Chelsea Louise Edmonds

Postdoctoral Research Associate · Cambridge Trust Scholar · Software Engineer · STEM Education Advocate
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Research Positions

University of Sheffield || Department of Computer Science — *Sheffield, UK*
Research Associate in Formal Verification — *Oct. 2023 - Present*

- Project: Employed under the EPSRC COVERT Grant exploring "Safe and secure COncurrent programming for adVancEd aRchi-Tectures", a joint project with the University of Surrey (Prof. Brijesh Dongal) and University of Kent (Prof. Mark Batty)
- Sheffield Lead PI: Prof. John Derrick, co-PI: Dr Andrei Popescu
- Member of the Foundations Group.

Education

University of Cambridge || Darwin College — *Cambridge, UK*
PhD in Computer Science — *Oct. 2019 - Present (Submitted Sept. 2023)*

- **Thesis Title**: Formalising Combinatorial Structures and Proof Techniques in Isabelle/HOL
- **Key Achievements**: New techniques for formally defining mathematical hierarchies, significant contributions to formal combinatorics libraries, development of intuitive formal proof techniques, 100% acceptance rate on 5 peer reviewed publications, including one distinguished paper award.
- Supervisor/Research Group: Member of the ALEXANDRIA Research Group, supervised by Prof. Lawrence Paulson
- Funding: PhD fully funded by a joint Cambridge Australia Scholarship and Department of Computer Science Studentship
- Completed the departments research skills program, including a beginner-intermediate German language course.

University of Queensland (UQ) — *Brisbane, Australia*
Bachelor of Engineering/Bachelor of Science — *2012 - 2017*

- Majors: Software Engineering and Mathematics
- **Key Achievements**: First Class Honours (GPA 6.75/7), University Medal, Class of 2017 "Future Leader" & UQ EAIT Scholar
- **Honours Thesis**: A Model Instantiation of a Rely-Guarantee Algebra (Supervised by Dr Larrissa Meinicke and Prof. Ian Hayes)
- Highlighted Coursework: Algorithms, Formal Methods, Python, Java, C, Machine Learning, Security, Coding & Cryptography
- Studied for one semester on exchange at the University of Edinburgh in 2014

Australian Music Examinations Board — *Brisbane, Australia*
Associate in Music Diploma (Violin) — *2014*

Awards, Scholarships, & Grants

Distinguished Paper Award, CPP2024 (awarded to the top 10% of accepted conference papers) *2024*
Academic Award, British Federation of Women Graduates (competitive award for PhD research excellence - £5000) *2022*
Silvia Breu Teaching Prize, Queens College, Cambridge (best computer science supervisor voted by students - £125) *2022*

Cambridge Australia Poynton International PhD Scholarship, Cambridge Trust (fees - £63 018 & funding - £45 902) *2019*
Qualcomm PhD Studentship, Department of Computer Science & Technology (fees - £25 011 & funding - £4416) *2019*

University Medal, University of Queensland (top 5% of First Class Honours Graduates) *2017*
ICT Young Achiever Award, Women in Technology, Queensland (leadership & notable contribution to ICT industry) *2017*
Top100 Future Leader Australia - Software Engineering Prize Winner, GradConnection *2017*

Fourth Year Engineering Travelling Fund, University of Queensland (academic excellence on exchange - $400 AUD) *2015*

Frank Joseph Murphy Bursary, University of Queensland (pre-exchange scholarship for academic merit - $7750 AUD) *2014*
Joan Wickham Memorial Prize, University of Queensland (highest female engineering GPA after two years -$1500 AUD) *2014*

Robogals Ericsson Scholarship, Robogals (Acknowledgement of Leadership Potential and Service - $3000 AUD) *2013*

Scholarship for Academic Merit & ICT Enabling Scholarship, University of Queensland ($6000 AUD) *2012*
Phyllis Cannon Scholarship, Brisbane Girls Grammar School (Alumni Award for academic success at university) *2012*

Professional Experience

Boeing || PhantomWorks International *Brisbane, Australia*

Software Engineer *Dec. 2017 - Sep. 2019*

- PhantomWorks International is Boeing's global department for advanced prototyping and developing new technology
- Researched and developed cutting edge software and algorithms for autonomous systems in a fast paced and demanding environment from requirements to testing stages (using C#, C++, internal scripting languages, DOORS)
- A member of the Engineering Team awarded Boeing Australia's 2019 Top Engineering Team Prize
- Completed a Systems Engineering course, the Boeing Australia Graduate Program, and was a STEM Outreach Ambassador

