

Department of Computer and Information Science
3330 Walnut Street, Philadelphia, PA - 19104

+1 (215) 605 0424

✉ nimits@seas.upenn.edu

📁 seas.upenn.edu/~nimits

🌐 nimit-singhania

Nimit Singhania

Research Interests

I am broadly interested in the field of program analysis and compilers. I like building practical tools that make life of programmers easier. I have explored various sub-themes including static analysis, automated testing, program synthesis, and compiler transformations.

Education

2013–present **PhD**, *University of Pennsylvania*, Philadelphia, US.

Thesis *Static Analysis for Improving Performance of GPU Programs.*

Building LLVM-based tools to help programmers write efficient GPU programs by automatically detecting and fixing performance issues in their programs.

Advisors Rajeev Alur and Joe Devietti

2006–2010 **B.Tech**, *Indian Institute of Technology*, Kanpur, India.

Research Experience

2016–2017 **GPU Drano: Static Analysis for Uncoalesced Accesses in GPU programs**, *University of Pennsylvania*.

Developed a light-weight static analysis to identify uncoalesced global memory accesses in CUDA programs, a well-documented access pattern known to produce poor performance on GPUs. The analysis uses a novel abstraction to track accessed locations as a function of thread ID and reports accesses that have a large coefficient for thread ID (which potentially leads to uncoalesced accesses). Such accesses refer to distant memory locations and require greater time and energy to complete. We implemented the analysis in LLVM. The analysis reported 180 accesses and found 111 uncoalesced accesses in Rodinia, a popular benchmark suite of GPU programs.

Summer 2017 **Automatic Stub Generation for Static Analysis of Android Applications**, *Google, Sunnyvale*.

Developed a tool to automatically generate library stubs for static analysis of Android applications. The stubs were previously written manually, which was tedious and error-prone. We built a tool to generate them automatically and used the tool to generate small stubs relevant to the analyses for Apache HttpClient and OpenJDK libraries.

2015–2016 **Loopy: Programmable and Formally Verified Loop Transformations**, *Nokia Bell Laboratories, Murray Hill*.

Developed a semi-automatic framework to transform loops in programs for performance. The programmer writes the transformation as a sequence of simple operations, and the framework takes in the specification and automatically implements and verifies the specified transformation. User-specification allows fine-grained control, while automation and verification reduce manual effort and prevent manual errors. We achieved up to 22x performance improvement over state-of-the-art optimizing compilers on Polybench, a suite of high-performance kernels. <https://github.com/nimit-singhania/loopy>

- 2013–2014 **Mosaic: Piecewise Affine Models from Input-Output Data**,
University of Pennsylvania.
Developed a tool to learn piecewise linear functions from real-valued input-output data. The tool uses a combination of ideas from machine learning (linear regression) and formal methods (counter-example guided learning) to learn simple functions that closely approximate given data. Evaluation shows better performance against existing approaches on real data from pick-and-place machines. <https://github.com/nimit-singhania/mosaic>
- 2011–2013 **Runtime Engine for Automating Test Automation**,
IBM Reserach India, New Delhi.
Worked on the backend engine for a tool to automate Web GUI testing and generate executable scripts from manually-written tests. Designed and developed an algorithm to identify change-resilient representation for web-page elements. The algorithm associates visually-proximate *cues or labels* with each web-page element. The labels help uniquely identify the element, even when the internal structure of the web-page is modified.
- 2014–2015 **Markov Decision Processes with Alternative Objectives**,
University of Pennsylvania.
Developed a formalism to capture optimal decision-making in probabilistic processes where multiple objectives exist but only one is actualized upon termination. It is useful to model scenarios where multiple agents, with different objective functions, compete to achieve a desired goal.

Work Experience

- 2013–present **Research Assistant**, *University of Pennsylvania, Phildelphia, US*.
- Summer 2017 **Software Engineering Intern**, *Google, Sunnyvale, US*.
- Summer 2015 **Research Intern**, *Nokia Bell Laboratories, Murray Hill, US*.
- 2010–2013 **Software Engineer**, *IBM Research, New Delhi, India*.
- Summer 2009 **Intern**, *Microsoft Research, Redmond, US*.
- Summer 2008 **Intern**, *NVIDIA, Pune, India*.

Skills

- Languagues C++, CUDA, Java, Python, Matlab
- Frameworks LLVM, Git, Bash, Make, Lex, Yacc

Teaching Experience

- Fall 2014 **Head TA**, CIS 262 Automata, Computability, and Complexity.
Designed homework assignments. Held tutorial sessions and office hours.
- Spring 2015 **TA**, CIS 540 Priciples of Embedded Systems.
Graded assignments and held office hours. Designed final project on model-checking based flight-controller design.
- Spring 2016 **TA**, CIS 511 Introduction to The Theory of Computation.
Graded assignments and held office hours. Held special help sessions for weaker students.

Interests

- Music I am interested in Indian music. I am associated with Penn Sargam, a south-asian fusion music group at Penn. I have performed with the group for last three years.
- Volunteering I have volunteered with iPraxis, an organization that promotes STEM fields among middle-school students. I helped students with their science-fair projects.

Conference Papers

- CAV 2017 **GPU Drano: Detecting Uncoalesced Accesses in GPU Programs**, Rajeev Alur, Joseph Devietti, Omar Navarro Leija, and Nimit Singhanian.
- SAS 2016 **Loopy: Programmable and Formally Verified Loop Transformations**, Kedar S Namjoshi and Nimit Singhanian.
- CSL 2016 **Hedging bets in Markov decision processes**, Rajeev Alur, Marco Faella, Sampath Kannan, and Nimit Singhanian.
- EMSOFT 2014 **Precise Piecewise Affine Models from Input-Output Data**, Rajeev Alur and Nimit Singhanian.
- CAV 2012 **Alternate and Learn: Finding witnesses without looking all over**, Nishant Sinha, Nimit Singhanian, Satish Chandra, and Manu Sridharan.
- FSE 2012 **Efficiently scripting change-resilient tests**, Suresh Thummalapenta, Nimit Singhanian, Pranavadatta Devaki, Saurabh Sinha, Satish Chandra, Achin K Das, and Srinivas Mangipudi.