COURSE DESCRIPTION CARD - SYLLABUS

Course name
Artificial intelligence in games [S2Inf1-SzInt>SIGRY]

Course

Field of study
Computing

Year/Semester
2/3

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
elective

Number of hours

Lecture
16

Laboratory classes
16

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

Students starting this course should have a basic knowledge of computational and memory complexity, machine learning algorithms and computer graphics. They should have the ability to model and solve algorithmic problems, programming skills and the ability to obtain information from provided sources. They should also understand the need to expand their competences. Moreover, in terms of social competences, they should exhibit honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture, and respect for other people.

Course objective

1. Demonstrating various scenarios of using artificial intelligence algorithms in games. 2. Presenting efficient algorithms used in board games. 3. Understanding methods of modeling the behavior of agents. 4. Providing knowledge about the methods of representing game environments and generative techniques for their creation. 5. Developing the ability to choose appropriate representations of agents, environment, and artificial intelligence techniques depending on the genre and the type of a game. 6. Improving students' skills to assess the advantages and disadvantages of artificial intelligence algorithms in specific applications.

Course-related learning outcomes

Knowledge:
has a structured and theoretically founded general knowledge related to key issues in artificial intelligence in games [k2st_w2]
has advanced detailed knowledge regarding applying artificial intelligence algorithms in games [k2st_w3]
has knowledge about development trends and the most important cutting edge achievements in ai in games and other selected and related scientific disciplines [k2st_w4]
has advanced and detailed knowledge of the processes occurring in the life cycle of hardware or software information systems [k2st_w5]

Skills:
is able to obtain information from literature, databases and other sources (both in polish and english), integrate them, interpret and critically evaluate them, draw conclusions and formulate and fully justify opinions [k2st_u1]
is able to plan and carry out experiments, including computer measurements and simulations, interpret the obtained results and draw conclusions and formulate and verify hypotheses related to complex engineering problems and simple research problems [k2st_u3]
can use analytical, simulation and experimental methods to formulate and solve engineering problems and simple research problems [k2st_u4]
can - when formulating and solving engineering tasks - integrate knowledge from different areas of computer science (and if necessary also knowledge from other scientific disciplines) and apply a systemic approach, also taking into account non-technical aspects [k2st_u5]
is able to assess the suitability and the possibility of using new achievements (methods and tools) and new it products [k2st_u6]

Social competences:
understands that in the field of it the knowledge and skills quickly become obsolete [k2st_k1]
understands the importance of using the latest knowledge in the field of computer science in solving research and practical problems [k2st_k2]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Formative assessment:
a) in lectures:
- based on answers to questions about the material discussed in previous lectures,
b) in laboratories:
- based on an assessment of the current progress in the implementation of tasks.

Summative assessment:
a) lectures: verification of the learning outcomes is carried out by:
- assessment of the knowledge and skills demonstrated in a test consisting of several questions of a test nature or short tasks. Exceeding 50% of the points allows to obtain a satisfactory grade.
- discussion of the test results,
b) laboratories: verification of the learning outcomes is carried out by:
- assessment of skills related to the implementation of laboratory exercises,
- continuous assessment during each class (oral answers) - rewarding the increase in the ability to use the learned principles and methods,
- evaluation of reports prepared partly during the classes and partly after their completion, with the possibility of using the Moodle platform,
- presenting the results of individual experiments.
Obtaining additional points for activity during classes, especially for:
- carrying out extended, non-obligatory experiments as part of laboratory tasks and describing them in the report,
- remarks to improve teaching materials.

Programme content

The classes cover the use of artificial intelligence algorithms in games, including topics like game theory, modeling behavior, environment representations, procedural content generation techniques, multi-agent

systems, rendering with neural networks, and music generation. Various scenarios and goals for using AI in games are explored. Students implement a simple game environment and heuristic, trained and optimized agent behavior as a practical application.

Course topics

Lectures:
The genesis and history of the use of artificial intelligence algorithms in games. Various scenarios and goals of using AI. Game theory. Modeling behavior with rules and Markov processes. Representations of the environment in games. Shape grammars. Algorithms for generating the game environment and content. Cellular automata. Fractals and L-systems. Generation of terrain and mazes. Generating the plot of the game. Multi-agent systems. Swarm intelligence. Rendering technologies such as upsampling with deep neural networks. Generating music – soundtrack for games. Examples of games using AI.

Laboratories:
Implementation of a simple game environment and agent behavior (computer players/bots). Designing and implementing an automatic method of assessing the interaction of a human player with bots by manually coding the heuristic rules, by employing learning (machine learning – inducing rules from examples, or reinforcement learning), and by optimization.

Teaching methods

Lecture: multimedia presentation illustrated with examples.
Laboratory exercises: presentation illustrated with examples and carrying out the tasks given by the teacher (practical exercises).

Bibliography

Basic
1. Ian Millington, Artificial intelligence for games, 3rd edition, Taylor & Francis, 2019.
2. Georgios N. Yannakakis and Julian Togelius, Artificial Intelligence and Games, Springer, 2018.

Additional
1. Diego Pérez Liébana, Simon M. Lucas, Raluca D. Gaina, Julian Togelius, Ahmed Khalifa, Jialin Liu, General Video Game Artificial Intelligence, Morgan & Claypool Publishers, 2019.

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	32	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	18	1,00