Swarat Chaudhuri

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Curriculum vitae

Research interests

My research background is in the areas of Programming Languages (PL) and Formal Methods (FM), and much of my recent work lies in the intersection of these areas and Artificial Intelligence. The primary objective of my recent research is to develop new foundations for *reliable*, *transparent*, and *secure* intelligent systems through a synthesis of ideas from PL, FM, and machine learning.

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.*

Employment

January 2020 onwards	**Associate Professor with Tenure**, *University of Texas at Austin.*
July 2015-December 2019	**Associate Professor with Tenure**, *Rice University.*
June-December 2017	**Visiting Professor**, *ETH Zürich.*
July 2011-June 2015	**Assistant Professor**, *Rice University.*
January 2008-May 2011	**Assistant Professor**, *Pennsylvania State University.*
Fall 2007	**Postdoctoral scientist**, *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

2019	**Distinguished Paper Award**, *PLDI 2019, for the paper "Optimization and Abstraction: A Synergistic Approach for Analyzing Neural Network Robustness".*
2015	**Google Research Award**, *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 "Robustness Analysis of Uncertain Programs: Algorithms, Theory, and Tools".*

Publications

[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`.]

Publications in Refereed Journals and Conferences

[NeurIPS20]   **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.

[NeurIPS20]   **Greg Anderson**, **Abhinav Verma**, Isil Dillig, and Swarat Chaudhuri. Neurosymbolic Reinforcement Learning with Formally Verified Exploration. *Neural Information Processing Systems (NeurIPS)*, 2020.

[VLDB20]   Rohan Mukherjee, Chris Jermaine, and Swarat Chaudhuri. Searching a Database of Source Codes Using Contextualized Code Search. *Very Large Databases (VLDB), 2020.*

[NeurIPS19]   **Abhinav Verma***, Hoang M. Le*, Yisong Yue, and Swarat Chaudhuri. Imitation-Projected Policy Gradient for Programmatic Reinforcement Learning. *Neural Information Processing Systems (NeurIPS)*, 2019.

[ICML19]   Richard Cheng, **Abhinav Verma**, Gabor Orosz, Swarat Chaudhuri, Yisong Yue, and Joel Burdick. Control Regularization for Reduced Variance Reinforcement Learning. *International Conference on Machine Learning (ICML)*, 2019.

[PLDI19]   Greg Anderson, Shankara Pailoor, Isil Dillig, and Swarat Chaudhuri. Optimization and Abstraction: A Synergistic Approach for Analyzing Neural Network Robustness. *Symposium on Programming Language Design and Implementation (PLDI)*, 2019.

[RAL19]   **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.

[ICLR19]   **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.

[NeurIPS18]   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.

[WAFR18]   **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.

[ICML18] **Abhinav Verma**, **Vijayaraghavan Murali**, Rishabh Singh, Pushmeet Kohli, and Swarat Chaudhuri. Programmatically Interpretable Reinforcement Learning. *International Conference on Machine Learning (ICML)*, 2018.

[CAV18] Suguman Bansal, Swarat Chaudhuri, and Moshe Y. Vardi. Automata vs. Linear-Programming Discounted-Sum Inclusion. *International Conference on Computer-Aided Verification (CAV)*, 2018.

[IJRR18] **Neil Dantam**, Swarat Chaudhuri, and Lydia Kavraki. An Incremental Constraint-Based Framework for Task and Motion Planning. *International Journal of Robotics Research*, 2018.

[RAM18] **Neil Dantam**, Swarat Chaudhuri, and Lydia Kavraki. The Task Motion Kit. *IEEE Robotics & Automation Magazine*, 2018.

[AAMAS18] **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.

[ICLR18] **Vijayaraghavan Murali**, Letao Qi, Swarat Chaudhuri, and Chris Jermaine. Neural Sketch Learning for Conditional Program Generation. *International Conference for Learning Representations*, 2018. Oral presentation, awarded to ∼2% of all submissions.

[S&P18] Timon Gehr, Matthew Mirman, Dana Drachsler Cohen, Petar Tsankov, Swarat Chaudhuri, and Martin Vechev. AI^2: Safety and Robustness Certification of Neural Networks with Abstract Interpretation. *IEEE Symposium on Security and Privacy (S&P)*, 2018.

[ICSE18] **Yanxin Lu**, Swarat Chaudhuri, David G. Melski, and Chris Jermaine. Program Splicing. *International Conference on Software Engineering (ICSE)*, 2018.

[FOSSACS18] 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.

[FSE17] **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.

[PLDI17] 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.

[RSS16] **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.

[ICAPS16] **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.

[PLDI16] 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.

[VMCAI16] 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.

[VSTTE15] Tewodros A. Beyene, Swarat Chaudhuri, Corneliu Popeea, and Andrey Rybalchenko. Recursive Games for Compositional Program Synthesis. *Verified Software: Theories, Tools, and Experiments (VSTTE)*, 2015.

