Xinrui(Henry) Li

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EDUCATION

Carnegie Mellon University *08/2026-Present*
Doctor of Philosophy in Computer Science, advised by Prof. Jeremy Avigad

University of California, Berkeley *08/2022-05/2026*
Bachelor of Arts in Applied Mathematics, Computer Science GPA: 3.929/4.0
Relevant Courses: Machine Learning, Algorithms, Formal Methods, Mathematical Logic, Numerical Solution to Differential Equations

SKILLS

- Programming & Systems: Python (NumPy, pandas, PyTorch, scikit-learn), C++, Java; Linux, Bash, Git; FastAPI, async I/O,
- ML, NLP: supervised learning, large-scale text preprocessing, prompt and pipeline design for LLMs, vLLM deployment
- Mathematics & Formal Methods: probability, optimization, numerical methods; Lean, Coq, Isabelle, interactive theorem proving

RESEARCH EXPERIENCE

Researcher; EleutherAI *06/2026-08/2026*
SemantEq: a reference-based evaluator for autoformalization in Lean 4 that certifies the semantic equivalence of formal statements with audited proofs

- Defined SemantEq, an equivalence relation on Lean 4 statements strictly finer than logical equivalence, generated by four meaning-preserving actions (rearrangement, bridge rewriting, change of variables, structural weakening)
- Built SemantEq-Eval, a model-free Lean 4 proof search whose verdicts rest on audited proof terms for both implications; 100% precision and 65.6% recall on ProofNetVerif vs. 95.8% and 61.8% for the prior method BEq+
- Built SemantEq-ProofAudit, which audits LLM-written proofs by their elaborated terms rather than tactic scripts; achieved 100% precision and raised recall on 407 equivalent pairs from 65.4% to 81.1%

Student Researcher; Berkeley Sky Computing Lab *02/2025-05/2026*
Rosetta Prover & Proof Gym: a LLM theorem prover for proof gen, auto-formalization, and cross-system formal translation in Coq/Isabelle/Lean; and a unified, async Python gym-style backend supporting verification and interaction with multiple proof assistants
Mentored by Dr. Kaiyu Yang (Meta Fundamental AI Research)

- Engineered ProofGym, a FastAPI server for parallel, asynchronous proof evaluation and proof search across formal languages
- Supported Lean's Proof-state forking, Isabelle's dynamic worker pooling, and multi-node serving with a custom load-balancer
- Achieved throughput improvement in whole-proof verification(7.5x) and proof search(2x-7x) tasks compared to similar platforms
- Curated a large-scale, structured multi-formal-language corpus, and built a training pipeline combining SFT, synthetic natural-formal pair generation, and informalize→reformalize cross-system translation to learn Coq↔Lean↔Isabelle commonalities

Research Assistant; Simons Institute for the Theory of Computing *05/2024-05/2026*
Theoretical Computer Science (TCS) Lean Library: a library of machine-verified proofs of core & advanced TCS topics including asymptotics, graph theory and coding/info theory in the proof assistant Lean
Mentored by Prof. Venkatesan Guruswami, Collaborated with Shilun Li

- Self-studied Lean Language, Self-Correcting Codes, and Information Theory
- Formalized 2k+ LoC theorems including Singleton, Hamming, GV Bound, and asymptotic estimation of binomial coefficient
- Investigate methods to formally define Reed-Solomon Code and prove relevant theorems

PUBLICATIONS

- **Li, X.***, Ammanamanchi, P. S., Bhat, S., Jamdar, R., Lin, Y., & Biderman, S. (2026). *SemantEq: Faithful Bidirectional Equivalence of Formal Statements.* arXiv preprint arXiv:2610.32919, under review at ICLR 2027. arXiv
- **Li, X.***, Ma, W., Bi, H., Li, Z., Si, X., & Yang, K. (2025). *ProofGym: Unifying LLM-Based Theorem Proving Across Formal Systems.* NeurIPS 2025 Workshop on Mathematical Reasoning and AI (MATH-AI), poster. OpenReview

Teaching Assistant; University of California, Berkeley *02/2025-05/2026*
Efficient Algorithms and Intractable Problems: Algorithm design, optimization (DP/LP), and NP-completeness
Introduction to Machine Learning: Theory to practice in ML covering regression, clustering, Neural networks, and transformers

- Graded assignments and projects for 600+ students; provided timely support and clarifications on course discussion forum