BIOENG-456

Controlling behavior in animals and robots

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Cursus	Sem.	Type
Life Sciences Engineering	MA2, MA4	Opt.
Neuro-X minor	E	Opt.
Neuro-X	MA2	Opt.
Robotics	MA2, MA4	Opt.

Language of teaching	English
Credits	4
Session	Summer
Semester	Spring
Exam	During the semester
Workload	120h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
Exercises	2 weekly
Number of positions	

Summary

Students will acquire an integrative view on biological and artificial algorithms for controlling autonomous behaviors in animals and robots. Students will synthesize and apply this knowledge in oral presentations and exercises.

Content

During the first half of the course, each topic will be introduced by preparatory primary scientific literature readings that are expanded upon during lecture and followed by (i) a presentation and discussion of these papers by student groups and (ii) guided Webots-based modeling exercises that are designed to test and consolidate knowledge. The last half of the course is a group mini-project working on analyzing new data. Lecture/presentation topics include:

- Defining behavior
- The body and behavior
- Taxis behaviors
- Neural networks
- Collective and social behaviors
- Internal states
- Hierarchical control

Keywords

- behavior
- neuroscience
- neural networks
- flies
- mice
- robots
- embodiment
- sensing
- locomotion
- navigation

Learning Prerequisites

Recommended courses

Neuroscience II: cellular mechanisms of brain function (or the equivalent)

Important concepts to start the course

Neuroscience
Robotics
Programming

Learning Outcomes

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

- Recall neurobiological and robotic algorithms for behavior
- Draw network models capable of carrying out simple behaviors
- Implement computational models to execute specific behaviors
- Hypothesize how changes in morphology, mechanical properties, or underlying algorithms would influence behaviors expressed

Transversal skills

- Identify the different roles that are involved in well-functioning teams and assume different roles, including leadership roles.
- Give feedback (critique) in an appropriate fashion.
- Make an oral presentation.
- Plan and carry out activities in a way which makes optimal use of available time and other resources.
- Use both general and domain specific IT resources and tools
- Access and evaluate appropriate sources of information.
- Summarize an article or a technical report.

Teaching methods

For the first half of the semester:
2h lectures per week, including a lecture by the professor as well as an oral presentation and guided discussion of primary scientific literature by a student group.
2h exercises per week, including a guided programming-based robotics simulation of behavioral control algorithms (problem solving, model building, project execution and presentation)
This first half of the course is consolidated and evaluated by a midterm exam.
For the second half of the semester: A group-based miniproject that is guided through lectures on data analysis and finalized through the submission of a Project Report and Presentation.

Expected student activities

Students are expected to attend lectures, actively engage in exercises, summarize and present a scientific study, participate in group discussions, and perform a miniproject in a group.

Assessment methods

Continued assessment during the semester.

Supervision

Assistants	Yes
Forum	Yes

Resources

Moodle Link

- https://go.epfl.ch/BIOENG-456