Jeremy Avigad

Personal Data

Born January 9, 1968, New York, N.Y. Citizenship: USA.

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Research Interests

Mathematical logic, formal methods in mathematics, history and philosophy of mathematics

Professional Experience

2008-present	Professor of Philosophy, Carnegie Mellon University
2022-present	Professor of Mathematical Sciences, Carnegie Mellon University
2021-present	Director, Charles C. Hoskinson Center for Formal Mathematics
2024-present	Dean's Chair of Logic and Philosophy of Mathematics, Carnegie Mellon University
2007-2021	Courtesy appointment, Department of Mathematical Sciences, Carnegie Mellon University
August 2016	Visiting Researcher, Microsoft Research, Redmond
August 2014	Visiting Researcher, Microsoft Research, Redmond
2009-2010	Visiting Researcher, Microsoft Research / Inria Joint Centre, Orsay
2003-2008	Associate Professor of Philosophy with tenure, Carnegie Mellon University
2002-2003	Associate Professor of Philosophy, Carnegie Mellon University
1996-2002	Assistant Professor of Philosophy, Carnegie Mellon University
Spring 1996	Special Year in Logic and Algorithms Postdoctoral Fellow, DIMACS
1995-1996	T. H. Hildebrandt Assistant Professor of Mathematics, University of Michigan

Education

1990-1995	University of California, Berkeley, Ph.D. (Mathematics) Dissertation: *Proof-Theoretic Investigations of Subsystems of Second-Order Arithmetic* Advisor: Jack Silver
1984-1989	Harvard University, B.A. magna cum laude (Mathematics)

Grants and Fellowships

2024-2026	Defense Advanced Research Projects Agency, "Industrial Scale Proof Engineering for Critical Trustworthy Applications" (with Marijn Heule, Bryan Parno, and Ruben Martins, as a subcontract to Collins Aerospace)
2022-2025	National Science Foundation Research Grant, "Synergy between Automated Reasoning and Interactive Theorem Proving" (with Marijn Heule)
2018-2021	Air Force Office of Scientific Research, "Constructive Methods and Formal Verification in Analysis" (with Steve Awodey, Stefan Mitsch, and André Platzer)
2018-2021	Alfred P. Sloan Foundation, "Formal Abstracts" (with Thomas Hales)
2016-2018	National Science Foundation Research Grant, "Verified computation and proof"
2014-2019	Air Force Office of Scientific Research, "MURI: Homotopy Type Theory: Unified Foundations of Mathematics and Computation," (co-PI; lead PI, Steve Awodey)

2012-2015	Air Force Office of Scientific Research, "Type Theory, Computation, and Interactive Theorem Proving" (co-PI Robert Harper)
2011-2014	National Science Foundation Research Grant, "Proof mining and formal verification"
2010-2011	Andrew W. Mellon Foundation, follow-up to the New Directions Fellowship
2009-2011	National Science Foundation, "Carnegie Mellon summer school in logic and formal epistemology" (co-PI David Danks)
2008-2009	Templeton Foundation, Exploring the Infinite Grant Program, "The infinite in combinatorics and number theory"
2007-2010	National Science Foundation Research Grant, "Collaborative research: Logical support for formal verification" (co-PIs Harvey Friedman, Murali Sitaraman, and Bruce Weide)
2006-2008	National Science Foundation, "Carnegie Mellon summer school in logic and formal epistemology" (co-PI Teddy Seidenfeld; renewed once)
2004-2007	National Science Foundation Research Grant, "Collaborative research: Theoretical support for mechanized proof assistants" (co-PI Harvey Friedman)
2003-2004	Andrew W. Mellon Foundation New Directions Fellowship
2000-2003	National Science Foundation Research Grant, "Constructive aspects of classical logic"
1996-1999	National Science Foundation Research Grant, "A model-theoretic approach to proof theory"

PAPERS

"Canonical for automated theorem proving in Lean," Chase Norman and Jeremy Avigad, submitted.

"Is mathematics obsolete?," submitted.

"Foundations," to appear in the *Handbook of Proof Assistants and their Applications in Mathematics and Computer Science*, edited by Jasmin Blanchette and Assia Mahboubi, Springer.

"Lean-auto: An interface between Lean 4 and automated theorem provers," Yicheng Qian, Joshua Clune, Clark Barrett, and Jeremy Avigad, to appear in *Computer Aided Verification (CAV)*, 2025.

"A proof-producing compiler for blockchain applications" (a revised and expanded version of the conference paper), Jeremy Avigad, Lior Goldberg, David Levit, Yoav Seginer, and Alon Titelman, *Journal of Automated Reasoning*, 61(9), 2025.

"ImProver: Agent-based automated proof optimization," Riyaz Ahuja, Jeremy Avigad, Prasad Tetali, and Sean Welleck, to appear in ICLR 2025.

"Certified knowledge compilation with application to formally verified model counting," Randal E. Bryant, Wojciech Nawrocki, Jeremy Avigad, Marijn Heule, *Journal of Artificial Intelligence Research*, 82:2057-2099, 2025.

"Anatomy of a formal proof," Jeremy Avigad, Johan Commelin, Heather Macbeth, and Adam Topaz, *Notices of the AMS*, 72(2):188-195, 2025.

"Verified substitution redundancy checking," Cayden Codel, Jeremy Avigad, and Marijn Heule, *Formal Methods in Computer-Aided Design (FMCAD) 2024*, 186-196. 2024.

"Duper: a proof-producing superposition theorem prover for dependent type theory," Joshua Clune, Yicheng Qian, Jeremy Avigad, and Alexander Bentkamp, in Yves Bertot, Temur Kutsia, and Michael Norrish, editors, *Interactive Theorem Proving (ITP) 2024.*

"Automated reasoning for mathematics," in Christoph Benzmüller, Marijn Heule, Renate Schmidt, editors, *International Joint Conference on Automated Reasoning (IJCAR) 2024*, Springer, 3-20, 2024.

