# Syllabus: CompModelsS18

# SPECIAL TOPICS IN NEURAL SCIENCE: Introduction to Computer Modeling of Neuronal Systems Neural-Ua 302-002, Neural-GA 3042-006

3 points. Spring term, 2018. Wednesday, 4-6pm, Meyer Rm 760. 1st class: January 24, 2018. Prerequisite: Calculus I-II. (seek consent of instructor if in doubt).

This is s dynamic syllabus. Most recent update: Jan 14, 2018

The first part of the course will involve primarily tutorials from Neurons in Action (NIA) (<u>http://neuronsinaction.com/home/main</u>), 2 or 3 per class. No matlab programming will be required for these tutorials but we will introduce some Matlab features and review some math concepts. 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 part 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; some starter codes will be provided by the instructor and some codes are included with SDA. Presentations will be by the instructor and students.

There will be homework assignments, exams, and maybe quizzes.

A tentative schedule:

Jan 24:

JR. Overview - Intro to Computl Neuro; sims & motivating anims w/ NIA/NEURON; Intro to NIA tutorial; NIA: The Membrane Tutorial

Jan 31:

JR. NIA: Equilibrium Potentials; The Na Action Potential

Feb 07:

NIA: Threshold: To Fire or Not to Fire NIA: Voltage Clamping a Patch JR:HH model, repetitive firing

## Feb 14:

JR: Intro to Matlab; Euler numerical integration and for ODE of passive decay.

Feb 21:

NIA: The Neuromuscular Junction NIA: Interactions of Synaptic Potentials

JR: NIA - Postsynaptic Inhibition

## Feb 28:

NIA: The Passive Axon NIA: The Unmyelinated Axon JR: NIA - The Myelinated Axon

#### Mar 07:

JR: Tutorial on ODEs – Intro to dynamical systems: dissecting the HH model; [[Morris-Lecar model, phase plane ?]]; Matlab - action potential upstroke (FHN)

#### Mar 14: Spring break

#### Mar 21:

NIA: Axon Diameter Change NIA: Synaptic Integration JR: NIA- Na and K Channel Kinetics

# Mar 28:

NIA: Coincidence Detection NIA: Site of Impulse Initiation

#### Apr 04:

JR - SDA: Intro to firing rate models: single e-e population for ShortTermMemory (STM) – Matlab codes.

Apr 11:

JR - SDA: Matlab codes for STM cont'd. [[ e-i distributed network – "bumps"?]] SDA: Half-center oscillator models: i-i network.

# Apr 18:

JR: SDA: Competition models: decision making; perceptual bistability

# Apr 25:

JR: SDA: Network oscillations: e-i network; thalamic rhythms; cortical damping. May 02:

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SDA: CPGs - development & swimming or xxx.

May 07 (Monday): Last day of classes

In-class exam, probably May 09.