Syllabus

COURSE HOME
SYLLABUS
LECTURE NOTES
LECTURE VIDEOS
ASSIGNMENTS
EXAM STUDY GUIDES
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Meeting Times

Lectures: 2 sessions / week, 90 minutes / session

Recitations: 1 session / week, 1 hour / session

Prerequisites

Physics II (8.02, 8.021, or 8.022), *6.0002 Introduction to Computational Thinking and Data Science*, and *9.01 Introduction to Neuroscience* or permission of the instructor.

Note: several modules of 8.02 can be found in the Open Learning Library.

Course Description

This course introduces quantitative approaches to understanding brain and cognitive functions. Topics include mathematical description of neurons, the response of neurons to sensory stimuli, simple neuronal networks, statistical inference and decision making. It covers foundational quantitative tools of data analysis in neuroscience: correlation, convolution, spectral analysis, principal components analysis. Mathematical concepts include simple differential equations and linear algebra.

Homework Assignments

There will be a total of seven (7) homework assignments. Release and due dates are indicated on the class schedule. Assignments are due by 11:59 pm on the due date.

Excused extensions on assigned work will be given only for significant illness or family crisis. If an excused extension or postponement is requested, you must notify me prior to the class period for which the work is due.

You will be allowed four (4) free days of unexcused extensions on homework assignments to flexibly manage scheduling difficulties across the semester. Once these free days have been used, late work will be penalized at 20% per day.

Additionally, the lowest problem set grade will be dropped in calculating your final grade.

Software Requirements

Assignments require the use of MATLAB® version 2017b. Therefore, it is essential that you install this software on your laptop.

Note: MIT OpenCourseWare does not provide student access or discounts for MATLAB software. It can be purchased from The MathWorks®. For more information about MATLAB Pricing and Licensing, contact The MathWorks directly.

Policy on Problem Set Collaboration

Collaboration is encouraged on problem sets, but you must write up your own solutions and develop your own MATLAB code. List the names of all your collaborators on the top of each problem set submission.

Midterm Exam

There will be two midterm exams, which will be held in class. Bring a calculator for the exams. For the second midterm, a take-home programming exercise will be assigned. Instructions for submission will be provided with assignment.

Final Exam

The final exam will be focused on the material presented after the second midterm. However, we will include a question pertaining to the material covered in the first midterm and a question for the material covered in the second midterm.

Grading

Grades are not matched to a specific curve in this subject. If everyone in the class does well, everyone can get an A. Grades will be assigned based on your overall, weighted class average using the weighting scheme presented below:

ACTIVITIES	PERCENTAGES
Homework Assignments	50%
2 Midterm Exams	30% (15% each)

ACTIVITIES	PERCENTAGES
Final Exam	20%

Class Schedule

L = Lecture

R = Recitation

SES #	TOPICS	KEY DATES
L1	Course Overview and Ionic Currents	PSet 1 assigned
R1	Intro to MATLAB and Ionic Currents	
L2	RC Circuit and Nernst Potential	
L3	Nernst Potential and Integrate and Fire Models	
R2	RC Model, Nernst Potential	
L4	Hodgkin Huxley Model Part 1	
	No Class	PSet 1 due PSet 2 assigned
R3	Integrate and Fire Model, Hodgkin Huxley Model	
L5	Hodgkin Huxley Model Part 2	
L6	Dendrites	
L7	Synapses	PSet 2 due PSet 3 assigned
	Midterm Review	
R5	Review Session	
	Midterm Exam	
L8	Spike Trains	PSet 4 assigned
R6	Spike Train Analysis	
L9	Receptive Fields	PSet 3 due
L10	Time Series	
R7	Spike Triggered Average, Poisson Process	
L11	Spectral Analysis Part 1	PSet 4 due
L12	Spectral Analysis Part 2	PSet 5 assigned

SES #	TOPICS	KEY DATES
R8	Spectral Analysis	
L13	Spectral Analysis Part 3	
	Midterm 2 Review	
R9	Midterm 2 Review	
	Midterm Exam 2	
R10	Help With PSet 5	
L14	Rate Models and Perceptrons	PSet 5 due Midterm Programming assigned
L15	Matrix Operations	
R11	Perceptons and Matrices	Midterm Programming due
L16	Basis Sets	PSet 6 assigned
L17	Principal Components Analysis	
R12	Principal Components Analysis	
L18	Recurrent Networks	PSet 6 due PSet 7 assigned
L19	Neural Integrators	
R13	Networks	
L20	Hopfield Networks	PSet 7 due
L21	Sequence Generation in Songbirds	
R14	Final Review	