

Programming and Data Analysis for Modern Neuroscience

NEU 365P/385P - Spring 2024

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Course Objective

The ability to read and write are obvious fundamental skills critical to all academic and quantitative pursuits.

Fast approaching this level of fundamental importance is the ability to write computer programs to analyze and manipulate data sets ever increasing in richness and size. This skillset is necessary to work with a wide array of systems whose models and behavior are sufficiently complex to make analysis by hand intractable.

In this course you will translate problems into code applying modern approaches for data analysis, statistical inference and modeling to various levels of neural systems and their component behavior. We will use Python as a coding environment, and you will be exposed to resources and options for scientific computing.

Although geared for neuroscience, the approaches covered in this course are highly salient for a wide array of applications.

Breadth over Depth

We will cover a wide array of topics rather than explore any one topic in great detail. Topics will be introduced at a level where you should be able to understand each concept and put them to use. However, realize up front that we may have only scratched the surface.

The goal of the course is to give you enough of a basic toolset that you will have the necessary foundation to develop programs for any concept that you understand.

Concept before Math

It is my opinion that in many cases it is advantageous to first gain a conceptual understanding for an analytical method prior to working through every step of the underlying math. In this course we will leverage computational resources that enable you to quickly apply and gain a working understanding of many data analysis techniques without requiring a complete breakdown of their mathematical basis.

This is not to say that the math is unimportant, but rather that your goal in this course will be both a conceptual understanding and practical working ability to utilize the approaches discussed. I leave it to you to gain a more complete mathematical understanding of those approaches you are interested in using outside of this course (*which you should do*). To that end, the working and conceptual understanding you gain here should make this a much easier task.

Finally, it is impossible to avoid math entirely when discussing data analysis techniques. I will endeavour to keep the math as basic as possible and focus on the concepts.

Course Policies

Prerequisites

There are no prerequisites for this course. *However, you are expected to be familiar with basic mathematical functions and concepts, and you will be asked to perform quantitative calculations and to think critically. This is NOT an easy course.*

Requirements

- You must **bring a laptop to class** for hands on participation. If you do not own a laptop, contact your department or the College of Natural Sciences to obtain a loaner for the duration of the course.
- You should:
 - be motivated
 - **be prepared to work hard**
 - be respectful
 - **help to foster an inclusive environment**
 - have fun!

Inclusion

Along with the entire Department of Neuroscience, this course embraces a notion of an intellectual community enriched and enhanced by diversity along a number of dimensions, including race, ethnicity and national origins, gender and gender identity, sexuality, class, ability level, and religion. We are especially committed to fostering an environment where you feel heard and respected in your courses.

Academic Integrity

It is perfectly fine to work with your fellow students or anyone else on the homework assignments. If you do so, **you must include a note on your assignment indicating with whom you collaborated**. Any academic dishonesty such as copying a fellow students assignment without collaborating in its completion will be severely punished as outlined by the University. **Most importantly, the ability to solve problems such as those in the assignments is exactly the skillset you are here to obtain.**

Accommodations

Students with disabilities may request appropriate academic accommodations from the Division of Diversity and Community Engagement, [Services for Students with Disabilities](#) (471-6259).

Contact

Please contact myself or the TA via **Canvas**.

Office Hours

Office hours will be both in person and over Zoom, so you can attend as you see fit. The Zoom link for office hours will be posted on **Canvas**.

Attendance

You are expected to attend all classes. **In-class quizzes cannot be made up.** If you have to miss a class, you must inform me as far ahead of time as is possible.

Grading

Your grade is determined by your cumulative points total from **attendance, homework, quizzes, exams, extra credit**, or anything else that is worth points in the course. For example, if you scored 70/100 on an exam and 90/100 combined on homework and accrued 10 pts of extra credit, then your grade percentage would be $(70+90+10)/(100+100) = 85\%$.

A: 90–100%
B: 80–89%
C: 70–79%
D: 60–69%
F: <60%

Depending on the distribution of scores, I may alter the above ranges to normalize to the difficulty of the assignments. If I do so, **any alteration will only be favorable to you and never unfavorable.** Note that in the case that I do change the ranges, *I will NOT apply a curve to the letter grades. I am very happy to give everyone an A if possible.*

Grading Rubric

Most questions will be worth 3 pts for which the grading rubric is:

+1 pt for a remotely valid attempt
+2 pts if there are only minor mistakes
+3 pts if appropriately addressed