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Research Statement
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Research Interests

I am most interested in research in the field of Programming Languages (PL), specifically type theory and compiler theory. The problems of the PL field are extremely interesting to me, and I find the tools used to solve those problems enjoyable. Most problems in PL start with deciding which universe you want to work in, then working from there.

My current research project is creating a dependent type system for WebAssembly (WASM). The short-term vision is to use it to detect possible runtime errors (e.g. memory errors) during compilation and provide extra information for the compiler to use during optimization of the code. More informed type systems have been previously used in performing optimizations when compiling high-level languages, but so far not for low-level languages. Currently, the WASM compiler can begin compiling a WASM program as it is being downloaded. Therefore, I will attempt to implement the dependent type system so that type checking can also be performed while the program is being downloaded.

For the long term, my plan is to use the dependent type system for proving compiler correctness properties of the WASM JIT compiler embedded in the Firefox browser. One easy property that can be proven is type preservation from the dependently typed WASM to the Dependently Typed Assembly Language (DTAL), which will ensure the absence of runtime errors in the generated code. This can also be used as a tool for proving correctness properties of compilation from high-level language down to WASM, eventually ensuring code constantly being downloaded and compiled will work without error. There is a story in PL about including proofs in code that can then be downloaded and verified before being used so that the end user can trust it. This project will help that story become closer to a reality by providing a way to include proofs in code and reduce the trusted computing base by proving correct essential components.

Personally, I plan to continue working on PL research for my career. I am unsure whether I want to stay in academia or not. However, I do know that I enjoy PL, I enjoy research, and I enjoy freedom to work on projects I find interesting. Therefore, I think that academia is the likely path for me.

I have extensive and diverse research experience, starting in my undergrad when I worked on a project working on formally verifying that webpage have accessible layouts. My first experience taught me about the research process and how to sustain productivity over large periods of time without deadlines. During the first year of my masters I worked on a project that compiled model-checkable specifications of distributed systems into implementations. I learned how to work with others on a large research project that spanned multiple fields, including systems and formal methods. I also learned that I do not like distributed systems research, and that PL is a better fit for me. Over a summer internship at MPI, working on a project that combined fuzz-testing with dynamic symbolic execution, I learned how to quickly get familiar working with new people and on a project in a field I'm not familiar with. My current research project is still quite young, but I have learned about the process of brainstorming a research idea.

Publications

"Verifying that Webpages have Accessible Layout". P. Panchekha, A. Geller, M. Ernst, Z. Tatlock, S. Kamil. Accepted to PLDI 18. (Acceptance rate: 22%. Available at http://cassius.uwplse.org/pldi18-paper.pdf)

Honors, Awards, etc…

UW Annual Dean's List 2017-2018

UW Dean's List Autumn 2017, Winter 2018, Spring 2018