Jingxuan Fan (She/Her/hers)

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EDUCATION

Harvard University **Cambridge, MA**
Ph.D. Candidate, Program in Neuroscience Expected Jan. 2026
Dissertation: Neural Circuit Computation Underlying Reward-Guided Navigation
M.S. in Applied Math (secondary) March 2024
Relevant Coursework: Reinforcement Learning, Neural Computation, Advanced Topics in Data Science, Physical Mathematics, TinyML and Efficient Deep Learning, Mathematical & Engineering Principles for Training Foundation Models

Massachusetts Institute of Technology **Cambridge, MA**
B.S. in Brain and Cognitive Science May 2020
Honors & Awards: Hans Lukas Teuber Award for Outstanding Academics, Walle J.H. Nauta Award for Outstanding Research

SKILL & INTERESTS

Programming skills: Python (PyTorch, Tensorflow, scikit-learn, Pandas, SciPy/NumPy), Matlab, SQL, Linux, Git
Modeling skills: generative models, reinforcement learning, representation learning, time series analysis, LLM benchmarking

SELECTED RESEARCH EXPERIENCE

Harvard University ***Cambridge, MA***
PhD Researcher, Dept. of Neurobiology *Expected Jan. 2026*

- **Developed a visual-olfactory virtual reality environment** to study reward-guided spatial reasoning and cognition; **Designed and trained an RNN-PPO agent with internal curiosity module (RND)** to simulate behavioral policies for reward-guided navigation and foraging tasks; **Conducted state space analysis** to extract low-dimensional neural dynamics representations and investigated their role in composing observable parameters in behavioral policies
- **Performed analysis on a novel *Drosophila* connectome dataset,** bridging existing brain and VNC datasets**; Led efforts in** NBLAST-based neuron matching of *Drosophila* central brain across large scale connectome datasets; **Performed graph embedding and hierarchical clustering** to multi-level sensory-motor pathways

Master's Researcher, Dept. of Applied Mathematics *March 2024*

- **Developed and implemented curiosity-driven exploration algorithm (PPO-RND)** for customized maze navigation tasks and achieved performance gain compared to simple exploration methods; Explained better performance through better latent representations and demonstrated that RND shapes latent representation similar to predictive auxiliary objectives
- **Developed a novel method** to improve T2I model's (diffusion transformer based) ability to generate objects with correct spatial relationships via embedding steering
- **Developed an automated method** to generate a large-scale, domain-specific dataset of graduate-level physical mathematics problems; **Benchmarked the performance of leading closed- and open-source LLMs** on this dataset; **Performed in-depth error analysis** to identify strengths and weaknesses in the LLMs' handling of complex mathematical problems; Paper accepted by **NeurIPS MATH-AI workshop**

Massachusetts Institute of Technology ***Cambridge, MA***
Undergraduate Researcher, Picower Institute *Sept.2017-May 2020*

- Conducted smFISH, IHC, q-PCR and behavioral assays to study the neural circuit for danger signal detection and avoidance during social behaviors and co-authored a paper published in ***Nature***

Undergraduate Researcher, McGovern Institute *Sept.2018-May 2020*

- Designed single-nanometer iron oxide nanoparticles as dopamine-responsive MRI sensors, developed brain-wide delivery methods to assess its distribution and functionality; Co-authored two papers published in ***JACS*** and ***PNAS***

PROFESSIONAL EXPERIENCE

Meta, Research Intern *May 2024-Aug. 2024*

- Developed a novel image-based feature representation tailored to high density sEMG and used customized CV models for gesture decoding and input feature attributions
- Introduced manifold capacity as a theoretical metric for representation quality evaluation and multimodal SSL loss
- Implemented generative models to extract disentangled factors in sEMG for generalization and data augmentation

UpHonest Capital, Scout *May 2023-present*

- Sourced deals in the field of AI-based provider tools for mental health and presented to the fund managers

Axoft, Software Intern *Sept. 2023-Dec. 2023*

- Developed and maintained in-house software pipelines for fluorescence imaging processing and spike sorting
- Applied statistical and machine learning models for neural decoding from population spiking and LFP data

Merck Research Laboratories, Research Intern *June 2018-Aug. 2018*

- Performed cell culture, immunoprecipitation and high throughput fluorescence imaging and quantification to characterize TDP-43 protein interaction networks and pathology in Amyotrophic Lateral Sclerosis (ALS) model

PUBLICATIONS

Fan, J., Martinson, S., Wang, E.Y., Hausknecht, K. (2024). HARDMath: A Benchmark Dataset for Challenging Problems in Applied Mathematics. **NeurIPS 2024 MATH-AI workshop**

Kwon, J.-T., Ryu, C., Lee, H., Sheffield, A., Fan, J., Cho, D. H., Bigler, S., Sullivan, H. A., Choe, H. K., Wickersham, I. R., Heiman, M., & Choi, G. B. (2021). An amygdala circuit that suppresses social engagement. **Nature**, 593(7857), 114–118.
Wei, H., Wiśniowska, A., Fan, J., Harvey, P., Li, Y., Wu, V., Hansen, E. C., Zhang, J., Kaul, M. G., Frey, A. M., Adam, G., Frenkel, A. I., Bawendi, M. G., & Jasanoff, A. (2021). Single-nanometer iron oxide nanoparticles as tissue-permeable MRI contrast agents. **Proceedings of the National Academy of Sciences**, 118(42).
Hsieh V., Okada S., Wei H., García-Álvarez I., Barandov A., Alvarado SR., Ohlendorf R., Fan J., Ortega A., Jasanoff A. (2019). Neurotransmitter-responsive nanosensors for T2-weighted magnetic resonance imaging. **Journal of the American Chemical Society**, 141 (40), 15751-15754