Vacation Student Software Engineer *Dec. 2016*

- Developed a software prototype for an augmented reality system and was offered a graduate contract on completion

RGB Assurance *Brisbane, Australia*

Casual Software Engineer (Student) *Dec. 2015 - Feb. 2016*

- RGB Assurance is an engineering consultancy firm specialising in software development and safety critical systems
- Developed and demonstrated a working android app prototype to test new system feasibility

Teaching Experience

Qualifications

Associate Fellow Advance HE, Granted through the Teaching Associates Programme at Cambridge CTL *2022*
Recognition of skills in teaching theory applied to practice, small group teaching, lecturing, and course design

Research Supervision

Undergraduate Summer Intern Co-Supervisor, Cambridge, Formalising the BSG Theorem, see publications. *Aug. 2022*

Undergraduate Teaching

Teaching Assistant, (led tutorials, assisted with course content, supported project groups University of Sheffield

- Logic - Second Year (Additionally Guest Lecturer) *2024*
- Software Hut - Second Year Project Course *2024*

Supervisor (Tutor), University of Cambridge (assigned and marked work, delivered small group tutorials)

- Logic & Proof - Second Year *2020 - 2023*
- Semantics of Programming Languages - Second Year *2021 - 2022*
- Discrete Mathematics & Formal Languages - First Year *2020 - 2022*
- Software & Security Engineering - First Year *2021 - 2022*
- Algorithms - First Year *2021*

Tutor & Demonstrator, University of Queensland (delivered large tutorials, practical work assistance, marking)

- CSSE1001: Introduction to Software Engineering - Python, First Year *2015 - 2017*
- CSSE2002: Programming in the Large - Java & OOP, Second Year *2017*
- MATH1061: Discrete Mathematics -First Year *2014 - 2015*

Outreach

Computer Science and Mathematics Session Leader , University of Cambridge *2020 - 2023*
Occasional online/in-person introductory lectures for high school students on university and research topics

STEM Outreach Ambassador, Boeing Australia, gave outreach lectures at high schools in Brisbane. *2018 - 2019*

Workshop Leader & Designer Robogals Brisbane, designed LEGO Mindstorms workshops for 6 to 18 year-olds. *2012 - 2017*
Logged over 165 individual teaching hours over 80 workshops

Service & Professional Development

Service and Leadership

University of Cambridge — *Cambridge*

Darwin College Students Association (DCSA) President — *Jun. 2022 - Jun. 2023*

- As a graduate student college, the DCSA is the sole student body at Darwin College
- Responsible for leading a group of 23 student volunteers to support the student community through running college wide initiatives, student communications, supporting sports/societies, peer welfare support, and organising social events.
- Served as a college trustee and member of the main College Council, alongside various other college committees.
- Key outcomes: successful Fresher's welcome fortnight, implementation of new initiatives to connect fellows and students, EDI sucesses (e.g. Women in Academia Program), established cost of living working group, transparent communication initiatives, implemented central record keeping, student representative on university postgraduate mental health taskforce.
- Previously Sports & Societies Officer 2021 to 2022.

WomenCL Mentoring and Outreach Co-chair — *Aug. 2020 - Jul. 2022*

- Responsible for the Computer Science Departments "Big Sister Little Sister" peer-mentoring programme.
- Organised events such as roundtable and panel discussions to encourage mentoring across department.

Department of Computer Science Volunteer Activities — *2019 - Present*

- Chaired MPhil Presentation Sessions and ran MPhil abstract review workshops
- Volunteered for Outreach Workshops and Open Days

Robogals — *Australia*

Regional Executive Officer (REO) Asia Pacific — *2015 - Oct. 2018*

- Robogals is an international not-for-profit aiming to inspire, engage, and empower young women into STEM careers.
- Member of the global leadership team, and led the APAC team to run regional initiatives and support 15 chapters in 5 countries.
- **Key Achievements**: Rebuilt regions partnerships, chapter support, and cultural awareness strategies, developed an Alumni program, led the organisation to achieve a Highly Commended Engineers Australia Diversity Award (not-for-profit category).

