ABHISHEK SINGH
abhishek.s@wustl.edu | LinkedIn | St. Louis, MO
Home | Google scholar | GitHub

Education

Washington University St. Louis, MO
Ph.D. Computer Science May 2023
Dissertation: Models and algorithms for real-time systems
Committee: Profs. Kunal Agrawal (chair), Sanjoy Baruah (advisor), Jeremy Buhler, Pontus Ekberg, Christopher Gill

University of North Carolina Chapel Hill, NC
M.S. Computer Science May 2019
Advisor: Cynthia Sturton

Birla Institute of Technology & Science Pilani, India
B.Tech. (Hons.) Computer Science May 2012

Research Experience

Washington University St. Louis, MO
Research assistant Aug. 2019 – May 2023

- Proposed techniques for improving the performance of systems that contain a mix of real-time and general-purpose components (used MINLP solvers such as BARON and formal tools such as TLA+ and Isabelle).
- Proposed models and algorithms for secure real-time systems (used ideas from operations research and complexity theory).
- Investigated the efficiency of fundamental algorithms in real-time systems theory in a fine-grained way (used ideas from parameterized complexity theory).
- Developed state-of-the-art fundamental algorithms in real-time systems theory (used ideas from cutting-plane theory and solvers such as CPLEX).
- Performed experiments on synthetic data sets to evaluate algorithms (used Python and C++; see this repository, for example).
- Details about my research can be found in my research statement.

University of North Carolina Chapel Hill, NC
Research assistant Aug. 2016 – May 2019

- Used model checking and interactive theorem proving to analyze the integrity of critical firmware variables (used disassemblers for x86 code, binary analysis frameworks such as BAP, and formal tools such as UCLID, Dafny, and Coq).
- Proposed models and algorithms for real-time systems with dataflow constraints.
- Performed experiments on synthetic data sets to evaluate algorithms (used Python, OCaml, and C++).

Journal Publications

- "Cutting-plane algorithms for preemptive uniprocessor real-time scheduling problems." Abhishek Singh. Real-Time Systems (2023).
- "On the intractability of preemptive single-machine job scheduling with release times, deadlines, and family setup times." Abhishek Singh. Information Processing Letters Volume 179 (2023).
- "Uniprocessor scheduling of real-time synchronous dataflow tasks." Abhishek Singh, Pontus Ekberg, and Sanjoy Baruah. Real-Time Systems 55, 1–31 (2019).

Conference Publications

- "Dimensions of fixed-priority aperiodic servers." Abhishek Singh and Sanjoy Baruah. Real-Time Networks and Systems (RTNS) 2023.
- "Fixed-parameter analysis of preemptive uniprocessor scheduling problems." Sanjoy Baruah, Pontus Ekberg, and Abhishek Singh (all authors contributed equally). IEEE Real-Time Systems Symposium (RTSS) 2022.
- "Minimizing Execution Duration in the Presence of Learning-Enabled Components." Kunal Agrawal, Alan Burns, Abhishek Singh, and Sanjoy Baruah. Design, Automation and Test in Europe Conference (DATE) 2020.
- "Global EDF-Based Scheduling of Multiple Independent Synchronous Dataflow Graphs." Abhishek Singh and Sanjoy Baruah. IEEE Real-Time Systems Symposium (RTSS) 2017.
- "Applying Real-Time Scheduling Theory to the Synchronous Data Flow Model of Computation." Abhishek Singh, Pontus Ekberg, and Sanjoy Baruah. Euromicro Conference on Real-Time Systems (ECRTS) 2017.

Teaching Experience

Washington University St. Louis, MO
Assistant in Instruction Fall 2021

- Delivered 3 classroom lectures on approximation algorithms (graduate-level).
- Suggested new supplemental materials, such as readings and videos.
- Designed problems on and graded assignments and exams.
- Answered student queries on online portal and during office hours.

University of North Carolina Chapel Hill, NC
Teaching assistant Fall 2017, 2018

- Graded assignments for 2 courses – algorithms and real-time systems (graduate-level).
- Delivered 2 classroom lectures.
- Held office hours to discuss the material covered in class.

Professional Experience

PolicyEngine Remote
Front-end developer (volunteer) Oct. 2023 – present

- Worked on the front end of PolicyEngine, an open-source software that computes the impacts of public policy.
- Refactored complex error-prone parts of the code using sound software design principles and unit tests to increase reliability of the app.
- Improved the CI/CD pipeline by enabling linting rules and promoted conventional programming practices.
- Developed new features that improved the accessibility of the app and fixed bugs.
- Used React, Python, Typescript and GitHub.

Adobe Systems Incorporated Noida, India
Member of technical staff Jan. 2012 – Jun. 2016

- Developed tools for end-users of Illustrator (a vector graphics editor written primarily in C++) in collaboration with end users, UX designers, and researchers.
- Led the design and development of a framework for creating pixel-perfect vector artwork in the editor, which resulted in multiple patents.
- Led the design and development of innovative tools in the editor that were showcased to users at conferences.
- Created prototypes of experimental tools for the editor for touchscreen devices.
- Developed web interfaces for data visualization using JavaScript.
- Tested and maintained parts of the editor.
- Participated in design and code reviews.

- Taught new and existing members the algorithmics of Bézier curves, which are the basis for many vector editors.
- Used Jira, Git, and Perforce for project management and version control.

Patents

- "Creation and rasterization of shapes using geometry, style settings, or location." United States Patents 10535121, 11288778. Abhishek Singh and Vivek Agrawal.

Recent Activities

- Reviewer for Journal of Scheduling 2023.
- Reviewer for Real-Time Systems Journal 2023.
- Member of Program Committee of IEEE Real-Time Systems Symposium (RTSS) 2023.
- Received Best Student Paper Award, 31st International Conference on Real-Time Networks and Systems, Dortmund, Germany, June 2023.
- Audited Fundamentals of Reinforcement Learning, University of Alberta, Coursera, December 2023.
- Completed Online Machine Learning Specialization. Stanford University, Coursera. December 2022 (used machine learning libraries such as NumPy, scikit-learn, and TensorFlow).

Skills (* indicates elementary proficiency)

- Languages: English, Hindi, Bengali*.
- Presentation: LaTeX, Word, PowerPoint.
- Programming: Python, C++, OCaml, JavaScript, React, TensorFlow*.
- Optimization: CPLEX, AMPL*.
- Formal methods: TLA+, Isabelle*, Dafny*, UCLID*, Coq*, FDR*.
- Systems for dev: macOS, Linux.
- Version control: GitHub, Bitbucket, Perforce*.

Research Interests

- modeling computer systems (esp. properties such as timeliness and security)
- algorithm design and analysis
- optimization (esp. discrete)
- machine learning (esp. reinforcement learning)
- formal methods (esp. interactive theorem proving)
- operations research (esp. scheduling)

Memberships

- Association for Computing Machinery (ACM)
- Institute of Electrical and Electronics Engineers (IEEE)
- IEEE Young Professionals
- IEEE Computer Society Technical Community on Real-Time Systems