Ulrik Torben Buchholtz, PhD

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RESEARCH SYNOPSIS

My research is motivated by the problem of giving *good, practical foundations of mathematics and computer science*. The goal is to have proof assistants that are worthy of their name, in bringing both a significant improvement over doing mathematics on paper and facilitating the development of correct and secure software.

EDUCATION

2008 – 2014 **Stanford University**: PhD, Mathematics.
Dissertation: *Unfolding of Systems of Inductive Definitions*
Dissertation Advisor: Solomon Feferman

2002 – 2008 **University of Copenhagen**: BSc & MSc, Mathematics.
Minors: Computer Science and Physics
MSc Thesis: *The Atiyah-Segal Completion Theorem*
MSc Thesis Advisor: Jesper Grodal

EMPLOYMENT HISTORY

2022 – ··· **University of Nottingham**, Assistant Professor at the School of Computer Science, member of the Functional Programming Lab.

2016 – 2021 **TU Darmstadt**, Department of Mathematics: Postdoc position in Mathematical Logic, working on homotopy type theory with Professors Kohlenbach and Streicher.

2015 – 2016 **Carnegie Mellon University**, Department of Philosophy: Postdoc position with Professor Awodey, working on homotopy type theory.

Fall 2014 **University of Copenhagen**, Department of Mathematics: short-term Postdoc position.

Spring 2014 **Universität Bern**, Institut für Informatik: Postdoc position with Professor Jäger, working on proof theory of applicative theories.

2008 – 2013 **Stanford University**: Alternating research assistant and teaching assistant for undergraduate mathematics courses.

2004 – 2008 **Cimco Aps**, Copenhagen: Lead developer responsible for geometric modeling and implementation of computer aided machining algorithms.

RESEARCH FELLOWSHIPS

Oct. 2018–Mar. 2019 **Centre for Advanced Study** at the Norwegian Academy of Science and Letters, Oslo, for the program *Homotopy Type Theory and Univalent Foundations* lead by Marc Bezem and Bjørn Ian Dundas.

RESEARCH PUBLICATIONS

Journal Articles

1. **Ulrik Buchholtz**, J. Daniel Christensen, Jarl G. Taxerås Flaten, and Egbert Rijke, "Central H-spaces and banded types", *Journal of Pure and Applied Algebra* (2025). doi: 10.1016/j.jpaa.2025.107963, arXiv: 2301.02636.

2. **Ulrik Buchholtz**, Tom de Jong, and Egbert Rijke, "On epimorphisms and acyclic types in univalent mathematics", *The Journal of Symbolic Logic* (2025), 1–36. doi: 10.1017/jsl.2024.76, arXiv: 2401.14106.

3. **Ulrik Buchholtz** and Egbert Rijke, "The long exact sequence of homotopy n-groups", *Mathematical Structures in Computer Science*, 33/8 (2023), 679–87. doi: 10.1017/S0960129523000038, arXiv: 1912.08696.

4. **Ulrik Buchholtz** and Jonathan Weinberger, "Synthetic fibered $(\infty, 1)$-category theory", *Higher Structures*, 7 (1 2023), 74–165. doi: 10.21136/HS.2023.04, arXiv: 2105.01724.

5. Marc Bezem, **Ulrik Buchholtz**, Daniel R. Grayson, and Michael Shulman, "Construction of the circle in UniMath", *Journal of Pure and Applied Algebra*, 225/10 (2021), 106687. doi: 10.1016/j.jpaa.2021.106687, arXiv: 1910.01856.

6. **Ulrik Buchholtz** and Kuen-Bang Hou (Favonia), "Cellular Cohomology in Homotopy Type Theory", *Logical Methods in Computer Science*, Volume 16, Issue 2 (June 2020), Journal version of LICS '18 paper. doi: 10.23638/LMCS-16(2:7)2020.

7. Marc Bezem, **Ulrik Buchholtz**, and Thierry Coquand, "Syntactic forcing models for coherent logic", *Indagationes Mathematicae*, 29/6 (2018), 1441–64. doi: 10.1016/j.indag.2018.06.004, arXiv: 1712.07743.

8. **Ulrik Buchholtz** and Egbert Rijke, "The Cayley–Dickson Construction in Homotopy Type Theory", *Higher Structures*, 2 (1 2018), 30–41. doi: 10.21136/HS.2018.02, arXiv: 1610.01134.

