

Swarat Chaudhuri

Professor
Department of Computer Science
The University of Texas, Austin, TX.

The University of Texas at Austin,
2317 Speedway
Austin, TX 78712-1199, USA.

Voice: +1-267-235-4767

Zoom: <https://utexas.zoom.us/my/swarat>

Email: swarat@cs.utexas.edu

Web: <https://www.cs.utexas.edu/~swarat>

Curriculum vitae (last updated in September 2023)

Current Research Interests

My research lies at the confluence of Machine Learning (ML), Programming Languages (PL), and Formal Methods (FM). On the one hand, I work on novel ML-based approaches to the programming and formal reasoning problems that are traditionally the forte of PL and FM. On the other hand, I bring a PL/FM perspective to classical ML problems, using a mix of symbolic and statistical methods to build learning-enabled systems that are resource-efficient, transparent, and secure by construction.

Education

2001–2007 **Doctor of Philosophy**, *University of Pennsylvania.*

Dissertation: *Logics and Algorithms for Software Model Checking*
(Advisor: Professor Rajeev Alur)

1997–2001 **Bachelor of Technology**, *Indian Institute of Technology, Kharagpur, India.*

Professional Experience

Sept. 2023 onwards **Full Professor**, *University of Texas at Austin.*

Jan. 2020–Aug. 2023 **Associate Professor with Tenure**, *University of Texas at Austin.*

July 2015–Dec. 2019 **Associate Professor with Tenure**, *Rice University.*

June–Dec. 2017 **Visiting Professor**, *ETH Zürich.*

July 2011–June 2015 **Assistant Professor**, *Rice University.*

January 2008–May 2011 **Assistant Professor**, *Pennsylvania State University.*

Fall 2007 **Visiting Researcher**, *NEC Laboratories America.*

Summers of 2002, 2005, 2006 **Summer intern**, *respectively at Lucent Bell Laboratories, Grammatech Corporation, and IBM T.J. Watson Research Center.*

Awards and Honors

2023 **The Op-Ed Project Public Voices Fellowship.**

2022 **Meta Research Award**, *for research on “Verified Learning of Neurosymbolic Programs”.*

2022 **Distinguished Paper Award**, *POPL 2022, for the paper “Bottom-Up Synthesis of Recursive Functional Programs using Angelic Execution”.*

2019 **Distinguished Paper Award**, *PLDI 2019, for the paper “Optimization and Abstraction: A Synergistic Approach for Analyzing Neural Network Robustness”.*

- 2015 **Google Research Award**, for research on “Statistical Program Synthesis for Productive API Usage”.
- 2011 **Distinguished Paper Award**, ESEC/FSE 2011, for the paper “Proving programs robust” (the paper was also selected as a CACM research highlight).
- 2010 **National Science Foundation CAREER Award**, for research on “Robustness Analysis of Uncertain Programs: Algorithms, Theory, and Tools”.
- 2007 **John Reynolds Doctoral Dissertation Award**, Presented annually by ACM SIGPLAN to the author of the outstanding doctoral dissertation in the area of Programming Languages.
- 2007 **Morris and Dorothy Rubinoff Award**, Presented by the University of Pennsylvania to a dissertation that has resulted in or could lead to innovative applications of computer technology.

Publications

[All articles below are refereed. In the author listings, names of students, visiting students, postdoctoral researchers, and research scientists whom I mentored and funded appear in bold type. All published papers are available at <http://www.cs.utexas.edu/~swarat/pubs>. Citation information is available on my Google Scholar page: <https://scholar.google.com/citations?user=9j6RBYQAAAAJ>.]

- 82. **Meghana A. Sistla**, Swarat Chaudhuri, and Thomas Reps. Symbolic Quantum Simulation with Quasimodo. *International Conference on Computer-Aided Verification (CAV)*, 2023.
- 81. **Greg Anderson**, Swarat Chaudhuri, and Isil Dillig. Guiding Safe Exploration with Weakest Preconditions. *International Conference on Learning Representations (ICLR)*, 2023.
- 80. Zayne Sprague, Kaj Bostrom, Swarat Chaudhuri, and Greg Durrett. Natural Language Deduction with Incomplete Information. *Empirical Methods in Natural Language Processing (EMNLP)*, 2022.
- 79. Kaj Bostrom, Zayne Sprague, Swarat Chaudhuri, and Greg Durrett. Natural Language Deduction through Search over Statement Compositions. *Findings of Empirical Methods in Natural Language Processing (EMNLP-Findings)*, 2022.
- 78. Jennifer J. Sun, Megan Tjandrasuwita, **Atharva Sehgal**, Armando Solar-Lezama, Swarat Chaudhuri, Yisong Yue, and Omar Costilla Reyes. Neurosymbolic Programming for Science. *NeurIPS 2022 AI for Science Workshop*.
- 77. Eric Zhan, Jennifer J. Sun, Ann Kennedy, Yisong Yue, and Swarat Chaudhuri. Unsupervised Learning of Neurosymbolic Encoders. *Transactions on Machine Learning Research (TMLR)*, 2022.
- 76. Cameron Voloshin, Hoang M. Le, Swarat Chaudhuri, and Yisong Yue. Policy Optimization with Linear Temporal Logic Constraints. *Neural Information Processing Systems (NeurIPS)*, 2022.
- 75. Suguman Bansal, Swarat Chaudhuri, and Moshe Y. Vardi. Comparator Automata in Quantitative Verification. *Logical Methods in Computer Science (LMCS)*, 2022.
- 74. **Chenxi Yang** and Swarat Chaudhuri. Safe Neurosymbolic Learning with Differentiable Symbolic Execution. *International Conference on Learning Representations (ICLR)*, 2022.
- 73. **Anders Miltner**, Adrian Trejo Nuñez, **Ana Brendel**, Swarat Chaudhuri, and Isil Dillig. Bottom-Up Synthesis of Recursive Functional Programs using Angelic Execution. *Principles of Programming Languages (POPL)*, 2022. (**Distinguished Paper**)

