
Education

- August 2021 **M.S. in Mathematical Science**, *Nagoya University*, Nagoya, Japan.
(expected) Focuses: theoretical computer science, category theory, algebraic geometry
- May 2019 **M.S. in Computer Science**, *Tufts University*, Medford, MA, USA.
Focus: functional programming & programming languages
- May 2018 **B.S. in Computer Science**, *magna cum laude*, with honors in thesis, *Tufts University*, Medford, MA, USA.
Second major: international relations. Minor: mathematics.

Experience

- Jul 2020 – **Research Assistant**, *Nagoya University*, Nagoya, Japan & remote.
I am working on validating and formally certifying OCaml GADT type inference under a research grant funded by the Tezos Foundation.
- Nov 2019 – **Freelance Developer**, Nagoya, Japan & remote.
Currently open to freelance work for a range of customers.
- Nov 2019 – **Contractor**, *SiFive, Inc.*, Remote.
- May 2020 I worked on using the Kami verification framework and Coq proof assistant to verify a realistic RISC-V processor.
- Aug – Sept 2019 **Intern**, *SiFive, Inc.*, San Mateo, CA, USA.
I worked on building and verifying in Coq a hardware ring buffer, an important component of a pipelined CPU.
- Jun – Aug 2018 **Research Visitor**, *Graduate School of Mathematics*, *Nagoya University*, Nagoya, Japan.
I was hosted by and worked with Professor Jacques Garrigue. My work resulted in a peer-reviewed conference publication.
- Mar 2017 – **Research Assistant**, *Department of Computer Science*, *Tufts University*, Medford, MA, USA.
May 2018 Research assistant under Professor Sam Guyer, working in the RedLine Systems Research Group. My work resulted in my senior honors thesis.
- Jul – Aug 2016 **Intern**, *Institute of Automation*, *Chinese Academy of Sciences*, Beijing, China.
Interned at the State Key Laboratory of Control and Management of Complex Systems, working on computer vision.

Technical Skills

Programming Languages

OCaml, Haskell, Python, Ruby, Java, C/C++.

Formal Methods & Verification

Interactive theorem proving (especially Coq & Agda), type systems, static analysis, program logics, formal methods for security.

Programming Environments & Software Engineering

Performance engineering (especially GC/runtime related), dynamic program analysis and instrumentation.

Other

Blockchain technology, Linux system management, web programming, Git version control system, natural languages (Mandarin Chinese, English and Japanese).

Projects

Certifiable OCaml Type Inference

I am working on building a machine-checkable specification of OCaml's core type system, including generalized algebraic datatypes (GADTs), as part of the Tezos Foundation-funded research project on Certifiable OCaml Type Inference (COCTI).

Formal Verification of RISC-V processors

I worked on using Coq and the embedded Kami verification framework to verify a realistic RISC-V processor with a modern microarchitecture; I was responsible for several proof engineering efforts and verification of some hardware components.

Formal verification of dynamic compact data structures

I did part of the design, implementation and modeling in Coq. A paper about our formalization has been accepted for publication.

<https://github.com/affeldt-aist/succinct>

Elephant Tracks II: high-performance, extensible GC tracing framework

I did most of the design and implementation of a prototype in C++. The prototype's performance increased more than 10× compared to our previous systems.

<https://github.com/ElephantTracksProject/et2-java>

JumboViz: visualizing GC traces

I did most of the JVM-related hacking in C++.

<https://github.com/HeapVisCapstone>

Research Publications

1. Reynald Affeldt, Jacques Garrigue, **Xuanrui Qi**, and Kazunari Tanaka. Proving Tree Algorithms for Succinct Data Structures. The 10th Conference on Interactive Theorem Proving (ITP 2019).
2. **Xuanrui (Ray) Qi**. Elephant Tracks II: Practical, Extensible Memory Tracing. Senior Honors Thesis, Tufts University, 2018.