Syllabus for NEU 256: Introduction to Computational Neuroscience, Winter 2018

Overview

Intro to Computational Neuroscience provides an introduction to basic computational methods for understanding what nervous systems do and for determining how they function. The course covers the structure of the brain, from neurons to circuits to regions, and also the computational and theoretical approaches to model the brain. The course will introduce students to the physiology of individual neurons, how they communicate through synapses and firing, and how they work together to create systems that control, learn and memorize. The course will include the application of mathematical and computational models to neural systems.

Learning Outcomes

By the end of this course you should be able to:

- describe how the brain "computes";
- describe different methods that computational neuroscientists use to model neural coding, both dynamically and over time;
- computationally model the biophysics of single neurons;
- computationally model the dynamics of networks of neurons.

Prerequisites

MAT 150, CSC 241, and NEU 201, or instructor approval

Textbooks

- *(NSM) Tutorial on Neural Systems Modeling,* by Thomas J. Anastasio, 2009. ISBN-10: 0878933395, ISBN-13: 978-0878933396
- Other readings available online as indicated

Attendance

Attendance in class is expected. A significant part of the grade for the course will be the in-class labs which you will do with a partner (more about that below).

Class Plan

The following class plan is tentative and subject to change as the course progresses.

- **Class 1:** (1/4) Overview; Basic Computations in Matlab
- **Class 2:** (1/11) Modeling; Matlab loops, relationals, spike times; Rate coding theory; Population coding
- **Class 3:** (1/18) Gill-withdrawal reflex in Aplysia; Positive Feedback and leaky integration; Feedback in series
- **Class 4:** (1/25) Vestibulo-ocular reflex; Velocity storage; Central Pattern Generators
- **Class 5:** (2/1) Lateral inhibition, edge detection; Activity bubbles

- **Class 6:** (2/8) Midterm
- **Class 7:** (2/15) Auto-associative memory; Memory recall; Hopfield networks
- **Class 8:** (2/22) Hopfield networks; Hippocampus and anterograde amnesia; Distributed vs. sparse representations
- **Class 9:** (3/1) Specializing for specific inputs; Brain maps; Tonotopic maps
- **Class 10:** (3/8) Orientation selectivity in the visual cortex; Information theory; Review
- **Class 11:** (3/15) Final Exam

Instructor Information

Email	peterh@cdm.depaul.edu
Home Page	http://reed.cs.depaul.edu/peterh/
Phone	312-362-5736
Office Hours	Monday 3:30-5:00PM at my office, Thursday 4-5:30PM at LPC (McGowan South 400) or by arrangement
Address	CDM Center 717 DePaul University 243 South Wabash Avenue Chicago, IL 60604-2301 USA

Assessment

Your final grade will be based on:

Labs	25%
HWs	25%
Midterm lecture	12.5%
Midterm Lab	12.5%
Final exam / proj	25%

The grading scale will be:

93.3	A
90	A-
86.6	B+
83.3	B
80	B-
76.6	C+
73.3	C
70	C-
66.6	D+
60	D
< 60	F

This course will use D2L for submission of Homeworks and Labs and posting of grades.

Labs: Each week in class, a significant portion of the class will be spent on hands-on activities to help you to (1) learn the various computational methods essential to analyzing data and modeling neuronal systems, and to (2) apply these methods to real-world neuronal data. You will do the labs with a randomly assigned partner, and (normally) that will be someone with a different background (neural or computational) than you. Each group will submit a joint lab submission for each lab.

Homeworks: Each homework (perhaps with the exception of the first) will have three parts: A computational part, a neural conceptual part, and part based on the readings due for that week. The homeworks will be submitted individually, **but** the grade for the first two parts will be shared with the lab partner from the previous week. Therefore, during the lab, you will have an incentive to learn from your partner what you need to know, and to teach your partner what they need to know.

Midterm: The mid-term test will be broken into two parts: an in-class portion covering terminology and understanding of systems neuroscience concepts covered in the readings and lecture, and an in-lab portion in which you will demonstrate proficiency in the programming techniques covered in lab.

Final: The final exam will consist of both lecture and lab components. It will cover material from the second half of the course.

Alternative Final Project: In place of taking the lab portion of the final exam, you may opt to instead complete a final project. This will be more work than preparing to take the final exam, but it will also be more rewarding. For the last four weeks of the quarter, you will work on a project involving modeling of a neuronal system and/or analysis of neuronal data. You are encouraged to apply computational techniques to your own neuroscience-related research. I will consult with you to guide your choice of topic. You will submit a written report detailing your work, as well as give a talk during the last week of class. The final projects can be done with a partner and they will be graded both on their computational and neural aspects, so you are encouraged to find a partner whose knowledge complements yours.

On Plagiarism

You are encouraged to discuss all homeworks and the project (if applicable) with your classmates. You are, however, required to complete them on your own (except for the projects which should be done with your partner). In particular, this means that you are not allowed to "cut and paste" text from anywhere else, *or to paraphrase* someone else's work, unless it is a *very small* part of your submission, the copied text is clearly indicated (i.e. surrounded by quotation marks), and the source is clearly identified (with citation and full reference information).

All assignments will be submitted to "Turn it in" for automatic plagiarism testing. This system is very good at finding things that have been copied, so just don't do it. If you have any questions about what constitutes plagiarism, please ask.

This course will be subject to the university's academic integrity policy. More information can be found at http://academicintegrity.depaul.edu/. If you have any questions, be sure to consult with your professor.

No phones visible in class

Unless you're looking at your textbook. Multitasking is a myth.

Students with disabilities

Students who feel they may need an accommodation based on the impact of a disability should contact the instructor privately to discuss their specific needs. All discussions will remain

confidential. To ensure that you receive the most appropriate accommodation based on your needs, contact the instructor as early as possible in the quarter (preferably within the first week of class), and make sure that you have contacted the Center for Students with Disabilities (CSD) at: Lewis 1420, 25 E. Jackson Blvd. Phone: (312)362-8002.

Academic Policies

All students are required to manage their class schedules each term in accordance with the deadlines for enrolling and withdrawing as indicated in the University Academic Calendar.

Online Course Evaluations

They are anonymous. Please do them. Your feedback is valuable and appreciated!

Syllabus Changes

This syllabus is subject to change as necessary during the quarter. If a change occurs, it will be thoroughly addressed during class, posted under Announcements on D2L and sent via emailed.

Please ensure that your email address is correct on campus connect.