Aalok Thakkar

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Research Statement

My research focuses on integrating **formal methods** and **artificial intelligence**. In particular, I have worked on applying formal methods in the context of synthesis of declarative programs, synthesis of reactive programs, bounded model checking, and verification of smart contracts. Additionally, I am interested in questions of Science Pedagogy and Computational Sustainability.

Employment

Ashoka University — Sonipat, Haryana
Assistant Professor · Computer Science — *August 2024 - Present*

- Leading a research project on program synthesis with hard and soft specifications in collaboration with IIT Delhi, exploring advanced methods in automated synthesis.
- Collaborative research with ISI Kolkata on compositional verification of Large Language Models (LLMs), focusing on ensuring model reliability and correctness.

Aptos Labs and Movement Labs — Seattle, WA
Research Scientist · Programming Languages — *Jul 2023 - May 2024*

- Designed specifications for 24 foundational Aptos Framework modules (with 106 functions), and verified them by through preconditions and post-conditions, aborts-if clauses, and loop invariants.
- Facilitated deployment throughout a range of projects across verification, compilation, and the VM groups.
- Lead programming language research on the Fractal interpreter that supports seamless deployment of Solidity smart contracts on Movement Lab's M1 and other Move-based chains.
- Implemented iterator loops in the Move Programming language; one of the most requested features in Move.

Amazon Web Services — Boston, MA
Research Intern · Automated Reasoning Group (ARG) — *Jun 2021 - Aug 2021*

- Implemented verification of loop contracts in C Bounded Model Checker (CBMC) by adding support for checking loop invariants, and assignment for loop history variables and ghost variables.
- The implementation was merged into the open-source project.

Education

University of Pennsylvania — Philadelphia, PA
Doctor of Philosophy (PhD) in Computer and Information Science — *Aug 2018 - May 2023*
Thesis: Example-guided Synthesis of Relational Queries

Chennai Mathematical Institute — Chennai, India
Bachelor of Science (BSc with Honours) in Mathematics and Computer Science — *Jun 2015 - Apr 2018*

Selected Publications

Relational Query Synthesis ⋈ Decision Tree Learning.
Aaditya Naik, Aalok Thakkar, Adam Stein, Rajeev Alur, Mayur Naik
International Conference on Very Large Databases, 2023-24.

Mobius: Synthesizing Relational Queries with Recursive and Invented Predicates.
Aalok Thakkar, Nathaniel Sands, Georgios Petrou, Rajeev Alur, Mayur Naik, Mukund Raghothaman
ACM SIGPLAN SPLASH , 2023.

Complexity of Relational Query Synthesis.
Aalok Thakkar, Rajeev Alur, Mayur Naik
Workshop on Synthesis, 2022.

Example-guided Synthesis of Relational Queries.
Aalok Thakkar, Aaditya Naik, Nathaniel Sands, Rajeev Alur, Mayur Naik, Mukund Raghothaman
ACM SIGPLAN PLDI, 2021.

Reopening Businesses and Risk of COVID-19 Transmission.
Ashley O'Donoghue, Tenzin Dechen, Whitney Pavlova, Michael Boals, Garba Moussa, Manvi Madan, Aalok Thakkar, Frank J. DeFalco, Jennifer P. Stevens
npj Digital Medicine, 2021.

Modular Synthesis of Reactive Programs.
Kedar S Namjoshi, Aalok Thakkar, Richard J Trefler
Workshop on Synthesis , 2020.

Concurrency in Boolean networks.
Thomas Chatain, Stephan Haar, J Kolcak, Loic Pauleve, Aalok Thakkar
Natural Computing, 2020.

Organizing and Reviewing Activities and Professional Affiliations

Organizer: FSTTCS 2024, FSTTCS 2025

Reviewer: POPL 2022 AEC, ISEC 2025, PLDI 2025 SRC, ATVA 2025 AEC, OOPSLA 2026, ACM Computing Surveys

Attendee: BRICS Young Science Forum 2024, ACM Pingala Interactions in Computing 2025

Member: Association for Computing Machinery (ACM) India, Vijnana Bharati

Grants

Data & AI Adoption Fellowship — EkStep Foundation
Establish AI Safety Benchmarks for Education and Agriculture Domains — *July 2025 - December 2026*

Darjeeling Revival Fellowship — Alt Carbon
Geostatistical Modelling for Enhanced Rock Weathering — *May 2025 - April 2026*

Adaptive and Inclusive Pedagogy — Mphasis Limited
Develop a relevant, adaptive, and inclusive curriculum. — *May 2025 - April 2026*