

Syllabus: Neurophysiological Analysis (MCB 493 NA)

Course Overview

The goal of this course is to introduce students to the different types of physiological data recorded from the brain and neurons and how to handle them analytically. We will develop a toolbox of analytical approaches and critical thinking skills for addressing different types of data and the strengths and weaknesses of different analytical approaches. Topics include the physiological origins of brain signals, fourier and time series analysis, point-processes, tuning curves, dimensionality reduction, and decoding using Bayesian and artificial neural network methods. Students will use Python to analyze real-world datasets through weekly computational labs and a final project.

Course Goals

- Students will be able to analyze diverse neurophysiological signals (e.g. LFP, EEG, spikes) by selecting and justifying appropriate signal processing and statistical techniques to characterize their fundamental properties.
- Students will be able to critically evaluate the assumptions, limitations, and potential artifacts associated with both neurophysiological recording techniques and data analysis methods.
- Students will be able to design and implement a complete data analysis pipeline in a programmatic environment (Python) to investigate a specific hypothesis relating neural dynamics to behavior or cognition, culminating in a formal project report.

Instructor Information



Dr. Jason Robert Climer

- jrclimer@illinois.edu
- Office: Burrill Hall, Room 463
- Office Phone: 217-300-1670

Office Hours

- TBD
- Office Hours Location: Hybrid and in Room 463
- Or by appointment, schedule by email

Academic Calendar

A course week is defined as the period between **Monday, 12:00 AM Central Time and Sunday, 11:55 PM Central Time**. For more information, see the [University's Academic Calendar](#).

This is a **3 credit hour** course. The course is **16 weeks long**. You should dedicate approximately **6 hours per week** to working on the course itself, but actual time commitments will vary depending on your input, needs, and personal study habits (see **Contact Hours** for more information). You are required to log on to the Canvas page and check your email a minimum of 3 days per week, but as discussions develop, you will probably need to do so more frequently.

Required Texts

Text and datasets will be provided digitally during the course.

Credit and Contact Hours

Following are instructor guidelines on creating a Contact Hours section of the syllabus taken from the Provost Office's information on [Assigning Credit Hours](#).

For Classroom-based Courses: Contact hours Class meets for 2 hours 40 minutes per week for 16 weeks.

Course Components

This course will consist of the following components:

Weekly Overviews

Each week will begin with a weekly overview, which will explain what the module is about, the learning goals you are expected to achieve, how long the module will take, and in what activities you will participate. Each week is designed with the same structure and activities unless otherwise specified. Weekly instructional activities are explained in greater detail below. Due dates of specific assignments appear on each week's overview page.

Readings and Lessons

Each module will contain a list of lessons and assigned readings. In some cases, optional or supplemental readings may be listed for further study. Lessons cover major topics from the readings but do not necessarily include all important information from the readings.

Assignment Discussions

Each Tuesday, we will review the assignments from the previous week and share solutions from the class. These discussions will provide an opportunity to engage with your classmates on strategies used to solve problems in the course.

Attendance

Attendance to class is expected. Students must sign in each class, with a contribution of 3 points each for the 30 class periods (12% of final grade total). Excused absences must be

obtained prior to class from the instructor. For absences spanning more than two lessons, please communicate with the course instructor.

Assignments

There will be an assignment each week, employing the concepts learned in the lectures and integrating them with concepts learned in the class. Rubrics will be provided for each assignment, with each assignment having a total of 10 points. Assignments not completed during the class time must be turned in by 11:59 on the Sunday following the assignment. The two lowest scores on assignments will be dropped. The purpose of these drops is to accommodate absences that would be excused and those that would not.

Weekly Quizzes

Weekly quizzes will cover key terms, concepts, and applications from the readings and video lectures. Most quizzes consist of 3 questions, have a 20-minute time limit, and allow one attempt. The two lowest scores on quizzes will be dropped. These quizzes will be offered in Canvas. The purpose of these drops is to accommodate absences that would be excused and those that would not.

Course Project

The capstone project is the major assignment for the course. Students will develop a data analysis pipeline for a real neuroscience dataset. Real life datasets will be provided. Students may also use a dataset from their own data or a publically available dataset. The goal is to integrate the analysis tools applied in the course to test a scientific hypothesis about the data. Final projects will be due during the final exam period. Students will submit a Project Proposal, a Progress Report, and the Final Project Report.

