Joshua Chen

About

I'm a PhD candidate in computer science at the Functional Programming Lab of the University of Nottingham.

My research is in programming languages, at the intersection of mathematics and computer science. I'm well versed in topics in mathematics and theoretical computer science, as well as the fundamentals of machine learning and writing good code.

Previously, I worked in machine learning and natural language processing at the Knowledge Discovery group at Fraunhofer IAIS, and on formalization and proof assistants at the Computational Logic group of the University of Innsbruck. Prior to that I majored in mathematics at the University of Bonn and the Australian National University.

Contact

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- GitHub: https://github.com/jaycech3n

Formal Education

- Oct 2020–present
  - *Ph.D. in Computer Science* University of Nottingham.
- Oct 2015–Sep 2018
  - *Masters in Mathematics* University of Bonn.
    German GPA 1.9.
- Jun 2013–Jul 2014
  - *B.Sc. (Hons) in Mathematics* The Australian National University.
    GPA 80%. First Class Honours.
- Feb 2010–Dec 2012
  - *B.Sc. in Mathematics* University of Canterbury.
    Minors in computer science and physics. GPA 8.64/9.00. Dean's Congratulations.

Teaching Experience

I have substantial experience teaching computer science and mathematics at both high school (secondary school) and university levels, as well as physics at high school level.

Subjects I have been teaching assistant/tutor for at university include:

- 2023

  - *Domain theory and denotational semantics* Graduate course. Midlands Graduate School '23.
- 2021–2023
  - *Introduction to formal reasoning* Formal logic in the Lean proof assistant. 2nd year Bachelors course. University of Nottingham.
  - *Introductory Haskell* 1st year Bachelors course. University of Nottingham.
- 2017–2018
  - *Machine learning* Masters course. University of Bonn.
- 2017
  - *Data mining and knowledge discovery* Masters course. University of Bonn.
- 2015
  - *Engineering mathematics* 1st year Bachelors course. University of Canterbury.
- 2014
  - *Mathematics and applications* 1st year Bachelors course. The Australian National University.
  - *Mathematics and applications* 1st year Bachelors course. University of Canterbury.
- 2013
  - *Discrete mathematics* 1st year Bachelors course. University of Canterbury.

Technical Skills

- Programming languages:
  - C++
  - Java
  - Python
  - Haskell
  - OCaml
  - Standard ML
  - Lean
  - Agda
  - Some amount of: Scala, MATLAB, Mathematica, Ruby
- Markup languages:
  - HTML, CSS
  - LaTeX
- Tools:
  - Git
  - Jupyter
  - Proof assistants: Lean, Coq, Agda, Isabelle

Awards

- 2013
  - ANU Mathematical Sciences Institute Honours scholarship
- 2012
  - ANU Summer Research scholarship
- 2011
  - University of Canterbury Peter Bryant Prize for Pure Mathematics
- 2010
  - University of Canterbury Dux scholarship

Previous Work & Research

- Jan 2019–Aug 2020
  - *Dependently typed and set-theoretic foundations for formalized mathematics in Isabelle* University of Innsbruck.
    Investigated dependently typed and set theoretic logics, infrastructure and tools for the formalization of mathematics in the Isabelle proof assistant, under the ERC-funded "SMART" project at the Computational Logic group.
- 2017–2018
  - *Machine learning and natural language processing for Copernicus EMS* Fraunhofer Institute for Intelligent Analysis and Information Systems.
    Worked in the Knowledge Discovery group, implenting and applying probabilistic models to analyze and classify topics in Twitter data corpora. Implemented targeted topic models in Java, and used Python for natural language processing of Twitter and Facebook data. This work was part of the European Union's E2mC project, a pilot project that used publicly available social media data for real-time support of its Copernicus emergency management service.
- 2015
  - *Enumeration and visualization of planar trivalent graphs* The Australian National University.
    Developed and implemented algorithms in Scala to count and automatically draw certain classes of planar graphs. Part of quantum algebra research investigating subfactors and planar algebras.
- 2013–2014
  - *Temperley-Lieb categories and skein modules* The Australian National University.
    Final year Honours research thesis in category theory, quantum algebra, and applications to low-dimensional topological invariants.
- Nov 2012–Jan 2013
  - *Integer houses in cyclotomic fields* The Australian National University. Summer research scholarship. Investigated questions concerning the dimensions of objects in fusion categories using Wolfram Mathematica.

