

Caleb Stanford

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Research Areas: Programming Languages and Systems

Education

- **University of Pennsylvania**

PhD student, computer science. Advisor: [Rajeev Alur](#). Fall 2016 – Spring 2022 (expected).

- **Brown University**

ScB, mathematics and computer science. Capstone Advisor: Tim Nelson. Fall 2013 – Spring 2016.

Industry Research Experience

- **Microsoft**, [Research in Software Engineering Group](#) (RiSE).

Advisors: Margus Veanes and Nikolaj Bjørner. Summer 2020.

- **Amazon Web Services**, [Automated Reasoning Group](#) (ARG).

Primary Advisor: Pauline Bolignano. Summer 2019.

Publications

**equal contribution †authors in alphabetical order*

1. **Guided Incremental Dead State Detection**, Caleb Stanford and Margus Veanes, Fall 2021. *In submission.*
2. **Stream Processing with Dependency-Guided Synchronization**, Konstantinos Kallas,^{*} Filip Nksic,^{*} Caleb Stanford,^{*} and Rajeev Alur. Principles and Practice of Parallel Programming (PPoPP), February 2022.
3. **Correctness in Stream Processing: Challenges and Opportunities**, Caleb Stanford, Konstantinos Kallas, and Rajeev Alur. Conference on Innovative Data Systems Research (CIDR), January 2022.
4. **Symbolic Boolean Derivatives for Efficiently Solving Extended Regular Expression Constraints**, Caleb Stanford, Margus Veanes, and Nikolaj Bjørner. Programming Language Design and Implementation (PLDI), June 2021.
5. **Synchronization Schemas**,[†] Rajeev Alur, Phillip Hilliard, Zachary Ives, Konstantinos Kallas, Konstantinos Mamouras, Filip Nksic, Caleb Stanford, Val Tannen, and Anton Xue. Invited Contribution to Principles of Database Systems (PODS), June 2021. *Invited paper.*
6. **DiffStream: Differential Output Testing for Stream Processing Programs**, Konstantinos Kallas,^{*} Filip Nksic,^{*} Caleb Stanford,^{*} and Rajeev Alur. Object-Oriented Programming, Systems, Languages, and Applications (OOPSLA), November 2020.
7. **Streamable Regular Transductions**,[†] Rajeev Alur, Dana Fisman, Konstantinos Mamouras, Mukund Raghothaman, and Caleb Stanford. Theoretical Computer Science (TCS), February 2020.
8. **Data-Trace Types for Distributed Stream Processing Systems**, Konstantinos Mamouras, Caleb Stanford, Rajeev Alur, Zachary Ives, and Val Tannen. Programming Language Design and Implementation (PLDI), June 2019.

9. **Modular Quantitative Monitoring**,[†] Rajeev Alur, Konstantinos Mamouras, and Caleb Stanford. Principles of Programming Languages (POPL), January 2019.
10. **Interfaces for Stream Processing Systems**,[†] Rajeev Alur, Konstantinos Mamouras, Caleb Stanford, and Val Tannen. Principles of Modeling: Festschrift Symposium in honor of Edward A. Lee, October 2017. *Invited paper*.
11. **Automata-Based Stream Processing**,[†] Rajeev Alur, Konstantinos Mamouras, and Caleb Stanford. International Colloquium on Automata, Languages, and Programming (ICALP), July 2017.

Open-Source Software

- **Guided incremental digraphs**: a data structure for incrementally tracking live and dead states for SMT applications.
- **dZ3**: A new constraint solver for regular expressions, now the default in Z3.
- **DiffStream**: Differential testing for [Apache Flink](#) programs.
- **Flumina**: A programming model for online applications with parallelizable synchronization primitives and predictable semantics.
- **Data transducers**: A general-purpose intermediate representation for online monitoring with performance guarantees.

Other Contributions

1. **Mathematical Muffin Morsels: Nobody Wants A Small Piece**, William Gasarch, Erik Metz, Jacob Prinz, and Daniel Smolyak. Book contribution, 2020.
2. **Context-Directed Reversals of Signed Permutations**,[†] Hannah Li, Jack Ramsey, Marion Scheepers, Haley Schilling, and Caleb Stanford. Outstanding presentation award for poster at the Joint Math Meetings (JMM), January 2016. Travel grant from JMM awarded.

