**MA665: Introduction to Modeling and Data Analysis in Neuroscience (Fall 2023)**

**Instructor:** Mark Kramer (mak@bu.edu)

**Course Hours:** September 5, 2023 – October 24, 2023**,** Tue & Thur, 12:30-1:45 PM, CAS B25B

**Office Hours:** Thursdays 2-3 PM, Fridays 12-1:30 PM, MCS 441

**Textbook:** None

**Course Website:**      <https://github.com/Mark-Kramer/BU-MA665-MA666>

**Prerequisites:** Graduate standing or consent of instructor.

This course is intended to introduce neuroscience graduate students to mathematical concepts in neuroscience. We will use experimental observations to motivate the study of mathematics and statistics. The course will focus on fundamental topics in mathematical neuroscience, with emphasis on quantifying neurophysiological time series and developing mathematical models of the activity observed. An important component of the course is an introduction to scientific computing. Completing the material in this course will provide you with an introduction to a subset of topics in computational neuroscience.

**Course goals:** To introduce mathematical concepts encountered in neuroscience research and more advanced neuroscience graduate courses. To teach basic programming skills. To think about problems in neuroscience in quantitative ways.

**Course requirements:** The main requirement in this course is effort. I expect your full effort during our course meetings, and outside of the course, to meet the course objectives. As part of this course, you may work together in teams, but must submit your own solutions to all assignments.

**Grades:** To earn an A, complete all assignments, and participate in class discussions. Effort towards understanding and solving each problem is more important than reporting a correct solution.

**Topic 1 Introduction**

Sept 5, 7: Programming Proficiency

**Topic 2 I&F** (watch online lectures)

Sept 12, 14: Class Discussion & Challenges: The integrate and fire neuron, and its extensions

**Topic 3 HH** (watch online lectures)

Sept 19, ~~21~~, 26: Class Discussion & Challenges: The Hodgkin-Huxley neuron

**Topic 4 Basic Analysis of Spike Train Data**

Sept 28, Oct 3,5: In class lecture(s), and example data analysis.

**Topic 5 ERP** (watch online lectures)

Oct 12, 17: Class Discussion & Challenges: The event-related potential

**Topic 6 Power spectrum** (watch online lectures)

Oct 19, 24: Class Discussion & Challenges: The power spectrum

**MA666: Advanced Modeling and Data Analysis in Neuroscience (Fall 2023)**

**Instructor:** Mark Kramer (mak@math.bu.edu)

**Course Hours:** October 26, 2023 – December 12, 2023**,** Tue & Thur, 12:30-1:45 PM, CAS B25B

**Office Hours:** Thursdays 2-3 PM, Fridays 12-1:30 PM, MCS 441

**Textbook:** None

**Course Website:**<https://github.com/Mark-Kramer/BU-MA665-MA666>

**Prerequisites:** Graduate standing or consent of instructor.

**Course goals:** The goal of this course is further study of topics in computational neuroscience. We will continue to focus on three broad areas of computational neuroscience: (1) computer programming, (2) data analysis, (3) modeling. You are encouraged to continue working collaboratively with your peers.

**Course requirements:** The main requirement in this course is effort. I expect your full effort during our course meetings, and outside of the course, to meet the course objectives. As part of this course, you may work together in teams, but must submit your own solutions to all assignments.

**Grades:** To earn an A, complete all assignments, participate in class discussions. Effort towards understanding and solving each problem is more important than reporting a correct solution.

**Schedule**

**Topic 7 Coherence** (watch online lectures)

Oct 26,31, Nov 2 Class Discussion & Challenges

**Topic 8 Spike-field coherence** (watch online lectures)

Nov 7,9~~,14~~ Lecture, Class Discussion & Challenges

**Topic 9 Cross-frequency coupling**

Nov 14,16,21~~,28~~ Class Discussion & Challenges

**Topic 10 ~~Rhythm models OR~~ Neural networks**

Nov 28,30~~, Dec 7~~ Class Discussion & Challenges

**Topic 11 A quick introduction to regression**

Dec 7,12 Class Discussion & Challenges