INTRO. TO NEURAL DATA ANALYSIS

NEUR 265: Spring, 2026

MEETINGS — TR: 11:00 – 12:15, Oechsle 211

INSTRUCTOR
DR. HENRY HALLOCK

Assistant Professor
Neuroscience

Office: Oechsle 303

HOW TO REACH ME

E-mail:
hallockh@lafayette.edu
Office Hours:
TR: 10:00-11:00
Schedule Meeting:
calendly.com/hallockh/

COURSE DESCRIPTION

How do neuroscientists make sense of the brain? How does the brain encode cognition and behavior? To answer these questions, we must use currently available tools to collect data from the brain. Once we have these data – what are the next steps? In this course, we will learn how to analyze real examples of neural data with the Python programming language.

LEARNING OUTCOMES

01 **Effectively write** code to perform basic analyses on several types of data

02 **Create** clean and intelligible graphs of your input and output data

03 **Draw** conclusions about brain-behavior relationships based on your analyses

04 **Organize** your data and code in a reproducible manner

COURSE RESOURCES

colab

We will be using Google Colaboratory (colab.research.google.com) to run our python code

All course materials, including in-class Colab notebooks, will be located in our main GitHub repo (github.com/hallockh/neur_265_spring2026)

ASSESSMENTS

Weekly Coding Assignments: 90 points total
Final Project: 75 points
Intro Essay/Reflection Essay: 10 points
In-Class Coding Notebooks: 40 points
Two In-Class Group Exams: 80 points

Total possible points: 295

WHY TAKE THIS COURSE?

If you are considering a career in neuroscience, psychology, or biology (or many other fields!), working with data is extremely common. If you are thinking about going to graduate school in any of these fields, working with data is a requirement. Doing science is a job, and coding has become a major tool that scientists use to do their job effectively.

STRATEGIES FOR SUCCESS

Ask for help Come to office hours	Talk to group mem-bers	Practice Do in-class assign-ments	Believe in your-self

COURSE SCHEDULE

1/27:	Introduction/Syllabus	
1/29:	Python Fundamentals	
1/30:		Intro Essay Due
2/3:	Data Structures in Python	
2/5:	Getting Familiar with Cell Types Data	
2/10:	Numpy	
2/12:	Pandas	
2/13:		Coding Homework #1 Due
2/17:	Conditionals	
2/19:	Loops/Functions	
		Coding Homework #2 Due
2/24:	Plotting	
2/26:	Basic Statistics	
		Coding Homework #3 Due
3/3:	RNA-Sequencing	
3/5:	Spatial Transcriptomics	
		Coding Homework #4 Due
3/10:	In-Class Group Exam #1	
3/12:	In-Class Group Exam #1 Oral	
3/17:	Cell Physiology/Morphology	
3/19:	Cell Physiology/Morphology	
3/24:	*In Vivo* Spiking Data	
3/26:	Place Cells	
		Coding Homework #5 Due
3/31:	Calcium Imaging Introduction	
4/2:	Population Dynamics	
		Coding Homework #6 Due
4/7:	The Event-Related Potential	
4/9:	Power Spectral Density	
		Coding Homework #7 Due
4/14:	Phase Coherence	
4/16:	Phase-Amplitude Coupling	
		Coding Homework #8 Due
4/21:	Neuroimaging	
4/23:	Machine Learning/BCIs	
		Coding Homework #9 Due
4/28:	In-Class Group Exam #2	
4/30:	In-Class Group Exam #2 Oral	
5/5:	Poster Presentations	
5/7:	Poster Presentations	
5/13:		Reflection Essay Due

ASSESSMENTS

TITLE: CODING HOMEWORK

DESCRIPTION:

Learning to effectively code will require practice outside of the classroom. Weekly practice will allow you to **write effective code**, **create graphical output**, and **organize your data and code.** Coding homework will build off of concepts and work that we do in-class during the week.

Coding homework will be assigned in Google Colaboratory (colab.research.google.com) each week. I will share the homework sheet with you in Colab (via your Lafayette-linked Google account). Homework assignments will look much like the assignments we do in-class. You will be prompted to create snippets of code within the Colab notebook. You will sometimes use outside datasets to finish your homework – these datasets will be provided to you via Google Drive.

