022**)*, Carlsbad, CA, July 11-13, 2022.
(Acceptance rate: 19.4%, 49 out of 253. Impact factor: 4.79)

[12] **R. Tao**, Y. Shi, **J. Yao**, **X. Li**, A. Javadi-Abhari, A. Cross, F. Chong, and R. Gu, "Giallar: Push-button Verification for the Qiskit Quantum Compiler." *Proceedings of the 43rd ACM SIGPLAN Conference on Programming Language Design and Implementation (**PLDI 2022**)*, San Diego, CA, June 13-17, 2022, pp. 641-656.
(Acceptance rate: 20.8%, 68 out of 326. Impact factor: 5.45)

[13] **R. Tao**, **J. Yao**, **X. Li**, Shih-Wei Li, J. Nieh, and R. Gu, "Formal Verification of a Multiprocessor Hypervisor on Arm Relaxed Memory Hardware." *Proceedings of the 28th ACM Symposium on Operating Systems Principles (**SOSP 2021**)*, Virtual Event, Germany, October 25-28, 2021, pp. 866-881.
(Acceptance rate: 15.5%, 54 out of 348. Impact factor: 6.11)

[14] S. Li*, **X. Li***, R. Gu, J. Nieh, and **J. Hui**, "Formally Verified Memory Protection for a Commodity Multiprocessor Hypervisor." *Proceedings of the 30th USENIX Security Symposium (**USENIX Security 2021**)*, Vancouver, British Columbia, Canada, August 11-13, 2021, pp. 3953-3970.
(Acceptance rate: 18.7%, 246 out of 1319. Impact factor: 13.04)

[15] **R. Tao**, Y. Shi, **J. Yao**, **J. Hui**, F. Chong, and R. Gu, "Gleipnir: Toward Practical Error Analysis for Quantum Programs." *Proceedings of the 42nd ACM SIGPLAN Conference on Programming Language Design and Implementation (**PLDI 2021**)*, Virtual Event, Canada, June 20-25, 2021, pp. 48-64.
(Acceptance rate: 27.2%, 87 out of 319. Impact factor: 5.45)

[16] S. Li*, **X. Li***, R. Gu, J. Nieh, and **J. Hui**, "A Secure and Formally Verified Linux KVM Hypervisor." *Proceedings of the 42nd IEEE Symposium on Security and Privacy (**S&P (Oakland) 2021**)*, San Francisco, CA, May 23-27, 2021, pp. 1782-1799.
(Acceptance rate: 11.8%, 115 out of 972. Impact factor: 11.38)
Media coverage: Columbia Engineering Team Builds First Hacker-resistant Cloud Software System.

[17] **J. Yao**, G. Ryan, **J. Wong**, S. Jana, and R. Gu, "Learning Nonlinear Loop Invariants with Gated Continuous Logic Networks." *Proceedings of the 41st ACM SIGPLAN Conference on Programming Language Design and Implementation (**PLDI 2020**)*, Virtual Event, June 15-19, 2020, pp. 106-120.
(Acceptance rate: 22.6%, 77 out of 341. Impact factor: 5.45)

[18] G. Ryan*, **J. Wong***, **J. Yao***, R. Gu, and S. Jana, "CLN2INV: Learning Loop Invariants with Continuous Logic Networks." *8th International Conference on Learning Representations (**ICLR 2020**)*, Virtual Event, April 26-May 1, 2020.

(Acceptance rate: 26.5%, 687 out of 2594. Impact factor: 11.38)

[19] M. Zou, H. Ding, D. Du, M. Fu, R. Gu, and H. Chen. "Using Concurrent Relational Logic with Helper for Verifying the AtomFS File System." *Proceedings of the 27th ACM Symposium on Operating Systems Principles (SOSP 2019)*, Ontario, Canada, October 27-30, 2019, pp. 259-274.
(Acceptance rate: 13.7%, 28 out of 276. Impact factor: 6.11)

[20] X. Yuan, J. Yang, and R. Gu, "Partial Order Aware Concurrency Sampling." *Proceedings of the 30th International Conference on Computer Aided Verification (CAV 2018)*, Oxford, UK, July 14-17, 2018, pp. 317-335.
(Acceptance rate: 24.2%, 30 out of 124. Impact factor: 5.45)

