

Tristan Knoth | Curriculum Vitae

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Research Interests

Computers are changing the world and I would like to make it easier to safely leverage this power. Thus, I'm interested in ways in which language design can make it easier for programmers to develop fast and correct software. I am interested in functional programming, type systems, and formal methods in general.

Education

UC San Diego

Ph.D., Computer Science

Advisor: Nadia Polikarpova

San Diego, CA

2017-Present

Grinnell College

B.A., Computer Science and Mathematics

Grinnell, IA

2013-2017

Professional Experience

UC San Diego

Graduate Student Researcher

San Diego, CA

2017-Present

Resource-Guided Program Synthesis

- Work with my advisor and collaborators at CMU to build a synthesizer that integrates resource analysis into the search procedure.
- ReSYN, our synthesizer, generates code in a high-level functional language given a refinement type signature and an upper bound on the implementation's resource usage
- The analysis is parametric with respect to the resource in question
- Relies upon a novel polymorphic, dependent, and affine type system for verifying functional properties and resource bounds. We define operational and denotational semantics to prove its soundness, as well as the relative soundness of the synthesis algorithm.

Program Synthesis for Safe Hybrid Systems

- Generate controls for unsupervised UAVs responsible for simple maintenance tasks.
- Synthesized code is correct-by-construction, guaranteeing that the devices will complete their tasks without running out of battery.

Fluxx Labs

Software Engineering Intern

San Francisco, CA

2016-2017

- As the lead developer on the project, designed, implemented, and shipped beta version of a native Android client for Fluxx's Grantmaker platform from scratch in the course of one summer.
- Enhanced Android application with support for SAML Single Sign-on.
- Extended and documented Javascript API for future Fluxx mobile developers.
- Integrated large-scale Ruby on Rails web application with DocuSign's template functionality.

Grinnell College

Student Researcher

Grinnell, IA

2015-2016

- Developed parallel algorithm with CUDA C++ and Open MPI to select multiple order statistics from distributed data sets using NVIDIA GPUs.
- Improved upon existing order statistic selection algorithms by guaranteeing correct responses instead of relying upon approximate statistical methods.
- Mitigated security concerns by performing data analysis locally instead of passing potentially sensitive data over the network.
- Non-optimized software package can select one-tenth percentiles from 2^{27} random data points in approximately 70ms.

Technical and Personal skills

- o **Computer Languages:** Haskell, C++, C, Python, Java, CUDA, MATLAB, Scheme, Ruby, JavaScript, R, HTML, CSS, Coq, Agda
- o **Other:** Mathematica, Stata, MPI, Z3, Android development, Arduino, Woodworking, Machining, Spanish

Awards & Honors

- o Runner-up, Student Research Competition, Graduate division, ICFP 2018
- o Trustee Honors Scholar (2013 - 2017)

Publications

- [1] Tristan Knoth, Di Wang, Nadia Polikarpova, and Jan Hoffmann. Resource-guided program synthesis, In submission 2018.