# GDAŃSK UNIVERSITY OF TECHNOLOGY

## Subject card

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| Subject name and code | Basics of deep learning, PG_00054289 | | |
| Field of study | Informatics | | |
| Date of commencement of studies | February 2024 | Academic year of realisation of subject | 2024/2025 |
| 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 | 2 | ECTS credits | 3.0 |
| Learning profile | general academic profile | Assessment form | assessment |
| Conducting unit | Department of Computer Architecture -> Faculty of Electronics, Telecommunications and Informatics | | |

| Name and surname of lecturer (lecturers) | Subject supervisor | dr hab. inż. Julian Szymański |
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| | Teachers | mgr inż. Karol Draszawka |

| 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 |
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| | Number of study hours | 30 | 10.0 | 35.0 | 75 |

| Subject objectives | The aim of the course is to familiarize students with the methods of deep learning for advanced data analysis. Typical areas of application of these types of methods include: image classification, speech recognition and natural language understanding. |
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| Learning outcomes | Course outcome | Subject outcome | Method of verification |
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| | [K7_U04] can apply knowledge of programming methods and techniques as well as select and apply appropriate programming methods and tools in computer software development or programming devices or controllers using microprocessors or programmable elements or systems specific to the field of study, making assessment and critical analysis of the prepared software as well as a synthesis and creative interpretation of information presented with it | Based on analysis of a problem, student is able to choose a suitable programming language, libraries, frameworks and IDE, which make the solution to the problem much easier to implement. | [SU4] Assessment of ability to use methods and tools |
| | [K7_W05] Knows and understands, to an increased extent, methods of process and function support, specific to the field of study. | Student knows machine learning methodology and, based on that, is able to adjust parameters of a particular neural network model to optimize its performance in a given problem. | [SW1] Assessment of factual knowledge |
| | [K7_U06] can analyse the operation of components, circuits and systems related to the field of study; measure their parameters; examine technical specifications; interpret obtained results and draw conclusions | For problems from artificial intelligence domain, such as computer vision, sound analysis, natural language understanding, student is able to choose a suitable deep neural network model and train it correctly, using available deep learning frameworks and tools. | [SU4] Assessment of ability to use methods and tools |
| | [K7_U42] can solve engineering and research problems including design, assessment and maintenance of information systems and applications, using experimental methods and management techniques | Student is able to quantitatively measure the performance of a deep model in a given problem and is able to suggest changes to the architecture of the model that can potentially improve this performance. | [SU2] Assessment of ability to analyse information [SU1] Assessment of task fulfilment |
| | [K7_W03] Knows and understands, to an increased extent, the construction and operating principles of components and systems related to the field of study, including theories, methods and complex relationships between them and selected specific issues - appropriate for the curriculum. | Student knows advantages and disadvantages of neural networks distributed knowledge representation. | [SW1] Assessment of factual knowledge |

| Subject contents | |
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| | 1. Machine learning and artificial neural networks basics |
| | 2. Image data analysis with convolutional neural networks |
| | 3. Sequence analysis with recurrent neural networks |
| | 4. Natural language neural models |
| | 5. Generalization improvement techniques |
| | 6. Deep learning optimization techniques |
| | 7. Practical methodology and tips for deep learning |

| Prerequisites and co-requisites | |
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| | Basic knowledge of linear algebra and statistics. |
| | Intermediate programming skills in Python. |

| Assessment methods and criteria | Subject passing criteria | Passing threshold | Percentage of the final grade |
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| | Multiple choice written test | 50.0% | 50.0% |
| | Project | 50.0% | 50.0% |

| Recommended reading | Basic literature | Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016, url: http://www.deeplearningbook.org/ <br><br> Michael Nielsen, "Neural Networks and Deep Learning", http://neuralnetworksanddeeplearning.com/ |
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| | Supplementary literature | Andrew Ng, "Machine Learning Yearning", http://www.mlyearning.org/ <br><br> Tutorials on deep learning frameworks pages, such as: https://www.tensorflow.org/tutorials, http://torch.ch/docs/tutorials.html |
| | eResources addresses | Adresy na platformie eNauczanie: |

| Example issues/ example questions/ tasks being completed | Present the architecture of a convolutional neural network, show its advantages over traditional networks and describe typical applications. <br><br> During the development of a deep learning project, a satisfactory level of training error was observed, but at the same time the testing error was unacceptable. What could be the reason for this? Consider several scenarios. Suggest ways to improve. |
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| Work placement | Not applicable |
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