[21] R. Gu, Z. Shao, J. Kim, X. Wu, J. Koenig, V. Sjöberg, H. Chen, D. Costanzo, and T.Ramananandro, "Certified Concurrent Abstraction Layers." *Proceedings of the 39th ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI 2018)*, Philadelphia, PA, June 18-22, 2018, pp. 646-661.
(Acceptance rate: 22.4%, 55 out of 245. Impact factor: 5.45)

[22] R. Gu, Z. Shao, H. Chen, X. Wu, J. Kim, V. Sjöberg, and D. Costanzo, "CertiKOS: An Extensible Architecture for Building Certified Concurrent OS Kernels." *Proceedings of the 12th Symposium on Operating Systems Design and Implementation (OSDI 2016)*, Savannah, GA, November 2-4, 2016, pp. 653-669.
(Acceptance rate: 17.6%, 47 out of 267. Impact factor: 4.79)
Media coverage: CertiKOS: A Breakthrough toward Hacker-Resistant Operating Systems.

[23] D. Costanzo. Z. Shao, and R. Gu, "End-to-End Verification of Information-Flow Security for C and Assembly Programs." *Proceedings of the 37th ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI 2016)*, Santa Barbara, CA, June 13-17, 2016, pp. 648-664.
(Acceptance rate: 15.8%, 48 out of 304. Impact factor: 5.45)

[24] C. Hao, X. Wu, Z. Shao, J. Lockerman, and R. Gu, "Toward Compositional Verification of Interruptible OS Kernels and Device Drivers." *Proceedings of the 37th ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI 2016)*, Santa Barbara, CA, June 13-17, 2016, pp. 431-447.
(Acceptance rate: 15.8%, 48 out of 304. Impact factor: 5.45)

[25] R. Gu, J. Koenig, T. Ramananandro, Z. Shao, X. Wu, S. Weng, H. Zhang, and Y. Guo, "Deep Specifications and Certified Abstraction Layers." *Proceedings of the 42nd ACM Symposium on Principles of Programming Languages (POPL 2015)*, Mumbai, India, January 12-18, 2015, pp. 595-608.
(Acceptance rate: 22.2%, 52 out of 234. Impact Factor: 7.42)

OTHER REFEREED JOURNAL AND CONFERENCE PAPERS

[26] J. Kim, J. Koenig, H. Chen, R. Gu, and Z. Shao, "ThreadAbs: A Template to Build Verified Thread-local Interfaces with Software Scheduler Abstractions." *Journal of Systems Architecture (JSA)*, 147, p.103046, 2024.
(Impact factor: 5.07)

[27] J. Kim, R. Gu, and Z. Shao, "SimplMM: A simplified and abstract multicore hardware model for large scale system software formal verification." *Journal of Systems Architecture (JSA)*, 147, p.103049, 2024.
(Impact factor: 5.07)

[28] S. Li*, **X. Li***, R. Gu, J. Nieh, and **J. Hui**, "A Secure and Formally Verified Linux KVM Hypervisor." *8th Annual Hot Topics in the Science of Security Symposium (HoTSoS 2021)*, virtually hosted by the National Security Agency, April 13-15, 2021.
(Acceptance rate: 54.5%, 12 out of 22)

[29] C. Hao, X. Wu, Z. Shao, J. Lockerman, and R. Gu, "Toward Compositional Verification of Interruptible OS Kernels and Device Drivers." *Journal of Automated Reasoning (JAR)*, 61(1-4), pp.141-189, 2018.
(Invited paper. Impact factor: 2.53)

[30] J. Kim, V. Sjöberg, R. Gu, and Z. Shao, "Safety and Liveness of MCS Lock—Layer by Layer." *Proceedings of*

the 15th Asian Symposium on Programming Languages and Systems (APLAS 2017), Suzhou, China, November 27-29, 2017, pp. 273-297.
(Acceptance rate: 42.9%, 27 out of 63)

INVITED JOURNAL AND MAGAZINE ARTICLES

[31] **X. Li**, **X. Li**, C. Dall, R. Gu, J. Nieh, Y. Sait, and G. Stockwell, "Enabling Realms with the Arm Confidential Compute Architecture." *In USENIX ;login:*, July 5, 2023.

[32] **S. Lin**, X. Sun, **J. Yao**, and R. Gu, "SciviK: A Versatile Framework for Specifying and Verifying Smart Contracts." *In Memorial Volume for Shoucheng Zhang, World Scientific*, September 2021. pp. 403-437.