"The design of mathematical language," in Bharath Sriraman, editor, *Handbook of the History and Philosophy of Mathematical Practice*, Springer, 3151-3189, 2024.

"Mathematics and the formal turn," *Bulletin of the American Mathematical Society*, 61:225-240, 2024.

"Two-sorted Frege arithmetic is not conservative," Stephen Mackereth and Jeremy Avigad, *Review of Symbolic Logic*, 16(4):1199-1232, 2023.

"What we talk about when we talk about mathematics," in Karine Chemla, José Ferreirós, Lizhen Ji, Erhard Scholz, and Chang Wang, editors, *The Richness of the History of Mathematics*, Springer, Cham, 651-658, 2023.

"Verified encodings for SAT Solvers," Cayden Codel, Jeremy Avigad, and Marijn Heule, in A. Nadel and K. Y. Rozier, eds., *Formal Methods in Computer Aided Design (FMCAD) 2023*, TU Wien Academic Press, 141-151, 2023.

"Certified knowledge compilation with application to verified model counting," Randal Bryant, Wojciech Nawrocki, Jeremy Avigad, and Marijn Heule, in Meena Mahajan and Friedrich Slivovsky, eds., *Theory and Applications of Satisfiabilty Testing (SAT)* 2023, Schloss Dagstuhl – Leibniz-Zentrum für Mathematik, 6:1–6:20, 2023.

"A proof-producing compiler for blockchain applications," Jeremy Avigad, Lior Goldberg, David Levit, Yoav Seginer, and Alon Titelman, in Adam Naumowicz and René Thiemann, eds., *Interactive Theorem Proving, (ITP)* 2023, Schloss Dagstuhl – Leibniz-Zentrum für Mathematik, 7:1–7:19, 2023.

"An impossible asylum," Jeremy Avigad, Seulkee Baek, Alexander Bentkamp, Marijn Heule, and Wojciech Nawrocki, *American Mathematical Monthly*, 130(5):446-453, 2023.

"Verified reductions for optimization," Alexander Bentkamp, Ramon Fernández Mir, and Jeremy Avigad. In Sriram Sankaranarayanan and Natasha Sharygina, eds., *Tools and Algorithms for the Construction and Analysis of Systems (TACAS) 2023*, Springer, 74-92, 2023.

"ProofNet: A benchmark for autoformalizing and formally proving undergraduate-level mathematics problems," Zhangir Azerbayev, Bartosz Piotrowski, Hailey Schoelkopf, Edward W. Ayers, Dragomir Radev, and Jeremy Avigad, preprint, 2023.

"Varieties of mathematical understanding," *Bulletin of the American Mathematical Society*, 59(1):99-117, 2022.

"A verified algebraic representation of Cairo program execution," Jeremy Avigad, Lior Goldberg, David Levit, Yoav Seginer, and Alon Titelman. In Andrei Popescu, Steve Zdancewic, editors, *Certified Proofs and Programs (CPP)*, 153-165, 2022.

"Progress on a perimeter surveillance problem," Jeremy Avigad, and Floris van Doorn. *IEEE Conference on Autonomous Systems (ICAS) 2021*.

"Reliability of mathematical inference," *Synthese*, 198(8):7377-7399, 2020.

"The Lean mathematical library," by The mathlib Community, in Jasmin Blanchette and Cătălin Hriţcu, editors, *Certified Proofs and Programs (CPP) 2020*, ACM Publications, 2020.

"Modularity in mathematics," *Review of Symbolic Logic*, 13:47-79, 2020.

"Learning logic and proof with an interactive theorem prover," Gila Hanna, David Reid, and Michael de Viliers, editors, *Proof Technology in Mathematics Research and Teaching*, Springer, Cham, 277-290. 2019.

"Quotients of polynomial functors," Jeremy Avigad, Mario Carneiro, and Simon Hudon, in John Harrison, John O'Leary, and Andrew Tolmach, editors, *Interactive Theorem Proving (ITP) 2019*, LIPIcs, 6:1-6:19 , 2019.

"Algorithmic barriers to representing conditional independence," Nathanael L. Ackerman, Jeremy Avigad, Cameron E. Freer, Daniel M. Roy, Jason M. Rute, to appear in *Logic in Computer Science (LICS) 2019*.

"Proof Theory," in *Introduction to Formal Philosophy*, edited by Vincent F. Hendricks and Sven Ove Hansson, Springer, Cham, 177-190, 2018.

"The mechanization of mathematics," *Notices of the AMS*, 65:681-690, 2018. Reprinted in Mircea Pitici editor, *The Best Writing on Mathematics 2019*, Princeton University Press, 2019, 150-170.

"Introduction to *Milestones in Interactive Theorem Proving*," Jeremy Avigad, Jasmin Christian Blanchette, Gerwin Klein, Lawrence Paulson, Andrei Popescu, and Gregor Snelting, *Journal of Automated Reasoning*, 61:1-8, 2018.

"A metaprogramming framework for formal verification," Gabriel Ebner, Sebastian Ullrich, Jared Roesch, Jeremy Avigad, and Leonardo de Moura, *Proceedings of the ACM on Programming Languages, International Conference on Functional Programming*, 1:34, 2017.

"A formally verified proof of the central limit theorem," Jeremy Avigad, Johannes Hölzl, and Luke Serafin, *Journal of Automated Reasoning*, 59(4):389-423, 2017.

"Character and object," Jeremy Avigad and Rebecca Morris, *Review of Symbolic Logic*, 9 (3): 480-510, 2016.

