

Jason Gross

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PRESENT ADDRESS

258 Prospect Street, Apt # 1L
Cambridge, MA 02139

PERMANENT ADDRESS

126 Hayrick Lane
Commack, NY 11725

EDUCATION

Massachusetts Institute of Technology, Cambridge, MA

Began Doctorate of Philosophy in Computer Science in September 2013

Research Interests: Programming Languages, Performance of Automation in Interactive Proof Assistants, Formal Verification, Homotopy Type Theory, Category Theory, Program Synthesis, Type Theory

G.P.A. 4.9/5.0

Bachelor of Science in Mathematics and Physics, June 2013

G.P.A. 4.6/5.0

Coursework:

- Computer Science: Inference and Information, Computer Systems Security, Geometric Computing, Foundations of Program Analysis, Performance Engineering of Software Systems, Structure and Interpretation of Computer Programs
- Mathematics: Paradox and Infinity, Category Theory for Scientists, Algebraic Topology I, Seminar in Topology, Introduction to Topology, Real Analysis, Abstract Algebra I & II, Differential Equations, Calculus I & II, Linear Algebra
- Physics: Modern Astrophysics, General Relativity (Graduate), Statistical Physics I & II, Quantum Physics I, II, & III, Classical Mechanics II, Waves and Vibrations, Special Relativity and the Physics of Spacetime
- Other Sciences: Introductory Biology, Introductory Chemistry, Design a Concentrated Solar Power Water Heater (seminar)
- Other: The Art and Science of Happiness, Metaphysics, Introduction to Musical Composition, Capitalism and Its Critics, Moral Psychology, Philosophy of Quantum Mechanics, Moral Problems and the Good Life, Philosophy of Love, Kaufman Teaching Certificate Program

EXPERIENCE

MIT CSAIL

September 2013–February 2021

Researcher

Cambridge, MA

- Researching program synthesis and verification with Adam Chlipala
- Collaboratively working on implementing one of the world's first algorithm-level-optimizing compilers
- Collaboratively implemented proven-correct crypto code now used by Google Chrome

EXPERIENCE

Coq Development Team, INRIA

June 2021–Present

Core Team Member

Nantes, France (remote)

- Stress Testing, Bug Reporting, Bug Minimizer, Compatibility Assurance
- Engineering and maintaining a bug minimizer for automatically producing minimized stand-alone test-cases from buggy code
- Researching performance issues that impact scalability of automated verification
- Have reported the plurality of all-time bugs in Coq (since 2012)

Machine Intelligence Research Institute

February 2021–Present

Research Staff

Berkeley, CA (remote)

- Performing self-directed research into topics in fundamental programming language theory and mathematics

MIT CSAIL

September 2013–February 2021

PhD Researcher

Cambridge, MA

- Main Research Project: Fiat Cryptography (github.com/mit-plv/fiat-crypto)
- Collaboratively implemented proven-correct cryptographic code now used by Google Chrome, and in the majority of secure connects from web browsers
- Led development of one of the world's first algorithm-level-optimizing compilers
- Wrote backends to C, Go, Java, and JSON; managed development of backends to Rust and Zig

INTERNSHIPS

Machine Intelligence Research Institute

June 2019–August 2019

Type Theory Intern

Berkeley, CA

- Worked on formalizing type theories and on proving things within proof assistants

Google

June 2018–August 2018

Software Engineering Intern

Cambridge, MA

- Worked with BoringSSL on integration of proven-correct low-level ECC primitives into Chrome

Google

June 2016–September 2016

Software Engineering Intern

Mountain View, CA

- Formalized low-level ECC primitives with proofs of correctness

MIT

Fall 2009–Present

Teacher

Cambridge, MA

- Taught classes on L^AT_EX, philosophy, linear algebra, and quantum mechanics for MIT Educational Studies Program's Splash, Spark, and Summer HSSP (High School Studies Program)
- Teaching Assistant for 8.012 (Physics I) and 8.022 (Physics II) in Experimental Study Group

MIT

September 2015–December 2015

TA for 6.172 (Performance Engineering)

Cambridge, MA

- Created and led recitations, taught students, and helped run class
- Analyzed and explained assembly output of `gcc -O3` to teach vectorization

