EPFL

BIO-612   **Mathematical methods for neuroscience**
Kanari Lida

Cursus	Sem.	Type
Neuroscience		Opt.

Language of teaching	English
Credits	3
Session	
Exam	Project report
Workload	90h
Hours	**70**
Lecture	28
Exercises	14
Practical work	14
Project	14
Number of positions	**20**

Frequency

Only this year

Remark

Next time: Fall 2024

Summary

This course teaches basic mathematical techniques that can be applied on biological and neuroscience challenges. During the course we will focus on solving similarity tasks with stochastic systems, random walks, algebraic topology and statistics.

Content

This course will teach students basic mathematical techniques that can be used to address biological challenges. During the course we will focus on the description of biological systems using statistics, machine learning, algebraic topology, stochastic systems and random walks. The students will learn how to apply these techniques on real-life problems of neuroscience. We will use examples from single cells, such as neurons and astrocytes, and neuronal networks that we will analyze and try to understand better using mathematical tools.

Course content:

* Introduction to mathematical problems
* Statistical methods for biological problems
* Introduction to machine learning
* Application of statistics and machine learning on neuroscience problems
* Introduction to algebraic topology and persistent homology
* Topology of neuronal morphologies
* Random walk and diffusion equations
* Application of random walks on neuronal morphologies

Note

Learning Outcomes:
* Understand mathematical concepts (statistics, random processes, algebraic topology) and their applications in a variety of biological problems
* Set up and solve similarity tasks based on experimental datasets
* Create computational models for the description, analysis and comparison of neuronal morphologies

Keywords

Neuroscience, Statistics, Random walks, Stochastic processes, algebraic topology, neuronal morphologies

Learning Prerequisites

Recommended courses

MATH-493
BIO-369, NX-450, CS-456

Resources

Moodle Link

- https://go.epfl.ch/BIO-612