



## Subject card

|   |   |  |                                     |            |  |         |     |
|---|---|--|-------------------------------------|------------|--|---------|-----|
| Subject name and code                       | Machine Learning I, PG_00053428   |  |                                     |            |  |         |     |
| Field of study                              | Automation, Robotics and Control Systems  |  |                                     |            |  |         |     |
| Date of commencement of studies             | February 2023   | Academic year of realisation of subject  |                                     |            | 2023/2024  |         |     |
| 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                           | 2   | ECTS credits   |                                     |            | 3.0  |         |     |
| Learning profile                            | general academic profile  | Assessment form  |                                     |            | assessment   |         |     |
| Conducting unit                             | Faculty of Electrical and Control Engineering   |  |                                     |            |  |         |     |
| Name and surname of lecturer (lecturers)    | Subject supervisor  | dr hab. inż. Michał Grochowski   |                                     |            |  |         |     |
|   | Teachers  | dr hab. inż. Michał Grochowski<br>dr inż. Bartosz Puchalski<br>Rafał Buler<br>Jakub Buler  |                                     |            |  |         |     |
| Lesson types and methods of instruction     | Lesson type   | Lecture  | Tutorial                            | Laboratory | Project  | Seminar | SUM |
|   | Number of study hours   | 15.0   | 0.0                                 | 0.0        | 15.0   | 0.0     | 30  |
|   | 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   | 30   | 10.0                                |            | 35.0   |         | 75  |
| Subject objectives                          | The aim of the course is to introduce students to a comprehensive knowledge of the dynamically developing field of Machine Learning and to indicate its practical applications in widely understood automation and computer science.  |  |                                     |            |  |         |     |
| Learning outcomes                           | Course outcome  | Subject outcome  |                                     |            | Method of verification   |         |     |
|   | K7_W11  | The student in a small team is able to design, prepare and carry out an experiment, and then draw appropriate conclusions. For example, he/she is able to prepare a diagnostic system, which allows to identify damage to a selected system. |                                     |            | [SW3] Assessment of knowledge contained in written work and projects |         |     |
|   | K7_U07  | Students will be able to apply known artificial intelligence tools and algorithms to solve research problems e.g. to design a neural classifier.   |                                     |            | [SU4] Assessment of ability to use methods and tools                 |         |     |
| Subject contents                            | <p>The programme contents will be realised in three thematic blocks: 1. Data analysis, among others:- exploratory research- data grouping, clustering - feature selection and extraction, - dimension reduction, - data normalization,- multidimensional data visualization. 2. Models and methods of their learning, e.g:- regression models, - Support vector machines, - Neural networks, - recurrent neural networks,- deep neural networks, - learning: supervised, unsupervised, semi-supervised, reinforcement learning- decision trees- random forests- ensembling and gradient boosting methods- automatic machine learning (AutoML)3. Model performance analysis and improvement, including- quality measures of model performance, - regularization techniques,- model validation,- selection of hyperparameters for models,- analysis of algorithm performance using explanatory artificial intelligence (XAI).</p> |  |                                     |            |  |         |     |

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|--|--|--|-------------------------------|
| Prerequisites and co-requisites                                | Basic knowledge of artificial intelligence methods and optimisation  |  |                               |
| Assessment methods and criteria                                | Subject passing criteria   | Passing threshold  | Percentage of the final grade |
|  | Kolokwium  | 50.0%  | 50.0%                         |
|  | Ocena projektu   | 50.0%  | 50.0%                         |
| Recommended reading  | Basic literature   | <ul style="list-style-type: none"> <li>Bonaccorso, G. Algorytmy uczenia maszynowego. Zaawansowane techniki implementacji. Helion, 2019</li> <li>Szeliga, M. Data Science i uczenie maszynowe. Wydawnictwo Naukowe PWN, 2017.</li> <li>Grus, J. Data science od podstaw. Analiza danych w Pythonie. Helion, 2019.</li> <li>Bengio, Y., Courville A., Goodfellow I. Deep Learning. Systemy uczące się. Wydawnictwo Naukowe PWN, 2018.</li> <li>Alpaydin, E. Introduction to Machine Learning. The MIT Press Cambridge, Massachusetts London, England 2010.</li> <li>Chollet, F. Deep Learning. Helion, 2019</li> </ul> |                               |
|  | Supplementary literature   | <ul style="list-style-type: none"> <li>Haykin, S. Neural Networks and Learning Machines (3rd Edition), Prentice Hall, 2009.</li> <li>Bishop C. M. Pattern Recognition and Machine Learning. Springer, 2006.</li> <li>MATLAB Statistics and Machine Learning Toolbox User's Guide, 2021.</li> <li>James, Gareth, et al. An introduction to statistical learning. Vol. 112. New York: springer, 2013.</li> <li>Murphy, Kevin P. Machine learning: a probabilistic perspective. MIT press, 2012.</li> </ul>   |                               |
|  | eResources addresses   | Adresy na platformie eNauczanie:<br>UCZENIE MASZYNOWE I [2023/24] - Moodle ID: 32199<br><a href="https://enauczanie.pg.edu.pl/moodle/course/view.php?id=32199">https://enauczanie.pg.edu.pl/moodle/course/view.php?id=32199</a>  |                               |
| Example issues/<br>example questions/<br>tasks being completed | <ul style="list-style-type: none"> <li>Feature mining and knowledge extraction from large data sets, data normalisation, treatment of missing data, dimension reduction, visualisation of multidimensional data.</li> <li>Analysis of footballers' characteristics in terms of their suitability for a given team/position.</li> <li>Detection of anomalies/diagnosis of processes on the basis of multidimensional analysis of signals from measuring devices.</li> </ul> |  |                               |
| Work placement   | Not applicable   |  |                               |