NEUROSCI 613: Neurophysiology and Computational Neuroscience
September 3 –October 1, 2019
M, T, Th 1-3pm
USB 4130

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

Description: This module focuses primarily on neurophysiology and provides a cursory introduction to computational modeling of neurons and neural networks. 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 and model simulations in Matlab 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. We will additionally investigate neural firing properties and neural network synchronization through simulating models using Matlab.

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 9/5/19, 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.

There will be 2 in-class exams. Exam 1 will be a written exam focused on neurophysiology of single neurons. Exam 2 will involve written responses and model simulations, similar to the computer labs, and cover content from the whole course.

Grades: Computer labs 55%, Exams 40%, Class Participation 5%

Contact Info:
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Date	Topic
Tues 9/3	Neural membrane potential and cable properties *Anatoli Lopatin*
Thurs 9/5	Computer lab 1: Hodgkin-Huxley model. Neurons in Action tutorials: Na action potential, Voltage clamping a patch, Na and K channel kinetics *Victoria Booth*
Mon 9/9	Action potentials and propagation *Anatoli Lopatin*
Tues 9/10	Computer lab 2: Hodgkin-Huxley model. Matlab: computing frequency-current relations *Victoria Booth* Computer Lab 1 due
Thurs 9/12	Computer lab 3: Action potential propagation. Neurons in Action tutorials: the unmyelinated axon, the myelinated axon, non-uniform channel density *Victoria Booth*
Fri 9/13	Computer Lab 2 due
Mon 9/16	Ion channels and channel diversity *Anatoli Lopatin*
Tues 9/17	Computer lab 4: Kinetics of ionic membrane currents. Neurons in Action tutorials: Na and K channel kinetics; Matlab: effects of additional ionic currents on frequency-current relations *Kamran Diba & Victoria Booth* Computer Lab 3 due
Thurs 9/19	**Exam 1** (LOPATIN); Synapses *Geoffrey Murphy*
Mon 9/23	Computer lab 5: Post-synaptic currents. Neurons in Action tutorials: interactions of synaptic potentials, synaptic integration *Kamran Diba & Victoria Booth*
Tues 9/24	Synapses and synaptic plasticity *Geoffrey Murphy* Computer Lab 4 due
Thurs 9/26	Computer lab 6: Synchrony and rhythms in neural networks using Matlab *Victoria Booth*
Sun 9/29	Computer Lab 5 due
Mon 9/30	Computer lab 6 continued: Synchrony and rhythms in neural networks using Matlab *Victoria Booth*
Tues 10/1	**Exam 2** (BOOTH & DIBA)
Sat 10/5	Computer Lab 6 due