AXEL LJUNGSTRÖM

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https://aljungstrom.github.io/

DEGREES

Doctor of Philosophy (Computational Mathematics) — *Stockholm University, 2025*
Licentiate of Philosophy (Computational Mathematics) — *Stockholm University, 2023*
Master of Science (Mathematics) — *Stockholm University/KTH, 2020*
Bachelor of Science (Mathematics) — *Stockholm University, 2018*
Bachelor of Arts (Theoretical Philosophy) — *Stockholm University, 2018*

EMPLOYMENT

Postdoctoral researcher — *2025–Present*
School of Computer Science, University of Nottingham, Nottingham, UK

PhD Candidate — *2020–2025*
Department of Mathematics, Stockholm University, Stockholm, Sweden
PhD candidate in computational mathematics (with teaching)

Teaching Assistant (Amanuens) — *2019–2020*
Department of Mathematics, Stockholm University, Stockholm, Sweden
Teaching and administration of undergraduate courses in mathematics

Digital Developer — *2018*
Liber, Solna, Sweden
Digitalisation of textbooks in mathematics, chemistry and physics

RESEARCH GRANTS AWARDED IN COMPETITION

International postdoc within natural and engineering sciences — *2025*
The Swedish Research Council (VR)
Amount awarded: 4 050 000 SEK. *Duration:* 3 years. *Approval rate:* 12%.
Note: I turned down this grant since I had already received funding for a similar project.

Postdoctoral Scholarship Program in Mathematics for researchers with a Swedish doctor's degree — *2025*
Knut and Alice Wallenberg Foundation (KAW)
Amount awarded: minimum of €64 000/year. *Duration:* 4 years.*
*2 years at the University of Nottingham and 2 years at a Swedish institution of my choice.

PUBLICATIONS AND PREPRINTS

- In my field of mathematics/computer science, it is common (and often more prestigious) to publish papers in (peer-reviewed) conference proceedings rather than in journals. The conference *Logic in Computer Science (LICS)* is particularly prestigious.
- A paper labelled with a 🏆 has received an award (details in the following section).

Cellular Methods in Homotopy Type Theory — *2025*
Axel Ljungström, Loïc Pujet
Preprint. Available: https://pujet.fr/pdf/cellular.pdf.

Formalising inductive and coinductive containers — *2025*
Stefania Damato, Thorsten Altenkirch, Axel Ljungström
To appear in Proceedings of the 16th International Conference on Interactive Theorem Proving (ITP 2025)

The Steenrod squares via unordered joins 🏆🏆 — *2025*
Axel Ljungström, David Wärn
To appear in Proceedings of the 40th Annual ACM/IEEE Symposium on Logic in Computer Science (LICS 2025)

Symmetric Monoidal Smash Products in Homotopy Type Theory 🏆 — *2024*
Axel Ljungström
Mathematical Structures in Computer Science. 2024;34(9):985-1007

Formalising and Computing the Fourth Homotopy Group of the 3-Sphere in Cubical Agda — *2024*
Axel Ljungström, Anders Mörtberg
Submitted. Available: https://arxiv.org/abs/2302.00151.
Extended journal version of 'Formalizing $\pi_4(\mathbb{S}^3) \cong \mathbb{Z}/2\mathbb{Z}$ and Computing a Brunerie Number in Cubical Agda'

Computational Synthetic Cohomology Theory in Homotopy Type Theory — *2024*
Axel Ljungström, Anders Mörtberg
To appear in Mathematical Structures in Computer Science

Formalizing $\pi_4(\mathbb{S}^3) \cong \mathbb{Z}/2\mathbb{Z}$ and Computing a Brunerie Number in Cubical Agda 🏆 — *2023*
Axel Ljungström, Anders Mörtberg
Proceedings of the 38th Annual ACM/IEEE Symposium on Logic in Computer Science (LICS 2023)

Computing Cohomology Rings in Cubical Agda 🏆 — *2023*
Thomas Lamiaux, Axel Ljungström, Anders Mörtberg

Proceedings of the 12th ACM SIGPLAN International Conference on Certified Programs and Proofs (CPP 2023)

Synthetic Integral Cohomology in Cubical Agda *2022*
Guillaume Brunerie, Axel Ljungström, Anders Mörtberg
Proceedings of the 30th EACSL Annual Conference on Computer Science Logic (CSL 2022)

PRIZES AND AWARDS

Sigrid Arrhenius Scholarship *2025*
Stockholm University, Sigrid Arrhenius Scholarship Fund
Scholarship of 90 000 SEK awarded anually to one promising PhD student working within the natural sciences

