Mia Cameron

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Education

University of California, San Diego Expected Dec 2024

B.S. Computer Science

B.S. Applied Mathematics

Biology minor

- **Relevant Coursework:** Calculus and Linear Algebra, Data Structures and Algorithms, Software Engineering, Real Analysis, Probability and Stochastic Processes, Statistics, Machine Learning, Cellular and Systems Neuroscience, General Biology and Chemistry

Major Projects

Biologically-plausible Neural Network Model of the Hippocampus Sept 2022 - Present

Salk Institute for Biological Studies *Sejnowski Lab*

- Developed an new, biologically-plausible learning algorithm for recurrent neural networks, based on the Recirculation algorithm for one-layer autoencoders. Studied its dynamics in relation to backpropagation-through-time, and under what conditions it is a valid approximation.
- Modelled sequence replay and prediction in the hippocampus, mapping different parts of the model to the distinct regions of the hippocampus.
- Presented work on the learning rule at the INC Winter School on Brains and Computation, [1] .
- Published as part of a project on using RNNs to model sequence prediction in the hippocampus [2].

Phage Genomics Research Initiative Sept 2020 - June 2021

UC San Diego *Dutton and Pogliano Labs*

- Presented original research at the Undergraduate Research Symposium on potential functions of an unknown, novel protein in Erwinia bacteriophage RAY. [3]
- Managed large datasets between several collaborators and developed scripts to automate bioinformatics pipelines and repetitive processes.
- Predicted protein structure with classical homology and deep-learning based bioinformatics tools (Phyre and AlphaFold), and identified conserved domains.

Minor Projects

- Developed a EEG paradigm to measure and classify relaxed and non-relaxed brain states in subjects. Collected data from participants using EEGLAB, and analyzed the data in MATLAB and Python. (link)
- Implemented classical neuronal dynamics models in Python, including the Hodgekin-Huxley and FitzHugh-Nagumo models of single-neurons, Tsodyks-Markram models of short-term synaptic plasticity, and network models of spatial working memory. (class projects in Neuronal Dynamics course)
- Implemented the Forward-Forward algorithm, which uses contrastive learning as a biologically-plausible alternative to backpropagation. (link)
- Implemented anti-hebbian learning, as a biologically-plausible way to decorrelate and sparsify data, in order to increase the memory capacity of a neural network. (link)
- Built a unsupervised machine learning model using PCA and K-means clustering to group stylistically similar historical paintings. (link)

Experience

- Reviewer for Neural Computation

Publications and Presentations

[1] M. Cameron and H. Esmeraldo, *Predictive recirculation: A model of encoding and replay of sequences in a recurrent neural network*, 2022. [Online]. Available: TODO, (presentation, Winter School on Brains and Computation Student Talks, Institute for Neural Computation, UC San Diego, December 16th 2022.

[2] Y. Chen, H. Zhang, M. Cameron, and T. Sejnowski, "Predictive sequence learning in the hippocampal formation," *Neuron (in-press)*, 2024.

[3] A. Prichard, J. Lee, T. G. Laughlin, *et al.*, "Identifying the core genome of the nucleus-forming bacteriophage family and characterization of erwinia phage ray," *bioRxiv*, 2023. doi: 10.1101/2023.02.24.529968. [Online]. Available: https://www.biorxiv.org/content/early/2023/02/25/2023.02.24.529968.

Skills

Programming: Python (NumPy, PyTorch, Tensorflow, Pandas), MATLAB, Java, C++, C, Haskell
Tools: Git, Linux, Latex, Blender, Adobe Illustrator
Analysis: Nonlinear Modelling, Neural Networks, Linear Algebra / Matrix Calculus, Stochastic Modelling, Statistics
Communication: Scientific writing, Scientific Presentation skills, Journal review, Literature review