

Archibald Samuel Elliott

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Known as: Sam

For the last four years, I have been working in Programming Languages and Compilers. This work has encompassed many stages of compilation, from implementing static and dynamic checks in Checked C, to designing optimizations and code generation in more recent research projects. These projects have also included solver-aided compilation and program synthesis techniques.

My work has spanned many different programming environments, from the conventional context of Checked C, to the concurrent and distributed setting of Erlang, and recently has included the parallel environment of GPUs.

Education

2015 → 2017 **M.S. Computer Science & Engineering**, *University of Washington*, Seattle, USA.

Putting the Checks into Checked C, *Master's Project*, Advised by Rastislav Bodik and Dan Grossman.

During two internships at Microsoft Research, working with David Tarditi, I developed the bounds propagation algorithm and the dynamic checks for Checked C, and performed the first evaluation of their performance overhead. Checked C is a C language extension that aims to make C safer, by adding bounds-checked pointer types.

Graduate Courses:

- Principles of Programming Languages (Tatlock)
- Computer Architecture (Oskin)
- Computer-Aided Reasoning for Software (Torlak)
- Probabilistic Robotics (Fox)
- PL Analysis & Implementation (Bodik)
- Design & Analysis Of Algorithms I (Rao)
- Hardware-Software Co-optimization for ML (Ceze)

2011 → 2015 **BSc (Hons) Computer Science**, *University of St Andrews*, St Andrews, UK, First Class Honours.

With Year Abroad (2013–2014) at the *University of Virginia*, Charlottesville, VA.

A Concurrency System for Idris & Erlang, *Bachelor's Dissertation*, Supervised by Edwin Brady.

I explored how Idris can be used to reason about the behaviour of concurrent Erlang programs. This included writing an Idris to Erlang compiler, and modelling Erlang's concurrency using dependent types. I won the 2015 *Lockheed Martin Award for Software Engineering* for this work.

Experience

2015 → 2018 **Research Assistant**, *University of Washington*, Seattle, WA.

I worked for Rastislav Bodik on projects applying program synthesis and solver technologies to optimizing compilers. In addition to my main project, Checked C, I have worked on domain-specific compilers for linear algebra programs and methods for using SMT- and ILP-solvers within compilation.

2018 **Research Intern**, *NVIDIA*, Redmond, WA.

I worked for Vinod Grover on a Halide-like compiler for linear algebra and other applications on GPUs.

2017 **Research Intern**, *Microsoft Research*, Redmond, WA.

I worked on the Checked C project, mentored by David Tarditi. I designed the bounds propagation algorithm and the run-time checks inserted by the compiler. In a second internship, I conducted the first study of the performance overhead of the run-time checks, including examining their interactions with LLVM's optimization pipeline.

2011 → 2015 **Freelance Software Engineer**, UK.

Clients included *The Wine Trade Ltd* (Cambridge, UK), and *Hypernumbers* (Linlithgow, UK).

2013 → 2014 **Junior Software Engineer**, *Basho Technologies*, Remote (London, UK & Cambridge, MA).

I designed and built convergent replicated data types (CRDTs) for Riak, a distributed database. Though an industrial role, we published in academic workshops and collaborated on research projects.

2012 **Research Intern**, *University of St Andrews*, St Andrews, UK.

I worked on the *ParaPhrase* project, developing Skel, a parallel skeleton framework for Erlang/OTP.

2010 → 2011 **Junior Software Developer**, *55degrees Ltd*, Glasgow, UK.

I built websites and other systems for a variety of both public and private sector clients.

Languages

C, C++, Erlang, Haskell, Idris, Python, Racket, Ruby, Rust

Open Source

Clang & LLVM The Checked C compiler is an open-source fork of Clang. I have also contributed to LLVM itself.
Riak My work on convergent replicated data types for Riak was and remains open-source.

Papers

- ASPLOS '19 *Swizzle Inventor: Data Movement Synthesis for GPU Kernels*, Phitchaya Mangpo Phothilimthana, **Archibald Samuel Elliott**, An Wang, Abhinav Jangda, Bastian Hagedorn, Henrik Barthels, Samuel J. Kaufman, Vinod Grover, Emina Torlak, and Rastislav Bodik. In: *Architectural Support for Programming Languages and Operating Systems*. April 2019.
- IEEE SecDev '18 *Checked C: Making C Safe by Extension*, **Archibald Samuel Elliott**, Andrew Ruef, Michael Hicks, and David Tarditi. In: *IEEE Cybersecurity Development Conference*. September 2018.
- IJPP 42.4 *Cost-Directed Refactoring for Parallel Erlang Programs*, Christopher Brown, Marco Danelutto, Kevin Hammond, Peter Kilpatrick, and **Archibald Elliott**. In: *International Journal of Parallel Programming* 42.4 (August 2014).
- PaPEC '14 *Riak DT Map: A Composable, Convergent Replicated Dictionary*, Russell Brown, Sean Cribbs, Christopher Meiklejohn, and **Sam Elliott**. In: *Principles and Practice of Eventual Consistency*. April 2014.

Dissertations

BSc (Hons) **Archibald Samuel Elliott**, *A Concurrency System for Idris & Erlang*. Bachelor's Dissertation. School of Computer Science, University of St Andrews, April 2015.

Technical Reports

- arXiv *Synthesizing Number Generators for Stochastic Computing using Mixed Integer Programming*, Vincent T. Lee, **Archibald Samuel Elliott**, Armin Alaghi, and Luis Ceze. In: *arXiv e-prints*, arXiv:1902.05971 (February 2019).
- Checked C TR02 **Archibald Samuel Elliott**, *Putting the Checks into Checked C*. Checked C Technical Report 2. Paul G. Allen School of Computer Science and Engineering, University of Washington, October 2017.

Conference Talks

- RICON West '13 *CRDTs: An Update (or maybe just a PUT)*, **Sam Elliott**. At: RICON West. San Francisco, USA, 2013.
- IFL '12 *Skel: A Streaming Process-based Skeleton Library for Erlang*, **Archibald Elliott**. At: Implementation and Application of Functional Languages. Oxford, UK, 2012.

Awards

2015 **Lockheed Martin Award for Software Engineering**. *ScotSoft 2015*, Edinburgh, UK.
For *A Concurrency System for Idris & Erlang*; Part of The Young Software Engineer of the Year Awards.

Other Interests

Sailing My primary hobby is sailing: from 2016 to 2018, I raced a 40' yacht based in Seattle. During that time, I occasionally joined other crews including a J/109 and a Farr ILC 40 for local racing and regattas. I have competed in both long-distance races and regattas in and around Puget Sound. A more complete listing of my sailing experience is available on my website.