# COURSE DESCRIPTION CARD - SYLLABUS

Course name
Data analysis and machine learning [S2FT2>ADiNM]

## Course

Field of study
Technical Physics

Year/Semester
1/1

Area of study (specialization)
–

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

## Number of hours

Lecture
0

Laboratory classes
30

Other
0

Tutorials
0

Projects/seminars
0

## Number of credit points

2,00

## Coordinators

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## Lecturers

## Prerequisites

Basic knowledge of programming, mathematics and statistics, ability to solve simple mathematical and technical problems based on existing knowledge, ability to obtain information from indicated sources, understanding of the need for self-education.

## Course objective

1. To acquaint students with methods of analyzing and processing data using the Python programming language. 2. To provide students with basic knowledge of selected algorithms of so-called machine learning. 3. To acquaint students with selected examples of practical application of data analysis, machine learning and parametric optimization techniques using the Python language.

## Course-related learning outcomes

Knowledge:
1. A student who has passed the course has in-depth, theoretically grounded knowledge of mathematics, physics, and chemistry, useful for the description and analysis of processes and physical systems relevant to solving technical problems.
2. A student who has passed the course has in-depth, theoretically grounded knowledge in the field of

computer simulations of n-body systems, continuous media, statistical systems, and systems based on quantum-mechanical models .

Skills:
1. A student who has passed the course is able to apply the acquired knowledge to model physical and technical processes, as well as to control and operate devices used in physical experiments.
2. A student who has passed the course is able to recognize non-technical aspects when formulating and solving engineering tasks in the field of Technical Physics.
3. A student who has passed the course is able to plan and conduct research aimed at characterizing functional materials, selected quantum processes, atomic, molecular, and condensed phase systems; can analyze and document research results; and is able to reference measurement standards and norms during measurements.
4. A student who has passed the course has the ability to self-educate and can determine directions for further learning.

Social competences:
1. A student who has passed the course is ready to adhere to the principles of professional ethics, including the responsibility for the reliability of the results of his/her work and their interpretation, as well as the evaluation of the work of others; he/she is aware of the importance of professional conduct and is responsible for the safety of his/her own work and that of the team.
2. A student who has passed the course understands the need and knows the possibilities for continuous learning-improving professional, personal, and social competencies; he/she is aware of the necessity to consult experts when solving engineering tasks that exceed his/her own competencies.
3. A student who has passed the course is able to work responsibly on a designated multi-threaded task, both independently and in a team; he/she can appropriately set priorities to accomplish tasks defined by himself/herself or others.

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

1. Individual project.
In terms of the methods used to verify the achieved learning outcomes, the following grading thresholds are applied:
50.1-60% - satisfactory;
60.1-70% - satisfactory plus;
70.1-80% - good;
80.1-90% - good plus;
from 90.1% - very good.
The grade is based on an individual project.

## Programme content

The scope of content includes: advanced use of the Python language, advanced data analysis techniques, selected machine learning algorithms.

## Course topics

1. Python environment configuration and the GIT version control system.
2. Python language basics.
3. Mathematical operations on data and their visualization.
4. operations on data using the Pandas library.
5. communication with SQL database in Python language.
6. acquisition of data from the Internet.
7. Review and use of selected datasets.
8. Review of selected machine learning algorithms.
9. classification problem.
10. The problem of univariate and multivariate regression.
11. The problem of dimensionality reduction of a dataset.
12. Comparison of supervised and unsupervised learning algorithms.
13. The problem of optimization of algorithm parameters.

14. Review and comparison of selected machine learning libraries for the Python language.

## Teaching methods

1. Multimedia presentation - introduction to the implemented topic of laboratory (computer) exercises.
2. Laboratory (computer) exercises - execution of specialized programs, individual work, discussion.
3. Individual student project work, discussion.

## Bibliography

Basic:
1. S. Raschka, V. Mirjalili, Python. Uczenie maszynowe, wydanie 2, Helion 2019.
2. A. Saha, Matematyka w Pythonie, Helion 2015.
3. A. Sweigart, Programowanie w Pythonie dla średnio zaawansowanych, Helion 2021.
4. C. Mayer, Kod Pythona w jednym wierszu, Helion 2021.

Additional:
1. M. Sobczyk, Statystyka, PWN 2007.
2. D. J. Rumsey, Statystyka dla bystrzaków, wyd. 2, Helion 2023.

## Breakdown of average student's workload

| | Hours | ECTS |
|---|---|---|
| Total workload | 50 | 2,00 |
| Classes requiring direct contact with the teacher | 30 | 1,00 |
| Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation) | 20 | 1,00 |