72. Arkabandhu Chowdhury, **Dipak Chaudhari**, Swarat Chaudhuri, and Chris Jermaine. Meta-
Meta Classification for One-Shot Learning. *Workshop on Applications of Computer Vision
(WACV)*, 2022.
71. Swarat Chaudhuri, Kevin Ellis, Oleksandr Polozov, Rishabh Singh, Armando Solar-Lezama,
and Yisong Yue. Neurosymbolic Programming. *Foundations and Trends in Programming
Languages (FnT)*, 2021.
70. Rohan Mukherjee, **Yeming Wen**, **Dipak Chaudhari**, Thomas W. Reps, Swarat Chaud-
huri, and Chris Jermaine. Neural Program Generation Modulo Static Analysis. *Neural
Information Processing Systems (NeurIPS)*, 2021. **(Spotlight Paper)**
69. Arkabandhu Chowdhury, Mingchao Jiang, Swarat Chaudhuri, and Chris Jermaine. Few-
shot Image Classification: Just Use a Library of Pre-trained Feature Extractors and a Simple
Classifier. *International Conference on Computer Vision (ICCV)*, 2021.
68. Kaj Bostrom, Xinyu Zhao, Swarat Chaudhuri, and Greg Durrett. Flexible Generation
of Natural Language Deductions. *Empirical Methods in Natural Language Processing
(EMNLP)*, 2021.
67. **Yue Wang**, **Abdullah Al Redwan Newaz**, Juan David Hernández, Swarat Chaudhuri,
and Lydia E. Kavragi. Online Partial Conditional Plan Synthesis for POMDPs With Safe-
Reachability Objectives: Methods and Experiments. *IEEE Transactions on Automation
Science and Engineering*, 2021.
66. Shlok Sobti, Rahul Shome, Swarat Chaudhuri, and Lydia E. Kavragi. A Sampling-based
Motion Planning Framework for Complex Motor Actions. *International Conference on
Intelligent Robots and Systems (IROS)*, 2021.
65. Jiayi Wei, Tongrui Li, Swarat Chaudhuri, Isil Dillig, and Joydeep Biswas. OneVision:
Centralized to Distributed Controller Synthesis with Delay Compensation. *International
Conference on Intelligent Robots and Systems (IROS)*, 2021.
64. **Ameesh Shah***, Eric Zhan*, Jennifer J. Sun, **Abhinav Verma**, Yisong Yue, and Swarat
Chaudhuri. Learning Differentiable Programs with Admissible Neural Heuristics. *Neural
Information Processing Systems (NeurIPS)*, 2020.
63. **Greg Anderson**, **Abhinav Verma**, Isil Dillig, and Swarat Chaudhuri. Neurosymbolic
Reinforcement Learning with Formally Verified Exploration. *Neural Information Processing
Systems (NeurIPS)*, 2020.
62. Rohan Mukherjee, Chris Jermaine, and Swarat Chaudhuri. Searching a Database of Source
Codes Using Contextualized Code Search. *Very Large Databases (VLDB)*, 2020.
61. **Abhinav Verma***, Hoang M. Le*, Yisong Yue, and Swarat Chaudhuri. Imitation-Projected
Policy Gradient for Programmatic Reinforcement Learning. *Neural Information Processing
Systems (NeurIPS)*, 2019.
60. Richard Cheng, **Abhinav Verma**, Gabor Orosz, Swarat Chaudhuri, Yisong Yue, and Joel
Burdick. Control Regularization for Reduced Variance Reinforcement Learning. *Interna-
tional Conference on Machine Learning (ICML)*, 2019.
59. Greg Anderson, Shankara Pailoor, Isil Dillig, and Swarat Chaudhuri. Optimization and Ab-
straction: A Synergistic Approach for Analyzing Neural Network Robustness. *Symposium
on Programming Language Design and Implementation (PLDI)*, 2019. **(Distinguished
Paper)**

