

Archibald Samuel Elliott

Programming Languages and Compilers

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 **MS Computer Science & Engineering**, *University of Washington*, Seattle, WA.

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

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 work 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. This work included writing papers and presentations, and collaborating with academics.

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**, Abhinav Jangda, Bastian Hagedorn, Henrik Barthels, Rastislav Bodik, and Vinod Grover. In: *Architectural Support for Programming Languages and Operating Systems (ASPLOS)*. Forthcoming.
- 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 (SecDev)*. 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

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.

Other Interests

Sailing My hobby is sailing: for the last two years, I have raced a 40' yacht called *Bravo Zulu*, based in Seattle. Occasionally I join other crews and have sailed a J-109 and a Farr ILC 40 in local regattas. I have competed in both long-distance races in and around Puget Sound, as well as Seattle-area regattas.