USC

BISC 462: Seminar in Neurobiology
Foundational Topics in Computational Neuroscience
Units: 2
Spring 2025—Thursdays—2:00-3:50PM

Location: HNB 107

Instructor: Prof. Jeffrey Moore
Office: HNB 520
Office Hours: By appointment
Contact Info: jdmoore@usc.edu. Expected response time: 48 hours

PROVISIONAL SYLLABUS

Course Description

This course is an interactive introduction to key concepts in theoretical and computational neuroscience, including: biophysical properties of neurons, statistical analysis of neuronal signals, and modeling of small networks of neurons. Every other week, a different student or group of students will present an instructor-defined topic (see course schedule below). The presenting student(s) will be responsible for providing a brief background, key concepts, and examples. On alternate weeks, class will consist of an interactive tutorial where students will work together on a problem set based on the topic from the previous week. Students will develop an understanding of how theoretical and computational approaches to neuroscience aid in investigating the nervous system, and how they lead to new scientific experiments and discoveries.

Learning Objectives

By the end of this course, students will be able to formulate and solve equations governing neuronal membrane potential dynamics, analyze neuronal signals to determine what information they encode, and devise and evaluate computer simulations of signaling in single neurons and networks of several neurons.

Prerequisite(s): None
Co-Requisite(s): None
Concurrent Enrollment: None
Recommended Preparation: Single variable calculus, NEUR 421, OR permission of instructor

Course Notes

Course will meet once weekly. Course will consist of bi-weekly student presentations on a specific topic, interleaved with bi-weekly in-class tutorials focusing on a problem set on the same topic. Students will each present at least one topic, either by themselves or in small groups depending on enrollment. Students are encouraged to consult with the instructor and each other in preparing their presentations and completing the problem sets. There are no exams.

Technological Proficiency and Hardware/Software Required

Some of the course problem sets will require elementary programming in MATLAB or equivalent language. Students may use their own personal computers, USC Computer Labs https://itservices.usc.edu/its-computing-centers/, and/or USC-provided laptops: USC Computing Center Laptop Loaner Program. MATLAB is freely available for USC affiliates: Software available to USC Campus.

Required Readings and Supplementary Materials

Required reading:

Koch C. *Biophysics of Computation: Information Processing in Single Neurons.* Oxford University Press, 2004
Dayan P & Abbott L. *Theoretical Neuroscience.* MIT Press, 2005
Available digitally free of charge for USC affiliates from USC Libraries.

Description and Assessment of Assignments

Problem sets are assigned bi-weekly. Typically, students will have two weeks to work on each assignment, including one in-class tutorial per assignment where they are encouraged to work together with other students and the instructor. Students are expected to work independently or in small groups for one week prior to the dedicated in-class session for each assignment. They are expected to come prepared to discuss the assignment with peers and the instructor. After the in-class tutorial they will typically have one additional week to complete and turn in the assignment.

Participation

Students are expected to attend every class unless they provide a good reason for the absence (e.g. illness, medical school interview, conference presentation, pandemic related issue) that they can document. Students are expected to participate in class by asking the presenter questions about the topic and contributing to in-class tutorials on assignments.

Assignment Submission Policy

Assignments are to be submitted by electronically by 11:59PM on the due date.

Grading Timeline

Assignments will typically be graded within two weeks of the due date.

Course Specific Policies

On time submission of assignments is encouraged. Late problem sets will be accepted up to 7 days past the due date. Scoring for late submissions will be penalized by multiplying the score by a factor of 0.9^n, where *n* is the number of calendar days the assignment is turned in after the due date. No credit is given for assignments >7 days past due. Late submissions will be graded by the end of the term.

Attendance

No points will be awarded for attendance alone, but participation, by definition, can only occur if student is in attendance (see Participation section)

Grading Breakdown

Students will be graded based on their in-class presentation (~1), bi-weekly problem sets (~7), and class participation.

Table 1 Grading Breakdown

Assessment Tool (assignments)	Points	% of Grade
Bi-weekly problem sets	40	40
In-class presentation(s)	45	45
Participation	15	15
TOTAL	100	100

Grading Scale

Course final grades will be determined using the following scale:

Table 2 Course Grading Scale

Letter grade	Corresponding numerical point range
A	90-100
A-	80-89
B+	75-79
B	66-74
B-	60-64
C+	55-59
C	45-54
C-	40-44
D+	35-39
D	25-34
D-	20-24
F	19 and below