58. **Yue Wang**, Swarat Chaudhuri, and Lydia Kavraki. Point-Based Policy Synthesis for POMDPs with Boolean and Quantitative Objectives. *IEEE Robotics and Automation Letters (RAL)*, 2019.
57. **Josh Michalenko**, **Abhinav Verma**, **Ameesh Shah**, Richard G. Baraniuk, Swarat Chaudhuri, Ankit B. Patel. Representing Formal Languages: A Comparison between Finite Automata and Recurrent Neural Networks. *International Conference on Learning Representations (ICLR)*, 2019.
56. Lazar Valkov, **Dipak Chaudhari**, Akash Srivastava, Charles A. Sutton, and Swarat Chaudhuri. Synthesis of Differentiable Functional Programs for Lifelong Learning. *Neural Information Processing Systems (NeurIPS)*, 2018.
55. **Yue Wang**, Swarat Chaudhuri, and Lydia Kavraki. Online Partial Conditional Plan Synthesis for POMDPs with Safe-Reachability Objectives. *Workshop on Algorithmic Foundations of Robotics (WAFR)*, 2018.
54. **Abhinav Verma**, **Vijayaraghavan Murali**, Rishabh Singh, Pushmeet Kohli, and Swarat Chaudhuri. Programmatically Interpretable Reinforcement Learning. *International Conference on Machine Learning (ICML)*, 2018. **(Long Talk)**
53. Suguman Bansal, Swarat Chaudhuri, and Moshe Y. Vardi. Automata vs. Linear-Programming Discounted-Sum Inclusion. *International Conference on Computer-Aided Verification (CAV)*, 2018.
52. **Neil Dantam**, Swarat Chaudhuri, and Lydia Kavraki. An Incremental Constraint-Based Framework for Task and Motion Planning. *International Journal of Robotics Research*, 2018.
51. **Neil Dantam**, Swarat Chaudhuri, and Lydia Kavraki. The Task Motion Kit. *IEEE Robotics & Automation Magazine*, 2018.
50. **Yue Wang**, Swarat Chaudhuri, and Lydia Kavraki. Bounded Policy Synthesis for POMDPs with Safe-Reachability Objectives. *International Conference on Autonomous Agents and Multiagent Systems (AAMAS)*, 2018.
49. **Vijayaraghavan Murali**, Letao Qi, Swarat Chaudhuri, and Chris Jermaine. Neural Sketch Learning for Conditional Program Generation. *International Conference for Learning Representations*, 2018. **(Oral Presentation)**
48. Timon Gehr, Matthew Mirman, Dana Drachler Cohen, Petar Tsankov, Swarat Chaudhuri, and Martin Vechev. AI²: Safety and Robustness Certification of Neural Networks with Abstract Interpretation. *IEEE Symposium on Security and Privacy (S&P)*, 2018.
47. **Yanxin Lu**, Swarat Chaudhuri, David G. Melski, and Chris Jermaine. Program Splicing. *International Conference on Software Engineering (ICSE)*, 2018.
46. Suguman Bansal, Swarat Chaudhuri, and Moshe Y. Vardi. Comparator Automata in Quantitative Verification. *International Conference on Foundations of Software Science and Computation Structures (FoSSaCS)*, 2018.
45. **Vijayaraghavan Murali**, Swarat Chaudhuri, and Chris Jermaine. Bayesian Specification Learning for Finding API Usage Errors. *European Software Engineering Conference and the ACM SIGSOFT Symposium on the Foundations of Software Engineering (ESEC/FSE)*, 2017.
44. Yu Feng, Ruben Martins, Jacob Van Geffen, Isil Dillig, and Swarat Chaudhuri. Component-Based Synthesis of Table Consolidation and Transformation Tasks from Examples. *ACM Conference on Programming Language Design and Implementation (PLDI)*, 2017.

43. **Neil T. Dantam**, Zachary Kingston, Swarat Chaudhuri, and Lydia E. Kavraki. Incremental Task and Motion Planning: A Constraint-Based Approach. *Robotics: Science and Systems (RSS)*, 2016.
42. **Yue Wang, Neil T. Dantam**, Swarat Chaudhuri, and Lydia E. Kavraki. Task and Motion Policy Synthesis as Liveness Games. *International Conference on Automated Planning and Scheduling (ICAPS)*, 2016.
41. Navid Yaghmazadeh, Christian Klinger, Isil Dillig, and Swarat Chaudhuri. Synthesizing transformations on hierarchically structured data. *ACM Conference on Programming Language Design and Implementation (PLDI)*, 2016.
40. Kengo Kido, Swarat Chaudhuri and Ichiro Hasuo. Abstract interpretation with infinitesimals — towards scalability in nonstandard static analysis. *International Conference on Verification, Model Checking, and Abstract Interpretation (VMCAI)*, 2016.
39. Zhenqi Huang, Yu Wang, Sayan Mitra, Geir Dullerud and Swarat Chaudhuri. Controller synthesis with inductive proofs for piecewise linear systems: an SMT-based algorithm. *54th IEEE Conference on Decision and Control (CDC)*, 2015.
38. Tewodros A. Beyene, Swarat Chaudhuri, Corneliu Popeea, and Andrey Rybalchenko. Recursive Games for Compositional Program Synthesis. *Verified Software: Theories, Tools, and Experiments (VSTTE)*, 2015.
37. **John Feser**, Swarat Chaudhuri, and Isil Dillig. Synthesizing data structure transformations from input-output examples. *ACM Conference on Programming Language Design and Implementation (PLDI)*, 2015.
36. **Yanxin Lu**, Joe Warren, Christopher Jermaine, Swarat Chaudhuri, and Scott Rixner. Grading the Graders: Motivating Peer Graders in a MOOC. *24th International World Wide Web Conference (WWW)*, 2015.
35. Anna Drummond, **Yanxin Lu**, Swarat Chaudhuri, Chris Jermaine, Scott Rixner, and Joe Warren. Learning to grade student programs in a massive open online course. *IEEE International Conference on Data Mining (ICDM)*, 2014.
34. Thomas Dillig, Isil Dillig, and Swarat Chaudhuri. Optimal guard synthesis for memory safety. *International Conference on Computer-Aided Verification (CAV)*, 2014.
33. Rishi Surendran, Raghavan Raman, Swarat Chaudhuri, John Mellor-Crummey, and Vivek Sarkar. Test Driven Repair of Data Races in Structured Parallel Programs. *ACM Conference on Programming Language Design and Implementation (PLDI)*, 2014.
32. **Srinivas Nedunuri, Sailesh Prabhu**, Mark Moll, Swarat Chaudhuri, and Lydia Kavraki. SMT-Based Synthesis of Integrated Task and Motion Plans for Mobile Manipulation. *IEEE International Conference on Robotics and Automation (ICRA)*, 2014.
31. Swarat Chaudhuri, **Martin Clochard**, and Armando Solar-Lezama. Bridging Boolean and quantitative synthesis using smoothed proof search. In *41st ACM Symposium on Principles of Programming Languages (POPL)*, 2014.
30. Tewodros Beyene, Swarat Chaudhuri, Corneliu Popeea, and Andrey Rybalchenko. A constraint-based approach to solving games on infinite graphs. In *41st ACM Symposium on Principles of Programming Languages (POPL)*, 2014.

