

Hanna Lachnitt

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Research Interests: Automated Reasoning, Formal Verification, Satisfiability Modulo Theories (SMT), Interactive Theorem Proving (ITP), Proof Certificates

PHD RESEARCH

expected graduation: summer 2027

My research has been centered around proof certificates for SMT solvers. My objective is to improve automation in the ITP Isabelle/HOL by reconstructing the SMT solver cvc5's proof certificates [3].

EDUCATION

- **Stanford University (USA)** *since 09/2020*
PhD, Computer Science
Advisor: Clark Barrett
 - GPA: 4.0
- **TU Wien (Austria)** *03/2018 – 06/2020*
MSc, Logic and Computation
Advisor: Laura Kovács
 - 1.0 (corresponds to 4.0 GPA), summa cum laude
- **Free University Berlin (Germany)** *10/2014 – 09/2017*
BSc, Computer Science
 - 1.3 (corresponds to 3.7 GPA), summa cum laude

SELECTED PUBLICATIONS

- [3] H. Lachnitt, M. Fleury, H. Barbosa, J. Jakpor, B. Andreotti, A. Reynolds, H.-J. Schurr, C. W. Barrett, and C. Tinelli. **Improving the SMT Proof Reconstruction Pipeline in Isabelle/HOL.** In *16th International Conference on Interactive Theorem Proving (ITP 2025)*, LIPIcs 352, pp. 26:1–26:22. Schloss Dagstuhl – Leibniz-Zentrum für Informatik, 2025.
- [5] H. Lachnitt, M. Fleury, L. Aniva, A. Reynolds, H. Barbosa, A. Nötzli, C. W. Barrett, and C. Tinelli. **IsaRare: Automatic Verification of SMT Rewrites in Isabelle/HOL.** In *30th International Conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS 2024)*, pp. 311–330. Springer, 2024.

RESEARCH EXPERIENCE

- **Visiting Researcher at UFMG (Brazil)** *06/2023*
Supervisor: Haniel Barbosa
Publication: [7]
 - We experimented with enriching the SAT proof format DRAT with theory information and tested its suitability for parallel checking.
 - We also worked on enhancing the Alethe proof format.
- **Research Collaboration** *11/2020 – 05/2022*
Supervisor: Caroline Trippel
Publication: [10]
 - We developed Leakage Containment Models (LCMs), a novel axiomatic security contract capturing extra-architectural communication (e.g. using the cache) and speculative execution.
- **Research Assistant, Automated Program Reasoning group, TU Wien** *09/2019 – 05/2020*
Master's Thesis: Formalizing Graph Trail Properties
Supervisor: Laura Kovács
Publication: [12]
 - I formalized a graph trail problem in Isabelle.
- **Research Assistant, Formal Methods in Security group, TU Wien** *06/2018 – 04/2019*
Supervisor: Matteo Maffei
 - I helped with a formalization of a small-step semantics of Ethereum Virtual Machine bytecode in the programming language F*.
- **Research Internship at the University of Cambridge** *06/2019 – 09/2019*
Supervisors: Anthony Bordg, Lawrence Paulson
Publication: [11]

- Formalization of quantum computing in Isabelle/HOL, including Deutsch’s algorithm, Deutsch–Jozsa algorithm, quantum Fourier transform and Grover’s algorithm.
- **Bachelor’s Thesis** 11/2016 – 01/2017
Systematic Verification of the Intuitionistic Modal Logic Cube in Isabelle/HOL
Supervisor: Christoph Benzmüller
 - Embedding of intuitionistic modal logics into higher-order logic.

AWARDS AND SCHOLARSHIPS

- **Distinguished Artifact Reviewer Award** at the International Conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS) 04/2026
- **VerifyThis Verification Competition** “Most impressive tool medley” 04/2024
- **SCP Best Tool Paper Award** for *cvc5: A Versatile and Industrial-Strength SMT Solver* 04/2022
- **Siemens Award for Excellence** 01/2020
- **Helmut Veith Stipend** 03/2018 – 02/2020
 - Financial scholarship for female students pursuing a Logic Master’s program at TU Wien, awarded to a single person per year
- **Deutschlandstipendium** (German National Scholarship) 10/2015 – 09/2016
 - Awarded by the Federal Republic of Germany for outstanding academic achievements

TEACHING & MENTORSHIP

- **Student Instructor at Stanford University** 09/2025 – 12/2025
CS257: Introduction to Automated Reasoning
 - I co-taught this class with Professor Caroline Trippel, which included giving half the lectures.
- **Teaching Assistant at Stanford University** 09/2022 – 12/2022
CS257: Introduction to Automated Reasoning 09/2023 – 12/2023
 - My duties involved office hours, correcting assignments, exams, and supervising the final class project.
 - Because 2022 was the first time the class was offered, I also designed most exercise sheets for the class.
- **Mentoring:** Jibiana Jakpor (now a PhD student at MIT) 2022 – 2025

COMMUNITY SERVICE

- **Program Committee member** of the 28th International Symposium on Symbolic and Numeric Algorithms for Scientific Computing (SYNASC 2026) 2026
- **Program Committee member** of the Satisfiability Checking and Symbolic Computation (SC²) Workshop 2026
- **Reviewer** CADE, TACAS, SC², SYNASC, Mathematics in Computer Science Journal various
- **Artifact reviewer** TACAS, ATVA 2023, 2024, 2025

