#### card of course

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| Subject name | Neural networks part I |

1. The placement of the subject in the study system

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| 1.1. Field of study | Computer science |
| 1.2. Form and path of study | Full-time/Part-time |
| 1.3. Level of education | First-cycle studies |
| 1.4. Study profile | Practical |

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| 1. 5. Specialty | Artificial intelligence |
| 1.6. Subject Coordinator | Dr inż. Róża Dzierżak |

2. General characteristics of the subject

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| 2.1. Belonging to a subject group | Directional/Practical |
| 2.2. Number of ECTS | 3 |
| 2.3. Language of lectures | Polish |
| 2.4. Semesters in which the subject is taught | III |
| 2.5.Criteria for selecting course participants | For specialization: Artificial Intelligence |

1. Learning outcomes and course delivery
   1. Subject Objectives

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| No. | Subject Objectives |
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| C1 | Understand the basic principles, architecture, and applications of artificial neural networks. |
| C2 | Implement basic neural network models using popular libraries such as TensorFlow and PyTorch. |
| C3 | Learn how to evaluate model performance and make adjustments for better fit. |

* 1. Subject-specific learning outcomes, divided into knowledge , skills and competences , with reference to the directional learning outcomes

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| No. | Description of subject  learning outcomes | Reference to  directional effects  learning (symbols) | Method of implementation (mark "X") | | | |
| ST | | NST | |
| Classes at the University | Activities on  the platform | Classes at the University | Activities on  the platform |
| After passing the course, the student knows and understands **the knowledge** | | | | | | |
| W1 | Knows basic concepts related to neural networks such as neuron, layer, activation, learning, and cost function. | INF\_W07  INF\_W10 INF\_W19 | X |  | X |  |
| W2 | Understands the differences between types of neural networks, including perceptron, MLP (Multilayer Perceptron), and recurrent networks. | X |  | X |  |
| W3 | Possesses knowledge of basic neural network training algorithms, including backpropagation and gradient descent. | X |  | X |  |
| W4 | Knows basic activation functions and their applications to different types of problems. | X |  | X |  |
| W5 | Understands the importance of training, validation, and test data in the model learning process. | X |  | X |  |
| After passing the course, the student is **able** to: | | | | | | |
| U1 | Can implement a simple neural network using TensorFlow or PyTorch. | INF\_U13 INF\_U19 INF\_U21 | X |  | X |  |
| U2 | Is able to prepare data for network training, including normalizing and dividing it into training, validation, and test sets. | X |  | X |  |
| U3 | It can analyze the performance of a neural network based on metrics such as accuracy, precision, and loss. | X |  | X |  |
| U4 | Is able to apply different activation functions and select the appropriate ones for a given problem. | X |  | X |  |
| U5 | Can modify model parameters to improve its performance, e.g. number of layers, number of neurons, learning rate. | X |  | X |  |
| U6 | Able to work in a team to implement projects related to neural networks. | X |  | X |  |
| After completing the course, the student is ready to take part in **social competences.** | | | | | | |
| K1 | Understands the importance of a responsible approach to the analysis and interpretation of the results of neural network models. | INF\_K05 | X |  | X |  |
| K2 | Is aware of the ethical challenges associated with the use of AI-based models. | X |  | X |  |

3.3. Forms of teaching and their number of hours - Full-time studies (ST), Part-time studies (NST)

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| Path | Lecture | Exercises | Design | Workshop | Laboratory | Seminar | Lecturer | Classes conducted using distance learning methods and techniques in the form of a lecture | Other | **ECTS points** |
| **ST** |  |  |  |  | 30 |  |  |  |  | 3 |
| **NST** |  |  |  |  | 15 |  |  |  |  | 3 |

3.4. Content of education (separately for each form of classes: (W, ĆW, PROJ, WAR, LAB, LEK, OTHER). It should be marked (X) how the given content will be implemented (classes at the university or classes on the e-learning platform conducted using distance learning methods and techniques)

