

## RESEARCH INTEREST

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My research focuses on integrating **formal methods** and **artificial intelligence**. In particular, I have worked on applying formal methods in the context of programming-by-examples (PBE) for relational queries, synthesis of reactive programs, bounded model checking, and verification of smart contracts.

## EMPLOYMENT

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### Movement Labs

*Research Engineer · Programming Languages*

Seattle, WA

*Feb 2024 - Present*

- Leading 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.
- Developing the MovementSDK stack in order to reduce gas cost (by 10x), support parallel execution (17x improvement), and security against vulnerabilities such as reentrancy bugs.

### Aptos Labs

*Research Scientist · Programming Languages*

Seattle, WA

*Jul 2023 - Jan 2024*

- Translated informal specifications for 24 foundational Aptos Framework modules (with 106 functions) to formal guarantees, and verified them by designing preconditions and post-conditions, aborts-if clauses, and loop invariants.
- Facilitated code deployment throughout a range of projects across verification, compilation, and the virtual machine groups.
- Implemented iterator loops in the Move Programming language. This was one of the most requested features in Move.

### Amazon Web Services

*Research Intern · Automated Reasoning Group (ARG)*

Boston, MA

*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.
- Presented the implementation to the CBMC team; the implementation was merged into the open-source project.

### Amazon Web Services

*Research Intern · Automated Reasoning Group (ARG)*

New York, NY

*Jun 2020 - Aug 2020*

- Designed unbounded proofs for the cyclic doubly-linked list of FreeRTOS, and verified them using VeriFast.
- Presented the proofs to the FreeRTOS team; three of the proofs were merged into the FreeRTOS repository.

### Nokia Bell Labs

*Research Intern · Multi-robot Systems*

Murray Hill, NJ

*Jun 2019 - Aug 2019*

- Formulated scalable methods for synthesis of multi-process reactive systems from temporal specifications using modularity and symmetry constraints.
- Implemented these synthesis methods and tested them on a range of benchmark suites from prior literature.
- Published and presented the research at the 9<sup>th</sup> Workshop on Synthesis (a part of CAV 2020).

## EDUCATION

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### University of Pennsylvania

*Doctor of Philosophy (PhD) in Computer and Information Science*  
Thesis: Example-guided Synthesis of Relational Queries

Philadelphia, PA

*Aug 2018 - May 2023*

### Chennai Mathematical Institute

*Bachelor of Science (BSc with Honours) in Mathematics and Computer Science*

Chennai, India

*Jun 2015 - Apr 2018*

## LEADERSHIP EXPERIENCE

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**Graduate and Professional Student Assembly:** Held multiple roles over five years of service, including the Vice President of Finance (VPF) and Chair for Inclusion, Diversity, Equity, Access, and Leadership. Managed the budgeting, individual and group grants, and reporting for the annual budget of 3.5 million dollars as well as led a team of 20 members as VPF.

**Graduate Student Engineering Government:** Served as President and Treasurer over two years. Organized two diversity summits, restructured the constitution, and led an executive board of 13 students and a general body of 22 representatives.

**Rangoli - the South Asian Association at Penn:** Was the President and Treasurer over three years. Facilitated over 20 large-scale social and cultural events, led orientations for incoming students, and spearheaded several advocacy initiatives.

## SELECTED PUBLICATIONS

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Relational Query Synthesis  $\bowtie$  Decision Tree Learning.

Aaditya Naik, Aalok Thakkar, Adam Stein, Rajeev Alur, Mayur Naik  
*International Conference on Very Large Databases*, 2023.

Mobius: Synthesizing Relational Queries with Recursive and Invented Predicates.

Aalok Thakkar, Nathaniel Sands, Georgios Petrou, Rajeev Alur, Mayur Naik, Mukund Raghothaman  
*ACM SIGPLAN conference on Systems, Programming, Languages, and Applications: Software for Humanity*, 2023.

Complexity of Relational Query Synthesis.

Aalok Thakkar, Rajeev Alur, M 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 International Conference on Programming Language Design and Implementation*, 2021.

Reopening businesses and risk of COVID-19 transmission.

Ashley ODonoghue, 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 Treffer  
*Workshop on Synthesis*, 2020.

Concurrency in Boolean networks.

Thomas Chatain, Stephan Haar, J Kolcak, Loic Pauleve, Aalok Thakkar  
*Natural Computing*, 2020.

## CORE SKILLS

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**Skills:** Collaboration, Written/Verbal Critical Thinking and Problem Solving, Leadership, Project Management

**Technologies:** Agile, Git, SQL, Office Suite, Skype, Dropbox

**Languages:** Rust, Python, Move, Scala, C, C + +, Java, HTML