Research & Publications

Peer-reviewed

- *Categories as Semicategories with Identities.* With Tom de Jong, Nicolai Kraus and Stiéphen Pradal. 29th International Conference on Types for Proofs and Programs (TYPES). Jun 2023. Extended abstract. Valencia. URL: https://types2023.webs.upv.es/TYPES2023.pdf.
- *Semisimplicial Types in Internal Categories with Families.* With Nicolai Kraus. 27th International Conference on Types for Proofs and Programs (TYPES). Jun 2021. Extended abstract. Leiden (virtual). URL: https://types21.liacs.nl/download/semisimplicial-types-in-internal-categories-with-families.
- *Homotopy Type Theory in Isabelle.* 12th International Conference on Interactive Theorem Proving (ITP). Jun 2021. Rome (virtual). URL: https://doi.org/10.4230/LIPIcs.ITP.2021.12.

Theses

- *An Implementation of Homotopy Type Theory in Isabelle.* Sep 2018. Masters thesis. Type theory, mathematical logic and proof assistants. University of Bonn. URL: https://arxiv.org/abs/1911.00399.
- *The Temperley-Lieb categories and skein modules.* May 2014. Bachelors (Honours) thesis. Diagrammatic quantum algebra and category theory. The Australian National University. URL: https://arxiv.org/abs/1502.06845.

Notes, reports, etc.

Miscellaneous technical writing.

- *Semantic (aka soft) types.* Nov 2019. Extended abstract. University of Innsbruck. URL: https://joshchen.io/pdf/soft-types-abstract.pdf.
- *Computational Fact-Checking.* Jul 2017. Technical report. University of Bonn. URL: https://joshchen.io/pdf/computational-fact-checking-report.pdf.
- *A pre-introduction to homotopy type theory.* 2017. Seminar notes. University of Bonn. URL: https://joshchen.io/pdf/hott-preintro-notes.pdf.

Talks

- *On internal models of type theory and Reedy fibrant diagrams.* YaMCATS meeting 29. Dec 2022. Invited talk. University of Manchester. Slides: https://joshchen.io/pdf/yamcats-29-slides.pdf.
- *Semisimplicial Types in Internal Categories with Families.* 27th International Conference on Types for Proofs and Programs (TYPES). Jun 2021.

Leiden (virtual). URL: https://joshchen.io/media/semisimplicial-types-in-internal-categories-with-families.mp4 Slides: https://joshchen.io/pdf/types-2021-slides.pdf.

- *Homotopy Type Theory in Isabelle.* 12th International Conference on Interactive Theorem Proving (ITP). Jun 2021. Rome (virtual). URL: https://youtu.be/fGnIdt_jPfA?t=4630 Slides: https://joshchen.io/pdf/itp-2021-slides.pdf.
- *Dependent Types in Isabelle.* 4th Prague Inter-Reasoning Workshop. Oct 2019. Czech Technical University.
- *Isabelle/HoTT.* Jul 2019. Seminar talk. Chair for Logic and Verification, Technical University of Munich.
- *Hybrid and Alternative Logics in Isabelle: Isabelle/Set.* Conference on Intelligent Computer Mathematics. Jul 2019. Doctoral program. Prague. Slides: https://joshchen.io/pdf/cicm-2019-slides.pdf.
- *Semantic Types.* May 2019. Seminar talk. Computational Logic research seminar, University of Innsbruck. Slides: https://joshchen.io/pdf/semantic-types-slides.pdf.
- *What is Mathematics?* 2014. Outreach talk, ANU Open Day. The Australian National University.
- *An Introduction to Topological Quantum Field Theory.* Australian Mathematical Sciences Student Conference. 2014. The University of Newcastle, Australia.
- *The Temperley-Lieb categories and Turaev-Viro skein modules.* ANU MSI Honours Conference. 2014. The Australian National University.

Organization & Service

- 2022
  - *Midlands Graduate School '22* Volunteered with organizing participant talks and social events.
- 2021–2023
  - *FP Lunch* Organized weekly lunchtime research seminar meetings for the Functional Programming Lab at the University of Nottingham.