Archibald Samuel Elliott

Programming Language & Compiler Developer

Cambridge, UK
sam@lenary.co.uk
lenary.co.uk
Known as: Sam
Pronouns: He/Him

I am a professional compiler developer and have worked on programming languages and compilers since 2014. Currently I manage a small software team made up of both compiler developers and firmware developers. My team and I work on the RISC-V target for LLVM and the software stack for the OpenTitan project.

I have worked on many parts of the Clang/LLVM project, from changes to the Clang driver and frontend – most significantly as part of the Checked C project where I implemented both static and dynamic bounds checks – and also changes to the LLVM backend, as part of my work on the RISC-V target. I have also written my own simple compilers when designing optimisations and DSLs, as part of my research into solver-aided compilation and other program synthesis techniques.

Experience

2020–Present **Senior Software Developer** and **Software Team Lead**, *lowRISC C.I.C.*, Cambridge, UK.
I split my time between contributing to the RISC-V target in LLVM, and helping to guide firmware development for the OpenTitan project. I have helped to coordinate changes to the RISC-V LLVM backend since LLVM 9.0, including contributing and reviewing changes to the RISC-V ELF psABI, and I help to ensure clang and the Rust compiler support RISC-V correctly.

2019–2020 **Software Developer**, *lowRISC C.I.C.*, Cambridge, UK.

2018 **Research Intern**, *NVIDIA*, Redmond, WA.
I worked for Vinod Grover on Fireiron, a Halide-like scheduling DSL for dense linear algebra on GPUs.

2017 **Research Intern**, *Microsoft*, Redmond, WA.
I worked on the Checked C project, mentored by David Tarditi at Microsoft Research. Checked C is a C language extension that aims to make C safer, by adding bounds-checked pointer types. During two internships, I first designed the bounds propagation algorithm and the run-time bounds checking, and then I conducted a study into its performance overhead.

2011–2015 **Freelance Software Developer**, UK.
Clients included *The Wine Trade Ltd*, and *Hypernumbers*.

2013–2014 **Junior Software Developer**, *Basho Technologies*, Remote (UK & USA).
I designed and built convergent replicated data types (CRDTs) for Riak, a distributed database.

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

Education

2015–2017 **M.S. Computer Science & Engineering**, *University of Washington*, Seattle, USA.
I worked in Rastislav Bodik's group (until 2018) on projects applying program synthesis and solver technologies to optimizing compilers, especially around using domain-specific compilers for linear algebra programs.

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.

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*, Advised by Edwin Brady.
I explored how Idris can be used to develop and reason about the behaviour of concurrent Erlang programs. I won the 2015 *Lockheed Martin Award for Software Engineering* for this work.

Open Source

At lowRISC, I am one of the contributors to the RISC-V LLVM backend. Prior to working with RISC-V, I worked on Checked C's fork of Clang.

I have lots of experience of working on open-source projects including OpenTitan, Rust, and Riak.

I have also contributed to open standards including the RISC-V ELF psABI, and the Checked C specification.

Languages

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

Papers

PACT '20 — **Fireiron: A Scheduling Language for High-Performance Linear Algebra on GPUs**, Bastian Hagedorn, Archibald Samuel Elliott, Henrik Barthels, Rastislav Bodik, and Vinod Grover. In: *Parallel Architectures and Compilation Techniques*. October 2020.

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.

Technical Reports

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.

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.

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 for local racing and a Farr ILC 40 for 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.