GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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| Subject name and code | Artificial Intelligence Methods, PG_00065723 | | | | | | |
| Field of study | METODY SZTUCZNEJ INTELIGENCJI | | | | | | |
| Date of commencement of studies | February 2026 | | Academic year of realisation of subject | 2025/2026 | | | |
| Education level | second-cycle studies | | Subject group | | | | |
| Mode of study | Full-time studies | | Mode of delivery | at the university | | | |
| Year of study | 1 | | Language of instruction | Polish | | | |
| Semester of study | 1 | | ECTS credits | 4.0 | | | |
| Learning profile | general academic profile | | Assessment form | assessment | | | |
| Conducting unit | Department of Control Engineering -> Faculty of Electrical and Control Engineering -> Wydziały Politechniki Gdańskiej | | | | | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | | prof. dr hab. inż. Roman Śmierzchalski | | | | |
| | Teachers | | | | | | |

**Lesson types**

| Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
|---|---|---|---|---|---|---|
| Number of study hours | 30.0 | 0.0 | 15.0 | 15.0 | 0.0 | 60 |

E-learning hours included: 0.0

**Learning activity and number of study hours**

| Learning activity | Participation in didactic classes included in study plan | Participation in consultation hours | Self-study | SUM |
|---|---|---|---|---|
| Number of study hours | 60 | 5.0 | 35.0 | 100 |

**Subject objectives**

The aim of the course is to introduce students to basic notions and concepts from the field of artificial intelligence.

**Learning outcomes**

| Course outcome | Subject outcome | Method of verification |
|---|---|---|
| [K7_W05] has knowledge of artificial intelligence computing techniques, inference, learning and solution-finding methods in algorithmic terms applied to automation and robotics systems | The student learns the basic principles of conducting work and research in an industrial environment, application of safety and occupational health and safety. | [SW1] Ocena wiedzy faktograficznej |
| [K7_U08] has the necessary preparation to work in an industrial environment, carry out research, apply principles of health and safety at work | The student learns the basic computational techniques of artificial Intelligence (methods of inference, learning and search for solutions) in an algorithmic approach, selects an algorithm AI to solve a specific practical technical task technical task, implements SI algorithm in a selected programming language programming language (Matlab or C++) to solve issues of decision-making processes, such as forecasting, planning, diagnostics, control, optimization. | [SU1] Ocena realizacji zadania |

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| Subject contents | Course content – lecture<br>LECTURE Basic definitions of intelligence, artificial intelligences, scope of research on artificial intelligence. Tasks of artificial intelligence formal and approximate inference, information-based learning, solution space search, - overview of intelligent computing techniques. Examples of tasks solved by artificial intelligence methods. Formal inference, task formulation, syntax and semantics of the language of logic, construction of an automatic inference system. Approximate inference, fuzzy logic - representation and processing of qualitative knowledge, fuzzy sets, operations on sets, fuzzy inference, fuzzy regulator, fuzzy rule bases on numerical data. Design of fuzzy autopilot for ship heading control. Neural networks, multilayer perceptron learning, reinforcement learning - task formulation, value function, reinforcement learning as a value function approximation method 4. Solution space search methods, evaluation function, heuristic evaluation methods. Random methods - climbing and random straying algorithm, simulated annealing algorithm. 5. solution space search with genetic algorithm (AG). Scheme and operation of AG, population representation, initial population, adaptation function, genetic operators, algorithm parameters. Theoretical basis of AG. Computer implementation of classical AG. Genetic techniques. Representation and structure of populations. AG solving optimization problems. Multicriteria optimization problem in AG. Example evolutionary route planning of an autonomous robot in an environment, trajectory determination of a ship in a collision situation at sea. Hybrid methods - techniques of combining fuzzy-neural systems (fuzzy neural networks), use of genetic algorithms for parameter tuning of fuzzy and neural models.<br><br>LABORATORY EXERCISES Fuzzy controller - evaluation of control system properties, resistance to disturbances. Synthesis of fuzzy controller - techniques of creating P, PI, PID fuzzy controller. Neural network learning test with teacher. Modeling of continuous industrial process using SN. Study of properties of genetic algorithm depending on selection method, coding method and operators used. Solving an optimization task with constraints using evolutionary method. Optimization of a robot's path in an environment using evolutionary method.<br><br>PROJECT Design of a selected control system using artificial intelligence. |
| Prerequisites and co-requisites | Knowledge from the course Fundamentals of Automatics |

**Assessment methods and criteria**

| Subject passing criteria | Passing threshold | Percentage of the final grade |
|---|---|---|
| Colloquium | 50.0% | 50.0% |
| Project documentation | 100.0% | 20.0% |
| Report on the exercises | 100.0% | 30.0% |

**Recommended reading**

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| Basic literature | 1. G. Luger, Artificial intelligence, Prentice Hall, 2008.<br>2. A. Zilouchian, M. Jamshidi, Intelligent Control Systems Using Soft Computing Methodologies, CRC Press, 2001<br>3. P. Cichosz, Systemy uczące się, Wydawnictwa Naukowo-Techniczne, Warszawa 2000.<br>4. S. Osowski, Sieci neuronowe w ujęciu algorytmicznym, Wydawnictwa Naukowo-Techniczne, Warszawa 1999.<br>5. J. Arabas, Wykłady z algorytmów ewolucyjnych, Wydawnictwa Naukowo-Techniczne, Warszawa 2001.<br>6. Andrzej Piegat, Modelowanie i sterowanie rozmyte. Exit, 1999<br>7. L. Rutkowski , Metody i techniki sztucznej inteligencji. Wydawnictwo Naukowe PWN, Warszawa, 2005 |
| Supplementary literature | 1. David E. Goldberg, Algorytmy genetyczne i ich zastosowania. WNT, 1995<br>2. D. Rutkowska, M. Piliński, L. Rutkowski, Sieci neuronowe, algorytmy genetyczne i systemy rozmyte. PWN, 1997<br>3. Zbigniew Michalewicz, Algorytmy genetyczne + struktury danych = programy ewolucyjne. WNT, 1999 |
| eResources addresses | |

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| Example issues/ example questions/ tasks being completed | Artificial intelligence tasks - formal and approximate inference, information-based learning, solution space search.<br>Fuzzy sets, operations on sets, fuzzy inference, fuzzy controller.<br>Neural networks, multilayer perceptron learning, reinforcement learning.<br>AG scheme and operation, population representation, initial population, adaptation function, genetic operators, algorithm parameters. |
| Practical activites within the subject | Not applicable |

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