Xuanrui (Ray) Qi

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Education

May 2019 **M.S. in Computer Science**, *Tufts University*, Medford, MA, USA.
Advisors: Samuel Z. Guyer
Unofficial mentors: Cyrus Omar (University of Chicago), Jacques Garrigue (Nagoya University)
GPA: 3.77/4.0

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
Advisor: Samuel Z. Guyer
GPA: 3.72/4.0

June 2014 **High School Diploma**, *Shenzhen Middle School*, Shenzhen, Guangdong, China.

Research Interests

Dependently-typed programming languages, theorem provers, type-driven development, typed functional programming languages, algebraic methods in theoretical computer science, constructive mathematics.

Research Experience

September 2018 – May 2019 **Master's Research**, *Department of Computer Science, Tufts University*, Medford, MA, USA.
Doing research independently for my master's degree.

June 2018 – August 2018 **Research Visitor**, *Graduate School of Mathematics, Nagoya University*, Nagoya, Japan.
Hosted and advised by Professor Jacques Garrigue.

March 2017 – 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.

Work Experience

2019 **Intern**, *SiFive*, San Mateo, CA, USA.
Interning at SiFive's San Mateo office, working with Murali Vijayaraghavan on formal methods, verification, and Coq.

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.

Research Projects

Formal Semantic Models for Tactic-Based Interactive Theorem Proving
Investigating formal semantic models for tactic-based user interaction with theorem provers and structural editors using a type theory with typed holes, based on contextual modal type theory.

Hazel: live programming with typed holes
Working on extending Hazel, the live programming language with typed holes, to support additional features. Currently, working on adding polymorphism and programmable edit actions. Supervised by Dr. Cyrus Omar (University of Chicago).

Formal verification of dynamic compact data structures
This is the project I worked on during my research visit at Nagoya University. We extended 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.

Elephant Tracks II: high-performance GC tracing toolkit
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. With a team of researchers from Google and the Australian National University, we aspire to bring the utility of memory tracing to more programmers, and to make memory tracing even greater. I am in charge of most of the implementation in C++ and Java.

JumboViz: visualizing GC traces
A visualization toolkit for Elephant Tracks (and Elephant Tracks II) GC traces, aiming to generate visualizations useful for programmers. This is a collaboration with a team at Tufts University.

Research Publications

Research Papers

1. Reynald Affeldt, Jacques Garrigue, **Xuanrui (Ray) Qi**, and Kazunari Tanaka. Proving Tree Algorithms for Succinct Data Structures. Submitted to 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. *Thesis committee*: Sam Guyer (chair), Kathleen Fisher.

Talk Material & 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.

Teaching Experience

Teaching Assistant

- Concurrent Programming (COMP 50CP), Fall 2017 & 2018, Tufts University

Non-Technical Courses

- Peer instructor (instructor of record), Spring 2018, Experimental College @ Tufts University

Other Activities

- Participant, Oregon Programming Languages Summer School 2017
- Programming Language Mentoring Workshop scholarship awardee, ICFP 2017
- Student Volunteer, POPL 2018