29. Swarat Chaudhuri, Azadeh Farzan, and Zachary Kincaid. Consistency analysis of decision-making programs. In *41st ACM Symposium on Principles of Programming Languages (POPL)*, 2014.
28. Sirinda Palahan, Domagoj Babic, Swarat Chaudhuri, and Daniel Kifer. Extraction of statistically significant malware behaviors. *Annual Computer Security Applications Conference (ACSAC)*, 2013.
27. Jisheng Zhao, **Roberto Lubliner**, Zoran Budimlic, Swarat Chaudhuri, and Vivek Sarkar. Isolation for nested task-parallelism. *International Conference on Object Oriented Programming, Systems, Languages and Applications (OOPSLA)*, 2013.
26. Roopsha Samanta, Jyotirmoy Deshmukh, and Swarat Chaudhuri. Robustness analysis of string transducers. In *Automated Technology for Verification and Analysis (ATVA)*, 2013.
25. Swarat Chaudhuri, Sriram Sankaranarayanan and Moshe Vardi. Regular real analysis. *ACM/IEEE Symposium on Logic in Computer Science (LICS)*, 2013.
24. Roopsha Samanta, Jyotirmoy Deshmukh, and Swarat Chaudhuri. Robustness analysis of networked systems. In *International Conference on Verification, Model Checking, and Abstract Interpretation (VMCAI)*, 2013.
23. Swarat Chaudhuri, Sumit Gulwani, and **Roberto Lubliner**. Continuity and robustness of programs. *Research highlights, Communication of the ACM (CACM)*, August 2012.
22. Swarat Chaudhuri and Armando Solar-Lezama. Euler: A System for numerical optimization of programs. In *International Conference on Computer-Aided Verification (CAV)*, 2012.
21. Rajeev Alur, Swarat Chaudhuri, and P. Madhusudan. Software model-checking with languages of nested trees. *ACM Transactions on Programming Languages and Systems (TOPLAS)*, Volume 33 Issue 5, November 2011.
20. Swarat Chaudhuri, Sumit Gulwani, **Roberto Lubliner**, and **Sara Navidpour**. Proving programs robust. *Joint European Software Engineering Conference and ACM Symposium on the Foundations of Software Engineering (ESEC/FSE)*, 2011. (**Distinguished Paper; Invited as a CACM Research Highlight**)
19. **Roberto Lubliner**, Jisheng Zhao, Zoran Budimlic, Swarat Chaudhuri, and Vivek Sarkar. Delegated isolation. *International Conference on Object Oriented Programming, Systems, Languages and Applications (OOPSLA)*, 2011.
18. William Enck, Damien Ocateau, Swarat Chaudhuri, and Patrick McDaniel. A path to Android application security. *The 20th USENIX Security Symposium*, 2011.
17. Swarat Chaudhuri and Armando Solar-Lezama. Smoothing a program soundly and robustly. In *International Conference on Computer-Aided Verification (CAV)*, 2011.
16. Saurabh Srivastava, Sumit Gulwani, Swarat Chaudhuri, and Jeff Foster. Path-based inductive synthesis for program inversion. *ACM Conference on Programming Language Design and Implementation (PLDI)*, 2011.
15. Pavol Černý, Arjun Radhakrishna, Damien Zufferey, Swarat Chaudhuri, and Rajeev Alur. Model checking of linearizability of concurrent list implementations. In *International Conference on Computer-Aided Verification (CAV)*, 2010.
14. Swarat Chaudhuri and Armando Solar-Lezama. Smooth interpretation. In *ACM Conference on Programming Language Design and Implementation (PLDI)*, 2010.

13. Swarat Chaudhuri, Sumit Gulwani, and **Roberto Lubliner**. Continuity analysis of programs. In *37th ACM Symposium on Principles of Programming Languages (POPL)*, 2010.
12. Rajeev Alur and Swarat Chaudhuri. Temporal reasoning for procedural programs. In *International Conference on Verification, Model Checking, and Abstract Interpretation (VMCAI)*, 2010.
11. **Roberto Lubliner**, Swarat Chaudhuri, and Pavol Černý. Parallel programming with object assemblies. In *International Conference on Object Oriented Programming, Systems, Languages and Applications (OOPSLA)*, 2009.
10. Chao Wang, Swarat Chaudhuri, Aarti Gupta, and Yang Yu. Symbolic Pruning of Concurrent Program Executions. In *7th Joint European Software Engineering Conference and ACM Symposium on the Foundations of Software Engineering (ESEC/FSE)*, 2009.
9. Sriram Sankaranarayanan, Swarat Chaudhuri, Franjo Ivancic, and Aarti Gupta. Dynamically inferring data preconditions over predicates by tree learning. In *International Symposium on Software Testing and Analysis (ISSTA)*, 2008.
8. Swarat Chaudhuri. Subcubic algorithms for recursive state machines. In *35th ACM Symposium on Principles of Programming Languages (POPL)*, 2008.
7. Swarat Chaudhuri and Rajeev Alur. Instrumenting C programs with nested word monitors. In *14th International Symposium on Model Checking Software*, 2007.
6. Rajeev Alur, Pavol Černý, and Swarat Chaudhuri. Model checking on trees with path equivalences. In *13th International Conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS)*, 2007.
5. Rajeev Alur and Swarat Chaudhuri. Branching pushdown tree automata. In *26th Conference on Foundations of Software Technology and Theoretical Computer Science (FSTTCS)*, 2006.
4. Rajeev Alur, Swarat Chaudhuri, and P. Madhusudan. Languages of nested trees. In *18th International Conference on Computer-Aided Verification (CAV)*, 2006.
3. Rajeev Alur, Swarat Chaudhuri, and P. Madhusudan. A fixpoint calculus for local and global program flows. In *33rd Annual ACM Symposium on Principles of Programming Languages (POPL)*, 2006.
2. Rajeev Alur, Swarat Chaudhuri, Kousha Etessami, and P. Madhusudan. On-the-fly reachability and cycle detection for recursive state machines. In *11th International Conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS)*, 2005.
1. Rajeev Alur, Swarat Chaudhuri, Kousha Etessami, Sudipto Guha, and Mihalis Yannakakis. Compression of partially ordered strings. In *14th International Conference on Concurrency Theory (CONCUR)*, 2003.

