

MICRO-515

Evolutionary robotics

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Cursus	Sem.	Type
Microtechnics	MA2, MA4	Opt.
Robotics, Control and Intelligent Systems		Opt.
Robotics	MA2, MA4	Opt.

Language of teaching	English
Credits	3
Session	Summer
Semester	Spring
Exam	Written
Workload	90h
Weeks	14
Hours	4 weekly
Courses	1.5 weekly
TP	.5 weekly
Project	1 weekly
Number of positions	

Summary

The course gives an introduction to evolutionary computation, its major algorithms, applications to optimization problems (including evolution of neural networks), and application to design and control of robots. It includes software exercises and project to evolve, build, and test a robot.

Content

- Natural and Artificial Evolution
- Principles of Evolutionary Computation
- Algorithms: Genetic Algorithms and Evolutionary Strategies
- Algorithms: Multi-objective optimization (various algorithms, including NSGA-II)
- Introduction to neural network architectures and learning methods, including reinforcement learning
- Evolution of Artificial Neural Networks and comparison to Reinforcement Learning
- Evolution of Neurocontrollers for mobile robots
- Morphological Growth and Evolution
- Evolution of Collective Systems: Competitive and Cooperative Evolution
- Evolution of bio-hybrid robots

Learning Prerequisites**Important concepts to start the course**

Programming skills (Python, Java, C++)

Learning Outcomes

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

- Apply new tools for software and hardware engineering
- Translate acquired theoretical knowledge in practical implementations during laboratory sessions

Teaching methods

Lectures, software exercises, and project involving evolution of morphology and neural control of robot, 3D printing of parts and assembly, test characterization of evolved robots.

Expected student activities

Attending lectures, asking critical questions, taking all exercises and completing assignments for the following week, forming groups and performing collaboratively project with physical robots, writing and presenting project results

Assessment methods

Mini-project report in powerpoint + presentation + written exam

Supervision

Office hours	No
Assistants	Yes
Forum	Yes

Resources

Bibliography

Floreano, D. & Mattiussi, C. (2008) Bioinspired Artificial Intelligence. MIT Press (selected chapters)

Ressources en bibliothèque

- [Bioinspired Artificial Intelligence / Floreano](#)

Moodle Link

- <https://go.epfl.ch/MICRO-515>