

EDUCATION

University of Maryland

Ph.D. Computer Science - Programming Languages

College Park, MD

August 2021 – Expected 2026

University of British Columbia

B.Sc. Computer Science

Vancouver, BC

September 2017 – May 2020

PUBLICATIONS

Deeper Properties for Programmable Testing

*Alperen Keles, **Justine Frank**, Ceren Mert, Harrison Goldstein, Leonidas Lampropoulos*

Under Review

Generating Well-Typed Terms that are not “Useless”

***Justine Frank**, Benjamin Quiring, Leonidas Lampropoulos*

POPL 2024

Indexed Types for a Statically Safe WebAssembly

*Adam Geller, **Justine Frank**, William Bowman*

POPL 2024

RESEARCH EXPERIENCE

Programming Languages at UMD

Graduate Research Assistant

College Park, MD

August 2021 – Present

My research focus is on creating better tools and methods for proving correctness of compilers and soundness of type systems.

- Working on a framework for creating executable formal specifications of intermittent systems using Interaction Trees. Future goals include using this framework to create mechanized proofs of correctness of non-interference type systems used to guarantee programs are well-behaved under intermittent execution, and writing a verified compiler targeting an intermittent processor.
- Working on a method for writing proofs about language implementations written as higher-order effectful definitional interpreters built using Interaction Trees to enabling easier development of formal language specifications and compiler correctness proofs.
- Developed an algorithm to randomly generate programs in higher-order functional languages that are more effective for finding bugs in language implementations by generating functions that use their arguments by construction.

UBC Software Practices Lab

Research Assistant

Vancouver, BC

May 2020 – August 2021

Worked on Wasm-prechk, an extension to WebAssembly that adds indexed types to facilitate the removal of dynamic checks currently needed by Wasm runtimes. Contributions include creating a formal model of the language and type system using PLT Redex, constructing a type system soundness proof, constructing a correctness proof for an embedding of plain Wasm into Wasm-prechk, and developing a type checker for Wasm-prechk.

SOFTWARE ENGINEERING EXPERIENCE

Dell EMC

Intern Software Engineer

Seattle, WA

June 2019 – August 2019

Worked on a re-implementation of plockstat, a utility for measuring statistics about pthread lock acquisitions and contentions for Solaris, for FreeBSD using DTrace probes. Also measured the nature of the observer effect when using this tool under different levels of contention.

UBC Orbit is a club for designing and building satellites for the Canadian CubeSat Design Challenge. As the software lead of the Payload team, I worked on the high-level design for the software on the payload module. This included implementing a camera interface to read the image from the sensor, processing and packetizing the image for down-linking, and designing and implementing the protocol by which the rest of the satellite interacts with the payload module.

PROJECTS AND CONTRIBUTIONS

Rocq-Word: <https://github.com/laelath/rocq-word>

A library providing definitions and operations for machine words in Rocq, with proofs relating operations on machine words to integer arithmetic.

JFunge: <https://github.com/laelath/jfunge>

A Befunge-to-x86_64-linux compiler with support for self-modifying code.

LangGen: <https://github.com/cm430/lang-gen>

A tool for generating programs from a specified subset of Racket for testing student compilers.

RackCheck: <https://github.com/bogdanp/rackcheck/commits?author=laelath>

A Racket property-based testing library. I replaced the existing shrinking system with an internal shrinking system based on Hedgehog, resulting in a system that is much more effective at generating small counterexamples.

FourCerty: <https://github.com/pdarragh/fourcerty/commits?author=laelath>

A formally verified compiler for a dynamically typed language with top level recursive functions written in Coq. Compiles to a custom intermediate stack-based language inspired by the design of CakeMLs intermediate representations.

Hack Match Bot: <https://github.com/laelath/hack-match-bot>

A bot that plays a block-matching game using state-space searching to plan moves. Written in Rust using Xlib to interact with the game window.

Kakoune: <https://github.com/mawww/kakoune/commits?author=laelath>

An open-source vim-like text editor that I have contributed several features and bug fixes to.