

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 PHD COMPUTER SCIENCE Advisor: Prof. Fredrik Kjolstad	09/2022 - Present
Massachusetts Institute of Technology MENG ELECTRICAL ENGINEERING & COMPUTER SCIENCE Advisors: Prof. Jonathan Ragan-Kelley & Dr. Andrew Adams Thesis: Optimizing Vector Instruction Selection for Digital Signal Processing	06/2021 - 06/2022 GPA: 5.0 / 5.0
Massachusetts Institute of Technology SB COMPUTER SCIENCE & ENGINEERING Advisors: Prof. Frédo Durand & Prof. Jonathan Ragan-Kelley Bachelor's Project: High Performance Image Processing with Fixed-Point Types	09/2017 - 06/2021 GPA: 5.0 / 5.0

Publications

- Alexander J. Root**, Maaz Bin Safeer Ahmad, Andrew Adams, Dillon Sharlet, Shoaib Kamil, and Jonathan Ragan-Kelley. *Fast Instruction Selection for Fast Digital Signal Processing*. ASPLOS 2023. <https://doi.org/10.1145/3623278.3624768>
- 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 RESEARCH ASSISTANT Researching sparse data reorganization and compilers for visual computing.	09/2022 - Present
Adobe Research RESEARCH INTERN (COMPILERS) Designed a language for separating algorithm from data structure format for geometric queries.	05/2023 - 08/2023
Adobe Research RESEARCH INTERN (COMPILERS) Developed a language and system for improving fixed-point vector instruction selection within the Halide compiler.	06/2022 - 11/2022
MIT Visual Computing Languages & Systems Group RESEARCH ASSISTANT Researched projects related to high-performance digital signal processing, including automatic quantization, bounds inference, and vector instruction selection.	05/2019 - 08/2022
Adobe Research RESEARCH INTERN (COMPILERS) Developed techniques for constant bounds approximations for use in Halide's compiler.	06/2021 - 12/2021

Intel RESEARCH INTERN (COMPILERS) Designed and implemented a new autoscheduler for Halide.	01/2021 - 05/2021
Microsoft SOFTWARE ENGINEERING INTERN Contributed to verification infrastructure for access of control of virtual machines.	06/2020 - 09/2020
Lawrence Livermore National Lab COMPUTATION INTERN Developed distributed numerical optimization methods.	06/2019 - 09/2019
Iterative Scopes ASSOCIATE SOFTWARE ENGINEER Automated and tested large scale image processing and machine vision systems using AWS.	02/2018 - 08/2018
Redding Electric Utility ENGINEERING INTERN Implemented query and reporting systems in C++ for financial data sets.	06/2017 - 08/2017

Awards, Fellowships, & Grants

- 2022-2025 **Graduate Research Fellowship**, NSF
- 2022-2023 **School of Engineering Fellowship**, Stanford
- 2020-2021 **Engineering Honor Society Member**, Tau Beta Pi
- 2019-2021 **National Honors Society Member**, Eta Kappa Nu
- 2019-2020 **Keel Foundation Undergraduate Research and Innovation Scholar**, MIT

Invited Talks

- May 2023. Fast Instruction Selection for Fast Digital Signal Processing. *Stanford Software Research Lunch*, Stanford, CA.
- 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 , Course Assistant	<i>CS, Stanford</i>
Fall 2021	6.818: Dynamic Computer Language Engineering , Teaching Assistant	<i>EECS, MIT</i>
Spring 2020	6.006: Introduction to Algorithms , Teaching Assistant	<i>EECS, MIT</i>
Spring 2019	6.006: Introduction to Algorithms , Teaching Assistant	<i>EECS, MIT</i>
January 2019	MIT Global Teaching Labs (Middle East) , Computer Science Instructor	<i>MIT MEET</i>

Mentoring

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