Once you have finished your homework, you will upload it as a Jupyter notebook in the main branch of your GitHub repository. You will do this by choosing “File”, and “Save a Copy in GitHub”.

Your notebooks will be scored on accuracy (does your code work?), organization and formatting (is your code as simple as possible?), and graphical output (are your graphs displaying the correct information? Are axes labeled?)

Each homework notebook will be worth 10 points (9 homework notebooks x 10 points = 90 points total).

SCORING:

Criteria	Weight	Unacceptable	Satisfactory	Exemplary
Accuracy	50%	(0 – 74.9%) Code does not run – produces errors consistently.	(75– 89.9%) Most code runs, but some produces errors.	(90 - 100%) All code runs perfectly.
Organization	15%	(0 – 74.9%) Code is extremely convoluted. Syntax that we have not covered in class is used.	(75-89.9%) Code is mostly clean, but sometimes convoluted.	(90 - 100%) All code is written as simply as possible, using only syntax covered in class.
Graphical Output	35%	(0 – 74.9%) Graphs display wrong output, axes aren’t labeled, graphs are formatted incorrectly.	(75-89.9%) Graphs are mostly formatted correctly, but might contain slight errors/formatting problems.	(90 - 100%) Graphs display correct content, axes are labeled correctly, formatting is correct.

ASSESSMENTS

TITLE: INTRO ESSAY/REFLECTION ESSAY

DESCRIPTION:

Anybody can become good at coding. The idea that people are innately “good” or “bad” at math, science, and coding is false. How good you become at coding is largely dependent on how much effort you put into learning how to do it, and how well you learn from failure. Failure is normal when analyzing data and learning how to code – your code will almost certainly fail at some point during this course. This assignment will help you develop the confidence to be successful at coding.

During the first week of class, you will write a short (1-page, single-spaced) essay detailing the following:

Your past coding experience, and your attitude toward coding (Do you like it? Are you apprehensive about it?)
Your opinion of what skills are necessary to become a proficient coder, and what skills are necessary to become a proficient data scientist.
Why you are taking this course, and what you hope to get out of it

For the reflective essay:

You will write a short (1-page, single-spaced) paper detailing the following:

How has your attitude toward coding changed from the first week of the semester? What has contributed to this change?
Which aspect/assignment have you liked the most during the course? Which have you liked the least? What are your reasons for both?
Reflect on the skills you thought were necessary for coding at the beginning of the course. Do you still think those same skills are the most important for coding? Why or why not?

SCORING (5 pts. per essay, 10 total points):

Criteria	Weight	Unacceptable	Satisfactory	Exemplary
Content	70%	(0 – 74.9%) Content (as outlined in the syllabus) is not present.	(75-89.9%) Paper is well summarized, content is generally present.	(90 - 100%) Paper is excellently summarized.
Clarity and Organization	30%	(0 – 74.9%) Summary lacks clear transitions. Too much (or too little) space is dedicated to one topic.	(75-89.9%) Transitions are present, and generally make sense. Outline of paper is clear.	(90 - 100%) Transitions are excellent. The summary flows well from beginning to end. Everything is presented in a logical order.

ASSESSMENTS

TITLE: IN-CLASS CODING NOTEBOOKS

DESCRIPTION:

During most classes this semester, we will work together on shared Jupyter notebooks that relate to the topic outlined in the syllabus for that day. Some of the work in these notebooks will be done synchronously – that is, everybody will follow along and complete code cells together. Other parts of these notebooks will be done in small groups. The purpose of these notebooks is to learn how to write code, organize neuroscience data, and create graphs of those data in a supportive environment. This understanding should serve as a scaffold for independent work done on coding homework notebooks.

At the end of each class period, students will be expected to submit their in-class notebooks on their GitHub repo (using the same steps for submitting coding homework). Submission of these notebooks will count toward a class participation grade (40 points, 2 points per notebook). Note that there are 23 classes with in-class notebooks this semester – this means that you can miss three notebooks, and still get full participation credit.