TECHNICAL REPORTS

[33] **R. Tao**, **J. Yao**, Shih-Wei Li, **X. Li**, J. Nieh, and R. Gu, "Verifying a Multiprocessor Hypervisor on Arm Relaxed Memory Hardware." Technical Report CUCS-005-21, Department of Computer Science, Columbia University, June 2021.

[34] S. Li*, **X. Li***, R. Gu, J. Nieh, and **J. Hui**, "Microverification of the Linux KVM Hypervisor: Proving VM Confidentiality and Integrity." Technical Report CUCS-003-20, Department of Computer Science, Columbia University, June 2020.

[35] Y. Shi*, **X. Li***, **R. Tao**, A. Javadi-Abhari, A. Cross, F. Chong, and R. Gu, "CertiQ: Contract-based Verification of a Realistic Quantum Compiler." Technical Report 1908.08963, arXiv, 2019.

[36] M. Liu, L. Rieg, Z. Shao, R. Gu, D. Costanzo, J. Kim, and M. Yoon, "Compositional Verification of Preemptive OS Kernels with Temporal and Spatial Isolation." Technical Report YALEU/DCS/TR-1549, Department of Computer Science, Yale University, 2019.

[37] R. Gu, Z. Shao, J. Kim, X. Wu, J. Koenig, V. Sjöberg, H. Chen, D. Costanzo, and T.Ramananandro, "Language and Compiler Support for Building Certified Concurrent Abstraction Layers." Technical Report YALEU/DCS/TR-1530, Department of Computer Science, Yale University, 2016.

FUNDING

[1] Principal Investigator, "CAREER: Automated Verification of Loops in Systems Code," Faculty Early Career Development Program (**CAREER**), National Science Foundation (**NSF**), CCF-2239484, **$525,000**, February 1, 2023 - January 31, 2028.

[2] Principal Investigator, "Learning Inductive Invariants for Real Distributed Protocols," Amazon Research Award, **Amazon**, April 1, 2022 - March 31, 2023, with Jason Nieh.

[3] Co-Principal Investigator, "FMitF: Track I: Verifying System Software on an Arm Multiprocessor Hardware Model," Formal Methods in the Field Program (FMitF), National Science Foundation (**NSF**), CCF-2124080, **$750,000**, October 1, 2021 - September 30, 2025, with Jason Nieh.

[4] Co-Principal Investigator, "Verifying System Software on an Arm Multiprocessor Hardware Model," Amazon Research Award, **Amazon**, August 1, 2021 - July 31, 2022, with Jason Nieh.

[5] Co-Principal Investigator, "REFUEL: Verified Composition and Flattening of Unified Enclave Layers," Verified Security and Performance Enhancement of Large Legacy Software (V-SPELLS) Program, Defense Advanced Research Projects Agency (**DARPA**), N6600121C4018, **$4,563,980**, April 1, 2021 - March 31, 2025, with Zhong Shao (Yale University), Abhishek Bhattacharjee (Yale University), Jason Nieh, and Gail Kaiser.

[6] Principal Investigator, "Microverification of the Linux KVM Hypervisor: Proving VM Confidentiality and Integrity," Amazon Research Award, **Amazon**, April 1, 2021 - March 31, 2022, with Jason Nieh.

[7] Principal Investigator, "SaTC: Medium: Microverification of Information-Flow Security for the Linux Operating System Kernel," Secure and Trustworthy Cyberspace Program (SaTC), National Science Foundation (**NSF**), CNS-2052947, **$1,167,034**, March 15, 2021 - February 28, 2025, with Jason Nieh.

[8] Principal Investigator, "Formal Verification of Trusted Firmware on Arm," **Arm**, **$126,400**, August 1, 2020 - July 31, 2021, with Jason Nieh.

[9] Co-Principal Investigator, "FMitF: Track I: A Secure and Verifiable Commodity Hypervisor," Formal Methods in the Field Program (FMitF), National Science Foundation (**NSF**), CCF-1918400, **$750,000**, October 1, 2019 - September 30, 2023, with Jason Nieh.

[10] Principal Investigator, "DeepSEA Framework for Building Certified Smart Contracts on IBM Hyperledger Platform," **Columbia-IBM Center** Seed Grant Award, **$200,000**, January 2019–December 2020.

[11] Principal Investigator, **Ethereum Foundation** Research Gift, 2019, with Zhong Shao (Yale University).