Research Funding

Sponsored Research Funding

Previous Funding

- PI *NSCORE: Neuro-Symbolic Co-Designer Using Oracle- Guided Synthesis and Reinforcement Learning*. DARPA Symbiotic Design award. SRI is the lead institution. Award period: 2020-2024. The program was canceled after two years. Amount under my supervision: \$600,000.

- co-PI *Artemis for Automated Software Generation*. DARPA Intent-Defined Adaptive Software (IDAS) award with Grammatech, Inc., Isil Dillig (UT Austin) and Armando Solar-Lezama (MIT). Award period: 2020-2021. The program was canceled after one year. Amount under my supervision in the originally funded project: \$1,300,000. OSP ID: 202000824.
- PI *Leveraging Symbolic Representations for Safe and Assured Learning*. DARPA Assured Autonomy award. Amount under my supervision: \$450,000. Award period: 2019-2021. OSP #: 202001724.
- PI *Formal Analysis and Synthesis of Multiagent Systems with Incentives*. Collaborative NSF Medium grant with Moshe Vardi and Rajeev Alur. Total amount: \$1,200,000. My amount: \$400,000. Award period 2017-2022. OSP ID: 202001353.
- PI *Automating Robot Programming Through Constraint Solving and Motion Planning*. Collaborative NSF Medium grant with Lydia Kavraki. Total amount: \$800,000. Amount under my supervision: \$400,000. Award period: 2015-2019.
- co-PI *Pliny: An End-to-End System for Big Code Analytics*. Award from the DARPA MUSE program. With Vivek Sarkar, Christopher Jermaine, Moshe Vardi, and Keith Cooper (Rice); Isil Dillig and Thomas Dillig (UT Austin); Thomas Reps and Ben Liblit (Wisconsin); and GrammaTech, Inc. The award spanned three technical areas; I was the lead of Technical Area 4, which focuses on program verification, repair, and synthesis. Total amount \$11,000,000. (approximately). Amount under my supervision: \$2,000,000. Award period: 2014-2018.
- co-PI *Science of Security for Systems*. NSA grant with Sayan Mitra and Geir Dullerud (UIUC). Total amount \$806,502. Amount under my supervision: \$150,000. Award period: 2014-2017.
- PI *Computer-Aided Grading, Feedback, and Assignment Creation in Massive Online Programming Courses*. Small NSF grant with Scott Rixner and Joe Warren. Total amount: \$300,000. Amount under my supervision: \$100,000. Award period: 2013-2015.
- PI *Marrying Program Analysis and Numerical Search*. Collaborative NSF Medium grant with Armando Solar-Lezama and Illya Hicks. Total amount \$1,200,000. Amount under my supervision: \$600,000. Award period: 2012-2016.
- PI *Chorus: Dynamic Isolation for Shared-Memory parallelism*. Collaborative NSF Medium grant with Vivek Sarkar. Total amount \$1,100,000. Amount under my supervision: \$600,000. Award period: 2010-2014.
- PI *CAREER: Robustness Analysis for Uncertain Programs: Theory, Algorithms, and Tools*. NSF CAREER award. Total amount \$426,457. Award period 2010-2015.

Current Funding

- PI *PPoSS: Large: A Full-stack Approach to Declarative Analytics at Scale*. NSF Large award with Thomas Gilray (Alabama), Kris Micinski (Syracuse), and others. Amount under my supervision: \$450,000. Award period 2023-2028.
- PI *Modular Neurosymbolic Programming*. DARPA seedling award. Amount: \$450,000. Award period 2023-2025. OSP ID: FP00002011.
- PI *SHF: Medium: Semantics-Aware Neural Models for Program Synthesis*. NSF Medium award with Chris Jermaine (Rice) and Tom Reps (Wisconsin). Total amount: \$1,200,000. Amount under my supervision: \$400,000. Award period 2022-2025. OSP ID: 202103319.

- co-PI *Reinforcement Learning Modulo Formal Verification : A Synergistic Approach to High-Assurance Autonomous Agents*. ONR Science of Artificial Intelligence award with Rajeev Alur (Penn), Ufuk Topcu (UT Austin), and Michael Littman (Brown). Amount under my supervision: \$300,000. Award period 2020-2024. OSP ID: 201903469.
- PI *Modularity, Constraints and Multimodality in Learning for Complex, Long-Horizon, Sequential Decision Making*. DoD (Army) award with Ufuk Topcu and Scott Niekum. Amount under my supervision: \$250,000. Award period: 2020-2023. OSP ID: 202003153.
- PI *Understanding the World with Code*. NSF Expeditions award with Armando Solar-Lezama, Michael Carbin, Martin Rinard, Regina Barzilay, Philip Sharp, and Tommi Jaakkola from MIT, Yisong Yue (Caltech), Isil Dillig (UT Austin), Chris Jermaine (Rice), Osbert Bastani (UPenn), and Noah Goodman (Stanford). Amount under my supervision: \$616,610. Award period 2020-2025. OSP ID: 202002325.
- PI *Bridging Automated Formal Reasoning and Continuous Optimization for Provable Safe Deep Learning*. Collaborative NSF Medium grant with Isil Dillig. Total amount: \$1,000,000. Amount under my supervision: \$500,000. Award period 2019-2023. OSP ID: 202000409.
- co-PI *AI Institute: A Vision for the Next Decade of Foundational Machine Learning*. AI Institute led by Adam Klivans. Award period 2020-2025. OSP ID: 202000138.

