Richard A. Eisenberg

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University of Pennsylvania
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Research Interests

Programming languages, functional programming, dependent type theory, proof-carrying code, generic programming. I want to make programs correct and elegant by construction.

Education

June 2016 (expected) PhD, University of Pennsylvania, Philadelphia, PA
Dissertation: *Dependent Types in Haskell: Theory and Practice*
Advisor: Stephanie Weirich

Harvard University, Cambridge, MA
June 2003 M.S., Computer Science
June 2003 B.A., Physics, *magna cum laude* with highest honors

Publications

Haskell'15 J. Stolarek, S. Peyton Jones, R. A. Eisenberg. *Injective Type Families for Haskell*. In *Proceedings of the 2015 ACM SIGPLAN Symposium on Haskell* (Haskell '15), ACM, 2015. pp. 118-128.

Haskell'14 T. Muranushi, R. A. Eisenberg. *Experience Report: Type-checking Polymorphic Units for Astrophysics Research in Haskell*. In *Proceedings of the 2014 ACM SIGPLAN Symposium on Haskell* (Haskell '14), ACM, 2014. pp. 31-38.

Haskell'14 R. A. Eisenberg, J. Stolarek. *Promoting Functions to Type Families in Haskell*. In *Proceedings of the 2014 ACM SIGPLAN Symposium on Haskell* (Haskell '14), ACM, 2014. pp. 95-106.

ICFP'14 J. Breitner, R. A. Eisenberg, S. Peyton Jones, S. Weirich. *Safe Zero-cost Coercions for Haskell*. In *Proceedings of the 19th ACM SIGPLAN International Conference on Functional Programming* (ICFP '14), ACM, 2014. pp. 189-202.

POPL'14 R. A. Eisenberg, D. Vytiniotis, S. Peyton Jones, S. Weirich. *Closed Type Families with Overlapping Equations*. In *Proceedings of the 41st ACM SIGPLAN-SIGACT Symposium on Principles of Programming Languages* (POPL '14), ACM, 2014. pp. 671-683.

OOPSLA'13 C. DeLozier, R. A. Eisenberg, S. Nagarakatte, P.-M. Osera, M. M. K. Martin, and S. Zdancewic. *Ironclad C++: A Library-Augmented Type-Safe Subset of C++*. In *Proceedings of the 2013 ACM SIGPLAN International Conference on Object Oriented Programming, Systems, Languages, & Applications* (OOPSLA '13), ACM, 2013. pp. 287-304.

ICFP'13 S. Weirich, J. Hsu, and R. A. Eisenberg. *System FC with Explicit Kind Equality*. In *Proceedings of the 18th ACM SIGPLAN International Conference on Functional Programming* (ICFP '13), ACM, 2013. pp. 275-286.

Haskell'12 R. A. Eisenberg and S. Weirich. *Dependently Typed Programming with Singletons*. In *Proceedings of the 2012 Haskell Symposium* (Haskell '12), ACM, 2012. pp. 117-130.

Technical Reports

2015 R. A. Eisenberg. *System FC, as implemented in GHC*.

2015 R. A. Eisenberg. *An Overabundance of Equality: Implementing Kind Equalities into Haskell*.

2015 J. Stolarek, S. Peyton Jones, R. A. Eisenberg. *Injective Type Families for Haskell (extended version)*. Politechnika Łódzka Technical Report, 2015.

2014 R. A. Eisenberg, J. Stolarek. *Promoting Functions to Type Families in Haskell (extended version)*. University of Pennsylvania Technical Report MS-CIS-14-09, 2014.

2014 J. Breitner, R. A. Eisenberg, S. Peyton Jones, S. Weirich. *Safe Zero-cost Coercions for Haskell (extended version)*. University of Pennsylvania Technical Report MS-CIS-14-07, 2014.

2013 R. A. Eisenberg, D. Vytiniotis, S. Peyton Jones, S. Weirich. *Closed Type Families with Overlapping Equations (extended version)*. University of Pennsylvania Technical Report MS-CIS-13-10, 2013.

2013 P.-M. Osera, R. A. Eisenberg, C. DeLozier, S. Nagarakatte, M. M. K. Martin, S. Zdancewic. *Core Ironclad*. University of Pennsylvania Technical Report MS-CIS-13-06, 2013.

2013 S. Weirich, J. Hsu, R. A. Eisenberg. *System FC with Explicit Kind Equality (extended version)*.

Drafts

submitted R. A. Eisenberg, S. Weirich, H. Ahmed. *Visible Type Application*. 2015.

submitted J. Breitner, R. A. Eisenberg, S. Peyton Jones, S. Weirich. *Safe Zero-cost Coercions for Haskell*. Invited expanded edition of the ICFP'14 paper for publication in the *Journal of Functional Programming*. 2015.

in progress S. Weirich, S. Peyton Jones, R. A. Eisenberg, D. Vytiniotis. *A reflection on types*. 2015.

Research-related open-source contributions

GHC core developer Core developer for the Glasgow Haskell Compiler (GHC), the main compiler for the Haskell functional programming language. Principal contributions:

- Kind equalities, based on *Kind Equalities* paper (ICFP'13); expect to merge in fall 2015
- Visible type application, based on draft paper; expect to merge in fall 2015
- New solver for type equality, based on draft paper submitted to JFP
- Roles, based on *Safe Zero-cost Coercions* paper (ICFP'14)
- Closed type families, based on *Closed Type Families* paper (POPL'14)
- Routine maintenance of Template Haskell implementation

Haskell packages The *singletons* package, described in the Haskell'12 and Haskell'14 papers.