[CDC15] 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.

[WWW15] **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.

[PLDI15] **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.

[ICDM14] 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.

[CAV14] Thomas Dillig, Isil Dillig, and Swarat Chaudhuri. Optimal guard synthesis for memory safety. *International Conference on Computer-Aided Verification (CAV)*, 2014.

[PLDI14] 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.

[ICRA14] **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.

[POPL14] 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.

[POPL14] 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.

[POPL14] Swarat Chaudhuri, Azadeh Farzan, and Zachary Kincaid. Consistency analysis of decision-making programs. In *41st ACM Symposium on Principles of Programming Languages (POPL)*, 2014.

[ACSAC13] Sirinda Palahan, Domagoj Babic, Swarat Chaudhuri, and Daniel Kifer. Extraction of statistically significant malware behaviors. *Annual Computer Security Applications Conference (ACSAC)*, 2013.

[OOPSLA13] Jisheng Zhao, **Roberto Lublinerman**, Zoran Budimlic, Swarat Chaudhuri, and Vivek Sarkar. Isolation for nested task-parallelism. *International Conference on Object Oriented Programming, Systems, Languages and Applications (OOPSLA)*, 2013.

[ATVA13] Roopsha Samanta, Jyotirmoy Deshmukh, and Swarat Chaudhuri. Robustness analysis of string transducers. In *Automated Technology for Verification and Analysis (ATVA)*, 2013.

[LICS13] Swarat Chaudhuri, Sriram Sankaranarayanan and Moshe Vardi. Regular real analysis. *ACM/IEEE Symposium on Logic in Computer Science (LICS)*, 2013.

[VMCAI13]   Roopsha Samanta, Jyotirmoy Deshmukh, and Swarat Chaudhuri. Robustness analysis of networked systems. In *International Conference on Verification, Model Checking, and Abstract Interpretation (VMCAI)*, 2013.

[CACM12]   Swarat Chaudhuri, Sumit Gulwani, and **Roberto Lublinerman**. Continuity and robustness of programs. *Research highlights, Communication of the ACM (CACM)*, August 2012.

[CAV12]   Swarat Chaudhuri and Armando Solar-Lezama. Euler: A System for numerical optimization of programs. In *International Conference on Computer-Aided Verification (CAV)*, 2012.

[TOPLAS11]   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, Novemner 2011.

[FSE11]   Swarat Chaudhuri, Sumit Gulwani, **Roberto Lublinerman**, and **Sara Navidpour**. Proving programs robust. *Joint European Software Engineering Conference and ACM Symposium on the Foundations of Software Engineering (ESEC/FSE)*, 2011.

[OOPSLA11]   **Roberto Lublinerman**, Jisheng Zhao, Zoran Budimlic, Swarat Chaudhuri, and Vivek Sarkar. Delegated isolation. *International Conference on Object Oriented Programming, Systems, Languages and Applications (OOPSLA)*, 2011.

[USENIX-SEC11]   William Enck, Damien Octeau, Swarat Chaudhuri, and Patrick McDaniel. A path to Android application security. *The 20th USENIX Security Symposium*, 2011.

[CAV11]   Swarat Chaudhuri and Armando Solar-Lezama. Smoothing a program soundly and robustly. In *International Conference on Computer-Aided Verification (CAV)*, 2011.

[PLDI11]   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.

[CAV10]   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.

[PLDI10]   Swarat Chaudhuri and Armando Solar-Lezama. Smooth interpretation. In *ACM Conference on Programming Language Design and Implementation (PLDI)*, 2010.

[POPL10]   Swarat Chaudhuri, Sumit Gulwani, and **Roberto Lublinerman**. Continuity analysis of programs. In *37th ACM Symposium on Principles of Programming Languages (POPL)*, 2010.

[VMCAI10]   Rajeev Alur and Swarat Chaudhuri. Temporal reasoning for procedural programs. In *International Conference on Verification, Model Checking, and Abstract Interpretation (VMCAI)*, 2010.

[OOPSLA09]   **Roberto Lublinerman**, Swarat Chaudhuri, and Pavol Černý. Parallel programming with object assemblies. In *International Conference on Object Oriented Programming, Systems, Languages and Applications (OOPSLA)*, 2009.

[FSE09]   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.

[ISSTA08]   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.

[POPL08]	Swarat Chaudhuri. Subcubic algorithms for recursive state machines. In *35th ACM Symposium on Principles of Programming Languages (POPL)*, 2008.
[SPIN07]	Swarat Chaudhuri and Rajeev Alur. Instrumenting C programs with nested word monitors. In *14th International Symposium on Model Checking Software*, 2007.
[TACAS07]	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.
[FSTTCS06]	Rajeev Alur and Swarat Chaudhuri. Branching pushdown tree automata. In *26th Conference on Foundations of Software Technology and Theoretical Computer Science (FSTTCS)*, 2006.
[CAV06]	Rajeev Alur, Swarat Chaudhuri, and P. Madhusudan. Languages of nested trees. In *18th International Conference on Computer-Aided Verification (CAV)*, 2006.
[POPL06]	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.
[TACAS05]	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.
[CONCUR03]	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.