MIRI

June 12–14, 2015

Decision Theory Workshop Attendee

Berkeley, CA

- Formalized various versions of Löb's theorem in Agda and Coq
- Learned about and worked on problems on the frontiers of decision theory

Microsoft Research

June 2014–August 2014

Intern

Cambridge, United Kingdom

- Created a language for specifying input/output behavior of x86 assembly programs with Andrew Kennedy and Nick Benton; Verified the I/O behavior of a number of simple programs
- Improved automation of the x86proved library

MIT CSAIL

April 2012–June 2014

Researcher

Cambridge, MA

- Entered a significant amount of category theory into the automated proof assistant Coq (<https://github.com/HoTT/HoTT/tree/master/theories/Categories>)
- Made progress towards an interface for databases and database migration on top of category theory in Coq with David Spivak and Adam Chlipala

- Presented “Building Database Management on top of Category Theory in Coq”, January 25, 2013, POPL 2013: 40th ACM SIGPLAN-SIGACT Symposium on Principles of Programming Languages
- Presented “Experience Implementing a Performant Category-Theory Library in Coq”, July 14, 2014, Interactive Theorem Proving 2014 Conference

MIT CSAIL

November 2009–September 2011

Researcher

Cambridge, MA

- Designed from scratch a data collection webpage, collected data for, and helped with research of Brenden Lake, Ruslan Salakhutdinov, and Josh Tenenbaum, on categorical and transfer learning (<https://jgross.scripts.mit.edu/alphabets/>)
- Co-author of “One shot learning of simple visual concepts” published in *Proceedings of the 33rd Annual Meeting of the Cognitive Science Society*.

MIT OCW

May–August 2010

Cambridge, MA

- Evaluated and categorized videos of Walter Lewin solving physics problems for updating the 8.01 (Physics I) OpenCourseWare (OCW) website.

Commack High School

Fall 2006–Summer 2009

Independent Researcher

Commack, NY

- Independently researched circuits over sets of natural numbers for three years.
- Won fourth place award in mathematics in ISEF (Intel International Science and Engineering Fair) in 2009, third place award in ISEF 2008.

Turnpike Total Appliance

Fall 2006–Summer 2009

Web Page Designer

Commack, NY

- Designed and improved main company website, took initiative to make more improvements.
- Proficient: Coq, \TeX macro language, Mathematica, git, Python, JavaScript, BASIC
- Working knowledge: \LaTeX , C, C++, Agda, OCaml, Haskell, Scheme, HTML, CSS, Perl, Java
- Basic knowledge: Matlab, Lean, Idris, Ruby, Go, Ur/Web, x86 Assembly

TEACHING

- Instructor at Monsoon Math Camp: category theory, linear logic, Löb’s theorem
- TA for 6.172 (Performance Engineering): Led recitations, analyzed and explained assembly output of `gcc -O3` to teach vectorization
- TA for 8.012 (Physics I) and 8.022 (Physics II) in Experimental Study Group
- Teacher at MIT ESP Programs: \LaTeX , philosophy, linear algebra, quantum mechanics

HONORS AND AWARDS

- Mathematics Honor Society (Commack High School)
- Collection of 12 original K’NEX synagogue models exhibited in various museums (2004–2008)
 - Collection of 12 original K’NEX synagogue models
 - Volunteered to give speeches and conduct K’NEX workshops for children at opening of exhibits, as well as in many locations in NY area
 - April 2008 — Gave interview for April edition of BabagaNewz Magazine and audio interview for BabagaNewz.com
 - October 2006 — Displayed in Gurwin Nursing Home on Long Island
 - February 2006 — Exhibited at Lisa Ann Watson Children’s Discovery Museum in Miami, Florida
 - October 2005 — Displayed at Shomrim (Society for New York City Jewish Police Officers)
 - February–April 2005 — Exhibited in Yeshiva University Museum in Manhattan

