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   *GPA: 4.0 / 4.0*
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

[OOPSLA 2024] *Compilation of Shape Operators on Sparse Arrays*.
Alexander J Root, Bobby Yan, Peiming Liu, Christophe Gyurgyik, Aart J.C. Bik, Fredrik Kjolstad

[OOPSLA 2024] *Compiler Support for Sparse Tensor Convolutions*.
Peiming Liu, **Alexander J Root**, Anlun Xu, Yinying Li, Fredrik Kjolstad, Aart J.C. Bik

[ASPLOS 2023] *Fast Instruction Selection for Fast Digital Signal Processing*.
Alexander J Root, Maaz Bin Safeer Ahmad, Andrew Adams, Dillon Sharlet, Shoaib Kamil, and Jonathan Ragan-Kelley

[ASPLOS 2022] *Vector Instruction Selection for Digital Signal Processors Using Program Synthesis*.
Maaz Bin Safeer Ahmad, **Alexander J Root**, Andrew Adams, Shoaib Kamil, and Alvin Cheung

IN REVIEW

[2025] *Fast Autoscheduling for Sparse Deep Learning*.
Bobby Yan, **Alexander J Root**, Trevor Gale, David Broman, Fredrik Kjolstad

Experience

Stanford Compilers Group   *09/2022 - Present*
RESEARCH ASSISTANT
Designing compilers for high-performance graphics and sparse array programming.

NVIDIA Research   *06/2025 - 08/2025*
RESEARCH INTERN (REAL-TIME GRAPHICS)
Developing a scheduling language for parallel recursive programs on GPUs (for BONSAI).

Adobe Research   *05/2023 - 08/2023*
RESEARCH INTERN (PROGRAMMING LANGUAGES AND PERFORMANCE)
Designed a domain-specific language (BONSAI) for geometric queries that decouples algorithm from accelerator data structure.

Adobe Research *06/2022 - 11/2022*

RESEARCH INTERN (PROGRAMMING LANGUAGES AND PERFORMANCE)

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 (PROGRAMMING LANGUAGES AND PERFORMANCE)

Developed techniques for constant bounds approximations for use in Halide's compiler.

Intel *01/2021 - 05/2021*

RESEARCH INTERN (DSL 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

2025-2026	**Innovation Fellowship**, Qualcomm
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: 2025, 2024, 2023

Transactions on Graphics (ToG) External Reviewer: 2025

ASPLOS Sub-reviewer: 2024

PLDI Sub-reviewer: 2023

Mentoring

Su25-Present	**Elton Manchester**, Undergradutate, *Performance-Parametric Path Tracing on the GPU*	*Stanford*
Fa24-Present	**Ishita Gupta**, Undergradutate, *Fast Parallel Memory Allocators for Rendering*	*Stanford*
Su24-Present	**Devanshu Ladsaria**, Undergradutate, *DSE for Parallel Tree Construction Algorithms*	*Stanford*
Sp22	**Mario Leyva**, Undergradutate, *Fast Porter-Duff Image Compositing*	*MIT CSAIL*
2021-2022	**Katherine Mohr**, Undergradutate, *Compiling Fast Term-Rewriting Systems*	*MIT CSAIL*
Su21	**Evan Lee**, Google Summer of Code (Halide) Intern, *Rewrite Rules Evaluation*	*GSoC*

Teaching

Spring 2025	**CS 343S: Domain-Specific Language Design Studio**, Teaching Fellow	*Stanford CS*
Spring 2024	**CS 343S: Domain-Specific Language Design Studio**, Teaching Fellow	*Stanford CS*
Winter 2024	**CS 343D: Domain-Specific Programming Models and Compilers**, Course Assistant	*Stanford CS*
Winter 2023	**CS 343D: Domain-Specific Programming Models and Compilers**, Course Assistant	*Stanford CS*
Fall 2021	**6.818: Dynamic Computer Language Engineering**, Teaching Assistant	*MIT EECS*
Spring 2020	**6.006: Introduction to Algorithms**, Teaching Assistant	*MIT EECS*
Spring 2019	**6.006: Introduction to Algorithms**, Teaching Assistant	*MIT EECS*
January 2019	**MIT Global Teaching Labs (Middle East)**, Computer Science Instructor	*MIT MEET*