TYPE OF CLASS: LABORATORY

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| No. | Content of the course | Reference to subject-specific learning outcomes | Method of implementation (mark "X") | | | |
| ST | | NST | |
| **Classes at the University** | **Activities on  the platform** | **Classes at the University** | **Activities on  the platform** |
| 1. | Introduction to Neural Networks  History, basic concepts, applications. | W1, K1 | X |  | X |  |
| 2. | Construction of a simple perceptron and its operation  Implementation of a perceptron in Python. | W1, U1 | X |  | X |  |
| 3. | Backpropagation and neural network training , algorithms and cost functions. | W3, U1 | X |  | X |  |
| 4. | Activation functions in neural networks, discussion of ReLU, Sigmoid, Tanh and their applications. | W4, U4 | X |  | X |  |
| 5. | Preparing data for network training, normalization, division into training, validation and test sets. databases. | W5, U2 | X |  | X |  |
| 6. | Implementing a multi-layer perceptron (MLP), developing the model in TensorFlow or PyTorch. | W2, U1, U5 | X |  | X |  |
| 7. | Network performance analysis, model evaluation metrics, loss and efficiency analysis. | W3, U3 | X |  | X |  |
| 8. | Presentation of the final project.  Review of projects, discussion, evaluation of results. | U6, K1, K2 | X |  | X |  |

3.5. Methods of verifying learning outcomes (indication and description of methods of conducting classes and verification of achievement of learning outcomes and method of documentation)

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| Subject Effects | Teaching methods | Methods of verifying learning outcomes | Documentation methods |
| KNOWLEDGE | | | |
| W1-W5 | Knowledge provided during the laboratory | Term Project: Implementing a Simple Neural Network for Data Classification  Description:  Students are required to implement a simple neural network that solves a classification problem on a database such as Iris, MNIST, or their own dataset. | The project was placed on the platform |
| SKILLS | | | |
| U1-U4 | Practical classes performed at computer stations | Term Project: Implementing a Simple Neural Network for Data Classification  Description:  Students are required to implement a simple neural network that solves a classification problem on a database such as Iris, MNIST, or their own dataset. | The project was placed on the platform |
| SOCIAL COMPETENCES | | | |
| K1-K3 | Practical classes performed at computer stations | Term Project: Implementing a Simple Neural Network for Data Classification  Description:  Students are required to implement a simple neural network that solves a classification problem on a database such as Iris, MNIST, or their own dataset. | The project was placed on the platform |

3.6. Assessment criteria for the achieved learning outcomes

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| Learning effect | For a grade of 3 or "pass."  the student knows and understands/is able to/is ready to | For a grade of 3.5, the student knows and understands/is able to/is ready to | For a grade of 4, the student knows and understands/is able to/is ready to | For a grade of 4.5, the student knows and understands/is able to/is ready to | For a grade of 5, the student knows and understands/is able to/is ready to |
| W | 51-60% of knowledge indicated in learning outcomes | 61-70% of knowledge indicated in learning outcomes | 71-80% of knowledge indicated in learning outcomes | 81-90% of knowledge indicated in learning outcomes | 91-100% of knowledge indicated in learning outcomes |
| U | 51-60% of skills indicated in learning outcomes | 61-70% of skills indicated in learning outcomes | 71-80% of skills indicated in learning outcomes | 81-90% of skills indicated in learning outcomes | 91-100% of skills indicated in learning outcomes |
| K | 51-60% of skills indicated in learning outcomes | 61-70% of skills indicated in learning outcomes | 71-80% of skills indicated in learning outcomes | 81-90% of skills indicated in learning outcomes | 91-100% of skills indicated in learning outcomes |

3.7. Literature

**Basic**

1. Julian David; Designing machine learning systems with Python Packt Publishing; Birmingham 2016
2. Géron A., "Uczenie maszynowe z użyciem Scikit-Learn i TensorFlow. Wydanie II", Helion, 2020.

**Supplementary:**

1. Ameisen Emmanuel; Building Machine Learning Powered Applications : Going from Idea to Product O'Reilly; Sebastopol 2020
2. Gagolewski M., "Przetwarzanie i analiza danych w języku Python", Wydawnictwo Naukowe PWN, 2021.

4. Student workload - ECTS points balance

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| **Types of student activity** | **Student Load** | |
| **ST** | **NST** |
| **Classes requiring direct contact between the student and the academic teacher at the university premises** | **30** | **15** |
| Classes included in the study plan | 30 | 15 |
| **Student's own work** | **45** | **60** |
| Ongoing preparation for classes, preparation of project work/presentations/etc. | 25 | 30 |
| Preparation for passing classes | 20 | 30 |
| **TOTAL STUDENT HOURLY LOAD** | **75** | **75** |
| **Number of ECTS points** | **3** | **3** |

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| Last change date | 30/09/2024 |
| The changes were introduced | INF Education Quality Team |
| The changes were approved | Arkadiusz Gwarda, M.A. |