

# Brennen A. Hill

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

## 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, Advanced Seminar (audit), Theory of Multi-agent ML, Mathematical Foundations of ML (upcoming).
- **AI Coursework:** Directed Study on LLMs with Dr. Sala, Game AI, Artificial Neural Networks, Artificial Intelligence, Game Theory & Learning.
- **Neuro Coursework:** Molecular & Cellular Mechanisms of Memory, Neurobiology, Computational Neuroscience (upcoming), Nanotechnology in Neuroscience (upcoming)

**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 (calculated by UW-Madison).
- **Graduate AI Coursework:** Neural Networks & Deep Learning II (audit).
- **Graduate Neuro Coursework:** Frontiers in Neurotechnology (audit), Behavioral & Cognitive Neuroscience (audit).
- **AI Coursework:** AI Planning & Decision Making, Mind & Machine (both).
- **Neuro/Bio Engineering Coursework:** Mind & Machine, Organoid Engineering (audit), Bioinformatics.

## RESEARCH EXPERIENCE

**Wisconsin Neuromorphic Computing and NeuroAI Lab;** Madison, WI  
*Founding Director & Research Lead*

*Jun 2024 - Present*

[UW-Madison Lab Page](#)

- Founded and direct to explore the intersection of neuroscience and artificial intelligence.
- Secured formal funding, dedicated space, support from Dr. Akhilesh Jaiswal as advisor, partnership with NeuroAI startup FinalSpark, and administrative support from UW-Madison.
- Lectured on neuroAI (e.g. STDP) to audiences of over 100 (including graduate students and professionals) and organized biweekly workshops.
- Mentoring 15 researchers from initial project proposals to research papers and advised 100.
- *Publications from this research:* [2], [5], [3].

**Dr. Frederic 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. Josiah 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), [6].

**Dr. Matthew 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 incorporating world models.
- 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), [4].

**Dr. Rajendra Kumar-Singh (Tufts University, Neuro); Boston, MA (Remote)***Oct 2025 - Present**NeuroAI Research Collaborator & AI Lead*

- Personally recruited by Dr. Kumar-Singh to serve as the AI lead for two proposed biomedical ventures.
- Authored comprehensive technical roadmaps analyzing competitive landscape, resource requirements, and strategic path for (1) a genAI platform for de novo AAV gene-therapy vector design & (2) a clinically-tailored AI vision aid for patients with AMD & Glaucoma.

**Dr. Michael Levin (Tufts University, Biology); Allen Discovery Center, (Remote)***Oct 2025 - Present**NeuroAI Research Mentee*

- Invited to mentorship from Dr. Levin to extend "Structural Plasticity as Active Inference" research [3].
- Designing embodied agents where the computational cells are the device and investigating model robustness to damage & topological changes.

**INDUSTRY RESEARCH ENGINEER EXPERIENCE****Stealth Mode Startup; Boston, MA***May 2025 - Present**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.

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## PUBLICATIONS: FIRST-AUTHOR, PEER-REVIEWED, & FULL-LENGTH

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**Representative:**

- 1 Brennen A. 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 A. 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 A. Hill**. "Structural Plasticity as Active Inference: A Biologically-Inspired Architecture for Homeostatic Control." *In Brain-Inspired Dynamics for Engineering Energy-Efficient Circuits and Artificial Intelligence.* [[arXiv:2511.02241](#)]
- 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.
- 4 Brennen A. 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:**

- 5 Brennen A. 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](#)]
- 6 Brennen A. Hill**. "Generative World Models of Tasks: LLM-Driven Hierarchical Scaffolding for Embodied Agents." *In NeurIPS 2025 Workshop on Embodied World Models for Decision Making.* [[arXiv:2509.04731](#)]

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## PUBLICATIONS: IN REVIEW, FIRST-AUTHOR, & FULL-LENGTH

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- 7 Brennen A. Hill**. "HEFT: A Coarse-to-Fine Hierarchy for Enhancing the Efficiency and Accuracy of Language Model Reasoning." *In review.* [[arXiv:2509.09801](#)]
- 8 Brennen A. 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](#)]

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## SELECTED RESEARCH PROJECTS

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- Representation Fine-Tuning for Vision-Language Models**  
Lead Researcher

Sep 2024 - Dec 2024  
[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*[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 [6].
- 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**

<b>Conference on Neural Information Processing Systems (NeurIPS)</b>	<i>Served as a peer reviewer upon nomination by the respective program committees:</i>	<i>Sep 2025</i>
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- 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)

<b>AAAI Conference on Artificial Intelligence</b>	<i>Served as a peer reviewer upon nomination by the respective program committees:</i>	<i>Nov 2025</i>
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- AAAI 2026 Workshop on Neuro for AI & AI for Neuro: Towards Multi-Modal Natural Intelligence (NeuroAI)

<b>Cortical Labs Journal Club</b>	<i>Oct 2024</i>
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*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**

<b>Madison Machine Learning</b>	<i>Sep 2025 - Present</i>
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*Co-Founder*

- Co-organizing and growing new community hub connecting machine learning researchers.
- Co-leading weekly technical deep-dives and critical discussions on SOTA papers in machine learning.

<b>Badger Solar Racing</b>	<i>Aug 2025 - Present</i>
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*Head of AI*

<b>Badger Ballroom Dance Team</b>	<i>Dec 2023 - Present</i>
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*Vice President and Vice-Captain*

<b>AI Club</b>	<i>Mar 2024 - Mar 2025</i>
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*Executive Boardmember and Webmaster*

<b>Ballroom Association UW-Madison</b>	<i>Dec 2022 - Dec 2023</i>
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*Executive Boardmember and Webmaster*

<b>Slow Food UW</b>	<i>Nov 2022</i>
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*Volunteer Leadership*

- Mobilized and coordinated a team of 30 to prepare and distribute pay-what-you-can meals.

<b>Agoura High School Math Honors Society</b>	<i>Aug 2020 - May 2022</i>
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*Math Tutor*

<b>Agoura High School Science Honors Society</b>	<i>Aug 2020 - May 2022</i>
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*Science Tutor*

<b>Thunder Warrior Gaming</b>	<i>Mar 2018 - Apr 2022</i>
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*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.

**GRANTS & FUNDING: UNDER REVIEW / PENDING**

**Science, Mathematics, and Research for Transformation (SMART) Scholarship-for-Service Program**

**Vitalik Buterin PhD Fellowship in AI Existential Safety**

**Department of Energy Computational Science Graduate Fellowship (DOE CSGF)**

**Link Foundation Modeling, Simulation, and Training Fellowship**