Understanding Encoding and Decoding Rules of a Biological Neural Network Using Machine Learning Techniques
PhD Preliminary Research Examination

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Abstract: Modern neural recording methodologies, including multi-electrode and optical recordings, allow us to monitor large population of neurons with high temporal resolution. In this dissertation, I will first develop computational and statistical methods to fully harness the capabilities of such large-scale neural recordings. Using these models, I will study fundamental principles of sensory processing in two relatively simple models of the olfactory system: fruit fly (Drosophila melanogaster) and locust (Schistocerca americana). In particular, I will focus on understanding how odor representations within a single exposure are refined across different populations of neurons (calcium imaging in flies; faster dynamics), and between different exposure within a single neural population (electrophysiology in locusts; slower dynamics). I will use the knowledge gained to develop a Boolean neural network model, and a Bayesian framework for training the same, to understand how the sensory information can be decoded. In sum, my dissertation will develop novel tools for understanding sensory information processing principles and cross-fertilize ideas from neuroscience to create novel neural network architectures.

Date: Tuesday, May, 7, 2019
Time: 2:00 p.m.
Location: Green Hall, Room 0120

Dissertation advisor:
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