

NEUROSCI 613: Neurophysiology and Computational Neuroscience
September 4 –October 2, 2018
M, T, Th 1-3pm
USB 4130

Coordinators:

Victoria Booth, Professor of Mathematics, Associate Professor of Anesthesiology
Anatoli Lopatin, Associate Professor of Molecular & Integrative Physiology
Geoffrey Murphy, Professor of Molecular & Integrative Physiology

Description: This module focuses on neurophysiology and provides an introduction to computational modeling of neurons. Lectures will cover the biophysics of neural membranes, electrophysiology of dendrites and axons, generation of action potentials and their axonal propagation, synaptic transmission and plasticity at synapses.

We will use the modeling package Neurons in Action to investigate these topics further. Neurons in Action has very detailed tutorials and the assigned computer labs will utilize the concepts in the tutorials and expand on these concepts in the assigned problems. For the last computer lab investigating neural networks, we will use Matlab with codes that will be provided.

Neurons in Action is available for purchase at the website neuronsinaction.com. Please purchase and download Neurons in Action to your laptop before class on Thursday 9/6/18, and bring your laptop to class on all the Computer Lab days. Note: Neurons in Action runs on Firefox but an older version of Firefox – it won't work on the current version of Firefox. The Firefox version that comes with the Neurons in Action download is the correct version, and will be installed with Neurons in Action.

In lieu of a final exam, the final assignment will be a critique of a journal paper implementing computational modeling to investigate neural or synaptic neurophysiology. Students may work in teams of 2. Teams will choose a paper from a provided list of candidate papers and the written critique must address specific questions/points that will be provided.

Grades: Problem set and computer labs 70%, team paper critique 25%, class participation 5%

Contact Info:

Victoria Booth, East Hall 3858, vbooth@umich.edu. Office Hours: TW 5:30-6:30pm, Th 11am-12pm
Anatoli Lopatin, alopatin@umich.edu
Geoffrey Murphy, murphyg@umich.edu

Date	Topic
Tues 9/4	Neural membrane potential and cable properties Anatoli Lopatin
Thurs 9/6	Intro to Neurons in Action, tutorials: the membrane, equilibrium potentials and Na action potential Victoria Booth
Mon 9/10	Action potentials and propagation Anatoli Lopatin
Tues 9/11	Computer lab 1: Hodgkin-Huxley model; Neurons in Action tutorials: Na action potential, Voltage clamping a patch, Na and K channel kinetics Victoria Booth
Thurs 9/13	Computer lab 2: Action potential propagation; Neurons in Action tutorials: the unmyelinated axon, the myelinated axon, non-uniform channel density Victoria Booth
Fri 9/14	Computer Lab 1 due (BOOTH)
Mon 9/17	Ion channels and channel diversity Anatoli Lopatin
Tues 9/18	Synapses Geoffrey Murphy Computer Lab 2 due (BOOTH)
Thurs 9/20	Computer lab 3: Ion channels; Neurons in Action tutorials: chattering ion channels, Na and K channel kinetics Victoria Booth
Mon 9/24	Computer lab 4: Synaptic currents; Neurons in Action tutorials: interactions of synaptic potentials, synaptic integration Victoria Booth Problem set 1 due (LOPATIN)
Tues 9/25	Synapses and synaptic plasticity Geoffrey Murphy Computer Lab 3 due (BOOTH)
Thurs 9/27	Computer lab 5: Synchrony and rhythms in neural networks using Matlab Victoria Booth
Fri - Sat 9/28-29	Neuroscience Graduate Program Retreat
Sun 9/30	Computer Lab 4 due (BOOTH)
Mon 10/1	Computer lab 5 continued: Synchrony and rhythms in neural networks using Matlab Victoria Booth
Tues 10/2	Case studies of modeling in neuroscience Victoria Booth
Wed 10/3	Computer Lab 5 due (BOOTH)
Fri 10/5	Team journal paper critique due