Conference Articles

9. Daniel Gratzer, Jonathan Weinberger, and **Ulrik Buchholtz**, "The Yoneda embedding in simplicial type theory", in *Proceedings of the 40th Annual ACM/IEEE Symposium on Logic in Computer Science* (LICS '25; Singapore, Singapore: IEEE, 2025), 127–42. doi: 10.1109/LICS65433.2025.00017, arXiv: 2501.13229.

10. **Ulrik Buchholtz** and Johannes Schipp von Branitz, "Primitive Recursive Dependent Type Theory", in *Proceedings of the 39th Annual ACM/IEEE Symposium on Logic in Computer Science* (LICS '24; Tallinn, Estonia: Association for Computing Machinery, 2024). doi: 10.1145/3661814.3662136, arXiv: 2404.01011.

11. Pierre Cagne, **Ulrik Buchholtz**, Nicolai Kraus, and Marc Bezem, "On symmetries of spheres in univalent foundations", in *Proceedings of the 39th Annual ACM/IEEE Symposium on Logic in Computer Science* (LICS '24; Tallinn, Estonia: Association for Computing Machinery, 2024). doi: 10.1145/3661814.3662115, arXiv: 2401.15037.

12. **Ulrik Buchholtz**, Floris van Doorn, and Egbert Rijke, "Higher Groups in Homotopy Type Theory", in *Proceedings of the 33rd Annual ACM/IEEE Symposium on Logic in Computer Science* (LICS '18; Oxford, United Kingdom: Association for Computing Machinery, 2018), 205–14. doi: 10.1145/3209108.3209150, arXiv: 1802.04315.

13. **Ulrik Buchholtz** and Kuen-Bang Hou (Favonia), "Cellular Cohomology in Homotopy Type Theory", in *Proceedings of the 33rd Annual ACM/IEEE Symposium on Logic in Computer Science* (LICS '18; Oxford, United Kingdom: Association for Computing Machinery, 2018), 521–9. doi: 10.1145/3209108.3209188, arXiv: 1802.02191.

14. **Ulrik Buchholtz** and Edward Morehouse, "Varieties of Cubical Sets", in *RAMICS 2017: Relational and Algebraic Methods in Computer Science*, 10226, ed. P. Höfner, D. Pous, and G. Struth (Lecture Notes in Computer Science; Cham: Springer, 2017). doi: 10.1007/978-3-319-57418-9_5, arXiv: 1701.08189.

15. **Ulrik Buchholtz** and Egbert Rijke, "The real projective spaces in homotopy type theory", in *Proceedings of the 32nd Annual ACM/IEEE Symposium on Logic in Computer Science* (LICS '17; Reykjavik, Iceland: IEEE, 2017), 1–8. doi: 10.1109/LICS.2017.8005146, arXiv: 1704.05770.

16. Floris van Doorn, Jakob von Raumer, and **Ulrik Buchholtz**, "Homotopy Type Theory in Lean", in *ITP 2017: Interactive Theorem Proving*, 10499, ed. M. Ayala-Rincón and C. Muñoz (Lecture Notes in Computer Science; Cham: Springer, 2017). doi: 10.1007/978-3-319-66107-0_30, arXiv: 1704.06781.

Book Chapters

17. **Ulrik Buchholtz**, "Higher Structures in Homotopy Type Theory", in *Reflections on the Foundations of Mathematics: Univalent Foundations, Set Theory and General Thoughts*, ed. Stefania Centrone, Deborah Kant, and Deniz Sarikaya (Cham: Springer International Publishing, 2019), 151–72. doi: 10.1007/978-3-030-15655-8_7, arXiv: 1807.02177.

18. **Ulrik Buchholtz**, Gerhard Jäger, and Thomas Strahm, "Theories of Proof-Theoretic Strength $\Psi(\Gamma_{\Omega+1})$", in *Concepts of Proof in Mathematics, Philosophy, and Computer Science* (Berlin, Boston: De Gruyter, 2016), 115–40. doi: 10.1515/9781501502620-007.

Submitted

19. Daniel Gratzer, Jonathan Weinberger, and **Ulrik Buchholtz**, *Directed univalence in simplicial homotopy type theory*, 2024, arXiv: 2407.09146.

