

Mukund Raghothaman

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Research Interests

Program synthesis, formal verification, probabilistic methods in static analysis, programming abstractions for stream processing

Education

University of Pennsylvania

Ph.D. in Computer Science

Thesis: *Regular Programming over Data Streams*

Advisor: Rajeev Alur

Philadelphia, PA

September, 2010–May, 2017

Indian Institute of Technology Guwahati

Bachelor of Technology in Computer Science

Thesis: *State Reachability in Counter Automata*

Advisor: Purandar Bhaduri

Guwahati, India

August, 2006–May, 2010

Experience

University of Pennsylvania

Postdoctoral Researcher

Advisor: Mayur Naik

By combining probabilistic and logical reasoning techniques, I am reducing false alarm rates, incorporating user feedback, and improving the usability of static analysis tools [PLDI18, MLP18, TR18c].

Philadelphia, PA

May, 2017–Present

École Polytechnique Fédérale de Lausanne

Visiting Researcher

Advisor: Viktor Kuncak

I worked on using patterns derived from code corpora and developed probabilistic enumeration techniques to improve the state of the art in program synthesis algorithms [TR17].

Lausanne, Switzerland

September–December, 2016

Microsoft Research Ltd.

Research Intern

Advisor: Youssef Hamadi, Yi Wei

I developed an algorithm to extract API usage idioms from open-source C# projects and a program synthesizer to answer natural language API-related queries [ICSE16].

Cambridge, UK

June–August, 2013, June–August, 2014

Microsoft Corporation

Software Development Engineer Intern

Manager: Bill Ramsey

I developed a prototype Visual Studio plugin for SCOPE, a SQL-like language used internally at Microsoft.

Redmond, WA

May–July, 2009

Teaching

CIS 700, Software Analysis and Testing

Graduate

Guest lecture on program synthesis.

University of Pennsylvania

Fall 2018

CIS 400, Senior Design Project

Undergraduate

Mentoring a group of four seniors to integrate continuous program reasoning tools into repository hosting services such as GitHub.

University of Pennsylvania

Fall 2018

CIS 500, Software Foundations

Graduate

Teaching assistant. Helped with updating and creating new pedagogical material, homework assignments and exams, and conducted office hours.

University of Pennsylvania

Spring 2012

CIS 262, Automata, Computability, and Complexity

Undergraduate

Teaching assistant. Conducted office hours, prepared solutions to assignments and exams, and graded them.

University of Pennsylvania

Fall 2011

Publications

Drafts.....

- [TR18a] Rajeev Alur, Dana Fisman, Konstantinos Mamouras, Mukund Raghothaman, and Caleb Stanford. Streamable regular transductions. Tech. rep. In submission. 2018. CoRR: abs/1807.03865.
- [TR18b] Kihong Heo, Mukund Raghothaman, Xujie Si, and Mayur Naik. Continuous Program Reasoning via Differential Bayesian Inference. In submission. 2018.
- [TR18c] Mukund Raghothaman, Xujie Si, Kihong Heo, and Mayur Naik. Difflog: Learning Datalog programs by continuous optimization. In submission. 2018.
- [TR17] Manos Koukoutos, Mukund Raghothaman, Etienne Kneuss, and Viktor Kuncak. On repair with probabilistic attribute grammars. Tech. rep. In submission. 2017. CoRR: abs/1707.04148.

Conference papers.....

- [PLDI18] Mukund Raghothaman, Sulekha Kulkarni, Kihong Heo, and Mayur Naik. User-guided program reasoning using Bayesian inference. In: *Proceedings of the 39th ACM SIGPLAN Conference on Programming Language Design and Implementation*. PLDI. ACM, 2018, pp. 722–735.
- [MLP18] Mukund Raghothaman, Sulekha Kulkarni, Richard Zhang, Xujie Si, Kihong Heo, Woosuk Lee, and Mayur Naik. Beyond deductive methods in program analysis. In: *Machine Learning for Programming*. 2018.
- [NeurIPS18] Xujie Si, Hanjun Dai, Mukund Raghothaman, Mayur Naik, and Le Song. Learning loop invariants for program verification. In: *Advances in Neural Information Processing Systems 31 (Spotlight; to appear)*. 2018.
- [PLDI17] Konstantinos Mamouras, Mukund Raghothaman, Rajeev Alur, Zachary Ives, and Sanjeev Khanna. StreamQRE: Modular specification and efficient evaluation of quantitative queries over streaming data. In: *Proceedings of the 38th ACM SIGPLAN Conference on Programming Language Design and Implementation*. PLDI. ACM, 2017, pp. 693–708.
- [ESOP16] Rajeev Alur, Dana Fisman, and Mukund Raghothaman. Regular programming for quantitative properties of data streams. In: *Programming Languages and Systems: 25th European Symposium on Programming*. ESOP. Springer, 2016, pp. 15–40.