"A heuristic prover for real inequalities," Jeremy Avigad, Robert Y. Lewis, and Cody Roux, *Journal of Automated Reasoning*, 56:367-386, 2016. Conference version in Gerwin Klein and Ruben Gamboa, eds., *Interactive Theorem Proving 2014*, Springer, Heidelberg, 61-76, 2014.

"Mathematics and language," in Ernest Davis and Philip Davis eds., *Mathematics, Substance, and Surmise: Views on the Meaning and Ontology of Mathematics*, Springer, Cham, 235-255, 2015.

"The Lean theorem prover (system description)," Leonardo de Moura, Soonho Kong, Jeremy Avigad, Floris van Doorn, and Jakob von Raumer. *25th International Conference on Automated Deduction (CADE-25)*, Berlin, Germany, 2015.

"Oscillation and the mean ergodic theorem for uniformly convex Banach spaces," Jeremy Avigad and Jason Rute, *Ergodic Theory and Dynamical Systems*, 35(4):1009-1027, 2015.

"Homotopy limits in type theory," Jeremy Avigad, Krzysztof Kapulkin, and Peter LeFanu Lumsdaine, *Mathematical Structures in Computer Science*, 25:1040-1070, 2015.

"The concept of 'character' in Dirichlet's theorem on primes in an arithmetic progression," Jeremy Avigad and Rebecca Morris, *Archive for History of Exact Science*, 68: 265-326, 2014.

"Formalized mathematics," Jeremy Avigad and John Harrison, *Communications of the Association for Computing Machinery* , 57(4):66-75, 2014.

"Computability and analysis: the legacy of Alan Turing," Jeremy Avigad and Vasco Brattka, in Rod Downey, editor, *Turing's Legacy: Developments from Turing's Ideas in Logic*, Cambridge University Press, 1-47, 2014.

"Ultraproducts and metastability," Jeremy Avigad and José Iovino, *New York Journal of Mathematics*, 19:713-727, 2013.

"A machine-checked proof of the Odd Order Theorem," Georges Gonthier, Andrea Asperti, Jeremy Avigad, Yves Bertot, Cyril Cohen, François Garillot, Stéphane Le Roux, Assia Mahboubi, Russell O'Connor, Sidi Ould Biha, Ioana Pasca, Laurence Rideau, Alexey Solovyev, Enrico Tassi, Laurent Théry, in Sandrine Blazy, Christine Paulin-Mohring, and David Pichardie, editors, *Interactive Theorem Proving 2013*, Springer, Berlin, pages 163-179, 2013.

"Uniform distribution and algorithmic randomness," *Journal of Symbolic Logic*, 78:334-344, 2013.

"Uncomputably noisy ergodic limits," *Notre Dame Journal of Formal Logic*, 53:347-350, 2012.

"Algorithmic randomness, reverse mathematics, and the dominated convergence theorem," Jeremy Avigad, Edward Dean, and Jason Rute, *Annals of Pure and Applied Logic*, 163:1854-1864, 2012.

"Inverting the Furstenberg correspondence," *Discrete and Continuous Dynamical Systems, Series A*, 32: 342-3431, 2012.

"Metastable convergence theorems," Jeremy Avigad, Edward Dean, and Jason Rute, *Journal of Logic and Analysis*, 4:3:1-19, 2012.

"Delta-complete decision procedures for satisfiability over the reals," Sicun Gao, Jeremy Avigad, and Edmund M. Clarke, in Bernard Gramlich et al., *Proceedings of the International Joint Conference on Automated Reasoning (IJCAR)*, 286-300, 2012.

"Delta-decidability over the reals," Sicun Gao, Jeremy Avigad, and Edmund M. Clarke, *Proceedings of the 27th Annual IEEE Symposium on Logic in Computer Science (LICS)*, 305-314, 2012.

"Zen and the art of formalization," Jeremy Avigad and Andrea Asperti, *Mathematical Structures in Computer Science*, special issue on interactive theorem proving and the formalization of mathematics, 21: 679-682, 2011.

"Building a push-button RESOLVE verifier: Progress and challenges," Murali Sitaraman, Bruce Adcock, Jeremy Avigad, Derek Bronish, Paolo Bucci, David Frazier, Harvey M. Friedman, Heather Harton, Wayne Heym, Jason Kirschenbaum, Joan Krone, Hampton Smith, Bruce W. Weide, *Formal Aspects of Computing*, 23:607-626, 2011.

"Understanding, formal verification, and the philosophy of mathematics," special issue of on "Logic and Philosophy Today," *Journal of the Indian Council of Philosophical Research*, 27: 161-197, 2010.

"Metastability in the Furstenberg-Zimmer tower," Jeremy Avigad and Henry Towsner, *Fundamenta Mathematicae*, 210:243-268, 2010.

"The computational content of classical arithmetic," in Solomon Feferman and Wilfried Sieg, eds., *Proofs, Categories, and Computations: Essays in Honor of Grigori Mints*, College Publications, 15-30, 2010.

"Gödel and the metamathematical tradition," in Charles Parsons et al. eds., *Kurt Gödel : Essays for his Centennial*, ASL Lecture Notes in Logic, Cambridge University Press, 45-60, 2010.

"Local stability of ergodic averages," Jeremy Avigad, Philipp Gerhardy, and Henry Towsner, *Transactions of the American Mathematical Society*, 362: 261-288, 2010.

"Functional interpretation and inductive definitions," Jeremy Avigad and Henry Towsner, *Journal of Symbolic Logic*, 74:1100-1120, 2009.

"A language for mathematical knowledge management," Steven Kieffer, Jeremy Avigad, and Harvey Friedman, *Studies in Logic, Grammar and Rhetoric* (special issue on computer reconstruction of the body of mathematics), 18:51-66, 2009.