Tutorials

Spring 2018	Swarat Chaudhuri, Chris Jermaine, and Vijayaraghavan Murali. Bayou: Deep Learning over "Big Code" for Program Analysis and Synthesis. Tutorial at *Symposium on Programming Language Design and Implementation (PLDI)*, 2018.

Teaching

Fall 2020	*Logic in Computer Science and Artificial Intelligence*. Undergraduate elective on logic in computer science at UT Austin.
Spring 2020	*Program Synthesis*. Introductory graduate course on program synthesis and learning at UT Austin. Diversity course for the CS department's PhD program.
Spring 2014, Fall 2014, Fall 2015, Fall 2016, Fall 2018, Fall 2019	*COMP 382: Reasoning about Algorithms*. Required undergraduate course on theoretical computer science at Rice University.
Spring 2018	*COMP 503: Reasoning about Software*. Introductory graduate course on formal methods at Rice University.
Fall 2012, Fall 2013, Spring 2015	*COMP 507: Computer-Aided Program Design*. Introductory graduate course on program verification and synthesis at Rice University.
Spring 2012, Spring 2013	*COMP 482: Design and Analysis of Algorithms*. Senior undergraduate course on algorithms at Rice University.
Spring 2013	*COMP 607: Automata, Logic, and Infinite Games*. Graduate seminar at Rice University.

Spring 2012	*COMP 607: Program Synthesis*. Graduate seminar at Rice University.
Fall 2011	*COMP 411: Principles of Programming Languages*. Senior undergraduate and entry-level graduate course on programming languages at Rice University.
Spring 2011	*CSE 598: Exploiting Concurrency Efficiently and Correctly*. 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	Abhinav Verma. Fall 2016 onwards. Transferred to UT Austin in Fall 2020. *Research topic:* Programmatic reinforcement learning.
	Chenxi Yang. Spring 2020 onwards. *Research topic:* Certified machine learning.
	Greg Anderson. Spring 2020 onwards, co-advised with Isil Dillig. *Research topic:* Formally verified reinforcement learning.
	Joshua Hoffman. Summer 2020 onwards, co-advised with Joydeep Biswas. *Research topic:* Lifelong reinforcement learning through neurosymbolic methods.
	Ethan Wen. Spring 2021 onwards. *Research topic:* Neurosymbolic program induction.
Postdoctoral Researchers	Calvin Smith. Summer 2020 onwards. *Research topic:* Learning logic programs from data.
	Anders Miltner. Summer 2020 onwards, co-advised with Isil Dillig. *Research topic:* Inductive program synthesis.
Research Scientist	Dipak Chaudhari. Fall 2020 onwards, postdoc from Summer 2017-Summer 2020. *Research topic:* Calculational program synthesis.
Masters Students	Surya Dwivedi. Fall 2020 onwards. *Research topic:* Programmatic reinforcement learning
Undergraduate Students	Joshua Deng. Fall 2020 onwards. *Research topic:* Learning programmatic models of RNA splicing.
	Aeddon Chipman. Fall 2020 onwards. *Research topic:* Inductive logic programming.

Graduated Ph.D. students	Roberto Lublinerman. Ph.D. student at Penn State (2008-2012). First employment at Google. Thesis: *Concurrent Assemblies: An execution model for irregular parallelism*.
	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.
Former postdoctoral researchers	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 an Assistant Professor at Colorado School of Mines. *Research topic:* Integrated task and motion planning for robots.
	Hassan Eldib. Summer 2015-Spring 2017; now an Assistant Professor 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	Jacqueline Li. Fall 2018-Summer 2019. *Research topic:* Learning-based program synthesis.
	Grace Tan. Fall 2018-Summer 2019. *Research topic:* Learning-based program synthesis.
	Kyran Adams. Fall 2018-Summer 2019. *Research topic:* Programmatically interpretable machine learning.

Visiting Ph.D. students	Kengo Kido. Student at University of Tokyo; visited May-June 2014. *Research topic:* Abstract interpretation using infinitesimals. Martin Clochard. Masters student at ENS Paris; visited March-August 2012. *Research topic:* Program synthesis using smoothed search.