[12] Principal Investigator, **Qtum Foundation** Research Gift, **$400,000**, 2018.

[13] Principal Investigator, **Baidu USA** Research Gift, 2017.

SERVICE

PROGRAM COMMITTEES

[1] Member of Program Committee, *30th ACM Symposium on Operating Systems Principles (SOSP 2024)*, Austin, TX, November, 2024.

[2] Member of Program Committee, *45th annual ACM SIGPLAN conference on Programming Language Design and Implementation (PLDI 2024)*, Copenhagen, Denmark, June 24-28, 2024.

[3] Member of Program Committee, *29th annual ACM SIGPLAN conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS 2024)*, San Diego, CA, April 27-May 1, 2024.

[4] Member of Program Committee, *The 19th edition of European Conference on Computer Systems (EuroSys 2024)*, Athens, Greece, April 22-25, 2024.

[5] Member of Program Committee, *21st Asian Symposium on Programming Languages and Systems (APLAS 2023)*, Taipei, Taiwan, November 26-29, 2023.

[6] Member of Program Committee, *43rd annual ACM SIGPLAN conference on Programming Language Design and Implementation (PLDI 2022)*, San Diego, CA, June 13-17, 2022.

[7] Member of External Review Committee, *27th ACM International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS 2022)*, Lausanne, Switzerland, February 28-March 4, 2022.

[8] Member of Program Committee, *49th ACM SIGPLAN Symposium on Principles of Programming Languages (POPL 2022)*, Philadelphia, PA, January 16-28, 2022.

[9] Member of Program Committee, *15th USENIX Symposium on Operating Systems Design and Implementation (OSDI 2021)*, Santa Clara, CA, July 14-16, 2021.

[10] Member of Program Committee, *41st annual ACM SIGPLAN conference on Programming Language Design and Implementation (PLDI 2020)*, Virtual Event, June 15-19, 2020.

[11] Member of Program Committee, *2020 IEEE Security Development Conference (SecDev 2020)*, Virtual Event, September 28-30, 2020.

[12] Member of Program Committee, *16th USENIX Symposium on Networked Systems Design and Implementation (NSDI 2019)*, Boston, MA, February 26-28, 2019.

[13] Member of Program Committee, *2019 ACM Symposium on Cloud Computing (SoCC 2019)*, Santa Cruz, CA, November 20-23, 2019.

[14] Member of Program Committee, *2019 IEEE Security Development Conference (SecDev 2019)*, McLean, VA, September 25-27, 2019.

[15] Member of Program Committee, *5th International Workshop on Coq for Programming Languages (CoqPL 2019)*, Cascais, Portugal, January 13-19, 2019.

[16] Member of External Review Committee, *39th annual ACM SIGPLAN conference on Programming Language Design and Implementation (PLDI 2018)*, Philadelphia, PA, June 18-22, 2018.

[17] Member of Student Research Competition Committee, *23rd ACM SIGPLAN International Conference on Functional Programming (ICFP 2018)*, St. Louis, MO, September 23-29, 2018.

[18] Member of Program Committee, *2018 IEEE Security Development Conference (SecDev 2018)*, Cambridge, MA, September 30-October 2, 2018.

FUNDING PROPOSAL REVIEWING

[19] Panelist, *National Science Foundation (NSF) Program on Secure and Trustworthy Cyberspace (SaTC).*

[20] Panelist, *National Science Foundation (NSF) Program on Software and Hardware Foundations (SHF).*

[21] Panelist, *National Science Foundation (NSF) Program on Secure and Trustworthy Cyberspace (SaTC).*

[22] Panelist, *National Science Foundation (NSF) Program on Quantum Idea Incubator for Transformational Advances in Quantum Systems (QII-TAQS).*

COLUMBIA SERVICE

[23] Member of Columbia Center for Digital Finance and Technologies, September 2022-present.

[24] Member of Columbia Quantum Initiative, February 2020-present.

[25] Academic Advisor of SEAS Undergraduates, July 2019-present.

[26] Member of Columbia Data Science Institute (DSI) Cybersecurity Center, February 2019-present.

OTHER SERVICE

[27] International Technology Advisor, Monetary Authority of Singapore (MAS), July 2023 - Present.

[28] Member of Hong Kong Task Force on Promoting Web3 Development, June 2023 - Present.

