Peiyang Song

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Education

6/2026 (expected) **California Institute of Technology** Pasadena, CA
B.S. in Computer Science & Minor in Robotics
Advisors: Prof. Steven Low & Prof. Günter Niemeyer.
GPA: **4.2/4.0** (some courses occasionally offer A+ grade = 4.3)

Research Interests

My research focuses on **LLM reasoning**, **agentic AI**, and **neuro-symbolic AI**. I aim to advance intelligent agents capable of rigorous reasoning by combining the strengths of neural and symbolic paradigms, with one central theme and two adjacent directions:

- **Central theme:** Integrating LLM reasoning, agentic AI, and neuro-symbolic methods by combining *neural* models (LLMs) with *symbolic* systems (e.g., Lean) to advance LLM-based agents for formal reasoning in mathematics and code.
- **Broader LLM reasoning:** Extending from formal to informal reasoning, exploring how LLMs can better handle reasoning in natural language contexts, informed by *cognitive science* principles and studies of *human-like reasoning* processes.
- **Broader neuro-symbolic AI:** Applying neuro-symbolic approaches to broader AI challenges beyond formal reasoning, including the design of energy-efficient machine learning systems.

Work Experience

6/2025 – Present **University of California, Berkeley** Berkeley, CA
Researcher @ Berkeley AI Research (BAIR) Lab and Sunblaze Group
Advisors: Prof. Dawn Song (UCB), Dr. Jingxuan He (UCB)

6/2024 – Present **Stanford University** Palo Alto, CA
Researcher @ Stanford AI Lab (SAIL) and Computation & Cognition Lab
Advisors: Prof. Noah Goodman (Stanford), Dr. Gabriel Poesia (Harvard)

2/2023 – 2/2025 **California Institute of Technology** Pasadena, CA
Research Fellow @ Anima AI+Science Lab
Advisors: Prof. Anima Anandkumar (Caltech), Dr. Kaiyu Yang (Meta)

11/2022 – 6/2024 **University of California, Santa Barbara** Santa Barbara, CA

Researcher @ Computer Architecture Lab (ArchLab)
Advisors: Prof. Timothy Sherwood (UCSB), Dr. Jeremy Lau (Google)

Selected Publications & Preprints

Refereed Publications

NeuS 2025 **Lean Copilot: Large Language Models as Copilots for Theorem Proving in Lean**
Peiyang Song, Kaiyu Yang, Anima Anandkumar
International Conference on Neuro-Symbolic Systems (NeuS), 2025
1.2k+ stars on Github, ranking 2nd after Mathlib4 among all Lean projects

IEEE Micro 2025 **Delay Space Arithmetic and Architecture**
Rhys Gretsch, Peiyang Song, Advait Madhavan, Jeremy Lau, Timothy Sherwood
IEEE Micro, 2025, **Top Picks**

ICLR 2025 **LeanAgent: Lifelong Learning for Formal Theorem Proving**
Adarsh Kumarappan*, Mo Tiwari*, Peiyang Song, Robert Joseph George, Chaowei Xiao, Anima Anandkumar
International Conference on Learning Representations (ICLR), 2025

EMNLP 2024 **In-Context Learning May Not Elicit Trustworthy Reasoning: A-Not-B Errors in Pretrained Language Models**
Pengrui Han*, Peiyang Song*, Haofei Yu, Jiaxuan You (* Equal Contribution)
Findings of Empirical Methods in Natural Language Processing (EMNLP), 2024

EMNLP 2024 **Creative and Context-Aware Translation of East Asian Idioms with GPT-4**
Kenan Tang*, Peiyang Song*, Yao Qin, Xifeng Yan (* Equal Contribution)
Findings of Empirical Methods in Natural Language Processing (EMNLP), 2024

ASPLOS 2024 **Energy Efficient Convolution with Temporal Arithmetic**
Rhys Gretsch, Peiyang Song, Advait Madhavan, Jeremy Lau, Timothy Sherwood
ACM International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS), 2024

NeurIPS 2023 **LeanDojo: Theorem Proving with Retrieval-Augmented Language Models**
Kaiyu Yang, Aidan Swope, Alex Gu, Rahul Chalamala, Peiyang Song, Shixing Yu, Saad Godil, Ryan Prenger, Anima Anandkumar
Neural Information Processing Systems (NeurIPS), 2023, **Oral Presentation**

Preprints

Preprint **A Survey on Large Language Model Reasoning Failures**

Peiyang Song*, Pengrui Han*, Noah Goodman (* Equal Contribution)