Course Schedule

Week	Topics	Instructional Activities
Week 1 (August 24 – August 29)	Introduction to Python	Quiz 1 (August 27) Assignment 1 (due August 30)
Week 2 (August 30 – September 5)	Signal Processing I	Quiz 2 (September 7) Assignment 2 (due September 6)
Week 3 (September 6 – September 12)	Signal Processing II	Quiz 3 (September 10) Assignment 3 (due September 13)
Week 4 (September 13 – September 19)	Signal Processing III	Quiz 4 (September 17) Assignment 4 (due September 20)
Week 5 (September 20 – September 26)	ERPs & Artifacts	Quiz 5 (September 24) Assignment 5 (due September 27)
Week 6 (September 27 – October 3)	Analyzing Spike Trains I	Quiz 6 (October 1) Assignment 6 (due October 4)
Week 7 (October 4 – October 10)	Analyzing Spike Trains II	Quiz 7 (October 8) Assignment 7 (due October 11)
Week 8 (October 11 – October 17)	Midterm Review & Project Proposals	Final Project Proposal due (October 13) Quiz 8 (October 15) Assignment 8 (due October 18)
Week 9 (October 18 – October 24)	Connectivity Analysis I	Quiz 9 (October 22) Assignment 9 (due October 25)
Week 10 (October 25 – October 31)	Connectivity Analysis II	Quiz 10 (October 29) Assignment 10 (due November 1)
Week 11	Population Analysis I	Quiz 11 (November 5)

Week	Topics	Instructional Activities
(November 1 – November 7)		Assignment 11 (due November 8)
Week 12 (November 8 – November 14)	Population Analysis II	Final Project Progress Report Due (November 10) Quiz 12 (November 12) Assignment 12 (due November 15)
Week 13 (November 15 – November 20)	Machine Learning I	Quiz 13 (November 19) Assignment 13 (due November 22)
Week 14 (November 30 – December 5)	Machine Learning II	Quiz 14 (December 3) Assignment 14 (due December 6)
Week 15 (December 6 – December 9)	Final project workshop	Quiz 15 (December 10) Assignment 15 (due December 13)
Week 16 TBD		Final project due (during Finals Period)

Grading

Grading Distribution

Instructional Activity	Occurrences	Point Value	Total Points
Assignments	13	10	130
Attendance Sign In	30	3	90
Weekly Quizzes	13	10	130
Final Project Proposal	1	50	50
Final Project Progress Report	1	50	50
Final Project	1	300	300
Total			750

Grading Scale

Percentage	Letter Grade
97-100	A+
94-96.5	A
90-93.5	A-
87-89.5	B+
84-86.5	B
80-83.5	B-
77-79.5	C+
74-76.5	C
70-73.5	C-
67-69.5	D+
64-66.5	D
60-63.5	D-
Below 59.5	F

Course Policies

Accommodations

To obtain disability-related academic adjustments and/or auxiliary aids, students should contact both the instructor and Disability Resources and Educational Services (DRES) as soon as possible. You can contact DRES at 1207 S. Oak Street, Champaign, (217) 333-1970, or via email at disability@illinois.edu. For more information, visit the [DRES website](#) or [apply for services](#).

Absence Policy

Students may not always be eligible to obtain an absence letter for missed classes. Absence letters cannot be used as an excuse from class or to permit make-up work. It is up to the instructor to authorize an excuse. Read the [Absence Letters](#) for more information. Students must communicate absences before the start of class to be excused. For absences lasting longer than two days, please discuss with the instructor. Excused absences will be considered on a case by case basis. The lowest two quizzes and assignments are dropped to accommodate absences that would be excused or would not.

Deadlines

If you are unable to meet a particular deadline, it is your responsibility to make prior arrangements with the instructors for that given week. Otherwise, work submitted later than the due date will receive 3 point deduction, and work submitted later than 1 days (11:59 the Monday following the due date) will not be considered for grading unless consent has been given by the instructor. As a reminder, the lowest two assignments will be dropped from the final grades.

