BioE332: Large-Scale Neural Modeling

This course examines the dynamics of large (>1000) networks of spiking neurons, with particular focus on how these networks achieve cognitive behaviors such as working memory, selective attention, and decision making. The course will feature lectures and labs using two Python-based simulators: **Brian**, a software platform, and **Neurogrid**, a hardware platform (developed in my lab) that simulates up to a million spiking neurons in real time. Most of the course will be project-based, allowing you to explore your individual interests. While there are certainly many great options for neuroscience courses, I think this one may be particularly interesting for students interested in spiking neurons, systems neuroscience, dynamical systems, or large-scale computational modeling.

Course Details: Based on modeling projects. Accompanying lectures provide background on systems neuroscience and on modeling techniques.

Prerequisites: A course in neuronal circuits (e.g., BIOE 103, BIO 217, NBIO 258), systems neurobiology (e.g., PSYCH 209A, NBIO 220), computational neuroscience (e.g., NENS 220, APPPHYS 293) or neuroengineering (e.g., EE124).

Goals: Link structure to function by developing circuit-level computational models of the nervous system.

Target Audience: This course is targeted to students already exposed to systems neuroscience and computational methods wishing to learn how to build large-scale spiking neuron models that link neuronal biophysics to neural circuits to cognitive behavior.

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Textbooks: None required. For background reading, **Eugene M. Izhikevich's** monograph, ***Dynamical Systems in Neuroscience,*** provides a good introduction to dynamical systems, cortical cell types, and single-neuron modeling.

Grading: Your grade will be based on written reports on three weekly modeling exercises performed individually (Weeks 2 through 4) and a written report on a final project performed in teams of two (Weeks 5 to 10). These reports will describe the implementation and results of an existing model and an extension of that model (or a new model). The project will count for 60% of your grade; the three weekly reports will make up the remaining 40%.

Late policy: Due days for written reports are specified in the Course Calendar. It is ***20% off the first day*** an assignment is late, and ***another 20% off the second day***. Assignments more than ***two days late will not be accepted***.

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