Alexander J. Root

PhD Student · Stanford

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Research Interests

My research interests broadly include domain-specific languages, compilers, and architectures for high-performance numerical computing, with an emphasis on visual computing applications.

Education

Stanford University *09/2022 - Present*
PhD Computer Science
Advisor: Prof. Fredrik Kjolstad

Massachusetts Institute of Technology *06/2021 - 06/2022*
MEng Electrical Engineering & Computer Science *GPA: 5.0 / 5.0*
Advisors: Prof. Jonathan Ragan-Kelley & Dr. Andrew Adams
Thesis: Optimizing Vector Instruction Selection for Digital Signal Processing

Massachusetts Institute of Technology *09/2017 - 06/2021*
SB Computer Science & Engineering *GPA: 5.0 / 5.0*
Advisors: Prof. Frédo Durand & Prof. Jonathan Ragan-Kelley
Bachelor's Project: High Performance Image Processing with Fixed-Point Types

Publications

Alexander J. Root, Maaz Bin Safeer Ahmad, Dillon Sharlet, Andrew Adams, Shoaib Kamil, and Jonathan Ragan-Kelley. *Fast Instruction Selection for Fast Digital Signal Processing*. (to appear in) ASPLOS 2024.

Maaz Bin Safeer Ahmad, **Alexander J. Root**, Andrew Adams, Shoaib Kamil, and Alvin Cheung. *Vector Instruction Selection for Digital Signal Processors Using Program Synthesis*. ASPLOS 2022. https://doi.org/10.1145/3503222.3507714

Experience

Stanford Compilers Group *09/2022 - Present*
Research Assistant
Researching sparse data reorganization and compilers for visual computing.

Adobe Research *06/2022 - 11/2022*
Research Intern (Compilers)
Developed a language and system for improving fixed-point vector instruction selection within the Halide compiler.

MIT Visual Computing Languages & Systems Group *05/2019 - 08/2022*
Research Assistant
Researched projects related to high-performance digital signal processing, including automatic quantization, bounds inference, and vector instruction selection.

Adobe Research *06/2021 - 12/2021*
Research Intern (Compilers)
Developed techniques for constant bounds approximations for use in Halide's compiler.

Intel *01/2021 - 05/2021*
Research Intern (Compilers)
Designed and implemented a new autoscheduler for Halide.

Microsoft *06/2020 - 09/2020*

Software Engineering Intern

Contributed to verification infrastructure for access of control of virtual machines.

Lawrence Livermore National Lab *06/2019 - 09/2019*

Computation Intern

Developed distributed numerical optimization methods.

Iterative Scopes *02/2018 - 08/2018*

Associate Software Engineer

Automated and tested large scale image processing and machine vision systems using AWS.

Redding Electric Utility *06/2017 - 08/2017*

Engineering Intern

Implemented query and reporting systems in C++ for financial data sets.

Awards, Fellowships, & Grants

2022-2025 **Graduate Research Fellowship**, NSF
2022 **School of Engineering Fellowship**, Stanford
2020 **Engineering Honor Society Member**, Tau Beta Pi
2019 **National Honors Society Member**, Eta Kappa Nu
2019 **Keel Foundation Undergraduate Research and Innovation Scholar**, MIT

Invited Talks

April 2023. Fast Instruction Selection for Fast Digital Signal Processing. *UCSD Graphics Seminar*, La Jolla, CA.

Teaching

Winter 2023 **CS 343D: Domain-Specific Programming Models and Compilers**, Teaching Assistant *CS, Stanford*
Fall 2021 **6.818: Dynamic Computer Language Engineering**, Teaching Assistant *EECS, MIT*
Spring 2020 **6.006: Introduction to Algorithms**, Teaching Assistant *EECS, MIT*
Spring 2019 **6.006: Introduction to Algorithms**, Teaching Assistant *EECS, MIT*
January 2019 **MIT Global Teaching Labs (Middle East)**, Computer Science Instructor *MIT MEET*

Mentoring

Spring 2022 **Mario Leyva**, UG Intern, *Fast Porter-Duff Image Compositing* *MIT CSAIL*
2021-2022 **Katherine Mohr**, UG Intern, *Compiling Fast Term-Rewriting Systems* *MIT CSAIL*
Summer 2021 **Evan Lee**, Halide Google Summer of Code Intern, *Rewrite Rules Evaluation* *GSoC*