Gifts

Previous Funding

- PI Google Faculty Award. Total amount \$50,000. Award year: 2015.
- PI \$10,000 gift from Microsoft Research. Award year: 2011.

Current Funding

- PI Meta Faculty Award. Total amount \$55,000. Award year: 2022.

Seminars and Lectures

- Summer 2023 *Neurosymbolic Programming for Science*. Invited seminar talk at the University of Pennsylvania. May 2023.

Safe Neurosymbolic Learning. Invited talk at the Workshop on AI and Static Analysis at PLDI 2023.

Differentiable Programming modulo Formal Verification. Invited talk at the Differentiable Almost Everything workshop at ICML 2023.
- Spring 2023 With Jennifer J. Sun, Atharva Sehgal, and Yisong Yue. Neurosymbolic Programming. Invited Tutorial at *Principles of Programming Languages (POPL)*, January 2023.
- Fall 2022 With Atharva Sehgal, Jennifer J. Sun, and Armando Solar-Lezama. Neurosymbolic Programming. Invited Tutorial at *Neural Information Processing Systems (NeurIPS)*, December 2022.
- Summer 2022 With Yisong Yue, Jennifer J. Sun and Atharva Sehgal. Neurosymbolic Program Synthesis. Invited tutorial at *Summer School on Neurosymbolic Programming*, 2022.
- Spring 2022 *Neurosymbolic Programming*. Invited seminar talk at Google Research India and USC.
- Summer and Fall 2020 *Neurosymbolic Programming*. Invited seminar talk at University of Wisconsin and Rice University.
- Summer 2019 *Machine Learning as Program Synthesis*. Invited keynote speech at the International Conference on Computer-Aided Verification (CAV), 2019.

- Summer 2019 *Policy Synthesis for Uncertain Autonomous Robots*. Invited keynote speech at the Workshop on Formal Methods for ML-Enabled Autonomous Systems (FOMLAS), 2019.
- Spring 2018 With Chris Jermaine and Vijayaraghavan Murali. Bayou: Deep Learning over “Big Code” for Program Analysis and Synthesis. Invited tutorial at *Symposium on Programming Language Design and Implementation (PLDI)*, 2018.
- Fall 2018 and Spring 2019 *Program Synthesis for Reliable and Interpretable Artificial Intelligence*. Invited talk at Georgia Tech, UT Austin, University of Michigan, EPFL, and UCLA.
- Spring 2018 *Program Synthesis at the Edge of Artificial Intelligence*. Invited talk at Microsoft Research, Google Brain, UC San Diego, and Caltech.
- Fall 2017 *Learning to Synthesize Programs*. Invited talk at CU Boulder.
- Fall 2017 *Program Synthesis: An Old New Problem*. Invited talk at EPFL.
- Spring 2017 *Learning to Write Code, Automatically*. Invited talk at Northeastern University, University of Pennsylvania, Princeton University, University of Maryland, Google NYC, Amazon NYC, and Brown University.
- November 2016 *Guiding Formal Methods with Discovered Knowledge*. Invited keynote talk at Haifa Verification Conference, Haifa, Israel.
- Spring 2014 *Adventures in Automated Programming*. Invited talk at Carnegie Mellon University, University of Illinois, and University of Pennsylvania.
- Summer 2013 *Bridging the Discrete and the Continuous in Reasoning about Programs*. Invited talk at Microsoft Research, Cambridge and Institute for Science and Technology, Austria.
- Summer 2012 *Computer-Aided Numerical Programming*. Invited talk at Ken Kennedy Institute for Information Technology (at Rice University) and Pennsylvania State University.
- Fall 2011 *Composing Composure: Reasoning about Robustness of Programs*. Invited talk at University of Pennsylvania, Princeton University.
- Spring 2011 *When Programs Make No Jumps: Marrying the Discrete and the Continuous in Program Analysis*. Invited talk at Rice University, Northeastern University, University of California at Irvine.
- Spring 2010, Summer 2010 *Cauchy: Towards an Analytical Calculus of Computation*. Invited talk at New York University, Cornell University, University of Toronto, and Microsoft Research.
- Fall 2009, Summer 2009 *Parallel Programming with Object Assemblies*. Invited talk at MIT and Microsoft Research.
- Fall 2008, Spring 2009 *Programming with Sociable Resources*. Invited talk at NEC Laboratories, University of Pennsylvania, and Rice University.
- Spring 2007 *Context-sensitive software model checking*. Invited talk at Pennsylvania State University, University of Texas at Austin, Carnegie Mellon University, NEC Laboratories America, and IBM T. J. Watson Research Center.

Professional Services

- Program Chair International Conference on Learning Representations (ICLR), 2024.
 NASA Formal Methods (NFM), 2023.
 Conference on Computer-Aided Verification (CAV), 2016.

Workshop on Numerical Software Verification (NSV), 2012.

Workshop on Programming Language Technology for Massive Open Online Courses (PLOOC), 2014.

POPL Off the Beaten Track (OBT), 2015.

Co-organizer Summer School on Neurosymbolic Programming, 2022.

Dagstuhl Workshop on *Game Theory in AI, Logic, and Algorithms*, 2017.

Workshop on Exploiting Concurrency Efficiently and Correctly (EC²), 2010 and 2011.

General Chair Symposium on Machine Programming (MAPS), 2022.

Area Chair International Conference for Learning Representations (ICLR), 2021, 2022.