The *units* package, described in the Haskell'14 experience report.

Presentations

Aug 2015 *Levity Polymorphism in Dependent Haskell*. Haskell Implementors' Workshop, Vancouver, Canada

Sep 2014 *Dependent Haskell*. Haskell Implementors' Workshop, Gothenburg, Sweden

Sep 2014 *Safe Zero-cost Coercions for Haskell*. ICFP, Gothenburg, Sweden

Jan 2014 *Closed Type Families with Overlapping Equations*. POPL, San Diego, CA

Sep 2013 *System FC with Explicit Kind Equality*. ICFP, Boston, MA

Sep 2013 *GeneralizedNewtypeDeriving is now Type-safe: How Roles Save the Day*. Haskell Implementors' Workshop, Boston, MA

Sep 2012 *Dependently Typed Programming with Singletons*. Haskell Symp., Copenhagen, Denmark

Honors and Awards

2014-16 Graduate Student Fellowship, Microsoft Research
One of 12 doctoral students chosen among candidates from U.S. and Canada.

2013-14 Fellowship for Teaching Excellence, U. of Penn. Center for Teaching and Learning
Nominated & selected as the graduate student departmental advocate for teaching.

2012 NSF Graduate Research Fellowship Program, Honorable Mention

2011-12 John Henry Towne Fellowship, U. of Penn. School of Engineering & Applied Science
Awarded to exceptionally qualified first-year doctoral students.

2002, 2003 John Harvard Scholarship
Awarded to undergraduates in the top 5% of their class

2001 Harvard College Scholarship
Awarded to undergraduates in the top 10% of their class

Professional Experience

Summer '13 Research Intern, Microsoft Research, Cambridge, UK. Mentored by Simon Peyton Jones.

Summer '02 Software Design Engineer Intern, Microsoft, Redmond, WA

Summer '01 Software Engineer Intern, Actuality Systems, Inc., Reading, MA

Teaching Experience

University

Instructor CIS194: Haskell Programming (12 students, mostly undergrad), fall 2014, U. of Penn.
CIS190: C++ Programming (19 students, mostly undergrad), fall 2012, U. of Penn.

Head TA CS50: Introduction to Computer Science (~100 undergrads), fall 2002, Harvard U.

TA CIS552: Advanced Programming (~40 students, grad & undergrad), fall 2013, U. of Penn.
CIS120: Programming Languages & Techniques (~100 undergrads), spring 2013, U. of Penn.
CS50: Introduction to Computer Science (~200 undergrads), fall 2001, Harvard U.
CS50: Introduction to Computer Science (~300 undergrads), fall 2000, Harvard U.

Undergrad Research Co-advisor Tiernan Garsys, Tayler Mandel, Lucas Peña, Noam Zilberstein. Senior Design Project: *Verification of System FC in Coq*, 2014-15.
Hamidhasan Ahmed. Summer research: *Explicit Type Application*, 2013.

High school

2008-11 The American School in London, London, UK
The American School in London is a private, co-educational K-12 school with an American curriculum.
Taught computer science and math, including AP Computer Science
Mentored high-school and middle-school FIRST robotics teams
Created new Digital Electronics course from scratch, including outfitting the lab

2003-08 Northfield Mount Hermon School, Mount Hermon, MA
Northfield Mount Hermon is a private, co-educational boarding high school.

Taught computer science and math, including AP Computer Science in Java

Dorm parent (3 years) and director (2 years), overseeing 40 students. Received the Parents Council Award for Excellence in Residential Life (2005).

Professional Activities

Mar 2016 Participant: Dagstuhl Seminar *Language Based Verification Tools for Functional Programs,* Wadern, Germany

Fall 2015 (expected) Awardee: Center for Teaching & Learning Teaching Certificate, U. of Penn.
Earning this certificate requires participation in ongoing conversations about teaching and participating in a teaching observation & reflection.

Aug 2015 Program Committee member: Haskell Implementors' Workshop, Vancouver, Canada

May 2015 Invited speaker: *A Practical Introduction to Haskell GADTs,* LambdaConf, Boulder, CO

Spring 2015 Organizer: Reading group on Pierce's *Types and Programming Languages,* U. of Penn.

Oct 2014 Invited speaker: *Dependent Types for Haskell*. New York City Haskell Users' Group, New York, NY

Oct 2014 Organizer: Hac Phi, a yearly Haskell weekend gathering, Philadelphia, PA

Aug 2012 Participant: Oregon Programming Languages Summer School, Eugene, OR

Outreach

Aug 2015 Organized and ran *Stencyl Boot Camp*, an introduction to programming for middle- and high-school students, West Tisbury, MA

Apr 2014 Led workshop to high school students on introduction to programming with Scratch for Women in Computer Science Day, U. of Penn.

Nov 2013 Presented introduction to Haskell at the Charter School of Wilmington, Wilmington, DE

Feb 2013 Consulted with educators at Merion Mercy Academy, a Catholic girls' high school, about starting a computer science program, Merion Station, PA

Feb 2013 Volunteered as Pit Coordinator at FIRST LEGO League regional championship, Philadelphia, PA