



ЦЕНТЪР ЗА ОБУЧЕНИЕ – БАН

1000 София
ул. „Сердика“ № 4
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Basic Information:

Course Title: REINFORCEMENT LEARNING

Lecturer: Prof. Dr. Petia Koprinkova-Hristova

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Total Teaching Hours: 30

Annotation (up to 150 words)

The course is an introduction to the theoretical foundations of reward/punishment learning, also known as reinforcement learning (RL). Its goal is to familiarize doctoral students with both the emergence and biological foundations of the method, as well as its mathematical interpretation and its applications for solving optimization problems. The topics covered in the course include an introduction to both the biological foundations of reinforcement learning, and the theory of RL and its application to optimization and adaptive control systems. Practical activities include implementing the algorithms in the open source Gymnasium environment in the Python language.

Course content (brief description by topics or modules)

1. Biological foundations of reinforcement learning
2. Dynamic programming
3. Markov processes
4. Monte Carlo methods
5. Temporal difference method
6. Table algorithms (Q-learning)
7. Approximation algorithms
8. Gradient algorithms
9. Applications for solving optimization problems
10. Applications for adaptive object control

Teaching and assessment methods

Lectures and exercises when gathering a group of at least 5 course participants.

Consultations with the teacher when conducting the course individually.

The acquired skills for simulation research of a selected learning algorithm for the purpose of controlling an object from the Gymnasium library of the Python language are assessed.

Competencies acquired as a result of training (3–5 points)

1. Knowledge of the origin and biological foundations of RL.
2. Knowledge of the theory of RL and its applications.
3. Skills for programming implementation of a selected RL algorithm for object management from the Gymnasium library in the Python language.



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Literature:

1. Sutton and Barto, Reinforcement Learning: an Introduction, 2nd Ed., MIT Press 2018;
<http://incompleteideas.net/book/RLbook2018.pdf>
2. Средата с отворен код Gynasium на езика Python:
https://gymnasium.farama.org/introduction/basic_usage/#

Additional information (optional) (e.g., special requirements, laboratory equipment, prior knowledge)

It is desirable that course participants have basic programming skills, preferably in the Python language.