In-class notebooks will be graded on completion and engagement. You do not have to have correct code in every code cell – rather, you should try to complete as much of the notebook as you can, and if you are struggling with a bit of code, you should add a comment in the relevant code cell that explains what you are struggling with, along with any error messages that you receive while trying to complete the cell. This will help me to identify areas that you are having trouble with so that we can focus on those areas in subsequent classes/on homework assignments.

ASSESSMENTS

TITLE: IN-CLASS GROUP EXAMS

DESCRIPTION:

Two weeks of the semester (see class schedule), we will have in-class coding exams. On the first day, these exams will consist of a Jupyter notebook that your group must complete by the end of the class period. You can use any resources that you would like during these exams, with the exception of LLMs. Each group must save their notebook to their personal GitHub repositories by the end of this the class period. *Each individual must contribute at least one piece of code to the notebook!*

On the second day of each exam, students will be tested orally on their notebooks. Each student will have a quick (5 minute) individual session with me in which I will ask them questions about their contributions to the notebook. During these sessions, I expect that students will be able to explain their code, how it works, and their thought process behind using it. I also expect that students will be able to interpret any output that comes from their code.

Each exam is worth 40 points (80 points total).

SCORING:

Criteria	Weight	Unacceptable	Satisfactory	Exemplary
Written Component	50%	(0 – 74.9%) Student did not contribute a substantial portion of code to the exam. The code does not run.	(75-89.9%) Code contributed to assignment is clunky, or does not reflect syntax that we learned in class.	(90 - 100%) Student contributed a solid amount of code to exam notebook, and this code runs well and is clearly written with syntax that was used in class.
Oral Component	50%	(0 – 74.9%) Student cannot describe code that was contributed to notebook, and/or cannot explain how this code works.	(75-89.9%) Student has a general idea of how code works, but cannot explain some key details .	(90 - 100%) Student has an excellent understanding of how their code functions, and how it created the output in the notebook.

ASSESSMENTS

TITLE: FINAL POSTER PROJECT

DESCRIPTION:

At the end of the semester, you will present a final project to the class. This project will be in the form of a scientific poster, with Introduction, Methods, Results, and Discussion sections. For this project, you will perform an original analysis of an open dataset from the Allen Brain Institute, and present the output (your visualizations) in the Results section of the poster. The Methods section of the poster will contain information about the analyses that you performed, including snippets of code. The Introduction section will contain a paragraph about which analysis you chose and why, and the Discussion section will contain a paragraph outlining your interpretation of your results, and why you think they might be important. This project will enable you to **draw conclusions** about brain-behavior relationships, **write** clean and efficient code, and **create** clean and intelligible graphs.

For the final project, I would like you to create a scientific poster that details the methods and results for two original analyses that you complete. These analyses must come from an open source dataset from the Allen Brain Institute. You may choose to analyze two datasets for your poster. You will be provided with a scientific poster template in our shared Google Drive folder later in the semester. Put your background/code/graphs/discussion/future directions in this template.

Here are the rules:

1) For each analysis, you should pick two dependent variables from one of the datasets. You should then compare these variables between at least two groups from that dataset. An example of two groups in the PatchSeq dataset would be Pvalb neurons vs. Sst neurons. An example of two groups in the Alzheimer's Pathology dataset would be APOE4 allele carriers vs. non-APOE4 allele carriers. There are a variety of groups to choose from in each dataset – if you have a question about what constitutes a group, please see me.

2) For each analysis, you should create the following:

a) Some way of visualizing the distribution of each dependent variable – a histogram, for example
b) Some way of visualizing the distribution of each grouping variable – a bar graph, or pie chart, for example
c) A scatter plot showing the relationship between the two dependent variables, with dots color-coded by group
d) Two boxplots – one for each dependent variable – showing how each dependent variable distribution differs between groups

ASSESSMENTS

TITLE: FINAL POSTER PROJECT

DESCRIPTION (CONTINUED):

3) You should put each graph in a section of the poster called “Results”. Each graph should have a short figure legend beneath it. The figure legend should contain a description of the graph, results of skewness tests for “a”, a description of how many observations of each group are in your dataset for “b”, a description of the correlation between your variables, and how that correlation might differ by group for “c”, and results (statistic and p-value) from either a t-test (if your data are normally distributed), or a Wilcoxon’s rank-sum test (if your data are not normally distributed) for “d”.

