Computational Neuroscience Study Group

2021-2022 Spring Semester

Location:	Room 1117 / Faculty of Electrical and Electronics Engineering
Time:	Monday, 5:30-7.00 pm, UTC+3
Contact:	akiferdemsagtekin@gmail.com

Prerequisites: Familiarity with differential equations.

Curriculum:

▌→ Group work, ▌→ Individual work.

- ▌Week 1: **The concept of modeling & using math to understand the brain (Presentation)**

- ▌**Individual Reading:** Biological foundations of neurons and synapses
  Resource for neurons: Neural Dynamics book chapter 1 part 1
  Resource for synapses: Principles of Computational Modelling in Neuroscience book part 7.1

- ▌Week 2: **Mathematical modeling of neurons, The leaky integrate-and-fire model**
  Video content: NeuroMatch week 2 day 3 tutorial 1
  Book content: Neuronal Dynamics book chapter 1 part 3
  Coding exercise: Python Brian2 library, tutorial 1

- ▌Week 3: **Mathematical modeling of synapses**
  Video content: NeuroMatch week 2 day 3 tutorial 3
  Book content: Principles of Computational Modelling in Neuroscience book part 7.2.
  Coding exercise: Python Brian2 library tutorial 2

- ▌**Individual coding:** Implementation of Izhikevich's 2003 paper in Brian 2 and elaborating the model with incorporating the synapse model learned in week 3.

- ▌Week 4: **Discussion of the individual coding part**

- ▌Week 5: **Introduction to dynamical systems theory**
  Book content: Nonlinear Dynamics and Chaos (Steven Strogatz) book chapter 2 and part 3.0

- ▌**Individual Reading:** Nonlinear Dynamics and Chaos (Steven Strogatz) book part 3.1 and 3.2

- ▌Week 6: **Relation of current and activity of neuron population (1D Rate model)**
  Video content: NeuroMatch week 2 day 4, first 47 slides

- ▌**Individual Reading:** Dynamical systems in 2D, null-clines, limit cycles. (Source will be provided)

- ▌Week 7: **Relation between two neuron populations (2D Rate model)**
  Video content: NeuroMatch week 2 day 4, 47-103 slides

- ▌**Individual Graduation Project**

  a-) Modeling of competing neural populations with spiking neuron model
  or
  b-) Modeling of competing neural populations with a rate model

- ▌Week 8: **Projects presentations and discussion**