Syllabus: CompModelsF13

SPECIAL TOPICS IN NEURAL SCIENCE: Introduction to Computer Modeling of Neuronal Systems NEURL-UA 302.020, NEURL-GA 3042.010 3 points. Fall term, 2013. Wednesday, 4:30-6:30pm, Meyer Rm 815. J. Rinzel. 1st class: Sept 4, 2013 Prerequisite: Calculus I-II. (seek consent of instructor if in doubt).

This is s dynamic syllabus. Most recent update: May 17, 2013

The first half of the course will involve tutorials from Neurons in Action (NIA) (http://neuronsinaction.com/home/main), 2 or 3 per class. No matlab programming will be required for these tutorials. NIA tutorials are self-contained with experimental-like protocols, and real-time interactive simulations on cellular neurophysiology. Tutorials will be presented by the instructor and students in discussion-like format, while running NIA.

The second half of the course will focus on firing-rate descriptions of neuronal population activity for system-level properties. Most of the material will be drawn from the book **Spikes, Decisions, and Actions: The Dynamical Foundations of Neuroscience** (SDA) by HR Wilson (<u>http://cvr.yorku.ca/webpages/wilson.htm#book</u>). Simulations will be carried out with Matlab (no prior experience is necessary); some starter codes will be provided by the instructor and some codes are included with SDA. Presentations will be by the instructor and students.

A tentative schedule:

Sept 4: JR Intro to Computl Neuro; sims & motivating anims w/ NIA/NEURON; Intro to NIA tutorial; NIA: The Membrane Tutorial

Sept 11: JR. NIA: Equilibrium Potentials; The Na Action Potential

Sept 18: Students. NIA: Threshold: To Fire or Not to Fire; Voltage Clamping a Patch JR: HH model, repetitive firing.

Sept 25: Students. NIA: The Neuromuscular Junction; Postsynaptic Inhibition; Interactions of Synaptic Potentials

Oct 2: Students. NIA: The Passive Axon; The Unmyelinated Axon; Axon Diameter Change

Oct 9: Students. NIA: Na and K Channel Kinetics; Synaptic Integration.

Oct 16: Students. NIA: Coincidence Detection; Site of Impulse Initiation; The Myelinated Axon

Oct 23: JR. Tutorial on dynamical systems; dissecting the HH model; Morris-Lecar model, phase plane; XPP demo (maybe)

Oct 30: JR. continued from Oct 23

Nov 6: JR. SDA: Firing rate models: The e-e single populn model for short term memory; Intro to Matlab codes: simulating the e-e populn model. Bistability, hysteresis, ramp input + codes.

Nov 13: No class, SFN meeting.

Nov 20: JR or students. SDA: Competition models: decision making; perceptual bistability/alternations.

Nov 27: Thanksgiving break.

Dec 4: Students. E-I network oscillations; Cortical damping; Thalamic rhythms; Receptive field properties

Dec 11: Final class day. Students. SDA: CPGs: development & swimming