- [ICSE16] Mukund Raghothaman, Yi Wei, and Youssef Hamadi. SWIM: Synthesizing What I Mean. Code search and idiomatic snippet synthesis. In: *Proceedings of the 38th International Conference on Software Engineering*. ICSE. ACM, 2016, pp. 357–367.
- [POPL15] Rajeev Alur, Loris D’Antoni, and Mukund Raghothaman. DReX: A declarative language for efficiently evaluating regular string transformations. In: *Proceedings of the 42nd Annual Symposium on Principles of Programming Languages*. POPL. ACM, 2015, pp. 125–137.
- [CAV15] Rajeev Alur, Mukund Raghothaman, Christos Stergiou, Stavros Tripakis, and Abhishek Udupa. Automatic completion of distributed protocols with symmetry. In: *Proceedings of the 27th International Conference on Computer Aided Verification*. CAV. Springer, 2015, pp. 395–412.
- [LICS14] Rajeev Alur, Adam Freilich, and Mukund Raghothaman. Regular combinators for string transformations. In: *Proceedings of the Joint Meeting of the 23rd Annual Conference on Computer Science Logic and the 29th Annual Symposium on Logic in Computer Science*. CSL-LICS. ACM, 2014, 9:1–9:10.
- [HVC14] Rajeev Alur, Milo Martin, Mukund Raghothaman, Christos Stergiou, Stavros Tripakis, and Abhishek Udupa. Synthesizing finite-state protocols from scenarios and requirements. In: *Hardware and Software: Verification and Testing: Proceedings of the 10th International Haifa Verification Conference*. HVC. Springer, 2014, pp. 75–91.
- [FMCAD13] Rajeev Alur, Rastislav Bodik, Garvit Juniwal, Milo Martin, Mukund Raghothaman, Sanjit Seshia, Rishabh Singh, Armando Solar-Lezama, Emina Torlak, and Abhishek Udupa. Syntax-guided synthesis. In: *Formal Methods in Computer-Aided Design*. FMCAD. Extended version published as [DSSE15]. IEEE, 2013, pp. 1–8.
- [LICS13] Rajeev Alur, Loris D’Antoni, Jyotirmoy Deshmukh, Mukund Raghothaman, and Yifei Yuan. Regular functions and cost register automata. In: *Proceedings of the 28th Annual Symposium on Logic in Computer Science*. LICS. IEEE, 2013, pp. 13–22.
- [ICALP13] Rajeev Alur and Mukund Raghothaman. Decision problems for additive regular functions. In: *Proceedings of the 40th International Colloquium on Automata, Languages, and Programming, Part II*. ICALP. Springer, 2013, pp. 37–48.

Journal papers.....

- [DSSE15] Rajeev Alur, Rastislav Bodik, Eric Dallal, Dana Fisman, Pranav Garg, Garvit Juniwal, Hadas Kress-Gazit, Madhusudan Parthasarathy, Milo Martin, Mukund Raghothaman, Shambwaditya Saha, Sanjit Seshia, Rishabh Singh, Armando Solar-Lezama, Emina Torlak, and Abhishek Udupa. Syntax-guided synthesis. In: *Dependable Software Systems Engineering*. IOS Press, 2015, pp. 1–25.

Theses.....

- [Ths17] Mukund Raghothaman. Regular programming over data streams. PhD thesis. University of Pennsylvania, 2017.

Technical reports.....

- [TR14] Mukund Raghothaman and Abhishek Udupa. Language to specify syntax-guided synthesis problems. Tech. rep. 2014. CoRR: abs/1405.5590.

Software

Bingo

Interactive system for ranking static analysis alarms [PLDI18, MLP18, TR18b]

CODE2INV

System to automatically synthesize loop invariants by reinforcement learning [NeurIPS18]

<https://github.com/PL-ML/code2inv>

Difflog

System to learn Datalog queries from input-output relations using numerical optimization [TR18c, MLP18]

SyGuS

Interchange format for syntax-guided synthesis problems [FMCAD13, TR14]

<https://github.com/rishabhs/sygnus-comp14>

SWIM

Natural language code search [ICSE16]

StreamQRE

Domain-specific language for easy, efficient stream processing [TR18a, Ths17, PLDI17, ESOP16]

<http://www.cis.upenn.edu/~rmukund/StreamQRE.html>

DReX

Highly expressive DSL for string transformations supporting fast, one-pass evaluation [Ths17, POPL15, LICS14]

<https://bitbucket.org/strexp/drex>

Awards

1. Second place in SyGuS competition 2014 for the stochastic SyGuS solver STOCH.
2. Honourable mention at the ACM ICPC Asia Regionals, 2009, held at IIT Kanpur.
3. National Talent Search Scholarship, 2004, by the National Council for Educational Research and Training.

Service

IBM PL Day 2018	Selection Committee Member
CAV 2017	Artifact Evaluation Committee Member
CAV 2016	Artifact Evaluation Committee Member
POPL 2016	Artifact Evaluation Committee Member
PLDI 2016	External Review Committee Member