Justin Ellis-Joyce

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Experience

Work Experience and Projects

HHMI Janelia March 2023 - Present

Research Engineer → PhD Candidate

- **FlySong:** With the wiring diagram and behavior of an animal, can we predict the activity of single neurons? By integrating high-resolution connectomes, optogenetic data, and behavioral outputs, I employed variational inference with biophysical neuron models, optimized through an autoencoder-like training paradigm to yield biologically plausible simulations. We seek to dramatically accelerate hypothesis generation for experimentalists through a systems-level understanding of complex biological systems. Presented at Berlin Connectomics Conference 2024 and various conferences at Janelia.
- **Locomotion:** Currently constructing a model which incorporates probabilistic machine learning and reinforcement learning to simulate the locomotion circuits of the fly ventral nerve cord in a physics engine, MuJoCo. The model simulates the brain and body of the fly simultaneously, using keypoint-tracked recordings to estimate single neuron activity and physical characteristics of the body simulataneously.

Johns Hopkins University Applied Physics Laboratory FT 2019 - 2023 — PT 2023 - Present

Research Engineer

- **IARPA MICRONS (2019-2025):** Technical lead on developing novel semi-automated proofreading tools to multiply the effectiveness of human proofreaders. This includes deep learning approaches alongside graph analysis and 3D computer vision techniques. Continuing to work on reinforcing current coregistration between structural and functional data using new data from performers as additional fiducials.
- **PRION (2022-2023):** Received internal grant funding to investigate health sector applications of connectomics. Investigated principles of neurodegeneration by modelling cysts and excitotoxicity in-silico using fly connectome models.
- **DARPA TITAN (2019-2020), NeuroAI-Engines(2020-2023):** Worked on various efforts including neuron modeling and connectome data science. Created simulations of neuron ensembles to interrogate mechanisms of memory and inform novel AI. Previously tested theories of subneuron computation to see if subcompartment models improve the resolution of neural representations in the fly navigation center. Investigated implementation of these models on neuromorphic hardware.
- **Other projects:** Stood up Neuprint, a graph database server, for internal use. Tasked and managed several cohorts of interns, and implemented a variety of novel machine learning and control systems methods.

Johns Hopkins University Applied Physics Laboratory Summer 2018

Research Intern

- Designed and implemented a machine learning algorithm to cheaply segment large, coarse swaths of electron microscopy brain data. Extensively proofread and annotated electron microscopy data, including in EM mouse neuroanatomy.

Education

2023 (Ongoing)	PhD in Neuroscience **Johns Hopkins University** (MD)
2022	MS in Mechanical Engineering **Johns Hopkins University** (MD)
2019	BS in Computer Engineering **Johns Hopkins University** (MD)
	President of Johns Hopkins University Robotics Club
2016	Ridgefield High School (CT)

Skills

Programming	Advanced: Python, including Jax, Pytorch, Tensorflow; Intermediate: MATLAB, C, C++, Java, Arduino, R
Misc. Software	Office, CAD (Solidworks, Autodesk), Photoshop, Illustrator, Lightroom, Unity
Other	Rock climbing, backpacking, birding, photography, cooking, painting, classical guitar