"A formal system for Euclid's *Elements,"* Jeremy Avigad, Edward Dean, and John Mumma, *Review of Symbolic Logic*, 2:700-768, 2009.

"The metamathematics of ergodic theory," *Annals of Pure and Applied Logic*, 157:64-76, 2009.

"Understanding proofs," in Paolo Mancosu, editor, *The Philosophy of Mathematical Practice*, Oxford University Press, 317-353, 2008.

"Computers in mathematical inquiry," in Paolo Mancosu, editor, *The Philosophy of Mathematical Practice*, Oxford University Press, 302-316, 2008.

Response to questionnaire, in Vincent F. Hendricks and Hannes Leitgeb, editors, *Philosophy of Mathematics: 5 questions*, Automatic Press / VIP, 2007.

"A formally verified proof of the prime number theorem," Jeremy Avigad, Kevin Donnelly, David Gray, and Paul Raff, *ACM Transactions on Computational Logic* 9(1:2):1-23, 2007.

"Philosophy of mathematics," in Constantin Boundas, editor, *The Edinburgh Companion to Twentieth-Century Philosophies*, Edinburgh University Press, 234-251, 2007; also published as *The Columbia Companion to Twentieth-Century Philosophies*, Columbia University Press, 2007.

"A decision procedure for 'big O' equations," Jeremy Avigad and Kevin Donnelly, *Journal of Automated Reasoning* 38: 353-373, 2007.

"Quantifier elimination for the reals with a predicate for the powers of two," Jeremy Avigad and Yimu Yin, *Theoretical Computer Science* 370:48-59, 2007.

"Combining decision procedures for the reals," Jeremy Avigad and Harvey Friedman, *Logical Methods in Computer Science* 2(4:4):1-42, 2006.

"Mathematical method and proof," *Synthese*, 153:105-159, 2006.

"Methodology and metaphysics in the development of Dedekind's theory of ideals," in José Ferreirós and Jeremy Gray, editors, *The Architecture of Modern Mathematics*, Oxford University Press, 159-286, 2006.

"Fundamental notions of analysis in subsystems of second-order arithmetic," Jeremy Avigad and Ksenija Simic, *Annals of Pure and Applied Logic*, 139:138-184, 2006.

"Weak theories of nonstandard arithmetic and analysis," in Stephen Simpson, editor, *Reverse Mathematics 2001*. A K Peters, 19-46, 2005.

"Forcing in proof theory," *Bulletin of Symbolic Logic*, 10:305-333, 2004.

"Formalizing O notation in Isabelle/HOL," Jeremy Avigad and Kevin Donnelly, in David Basin and Michaël Rusinowitch, editors, *Automated Reasoning: second international joint conference, IJCAR 2004*, Lecture Notes in Artificial Intelligence 3097, Springer, 357-371, 2004.

"Number theory and elementary arithmetic," *Philosophia Mathematica*, 11:257-284, 2003.

"Eliminating definitions and Skolem functions in first-order logic," *ACM Transactions on Computational Logic*, 4:402-415, 2003. (Conference version: *Proceedings of the 16th annual IEEE Symposium on Logic in Computer Science*, 139-146, 2001.)

"The epsilon calculus," Jeremy Avigad and Richard Zach, in the *Stanford Encyclopedia of Philosophy*, 2002.

"Saturated models of universal theories," *Annals of Pure and Applied Logic*, 118:219-234, 2002.

"Ordinal analysis without proofs," in Wilfried Sieg et. al, eds., *Reflections on the Foundations of Mathematics: Essays in Honor of Solomon Feferman*, Association for Symbolic Logic, A K Peters, 1-36, 2002.

"Transfer principles in nonstandard intuitionistic arithmetic," Jeremy Avigad and Jeffrey Helzner, *Archive for Mathematical Logic*, 41:581-602, 2002.

"An ordinal analysis of admissible set theory using recursion on ordinal notations," Jeremy Avigad, *Journal of Mathematical Logic*, 2:91-112, 2002.

"Update procedures and the 1-consistency of arithmetic," Jeremy Avigad, *Mathematical Logic Quarterly*, 48:3-13, 2002.

"Algebraic proofs of cut elimination," *Journal of Logic and Algebraic Programming*, 49:15-30, 2001.

"Interpreting classical theories in constructive ones," *Journal of Symbolic Logic*, 65:1785-1812, 2000.

"A realizability interpretation for classical arithmetic," in Buss, Hájek, and Pudlák eds., *Logic Colloquium '98*, Lecture Notes in Logic 13, AK Peters, 57-90, 2000.

"The model-theoretic ordinal analysis of predicative theories," Jeremy Avigad and Richard Sommer, *Journal of Symbolic Logic*, 64:327-349, 1999.

"Gödel's functional (Dialectica) interpretation," Jeremy Avigad and Solomon Feferman, in the *Handbook of Proof Theory*, Samuel Buss, ed., Elsevier 337-405, 1998.

"An effective proof that open sets are Ramsey," *Archive for Mathematical Logic*, 37:235-240, 1998.

"Predicative functionals and an interpretation of ID$^{<\omega}$," *Annals of Pure and Applied Logic*, 92:1-34, 1998.

"Plausibly hard combinatorial tautologies," in Paul Beame and Samuel Buss, eds., *Proof Complexity and Feasible Arithmetics*, AMS Publications 1-12, 1997.

"A model-theoretic approach to ordinal analysis," Jeremy Avigad and Richard Sommer, *Bulletin of Symbolic Logic*, 3:17-52, 1997.

"Formalizing forcing arguments in subsystems of second-order arithmetic," *Annals of Pure and Applied Logic*, 82:165-191, 1996.

"On the relationship between ATR_0 and $ID^{<\omega}$," *Journal of Symbolic Logic*, 61:768-779, 1996.

