NX-414

Brain-like computation and intelligence

Mathis Alexander

Cursus	Sem.	Type
Computational biology minor	E	Opt.
Data science minor	E	Opt.
Life Sciences Engineering	MA2, MA4	Opt.
Neuro-X minor	E	Opt.
Neuro-X	MA2, MA4	Opt.

Language of teaching	English
Credits	4
Session	Summer
Semester	Spring
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Lecture	2 weekly
Exercises	2 weekly
Number of positions	

Summary

Recent advances in machine learning have contributed to the emergence of powerful models for how humans and other animals reason and behave. In this course we will compare and contrast how such brain models as well as brains create intelligent behaviour.

Content

- Neural code and sparse coding
- Plasticity and Hebbian learning
- Bayesian brain
- Transformers and (biological) attention
- Goal-driven models of vision, proprioception, navigation and language
- Motor control (control theory, reinforcement learning)
- Transfer, continual and curriculum learning

Keywords

Python, NeuroAI, Deep Learning, Perception, Behavior, Motor Control and Learning

Learning Prerequisites

Recommended courses

CS-433 (strongly recommended)

Important concepts to start the course

Programming in Python, good mathematics and machine learning background

Learning Outcomes

By the end of the course, the student must be able to:

- Formulate models of brain function
- Hypothesize potential mechanisms that give rise to behavior
- Design models of brain functions
- Characterize current models of brain function

Transversal skills

- Set objectives and design an action plan to reach those objectives.
- Demonstrate the capacity for critical thinking
- Write a scientific or technical report.
- Summarize an article or a technical report.

Teaching methods

Lectures and exercises to discuss and work on problem sets (both numerical and analytical).

Expected student activities

Attend lectures and take notes during lectures, participate in quizzes and read scientific articles. Solve the problem sets and take the final exam.

Assessment methods

The final mark is a combination of three evaluations: problem sets (25%), quizzes (25%), final exam (50%).

Supervision

Office hours	Yes
Assistants	Yes
Forum	Yes

Resources

Virtual desktop infrastructure (VDI)

No

Moodle Link

- https://go.epfl.ch/NX-414