4) Your poster should contain a “Background” section. This section should contain a couple of paragraphs outlining the dependent variables/groups you chose to use – for example, what are Pvalb and Sst? Why are they important? Why would we be interested in comparing them? What is APOE? What are the different APOE alleles, and how common are they? What is the relationship between APOE and Alzheimer’s disease?

You should have some sort of rationale as to why you chose your dependent variables/groups – in other words, why did you pick those specific comparisons? What do we know about how your dependent variables might differ? What has already been found about the relationships between those dependent variables in the groups that you chose? Why might comparing these variables in these groups be important?

You should include at least 3 references (scientific, peer-reviewed articles) in this section. This section should also contain your hypotheses for each analysis. You can find references through resources like Google Scholar (scholar.google.com), or PubMed (pubmed.gov). Use in-text citation only for your sources, in the following format: Last name, first name, Title, Volume: Page numbers, Year of publication.

5) Your poster should contain a “Methods” section. This section should contain the python code, copied and pasted exactly as you ran it, that you used to perform your analyses.

6) Your poster should contain a “Conclusions” section. This section should contain an interpretation of your results – did your analyses support your original hypotheses? What new information was gained from doing these analyses?

7) Your poster should contain a “Future Directions” section. This section should contain a paragraph with a couple of ideas about important experiments that should be done to further elucidate the relationships between the groups that you chose.

Your poster should be saved as a .pdf and e-mailed (or shared via Google Drive) to me no later than Monday, May 4th. It is *extremely* important that you send your poster to me by this date – otherwise, we will not have time to print the poster, and you will lose points as a consequence. :

ASSESSMENTS

TITLE: FINAL POSTER PROJECT

SCORING:

Criteria	Weight	Unacceptable	Satisfactory	Exemplary
Content	35%	(0 – 74.9%) The required content (as outlined in the assessment plan) is not present. Code is missing. Introduction section is incomplete. No references. Graphs are missing.	(75– 89.9%) The required content is generally present. Some parts may be missing (references, graphs, background information, etc.)	(90 - 100%) The required content is clearly present and summarized well. All required information, as outlined in the assessment plan, is present on the poster.
Organization	35%	(0 – 74.9%) The poster is not formatted correctly. Ideas are difficult to follow. Too much text/not enough graphs. Graphs and text are difficult to read. Graphs are incorrect.	(75-89.9%) The poster is generally formatted correctly, but some parts may be sloppy.	(90 - 100%) The poster is formatted perfectly. The flow from Introduction to Discussion is immaculate. Ideas are easy to follow. Graphs are well done and easy to interpret. Legends are formatted correctly. Interplay between text and graphics is visually pleasing.
Oral Presentation	30%	(0 – 74.9%) Figures and concepts on poster are not explained correctly. Student cannot answer questions about analyses/graphs. Presentation is rushed/takes too long. Student stumbles over words and/or reads from notecards.	(75-89.9%) Explanation of content is mostly good. Student is unsure about some parts of poster.	(90 - 100%) Student engages with audience, explains everything on poster perfectly and with confidence. Student can answer questions thoughtfully and completely.

LAFAYETTE POLICIES

Student Code of Conduct:

All students are expected to abide by the Student Code of Conduct including policies around academic integrity whether we are in a face-to-face or remote classroom environment. Please be sure to review the Student Code of Conduct through the following link: https://conduct.lafayette.edu/student-handbook/student-code-of-conduct/

Proper Use of Course Materials:

At Lafayette College, all course materials are proprietary and for class purposes only. This includes posted recordings of lectures, worksheets, discussion prompts, and other course items. Such materials should not be reposted. Online discussions should also remain private and not be shared outside of the course. You must request my permission prior to creating your own recordings of class materials, and any recordings are not to be shared or posted online even when permission is granted to record. If you have any questions about proper usage of course materials please contact me via email (hallockh@lafayette.edu).

