EPFL

BIOENG-456   **Controlling behavior in animals and robots**

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Cursus	Sem.	Type
Bioengineering	MA2, MA4	Opt.
Life Sciences Engineering	MA2	Opt.
Robotics	MA2	Opt.
Sciences du vivant	MA2, MA4	Opt.

Language of teaching	English
Credits	4
Withdrawal	Unauthorized
Session	Summer
Semester	Spring
Exam	During the semester
Workload	120h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
Exercises	2 weekly
Number of positions	**40**

It is not allowed to withdraw from this subject after the registration deadline.

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

Each subject will be introduced by preparatory readings that are expanded upon during lecture and followed by (i) a presentation and discussion of primary literature by students and (ii) modeling exercises designed to test and consolidate knowledge. Topics include:

- Defining behavior
- The body and behavior
- Taxis behaviors
- Feed-forward neural networks
- Collective and social behaviors
- Internal states
- Hierarchical control
- Generating internal maps
- Navigation with planning
- Recurrent neural networks
- Navigation with environmental cues
- Evolving innate behaviors

Keywords

- behavior
- neuroscience
- neural networks
- flies
- mice
- robots

- embodiment
- sensing
- locomotion
- navigation
- evolution

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
2h lectures per week
2h exercises per week
Exercises (problem solving, model building, project execution and presentation)
Preparation and oral presentations of scientific material

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

Assessment methods
Continued assessment during the semester