– December 2004 — Displayed at Suffolk Y-JCC in Commack

- Graduated Cum Laude from Commack High School (June 2009)
- Commack High School Outstanding Academic Performance (June 2009)
- Florence Burns Scholarship for Achievement of Excellence in Computer Science (June 2009)
- Theodore R. Spedale Award for Achievement of Excellence in Mathematics (June 2009)
- Commack High School Mathematics Research Award (June 2009)
- President's Award for Educational Excellence (June 2009)
- AP Scholar with Distinction (2009)
- Robert C. Byrd Honors Scholarship (June 2009)
- ISEF (Intel International Science & Engineering Fair)
 - Math research paper, "Circuits over Sets of Natural Numbers" won 3rd Place in Math in Atlanta, May 2008
 - Math research paper, "An Investigation of the Closure of the Set of Singleton Sets of Natural Numbers under $\cup, \cap, -, +, \times$ " won 4th place in Math in Reno, May 2009
- LISEF (Long Island Science & Engineering Fair) — Won First Place Grand Award in Math in March 2009; selected to participate in ISEF 2009
- 2009 National Merit Scholarship Finalist (February 2009)
- JSHS (Junior Science & Humanities Symposium) — Invited to present math research paper, February 2009 and February 2008
- Rensselaer Medal — Awarded the Rensselaer Polytechnic Institute's Rensselaer Medal, June 2008
- Outstanding Junior Award — sole recipient, awarded by Suffolk County Math Teacher's Association (June 2008)
- County All-Star Interscholastic Math League — competed at NYSML (New York State Mathematics League) and ARML (American Regions Mathematics League) during junior, sophomore and freshmen years, 2006–2009; Achieved individual high score for team in 2009
- Suffolk County Senior High Interscholastic Math League — 2nd in county in 2009, 1st in county in 2008, 3rd in county in 2007
- NYSSEF (New York State Science and Engineering Fair)
 - 2008 (11th grade) — 1st in math in Intel division, one of four first place individual winners in fair, Mu Alpha Theta award, Army award, Ohio Wesleyan University Scholarship
 - 2007 (10th grade) — 1st in math in Andromeda Division, earned Mu Alpha Theta Award from National Mathematics Honor Society
- Long Island Math Fair
 - 2008 (11th grade) — Earned gold medal for "Group Theory" project
 - 2007 (10th grade) — Earned gold medal for "Circuits over Sets of Natural Numbers" project
 - 2006 (9th grade) — Earned gold medal for "Prime Numbers" project
 - 2005 (8th grade) — Earned gold medal for "The Fourth Spatial Dimension" project
 - 2004 (7th grade) — Earned gold medal for "The Seven Bridges of Königsberg" project
- AIME (American Invitational Mathematics Examination)
 - 2009 (12th grade) - ???
 - 2008 (11th grade) - score of 8
 - 2007 (10th grade) - score of 4
 - 2006 (9th grade) - score of 1
- American Mathematics Contest 12 (AMC-12)
 - 2009 (12th grade) - score of ???
 - 2008 (11th grade) - score of 120, top 1% nationwide, earned title of "School Winner"
 - 2007 (10th grade) - score of 103.5, top 1% nationwide, earned title of "School Winner"
- American Mathematics Contest 10 (AMC-10)

- 2006 (9th grade) - score of 127.5, top 1% nationwide, earned title of “School Winner”
- 2005 (8th grade) - score of 118.5, earned title of “School Winner” in high school as an 8th grader in the 9th grade honors math class
- Suffolk County Mathematics Contest
 - 2009 (12th grade) - ???
 - 2008 (11th grade) - 1st place in county competing with 12th graders
 - 2007 (10th grade) - 4th place in county competing with 11th graders
 - 2006 (9th grade) - 4th place in county competing with 10th graders
 - 2005 (8th grade) - 5th place in county competing with 9th graders
 - 2004 (7th grade) - 1st place in county
- Suffolk County Mathematics Teachers Association (SCMTA) Tournament
 - 2009 (12th grade) - ??????th in county
 - 2008 (11th grade) - 4th in county
 - 2007 (10th grade) - 2nd in county
 - 2006 (9th grade) - 1st in county
- Commack High School Mathematics Department Awards — June 2008, June 2007, and June 2006
- Commack Middle School Mathematics Departmental Award — was only student of 605 students to receive Commack Middle School mathematics departmental award, 2005
- Suffolk County Mathcounts — placed first in county as individual, 2005
- USA Mathematics Talent Search (USAMTS), 2007–2008; Placed on National List of Students with 6 Commended Solutions in 2008, silver medal in 2008
- Harvard-MIT Mathematics Tournament (HMMT), February 2009, 2008, and 2007
- New York State Science Olympiads
 - February 2008 — 2nd place in Environmental Chemistry, 4th place in Circuit Lab, 4th place in Five Star Science
 - February 2007 — 4th place in Circuit Lab
- Mandelbrot Competition, team that competes in national competitions, 2006–2009; Placed on National Leaderboard (Top Tier) in 2008; co-captain in 2007–2008, captain in 2008–2009
- American Computer Science League (ACSL) Club, 2005–present; President in 2008–2009
- United States of America Computer Olympiad (USACO), 2005–present
- Suffolk County Senior High Interscholastic Math League, 2005–present
- Article was published in Teen Ink Magazine (November 2007)