TECHNICAL REPORTS AND UNPUBLISHED MANUSCRIPTS

"A formalization of the mutilated chessboard problem," notes, 2019.

"Automated reasoning for the working mathematician," notes, 2019.

"Elaboration in dependent type theory," Leonardo de Moura, Jeremy Avigad, Soonho Kong, and Cody Roux, 2015. manuscript.

"A formally verified proof of the Central Limit Theorem (preliminary announcement)," Jeremy Avigad, Johannes Hölzl, and Luke Serafin, presented to the Isabelle workshop , Vienna, July 2014. On arXiv.

"A variant of the double-negation translation," Carnegie Mellon Technical Report CMU-PHIL-179, 2006.

"Notes on a formalization of the prime number theorem," Carnegie Mellon Technical Report CMU-PHIL-163, 2004.

"Dedekind's 1871 version of the theory of ideals," Carnegie Mellon Technical Report CMU-PHIL-162, 2004.

"Notes on $\prod^1_1$ conservativity, ω-submodels, and the collection schema," Carnegie Mellon Technical Report CMU-PHIL-125, 2001.

"'Clarifying the nature of the infinite': the development of metamathematics and proof theory," with Erich H. Reck, Carnegie Mellon Technical Report CMU-PHIL-120, 2001.

BOOK

Mathematical Logic and Computation, Cambridge University Press, 2022.

ONLINE BOOKS

Mathematics in Lean, Jeremy Avigad and Patrick Massot. In progress. https://leanprover-community.github.io/mathematics_in_lean

Logic and Mechanized Reasoning, Jeremy Avigad, Marijn Heule, and Wojciech Nawrocki. In progress. https://avigad.github.io/lamr

Theorem Proving in Lean 4, Jeremy Avigad, Leonardo de Moura, Soonho Kong, and Sebastian Ulrich. http://leanprover.github.io/theorem_proving_in_lean4

Logic and Proof, Jeremy Avigad, Floris van Doorn, and Robert Lewis. http://leanprover.github.io/logic_and_proof

REVIEWS

Review of *Logic's Lost Genius: The Life of Gerhard Gentzen*, by Eckart Menzler-Trott and *Gentzen's Centenary: The Quest for Consistency*, edited by Reinhard Kahle and Michael Rathjen, *Notices of the American Mathematical Society*, 63(11):1288-1292, 2016.

Review of *Dense Sphere Packings: A Blueprint for Formal Proofs*, by Thomas Hales, *Bulletin of Symbolic Logic*, 20(4):500-501, 2014.

Review of *Why is there Philosophy of Mathematics at All?,* by Ian Hacking, *Newsletter of the London Mathematical Society*, December, 2014.

Review of *Alan Turing: His Work and Impact*, edited by S. Barry Cooper and Jan van Leeuwen, *Notices of the American Mathematical Society*, 61(8):886-890, 2014.

Review of *Proof and Other Dilemmas: Mathematics and Philosophy*, edited by Bonnie Gold and Roger A. Simons, *Notices of the American Mathematical Society*, 58(11): 1580-1584, 2011.

Review of the *Handbook of Practical Logic and Automated Reasoning*, by John Harrison, *Theory and Practice of Logic Programming*, 10:237-241, 2010.

Review of *Plato's Ghost: The Modernist Transformation of Mathematics*, by Jeremy Gray, *Mathematical Intelligencer*. 32(2):79-81, 2010.

Review of *Visual Thinking in Mathematics: An Epistemological Study*, by Marcus Giaquinto, *Philosophia Mathematica*, 17:95-108, 2009.

Review of *The Provenance of Pure Reason: Essays in the Philosophy of Mathematics and its History*, by William Tait, *Bulletin of Symbolic Logic*, 12:608-611, 2006.

Review of *The Birth of Model Theory: Löwenheim's Theorem in the Frame of the Theory of Relatives*, by Calixto Badesa, *Mathematical Intelligencer*, 28(4):67-71, 2006.

Review of *Gnomes in the Fog: The Reception of Brouwer's Intuitionism in the 1920s*, by Dennis E. Hesseling, *Mathematical Intelligencer*, 28(4):71-74, 2006.

Review of "Explicit provability and constructive semantics," by Sergei Artemov, *Bulletin of Symbolic Logic* 8:432, 2002.

Review of *Proofs and Confirmations*, by David Bressoud, *SIGACT Newsletter*, 32:4-5, 2001.

Review of *Basic Proof Theory*, by A.S. Troelstra and Helmut Schwichtenberg, *SIGACT Newsletter*, 32, 2001.

Review of "Some results on cut-elimination, provable well-orderings, induction, and reflection," by Toshiyasu Arai, *Bulletin of Symbolic Logic*, 7:77-78, 2001

Review of *In the Light of Logic*, by Solomon Feferman, *Journal of Philosophy*, 96:638-642, 1999.

Review of *First-Order Logic*, by Raymond Smullyan, *Journal of Symbolic Logic*, 61:351, 1996.

EDITED PROCEEDINGS

Jeremy Avigad and Assia Mahboubi, editors, *Interactive Theorem Proving 2018*, Springer.

Jeremy Avigad and Adam Chlipala, editors, *Proceedings of the 5th ACM SIGPLAN Conference on Certified Programs and Proofs, Saint Petersburg, FL, USA, January 20-22,* ACM, 2016.