Neural Information Processing Systems (NeurIPS), 2020, 2021, 2022, 2023.

International Conference on Machine Learning (ICML), 2021, 2022, 2023.

Conference on Computer-Aided Verification (CAV), 2019.

Associate Editor ACM Transactions on Programming Languages and Systems (TOPLAS), 2021-current.

Action Editor Transactions on Machine Learning Research (TMLR), 2021-current.

Program Committee ACM Symposium on Programming Language Design and Implementation (PLDI), 2013, 2017, and 2021

ACM Symposium on Principles of Programming Languages (POPL), 2012, 2015, and 2019.

Conference on Computer-Aided Verification (CAV), 2012, 2015, 2016, 2017, 2018, 2019, 2020, 2022, 2023.

Symposium on Logic in Computer Science (LICS), 2022.

ACM Conference on Object-Oriented Programming, Systems, Languages, and Applications (OOPSLA), 2014.

AAAI Conference on Artificial Intelligence (AAAI), 2020 and 2021.

Conference on Uncertainty in Artificial Intelligence (UAI), 2019 and 2020.

Conference on Verification, Model Checking, and Abstract Interpretation (VMCAI), 2011 and 2021.

Foundations of Software Science and Computation Structures (FoSSaCS), 2013.

Workshop on Numerical Software Verification (NSV), 2011.

Symposium on Automated Technology for Verification and Analysis (ATVA), 2011.

Symposium on Games, Automata, Logics and Formal Verification (GandALF), 2011.

ACM Conference on Languages, Compilers, and Tools for Embedded Systems (LCTES), 2009.

15th Conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS), 2009.

External review committee and External Program Committee	ACM Symposium on Programming Language Design and Implementation (PLDI), in 2012, 2014, 2015, 2016, 2019. ACM Conference on Object-Oriented Programming, Systems, Languages, and Applications (OOPSLA), in 2011 and 2013. ACM Symposium on Principles of Programming Languages (POPL), 2013.
Publicity Chair	ACM Symposium on Principles of Programming Languages (POPL), 2010–12.
Referee	Many venues, including Neural Information Processing Systems (NeurIPS), International Conference on Machine Learning (ICML), International Conference on Learning Representations (ICLR), Principles of Programming Languages (POPL), Computer-Aided Verification (CAV), Programming Language Design and Implementation (PLDI), Principles of Parallel Programming (PPoPP), Logic in Computer Science (LICS), Tools and Algorithms for the Construction and Analysis of Systems (TACAS), Concurrency Theory (CONCUR), Static Analysis Symposium (SAS), Computer Science Logic (CSL), Journal of Logic and Algebraic Programming, Symposium on Discrete Algorithms (SODA), Architectural Support for Programming Languages and Operating Systems (ASPLOS), Foundations of Software Technology and Theoretical Computer Science (FSTTCS), ACM Transactions on Programming Languages and Systems (TOPLAS).

Teaching

Fall 2023	<i>Trustworthy Machine Learning</i> . Undergraduate elective on safe and trustworthy machine learning at UT Austin.
Spring 2020, Spring 2021, Spring 2022, Spring 2023	<i>Program Synthesis</i> . Introductory graduate course on program synthesis and learning at UT Austin. Diversity course for the CS department's PhD program.
Fall 2021	<i>Safe and Ethical AI</i> . Undergraduate elective on safe and trustworthy machine learning at UT Austin.
Fall 2020	<i>Logic in Computer Science and Artificial Intelligence</i> . Undergraduate elective on logic in computer science at UT Austin.
Spring 2014, Fall 2014, Fall 2015, Fall 2016, Fall 2018, Fall 2019	<i>COMP 382: Reasoning about Algorithms</i> . Required undergraduate course on theoretical computer science at Rice University.
Spring 2018	<i>COMP 503: Reasoning about Software</i> . Introductory graduate course on formal methods at Rice University.
Fall 2012, Fall 2013, Spring 2015	<i>COMP 507: Computer-Aided Program Design</i> . Introductory graduate course on program verification and synthesis at Rice University.
Spring 2012, Spring 2013	<i>COMP 482: Design and Analysis of Algorithms</i> . Senior undergraduate course on algorithms at Rice University.
Spring 2013	<i>COMP 607: Automata, Logic, and Infinite Games</i> . Graduate seminar at Rice University.
Spring 2012	<i>COMP 607: Program Synthesis</i> . Graduate seminar at Rice University.
Fall 2011	<i>COMP 411: Principles of Programming Languages</i> . Senior undergraduate and entry-level graduate course on programming languages at Rice University.
Spring 2011	<i>CSE 598: Exploiting Concurrency Efficiently and Correctly</i> . Graduate-level course on concurrent and parallel programming at Pennsylvania State University.

- Fall 2010, Fall 2009, Fall 2008 *CMPSC 461: Programming Language Concepts.* Senior undergraduate and entry-level graduate course on programming languages at Pennsylvania State University.
- Fall 2010 *CSE 597-C: Program Analysis Seminar.* Graduate-level seminar on program analysis and synthesis at Pennsylvania State University.
- Spring 2010 *CSE 520: The Science of Computer Programming.* Graduate-level course on program verification and abstract interpretation at Pennsylvania State University.
- Spring 2009 *CSE 598: Program Analysis.* Advanced graduate-level course on program analysis and abstract interpretation at Pennsylvania State University.
- Spring 2008 *CSE 598: Computer-Aided Verification.* Advanced graduate-level course on model checking at Pennsylvania State University.