Selected Honor(s)

- **Heidelberg Laureate Forum 2019**: Recipients of the most prestigious awards in mathematics and computer science meet 200 young researchers from around the world. Selected to attend with funding (all except travel), September 22–27, 2019, Heidelberg, Germany.

Educational Experience

- **Dagstuhl Seminar 19071**: Specification formalisms for modern cyber-physical systems. February 10–15, 2019, Schloss Dagstuhl, Germany. Invitational research seminar (approx. 40 participants).
- **Marktoberdorf Summer School**: Logical methods for safety and security of software systems. August 2–11, 2017, Marktoberdorf, Germany. Accepted with travel grant awarded.
- **Lipa Summer School**: Topics connected to logic in computer science. July 3–6, 2017, University of Warsaw.
- **NASSLLI**: North American Summer School on Logic, Language, and Information. July 9–16, 2016, Rutgers University. Scholarship awarded.

Teaching

- **Teaching Certificate** from the Center for Teaching and Learning (CTL), UPenn. Completed Spring 2021.
- **Instructor** for Rust Programming (CIS 198), UPenn. Spring 2021.

- *Course evaluations (0=Poor, 1=Fair, 2=Good, 3=Very Good, 4=Excellent):* Quality of instructor (3.2), quality of course (2.9), accessibility of instructor (3.0), ability to stimulate interest (3.0), amount learned (3.1).
- **Graduate TA** for Theory of Computation (CIS 511), UPenn. Spring 2018.
- **Graduate TA** for Software Foundations (CIS 500), UPenn. Fall 2017.
- **TA** for online courses at the Art of Problem Solving (AoPS). Summer 2016.
- **Instructor** for LaTeX workshops at the Science Center, Brown. Spring 2014 – Spring 2016.
- **TA** for Discrete Structures and Probability (CS 22), Brown. Spring 2016.
- **TA** for Models of Computation (CS 51), Brown. Fall 2015.
- **Tutor** for the Math Resource Center, Brown. Fall 2014 – Fall 2015.
- **Tutor** for Math 90 Calculus. Fall 2014.
- **Counselor** at the national middle school math program MathPath. Summer 2013 and Summer 2014.
- **Instructor** for Math Circle for high school students, BYU. Fall 2012 – Spring 2013.

Leadership

- **Student representative**, [Doctoral Advisory Board](#), UPenn School of Engineering, Fall 2021 – Present.
- **Co-chair**, [UPenn CIS Doctoral Association](#) and PhD student-faculty representative, Fall 2018 – Fall 2021.

Outreach

- **Instructor** for AP Computer Science, [Steppingstone Scholars high school outreach program](#). Fall 2021.
- **Co-founder and problem-writer** for the [Utah Math Olympiad](#), an annual high school mathematics contest. 2013 – present.
- **Volunteer**, [SIGPLAN-M Mentoring Program](#), Summer 2021 – Present.
- **Volunteer**, UPenn Applicant-Support Program (for under-served or under-represented communities in the admissions process), Fall 2020.

Service

- **Reviewer**, Transactions on Cyber-Physical Systems (TCPS), 2021.
- **Reviewer**, Mathematical Foundations of Computer Science (MFCS), 2021.
- **Reviewer**, CAV 2021.
- **Artifact Evaluation Committee**, POPL 2021.
- **Artifact Evaluation Committee**, CAV 2019.
- **Reviewer**, Conference on Concurrency Theory (CONCUR), 2018.

Programming Languages

- **Fluent:** Python, C++, Rust
- **Experienced:** Coq, Erlang, Java, OCaml
- **Tools:** Git, Alloy (a constraint solver for system design), LaTeX

Miscellaneous

- **Putnam math exam:** Three national ranks in the top 3-5%: 163.5 (2015), 150 (2014), 136 (2013), and 319 (2012) out of 4000+ participants. Scores of 30, 40, 40, and 30, respectively.
- **Mathematics Graduate Record Exam (subject GRE):** Score 900 (97th percentile) in fall 2015.
- **ACM International Collegiate Programming Contest (ICPC):** 3rd place team at qualifier round (fall 2014, fall 2015), 5th place team at regionals (fall 2015).