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| **WSB University Branch/Department of Jaworzno** |
| **Field of study: Computer Science** |
| **Subject: Artificial intelligence methods** |
| **Educational profile: practical** |
| **Level of education: undergraduate studies** |
| **Number of hours** **per semester** | 1 | 2 | 3 | 4 |
| I | II | III | IV | V | **VI** | VII |
| **Full-time studies**(w/w/lab/pr/e)\* |  |  |  |  |  | **16w/16lab** |  |
| **Part-time studies**(w/æw/lab/pr/e) |  |  |  |  |  | **12w/12lab** |  |
| **LANGUAGE OF INSTRUCTION** | Polish |
| **LECTURER** | D. Eng. Rafał Deja, Prof. AWSB |
| **FORM OF ACTIVITIES** | Lecture, laboratory, consultation |
| **SUBJECT OBJECTIVES** | Introduction to: basic issues and methods of artificial intelligence, variety of methods based on mimicking nature, heuristic methods based on search with constraints, and knowledge representations and inference. |
| **Reference to learning outcomes** | **Description of the learning outcomes** | **Means of verification of the effect****learning** |
| **Directional effect** | **PRK** |
| **NEWS** |
| INF\_W02INF\_W09 | P6S\_WG | The student knows and understands machine learning algorithms based on, among other things, neural networks. | Completion of neural network configuration and learning tasks, written exam |
| INF\_W02INF\_W09 | P6S\_WG | The student knows and understands the problem of classification and prediction and the problems associated with uncertain and incomplete knowledge. | Performance of classification tasks and quality assessment of the classifier by cross-validation, written examination |
| INF\_W02INF\_W09 | P6S\_WG | The student knows and understands heuristic algorithms their meaning and application in particular evolutionary and genetic algorithms. | Tasks to prepare a suitable algorithm for a given optimisation problem, written examination |
| **SKILLS** |
| INF\_U10INF\_U02INF\_U08INF\_U12 | P6S\_UW | The student is able to design a simple neural network model and can verify the proposed model in a data classification task | Performing the tasks, providing a description of the configuration |
| INF\_U07INF\_U08INF\_U11 | P6S\_UW | The student is able to solve a given optimisation problem using heuristic algorithms. | Execution of tasks, provision of optimisation results for a given problem |
| INF\_U10 | P6S\_UW | Students can design a simple controller using fuzzy sets | Carrying out tasks, providing an example of inference |
| INF\_U01INF\_U02INF\_U03 | P6S\_UW | Able to independently acquire the relevant knowledge and skills necessary to complete tasks. | Performance of tasks requiring independent knowledge |
| **Student workload (in teaching hours 1h =45 minutes)\*\***  |
| **Stationary**attendance at lectures = 16participation in exercises/laboratories = 16Preparation for exercises/laboratory = 23lecture preparation = 20Exam preparation/assessment = 15implementation of project tasks =e-learning =credit/examination = 6other (consultation) = 4**TOTAL: 100h****Number of ECTS credits: 4****including in practical classes: 2** | **Part-time**attendance at lectures = 12participation in exercises/laboratories = 12Preparation for exercises/laboratory = 28lecture preparation = 23Exam preparation/assessment = 15implementation of project tasks =e-learning =credit/examination = 6other (consultation) = 4**TOTAL: 100h****Number of ECTS credits: 4****including in practical classes: 2** |
| **PREREQUISITES** | Fundamentals of computer programming, knowledge of languages and paradigms and object-oriented programming. Fundamentals of mathematical logic |
| **SUBJECT CONTENT**(broken down into face-to-face and e-learning classes) | Lecture:Content delivered in a face-to-face format: * Introduction:
	1. History of the development of AI, areas of application. Awareness,
	2. Related sciences - cognitive sciences, robotics, expert systems
* Problems solved by artificial intelligence methods
	1. classification, clustering, regression, optimisation
	2. examples of real-life problems.
* Teaching methods
	1. supervised, unsupervised learning
	2. reinforcement learning
	3. machine learning
* Neural networks
	1. perceptron, construction of sigmoidal neuron, types of neural network learning, radial basis function neuron, , self-organizing networks, recurrent networks, types of networks in relation to artificial intelligence problems
	2. Hebb methods, back propagation method
* Other artificial intelligence methods
	1. population-based methods (PSO, artificial immunology)
	2. approximate yields
* Artificial intelligence systems and languages: TensorFlow, J4DL, Cafee

Content delivered via e-learning:* Deep learning (DL)
	1. Boltzman machine, limited Boltzman machine, braided networks
	2. basic learning methods for multilayer neural networks in DL architecture
* Evolutionary algorithms
	1. Basic: concept of evolutionary algorithm, genetic algorithm, genetic programming, evolutionary strategies, exploration and exploitation, genetic operators. Convergence of evolutionary algorithms.
	2. examples of applications of evolutionary algorithms.
* Fuzzy logic
	1. Concept of fuzzy set, fuzzy number, fuzzy logic, fuzzy controller, fusification, defuzzification, fuzzy networks.
	2. examples of application of fuzzy logic, types of fuzzy networks

Lab:Content delivered in a face-to-face format: * Artificial neural networks. A machine learning algorithm with backward error propagation. Classification problems.
* Evolutionary methods and genetic algorithms.
* Logic-based methods and expert systems.
	1. Inference using rough set theory
	2. Inference using fuzzy set theory
* Classification algorithm using decision trees

Content delivered via e-learning: not applicable |
| **LITERATURE** **COMPULSORY** | * Deep Learning Tutorial, Release 0.1. LISA lab, University of Montreal, June 29, 2015
* Mariusz Flasinski, Introduction to artificial intelligence, PWN latest edition
* L. Rutkowski: Methods and techniques of artificial intelligence. (2nd ed.), Warsaw : PWN, latest edition.
* Ian Goodfellow and Yoshua Bengio and Aaron Courville : Deep Learning; An MIT Press book; www.deeplearningbook.org.
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| **LITERATURE** **SUPPLEMENTARY**(including min. 2 items in English; book publications or articles) | * Cichosz, Pawel. Data mining algorithms: explained using R. John Wiley & Sons, 2014.
* S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 3rd Ed., Pearson, 2010.
* Cichosz P., Systemy uczące się, WNT Warsaw, 2000, ISBN 83-204-2544
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| **TEACHING METHODS**(broken down face-to-face classes and e-learning) | In direct form:* Slide show, demonstration of a sample program, traditional method with a whiteboard
* Lesson and lecture structure,
* Exercises using computers

In the form of e-learning: material in the form of slides and articles on artificial intelligence methods, video presentations of the material, assignments and tests |
| **LEARNING AIDS** | Video-projector, e-learning platform (Moodle) |
| **PROJECT**(insofar as it is carried out in the course module) | Not applicable |
| **FORM AND CONDITIONS OF PASSING**(broken down into face-to-face and e-learning classes) | * Lecture - exam
* Laboratory - pass/fail
* Evaluation of activities in lecture and on the e-learning platform
* Evaluation of the performance of tasks, carried out in teams. A description of the solution should be presented in the form of documentation.
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