Materials, assignments, and discussions will be hosted on Ed Discussion. Use the link in the left-side menu to access.

Computational neuroscience refers to research that adapts tools from disciplines like mathematics, statistics, and computer science to investigate various functions of the nervous system. In this course, we will cover a range of topics under the umbrella of computational neuroscience at both conceptual and practical levels, learning about tools for working with experimental (spiking) data and working in the theoretical realm. After examining a variety of existing models, students will have an opportunity to develop their own computational neuroscience projects on topics of their choice.

While the course will be taught an introductory level, there are a few **required prerequisites.** Students should have completed Neuro/MCB 80, some prior experience coding in Python or Matlab, and some familiarity with linear algebra and differential equations. See below for more information about these prerequisites and other course logistics.

If you would like to enroll in the course, please fill out **this interest form** before the lottery deadline (11:59 pm on November 8) and request permission to enroll through my.harvard.

Update: the course is full. Check back in Spring 2025!

Instructor:

Dr. Kristina Penikis (she/her)

Email: kpenikis@fas.harvard.edu

Office Hours: https://calendly.com/kpenikis-neuro

Spring 2024 Course Syllabus

Course format:

There will be two in-person synchronous meetings per week, on **Tuesdays and Thursdays at 10:30â€“11:45 am**, consisting of a mix of lecturing, discussion, and active learning exercises. Students will need to bring a laptop to class. We expect students to attend and be active participants in these activities in order to get the most from this course. In terms of grading of engagement, we are not judging the content of your questions or correctness of your contributions, just that you are participating and helping to create a safe and curious environment. Coming to office hours and participating in online discussion boards also count as engagement.

There will also be **one section per week**, led by the course Teaching Fellow. **Location and time TBD** based on polling the class. Sections will consist of concept review and homework and project help.

Sections are optional but highly recommended. Engagement with and attendance at sections will be taken into account if your grade is an edge case (for example, if you are on the border between an A- and a B+).

The course will use the Ed platform for all materials and assignments. A link to the class Ed page will be added to the left-hand menu here in Canvas once enrollment is settled. Students should use the Ed Discussion as the primary platform for course communication. This is better than email because other students may have the same question, and everyone can see the Ed discussion threads.

Prerequisites & typical enrollees:

This course fulfills the requirement of a Foundational course for the neuroscience concentration, so typical enrollees are concentrators in their sophomore or junior year. Neuroscience students may also use this course to fulfill an advanced elective. We also welcome students from other concentrations who meet prerequisites!

Background and prerequisites:

- **Neuro 80:** Required prerequisite for all students.
- **Programming:** Python will be used in the assignments so you are expected to have some basic experience and familiarity with Python, especially the numpy library. We will have a refresher section on Python towards the beginning of the course. If you have experience with a similar programming language (such as Matlab), you will be able to succeed in the course if you are willing to spend a few hours learning Python. This self-paced Python boot camp from Harvard provides an overview of the basics.
- **Linear Algebra & Differential Equations:** Familiarity with linear algebra and differential equations (Math 21b/22a) will be assumed. In particular, you will need knowledge of matrix multiplication, eigenvalues/vectors, and the basics of differential equations and dynamical systems. The TF will hold review sections on key concepts at the beginning of the course.

If you meet some but not all prerequisites or if you're unsure whether you're prepared, I encourage you to email me.

This course will be offered in the Spring semester every year.

Assignments & grading:

Homework assignments (every other week)	50%
Final project	20%
Open-note quizzes (following every lecture)	10%
Student engagement	20%

Homework assignments

A large part of the course consists of structured assignments due every two weeks. You will complete code, play with demos, answer questions, and occasionally even do math by hand. The purpose of these is to practice using the methods for data analysis we cover and to engage more deeply with the models and concepts. This is not a programming course so you will not be expected to code complex analyses or models from scratch - we will provide much of the code. You may work individually or collaborate in small groups of 2-3 people on these, but you are expected to submit your own answers (a group should not submit identical notebooks).

Open-note quizzes

After every class (before the next class), we ask that you complete an open notes quiz, which should take about 5-15 minutes. Most quiz questions will cover content from that day, but some will refer to previous content. The purpose of these quizzes is to help you consolidate your knowledge, pinpoint areas of confusion, and revisit previous material to aid recall. These quizzes will be pass-fail -- as long as you complete them at above chance levels (showing effort beyond random guessing), you will pass them.

Final project

There is no final exam for this course. Instead, you will complete a final project, either as an individual or in a small group of 2-3 people. You will be provided with real neural data sets and starting ideas/questions but the project you choose is up to you! This is your chance to try out your own computational neuroscience research and answer questions you are interested in. You will be expected to propose your idea before getting started, do a final presentation, and submit a write-up.

Materials:

Readings, videos, resources, etc. will accompany many of the lectures. All required materials will be provided at no cost to students.

Here are a few to start:

- Theoretical Neuroscience - Peter Dayan and Larry Abbott
- Neuronal Dynamics - Wulfram Gerstner, Werner M. Kistler, Richard Naud and Liam Paninski
- Good Research Code Handbook - Patrick Mineault

Absence and late work policies:

Students are expected to come to class and submit homework assignments on time. That said, if you cannot attend a class, need an extension, or have other concerns or extenuating circumstances, please email me **before** the due date/class date. Given proactive communication, I am willing to work with you to accommodate adversity that arises during the semester.