

Alexander J Root

PHD STUDENT · STANFORD

✉ ajroot@stanford.edu | 🏠 rootjalex.github.io | 📺 [rootjalex](#)

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 GPA: 4.0 / 4.0
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**, Bobby Yan, Peiming Liu, Christophe Gyurgyik, Aart J.C. Bik, Fredrik Kjolstad. *Compilation of Shape Operators on Sparse Arrays*. OOPSLA 2024. <https://doi.org/10.1145/3689752>
- Peiming Liu, **Alexander J Root**, Anlun Xu, Yinying Li, Fredrik Kjolstad, Aart J.C. Bik. *Compiler Support for Sparse Tensor Convolutions*. OOPSLA 2024. <https://doi.org/10.1145/3689721>
- 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>

IN REVIEW

- Bobby Yan, **Alexander J Root**, Trevor Gale, David Broman, Fredrik Kjolstad. *Scorch: A Library for Sparse Deep Learning*. Under Submission. <https://arxiv.org/abs/2405.16883>

Experience

Stanford Compilers Group RESEARCH ASSISTANT Designing compilers for high-performance graphics and sparse array programming.	09/2022 - Present
Adobe Research RESEARCH INTERN (COMPILERS) Designed a domain-specific language for geometric queries that decouples algorithm from accelerator data structure.	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

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 in C++.

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

2022-2023 **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

June 2024. Decoupling Spatial Queries from Accelerator Trees. *Samsung*, Virtual.

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

Service

SIGGRAPH Asia External Reviewer: 2024, 2023

ASPLOS Sub-reviewer: 2024

PLDI Sub-reviewer: 2023

Mentoring

Summer 2024 **Devanshu Ladsaria**, Undergraduate, *Mapping Sparse Array Operations to GPUs*

Stanford

Spring 2022 **Mario Leyva**, Undergraduate, *Fast Porter-Duff Image Compositing*

MIT CSAIL

2021-2022 **Katherine Mohr**, Undergraduate, *Compiling Fast Term-Rewriting Systems*

MIT CSAIL

Summer 2021 **Evan Lee**, Halide Google Summer of Code Intern, *Rewrite Rules Evaluation*

GSoC

Teaching

Spring 2024	CS 343S: Domain-Specific Language Design Studio , Teaching Fellow	<i>CS, Stanford</i>
Winter 2024	CS 343D: Domain-Specific Programming Models and Compilers , Course Assistant	<i>CS, Stanford</i>
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>