PHD STUDENTS

James Gallicchio (Computer Science, co-advised with Marijn Heule, current)

Chase Norman (Computer Science, current)

Cayden Codel (Computer Science, co-advised with Marijn Heule, current)

Hannah Fechtner (Logic, Computation, and Methodology, current)

Joshua Clune (Computer Science, current)

Wojciech Narwocki (Logic, Computation, and Methodology, current)

Mario Carneiro (Pure and Applied Logic, 2022), *Metamath Zero: From logic, to proof assistant, to verified computation*

Floris van Doorn (Pure and Applied Logic, 2018), *On the formalization of higher inductive types and synthetic homotopy theory*

Robert Lewis (Pure and Applied Logic, 2017), *Two tools for formalizing mathematical proofs*

Rebecca Morris (Logic, Computation, and Methodology, 2015), *Appropriate steps: a theory of motivated proof*

Jason Rute (Mathematical Sciences, 2013), *Topics in algorithmic randomness and computable analysis.*

Sicun Gao (Logic, Computation, and Methodology, 2012, co-advised with Ed Clarke), *Computable analysis, decision procedures, and hybrid automata:a new framework for the formal verification of cyber-physical system*

Henry Towsner (PhD, Mathematical Sciences, 2008), *Some results in logic and ergodic theory*

Yimu Yin (PhD, Logic, Computation, and Methodology, 2008), *Sets, models, and valued fields*

Kerry Ojakian (PhD, Mathematical Sciences, 2004), *Combinatorics in bounded arithmetic*

Ksenija Simic (PhD, Mathematical Sciences, 2004), *Aspects of ergodic theory in subsystems of second-order arithmetic*

PhD committees I have served on (in Philosophy and at Carnegie Mellon, unless otherwise noted): Jure Taslak (Computer Science, University of Ljubljana, current), Albert Jiang (Computer Science, Cambridge University, 2024), Stephen Mackereth (University of Pittsburgh, 2024), André Hernández-Espiet (Mathematics, Rutgers, 2024), Katherine Kosaian (Computer Science, 2023), Soonho Kong (Computer Science, 2023), Jesse Han (Mathematics, University of Pittsburgh, 2022), Oskar Abrahamsson (Chalmers University of Technology and University of Gothenberg, Computer Science and Engineering, 2022), Andrew Warren (2022), Yong Kiam Tan (Computer Science, 2022), Edward Ayers (Mathematics, Cambridge University, 2021), Marcos Mazari (Mathematics, 2021), Jonathan Sterling (Computer Science, 2021), Gabriel Ebner (Computer Science, TU Vienna, 2020), Carlo Angiuli (Computer Science, 2019), Joseph Tassarotti (Computer Science, 2018), Nathan Fulton (Computer Science, 2018), Egbert Rijke (2018), Andrew Zucker (Mathematics, 2018), Mate Szabo (2017), Sebastian Vasey (Mathematical Sciences, 2017), Kuen-Bang Hou (Favonia) (Computer Science, 2017), Yacin Hamami (Vrije Universiteit Brussel, May, 2016), William Gunther (Mathematics, 2015), Tyke Nunez (University of Pittsburgh, 2015), Krzysztof Kapulkin (University of Pittsburgh, Mathematics, 2014), Spencer Breiner (2014), Shawn Standefer (University of Pittsburgh, 2013), Alexey Solovyev (University of Pittsburgh, Mathematics, 2012), Cyril Cohen (École Polytechnique, Computer Science, 2012), Ashwini Aroksar (Mathematical Sciences, 2012), Alexander Kreuzer (Mathematics, TU Munich, 2012), Matthew Szudzik (Mathematical Sciences, 2010), Jesse Alama (Stanford, 2009), Chetan Balwe (Mathematics, University of Pittsburgh, 2008), Amine Chaieb (Computer Science, TU Munich, 2008), Henrik Forsell (2007), Jeremy Heis (Philosophy, University of Pittsburgh, 2007), Kaustuv Chaudhuri (Computer Science, 2006), Jyotsna Diwadkar (Mathematics, University of Pittsburgh, 2006), John Mumma (2006), Dirk Schlimm (2005), Mark Ravaglia (2003), John Krueger (Mathematical Sciences, 2003), Jesse Hughes (2001), Barbara Kauffmann (2000), Alberto Momigliano (2000), John Byrnes (1999)

MS STUDENTS

Paula Neeley (MS, Logic, Computation, and Methodology, 2020), *A formalization of dynamic epistemic logic*

Andrew Warren (MS, Mathematical Sciences, 2019), *Fluctuation bounds for ergodic averages of amenable groups on uniformly convex Banach spaces*

Seulkee Baek (MS, Logic, Computation, and Methodology, 2019), *Reflected decision procedures in Lean*

Minchao Wu (MS, Logic, Computation, and Methodology, 2017), *A formally verified proof of Kruskal's tree theorem in Lean*

Sebastian Ullrich (MS from Karlsruhe Institute of Technology, 2016), *Simple verification of Rust programs via functional purification*

Andrew Zipperer (MS, Logic, Computation, and Methodology, 2016), *A formalization of elementary group theory in the proof assistant Lean*

Luke Serafin (MS, Mathematical Sciences, 2015), *A formally verified proof of the central limit theorem*

Jakob von Raumer (MS from Karlsruhe Institute of Technology, summer 2015), *Formalization of non-abelian topology for homotopy type theory*

Benjamin Northrop (MS, Logic, Computation, and Methodology, 2011), *Automated diagrammatic reasoning: a proof checker for the language of E*

Spencer Breiner (MS, Logic, Computation, and Methodology, 2010), *Towards a practical understanding of mathematical structuralism*

Edward Dean (MS, Logic, Computation, and Methodology, 2008), *In defense of Euclidean proof*

Steven Kieffer (MS, Logic, Computation, and Methodology, 2007), *A language for mathematical knowledge management*

Aaron Hertz (MS, Mathematical Sciences, 2004), *A constructive version of the Hilbert basis theorem*

Doug White (MS, Logic, Computation, and Methodology, 2004), *Axiomatics, methodology, and Dedekind's theory of ideals*

