NE593:	**Topics in Computational Neuroscience: Modeling Rhythms in the Brain (S2026)**
Instructor:	Mark Kramer (mak@bu.edu)
Course Hours:	Tuesday & Thursday, 11:00 am-12:15 pm, CAS 227
Office Hours:	CDS 441, Tuesday 12:30-1:30 pm, Friday 3-4 pm
Textbook:	None
Course Website:	https://mark-kramer.github.io/BU-NE593
Prerequisites:	NE204 or CN510, MA124, or consent of instructor

Course Overview. Neural rhythms are believed to play an important role in cognitive processes, ranging from attention to memory to motor control, and in pathological brain activity related to disease. This course introduces mathematical approaches to modeling rhythmic and arrhythmic neural activity. Students will examine computational models of artificial and biological neurons, with coursework focused on the implementation and simulation of these models. Students will gain both an intuitive understanding and a practical mastery of computational models fundamental to artificial and biological neural networks and develop the programming and data visualization skills important to scientific inquiry in general, and neuroscience in particular.

Course Requirements. Our daily course format will consist of lectures and in-class exercises. Class exercises will typically involve Python programming to implement the concepts discussed. Please attend lectures. If you know in advance that you will need to miss a lecture, please notify me by email.

Exams. You must attend the exams. Missed exams will receive no credit. Please plan travel accordingly.

Exam 1	Thursday, March 5
Exam 2	During final exam period

Quizzes. Approximately weekly, you will complete a brief in-class quiz. Quiz topics will cover recent course material. Responses to quiz questions must be yours, without outside assistance. I will drop your lowest two quiz scores.

Project. You will work in small groups to complete a project. In this project, you will read material (usually a peer-reviewed paper) relevant to the course and present it to the class. You will also provide a brief summary of your presentation. Our goal is to practice scientific presentation skills not (yet) simply replicated by machines.

Grading

Quizzes	34% of grade
Exams	33% of grade
Project	33% of grade

LLM Policy. You are welcome to use LLMs (e.g., ChatGPT, Gemini) to *help* you understand course concepts. However, you will not use LLMs to *complete* quizzes, exams, or your presentation.

Academic Honesty. Please abide by the CAS Academic Conduct Code, which can be found at http://www.bu.edu/academics/policies/academic-conduct-code/. Cases of academic misconduct will be reported to the Dean of CAS and the Director of the Neuroscience Program.

University Drop Dates and other important information can be found at https://www.bu.edu/reg/calendars/semester/

Material to be covered. Below is an outline of the material to be covered. Each topic will consist of lectures and computational exercises. Readings will accompany most topics to provide a broader view of the role neuroscience plays in society. Modifications to the reading and schedule may occur throughout the semester.

Topic 1	Introduction	Rhythms + Programming Habits
Topic 2	Discrete Models	Perceptron + Training
Topic 3	Discrete Models	Hopfield model + Linear Algebra
Topic 4	Discrete Models	Recurrent Neural Networks (RNN)
Topic 5	1D Continuous Models	Leaky Integrate & Fire
Topic 6	4D Continuous Models	Hodgkin-Huxley (briefly)
Topic 7	2D Continuous Models	FitzHugh-Nagumo
Topic 8	2D Continuous Models	A “simple” oscillator model
Topic 9	Gamma rhythms	ING, PING, sparse PING
Topic 10	Beta rhythm	Funky currents & bursting