

# Richard A. Eisenberg

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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.

## Appointments

2016 – Assistant Professor, Bryn Mawr College

## Education

Sep 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'16 M. Pickering, G. Érdi, S. Peyton Jones, R. A. Eisenberg. *Pattern Synonyms*. In *Proceedings of the 2016 ACM SIGPLAN Symposium on Haskell (Haskell '16)*, ACM, 2016.
- JFP'16 J. Breitner, R. A. Eisenberg, S. Peyton Jones, S. Weirich. *Safe Zero-cost Coercions for Haskell*. In *Journal of Functional Programming*. Cambridge University Press, 2016.
- ESOP'16 R. A. Eisenberg, S. Weirich, H. Ahmed. *Visible Type Application*. In *Programming Languages and Systems: 25th European Symposium on Programming (ESOP '16)*. LNCS 9632, Springer, 2016. pp. 229-254.
- Wadlerfest '16 S. Peyton Jones, S. Weirich, R. A. Eisenberg, D. Vytiniotis. *A reflection on types*. In *A List of Successes that Can Change the World*, a festschrift in honor of Phil Wadler. LNCS 9600, Springer, 2016. pp. 292-317
- 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*. University of Pennsylvania Technical Report MS-CIS-15-09, 2015.
- 2015 R. A. Eisenberg. *An Overabundance of Equality: Implementing Kind Equalities into Haskell*. University of Pennsylvania Technical Report MS-CIS-15-10, 2015.
- 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)*, University of Pennsylvania Technical Report MS-CIS-15-11, 2013.

### **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)
- Visible type application, based on *Visible type applications* paper (ESOP'16)
- 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**

Apr 2016 *Visible Type Application*. European Symposium on Programming, Eindhoven, Netherlands

- 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**

- 2016 Penn Prize for Excellence in Teaching by Graduate Students, U. of Penn.  
*One of 10 graduate students across the university recognized for our teaching, nominated by undergraduates*
- 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**

- Dec 2015 - present Consultant, Awake Networks, Mountain View, CA. My task is to help design an efficient domain-specific language embedded in Haskell to be used in a networking security product.
- 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**

- Sep 2016 Program Committee member: Haskell Symposium
- Sep 2016 Program Committee member: Workshop on Type Directed Programming
- Mar 2016 Participant: Dagstuhl Seminar *Language Based Verification Tools for Functional Programs*, Wadern, Germany
- Nov 2015 - present Member: Haskell Prime Committee, for updating the standard for the Haskell language
- Nov 2015, Organizer: Hac Phi, a yearly weekend-long Haskell exchange, Philadelphia, PA  
Oct 2014
- Oct 2015 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
- Oct 2014 Invited speaker: *Dependent Types for Haskell*. New York City Haskell Users' Group, New York, NY

## **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