Jessi Berkelhammer (MS, Logic, Computation, and Methodology, 2003), *From reducibility to extensionality: the two editions of* Principia Mathematica

Erica Lucast (MS, Logic, Computation, and Methodology, 2002), *A new case for proof in mathematics curricula*

MS committees I have served on (in Philosophy, unless otherwise noted): Connor Gordon (Mathematical Sciences, 2024), Tomaz Mascarenhas (Computer Science, Universidade Federal de Minas Gerais, 2023), David Vitali (2020), William Nalls (2017), Evan Cavallo (Mathematical Sciences, 2015), David Carper (2011), Hans-Christoph Kotzsch (2011), Brian Leary (Mathematical Sciences, 2009), Nick Radcliffe (2008), Dave Gilbert (2008), Kohei Kishida (2007), George Schaeffer (Mathematical Sciences, 2007), Lindsay Spriggs (2007), Michael Warren (2004), Adam Kramer (2004), Keith Douglas (2003), Charlie Smart (Mathematical Sciences, 2002), John Mumma (2001), Jeffrey Helzner (2001), Johanna Franklin (Mathematical Sciences, 2001), Jay Kim (1999), Nathaniel Segerlind (Mathematical Sciences, 1998), Mark Ravaglia (1997), Chris Skalka (1997)

UNDERGRADUATE PROJECTS SUPERVISED

Alex Gillon (BS, Logic and Computation, 2024), *Verified AVL Trees in Lean 4*

Minsung Cho (BS, Logic and Computation, 2022), *The Cops and Robber Game in Lean*

Ashley Watt (BS, Logic and Computation, 2019), *Treaps in Lean*

Kelvin Rojas (BS, Logic and Computation, 2015), *A Computational Proof-Checker for the Language E*

Erin Korber (BS, Logic and Computation, 2005), *Implementing Decision Procedures for the Real Numbers*

POSTDOCS SUPERVISED

Tomas Skrivan, 2022-present

Mario Carneiro, 2022-2024

Mohammad Ali Nezhad, 2022-2023

Edward Ayers, 2022

Gabriel Ebner, 2021-2022

Bruno Bentzen, 2019-2021

Simon Hudon, 2019-2021

Johannes Hölzl, 2017

Cody Roux, 2012-2014

Philipp Gerhardy, 2006-2007

EDITORIAL WORK

Member, editorial board, *Journal of Symbolic Logic,* 2024-present.
Member, scientific advisory board, *Annals of Formalized Mathematics,* 2024-present.
Member, editorial board, *Journal of Automated Reasoning,* 2007-present.
Member, editorial board, *Logical Methods in Computer Science,* 2015-2024

Reviewer, *Artificial Intelligence to Assist Mathematical Reasoning: Proceedings of a Workshop*, National Academies of Sciences, Engineering, and Medicine, 2023.
Member, editorial board, *Journal of Formalized Reasoning,* 2007-2020.
Member, editorial board, *Perspectives in Logic,* 2018-2022.
Co-editor (with Assia Mahboubi), special issue of the *Journal of Automated Reasoning*, "Selected extended papers from ITP 2018."
Member, editorial board, *Computability,* 2011-2019.
Journal manager, and member, editorial board, *Journal of Logic and Analysis,* 2008-2019.
Co-editor (with Lawrence Paulson and Gerwin Klein), special issue of the *Journal of Automated Reasoning,* "Milestones in Interactive Theorem Proving".
Member, editorial board, ASL Lecture Notes in Logic, 2006-2016.
Coordinating editor, *Review of Symbolic Logic*, 2010-2013.
Member, editorial board, *Notre Dame Journal of Formal Logic,* 2004-2011.
Member, advisory board, *Review of Symbolic Logic*, 2007-2010.
Member, editorial board, *Logic and Analysis,* 2006-2008.
Co-editor (with Andrea Asperti), special issue of the *Mathematical Structures in Computer Science*, "Advances and Perspectives in the Mechanization of Mathematics"
Co-editor (with Arnold Beckmann and Georg Moser) of a special issue of the *Annals of Pure and Applied Logic* in honor of Wolfram Pohlers' 60th birthday, October 2005.
Referee for *Journal of Symbolic Logic, Annals of Pure and Applied Logic, Journal of Mathematical Logic, Archive for Mathematical Logic, Mathematical Logic Quarterly, Notre Dame Journal of Formal Logic, Journal of Philosophical Logic, Bulletin of Symbolic Logic, Review of Symbolic Logic, Journal of Logic and Analysis, Advances in Mathematics, Monsatshefte für Mathematik, Transactions of the American Mathematical Society, Proceedings of the American Mathematical Society, Philosophical Transactions of the Royal Society, Monatshefte für Mathematik, Ergodic Theory and Dynamical Systems, American Mathematical Monthly, Discrete Mathematics, Experimental Mathematics, Theoretical Computer Science, Mathematical Structures in Computer Science, Journal of Logic and Computation, Information and Computation, Logical Methods in Computer Science, History and Philosophy of Logic, Synthese, Dialectica, Episteme, Philosophia Mathematica, Theoria, Journal of the American Philosophical Association;* for conferences: *Logic in Computer Science, Computer Science Logic, Computability in Europe, Conference on Automated Deduction, Interactive Theorem Proving, Workshop on Logic, Language, Information and Computation, Types, Certified Proofs and Programs*; as well as for other journals and conferences, and various books and collections.

