Annex 3

Didactic manual for the new program in the Spinaker project, i.e. for IMPK – Intensive International Education Program

1. Description of the IMPK program

Course title: **Artificial Intelligence Using Python Programming**

Course Topics: The course includes a comprehensive introduction to Python programming with an emphasis on applications in artificial intelligence and machine learning. Participants will learn Python syntax, data structures, functions, and working with files, and then master the key libraries of the data ecosystem: NumPy, pandas, and Matplotlib. The program guides you through the full cycle of working with data – from preparation and pre-processing, through the construction of machine learning models, to the training and evaluation of simple neural networks in TensorFlow/Keras. Evaluation metrics, cross-validation, and hyperparameter tuning are discussed. The classes end with the implementation of a practical project, in which participants will apply the acquired knowledge in a real analytical-AI task.

- Form of implementation: remote
- Target group: foreign students, optionally Polish
- Language: English
- Author of the manual: Kamil Musiał

2. Learning outcomes

Effects in terms of knowledge:
Upon completion of the course, the participant:
- knows Python syntax and major data structures (lists, dictionaries, tuples, sets) and understands their computational complexity and applications;
- understands Python programming paradigms (functions, modules, import, virtual environments) and good code organization practices;
- knows the basics of tabular and numerical data processing using NumPy and pandas, including data types, indexing, linking and aggregations;
- understands the principles of data visualization in Matplotlib (chart selection, labeling, aesthetics and inference);
- knows the step-by-step process of machine learning: data acquisition and cleaning, division into sets, model selection, metrics, cross-validation, avoiding retraining;

- knows the basic ML algorithms (regression, classification, trees/random forest, KNN, SVM – at the level of ideas and applications) and their limitations;
- understands the basics of neural networks and the role of hyperparameters, activation functions, optimizers in TensorFlow/Keras;
- understands good engineering practices: versioning, documentation, reproducibility, ethical and legal aspects of working with data.

Skills outcomes:

Upon completion of the course, the participant:

- can prepare a work environment in Python (installation, virtual environment, package management) and efficiently use IDEs/notebooks;
- can load, clean, and transform datasets and then visualize key dependencies in pandas/Matplotlib;
- can build, match and evaluate a classic ML model using appropriate metrics and cross-validation;
- can prepare and train a simple neural network in TensorFlow/Keras, monitor the learning process and select basic hyperparameters;
- can compare alternative models/settings and justify the choice of solution based on hard quality indicators;
- can prepare a concise report/notebook with data description, code, results and conclusions, ensuring reproducibility;
- can lead a mini-final project: define the problem, prepare data, build a baseline, improve the model and present the results.

Effects in the field of social competences:

Upon completion of the course, the participant:

- is ready to work in a team on analytical and programming tasks (role sharing, code review, technical communication);
- demonstrates responsibility for the quality and transparency of the code (applies standards, documents decisions, takes care of the repeatability of results);
- respects the principles of ethical data processing (anonymization, minimization, conscious selection of metrics and interpretation of models);
- adopts a critical attitude towards the results (verifies assumptions, assesses the risk of bias, avoids excessive generalizations);
- effectively communicates the results of work to non-technical stakeholders (translation of metrics into business conclusions);
- is ready for further self-education in the area of analytics and AI (tracking documentation, experimenting, updating tools).

3. Requirements for participants

Requirements for participants:

- English language level of at least B2,
- access to a computer with the Internet,
- basic computer skills