The long term (e.g. following completion of the course) retention, out-of-class sharing, distribution or posting of any remote instruction materials associated with this course is not allowed. Doing so constitutes a violation of Academic Honesty and of the policies of this class. In using instruction materials, you commit to 1) *not* retaining these materials (post-final exam) and 2) *never* sharing these materials. Any Lafayette student not enrolled in *Introduction to Neuroscience* during the Fall 2021 semester who is willingly in receipt of instruction materials from this class is also in violation of Academic Honesty.

Academic Honesty:

Students are expected to adhere to the academic honesty guidelines explained in the Student Handbook of Lafayette College. Any infraction of these principles will be referred immediately to the Office of the Dean of Studies for adjudication.

Privacy Statement:

Moodle contains student information that is protected by the Family Educational Right to Privacy Act (FERPA). Disclosure to unauthorized parties violates federal privacy laws. Courses using Moodle will make student information visible to other students in this class. Please remember that this information is protected by these federal privacy laws and must not be shared with anyone outside the class. Questions can be referred to the Registrar's Office.

Academic Accommodation:

In compliance with Lafayette College policy and equal access laws, we are available to discuss appropriate academic accommodations that you may require as a student with a disability. Requests for academic accommodations need to be made during the first two weeks of the semester, except for unusual circumstances, so arrangements can be made. You must register with the Office of the Dean of Advising and Co-Curricular Programs for disability verification and for determination of reasonable academic accommodations.

LAFAYETTE POLICIES

Federal Credit Hour Policy and Guidelines:

The student work in this course is in full compliance with the federal definition of a four *[two or one as appropriate for half and quarter unit courses]* credit hour course. Please see the Registrar's Office web site (http://registrar.lafayette.edu/additional-resources/cep-course-proposal/) for the full policy and practice statement.

College Mission:

In an environment that fosters the free exchange of ideas, Lafayette College seeks to nurture the inquiring mind and to integrate intellectual, social, and personal growth. The College strives to develop students' skills of critical thinking, verbal communication, and quantitative reasoning and their capacity for creative endeavor; it encourages students to examine the traditions of their own culture and those of others; to develop systems of values that include an understanding of personal, social, and professional responsibility; and to regard education as an indispensable, lifelong process.

Statement on Diversity:

Lafayette College is committed to creating a diverse community: one that is inclusive and responsive, and is supportive of each and all of its faculty, students, and staff. The College seeks to promote diversity in its many manifestations. These include but are not limited to race, ethnicity, socioeconomic status, gender, gender identity, sexual orientation, religion, disability, and place of origin. The College recognizes that we live in an increasingly interconnected, globalized world, and that students benefit from learning in educational and social contexts in which there are participants from all manner of backgrounds. The goal is to encourage students to consider diverse experiences and perspectives throughout their lives. All members of the College community share a responsibility for creating, maintaining, and developing a learning environment in which difference is valued, equity is sought, and inclusiveness is practiced.

Attendance Policy:

I do not require attendance in this class. In-class notebooks count toward your participation grade. In-class notebooks will also prepare you for coding homework, your final project, and your exams. As such, coming to class on a regular basis is crucial for your ability to learn the material and do well.

Artificial Intelligence Policy:

Large language models (like ChatGPT) can be really useful tools for programmers. There is no way that any person can remember all language syntax, or know how to fix every error from memory. All programmers use tools (Google, Stack Overflow, ChatGPT) to help them code. As such, LLMs are appropriate for troubleshooting errors, or helping us work our way out of a mental coding block. Efficient programming, however, still requires a base level of coding knowledge. This level of coding knowledge will be tested during exams without the use of LLMs. At other times (in-class notebooks, homework), it is appropriate to use LLMs to troubleshoot coding problems. Note, however, that many times in this class, we will be working with highly specific data that is structured in a very specific way, and LLMs may have a difficult time helping you accurately understand what you're working with.