Robert Rand

EDUCATION

University of Pennsylvania, Philadelphia, PA
Ph.D. in Computer and Information Sciences, December 2018
Dissertation title: *Formally Verified Quantum Programming*
Advisor: Steve Zdancewic

Yeshiva University, Yeshiva College, New York, NY
B.A. Summa Cum Laude in Computer Science and Mathematics, May 2011
Gertrude Nissenbaum Memorial Award for Excellence in Computer Science
Professor Daniel Block Memorial Award for Excellence in Mathematics
Honors Thesis Advisor: Kira Adaricheva

EMPLOYMENT

University of Chicago, Chicago, IL

July 2020 – Present: Assistant Professor of Computer Science

- Working at the intersection of Quantum Computing, Programming Languages, and Formal Verification.
- Affiliate appointment at Argonne National Labs; member of the Chicago Quantum Exchange.

University of Maryland, College Park, MD

September 2018 – June 2020: Basili Postdoctoral Fellow

- Studied quantum programming and compilation.
- Supervisors: Michael Hicks and Xiaodi Wu.

Microsoft Research, Cambridge, United Kingdom

Summer 2016: Research Intern

- Worked on extending Microsoft Excel with anonymous functions and probability distributions (Project Yellow).
- Supervisor: Andy Gordon. Also worked with Neil Toronto, Claudio Russo and Simon Peyton-Jones.

Bundle Corporation, New York, NY

August 2011 – August 2012: Data Scientist

- Analyzed datasets of anonymized consumer transaction records to produce relevant metrics about merchants.
- Devised and implemented new additions to the Bundle website, including personalized Bundle Scores, related merchants, and neighborhood merchant rankings
- Provided data support in numerous other areas, including developing heuristics to identify closed merchants, and analyzing consumer trends for Bundle Infographics and National Spending Reports.

PUBLICATIONS

- Kesha Hietala, Robert Rand, Shih-Han Hung, Liyi Li and Michael Hicks. “Proving Quantum Programs Correct”. *Interactive Theorem Proving, 2021*.
- Kesha Hietala, Robert Rand, Shih-Han Hung, Xiaodi Wu, Michael Hicks. “A Verified Optimizer for Quantum Programs”. *Principles of Programming Languages, 2021* **(distinguished paper)**.
- Robert Rand, Aarthi Sundaram, Kartik Singhal, Brad Lackey. “Gottesman Types for Quantum Programs”. *Quantum Physics and Logic*, 2020.
- Kesha Hietala, Robert Rand, Shih-Han Hung, Xiaodi Wu, Michael Hicks. “Verified Optimization in a Quantum Intermediate Representation”. *Presented at Quantum Physics and Logic*, 2019.
- Robert Rand, Kesha Hietala, Michael Hicks. “Formal Verification vs. Quantum Uncertainty”. *Summit on Advances in Programming Languages,* 2019.
- Robert Rand, Jennifer Paykin, Dong-Ho Lee, and Steve Zdancewic. “ReQWIRE: Reasoning about Reversible Quantum Circuits”. *Quantum Physics and Logic*, 2018.
- Robert Rand, Jennifer Paykin, and Steve Zdancewic. “QWIRE Practice: Formal Verification of Quantum Circuits in Coq”. *Quantum Physics and Logic*, 2017.
- Jennifer Paykin, Robert Rand, and Steve Zdancewic. "QWIRE: A Core Language for Quantum Circuits”. *Principles of Programming Languages*, 2017.
- Robert Rand and Steve Zdancewic. "VPHL: A Verified Partial-Correctness Logic for Probabilistic Programs”. *Mathematical Foundations of Programming Semantics,* 2015.
- Kira Adaricheva, James B. Nation, and Robert Rand. “Ordered direct implicational basis of a finite closure system”. *Discrete Applied Mathematics,* 2013.

WORKSHOP PAPERS

- Robert Rand, Aarthi Sundaram, Kartik Singhal and Brad Lackey, “Tracking Errors through Types in Quantum Programs”. *Programming Languages for Quantum Computing*, 2021.
- Kartik Singhal, Sarah Marshall, Kesha Hietala and Robert Rand, “Toward a Type-Theoretic Interpretation of Q#”. *Programming Languages for Quantum Computing*, 2021.
- Kesha Hietala, Liyi Li, Akshaj Gaur, Aaron Green, Robert Rand, Xiaodi Wu and Michael Hicks, “Expanding the VOQC Toolkit”. *Programming Languages for Quantum Computing*, 2021.
- Kesha Hietala, Robert Rand, and Michael Hicks, “Tracking Errors through Types in Quantum Programs”. *Programming Languages for Quantum Computing*, 2020.
- Kartik Singhal, Robert Rand and Michael Hicks, “Verified translation between low-level quantum languages”. *Programming Languages for Quantum Computing*, 2020.
- Robert Rand, Jennifer Paykin and Steve Zdancewic, “Phantom Types for Quantum Programs”. *Coq for Programming Languages*, 2017.
- Robert Rand and Steve Zdancewic, “Models for Probabilistic Programs with an Adversary”. *Probabilistic Programming Semantics*, 2016.