Robogals UQ President/Secretary/Volunteer — *2012 - 2015*

- Rebuilt the chapter from 3 volunteers to a growing and stable chapter of over 40 volunteers and many external supporters

University of Queensland — *Brisbane*

Student Mentor, Leader & Ambassador — *2012 - 2017*

- **Student Mentor for the UQ Young Scholars Program** (2016 - 2017), an academic extension and enrichment opportunity for high achieving grade 11 students including a week long residential camp and mentoring through year 12.
- **Women in Engineering Student Leader** (2014 - 2015), an award winning initiative which successfully increased gender diversity across the faculty. Contributed to program development, networking events, and high school outreach.
- **ICT Ambassador** (2012 - 2014), including representing UQ at open days, welcome events, and tertiary study expos.

Conferences & Peer Review

Conference Organisation

- POPL 2023: Conference Student Volunteer & Session Preview Chair
- Isabelle Workshop 2022: Session Chair

Peer Review

- Journal of Automated Reasoning
- Formal Aspects of Computing
- IJCAR: Sub-reviewer
- ITP: Sub-reviewer

Professional Memberships/Affiliations

- AdvanceHE: Associate Fellow

Publications

Journal Articles

C. Edmonds, A. Koutsoukou-Argyraki, and L. C. Paulson. 2023. Formalising Szemerédi's Regularity Lemma and Roth's Theorem on Arithmetic Progressions in Isabelle/HOL. *Journal Automated Reasoning*, Vol. 67. doi:10.1007/s10817-022-09650-2

Conference Proceedings

C. Edmonds and L. C. Paulson. 2024. Formal Probabilistic Methods for Combinatorial Structures using the Lovász Local Lemma. In *Proceedings 13th ACM SIGPLAN Int. Conf. Certified Programs and Proofs (CPP 2024)*. Association for Computing Machinery, New York, NY, USA, 132–146. doi: 10.1145/3636501.3636946. **(Distinguished Paper Award)**.

A. Koutsoukou-Argyraki, M. Bakšys, and **C. Edmonds**. 2023. A Formalisation of the Balog–Szemerédi–Gowers Theorem in Isabelle/HOL. In *Proceedings 12th ACM SIGPLAN Int. Conf. Certified Programs and Proofs (CPP 2023)*. Association for Computing Machinery, New York, NY, USA, 225–238. doi: 10.1145/3573105.3575680 . *Note: Co-supervisor and equal contributor*.

C. Edmonds and L. C. Paulson. 2022. Formalising Fisher's Inequality: Formal Linear Algebraic Proof Techniques in Combinatorics. In *13th Int. Conf. Interactive Theorem Proving (ITP 2022)*. J. Andronick and L. de Moura, Ed. Vol. 237. Leibniz International Proceedings in Informatics (LIPIcs). 11:1-11:19. doi: 10.4230/LIPIcs.ITP.2022.11

C. Edmonds and L. C. Paulson. 2021. A Modular First Formalisation of Combinatorial Design Theory, in *14th Int. Conf. Intelligent Computer Mathematics (CICM 2021)*. F. Kamareddine and C. Sacerdoti Coen, Ed. Vol 12833. Springer International Publishing. 3-11, doi: 10.1007/978-3-030-81097-9_1

Formalisation Libraries

**Note: Archive of Formal Proof entries are peer reviewed for style and originality before being published.*

C. Edmonds. Sep. 2023. Hypergraph Colouring Bounds. *Archive of Formal Proof*. `https://www.isa-afp.org/entries/Hypergraph_Colourings.html`. Formal Proof Development.

C. Edmonds. Sep. 2023. Hypergraphs. *Archive of Formal Proof*. `https://www.isa-afp.org/entries/Hypergraph_Basics.html`. Formal Proof Development.

C. Edmonds. Sep. 2023. General Probabilistic Techniques for Combinatorics and the Lovász Local Lemma. *Archive of Formal Proofs*. `https://www.isa-afp.org/entries/Lovasz_Local.html`. Formal Proof Development.

A. Koutsoukou-Argyraki, M. Bakšys, and **C. Edmonds**. Nov. 2022. The Balog–Szemerédi–Gowers Theorem. *Archive of Formal Proofs*. `https://www.isa-afp.org/entries/Balog_Szemeredi_Gowers.html`. Formal Proof Development.

