MATH 680  Introduction to Computational Neuroscience

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Lectures:  Thur 6-9, Matheson Hall 311
Office hours:  T 2:30-3:30 and appointment
Course webpage:  www.math.drexel.edu/~medvedev/classes/math680/
contains homework assignments and announcements.

Description: The course focuses on mathematical concepts and techniques used in computational neuroscience. It is designed to provide students with necessary mathematical background for formulating, simulating, and analyzing models of individual neurons and neural networks. The course will serve as a gentle introduction to the theory of nonlinear differential and difference equations in the context of neuroscience modeling. The topics to be covered include a review of basic facts about electrophysiology of neural cells, one dimensional dynamical systems, phase plane techniques, bifurcations, and their applications to analysis of neural excitability. The students will learn basic models of excitable membranes such as Hodgkin-Huxley and Morris-Lecar models. They will acquire hands-on experience in numerical simulations of differential and difference equations using MATLAB. The course is aimed at graduate and advanced undergraduate students interested in computational biology and applied mathematics. Students with non-math majors are encouraged to enroll.

Prerequisites: calculus, differential equations.

Text: E.M. Izhikevich, Dynamical Systems in Neuroscience: The Geometry of Excitability and Bursting, to be published. The copies of the book can be ordered from the university copy center (next to the bookstore).

MATLAB is a powerful numerical software package. It is widely used for research in computational neuroscience. We will gradually develop skills of using MATLAB through the in class examples and homework problems. Most homework assignments will contain problems to be solved numerically in MATLAB. MATLAB is available in the computer lab located on the first floor in the Korman Center. You may also check about the availability of MATLAB in the computer labs in your departments. If you work in the computer lab at Korman you will need to activate your dunx1 (Academic Unix) account. Finally, if you are using Linux you may use MATLAB installed on the machines of the Mathematics Department. Please let me know if you choose the latter option.

Homework: I will assign a set of homework problems after every lecture and will collect them in class approximately every other week. Students are encouraged to discuss the homework and to work together on the problems. However, each student is responsible for final preparation of her/his homework papers. The presentation is important. Solutions should be presented in the order the problems were assigned. Every solution should be given
a concise but sufficient explanation and written up legibly.

**Assessment:** Your final grade will be based on your performance on homework projects and on the final project.

**A few useful references:**

**Physiology:**


**Computational Neuroscience:**

P Dayan and LF Abbott, Theoretical Neuroscience.
J Keener and J Sneyd, Mathematical Physiology
CP Fall, ES Marland, JM Wagner, and JJ Tyson, Computational Cell Biology

**MATLAB:**

DJ Higham and NJ Higham, Matlab Guide
P Pratap, Getting Started with Matlab.