# GDAŃSK UNIVERSITY OF TECHNOLOGY

## Subject card

| | |
|---|---|
| Subject name and code | Deep Learning Architecture, PG_00054418 |
| Field of study | Informatics |

| | | | |
|---|---|---|---|
| Date of commencement of studies | February 2024 | Academic year of realisation of subject | 2023/2024 |
| Education level | second-cycle studies | Subject group | Optional subject group<br>Subject group related to scientific research in the field of study |
| 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 Algorithms and Systems Modelling -> Faculty of Electronics, Telecommunications and Informatics |

| Name and surname of lecturer (lecturers) | Subject supervisor | dr inż. Paweł Kowalski |
|---|---|---|
| | Teachers | Paweł Kowalski |

| 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 | 8.0 | 62.0 | 100 |

| Subject objectives | In recent years, a breakthrough in the practical use of deep learning has been made. These methods have become irreplaceable due to the volume of data that requires analysis and processing. Tasks such as image recognition or natural language processing are implemented extremely effectively. In addition, the purpose of scientific research are as abstract tasks as creating art or music.<br><br>The aim of the course is to present theories, architectures, practical applications of deep neural networks, the results of current scientific research and potential development directions. |
|---|---|

| Learning outcomes | | | |
|---|---|---|---|
| | Course outcome | Subject outcome | Method of verification |
| | [K7_U42] can solve engineering and research problems including design, assessment and maintenance of information systems and applications, using experimental methods and management techniques | He understands the specificity of construction and the areas of application of different deep learning architectures. He can choose models for various problems. He can choose between building a new one and using a ready model for various problems. | [SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information |
| | [K7_W04] Knows and understands, to an advanced extent, the principles, methods and techniques of programming and the principles of computer software development or programming devices or controllers using microprocessors or programmable elements or systems specific to the field of study, and organisation of systems using computers or such devices | He knows the basics of neural network construction, operations performed in neural network layers, the importance of activation functions, functions used in classification and regression tasks, and is able to select the appropriate loss function. Is able to design selected elements of the neural network in selected programming packages | [SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge |
| | [K7_U07] can apply advanced methods of process and function support, specific to the field of study | He can analyze the class of problem solved by machine learning algorithms, analyze and select data, and properly divide the training set. Is able to solve problems using various architectures of deep neural networks | [SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject |
| | [K7_W42] Knows and understands, to an increased extent, the principles and trends in the analysis and design of local and distributed IT systems and the basics of computer modeling and computerization of complex cognitive and decision-making processes. | Knows and understands the methods of learning neural networks. He knows the problems associated with creating deep architectures of neural networks and can identify and apply methods to counteract problems. | [SW1] Assessment of factual knowledge |
| | [K7_K02] is ready to provide critical evaluation of received content and to acknowledge the importance of knowledge in solving cognitive and practical problems | Know how to translate known neural network methods on other practical problems. | [SK5] Assessment of ability to solve problems that arise in practice |
| Subject contents | 1. Basics of neural networks on the example of logistic regression 2. Gradient algorithm and methods for optimizing the learning process 3. Neural networks, training of neural networks 4. Convergent neural networks, the most popular architectures including the VGG network, Resnet, Inception, SENet 5. Application of convolutional networks in computer vision (classification, detection, segmentation) 6. Introduction to NLP (natural language processing), language models 7. Recurrent neural networks including models LSTM, GRU 8. Visualization and an attempt to understand the learning process in neural networks 9. Analysis of selected problems using classical, convolutional and recurrent neural networks | | |

| Prerequisites and co-requisites | Basics of linear algebra |  |  |
|---|---|---|---|
|  | Basics of mathematical analysis |  |  |
|  | Basics of probability theory |  |  |
|  | Subject artificial intelligence |  |  |
|  | Knowledge of scripting languages |  |  |

| Assessment methods and criteria | Subject passing criteria | Passing threshold | Percentage of the final grade |
|---|---|---|---|
|  | Midterm colloquium | 50.0% | 50.0% |
|  | Project | 50.0% | 50.0% |

| Recommended reading | Basic literature | •Deep learning: Ian Goodfellow and Yoshua Bengio and Aaron Courville: http://www.deeplearningbook.org/ <br><br>•Neural Networks and Deep Learning: Michael Nielsen http://neuralnetworksanddeeplearning.com/index.htm |
|---|---|---|
|  | Supplementary literature | no recommendations |
|  | eResources addresses | Adresy na platformie eNauczanie: |

| Example issues/ example questions/ tasks being completed | |
|---|---|
| Work placement | Not applicable |