SELECTED INVITED TALKS

[1] The 11th Internet Security Conference 2023, "New Progress of Systems Verification in Safety-critical Software," August 09, 2023.

[2] Beijing Cyber Security Conference 2023, "Web 3 Code Security—Apply Intelligent Analysis in Auditing Practices," July 06, 2023.

[3] Open Source Operating System Annual Technical Conference 2023, "Microverification of the Linux KVM Hypervisor," March 26, 2023.

[4] Goldman Sachs TechNet Conference Asia Pacific 2022, "Securing the Web3 World," May 27, 2022.

[5] World Economic Forum, "Shaping the Future of Technology Governance: Blockchain and Digital Assets," May 25, 2022.

[6] Yale Innovation Summit, "Startup journeys from Yale to Unicorn," May 18, 2022.

[7] Columbia Engineering's Alumni Weekend 2020, "Towards Building Trustworthy Blockchain Systems," June 06, 2020.

[8] IoT and Blockchain Workshop, "Towards Building Trustworthy Blockchain Systems," November 11, 2019.

[9] Trustworthy AI Symposium, "Linux KVM Microverification," October 30, 2019.

[10] New England Systems Verification Day, "Linux KVM Microverification," October 18, 2019.

[11] The Shoucheng Zhang Memorial Workshop, "Towards Building Trustworthy Blockchain Systems," May 03, 2019.

[12] Columbia Data Science Day, "Towards Building Trustworthy Blockchain Systems," April 03, 2019.

[13] DHVC Professor Workshop, "Towards Building Trustworthy Blockchain Systems," August 02, 2018.

[14] DeepSpec Summer School, "Overview of CertiKOS," July 20, 2018.

[15] Yale US China Forum, "Towards Building Trustworthy Blockchain Systems," April 28, 2018.

[16] New England Systems Verification Day, "Overview of CertiKOS," October 06, 2017.

[17] Invited talk, titled "Building Fully Trustworthy OS Kernels through Formal Verification," delivered at multiple universities and industrial labs: Columbia University, The University of Chicago, University of Washington, University of Pennsylvania, New York University, Princeton University, The Pennsylvania State University, Boston University, University of Connecticut, Google, Ant Group, 2017.

[18] Yale Programming Languages Day, "Deep Specifications and Certified Abstraction Layers," November 04, 2015.

[19] New England Programming Languages and Systems Symposium, "Deep Specifications and Certified Abstraction Layers," June 03, 2015.

[20] High Confidence Software and Systems Conference, "Deep Specifications and Certified Abstraction Layers," May 04, 2015.

SELECTED MEDIA COVERAGE

[1] Bernadette Young, "New Tool Automates the Formal Verification of Systems Software," Columbia Engineering, October 27, 2023.

[2] Chirs Ramming, "VMware Systems Research Award Recipient Named," VMware, January 31, 2023.

[3] Clive Thompson, "The computer scientist who hunts for costly bugs in crypto code," **MIT Techology Review**, January 02, 2023.

[4] Tom Wilson and Medha Singh, "Cryptoverse: Blockchain bridges fall into troubled waters," **Reuters**, August 11, 2022.

[5] "With $5.75M Grant, Yale Leads Multidisciplinary Blockchain Center," Yale School of Engineering & Applied Science, August 4, 2022.

[6] Holly Evarts, "New Computing Architecture Protects Sensitive Private Data," Columbia Engineering, July 15, 2022.

[7] Jacquelyn Melinek, "Crypto hackers are increasingly phishing for new bait on social media," **TechCrunch**, July 7, 2022.

[8] Victoria Vergolina, "Crypto Hacks on Social Media Platforms Have Investors Paying Attention," **Bloomberg**,

June 13, 2022.

[9] Stacy-Marie Ishmael, "Hacking Crypto Through Social Media," **Bloomberg**, June 12, 2022.

[10] David Jolly, "Colossal Terra Crash Amplifies Calls to Open Stablecoin Books," Bloomberg Law, May 24, 2022.

[11] Hannah Miller, "Bored Ape Thefts on Instagram Are Crypto's Latest Hack Headaches," **Bloomberg**, May 04, 2022.

[12] Olga Kharif and Hannah Miller, "Bored Ape Instagram Hack Cost NFT Owners $3 Million," **Bloomberg**, April 25, 2022.

