ABHISHEK SINGH
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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: Prof. Cynthia Sturton

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

Research Interests

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

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.
- Proposed models and algorithms for secure real-time systems using ideas from operations research and complexity theory.
- Investigated the efficiency of fundamental algorithms in real-time systems theory in a fine-grained way using ideas from parameterized complexity theory.
- Developed state-of-the-art fundamental algorithms in real-time systems theory using ideas from integer programming theory.
- Performed experiments on synthetic data sets to evaluate algorithms; see this repository, for example.

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 using disassemblers for x86 code and formal tools (model checkers, theorem provers).
- Proposed models and algorithms for real-time systems with dataflow constraints.
- Performed experiments on synthetic data sets to evaluate algorithms.

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.

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.
- 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.

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.