C. Edmonds. Sep. 2022. Undirected Graph Theory. *Archive of Formal Proofs*. `https://www.isa-afp.org/entries/Undirected_Graph_Theory.html`. Formal Proof Development

C. Edmonds. Apr. 2022. Fisher's Inequality: Linear Algebraic Techniques for Combinatorics. *Archive of Formal Proofs*. `https://www.isa-afp.org/entries/Fishers_Inequality.html`. Formal Proof Development

C. Edmonds, A. Koutsoukou-Argyraki, and L. C. Paulson. Dec. 2021. Roth's Theorem. *Archive of Formal Proofs*. `https://www.isa-afp.org/entries/Roth_Arithmetic_Progressions.html`. Formal Proof Development

C. Edmonds, A. Koutsoukou-Argyraki, and L. C. Paulson. Nov. 2021. Szemerédi's Regularity Lemma. *Archive of Formal Proofs*. `https://www.isa-afp.org/entries/Szemeredi_Regularity.html`. Formal Proof Development

C. Edmonds. Aug. 2021. Combinatorial Design Theory. *Archive of Formal Proofs*. `https://www.isa-afp.org/entries/Design_Theory.html`. Formal Proof Development

C. Edmonds. Apr.2020. Lucas' Theorem. *Archive of Formal Proofs*. `https://www.isa-afp.org/entries/Lucas_Theorem.html`. Formal Proof Development

Workshop Papers

C. Edmonds and L.C. Paulson. 2020. Lucas's Theorem: Formalising Generating Function Proofs. In *Isabelle Workshop 2020*. Available online: `https://sketis.net/isabelle/isabelle-workshop-2020`

In Preparation

C. Edmonds and L. C. Paulson. A Locale-Centric Approach to Formalising Mathematics Hierarchies. Journal Paper. Intended for submission to the Journal of Automated Reasoning.

Presentations

Invited Talks

February 2024. Invited Thematic *Formalising Combinatorial Mathematics: A Modular Approach*. Speaker: XVI Summer Workshop in Mathematics. Universidade de Brasília. Remote presentation .

May 2023. *The Locale-Centric Approach for Formalising Mathematical Hierarchies*. Verification Group Seminar Series, Department of Computer Science, University of Sheffield, UK.

May 2021. *Maths by Machine: Formal Proof Technology and Combinatorial Challenges*. Guest Speaker: UQ Maths and Computing Society "Math Talks" Event, Brisbane, Australia.

Conference/Workshop Presentations

***** indicates presentation on a publication in the conference proceedings*

Jan. 2024. *Probabilistic Methods for Combinatorial Structures in Isabelle/HOL*. Presentation: Workshop on Foundations of Computation, Sheffield, UK.

Jan. 2024. *Formal Probabilistic Methods for Combinatorial Structures using the Lovász Local Lemma**. Presentation: CPP 2024, London, UK.

Jul. 2023. *An Introduction to the Probabilistic Method for Combinatorics in Isabelle/HOL*. Presentation: Women in EuroProofNet Workshop 2023, associated with ITP2023, Bialystok, Poland.

Apr. 2023. *An Introduction to Formal Verification in Isabelle/HOL*. Workshop: Oxbridge Women in Computer Science Conference, Cambridge, UK.

Jan. 2023. *A Formalisation of the Balog–Szemerédi–Gowers Theorem in Isabelle/HOL** (Speaker for joint work with A. Koutsoukou-Argyraki and M. Bakšys). Presentation: CPP 2023, Boston, MA, USA.

Aug. 2022. *Formalising Fisher's Inequality: Formal Linear Algebraic Proof Techniques in Combinatorics**. Presentation: ITP 2022 (at FLOC), Haifa, Israel.

Aug. 2021. *A Modular First Formalisation of Combinatorial Design Theory**. Presentation: CICM 2021, Online.

Dec. 2020. *Lucas's Theorem: A Generating Function Proof*. Presentation: Oxbridge Women in Computer Science Conference, Online. Awarded second prize for best student presentation

Jun. 2020. *Lucas's Theorem: Formalising Generating Function Proofs*. Presentation: Isabelle Workshop 2020, associated with IJCAR2020, Online.

Local Seminars/Talk Series

March 2023. *The Locale-Centric Approach to Formalising Mathematical Hierarchies in Isabelle/HOL*. University of Cambridge Formalisation of Mathematics Seminar Series: Department of Mathematics & Department of Computer Science, Cambridge, UK.

March 2023. *Formalising the Probabilisitic Method in Isabelle/HOL*. Tech Talks: WomenCL, Department of Computer Science, Cambridge, UK.

July 2022. *Linear Algebraic proof Techniques in Isabelle/HOL*. Theory Group PhD Seminars: Department of Computer Science, Cambridge, UK.

July 2021. *A First Modular Formalisation of Combinatorial Design Theory*. Theory Group PhD Seminars: Department of Computer Science, Online.