ICML AI for Math (AI4MATH) Workshop, 2025

Preprint **AI Impact on Human Proof Formalization Workflows**

Katherine M. Collins*, Simon Frieder*, Jonas Bayer, Jacob Loader, Jeck Lim, Peiyang Song, Fabian Zasier, Lexin Zhou, Shanda Li, Shi-Zhuo Looi, Jose Hernandez-Orallo, Joshua B. Tenenbaum, Cameron Freer, Umang Bhatt, Adrian Weller, Valerie Chen†, Ilia Sucholutsky† (* Equal Contribution, † Equal Advising)

NeurIPS Workshop on Mathematical Reasoning and AI (MATH-AI), 2025

Preprint **LeanProgress: Guiding Search for Neural Theorem Proving via Proof Progress Prediction**

Suozhi Huang, Peiyang Song, Robert Joseph George, Anima Anandkumar

ICLR VerifAI: AI Verification in the Wild Workshop, 2025

Preprint **The Personality Illusion: Revealing Dissociation Between Self-Reports & Behavior in LLMs**

Pengrui Han*, Rafal D. Kocielnik*, Peiyang Song, Ramit Debnath, Dean Mobbs, Anima Anandkumar, R. Michael Alvarez

NeurIPS LAW Workshop: Bridging Language, Agent, and World Models, 2025

NeurIPS Workshop on LLM Persona Modeling, 2025, **Oral Presentation**

Preprint **Energy-Aware Temporal Function Approximation**

Peiyang Song, Rhys Gretsch, Jeremy Lau, and Timothy Sherwood

In Submission, Manuscript Available upon Request

Selected Awards

10/2025 **Caltech FCC Appreciation Award**

In recognition of outstanding service in mentoring first-year Caltech students

5/2025 **ICLR Notable Reviewer Award**

In recognition of outstanding reviewer work at ICLR 2025

4/2025 **George W. Housner Student Discovery Fund**

For the Lean Copilot paper

2/2025 **IEEE Micro Top Pick Award**

For the Delay Space Arithmetic and Architecture paper

8/2023 **Early Research Scholarship**
In recognition of research work done in early undergradudate study

4/2023 **Caltech SURF Award**
For the LeanDojo and Lean Copilot papers

Selected Media

2025 **Researchers Discover "Personality Illusion" to Reveal a Profound Disconnect Between Language and Behavior in LLMs**
MIT Technology Review China

2024 **Mathematicians' Newest Assistants Are Artificially Intelligent**
Scientific American

2024 **LeanAgent: The First Life-Long Learning Agent for Formal Theorem Proving in Lean**
MarkTechPost

2024 **Lean Copilot: An AI Tool That Allows Large Language Models (LLMs) to Be Used in Lean for Proof Automation**
MarkTechPost

2023 **Can LLMs Generate Mathematical Proofs That Can Be Rigorously Checked?**
MarkTechPost

Invited Talks & Tutorials

LLM Reasoning for Math and Code

10/2025 Carnegie Mellon University L3 Lab

Tutorial: Neuro-Symbolic Theorem Proving with Lean

9/2024 3rd Neuro-Symbolic AI Summer School (NSSS)

Towards An AI Mathematician

12/2023 UC Santa Barbara NLP Lab
11/2023 CCS Research & Creative Activities Conference (RACA-CON)
8/2023 Caltech SURF Seminar Day

Teaching Experience

Fall 2025 **ME/CS/EE 133A: Robotics – Kinematics**
Teaching Assistant @ *California Institute of Technology*

Academic Services

Reviewer

Conference on Neural Information Processing Systems (NeurIPS)
International Conference on Learning Representations (ICLR)
Association for Computational Linguistics Rolling Review (ARR)
Annual Meeting of the Association for Computational Linguistics (ACL)
Conference on Empirical Methods in Natural Language Processing (EMNLP)
International Joint Conference on Natural Language Processing (IJCNLP)
Asia-Pacific Chapter of the Association for Computational Linguistics (AACL)

NeurIPS Mathematical Reasoning and AI (MATH-AI) Workshop
NeurIPS Workshop on Deep Learning for Code (DL4C)
NeurIPS Workshop on Behavioral Machine Learning
ICLR VerifAI: AI Verification in the Wild Workshop
ICLR Workshop on Representational Alignment (Re-Align)
ICML AI for Math (AI4MATH) Workshop
ICML Workshop on LLMs and Cognition (LLM-Cognition)
ICML Workshop on Assessing World Models
ICML Workshop on on Models of Human Feedback for AI Alignment (MoFA)

Organizing Staff Agentic AI Summit 2025 @ UC Berkeley

On-Campus Services & Appointments

Caltech Admissions Ambassador @ Caltech Undergraduate Admissions Office
First-Year Caltech Connector (FCC) @ Student & Family Engagement Office

Languages

Programming Python, C++, Lean 4, Java, C, PASCAL, Rocq, OCaml, C#

Natural English (TOEFL 117/120), Chinese (Native)