RESEARCH TALKS

- "Towards a Verified Quantum Stack". American University Computer Science Colloquium, 2019.
- "Verified Quantum Programs for the NISQ Era". MURI Review, University of Maryland, 2019.
- "Formally Verifying Quantum Protocols". Workshop on Higher Category Approach to Certifiably Correct Quantum Information Processing Systems, 2018.
- "Verified Quantum Programming in QWIRE: Optimization and Error Correction". Dagstuhl Seminar on Quantum Programming Languages, 2018.
- "Formally Verified Quantum Computing". Yeshiva University Physics Colloquium, 2018.
- "Provably Correct Quantum Programming". Hofstra University Mathematics Seminar, 2018.
- "Verified Quantum Programming in QWIRE". MURI Review, UC Berkeley, 2017.
- "Formally Verifying Your Quantum Programs". New Jersey Programming Languages and Systems, 2017.
- "Verifying Probabilistic Programs in the Presence of an Adversary". International Conference on Functional Programming, 2015.

TUTORIALS

- Robert Rand, "Verified Quantum Computing". *Principles of Programming Languages*, 2020.
- Robert Rand, "Quantum Circuits and Quantum Programs" and "Formally Verified Quantum Computing". *Winter School on Quantum Computing at Emory*, 2020.
- Robert Rand and Arthur Azevedo de Amorim, "Programs and Proofs in the Coq Proof Assistant". *Principles of Programming Languages*, 2016.
- Robert Rand and Arthur Azevedo de Amorim, "An Introduction to the Coq Proof Assistant". *Commercial Users of Functional Programming*, September 2015.

TEACHING

- Instructor, "Quantum Programming and Verification", University of Chicago, Spring 2021
- Instructor, "Programming Proofs", University of Chicago, Winter 2021
- Instructor, "Discrete Mathematics", University of Chicago, Fall 2020
- Instructor, "Program Analysis and Understanding", University of Maryland, Spring 2019
- Instructor, "Python Programming", University of Pennsylvania, Fall 2015 and Spring 2016
- Teaching Assistant, "Introduction to Algorithms", University of Pennsylvania, Spring 2014
- Teaching Assistant, "Automata, Computability, and Complexity", University of Pennsylvania, Fall 2013
- Lab Instructor, "Introduction to Algorithms", Yeshiva University, Fall 2010
- Recitation Instructor, "Discrete Structures", Yeshiva University, Spring 2009 and 2010

REVIEWER

- Programming Languages Design and Implementation (PLDI), 2022. *Program Committee*
- European Symposium on Programming Languages (ESOP), 2022. *Program Committee*
- Quantum Computing and Engineering (QCE), 2021. *Program Committee*
- Quantum Physics and Logic (QPL), 2021
- Transactions on Software Engineering and Methodology (TOSEM), 2021
- ACM Transactions on Quantum Computing, 2021
- Programming Languages for Quantum Computing (PLanQC), 2020, 2021. (*PC Chair* in 2020, *PC/SC* in 2021)
- Object-Oriented Programming, Systems, Languages & Applications (OOPSLA), 2020. *External Review Committee*
- Asian Symposium on Programming Languages and Systems (APLAS), 2020.
- Quantum Cryptography (QCrypt), 2020.
- International Colloquium on Automata, Languages and Programming (ICALP), 2020.
- International Conference on Functional Programming (ICFP), 2020.
- Mathematical Foundations of Computer Science (MFCS), 2020.
- Foundations of Software Science and Computation Structures (FoSSaCS), 2020
- Quantum Information Processing (QIP), 2020
- Reversible Computing (RC), 2019. *Program Committee*
- Principles of Programming Languages (POPL), 2019. *Artifact Evaluation Committee*
- Programming Languages Design and Implementation (PLDI), 2019
- Applied Science, 2019
- Quantum, 2018–2020
- Quantum Information Processing Journal (QINP), 2018, 2019
- Journal of Automated Reasoning (JARS), 2017, 2018
- Logic in Computer Science (LICS), 2016, 2018, 2019
- Mathematical Foundations of Programming Semantics (MFPS), 2016
- European Symposium on Programming Languages (ESOP), 2014
- ERGO, An Open Access Journal of Philosophy, 2014

AWARDS / GRANTS

- Co-PI: “EPiQC: Enabling Practical-scale Quantum Computing”, Project Grant CCF-1730449. Funded by the National Science Foundation (NSF). University of Chicago. $4,943,188 total, Mar 2018 – Feb 2023.

- Co-PI: “Software Assurance for Quantum Programs”, Project Grant FA95502110051. Funded by the Air Force Research Laboratory (DOD - USAF - AFMC). Joint between University of Maryland (Michael Hicks) and University of Chicago (Robert Rand). $450,000 total, Jan 2021 – Dec 2023.

- Victor Basili Postdoctoral Fellowship (2018-July 2020).

MEMBERSHIPS

- Member, Association for Computing Machinery (ACM), July 2015 – present.
    - Member, ACM Special Interest Group on Programming Languages (SIGPLAN)
    - Member, ACM Special Interest Group on Logic and Computation (SIGLOG)