

# Keyur Parag Joshi

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## Education

### University of Illinois Urbana-Champaign (UIUC), USA

August 2017 – May 2024

PhD in Computer Science

*Research focus* – analysis of quantitative uncertainty in programs and systems; effective application of approximations

### Indian Institute of Technology, Hyderabad (IITH), India

August 2013 – May 2017

Bachelor of Technology (Honours) in Computer Science and Engineering

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## Skills

**Programming:** Extensive experience – Python, C/C++, Git, Make, Bash. Additional experience – LLVM, ANTLR, PyTorch

**Soft Skills:** Teamwork (10+ team members), communication, documentation (developer and end-user)

**Languages:** English (native proficiency), German (elementary proficiency)

**Coursework:** Programming Languages, Compilers and Optimizations, Data Structures and Algorithms, Software Engineering, Approximate Algorithms, Software Verification, Machine Learning, etc.

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## Work Experience

### Microsoft Research India – Research Intern

May 2022 – August 2022

- Designed and implemented a library for training neural networks such as RNNs exclusively using fixed-point arithmetic
  - Demonstrated proof-of-concept which achieved accuracy similar to that of a floating-point implementation of the same RNN
  - Published open-source tool at [github.com/KPJoshi/Fixed-Point-RNN-Training](https://github.com/KPJoshi/Fixed-Point-RNN-Training)
  - *Skills used* – Python, PyTorch, Git, compilers, approximation, documentation, etc.
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## Open-Source Tools

**Fixed-Point-RNN-Training:** Tool for training RNNs using exclusively fixed-point arithmetic

- Tool, example, and tutorial available at [github.com/KPJoshi/Fixed-Point-RNN-Training](https://github.com/KPJoshi/Fixed-Point-RNN-Training)
- *Skills used* – Python, PyTorch, Git, compilers, approximation, documentation, etc.

**AxProf:** Tool for statistical analysis of the precision of approximate algorithms

- Successfully found bugs in multiple approximate algorithm implementations
- Tool, examples, and tutorial available at [axprof.org](https://axprof.org)
- *Skills used* – Python, Git, compilers, approximation, statistical analysis, etc.

**Parallely:** Tool for static analysis of quantitative error propagation in parallel programs

- Tool and instructions available at [github.com/uiuc-arc/parallely](https://github.com/uiuc-arc/parallely)
- *Skills used* – Python, Git, program analysis, compilers, etc.

## Recent Research

- **Efficient protection of programs against silent data corruptions:** Silent Data Corruptions (SDCs) incorrectly alter program data in an insidious manner. SDCs are increasingly common in large-scale systems due to transistor scaling. We propose a composable analysis of the effects of errors that cause SDCs in programs. Our analysis selects a set of vulnerable instructions to protect against SDCs that maximizes protection while minimizing runtime overhead. When the program is modified, our analysis saves time by only re-analyzing modified program sections.  
*Under submission; preprint available: [arxiv.org/abs/2403.13989](https://arxiv.org/abs/2403.13989)*
  - **Surrogate models for autonomous vehicle systems:** Modern autonomous vehicles use neural networks and other complex components to perceive the environment and/or to make control decisions. Simulating these systems to ensure they do not violate safety properties is costly. Our two-step approach enables the creation of cheap surrogate models which can be used to check safety properties. Using our surrogate models, we efficiently and precisely estimate the probability of a safety violation in multiple autonomous vehicle scenarios.  
*Under submission; preprint available: [arxiv.org/abs/2208.02232](https://arxiv.org/abs/2208.02232)*
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## Publications

- **Compositional Analysis of the Effects of Uncertainty on Computations**  
**Keyur Joshi**  
*PhD Dissertation (2024)*
- **[Under Submission] FastFlip: Compositional Error Injection Analysis**  
**Keyur Joshi**, Rahul Singh, Tommaso Bassetto, Sarita Adve, Darko Marinov, Sasa Misailovic  
*Preprint available: [arxiv.org/abs/2403.13989](https://arxiv.org/abs/2403.13989)*
- **[Under Submission] GAS: Generating Fast and Accurate Surrogate Models for Autonomous Vehicle Systems**  
**Keyur Joshi**, Chiao Hsieh, Sayan Mitra, Sasa Misailovic  
*Preprint available: [arxiv.org/abs/2208.02232](https://arxiv.org/abs/2208.02232)*
- **Verifying Controllers with Vision-based Perception Using Safe Approximate Abstractions**  
Chiao Hsieh, Yangge Li, Dawei Sun, **Keyur Joshi**, Sasa Misailovic, Sayan Mitra  
*Embedded Software (EMSOFT 2022)*
- **Diamont: Dynamic Monitoring of Uncertainty for Distributed Asynchronous Programs**  
Vimuth Fernando, **Keyur Joshi**, Jacob Laurel, Sasa Misailovic  
*International Conference on Runtime Verification (RV 2021)*
- **ApproxTuner: A Compiler and Runtime System for Adaptive Approximations**  
Hashim Sharif, Maria Kotsifakou, Yifan Zhao, Akash Kothari, Ben Schreiber, Elizabeth Wang, Yasmin Sarita, Nathan Zhao, **Keyur Joshi**, Vikram Adve, Sasa Misailovic, Sarita Adve  
*ACM SIGPLAN Symposium on Principles and Practice of Parallel Programming (PPOPP 2021)*
- **Aloe: Verifying Reliability of Approximate Programs in the Presence of Recovery Mechanisms**  
**Keyur Joshi**, Vimuth Fernando, Sasa Misailovic  
*IEEE/ACM International Symposium on Code Generation and Optimization (CGO 2020)*
- **Statistical Algorithmic Profiling for Randomized Approximate Programs**  
**Keyur Joshi**, Vimuth Fernando, Sasa Misailovic  
*ACM/IEEE International Conference on Software Engineering (ICSE 2019)*
- **Verifying Safety and Accuracy of Approximate Parallel Programs via Canonical Sequentialization**  
Vimuth Fernando, **Keyur Joshi**, Sasa Misailovic  
*ACM SIGPLAN Conference on Object-Oriented Programming, Systems, Languages and Applications (OOPSLA 2019)*
- **ApproxHPVM: A Portable Compiler IR for Accuracy-Aware Optimizations**  
Hashim Sharif, Prakash Srivastava, Muhammad Huzaifa, Maria Kotsifakou, **Keyur Joshi**, Yasmin Sarita, Nathan Zhao, Vikram S. Adve, Sasa Misailovic, Sarita Adve  
*ACM SIGPLAN Conference on Object-Oriented Programming, Systems, Languages and Applications (OOPSLA 2019)*
- **Identifying Optimal Parameters for Randomized Approximate Algorithms**  
Vimuth Fernando, **Keyur Joshi**, Darko Marinov, Sasa Misailovic  
*Workshop on Approximate Computing Across the Stack (WAX 2019) (Co-located with PLDI 2019)*