External funding

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). My amount: $300,000. Award period 2020-2024.
PI	*Leveraging Symbolic Representations for Safe and Assured Learning.* DARPA Assured Autonomy award. My amount: $450,000. Award period: 2019-2021.
PI	*NSCORE: Neuro-Symbolic Co-Designer Using Oracle- Guided Synthesis and Reinforcement Learning.* DARPA Symbiotic Design award. SRI is the lead institution. My amount: $600,000. Award period: 2020-2024.
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). My amount: $1,200,000. Award period: 2020-2024.
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). My amount: $616,610. Award period 2020-2025.
PI	*Bridging Automated Formal Reasoning and Continuous Optimization for Provable Safe Deep Learning.* Collaborative NSF Medium grant with Isil Dillig. My amount: $500,000. Award period 2019-2023.
PI	*Formal Analysis and Synthesis of Multiagent Systems with Incentives.* Collaborative NSF Medium grant with Moshe Vardi and Rajeev Alur. My amount: $300,000. Award period 2017-2021.
PI	*Automating Robot Programming Through Constraint Solving and Motion Planning.* Collaborative NSF Medium grant with Lydia Kavraki. Total amount $1,000,000. Award period 2015-2019.
Gift	Google Faculty Award. Total amount $50,000. 2015.
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 spans three technical areas; I am the lead of Technical Area 4, which focuses on program verification, repair, and synthesis. Total amount $11 million (approximately). 2014-2018.
co-PI	*Science of Security for Systems.* NSA grant with Sayan Mitra and Geir Dullerud (UIUC). Total amount $806,502. 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. 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. Award period 2012-2016.

PI   *Chorus: Dynamic Isolation for Shared-Memory parallelism*. Collaborative NSF Medium grant with Vivek Sarkar. Total amount $1,200,000. Award period 2010-2014.

Gift $10,000 gift from Microsoft Research. 2011.

PI   *CAREER: Robustness Analysis for Uncertain Programs: Theory, Algorithms, and Tools*. NSF CAREER award. Total amount $426,457. Award period 2010-2015.

Committee service

Program Chair   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.

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

Neural Information Processing Systems (NeurIPS), 2020.

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

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.

ACM Conference on Object-Oriented Programming, Systems, Languages, and Applications (OOPSLA), 2014 and 2021.

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.

Co-organizer Workshop on Exploiting Concurrency Efficiently and Correctly (EC^2), 2010 and 2011.

Referee Many venues, including Neural Information Processing Systems (NeurIPS), 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).

Invited talks

Summer and Fall 2020 *Neurosymbolic Programming*. Invited seminar talk at University of Wisconsin and Rice University.

Summer 2019 *Machine Learning as Program Synthesis*. Keynote speech at the International Conference on Computer-Aided Verification (CAV), 2019.

Fall 2018 and Spring 2019 *Program Synthesis for Reliable and Interpretable Artificial Intelligence*. Given at Georgia Tech, UT Austin, University of Michigan, EPFL, and UCLA.

Spring 2018 *Program Synthesis at the Edge of Artificial Intelligence*. Given at Microsoft Research, Google Brain, UC San Diego, and Caltech.

Fall 2017 *Learning to Synthesize Programs*. Given at CU Boulder.

Fall 2017 *Program Synthesis: An Old New Problem*. Given at EPFL.

Spring 2017 *Learning to Write Code, Automatically*. Given 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*. Keynote talk at Haifa Verification Conference, Haifa, Israel.
Spring 2014	*Adventures in Automated Programming*. Given at Carnegie Mellon University, University of Illinois, and University of Pennsylvania.
Summer 2013	*Bridging the Discrete and the Continuous in Reasoning about Programs*. Given at Microsoft Research, Cambridge and Institute for Science and Technology, Austria.
Summer 2012	*Computer-Aided Numerical Programming*. Given at Ken Kennedy Institute for Information Technology (at Rice University) and Pennsylvania State University.
Fall 2011	*Composing Composure: Reasoning about Robustness of Programs*. Given at University of Pennsylvania, Princeton University.
Spring 2011	*When Programs Make No Jumps: Marrying the Discrete and the Continuous in Program Analysis*. Given at Rice University, Northeastern University, University of California at Irvine.
Spring 2010, Summer 2010	*Cauchy: Towards an Analytical Calculus of Computation*. Given at New York University, Cornell University, University of Toronto, and Microsoft Research.
Fall 2009, Summer 2009	*Parallel Programming with Object Assemblies*. Given at MIT and Microsoft Research.
Fall 2008, Spring 2009	*Programming with Sociable Resources*. Given at NEC Laboratories, University of Pennsylvania, and Rice University.
Spring 2007	*Context-sensitive software model checking*. Given at Pennsylvania State University, University of Texas at Austin, Carnegie Mellon University, NEC Laboratories America, and IBM T. J. Watson Research Center.

Professional memberships

Member of the Association for Computing Machinery (ACM) and the Special Interest Group on Programming Languages (ACM SIGPLAN).

Personal

Date of birth	March 27, 1979.
Citizenship	Citizen of the United States.