COMMUNITY SERVICE AND INVOLVEMENT

- Member of National Math Honor Society; Tutor students in math both in and out of school (2007–2009)
- Member of National Technology Honor Society (2007–2009)

OTHER ACTIVITIES

- Co-maintainer of the Fiat Cryptography project ([mit-plv/fiat-crypto](https://github.com/mit-plv/fiat-crypto) on GitHub)
- Co-maintainer of the homotopy type theory Coq repository ([HoTT/Coq](https://github.com/HoTT/Coq) on GitHub)
- Program Committee Member of CoqPL 2022
- MIRI Decision Theory Workshop Attendee: Formalized various versions of Löb’s theorem in Agda and Coq
- Committer to the SIPB BarnOwl project (<https://barnowl.mit.edu>)
- SIPB (Student Information and Processing Board) Member
- Was project leader for MITeX, an online interface for composing L^AT_EX
- President of Tech Squares, MIT’s Square Dancing Club (May 2013–October 2014)
- HMMT Solutions Editor (2010)

- Canada/USA Mathcamp (Summers 2006–2009)

INTERESTS

- Philosophy
- Programming
- Dancing, especially tango, contra, and square dancing
- Neuroscience
- Hiking
- MIT Mystery Hunt, Participated on Manic Sages Team, January 2008–2012

PRESENTATIONS AND PUBLICATIONS

- [Gro21a] Jason S. Gross. “Performance Engineering of Proof-Based Software Systems at Scale”. PhD Thesis. Massachusetts Institute of Technology, Feb. 2021. URL: <https://people.csail.mit.edu/jgross/personal-website/papers/2021-JGross-PhD-EECS-Feb2021.pdf>.
- [Gro21b] Jason Gross. *A Limited Case for Reification by Type Inference*. Presented at The Seventh International Workshop on Coq for Programming Languages (CoqPL’21). Jan. 2021. URL: <https://people.csail.mit.edu/jgross/personal-website/papers/2021-reification-by-type-inference-coqpl.pdf>.
- [Huh+21] Linden B. Huhmann, Charles F. Harvey, Jason Gross, Anjal Uddin, Imtiaz Choudhury, Kazi M. Ahmed, John M. Duxbury, Benjamin Bostick, and Alexander van Geen. “Evaluation of a field kit for testing arsenic in paddy soil contaminated by irrigation water”. In: *Geoderma* 382 (Jan. 2021), p. 114755. ISSN: 0016-7061. DOI: 10.1016/j.geoderma.2020.114755.
- [Pit+20] Clément Pit-Claudel, Peng Wang, Benjamin Delaware, Jason Gross, and Adam Chlipala. “Extensible Extraction of Efficient Imperative Programs with Foreign Functions, Manually Managed Memory, and Proofs”. In: *Proceedings of the 9th International Joint Conference on Automated Reasoning (IJCAR’20)*. Ed. by Nicolas Peltier and Viorica Sofronie-Stokkermans. Paris, France: Springer International Publishing, June 2020, pp. 119–137. ISBN: 978-3-030-51054-1. DOI: 10.1007/978-3-030-51054-1_7.
- [Erb+19] Andres Erbsen, Jade Philipoom, Jason Gross, Robert Sloan, and Adam Chlipala. “Simple High-Level Code For Cryptographic Arithmetic – With Proofs, Without Compromises”. In: *Proceedings of the 40th IEEE Symposium on Security and Privacy (S&P’19)*. May 2019. DOI: 10.1145/3421473.3421477. URL: <https://people.csail.mit.edu/jgross/personal-website/papers/2019-fiat-crypto-ieee-sp.pdf>.
- [Gro18] Jason Gross. *Presentation Proposal for Teaching Your Rooster to Crow in C*. Presented at The Coq Workshop 2018. July 2018. URL: <https://people.csail.mit.edu/jgross/personal-website/presentations/coq-workshop-2018/coq-workshop-proposal-notations.pdf>.
- [GEC18] Jason Gross, Andres Erbsen, and Adam Chlipala. “Reification by Parametricity: Fast Setup for Proof by Reflection, in Two Lines of Ltac”. In: *Proceedings of the 9th International Conference on Interactive Theorem Proving (ITP’18)*. Ed. by Jeremy Avigad and Assia Mahboubi. Cham: Springer International Publishing, July 2018, pp. 289–305. ISBN: 978-3-319-94821-8. DOI: 10.1007/978-3-319-94821-8_17. URL: <https://people.csail.mit.edu/jgross/personal-website/papers/2018-reification-by-parametricity-ity-camera-ready.pdf>.

