Introduction to Computational Neuroscience

Biol645
Math635

Biol432
Math430

Syllabus

Instructor: Horacio G. Rotstein

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Course website:

http://web.njit.edu/~horacio/IntroCompNeuro/IntroCompNeuroF20.html

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NJIT Honor Code: All students should be aware that the we take the NJIT Honor Code very seriously and enforces it strictly. This means there must not be any forms of plagiarism; i.e., copying of homework, class projects, or lab assignments, or any form of cheating in quizzes and exams. Under the Honor Code students are obligated to report any such activities to the instructor.

http://www.njit.edu/academics/honorcode.php

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Textbook:

“An Introductory Course in Computational Neuroscience", by P. Millerm MIT Press (2018), 1st edition. ISBN 978-0-262038256

Recommended books:

* "Mathematical Foundations of Neuroscience", by G. B. Ermentrout & D. H. Terman - Springer (2010), 1st edition. ISBN 978-0-387-87707-5

* "Foundations of Cellular Neurophysiology", by Daniel Johnston and Samuel M.-S. Wu. The MIT Press, 1995. ISBN 0-262-10053-3

* "Dynamical Systems in Neuroscience: The Geometry of Excitability and Bursting", by Eugene M. Izhikevich. The MIT Press, 2007. ISBN 0-262-09043-8

* "Biophysics of Computation - Information processing in single neurons", by Christof Koch. Oxford University Press, 1999. ISBN 0-19-510491-9

* "Theoretical Neuroscience: Computational and Mathematical Modeling of Neural Systems", by Peter Dayan and Larry F. Abbott. The MIT Press,2001. ISBN 0-262-04199-5

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Grading Policy:

Undergraduate:

Homework, quizzes & class participation:	40 %
Midterm exam/project:	30 %
Final exam (project/presentation):	30 %

Graduate:

Homework, quizzes & class participation:	40 %
Midterm exam/project:	30 %
Project / Presentations:	30 %

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Class Policy - Attendance and Participation:

Students are expected to participate in the class discussion

Students must attend all classes.

Absence from class will inhibit your ability to fully participate in class discussions and problem solving sessions and, therefore, affect your grade.

Tardiness to class is very disruptive to the instructor and students and will not be tolerated.

All cellular phones and other electronic devices must be switched off during class and exams times

Chatting using electronic devices during class time will not be tolerated

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Homework Policy:

A number of assignments will be given out during the semester.

Each assignment is designed to be a learning tool

Assignments will must be submitted on the published due date.

The source code used for the calculations MUST accompany the submitted homework.

Students must be able to orally explain their results and codes upon request.

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Makeup Exam Policy:

There will be no makeup exams/projects, except in rare and extenuating situations where the student has a legitimate reason for missing an exam or a project deadline.

In all cases, the student must present written verifiable proof of the reason for missing the exam/project presentation (e.g., a doctor's note, police report, court notice, etc), clearly stating the date AND times of the mitigating problem. This information must be validated by the Dean of Students

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Software:

Working knowledge of coding and the use of an appropriate software is required

Every student is required to learn how to use Matlab (class 4) or use any other software according to his/her preference.

Matlab can be downloaded through NJIT

Every student is required to arrange for a computer to be available to her/him by next week. No exceptions!

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Course Description:

Mathematical and computational introduction to the biophysical mechanisms that underlie physiological functions of single neurons.

Mathematical modeling of single neurons

Computational simulations

Dynamical systems tools (phase-plane analysis)

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Course Description:

The passive membrane equation

How to solve ODEs

Introduction to Matlab (tutorial in the class website)

Dynamics of the passive membrane equation

Integrate-and-fire models

The Hodgkin-Huxley model

The cable equation

Discussion on modeling and simulations

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Course Description:

Introduction to Dynamical Systems

Reduced one- and two-dimensional neural models

One-dimensional neural models: Phase-space analysis

Two-dimensional neural models: Phase-space analysis

Subthreshold oscillations and the canard phenomenon

Subthreshold and suprathreshold resonance

Bursting