Brennen Hill

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Education

University of Wisconsin-Madison; Madison, WI *Expected Graduation May 2026*
Bachelor of Science in Computer Science

- **GPA:** 3.81/4.0.
- **Honors:** Letters & Science Dean's List, Honors in Computer Science Program, Letters & Science Honors Program.
- **Graduate AI Coursework:** Foundation Models, Learning-Based Image Synthesis, Advanced Robotics, Advanced Reinforcement Learning, Theory of Multi-agent Machine Learning.
- **AI Coursework:** Directed Study on LLMs with Dr. Sala, Game AI, Neurobiology, Artificial Neural Networks, Artificial Intelligence, Game Theory and Learning.
- **Neuro Coursework:** Molecular and Cellular Mechanisms of Memory, Neurobiology.

National University of Singapore; Singapore *Jan 2025 - May 2025*
Exchange Scholar

- Awarded a merit-based placement through a highly competitive, university-wide application process.
- **GPA:** 3.75/4.0.
- **Graduate AI Coursework:** Neural Networks and Deep Learning II (audit).
- **Graduate Neuro Coursework:** Frontiers in Neurotechnology (audit), Behavioral & Cognitive Neuroscience (audit).
- **AI Coursework:** AI Planning and Decision Making, Mind and Machine (both).
- **Neuro/Bio Engineering Coursework:** Bioinformatics, Organoid Engineering (audit), Mind and Machine.

Research Experience

Wisconsin Neuromorphic Computing and NeuroAI Lab; Madison, WI *Jun 2024 - Present*
Founding Director & Research Lead UW-Madison Website

- Established and direct a university-sanctioned entity to explore the intersection of neuroscience and artificial intelligence.
- Secured formal funding, dedicated space, and administrative support from UW-Madison.
- Delivered lectures on advanced topics intersecting neuroscience and AI to audiences of over 100.
- Mentoring researchers from initial project proposals to research papers.
- *Publications from this research:* [2], [4].

Dr. Sala's Sprocket Lab; Madison, WI *Sep 2024 - Present*
Foundation Models Researcher

- Researching and implementing novel methods for editing representations within large language models including coarse-to-fine pipelines.
- Worked with big data, GPU clusters, and high throughput systems.
- *Publications from this research:* [6], [7].

Dr. Hanna's Badger RL Lab; Madison, WI *May 2024 - Present*
Reinforcement Learning Researcher

- Designing and implementing reinforcement learning policies to train physical robots for autonomous soccer, focusing on multi-agent coordination.
- Key Accomplishments: Top ranking in RoboCup International Robotics Competition (3rd place in the Standard Platform League 2025; 1st place in the Challenge Shield League 2024).
- *Publications from this research:* [1] (in collaboration with Dr. Berland's Lab), [5].

Dr. Berland's Complex Play Lab; Madison, WI *Apr 2024 - Present*
Reinforcement Learning Researcher

- Architecting communication strategies between agents in multi-agent reinforcement learning (MARL) environments.
- Researched and developed a novel adversarial co-evolution framework to automatically generate curriculum for MARL.
- *Publications from this research:* [1] (in collaboration with Dr. Hanna's Lab), [3].

Industry Research Engineer Experience

Stealth Mode Startup; Boston, MA — *May 2025 - Current*
Software Engineer (Research Engineer) — Project Page

- Spearheaded the complete research and development lifecycle for a novel artificial intelligence system, taking the project from an ambiguous high-level goal to a fully deployed, production-ready system.
- Devised, prototyped, and implemented a custom, hardware-aware algorithm that significantly outperformed SOTA approaches by over 100x in accuracy on the system's hardware.

HRL Hughes Research Laboratories; Malibu, CA — *Summer 2024 & Summer 2023*
Quantum Software Intern (Research Engineer)

- **Quantum Compiler Optimization via Template Matching** — Project Page
  - Engineered a production-ready implementation of an exact pattern matching algorithm within the Quilc quantum compiler, translating a novel theoretical method into a high-impact optimization tool.
  - Reduced quantum circuit depth by up to 37%, shortening execution time on quantum hardware, directly enhancing algorithmic fidelity by mitigating qubit decoherence.
- **Low-Level Quantum Control Compiler** — Project Page
  - Architected a multi-pass compiler in Common Lisp to generate optimized binary directly for a custom quantum control processor (the QICK tProcessor ISA), creating a low-level pathway for direct FPGA execution to maximize performance and control flexibility.
  - Designed and implemented a custom assembly language to bridge high-level experimental logic with the hardware instruction set, enabling advanced compiler optimizations, automatic resource allocation, and precise picosecond-level timing calculations.
- Awarded a return offer after each period with HRL in recognition of significant technical contributions and research impact.