Research group

- Ph.D. students
- Chenxi Yang. Spring 2020 onwards.
Research topic: Formally verified machine learning.
- Atharva Sehgal. Fall 2021 onwards.
Research topic: Rule learning from perceptual inputs.
- Meghana Sistla. Fall 2021 onwards.
Research topic: CFLOBDDs: a new class of succinct decision diagrams.
- Joshua Hoffman. Summer 2020 onwards.
Research topic: Lifelong reinforcement learning through neurosymbolic methods.
- Yeming Wen. Spring 2021 onwards.
Research topic: Neurosymbolic language models for code.
- Thomas Logan. Fall 2022 onwards.
Research topic: ML-aided program verification.
- Amitayush Thakur. Fall 2022 onwards.
Research topic: Neural theorem proving.
- Eric Hsiung. Fall 2022 onwards, coadvised with Joydeep Biswas.
Research topic: Learning Reward Models from Human Feedback.
- Dweep Trivedi. Fall 2022 onwards.
Research topic: Modular neurosymbolic programming for lifelong learning.
- Han Zhong. Fall 2023 onwards; co-advised with Isil Dillig.
Research topic: Neurosymbolic probabilistic programming.
- Luniyu Nie. Fall 2023 onwards.
Research topic: Resource-efficient language models.
- George Tsoukalas. Fall 2023 onwards.
Research topic: Neural theorem proving.
- Masters students
- Samuel Anklesaria. Fall 2021 onwards.
Research topic: Bayesian program synthesis.
- Graduated Ph.D. students
- Greg Anderson. Spring 2020-Summer 2023, co-advised with Isil Dillig.
Thesis Neurosymbolic Approaches to Safe Machine Learning.
First employment: Assistant Professor, Reed College, starting Fall 2023.

Abhinav Verma. Ph.D. student at Rice (2016-2020), Ph.D. student at UT Austin (Fall 2020-Summer 2021).

Thesis: Programmatic reinforcement learning.

First employment: Hartz Family Career Development Assistant Professor, Penn State University, Fall 2022 onwards.

Yue Wang. Ph.D. student at Rice (2013-2018). First employment at Facebook.

Thesis: Bounded Policy Synthesis for POMDPs with Safe-Reachability Objectives.

Yanxin Lu. Ph.D. student at Rice (2012-2018). First employment at Facebook.

Thesis: Corpus-Driven Systems for Program Synthesis and Refactoring.

Roberto Lubliner. Ph.D. student at Penn State (2008-2012). First employment at Google.

Thesis: *Concurrent Assemblies: An execution model for irregular parallelism.*

Former Postdoctoral Researchers Anders Miltner. Summer 2020-2022, co-advised with Isil Dillig. Now a faculty member at Simon Fraser University.

Research topic: Inductive program synthesis.

Calvin Smith. Summer 2020-Spring 2022; now an engineer at durable.ai.

Research topic: Learning logic programs from data.

Dipak Chaudhari. Summer 2017-Spring 2022.

Research topic: Neural program synthesis; calculational program synthesis.

Vijayaraghavan Murali. Spring 2015-Summer 2018; currently a researcher at Facebook.

Research topic: Neural program analysis and synthesis.

Edwin Westbrook. Summer 2011-Summer 2013; currently a researcher at Galois.

Research topic: Language-based approximate computation.

Srinivas Nedunuri. Summer 2012-Fall 2014; now a researcher at Sandia National Laboratories.

Research topic: Synthesis of policies and programs for robots.

Neil Dantam. Spring 2015-Summer 2017, now a faculty member at Colorado School of Mines.

Research topic: Integrated task and motion planning for robots.

Hassan Eldib. Summer 2015-Spring 2017; now a faculty member at Arab Academy for Science and Technology, Cairo.

Research topic: Data-driven program synthesis.

Graduated Masters students Ameesh Shah. Undergraduate researcher at Rice from Fall 2017-Summer 2019; Masters student from Summer 2019-Summer 2020; now a Ph.D. student at UC Berkeley.

Topic of master's thesis: Learning differentiable programs with admissible neural heuristics.

John Feser. Undergraduate researcher at Rice from Fall 2013-Spring 2015; Masters student from Summer 2015-Summer 2016; now a Ph.D. student at MIT.

Topic of master's thesis: Inductive Program Synthesis from Input-Output Examples.

Afsaneh Rahbar. MS student at Rice; finished MS in Fall 2017.

Topic of master's thesis: Data-driven program verification

Suguman Bansal. MS student at Rice; finished MS in Summer 2016.

Topic of master's thesis: Algorithmic analysis of regular repeated games.

Sailesh Prabhu. MS student at Rice. Graduated Summer 2014.
Topic of master's thesis: Automatic synthesis of robot motion plans.

Ye Fang. Fall 2012-Fall 2014.
Topic of master's thesis: Computer-aided mechanism design

Sara Navidpour. ME (Masters without thesis) student at Penn State; graduated Fall 2011.

Former
Undergraduate
Researchers

Ana Brendel. UT Austin, Fall 2020-Summer 2022.
Research topic: Program synthesis using angelic execution.

Jack Roper. UT Austin, Fall 2021-Summer 2022.
Research topic: Data generation and augmentation for neural program synthesis.

Jacqueline Li. Rice University, Fall 2018-Summer 2019.
Research topic: Learning-based program synthesis.

Grace Tan. Rice University, Fall 2018-Summer 2019.
Research topic: Learning-based program synthesis.

Kyran Adams. Rice University, Fall 2018-Summer 2019.
Research topic: Programmatically interpretable machine learning.

Visiting Ph.D.
students

Kengo Kido. Student at University of Tokyo; visited Rice during May-June 2014.
Research topic: Abstract interpretation using infinitesimals.

Martin Clochard. Masters student at ENS Paris; visited Rice during March-August 2012.
Research topic: Program synthesis using smoothed search.

Professional Societies

Member Association of Computing Machinery (ACM)

Member Institute for Electrical and Electronics Engineers (IEEE)