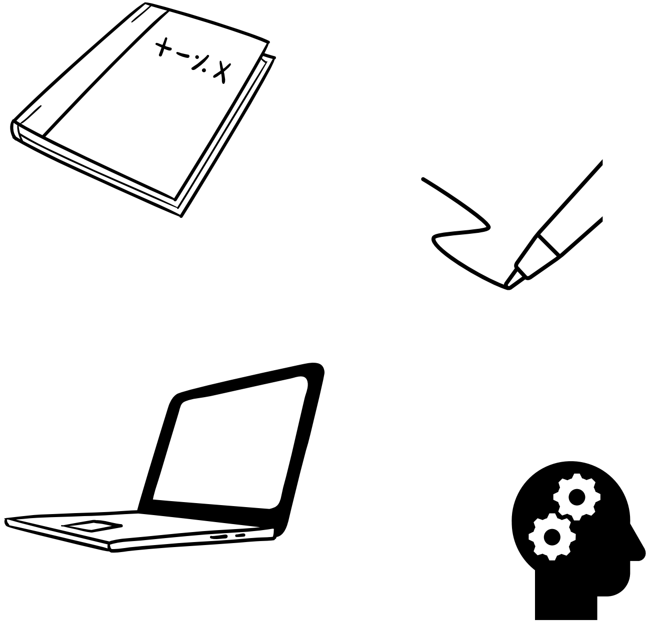


Organisation of exercises

NX 465

Computational Neuroscience:
Neuronal Dynamics

Your TAs

Kasper Smeets

Shuqi Wang

Louis Pezon

Exercise sessions

- **Exercises**
  - Pen and paper exercises
  - Python exercises

- **Mini-project**
  - In groups of 2
  - Handed out around week 7
  - 2 topics to choose from
  - Coding + written report (30% of final grade)
  - Mandatory!

Pen and paper exercises

- On the content of the lecture
- Partly covered together during class
- Released weekly
- Answers released later in the week

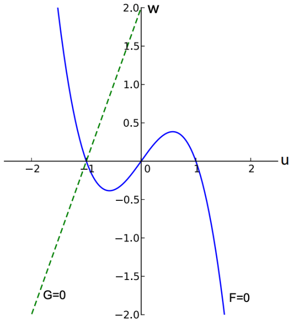
- Exam material!

Exercise 1: Inhibitory rebound

Consider the following two-dimensional Fitzhugh-Nagumo model:

$$\left[\begin{array}{lcl} \frac{du}{dt} & = & u\left(1-u^2\right) - w + I \equiv F(u,w) \\ \frac{dw}{dt} & = & \varepsilon\left(u - 0.5w + 1\right) \equiv \varepsilon G(u,w)\,, \end{array}\right. \tag{1}$$

where $\varepsilon \ll 1$.



1.1 Suppose that an inhibitory current step is applied,

$$I(t) = \begin{cases} -I_0 & t \leq 0 \\ 0 & t > 0 \end{cases}$$

How does the fixed point move?

1.2 What happens after the driving current is removed? Sketch the form of the trajectories for increasing values of I_0. What happens for large I_0?

Exercise 2: Phase Plane Analysis

In this exercise, we use the phase plane to study the dynamics of a two dimensional, nonlinear neuron model. The system is described by:

$$\begin{cases} \frac{d}{dt}u = F(u,w) \\ \frac{d}{dt}w = G(u,w) \end{cases} \tag{2}$$

where $F(u,w) = f(u) - w + I(t)$ and $G(u,w) = \epsilon(g(u) - w)$ with $\epsilon = 0.1$. $I(t)$ is an external current.

Python exercises

- Complementary to the written exercises
- Using pre-implemented functions
- Easy network simulations with Brian2

