Xiaojia Rao

Imperial College London • London, UK | *Updated: January 28, 2025*
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Current Position

PhD Student London, UK
Imperial College London *Oct. 2020 - Present*

- Research Interests: Proof Assistants, Mechanised Verification, Type Theory, Programming Languages
- Advisor: Philippa Gardner
- External Advisor: Conrad Watt

Education

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*
- Class I, Part IA/IB/II

Active Projects

- *WasmCert-Coq*: A mechanisation of the W3C WebAssembly specification in the Coq (Rocq) proof assistant. Maintained since the pre-1.0 draft and updated to W3C 2.0 editor's draft, with the subtyping system from upcoming proposals.

Selected Publications

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

   Despite WebAssembly in its name, a considerable proportion of this paper investigates the theoretical relationship between the type soundness property and properties of executable semantics. The paper then 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. 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), June 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.

3. 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 is a shorter paper describing the two Wasm 1.0 mechanisations designed and implemented in Isabelle/HOL and Coq separately.

Work Experience

Softwire London, UK
Software Engineer Intern *Jun. 2017 - Sep. 2017*

Jane Street Capital London, UK
Quantitative Trading Intern *Jun. 2016 - Sep. 2016*

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)

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

Programming Languages

- Expert: -
- Proficient: Coq(Rocq), C++, Python, WebAssembly
- Knowledgeable: OCaml, JavaScript

Natural Languages

- Native: Mandarin Chinese
- Proficient: English

Other Qualifications

- GRE Mathematics: 970 (99th percentile)