# 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*