Publications: First-Author Peer-Reviewed

Representative First-Author Peer-Reviewed Publications

1 **Brennen Hill**, Mant Koh En Wei, Thangavel Jishnuanandh. "Communicating Plans, Not Percepts: Scalable Multi-Agent Coordination with Embodied World Models ." *In proceedings of **NeurIPS 2025** Workshop on Scaling Environments for Agents; in NeurIPS 2025 Workshop on Embodied World Models for Decision Making; and in NeurIPS 2025 Workshop on Optimization for Machine Learning*. [arXiv:2508.02912]

Developed a novel intention communication framework in MARL that achieved >96% success in a complex coordination task using a learned world model for latent trajectory planning and a self-attention mechanism to encode and share agent intentions, significantly outperforming emergent protocols.

2 **Brennen Hill**, Zhang Xinyu, Timothy Putra Prasetio. "The Geometry of Cortical Computation: Manifold Disentanglement and Predictive Dynamics in VCNet ." *In proceedings of **NeurIPS 2025** Workshop on Symmetry and Geometry in Neural Representations and in NeurIPS 2025 Workshop on Interpreting Cognition in Deep Learning Models*. [arxiv:2508.02995]

Designed VCNet, a novel architecture emulating the primate visual cortex, achieving state-of-the-art accuracy on two vision benchmarks with over 10x greater parameter efficiency than standard models.

3 **Brennen Hill**. "Co-Evolving Complexity: An Adversarial Framework for Automatic MARL Curricula ." *In proceedings of **NeurIPS 2025** Workshop on Scaling Environments for Agents*. [arXiv:2509.03771]

Developed a novel adversarial co-evolution framework to automatically generate a curriculum for multi-agent reinforcement learning that induces complex emergent strategies, increasing agent task performance by over 300% compared to baseline.

Additional First-Author Peer-Reviewed Publications.

4 **Brennen Hill**. "The Physical Basis of Prediction: World Model Formation in Neural Organoids via an LLM-Generated Curriculum ." *In proceedings of **NeurIPS 2025** Workshop on Scaling Environments for Agents and in NeurIPS 2025 Workshop on Embodied World Models for Decision Making*. [arXiv:2509.04633]

5 **Brennen Hill**. "Hierarchical Task Environments as the Next Frontier for Embodied World Models in Robot Soccer ." *In **NeurIPS 2025** Workshop on Embodied World Models for Decision Making*. [arXiv:2509.04731]

Publications: In Review

6 **Brennen Hill**. "HEFT: A Coarse-to-Fine Hierarchy for Enhancing the Efficiency and Accuracy of Language Model Reasoning." *In preparation*. [arXiv:2509.09801]

7 **Brennen Hill**, Surendra Parla, Venkata Abhijeeth Balabhadruni, Atharv Prajod Padmalayam, Sujay Chandra Shekara Sharma. "Breaking to Build: A Threat Model of Prompt-Based Attacks for Securing LLMs." *In preparation*. [arXiv:2509.04615]

Selected Research Projects

Representation Fine-Tuning for Vision-Language Models *Sep 2024 - Dec 2024*
Lead Researcher Project Page

- Investigated Representation Fine-Tuning, a parameter-efficient fine-tuning method, on a vision-language model (nanoLLaVA) for a spatial reasoning task.
- Co-authored a research paper demonstrating that ReFT achieved accuracy comparable to LoRA (65.7% vs. 66.0%) while using nearly 10x fewer trainable parameters (0.019% of the model).

Reinforcement Learning for Quadruped Roller Skating *Sep 2024 - Dec 2024*
Researcher Project Page

- Co-authored a research paper on training a Unitree Go1 quadruped robot with passive wheels to skate using reinforcement learning in the Isaac Gym simulator.
- Developed an RL policy that resulted in emergent complex behaviors, including automatic gait switching from a stable diagonal gait at low speeds to a dynamic galloping gait at high speeds (3 m/s).

