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nimit-singhania

Nimit Singhania

Education

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

Interests Formal Methods, Program Analysis, Programming Languages

Thesis *Formal Methods for Performance on Heterogeneous Architectures*.

I am building formal tools to help programmers write correct and efficient programs for underlying architectures.

Advisors Rajeev Alur and Joe Devietti

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

Research Experience

2016–present **Static Detection of Uncoalesced Accesses in CUDA programs**,
University of Pennsylvania.

A static compile-time analysis to identify uncoalesced global memory accesses in CUDA programs, a well documented pattern known to produce poor performance on GPUs. The analysis tracks array indices as a function of thread IDs and reports memory accesses where the indices have a non-linear or large linear dependency on thread ID. We have implemented it in GPUCC, an open-source LLVM-based compiler for CUDA programs. We identify existing bugs in Rodinia, a popular benchmark suite of GPU programs.

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

A loop-transformation framework that allows programmers to specify rich transformations, which are then implemented and verified automatically. User-specification provides programmers control over the transformation, while automation and verification reduce manual effort and prevent manual errors. We have implemented it in Polly, a polyhedral library for LLVM and evaluated it on Polybench, a benchmark suite of high-performance kernels. We achieve up to 22x performance improvements over state-of-the-art compilers.

2013–2014 **Mosaic: Piecewise Affine Models from Input-Output Data**,
University of Pennsylvania.

A tool to learn piecewise linear functions from real-valued input-output data. It uses ideas from machine learning (linear regression) and formal methods (CEGIS, interpolant generation) to generate simple functions which closely approximate the given data. Evaluation shows better performance against existing approaches, on real-data from pick-and-place machines.

2010–2012 **Scalable Symbolic Bug Detection**,
IBM Reserach India.

We developed techniques to scale bug detection to large programs with multiple procedures. We exploit modularity of the program via demand-driven scope expansion of the analysis, while building and reusing compact procedure summaries in the process.

2014–2015 **Markov Decision Processes with Alternative Objectives**,
University of Pennsylvania.

A new formalism to capture optimal decision making in probabilistic processes where there are multiple objectives but only one is actualized in the end. This can model scenarios where multiple agents, with different objective functions, compete or collaborate to achieve a desired goal.

Work Experience

2013–present **Research Assistant**, *University of Pennsylvania*, Philadelphia, US.

Summer 2015 **Research Intern**, *Bell Laboratories, Nokia*, 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

Programming Languages C/C++, Java, Python, Matlab

Frameworks LLVM, Polly, Git, Bash, Make, Lex, Yacc

Teaching Experience

Fall 2014 **Head TA**, CIS 262 Automata, Computability, and Complexity.

Spring 2015 **TA**, CIS 540 Principles of Embedded Systems.

Spring 2016 **TA**, CIS 511 Introduction to The Theory of Computation.

Interests

Music I am interested in Indian music. I have performed as part of Penn Sargam, a South Asian fusion music group at Penn.

Conference Papers

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.

ICSE 2012 **Automating Test Automation**, Suresh Thummalapenta, Saurabh Sinha, Nimit Singhanian, and Satish Chandra.