

# Brennen Hill

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[Brennen-A-Hill](#) | [Brennen-Hill](#) | [E7N2fXkAAAAJ](#)

## EDUCATION

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**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

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**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:* [7], [8].

**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

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**Stealth Mode Startup;** Boston, MA  
Software Engineer (Research Engineer)

May 2025 - Current

[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  
Quantum Software Intern (Research Engineer)

Summer 2024 & Summer 2023

### • 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

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### 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 Prasetyo. "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

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- 6 **Brennen Hill**. "Structural Plasticity as Active Inference: A Biologically-Inspired Architecture for Homeostatic Control." *In review*. [Preprint forthcoming on arXiv]  
Developed a novel architecture that integrates synaptic and structural plasticity, demonstrating that computational agents can solve tasks by physically migrating their processing units on a grid to minimize local prediction error, driven solely by an intrinsic, active inference-based objective.
- 7 **Brennen Hill**. "HEFT: A Coarse-to-Fine Hierarchy for Enhancing the Efficiency and Accuracy of Language Model Reasoning." *In review*. [[arXiv:2509.09801](#)]
- 8 **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 review*. [[arXiv:2509.04615](#)]

## SELECTED RESEARCH PROJECTS

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- 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

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- 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 resources, 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 Business 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**  
*Math Tutor*

*Aug 2020 - May 2022*

**Agoura Highschool Science Honors Society**  
*Science Tutor*

*Aug 2020 - May 2022*