Xiaojia Rao

Imperial College London • London, UK | *Updated: March 3, 2026*
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Current Position

Independent Researcher London, UK
Jan. 2026 - Present

- Continuing development of *WasmCert-Coq*, a mechanisation of the W3C WebAssembly specification in Rocq (Coq), developing efficient persistent memory representations for extracted runtimes.
- Maintaining 100% validation against the official WebAssembly 2.0 test suite and CI stability across Rocq version updates.
- Developing a Lean4 port of WasmCert-Coq to explore Lean-based optimisation strategies for the resulting extracted runtime.

Education

Imperial College London London, UK
PhD in Computer Science *Oct. 2020 - Nov. 2025*
- *Thesis: Designing and Maintaining an Efficient WebAssembly Mechanisation*
- Advisors: Philippa Gardner, Conrad Watt

Imperial College London London, UK
MSc Advanced Computing *2019-2020*
- Average Grade: 84.58/100 (Distinction, top of cohort)

University of Cambridge Cambridge, UK
Mathematics (Master of Mathematics, Bachelor of Art), St. Johns College *2015-2019*
- Part III Expository Essay: *Fraenkel-Mostowski Models of Set Theory*
- Class I, Part IA/IB/II
- College Wright Prize (Top 1/3 of Class I), Part IA/IB

Publications

1. Xiaojia Rao, Stefan Radziuk, Conrad Watt, and Philippa Gardner. Progressful interpreters for efficient webassembly mechanisation. *Proc. ACM Program. Lang.*, 9(POPL), 2025

   This paper investigates the theoretical relationship between the type soundness property and properties of executable semantics. The paper proposes a new design of a dependently-typed progressful interpreter which consolidates various desirable properties into one function. All methods discussed are then applied to WebAssembly to demonstrate their feasibility.

2. Dongjun Youn, Wonho Shin, Jaehyun Lee, Sukyoung Ryu, Joachim Breitner, Philippa Gardner, Sam Lindley, Matija Pretnar, Xiaojia Rao, Conrad Watt, and Andreas Rossberg. Bringing the webassembly standard up to speed with spectec. *Proc. ACM Program. Lang.*, 8(PLDI), June 2024

This paper describes a new DSL targeted at defining the Wasm specification, which serves as the single source of truths for multiple downstream artifacts, including the Latex and Prose rendering for the specification document, an animated interpreter, and potential theorem prover mechanisations.

3. Xiaojia Rao*, Aïna Linn Georges*, Maxime Legoupil, Conrad Watt, Jean Pichon-Pharabod, Philippa Gardner, and Lars Birkedal. Iris-wasm: Robust and modular verification of webassembly programs. *Proc. ACM Program. Lang.*, 7(PLDI), 2023

   This paper designs and implements a higher-order program logic for WebAssembly based on the Iris separation logic framework in the Coq proof assistant. Some higher-order examples are verified to demonstrate the expressiveness of this program logic instantiated in Iris.

4. Conrad Watt, Xiaojia Rao, Jean Pichon-Pharabod, Martin Bodin, and Philippa Gardner. Two mechanisations of webassembly 1.0. In Marieke Huisman, Corina S. Pasareanu, and Naijun Zhan, editors, *Proceedings of the 24th international symposium of Formal Methods (FM21), Beijing, China; November 20-25, 2021*, volume 13047 of *Lecture Notes in Computer Science*, pages 61–79. Springer, 2021

   This paper describes the two Wasm 1.0 mechanisations designed and implemented in the Isabelle/HOL and Coq theorem provers separately. The paper also describes the various soundness results proved in the mechanisation, including type soundness, type checker correctness, and other properties.

Teaching

Teaching Assistant London, UK

Imperial College London

- Scalable Software Verification (Philippa Gardner, 2020-2023)
- Models of Computation (Azalea Raad, Herbert Wiklicky, Sophia Drossopoulou, 2020-2022)
- Probability and Statistics (Giuliano Casale, 2021-2022)
- Graphs and Algorithms (Iain Philipps, 2021)
- Reasoning about Programs (Sophia Drossopoulou, 2021)

Master Project/Undergraduate Final Year Project Technical Supervisor London, UK

Imperial College London

- Diego Cupello (Wasm-SpecTec Generation of Coq Mechanisation, 2024, CPP Department Award)
- Henit Mandaliya (Type Soundness of WebAssembly 2.0, 2023)
- Stefan Radziuk (Sound and Progressful Interpreter for WebAssembly, 2023, Distinguished Project Prize)
- Liqing Yang (Soundness of WebAssembly Module Instantiation, 2022)

Work Experience

Softwire London, UK

Software Engineer Intern *Jun. 2017 - Sep. 2017*

Jane Street Capital London, UK

Quantitative Trading Intern *Jun. 2016 - Sep. 2016*

Prizes and Awards

CPP Award for Academic Excellence London, UK
Top of cohort at Imperial College, MSc Advanced Computing *2019-2020*

Wright Prize Cambridge, UK
Top 1/3 of Class I at University of Cambridge, Mathematics Tripos *2015-2016, 2016-2017*

Other Prizes

- Singapore Mathematics Olympiad:
  Open Category: Gold (2011-2014, rank 17/12/14 in 2012/13/14)
  Senior Category: Gold, rank 3 (2011)
- Singapore National Olympiad in Informatics: Gold, rank 1 (2011)

Skills and Qualifications

Theorem Provers

- Rocq(Coq): Advanced mechanisation experience
- Lean: Knowledgable, active development

Programming Languages

- WebAssembly, OCaml, C, Python, JavaScript, Rust

Natural Languages

- Native: Mandarin Chinese
- Proficient: English