[13] Carly Olson, "North Korea, NFTs and a hit video game: inside a $500m cryptocurrency theft," **The Guardian**, April 16, 2022.

[14] Jacquelyn Melinek, "Goldman Sachs joins other investors in $88M round for web3 and blockchain security firm CertiK," **TechCrunch**, April 7, 2022.

[15] David Uberti, "How Hackers Target Bridges Between Blockchains for Crypto Heists," **The Wall Street Journal**, April 5, 2022.

[16] MacKenzie Sigalos, "More than $320 million stolen in latest apparent crypto hack," **CNBC**, February 03, 2022.

[17] Charles Q. Choi, "SeKVM Makes Cloud Computing Provably Secure Columbia University researchers have created a secure Linux-based hypervisor," IEEE Spectrum, June 07, 2021.

[18] Holly Evarts, "Columbia Engineering Team Builds First Hacker-resistant Cloud Software System," Columbia Engineering, May 24, 2021.

[19] Ellen Kan "Yale computer scientists unveil new OS," Yale Daily News, November 18, 2016.

[20] William Weir, "CertiKOS: A breakthrough toward hacker-resistant operating systems," Yale News, November 14, 2016.

MENTORING

CURRENT PhD STUDENTS

Jianan Yao 2019-present. Expected to graduate in 2024.
Thesis: Automated Inference of Inductive Invariants for Verifying Distributed Protocols.

Runzhou Tao 2019-present. Expected to graduate in 2024.
Thesis: Formal Verification for Quantum Programs and Compilers.

Xupeng Li 2019-present. Expected to graduate in 2024.
Thesis: Microverification for Complex Systems Software on Arm Hardware.

Xuheng Li 2020-present. Co-advised with Jason Nieh.
Research interest: Computer Systems; Formal Verification.

Raphael Sofaer 2021-present. Co-advised with Junfeng Yang and Jason Nieh.
Research interest: Computer Systems.

Fanqi Yu 2022-present. Co-advised with Jason Nieh.
Research interest: Computer Systems; Formal Verification.

Kele Huang 2022-present. Co-advised with Jason Nieh.
Research interest: Computer Systems; Quantum Computing; Formal Verification.

MS ADVISING

Qiang Wei 2022-present.

John Hui 2018-2020. Now Ph.D. at Columbia University.

Linghan Kong 2019-2020.

UNDERGRAD RESEARCH ADVISING

Justin Wong 2018-2020. Now Ph.D. at The University of California, Berkeley.

Jerry Lin 2019-2020. Now Ph.D. at The University of California, Berkeley.

Amanda Liu 2019-2020. Now Ph.D. at Massachusetts Institute of Technology,.

River Dillon Keefer 2019-2020. Now at MakerDAO.

Marcus Blake 2020-2021. Now M.S. at Columbia University.

Alpha Kaba 2022.

Ryan Zhao 2023.

HIGH SCHOOL

Frank Yang 2020. Accepted to Columbia University.

Patrick Chen 2022. Accepted to New York University.

Peter Yu 2022. Accepted to Columbia University.

PHD DISSERTATION COMMITTEES

Xinhao Yuan. Defended 2019.
Thesis: Effective Randomized Concurrency Testing with Partial Order Methods.

Richard Townsend. Defended 2019.
Thesis: Compiling Irregular Software to Specialized Hardware.

Jintack Lim. Defended 2020.
Thesis: The Design, Implementation, and Evaluation of Software and Architectural Support for Nested Virtualization on Modern Architectures.

Shih-Wei Li. Defended 2021.
Thesis: A Secure and Formally Verified Commodity Multiprocessor Hypervisor.

Ryan Bernstein. Defended 2023.
Thesis: Abstractions for Probabilistic Programming to Support Model Development.

Anthony Saieva. Defended 2023.
Thesis: Methods and Tools for Practical Software Testing and Maintenance.

TEACHING EXPERIENCE

COMS 4115 Programming Languages and Translators, Columbia University.
Spring 2024; Fall 2022; Spring 2022; Spring 2020; Spring 2019.

COMS E6998 Formal Verification of Systems Software, Columbia University.
Fall 2023; Fall 2021; Fall 2020; Fall 2019; Fall 2018.

COMS W3101 Programming Languages, Columbia University. Spring 2018.

Blockchain Cyberdefense Design Challenge, Columbia-IBM Center. Summer 2021.

Graduate Seminar on Systems.