#### card of course

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| Subject name | Python Programming - KERAS Library |

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 | 6 |
| 2.3. Language of lectures | English |
| 2.4. Semesters in which the subject is taught | V |
| 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 | Familiarization with the Keras library, learning the basic functions and capabilities of Keras as a tool for building neural networks. |
| C2 | Build, train, and optimize deep learning models with Keras. |
| C3 | Solve complex problems such as image classification, temporal sequence analysis, and natural language processing. |

* 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 the basic functions and capabilities of the Keras library, including the construction of sequential and functional models. | INF\_W07  INF\_W10  INF\_W19 |  | X |  | X |
| W2 | Understands the process of creating neural networks, including defining layers, activation functions, and optimizers. |  | X |  | X |
| W3 | Knows basic methods of preparing data for training deep learning models. |  | X |  | X |
| W4 | Understands the different types of layers in Keras such as Dense, Convolutional, Recurrent, and their applications. |  | X |  | X |
| W5 | Knows methods for evaluating and visualizing the results of model execution in Keras. |  | X |  | X |
| After passing the course, the student is **able** to: | | | | | | |
| U1 | Can implement deep learning models in Keras using sequential and functional models. | INF\_U13  INF\_U19  INF\_U21 | X |  | X |  |
| U2 | Is able to prepare data for model training, including normalization, data augmentation, and creation of training, validation, and test sets. | X |  | X |  |
| U3 | Can use different types of layers in models and adjust their parameters to specific problems. | X |  | X |  |
| U4 | Is able to perform the model training process, including hyperparameter tuning, regularization, and use of callbacks. | X |  | X |  |
| U5 | Can interpret model results, create visualizations and prepare a report analyzing the results. | X |  | X |  |
| After completing the course, the student is ready to take part in **social competences.** | | | | | | |
| K1 | Understands the importance of machine learning in data analysis and decision-making. | INF\_K02 | X |  | X |  |
| K2 | Ready to work on analytical projects using collaboration tools (e.g. Git, Jupyter Notebook). | 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** |  |  |  |  | 40 |  |  | 30 |  | 6 |
| **NST** |  |  |  |  | 20 |  |  | 15 |  | 6 |

* 1. Content of education (separately for each form of classes: (W, ĆW, PROJ, WAR, LAB, LEK, OTHER). Please mark (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: LECTURE

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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. | Keras basics: Library structure, introduction to sequential and functional models. | W1 |  | X |  | X |
| 2. | Building deep learning models in Keras: Defining layers, choosing activation functions and optimizers. | W1, W2 |  | X |  | X |
| 3. | Preparing data for model training: Techniques for normalization, data augmentation, and division into training, validation, and test sets. | W3 |  | X |  | X |
| 4. | Overview of layer types in Keras: Dense, Convolutional, Recurrent, BatchNormalization and Dropout layers – applications and parameters. | W2, W4 |  | X |  | X |
| 5. | Model training process in Keras: Using callbacks, regularization methods and hyperparameter tuning. | W2, W4 |  | X |  | X |
| 6. | Analysis and visualization of model results: Performance measures, loss and accuracy graphs, interpretation of confusion matrices. | W5 |  | X |  | X |
| 7. | Summary of classes and discussion of grades |  |  | X |  | X |

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 Keras library, library structure, sequential and functional models. | K1, K2 |  | X |  | X |
| 2. | Building deep learning models in Keras,  defining layers, activation functions, optimizers. | U1 |  | X |  | X |
| 3. | Preparing data for model training, normalization, augmentation, data division. | U2 |  | X |  | X |
| 4. | Layer types in Keras, Dense, Convolutional, Recurrent, BatchNormalization, Dropout layers. | U3 |  | X |  | X |
| 5. | Model training in Keras, callbacks, regularization, hyperparameter tuning. | U4 |  | X |  | X |
| 6. | Evaluation and visualization of model results  Performance measures, loss and accuracy charts, confusion matrix. | U5 |  | X |  | X |
| 7. | Summary of classes and discussion of grades |  |  | 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 | Lecture using presentations and programming tools | Exam on the platform | Archiving on the platform |
| SKILLS | | | |
| U1-U5 | Practical classes performed at computer stations | Term Project: Building and Training a Deep Learning Model in Keras  Description:Students are tasked with building a deep learning model in Keras to solve a chosen problem (e.g. image classification, temporal data analysis, or text processing). | The project was placed on the platform |
| SOCIAL COMPETENCES | | | |
| K1-K2 | Practical classes performed at computer stations | Term Project: Building and Training a Deep Learning Model in Keras  Description:Students are tasked with building a deep learning model in Keras to solve a chosen problem (e.g. image classification, temporal data analysis, or text processing). | 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. Ameisen Emmanuel; Building Machine Learning Powered Applications : Going from Idea to Product O'Reilly; Sebastopol 2020
2. Raschka S., Mirjalili V., "Python Machine Learning. Wydanie III", Helion, 2021.
3. Grus J., "Data Science z wykorzystaniem Pythona", Helion, 2020

**Supplementary**

1. Julian David; Designing machine learning systems with Python; Packt Publishing; Birmingham 2016
2. Beazley David, Python Zwięzłe kompendium dla programisty, Helion, 2024
3. Wróblewski Piotr, Machine learning i natural language processing w programowaniu.. Podręcznik z ćwiczeniami w Pythonie, Helion, 2024

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** | **70** | **35** |
| Classes included in the study plan | 70 | 35 |
| **Student's own work** | **80** | **115** |
| Ongoing preparation for classes, preparation of project work/presentations/etc. | 40 | 60 |
| Preparation for passing classes | 40 | 55 |
| **TOTAL STUDENT HOURLY LOAD** | **150** | **150** |
| **Number of ECTS points** | **6** | **6** |

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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. |