- [Chl+17] Adam Chlipala, Benjamin Delaware, Samuel Duchovni, Jason Gross, Clément Pit-Claudel, Sorawit Suriyakarn, Peng Wang, and Katherine Ye. “The End of History? Using a Proof Assistant to Replace Language Design with Library Design”. In: *Proceedings of the The 2nd Summit on Advances in Programming Languages (SNAPL’17)*. Ed. by Benjamin S. Lerner, Rastislav Bodík, and Shriram Krishnamurthi. Vol. 71. Leibniz International Proceedings in Informatics (LIPIcs). Asilomar, CA, USA: Schloss Dagstuhl–Leibniz-Zentrum fuer Informatik, May 2017, 3:1–3:15. ISBN: 978-3-95977-032-3. DOI: 10.4230/LIPIcs.SNAPL.2017.3. URL: <https://people.csail.mit.edu/jgross/personal-website/papers/FiatSNAPL17.pdf>.
- [Bau+17] Andrej Bauer, Jason Gross, Peter LeFanu Lumsdaine, Michael Shulman, Matthieu Sozeau, and Bas Spitters. “The HoTT Library: A Formalization of Homotopy Type Theory in Coq”. In: *Proceedings of the 6th ACM SIGPLAN Conference on Certified Programs and Proofs*. CPP 2017. Paris, France: ACM, Jan. 2017, pp. 164–172. ISBN: 978-1-4503-4705-1. DOI: 10.1145/3018610.3018615. eprint: 1610.04591. URL: <https://people.csail.mit.edu/jgross/personal-website/papers/2017-HoTT-formalization.pdf>.
- [Gro16] Jason Gross. *The HoTT/HoTT Library in Coq: Designing for Speed*. Presented at The 5th International Congress on Mathematical Software (ICMS 2016). July 2016. URL: <https://people.csail.mit.edu/jgross/personal-website/presentations/icms-2016/hott-hott-and-category-coq-experience.pdf>.
- [Gro15a] Jason Gross. “An Extensible Framework for Synthesizing Efficient, Verified Parsers”. MA thesis. Massachusetts Institute of Technology, Sept. 2015. URL: <https://people.csail.mit.edu/jgross/personal-website/papers/2015-jgross-thesis.pdf>.
- [Del+15] Ben Delaware, Clément Pit-Claudel, Jason Gross, and Adam Chlipala. “Fiat: Deductive Synthesis of Abstract Data Types in a Proof Assistant”. In: *Proceedings of the 42nd ACM SIGPLAN-SIGACT Symposium on Principles of Programming Languages (POPL’15)*. Jan. 2015. DOI: 10.1145/2775051.2677006. URL: <https://people.csail.mit.edu/jgross/personal-website/papers/2015-adt-synthesis.pdf>.
- [Gro15b] Jason Gross. *Coq Bug Minimizer*. Presented at The First International Workshop on Coq for PL (CoqPL’15). Jan. 2015. URL: <https://people.csail.mit.edu/jgross/personal-website/papers/2015-coq-bug-minimizer.pdf>.
- [TG15] Tobias Tebbi and Jason Gross. *A Profiler for Ltac*. Presented at The First International Workshop on Coq for PL (CoqPL’15). Jan. 2015. URL: <https://people.csail.mit.edu/jgross/personal-website/papers/2015-ltac-profiler.pdf>.
- [Gro14a] Jason Gross. *Presentation: Input, Output, and Automation in x86 Proved*. Presented at Microsoft Research, Cambridge, UK. Aug. 2014. URL: <https://people.csail.mit.edu/jgross/personal-website/presentations/msr-2014-final-talk/input-output-and-automation-in-x86proved.pdf>.
- [GCS14] Jason Gross, Adam Chlipala, and David I. Spivak. “Experience Implementing a Performant Category-Theory Library in Coq”. In: *Proceedings of the 5th International Conference on Interactive Theorem Proving (ITP’14)*. Ed. by Gerwin Klein and Ruben Gamboa. Cham: Springer International Publishing, July 2014, pp. 275–291. ISBN: 978-3-319-08970-6. DOI: 10.1007/978-3-319-08970-6_18. eprint: 1401.7694. URL: <https://people.csail.mit.edu/jgross/personal-website/papers/category-coq-experience-ityp-submission-final.pdf>.
- [Gro14b] Jason Gross. *Presentation Proposal for Three Neat Tricks in Coq 8.5*. Presented at the 6th Coq Workshop. Apr. 2014. URL: <https://people.csail.mit.edu/jgross/personal-website/presentations/coq-workshop-2014/coq-workshop-proposal-tactics-in-terms.pdf>.