Kleene Award *2025*
Logic in Computer Science 2025 (LICS 2025)
For 'The Steenrod squares via unordered joins' (with Wärn)

Distinguished Paper Award *2025*
Logic in Computer Science 2025 (LICS 2025)
For 'The Steenrod squares via unordered joins' (with Wärn)

Distinguished Paper Award *2023*
Logic in Computer Science 2023 (LICS 2023)
For 'Formalizing $\pi_4(\mathbb{S}^3) \cong \mathbb{Z}/2\mathbb{Z}$ and Computing a Brunerie Number in Cubical Agda' (with Mörtberg)

Best Student Paper Award *2023*
The Second International Conference on Homotopy Type Theory (HoTT 2023)
For an early version of 'Symmetric Monoidal Smash Products in Homotopy Type Theory'

Distinguished Paper Award *2023*
Certified Programs and Proofs 2023 (CPP 2023)
For 'Computing Cohomology Rings in Cubical Agda' (with Lamiaux and Mörtberg)

Mittag-Leffler Prize *2021*
Stockholm University
Prize awarded for excellent master's theses in mathematics

Dougall Prize *2016*
University of Glasgow, Department of Mathematics
Prize awarded to 'top students in mathematics on undergraduate level'

OTHER WRITINGS

Yet another homotopy group, yet another Brunerie number *2025*
Tom Jack, Axel Ljungström
Extended abstract (peer-reviewed) at TYPES 2025
Available: https://msp.cis.strath.ac.uk/types2025/TYPES2025-book-of-abstracts.pdf#page=110

Towards computing the second stable homotopy group of spheres in HoTT *2025*
Tom Jack, Axel Ljungström
Extended abstract (peer-reviewed) at the Workshop on Homotopy Type Theory/Univalent Foundations 2025
Available: https://hott-uf.github.io/2025/abstracts/HoTTUF_2025_paper_5.pdf

Hurewicz and Brouwer *2025*
Axel Ljungström, Loïc Pujet
Extended abstract (peer-reviewed) at the Workshop on Homotopy Type Theory/Univalent Foundations 2025
Available: https://hott-uf.github.io/2025/abstracts/HoTTUF_2025_paper_22.pdf

Some properties of Whitehead products *2025*
Axel Ljungström
Extended abstract (peer-reviewed) at the Workshop on Homotopy Type Theory/Univalent Foundations 2025
Available: https://hott-uf.github.io/2025/abstracts/HoTTUF_2025_paper_23.pdf

A Constructive Cellular Approximation Theorem in HoTT *2024*
Axel Ljungström, Loïc Pujet
Extended abstract (peer-reviewed) at TYPES 2024
Available: https://types2024.itu.dk/abstracts.pdf#page=113

Revisiting the Steenrod Squares in HoTT *2024*
Axel Ljungström, David Wärn
Extended abstract (peer-reviewed) at TYPES 2024
Available: https://types2024.itu.dk/abstracts.pdf#page=116

Cellular Homology and the Cellular Approximation Theorem *2024*
Axel Ljungström, Anders Mörtberg, Loïc Pujet
Extended abstract (peer-reviewed) at the Workshop on Homotopy Type Theory/Univalent Foundations 2024
Available: https://hott-uf.github.io/2024/abstracts/HoTTUF_2024_paper_12.pdf

The Steenrod Squares in HoTT Revisited *2024*
Axel Ljungström, David Wärn
Extended abstract (peer-reviewed) at the Workshop on Homotopy Type Theory/Univalent Foundations 2024
Available: https://hott-uf.github.io/2024/abstracts/HoTTUF_2024_paper_8.pdf

The Brunerie Number Is -2 *2023*
Axel Ljungström
Blog post. Available: https://homotopytypetheory.org/2022/06/09/the-brunerie-number-is-2/

CONFERENCE AND WORKSHOP PRESENTATIONS

Invited:

More cellular (co)homology in HoTT *2024*
Running HoTT, NYU Abu Dhabi, UAE
Cohomology Theory and Brunerie Numbers in Cubical Agda *2023*
Formalization of Cohomology Theories, Banff (International Research Station), Canada

Contributed:

Yet another homotopy group, yet another Brunerie number *2025*
TYPES 2025, Glasgow, UK
Some properties of Whitehead products *2025*
Workshop on Homotopy Type Theory/Univalent Foundations 2025, Genoa, Italy
Revisiting the Steenrod Squares in HoTT *2024*
TYPES 2024, Copenhagen, Denmark
The Steenrod Squares in HoTT Revisited *2024*
Workshop on Homotopy Type Theory/Univalent Foundations 2024, Leuven, Belgium
Cellular Homology and the Cellular Approximation Theorem *2024*
Workshop on Homotopy Type Theory/Univalent Foundations 2024, Leuven, Belgium
Symmetric Monoidal Smash Products in HoTT *2023*
The Second International Conference on Homotopy Type Theory, Pittsburgh, USA
Smash Products Are Symmetric Monoidal in HoTT *2023*
Workshop on Homotopy Type Theory/Univalent Foundations 2023, Vienna, Austria
Formalizing $\pi_4(\mathbf{S}^3) \cong \mathbb{Z}/\mathbf{2}\mathbb{Z}$ and Computing a Brunerie Number in Cubical Agda *2023*
Logic in Computer Science 2023, Boston, USA
The 4th Homotopy Group of the 3-Sphere in Cubical Agda *2022*
TYPES 2022, Nantes, France
Synthetic Cohomology Theory in Cubical Agda *2022*
Computer Science Logic 2022, Virtual

SEMINAR PRESENTATIONS

Invited:

$\pi_4(\mathbf{S}^3) \cong \mathbb{Z}/\mathbf{2}\mathbb{Z}$ in Cubical Agda *2023*
Seminar (Logical Foundations of Computation, University of Turin), Turin, Italy
Introduction to Cubical Agda *2023*
Seminar (Logical Foundations of Computation, University of Turin), Turin, Italy
Dealing With Smash Products in HoTT *2023*
The Stockholm-Göteborg Type Theory Seminar, Gothenburg, Sweden
Calculating a Brunerie Number *2022*
Homotopy Type Theory Electronic Seminar Talks, Virtual
Cohomology Computations in Cubical Agda *2021*
The Stockholm-Göteborg Type Theory Seminar, Virtual

Local (Stockholm University, Department of Mathematics):

Steenrod squares, the HoTT way *2024*
Logic Seminar
Dealing With Smash Products in HoTT *2023*
Logic Seminar
Introduction to Agda *2022*
Computational Mathematics Seminar
Introduction to Homotopy Type Theory *2022*
Graduate Seminar
An Excursion Into Algebraic Topology and Homotopy Type Theory *2021*
Computational Mathematics Seminar
Synthetic Cohomology Theory in Cubical Agda *2020*
Logic Seminar

TEACHING AT STOCKHOLM UNIVERSITY

As lecturer:

Computational Mathematics (DA7067) *2024*

Master's course on selected topics in computational mathematics (lecturer for module on SAT-solving) **As teaching assistant:**

Datastructures and Algorithms (DA4006) *2024–2025*
Intermediate level bachelor's course covering data structures, rudimentary complexity theory and algorithms
Programming paradigms (DA4003) *2025*
Advanced bachelor's course covering e.g. object-oriented and functional programming
Algorithms and Complexity (DA4005) *2022–2024*
Advanced bachelor's course covering Turing machines, NP-completeness, graph theory and algorithms
Computer Science for Mathematicians (DA3018) *2021–2023*
Intermediate level bachelor's course covering Unix, Java, data structures and rudimentary complexity theory
Programming Techniques for Mathematicians (DA2004) *2020–2022*
Introductory programming course for bachelor students in mathematics (in Python)
Mathematics III – Abstract Algebra (MM5020) *2020*
Advanced bachelor's course covering group theory, rings, fields and vector spaces
Preparatory Course in Mathematics (MM1003) *2019–2020*
Course preparing students for university level mathematics
Mathematics I (MM2001) *2019–2020*
Standard first year course (30 ECTS) covering elementary algebra and analysis

ADDITIONAL TEACHING EXPERIENCE

HoTTEST Summer School 2022 *2022*
Virtual (organised via Johns Hopkins University, Department of Mathematics)
Summer school on Homotopy Type Theory (teaching assistant)
EPIT 2020 – Spring School on Homotopy Type Theory *2021*
Virtual
Spring school on Homotopy Type Theory (teaching assistant)

OTHER ACTIVITIES

Referee —
Logic in Computer Science (LICS), Mathematical Structures in Computer Science (MSCS)
International Conference on Mathematical and Computational Linguistics for Proofs (MCLP) *2025*
Orsay, France
Chair
Midlands Graduate School in the Foundations of Computing Science (MGS) *2022*
Nottingham, UK
Participant
Logic and Algorithms in Computational Linguistics 2021 (LACompLing2021) *2021*
Virtual
Member of the local organising committee
EPIT 2020 – Spring School on Homotopy Type Theory *2021*
Virtual
Participant
Logic and Algorithms in Computational Linguistics 2018 (LACompLing2018) *2018*
Stockholm, Sweden
Member of the local organising committee