Home » Courses » Brain and Cognitive Sciences » Introduction to Neural Computation » Syllabus

# **Syllabus**

COURSE HOME	Meeting Times	
SYLLABUS	Lectures: 2 sessions / week, 90 minutes / session  Recitations: 1 session / week, 1 hour / session	
LECTURE NOTES	Prerequisites	
■ LECTURE VIDEOS	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.	
ASSIGNMENTS	Course Description	
EXAM STUDY GUIDES	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	
DOWNLOAD COURSE MATERIALS	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.	
THE STATE OF THE S	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<sup>®</sup> 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<sup>®</sup>. 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 takehome 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

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	

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