COURSE DESCRIPTION CARD - SYLLABUS

Course name
Advanced Methods of Computational Intelligence [S2Inf1-SzInt>ZMIO]

Course

Field of study
Computing

Year/Semester
1/1

Area of study (specialization)
Artificial Intelligence

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
30

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

dr inż. Andrzej Szwabe
andrzej.szwabe@put.poznan.pl

Lecturers

dr inż. Andrzej Szwabe
andrzej.szwabe@put.poznan.pl

Prerequisites

A person starting this course should have basic knowledge in mathematics, in particular in the theory of probability, and programming skills.

Course objective

The aim of the course is to familiarize students with selected issues of computational intelligence, in particular in the field of reinforcement learning and Bayesian networks, and to teach them the practical application of selected methods to solve exemplary problems.

Course-related learning outcomes

Knowledge:
has a structured and theoretically founded general knowledge related to key issues in the field of computational intelligence [k2st_w2]
has advanced detailed knowledge regarding selected it issues like markov decision problems or reinforcement learning [k2st_w3]
has knowledge about development trends and the most important cutting edge achievements in computational intelligence [k2st_w4]

knows advanced methods, techniques and tools used to solve computational intelligence problems [k2st_w6]

Skills:
can use analytical, simulation and experimental methods to formulate and solve problems and simple research problems [k2st_u4]
can — when formulating and solving tasks — integrate knowledge from different areas of computing science including specialized computing libraries [k2st_u5]
is able to solve complex tasks containing a research component iwth known methods of computing intelligence [k2st_u10]

Social competences:
understands that in the field of computational intelligence new methods and algorithms are constantly being developed [k2st_k1]
understands the importance of using the latest knowledge in the field of computing intelligence in solving research and practical problems [k2st_k2]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Formative assessment:
a) lectures: on the basis of answers to questions about the material discussed in lectures,
b) laboratories: based on an assessment of the current progress in the implementation of tasks.
Summative assessment:
a) lectures: assessment of the knowledge and skills demonstrated during the test consisting of several test questions or short tasks. Exceeding 50% of the points allows to obtain a satisfactory grade.
b) in the field of laboratories: assessment of the implementation of laboratory exercises, oral answers and reports prepared partly during the classes and partly after their completion.

Programme content

Fundamentals of probability. Bayes rule. Independence of random variables. Bayesian networks. Inference algorithms in networks. Network design. Automatic network constructing. Markov decision problems. The concept of optimal policy, the utility of states. Bellman equation. Value iteration algorithm, policy iteration. Reinforcement learning. Adaptive dynamic programming algorithm. Temporal difference learning. Exploration-exploitation tradeoff. Q-learning algorithm with extensions. Gradient methods. Actor-Critic algorithm.

Course topics

Fundamentals of probability. Bayes rule. Independence of random variables. Bayesian networks. Inference algorithms in networks. Network design. Automatic network constructing. Markov decision problems. The concept of optimal policy, the utility of states. Bellman equation. Value iteration algorithm, policy iteration. Reinforcement learning. Adaptive dynamic programming algorithm. Temporal difference learning. Exploration-exploitation tradeoff. Q-learning algorithm with extensions. Gradient methods. Actor-Critic algorithm.

Teaching methods

Lectures: multimedia presentation, illustrated with examples given on the board.
Laboratory: presentation illustrated with examples given on the blackboard and carrying out the tasks given by the teacher - practical exercises.

Bibliography

Basic
1. Richard S. Sutton and Andrew G. Barto, „Reinforcement Learning: An Introduction", 2018 (online: http://incompleteideas.net/book/the-book.html)
2. Stuart Russell and Peter Norvig, „Artificial Intelligence: A Modern Approach”, 2020
Additional

1. Rudolf Kruse, Christian Borgelt, Frank Klawonn, Christian Moewes, Matthias Steinbrecher, „Computational Intelligence”, 2013

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	60	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	40	1,50