Instructor Responses

Instructor Feedback and Turnaround Time

Questions posted to the **Q & A Forum** generally will be answered within 48 hours. If possible, students are encouraged to answer questions posted by other students to the General Q & A forum, rather than waiting for an instructor's response.

Assignments submitted online will be reviewed and graded by the instructor by the following class period. Project milestones and quizzes will be graded within 5 business days.

Responding to E-mails and Phone Calls

The instructor will respond to e-mail messages and phone calls within 24 hours of receiving them unless the instructor notifies you ahead of time of an inability to do so. **When sending e-mail, include a subject line that identifies the course number and nature of your question.** The instructor may not respond to questions sent to him or her that should be posted in the **Q & A Forum**. Please don't be offended if you are asked to forward your question to this location. E-mail is the preferred method of contacting the instructor.

Responding to the Discussion Forums

The role of the instructor within the discussion forums is to facilitate discussion by providing probing questions, asking for clarification, and helping solve conflicts, as necessary. The

instructor will not respond to every post; you are encouraged to share your thoughts, experiences, and ideas with each other as well. This is a resource available to students and grading will not be determined on participation.

Academic Integrity

Students should pay particular attention to Article 1, Part 4: Academic Integrity on the [Student Code](#) website. Academic dishonesty may result in a failing grade. Every student is expected to review and abide by the [Academic Integrity Policy](#). Ignorance is not an excuse for any academic dishonesty. You are responsible for reading this policy to ensure everything is understood. Feel free to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

Expectations

Examples of academic dishonesty include the following:

- Cheating
- Fabrication
- Facilitating infractions of academic integrity
- Plagiarism and non-original works
- Bribes, favors, and threats
- Academic interference
- Examination by proxy
- Grade tampering

Copyright

Student Content

Participants in University of Illinois courses retain copyright of all assignments and posts they complete; however, all materials may be used for educational purposes within the given course. In group projects, only the portion of the work completed by a particular individual is copyrighted by that individual. The University of Illinois may request that students' materials be shared with future courses, but such sharing will only be done with the students' consent. The information that students submit during a course may, however, be used for the purposes of administrative data collection and research. No personal information is retained without the students' consent.

Non-Student Content

Everything on this site and within University of Illinois courses is copyrighted. The copyrights of all non-student work are owned by the University of Illinois Board of Trustees, except in approved cases where the original creator retains copyright of the material. Copyrights to external links are owned by or are the responsibility of those external sites. Students are free to view and print material from this site so long as

- The material is used for informational purposes only.

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These materials may not be mirrored or reproduced on non-University of Illinois websites without the express written permission of the University of Illinois Board of Trustees. To request permission, please contact the academic unit for the program.

Disruptive Behavior

Behavior that persistently or grossly interferes with classroom activities is considered disruptive behavior and may be subject to disciplinary action. Such behavior inhibits other students' ability to learn and an instructor's ability to teach. A student responsible for disruptive behavior may be required to leave class pending discussion and resolution of the problem and may be reported to the [Office for Student Conflict Resolution](#) (email conflictresolution@illinois.edu or call 333-3680) for disciplinary action.

Netiquette

In any social interaction, certain rules of etiquette are expected and contribute to more enjoyable and productive communication. The following are tips for interacting online via e-mail or discussion board messages, adapted from guidelines originally compiled by Chuq Von Rospach and Gene Spafford (1995):

- Remember that the person receiving your message is someone like you, deserving and appreciating courtesy and respect.
- Be brief; succinct, thoughtful messages have the greatest effect.
- Your messages reflect on you personally; take time to make sure that you are proud of their form and content.
- Use descriptive subject headings in your e-mails.
- Think about your audience and the relevance of your messages.
- Be careful when you use humor and sarcasm; absent the voice inflections and body language that aid face-to-face communication, Internet messages are easy to misinterpret.
- When making follow-up comments, summarize the parts of the message to which you are responding.
- Avoid repeating what has already been said; needless repetition is ineffective communication.
- Cite appropriate references whenever using someone else's ideas, thoughts, or words.

AI Policy

Increasingly, AI is used by beginner and expert coders alike for coding projects. Unless specifically prohibited for an assignment, AI use in coding is permitted in this course. When used, please cite the prompts and service used to generate the code and specify how it was

tested before inclusion in the assignment. Use of AI in absence of citation will be considered academic dishonestly.

