

# Brennen Hill

+1-818-322-5574 | [bahill4@wisc.edu](mailto:bahill4@wisc.edu) | [BrennenHill.com](https://BrennenHill.com)  
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## EDUCATION

**University of Wisconsin-Madison;** Madison, WI  
*Bachelor of Science in Computer Science*

*Expected Graduation May 2026*

- **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  
*Exchange Scholar*

*Jan 2025 - May 2025*

- 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  
*Founding Director & Research Lead*

*Jun 2024 - Present*  
[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  
*Foundation Models Researcher*

*Sep 2024 - Present*

- 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  
*Reinforcement Learning Researcher*

*May 2024 - Present*

- 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  
*Reinforcement Learning Researcher*

*Apr 2024 - Present*

- 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

May 2025 - Current

[Project Page](#)

Software Engineer (Research Engineer)

- 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

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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 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**. "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

### Representation Fine-Tuning for Vision-Language Models

Sep 2024 - Dec 2024

[Project Page](#)

Lead Researcher

- 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

[Project Page](#)

Researcher

- 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 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*

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**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.

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**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*