Xuanrui (Ray) Qi

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Education

May 2019 (expected)	**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.
June 2014	**High School Diploma**, *Shenzhen Middle School*, Shenzhen, Guangdong, China.

Experience

Sep 2018 –	**Graduate Researcher**, *Department of Computer Science, Tufts University*, Medford, MA, USA. Doing research for my master's degree.
Jun – Aug 2018	**Research Visitor**, *Graduate School of Mathematics, Nagoya University*, Nagoya, Japan. Hosted by and working with Professor Jacques Garrigue.
Mar – May 2018	**Research Assistant**, *Department of Computer Science, Tufts University*, Medford, MA, USA. Research assistant under Professor Sam Guyer, working in the RedLine Systems Research Group.
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.
Sep – Dec 2017 & Sep 2018 – Dec 2018	**Teaching Assistant**, *Department of Computer Science, Tufts University*, Medford, MA, USA. Course: Concurrent Programming.

Technical Skills

Programming Languages

Haskell, OCaml, Standard ML, Erlang, Scheme, Python, Java, C/C++

Programming & Software Engineering

Performance engineering (especially GC/interpreted runtime related), dynamic program analysis, concurrent programming, low-level/systems programming

Formal Methods

Theorem proving (Coq, Idris, Agda), type systems, static analysis, program logics, SMT-assisted reasoning

Security

`nmap`, packet analysis, penetration testing, web security (SQL injection, cross-site scripting, etc.), systems security

Other

Git, Linux system administration (Arch & Ubuntu)

Projects

Formal verification of dynamic compact data structures

Worked on extending a previous Coq formalization and verification of properties of compact data structures — namely efficient bit vectors — by adding and verifying dynamic operations to the said data structures. I did most of the implementation and proving in Coq, in which I developed (or helped develop) two different representations of the said data structures and contributed significantly to their correctness proofs. We are currently working on a publication about our work.

`https://github.com/affeldt-aist/succinct`

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

This is the research project leading to my senior honors thesis at Tufts University. Elephant Tracks II is a dynamic analysis framework for memory in managed programming languages which works by generating a memory trace, i.e. record of object allocations, pointer updates, and object deaths. Using a new architecture and new techniques my advisor and I developed, I implemented a research prototype of such a memory tracer which improved its performance about 10 to 100 times compared to its predecessor. I am in charge of most of the implementation in C++ and Java.

`https://github.com/ElephantTracksProject/et2-java`

JumboViz: visualizing GC traces

We created a visualization toolkit for Elephant Tracks (and Elephant Tracks II) GC traces, aiming to generate visualizations useful for programmers. This is my senior design project, done as a collaboration with a team at Tufts University. The implementation was in a combination C++, Java and JavaScript; I worked mainly on the C++ and Java parts.

Dynamic, Distributed File Backup System

I built a working prototype of a dynamic, distributed file backup system in Erlang in collaboration with two teammates. I was in charge of most of the networking and file-system handling components. The system was designed to be mostly functional with functional components.

Research Publications

Research Papers

1. Reynald Affeldt, Jacques Garrigue, **Xuanrui Qi**, and Kazunari Tanaka. Proving Tree Algorithms for Succinct Data Structures. Working draft, in submission.
2. **Xuanrui (Ray) Qi**. Elephant Tracks II: Practical, Extensible Memory Tracing. Senior Honors Thesis, Tufts University, 2018.

Talks & Presentations

1. **Xuanrui (Ray) Qi**. From Tactics to Structure Editors for Proofs. Off the Beaten Track 2019 (*OBT '19*).
2. **Xuanrui (Ray) Qi**. A Practical and Extensible Framework for Garbage Collection Tracing. SPLASH 2018 Student Research Competition.

Relevant Coursework

"Programming Languages" (incl. functional programming), "Concurrent Programming" (in Erlang), "Program Analysis, Verification & Synthesis", "Computer Systems Security", "Cryptography", "Foundations and Pragmatics of Dependently-Typed Systems for Interactive Proof-Assistance and Certifiably-Safe Programming"