PROFESSIONAL EXPERIENCE

- **Apple** 06/2026 – 08/2026
Hardware Formal Verification Intern
Supervisor: Thomas Rasmussen
 - TBA, waiting for release confirmation
- **Amazon (AWS)** 06/2022 – 09/2022
Applied Science Intern
Supervisor: Robert Jones
 - During the internship at AWS, my team developed EDRAT, a new SMT proof format that extends the popular DRAT format for SAT proofs with theory reasoning. I worked on instructing the cvc5 SMT solver to output EDRAT proofs (see publication [4]).
- **Apple** 06/2021 – 09/2021
Software Formal Verification Intern
Supervisor: Tim Pruss
 - I formally verified key aspects of a kernel system using the Isabelle proof assistant and gained experience verifying C code using the AutoCorres plugin.
- **Bundesdruckerei GmbH** 08/2016 – 09/2016
Intern
 - Contributed to the first draft of the standard ISO/IEC 39794-5: Information technology – Biometric data interchange formats – Part 5: Face Image Data

VOLUNTARY WORK

- **Faculty Search Committee member** at Stanford's CS department 2025
- **Chair of the PhD Advisory Council** at Stanford's CS department 11/2022 – 11/2023
- **Co-Organizer of the Women in CS Lunch** at Stanford 09/2021 – 12/2022
- **Student Reader** on the Admissions Committee for CS PhD students at Stanford 10/2022 – 12/2022
- **Other:**
 - Part of a team representing the Stanford CS Department at the Grace Hopper Conference, student buddy for new PhD students, ...

LIST OF PUBLICATIONS

- [1] A. Reynolds, H.-J. Schurr, H. Barbosa, O. Israel, J. Jakpor, H. Lachnitt, A. Mohamed, A. Niemetz, M. Preiner, Y. Zohar, R. B. Jones, C. W. Barrett, and C. Tinelli. **The Cooperating Proof Calculus: Comprehensive Proofs for an SMT Solver**. In *38th International Conference on Computer Aided Verification (CAV 2026)*, Part II, LNCS 16683, pp. 188–212. Springer, 2026.
- [2] S. Binder, H. Lachnitt, and K. Kosaian. **Apply2Isar: Automatically Converting Isabelle/HOL Apply-Style Proofs to Structured Isar**. In *17th International Conference on Interactive Theorem Proving (ITP 2026)*, LIPIcs 382, pp. 18:1–18:20. Schloss Dagstuhl – Leibniz-Zentrum für Informatik, 2026.
- [3] H. Lachnitt, M. Fleury, H. Barbosa, J. Jakpor, B. Andreotti, A. Reynolds, H.-J. Schurr, C. W. Barrett, and C. Tinelli. **Improving the SMT Proof Reconstruction Pipeline in Isabelle/HOL**. In *16th International Conference on Interactive Theorem Proving (ITP 2025)*, LIPIcs 352, pp. 26:1–26:22. Schloss Dagstuhl – Leibniz-Zentrum für Informatik, 2025.
- [4] S. Hitarth, C. R. Codel, H. Lachnitt, and B. Dutertre. **Extending DRAT to SMT**. In *Formal Methods in Computer-Aided Design (FMCAD 2024)*, pp. 1–11. IEEE, 2024.
- [5] H. Lachnitt, M. Fleury, L. Aniva, A. Reynolds, H. Barbosa, A. Nötzli, C. W. Barrett, and C. Tinelli. **IsaRare: Automatic Verification of SMT Rewrites in Isabelle/HOL**. In *30th International Conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS 2024)*, pp. 311–330. Springer, 2024.
- [6] H. Barbosa, C. W. Barrett, B. Cook, B. Dutertre, G. Kremer, H. Lachnitt, A. Niemetz, A. Nötzli, A. Ozdemir, M. Preiner, A. Reynolds, C. Tinelli, and Y. Zohar. **Generating and Exploiting Automated Reasoning Proof Certificates**. In *Communications of the ACM* 66(10), pp. 86–95. ACM, 2023.
- [7] B. Andreotti, H. Lachnitt, and H. Barbosa. **Carcara: An Efficient Proof Checker and Elaborator for SMT Proofs in the Alethe Format**. In *29th International Conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS 2023)*, Part I, LNCS 13993, pp. 367–386. Springer, 2023.
- [8] H. Barbosa, A. Reynolds, G. Kremer, H. Lachnitt, A. Niemetz, A. Nötzli, A. Ozdemir, M. Preiner, A. Viswanathan, S. Viteri, Y. Zohar, C. Tinelli, and C. W. Barrett. **Flexible Proof Production in an Industrial-Strength SMT Solver**. In *11th International Joint Conference on Automated Reasoning (IJCAR 2022)*, LNCS 13385, pp. 15–35. Springer, 2022.
- [9] H. Barbosa, C. W. Barrett, M. Brain, G. Kremer, H. Lachnitt, M. Mann, A. Mohamed, M. Mohamed, A. Niemetz, A. Nötzli, A. Ozdemir, M. Preiner, A. Reynolds, Y. Sheng, C. Tinelli, and Y. Zohar. **cvc5: A Versatile and Industrial-Strength SMT Solver**. In *28th International Conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS 2022)*, Part I, LNCS 13243, pp. 415–442. Springer, 2022.
- [10] N. Mosier, H. Lachnitt, H. Nemati, and C. Trippel. **Axiomatic Hardware-Software Contracts for Security**. In *49th Annual International Symposium on Computer Architecture (ISCA 2022)*, pp. 72–86. ACM, 2022.
- [11] A. Bordg, H. Lachnitt, and Y. He. **Certified Quantum Computation in Isabelle/HOL**. In *Journal of Automated Reasoning* 65(5), pp. 691–709, 2021.
- [12] L. Kovács, H. Lachnitt, and S. Szeider. **Formalizing Graph Trail Properties in Isabelle/HOL**. In *13th International Conference on Intelligent Computer Mathematics (CICM 2020)*, LNCS 12236, pp. 190–205. Springer, 2020.