- We can help with the installation of the neuronal dynamics package

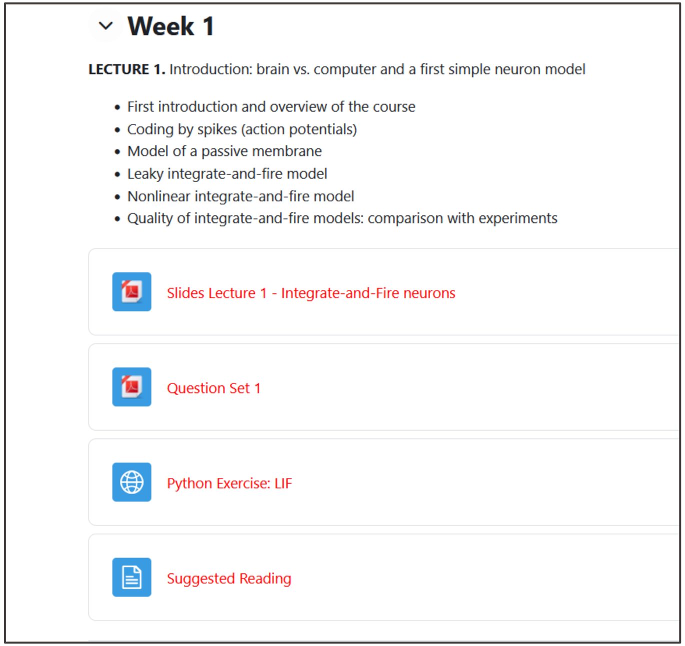
Neuronal Dynamics: Python Exercises

This documentation is automatically generated documentation from the corresponding code repository hosted at Github. The repository contains python exercises accompanying the book Neuronal Dynamics by Wulfram Gerstner, Werner M. Kistler, Richard Naud and Liam Paninski.

Contents

Moodle page

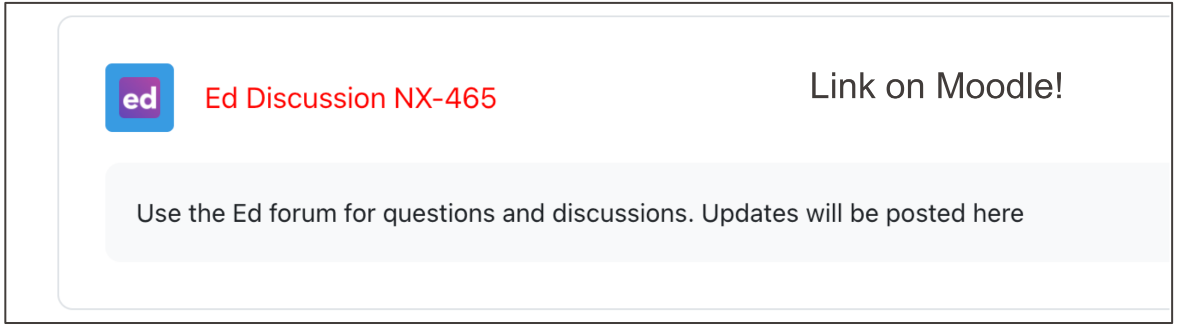
- Course overview
- Course material:
  - Video lectures
  - Slides
  - Exercises
  - Solutions
  - Announcements



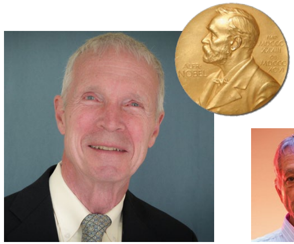
ED Discussion

- Q&A and discussion forum
- Ask questions and answer other students

- Moderated by TAs



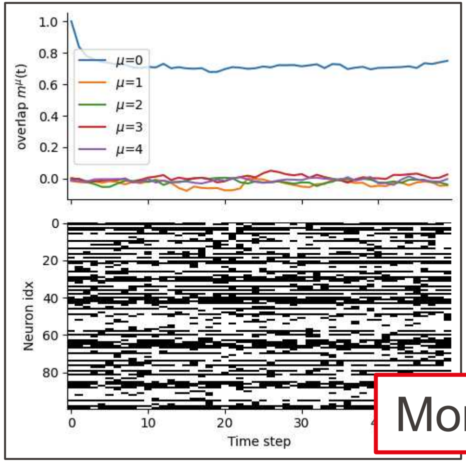
Mini-projects

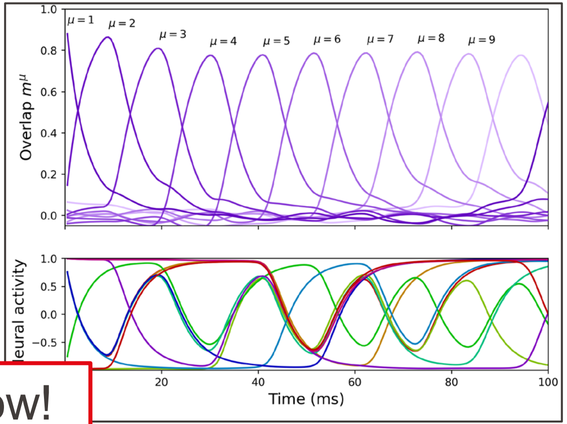


- In pairs!
- Choose from two projects:

Bioplausible Hopfield model
Model of memory storage and recall with biological constraints

Dynamic Hopfield model
Model of information propagation through cyclical dynamics





More details will follow!