Eddie Jones

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I'm a PhD candidate at the University of Bristol, focusing on functional programming, verification, and programming languages in general. I'm currently interested in how, at a high level, equational logics can lead to a style of reasoning that is accessible to the everyday programmer and, more specifically, the technologies that can enable this.

PUBLICATIONS

Higher-order MSL — Unpublished 2022

- The monadic shallow linear (MSL) class of Horn clauses is a decidable fragment of first-order logic. Our most recent work proposes an extensions to higher-order logic intended to capture the complex control flow patterns found in higher-order programming languages. We show that our fragment is interreducible with higher-order recursion schemes, the traditional approach to higher-order model checking, and show that it too is decidable by a resolution-based decision procedure.
- As an application, we consider a novel lightweight approach to verifying socket programs that could be extended to effectful programs in general.

CycleQ: An efficient basis for cyclic equational reasonings — PLDI 2022

- Cyclic proofs are an alternative to traditional inductive proofs that eschew explicit induction hypotheses. The advantage of this is that they naturally extend to mutual induction, somewhat mitigating the difficulties that arise from induction being non-analytic, i.e. the need to strengthen induction hypotheses, and are well-suited to goal-orientated proof search. Unfortunately, existing proof search algorithms for these systems don't perform well in an equational setting. We observe why this is the case and develop a new cyclic proof system/proof search algorithm that seamlessly handles equational reasoning.
- As part of this work, we showed that, despite being very simple, our proof system subsumes the various approaches to inductive equational reasoning that come under the family of "inductionless induction". We also developed an efficient mechanism for verifying the correctness of proofs that takes advantage of the size-change principle of program termination.
- This publication provided me with a great opportunity to present our research to and get feedback from an international audience.

Intensional Datatype Refinement — POPL 2021

- In this paper, we presented a higher-order program analysis that detects potential runtime errors that may occur due to incomplete pattern-matching expression. Unlike previous approaches, we tackled the issue of performance without significantly compromising on expressivity. The analysis infers polymorphic and path-sensitive types allowing for more modular usage. By uncovering the right restrictions, we created a compositional analysis that is ultimately linear in the size of the program. Thus, allowing it to rolled out on larger scales. Its performance is witnessed not just by a formal complexity guarantee but also by an efficient implementation that we developed as a plugin for the Glasgow Haskell Compiler.

EDUCATION

PhD Computer Science — University of Bristol 2019 —

- Oregon Programming Languages Summer School (2021)
- Midlands Graduate School in the Foundations of Computing Science (2021)

BSc (Hons) Mathematics and Computer Science — University of Bristol 2016 — 2019

- I wholeheartedly enjoyed my degree despite the increased challenges of joint honours. I found that fluency in mathematical thinking gave me the analytical skills necessary to shed new light on the practical challenges faced in computer science. I averaged 85% across a range of modules including:

    - Language Engineering
    - Theory of Computation
    - Types & Lambda Calculus
    - Set Theory
    - Combinatorics
    - Dynamic Systems
    - Machine Learning
    - AI & Logic Programming
    - Computational Neuroscience

- Research experience:
    - *The Dynamics of Dialects*. For my undergraduate dissertation, I used a model of natural language acquisition to to investigate how social networks influence the propagation of cultural symbols through a series of simulations. It received a first-class mark of 87%.
    - *Applied Optimisation Research Internship*. In my second year, I was a research intern. This project considered the problem of designing a car park layout for a given space that maximised the number of cars. It involved a satisfying mix of calculus, geometry, and simulation (mostly in MATLAB).

- Awards:
    - Top Mathematics and Computer Science Graduate 2019
    - Top 10 Second Year Student in Computer Science, awarded by Netcraft
    - Top 5 First Year Student in Computer Science, awarded by Bank of America Merrill Lynch

A levels — Peter Symonds College 2014 — 2016

- Mathematics A*
- Further Mathematics A
- Physics A
- (AS) Economics A

Swanmore College of Technology 2009 — 2014

- 13 GCSE including Mathematics, Science, English, and French.

TEACHING

Teaching Assistant 2018 —

- I have always enjoyed conveying my passions for subjects, and so I was delighted to get some experience as a teaching assistant. Across the following units, I lead problem classes, helped the students in labs, as well as producing and marking homework sheets:
    - Language Engineering
    - Theory of Computation
    - Functional Programming
    - Types & Lambda Calculus
    - Data Structures & Algorithms
    - Advanced Topics in Programming Languages

- I have also taken on the role of program-level teaching assistant that involves leading tutorials designed to cross module boundaries and encourage the students to think outside the box. These flexible sessions have been particularly enjoyable as it more naturally leads to a rapport with the students.

LANGUAGES & TOOLS

Advanced
- Haskell
- Functional Programming
- Mathematics

Experience With
- C
- Python
- LaTeX
- Rust
- Git
- Linux

HOBBIES & INTERESTS

Apart from computer science, I generally enjoy being physically active. For many years, I practiced Taekwondo up-to a 2nd Dan black belt, but my current obsession is bouldering.

I also love reading and rarely have fewer than two books on the go. Some of my favourite genres include sci-fi, history and philosophy.