Honors and Awards

RoboCup International Robotics Competition *May 2024 - Present*
3rd Place (Standard Platform League 2025), 1st Place (Shield 2024)

- Achieved top placements in a competition that serves as an international scientific benchmark for multi-agent AI in adversarial environments, using fully autonomous, identical NAO robots.
- Guided the team's technical strategy by conducting a comprehensive literature review on multi-robot soccer, leading to a publication on language-driven world models [5].
- Designed and implemented the multi-agent coordination protocols for collaborative passing that formed a component of our team's winning strategy, applying concepts from my research [1].

National University of Singapore School of Computing Showcase *Jan 2025 - Present*
Presenter

- Selected to present a self-developed 3D videogame to an audience of over 100 students and faculty.
- The game featured AI-driven monster agents that used complex pathfinding algorithms to navigate dynamic 3D environments and make strategic targeting decisions; complex player abilities including harvesting resoucres, crafting equipment, and placing structures; and representing a unique mix of PvE, survival, resource management, and tower defense.

University of Wisconsin-Madison *Sept 2022 - Present*
Dean's List, Honors in Computer Science Program, Letters & Science Honors Program

NASA International Space Apps Challenge 2024 *Oct 2024*
Honorable Mention Project Page

- Received a global Honorable Mention, only awarded to 19 of 93,520 (0.02%) global participants.
- Processed large-scale NASA/ESA astronomical data and implemented the 3D visualization, rendering, and user interface.

- Won the Chicago hackathon and advanced to global finals; additionally awarded Best Presentation.

Hack Midwest 2024 *Oct 2024*
Winner (awarded $2,500) Project Page
- Won (of over 300 developers), awarded $2,500, and noted for Best Enterprise-Scale Buisnesss Solution.
- Designed and built "Badger Vision," an AI-powered assistive tool to help individuals with prosopagnosia (face blindness) by providing real-time audio cues for face identification and emotion recognition.
- Implemented a computer vision pipeline using deep learning (convolutional neural networks) to identify individuals and classify their emotional expressions from a live low-level video stream.

Agoura High School *Aug 2018 - May 2022*
Valedictorian of 600, 4.6/4.0 GPA, International Baccalaureate Diploma, State Golden State Seal Merit Award, State Seal of Biliteracy, 4-year Scholar Athlete

Professional Research Service

Conference on Neural Information Processing Systems (NeurIPS) *Sep 2025*
Served as a peer reviewer upon nomination by the respective program committees:
- Neurips 2025 Workshop on Scaling Environments for Agents (SEA)
- Neurips 2025 Workshop on Aligning Reinforcement Learning Experimentalists and Theorists (ARLET)
- Neurips 2025 Workshop on Interpreting Cognition in Deep Learning Models (CogInterp)
- Neurips 2025 Workshop on Efficient Reasoning (ER)
- Neurips 2025 Workshop on Data on the Brain and Mind Findings (DBM)
- Neurips 2025 Workshop on Symmetry and Geometry in Neural Representations (NeurReps)

Cortical Labs Journal Club *Oct 2024*
Host and speaker
- Presented a critical analysis on the origins of intelligence, synthesizing concepts of scale-free cognition and developmental bioelectricity, and referencing work by Dr. Levin to discuss how higher-level agency evolves from the homeostatic, problem-solving capabilities of cellular collectives.
- Facilitated a post-talk discussion with researchers on the future of synthetic biological intelligence and the applications of the mechanisms presented.
- Invited to give future talks in recognition of the presentation's quality and the engaging discussion.

Leadership & Professional Experience

Madison Machine Learning *Sep 2025 - Present*
Co-Founder
- Co-organizing and growing a new community hub connecting machine learning students, faculty, and industry professionals.
- Co-leading weekly technical deep-dives and facilitating critical discussions on state-of-the-art papers in machine learning.

Badger Ballroom Dance Team *Dec 2023 - Present*
Vice President and Vice-Captain

AI Club *Mar 2024 - Mar 2025*
Executive Boardmember and Webmaster

Ballroom Association UW-Madison *Dec 2022 - Dec 2023*
Executive Boardmember and Webmaster

Thunder Warrior Gaming *Mar 2018 - Apr 2022*
Lead Developer and Founder Project Page
- Designed, built, self-published, and marketed the video game Thunder Warrior: Genesis.
- Achieved net profit.
- Engineered a custom game engine, multiplayer server, database, 3D models, and animations.

Agoura Highschool Math Honors Society *Aug 2020 - May 2022*
Math Tutor

Agoura Highschool Science Honors Society *Aug 2020 - May 2022*
Science Tutor