Recording

Audio and video recording of the course lectures and discussion periods is prohibited. Distribution of course materials and recordings is also prohibited. If recordings are needed for a DRES accommodation, please contact the instructor as soon as possible.

Communications

Daily Contact

Your daily contact should be via the discussion forums in our Learning Management System and via e-mail. Questions that are not personal should be posted in the Q & A forum. All other communications should be initiated via email (listed on the Instructor Information page).

Course Questions

Questions pertaining to the course should be posted in our **Q & A Forum** discussion forum. You can get to this forum from the course home page. Posting questions here allows everyone to benefit from the answers. If you have a question, someone else is probably wondering the same thing. Anyone submitting a question via e-mail will be directed to resubmit the question to the Q & A discussion forum. Also, participants should not hesitate to answer questions posed by peers if they know the answers and the instructor has not yet responded. This not only expedites the process but also encourages peer interaction and support.

Personal and Grade-related Questions

Questions of a personal nature should first be sent to the instructor's e-mail address (listed on the **Instructor Information** page). **When sending e-mail, include a subject that identifies the course number and nature of your question.**

Emergencies

If you have an emergency that will keep you from participating in the course, please notify your instructor by using the instructor's e-mail address (listed on the Instructor Information page). Provide callback information in your e-mail (if necessary). You should also notify your program director of any emergencies.

Announcements

The **Announcements** forum serves as a way for your instructor and University of Illinois administrators to make announcements within our virtual learning environment. Announcements posted here will also be sent to your Illinois e-mail address, so be sure to check your e-mail or the Announcements forum at least once a day to see whether any new announcements have been made.

Mental Health

Significant stress, mood changes, excessive worry, substance/alcohol misuse or interferences in eating or sleep can have an impact on academic performance, social development, and

emotional wellbeing. The University of Illinois offers a variety of confidential services including individual and group counseling, crisis intervention, psychiatric services, and specialized screenings which are covered through the Student Health Fee. If you or someone you know experiences any of the above mental health concerns, it is strongly encouraged to contact or visit any of the University's resources provided below. Getting help is a smart and courageous thing to do for yourself and for those who care about you.

- Counseling Center (217) 333-3704
- McKinley Health Center (217) 333-2700
- National Suicide Prevention Lifeline (800) 273-8255
- Rosecrance Crisis Line (217) 359-4141 (available 24/7, 365 days a year)

If you are in immediate danger, call 911.

*This statement is approved by the University of Illinois Counseling Center.

Community of Care

As members of the Illinois community, we each have a responsibility to express care and concern for one another. If you come across a classmate whose behavior concerns you, whether in regards to their well-being or yours, we encourage you to refer this behavior to the Student Assistance Center (217-333-0050 or read for more information on [behavior concerns or intervention tips](#)). Based on your report, the staff in the Student Assistance Center reaches out to students to make sure they have the support they need to be healthy and safe.

Further, as a Community of Care, we want to support you in your overall wellness. We know that students sometimes face challenges that can impact academic performance (examples include mental health concerns, food insecurity, homelessness, personal emergencies). Should you find that you are managing such a challenge and that it is interfering with your coursework, you are encouraged to contact the Student Assistance Center (SAC) in the Office of the Dean of Students for support and referrals to campus and/or community resources.

Emergency Response Recommendations

Emergency response recommendations and campus building floor plans can be found at the [Division of Public Safety](#). I encourage you to review this website within the first 10 days of class.

Religious Observances

Illinois law requires the University to reasonably accommodate its students' religious beliefs, observances, and practices in regard to admissions, class attendance, and the scheduling of examinations and work requirements. Students should complete the Request for Accommodation for Religious Observances form should any instructors require an absence letter in order to manage the absence. In order to best facilitate planning and communication between students and faculty, students should make requests for absence letters as early as possible in the semester in which the request applies.

Sexual Misconduct Reporting Obligation

The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX

and Disability Office. In turn, an individual with the Title IX and Disability Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options.

A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality, can be found in the [Confidential Resources](#) section. Other information about resources and reporting is available at wecare.illinois.edu.