Other professional service

Board of Directors, Lean Focused Research Organization, 2023-present
Member, program committee, Certified Programs and Proofs (CPP), 2024
Lean community admin team, 2023-present
Lean community code of conduct team, 2022-present
Co-organizer, MSRI Summer Graduate School on Formalization of Mathematics, 2023
Member, program committee, Conference on Automated Deduction (CADE), 2023
Member, program committee, Interactive Theorem Proving (ITP), 2023
Co-organizer, Machine Assisted Proofs, IPAM, 2023
Co-organizer, Lean for the Curious Mathematician, Institute for Computational and Experimental Research in Mathematics, Providence, 2022
Member, program committee, Interactive Theorem Proving (ITP), 2022
Member, program committee, Interactive Theorem Proving (ITP), 2021
Member, program committee, Computer Science Logic (CSL), 2021
Member, program committee, IJCAR, 2020
Member, prizes and awards committee, Association of Symbolic Logic, 2016-2020
Member, program committee, Interactive Theorem Proving (ITP), 2019
Co-organizer, Formal Methods in Mathematics / Lean Together 2020, Carnegie Mellon, Pittsburgh, 2020
Co-organizer, Ken Manders's contributions to the History and Philosophy of Mathematics, University of Pittsburgh, November 2018
Organizer, Applications of Formal Methods to Control Theory and Dynamical Systems, Carnegie Mellon, Pittsburgh, June 2018
Co-organizer, From the Fundamental Lemma to Discrete Geometry, to Formal Verification: A conference in honor of Thomas C. Hales on the occasion of his 60th birthday, University of Pittsburgh, June 2018
Co-chair, program committee, Interactive Theorem Proving (ITP), 2018
Co-organizer, Big Proof, a six week program at the Isaac Newton Institute, Cambridge, 2017
Member, program committee, Interactive Theorem Proving (ITP), 2017
Co-organizer, Ergodic Theory Interacts with Algorithmic Randomness, BIRS worskhop Oaxaca, 2016
Member, program committee, Interactive Theorem Proving (ITP), 2016
Co-chair, program committee, Certified Proofs and Programs, 2016
Chair, program committee, Logic Colloquium, 2014.
Member, program committee, Interactive Theorem Proving (ITP), 2014.
Member, executive council, Association for Symbolic Logic, 2013-2015.
Member, program committee, Interactive Theorem Proving (ITP), 2013.
Member, program committee, Conferences on Intelligent Computer Mathematics (CICM), 2013.
Member, program committee, Computer Science Logic (CSL), 2012.
Member, program committee, Mathematical Knowledge Management (MKM), 2012.
Member, program committee, Model Theory and Proof Theory of Arithmetic, 2012.
Member, program committee, Association for Symbolic Logic annual meeting, Spring 2012.
Member, program committee, Proof Search in Axiomatic Theories and Type Theories workshop at CADE 2011.
Member, program committee, Interactive Theorem Proving (ITP), 2011.
Member, program committee, Logic Colloquium 2011.
Member, program committee, 17th Workshop on Logic, Language, Information, and Computation (WoLLIC), 2011.
Member, program committee, Mathematical Logic division of the International Congress of Logic, Methodology, and Philosophy of Science, 2011.
Organizer (with Ulrich Kohlenbach and Henry Towsner). "Logic and analysis" joint AMS/ASL special session, American Mathematical Society annual meeting, New Orleans, January 2011.

Board of jurors, Kurt Gödel Research Fellowship Prize Program, 2010-2011.
Member, program committee, Interactive Theorem Proving (ITP), 2010.
Chair, Association for Symbolic Logic Committee on Logic in North America, 2008-2009.
Member, Association for Symbolic Logic Committee on Logic in North America, 2004-2009.
Member, program committee, Reverse Mathematics: Foundations and Applications, 2009.
Member, Association for Symbolic Logic Council, 2007-2009.
Member, Association for Symbolic Logic Nominating Committee, 2009.
Member, scientific committee, Logic and Mathematics, 2009
Member, program committee, Theorem Proving in Higher-Order Logic (TPHOLs), 2009.
Member, scientific committee, 14th Latin-American Symposium on Mathematical Logic, 2008.
Organizer (with Reed Solomon), "Effective aspects of measure theory and analysis" special session, Association for Symbolic Logic annual meeting, Montreal, May 2006.
Taught (with Henry Towsner) a two week short-course in proof theory at Notre Dame, under NSF grant "Two Conferences in Logic at Notre Dame," June 6-17, 2005.
Member, program committee for the 13th Workshop on Logic, Language, Information, and Computation, 2006.
Chair, local organizing committee, Association for Symbolic Logic annual meeting, Spring 2004.
Member, program committee, joint Association for Symbolic Logic and American Philosophical Association meeting, Minneapolis, May 2001.
Organizer (with Steve Awodey), Midwest Philosophy of Mathematics Workshop, Carnegie Mellon University, December 2000.
Member, program committee for the Association for Symbolic Logic annual meeting, Urbana-Champaign, May 2000.
Organizer (with Toni Pitassi), "Proof theory and complexity" special session, Association for Symbolic Logic annual meeting, Urbana-Champaign, May 2000.

UNIVERSITY SERVICE

Libraries Ad Hoc Tenure and Promotion Committee, 2020-2022
University Committee on Tenure Appointments, 2017-2019
Chair, Hiring Committee, Philosophy, 2013-2014
Director, Graduate Studies in Philosophy, 2005-2009, and 2011-2012
Founder and director, Carnegie Mellon Summer School in Logic and Formal Epistemology, 2005-2010
Chair, H&SS Promotion and Tenure Committee, 2008-2009
Member, Posner Intern selection committee, 2004-present
Director, Logic and Computation Major, 1998-2005
University Education Council, 2002-2005
University Committee on Non-tenure Appointments, 2002-2005
Philosophy Department webmaster, 2001-2005
Faculty Senate, 2000-2004
Organizer, Pure and Applied Logic Colloquium and Philosophy Colloquium, 1996-1998