- [Gro14c] Jason Gross. *Jason Gross' Wishlist for Coq*. Jan. 2014. URL: <https://people.csail.mit.edu/jgross/personal-website/presentations/coq-8.6-wishlist/jgross-coq-8-6-wishlist-no-pause.pdf>.
- [Gro14d] Jason Gross. *POPL: Minute Madness: Category Theory in Coq, and Program Synthesis*. Presented at the 41st ACM SIGPLAN-SIGACT Symposium on Principles of Programming Languages (POPL'14). Jan. 2014. URL: <https://people.csail.mit.edu/jgross/personal-website/presentations/popl-2014-minute-madness/jason-gross-minute-madness.pdf>.
- [Gro13a] Jason Gross. *CSAIL Student Workshop 2013: Computational Higher Inductive Types: Computing with Custom Equalities*. Presented at the 2014 MIT CSAIL Student Workshop. Oct. 2013. URL: <https://people.csail.mit.edu/jgross/personal-website/presentations/csw-2013/jgross-presentation-no-pause.pdf>.
- [Gro13b] Jason Gross. *Building Database Management on top of Category Theory in Coq*. Presented as a student talk at the 40th ACM SIGPLAN-SIGACT Symposium on Principles of Programming Languages (POPL'13). Jan. 2013. URL: <https://people.csail.mit.edu/jgross/personal-website/presentations/popl-2013/jgross-student-talk.pdf>.
- [Gro13c] Jason Gross. *POPL: Minute Madness: Database Management on top of Category Theory in Coq: Category of Relational Schemas = Category of Categories*. Presented at the 40th ACM SIGPLAN-SIGACT Symposium on Principles of Programming Languages (POPL'13). Jan. 2013. URL: <https://people.csail.mit.edu/jgross/personal-website/presentations/popl-2013/minute-madness.pdf>.
- [Lak+11] Brenden M. Lake, Ruslan Salakhutdinov, Jason Gross, and Joshua B. Tenenbaum. "One shot learning of simple visual concepts". In: *Proceedings of the 33rd Annual Conference of the Cognitive Science Society*. 2011. URL: <https://people.csail.mit.edu/jgross/personal-website/papers/LakeEtAl2011CogSci.pdf>.