INVITED ADDRESSES

Sep. 2025	Conference for 50 Years of Explicit Mathematics, Tübingen: *From Explicit Mathematics to Synthetic Mathematics*
	Conference on Synthetic mathematics, logic-affine computation and efficient proof systems, CIRM: *Towards synthetic locale theory*
Jul. 2025	Logic Colloquium, Vienna: *Logical aspects of simplicial type theory*
May 2024	Workshop on inductive definitions, Prague: *Coinductive definitions and constructive mathematics*
Jun. 2021	TYPES Conference, Leiden: *Genuine pairs and the trouble with triples in homotopy type theory*
Apr. 2021	HoTTEST, online: *(Co)cartesian families in simplicial type theory*
May 2020	Dagstuhl workshop on automation and geometric logic, Dagstuhl. (Postponed to 2021 due to Covid-19)
Jan. 2020	Conference on Formal Methods in Mathematics / Lean Together, CMU, Pittsburgh: *Higher Algebra in Homotopy Type Theory*
Dec. 2019	Workshop on Foundations and Applications of Univalent Mathematics, Herrsching: *The long exact sequence of higher groups from a fibration*
Aug. 2019	International Conference on Homotopy Type Theory, CMU, Pittsburgh: *Musings about 2-groups*

INVITED ADDRESSES (continued)

Mar. 2019 — Geometry in Modal Homotopy Type Theory, CMU, Pittsburgh: *Non-abelian cohomology* and *Universes in toy models of spatial type theory*

Mar. 2018 — HoTTEST, online: *From Higher Groups to Homotopy Surfaces*

Sep. 2017 — Workshop on Homotopy Type Theory/Univalent Foundations, Oxford: *Formalizing type theory in type theory using nominal techniques*

SERVICE

- Programme Committe member for TYPES 2023 and the HoTT/UF Workshop 2023.
- Reviewer for journals: Annals of Pure and Applied Logic (APAL), Homology, Homotopy and Applications (HHA), Logical Methods in Computer Science (LMCS), Mathematical Structures in Computer Science (MSCS), Journal of Symbolic Logic (JSL), Review of Symbolic Logic (RSL), Symmetry, Integrability and Geometry: Methods and Applications (SIGMA).
- Reviewer for conferences: Formal Structures for Computation and Deduction (FSCD), Logic in Computer Science (LICS), Typed Lambda Calculi and Applications (TLCA).
- For outreach, I put recordings of my talks, as well as the lectures from my seminar on *Intuitionism and Constructive Mathematics* at CMU 2016 on my YouTube channel: `https://www.youtube.com/c/UlrikBuchholtz`
- I gave an advanced course at the Midlands Graduate School 2024 in Leicester: `https://ulrikbuchholtz.dk/mgs2024-synthetic-homotopy-theory.pdf`
- I gave three lectures as part of the HoTTEST Summer School 2022: `https://www.uwo.ca/math/faculty/kapulkin/seminars/hottest_summer_school_2022.html` The goal of the summer school was to make homotopy type theory accessible to, and inclusive of, everyone who is interested, regardless of cultural background, age, ability, formal education, ethnicity, gender identity, or expression

TEACHING

2022– — Convenor for *Mathematics for Computer Scientists 2*, on linear algebra, using a customized textbook: `https://ulrikbuchholtz.dk/ila/`

2019–20 — Lecturer for *Introduction to Homotopy Type Theory*, a self-designed course at TU Darmstadt

2016–2021 — Teaching Assistant for undergraduate and graduate courses (*Linear Algebra*, *Analysis*, *Mathematics for Engineers*, *Logic for Computer Science*, and *Model Theory*) as part of qualifying for the *Habilitation*, TU Darmstadt.

2015–16 — Lecturer for *Category Theory*, Carnegie Mellon University. Gave seminars on algebraic topology as well as on intuitionism and constructive mathematics.

Fall 2014 — Lecturer for *Linear Algebra*, University of Copenhagen.

2014 — Lecturer for *Automaten und formale Sprachen*, Universität Bern. Gave a seminar on homotopy type theory.

2010–13 — Teaching Assistant for undergraduate courses, Stanford University.

2007 — Teaching Assistant for courses in topology, University of Copenhagen.

2003–2008 — Instructor for Danish contestants in High School Mathematics competitions; Deputy leader for the Danish team at the 49th International Mathematical Olympiad.

MISCELLANEOUS

- Fluent in Danish, English, and German; understands Swedish and Norwegian; reads French.
- Proficient in the use of the proof assistants Agda, Coq, and Lean.
- Good communication skills.
- Proficient in the use of the programming languages C, C++, Python, Standard ML, OCaml, Haskell, Prolog, and Julia.
- Instructor for Danish contestants in High School Mathematics competitions (2004–2008); Deputy leader for the Danish team at the 49$^{\text{th}}$ International Mathematical Olympiad (2008).
- Participated in the 42$^{\text{nd}}$ International Mathematical Olympiad (2001), the 33$^{\text{rd}}$ International Physics Olympiad (2002, Bronze Medal), and the 14$^{\text{th}}$ International Olympiad in Informatics (2002).