PROVISIONAL Course Schedule

Table 3 Course schedule

	Topics/Daily Activities	Readings/Preparation	Deliverables
Week 1	Course Overview + MATLAB Tutorial (Instructor Presentation)	Dayan & Abbott Ch 1.1	Problem Set 0 Assigned
Week 2	Problem Set 0 Tutorial (Interactive Tutorial)		
Week 3	RC Circuits (Student Presentation)	None	Problem Set 0 due; Problem Set 1 Assigned
Week 4	Problem Set 1 Tutorial (Interactive Tutorial)		
Week 5	Electrical Properties of Neurons (Student Presentation)	Koch Ch 1.1-1.2 Optional: Dayan & Abbott Ch 5.1-5.3	Problem Set 1 due; Problem Set 2 Assigned
Week 6	Problem Set 2 Tutorial (Interactive Tutorial)		
Week 7	Integrate and Fire model (student presentation)	Koch Ch. 14.2 Optional: Dayan & Abbott Ch 5.4	Problem Set 2 due; Problem Set 3 Assigned
Week 8	Problem Set 3 Tutorial (Interactive Tutorial)		
Week 9	Models of synapses (Student Presentation)	Koch Ch 1.4	Problem Set 3 due; Problem Set 4 Assigned
Week 10	Problem Set 4 Tutorial (Interactive Tutorial)		
Week 11	Hodgkin and Huxley model (Student presentation)	Koch Ch 6.1-6.3 Optional: Dayan & Abbott Ch 5.5-5.6	Problem Set 4 due; Problem Set 5 Assigned
Week 12	Problem Set 5 Tutorial (Interactive Tutorial)		
Week 13	Spike Train Statistics / Spike-triggered average (Student presentation)	Dayan & Abbott Ch 1.4	Problem Set 5 due; Problem Set 6 Assigned
Week 14	Problem Set 6 Tutorial (Interactive Tutorial)		
Week 15	Computing with Neuronal Networks/ "Neuronify" simulation (Instructor presentation)	None	Problem Set 6 due; Problem Set 7 Assigned
FINAL	NO EXAM - Problem Set 7 Tutorial (Interactive Tutorial)		Refer to the final exam schedule in the USC *Schedule of Classes* at classes.usc.edu.

Academic Integrity

The University of Southern California is foremost a learning community committed to fostering successful scholars and researchers dedicated to the pursuit of knowledge and the transmission of ideas. Academic misconduct is in contrast to the university's mission to educate students through a broad array of first-rank academic, professional, and extracurricular programs and includes any act of dishonesty in the submission of academic work (either in draft or final form).

This course will follow the expectations for academic integrity as stated in the USC Student Handbook. All students are expected to submit assignments that are original work and prepared specifically for the course/section in this academic term. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s). Students suspected of engaging in academic misconduct will be reported to the Office of Academic Integrity.

Other violations of academic misconduct include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

Academic dishonesty has a far-reaching impact and is considered a serious offense against the university. Violations will result in a grade penalty, such as a failing grade on the assignment or in the course, and disciplinary action from the university itself, such as suspension or even expulsion.

For more information about academic integrity see the student handbook or the Office of Academic Integrity's website, and university policies on Research and Scholarship Misconduct.

Please ask your instructor if you are unsure what constitutes unauthorized assistance on an exam or assignment or what information requires citation and/or attribution.

Policy for the use of AI Generators in the course: Not permitted

This course aims to develop creative, analytical, and critical thinking skills. Therefore, all assignments should be prepared by the student working individually or in groups. Students may not have another person or entity complete any substantive portion of the assignment. Developing strong competencies in these areas will prepare you for a competitive workplace. Therefore, using AI-generated text, code, or other content is prohibited in this course, will be identified as plagiarism, and will be reported to the Office of Academic Integrity.

If found responsible for an academic violation, students may be assigned university outcomes, such as suspension or expulsion from the university, and grade penalties, such as an "F" grade on the assignment, exam, or in the course.

Course Content Distribution and Synchronous Session Recordings Policies

USC has policies that prohibit recording and distribution of any synchronous and asynchronous course content outside of the learning environment.

Recording a university class without the express permission of the instructor and announcement to the class, or unless conducted pursuant to an Office of Student Accessibility Services (OSAS) accommodation. Recording can inhibit free discussion in the future, and thus infringe on the academic freedom of other students as well as the instructor. (Living our Unifying Values: The USC Student Handbook, page 13).

Distribution or use of notes, recordings, exams, or other intellectual property, based on university classes or lectures without the express permission of the instructor for purposes other than individual or group study. This includes but is not limited to providing materials for distribution by services publishing course materials. This restriction on unauthorized use also applies to all information, which had been distributed to students or in any way had been displayed for use in relation to the class, whether obtained in class, via

email, on the internet, or via any other media. Distributing course material without the instructor's permission will be presumed to be an intentional act to facilitate or enable academic dishonestly and is strictly prohibited. (Living our Unifying Values: The USC Student Handbook, page 13).

Course Evaluations

Course evaluation occurs at the end of the semester university-wide. It is an important review of students' experience in the class. The process and intent of the end-of-semester evaluation will be provided at the appropriate time.

Statement on University Academic and Support Systems

Students and Disability Accommodations:
USC welcomes students with disabilities into all of the University's educational programs. The Office of Student Accessibility Services (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Student Financial Aid and Satisfactory Academic Progress:
To be eligible for certain kinds of financial aid, students are required to maintain Satisfactory Academic Progress (SAP) toward their degree objectives. Visit the Financial Aid Office webpage for undergraduate- and graduate-level SAP eligibility requirements and the appeals process.

Support Systems:
Counseling and Mental Health - *(213) 740-9355 – 24/7 on call*
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

988 Suicide and Crisis Lifeline - *988 for both calls and text messages – 24/7 on call*
The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline consists of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

Relationship and Sexual Violence Prevention Services (RSVP) - *(213) 740-9355(WELL) – 24/7 on call*
Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

Office for Equity, Equal Opportunity, and Title IX (EEO-TIX) - *(213) 740-5086*
Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - *(213) 740-2500*
Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

The Office of Student Accessibility Services (OSAS) - *(213) 740-0776*
OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

USC Campus Support and Intervention - *(213) 740-0411*
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity, Equity and Inclusion - *(213) 740-2101*
Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - *UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call*
Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - *UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7 on call*
Non-emergency assistance or information.

Office of the Ombuds - *(213) 821-9556 (UPC) / (323-442-0382 (HSC)*
A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

Occupational Therapy Faculty Practice - *(323) 442-2850 or* otfp@med.usc.edu
Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.