COURSE DESCRIPTION CARD - SYLLABUS

Course name
Introduction to Machine Learning [S1DSwB1>WdUM]

Course

Field of study
Data Science in Business

Year/Semester
1/2

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
0

Other
0

Tutorials
30

Projects/seminars
0

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

Students should have a basic understanding of Python (data structures, loops, functions, basic libraries) and mathematical analysis (linear algebra, matrix calculus, and differential calculus).

Course objective

The aim of this course is to introduce students to key concepts, methods, and tools of machine learning. Students will explore both the theoretical foundations of algorithms and their mathematical aspects, including regression, classification, and clustering models. The course will cover model validation methods, dimensionality reduction, and techniques for improving prediction quality, such as regularization and hyperparameter tuning.

Course-related learning outcomes

Knowledge:
Explains the basic concepts and mathematical foundations of machine learning, including regression,

classification, and clustering of data [DSB1_W01].
Characterizes the process of creating ML models, from data preprocessing and feature engineering to validation, hyperparameter tuning, and result interpretation [DSB1_W03].
Describes key machine learning methods, such as linear and logistic regression, decision trees, SVM, ensemble methods, and clustering algorithms [DSB1_W02].

Skills:
Applies regression methods (linear, logistic, Ridge, Lasso) for data analysis and outcome prediction [DSB1_U02].
Designs and conducts experiments using classification and clustering algorithms, such as decision trees, k-NN, SVM, and DBSCAN [DSB1_U03].
Uses dimensionality reduction methods, such as PCA, and feature engineering to improve model performance [DSB1_U04].
Analyzes the performance of ML models in terms of errors, overfitting, and interpretability [DSB1_U07].
Creates a complete analytical pipeline, from data processing to ML model evaluation [DSB1_U08].
Uses ML tools, such as scikit-learn, TensorFlow, or PyTorch, to implement machine learning models [DSB1_U09].
Justifies the selection of data analysis methods and evaluates the effectiveness of models based on quality metrics [DSB1_U11].
Develops machine learning skills by staying updated with the latest scientific and practical advancements [DSB1_U15].
Selects appropriate sources of knowledge and tools for designing and implementing machine learning models [DSB1_U01].

Social competences:
Evaluates the impact of ML methods on decision-making processes in business and data analysis, considering ethics and potential risks [DSB1_K05].
Collaborates in interdisciplinary teams on projects related to the implementation and optimization of ML models [DSB1_K02].

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture:
There are two tests, each graded in the form of points-50 points per test. The final grade is determined by the sum of points from both tests. The first test takes place midway through the course, while the second is held at the end. The passing threshold is a total of 50 points from both tests.
Laboratories:
There are two tests, each graded in the form of points-50 points per test. The final grade is determined by the sum of points from both tests. The first test takes place midway through the course, while the second is held at the end. The passing threshold is a total of 50 points from both tests.

Programme content

The course covers fundamental concepts, methods, and tools of machine learning, with a strong emphasis on their mathematical foundations. Students will explore the history of ML, key concepts, and the full model development process-from data preprocessing to validation and result interpretation.
The course will cover regression methods (linear, logistic, Ridge, Lasso), classification algorithms (decision trees, k-NN, SVM, ensemble models), and clustering techniques (k-means, DBSCAN, hierarchical clustering). Students will also learn dimensionality reduction (PCA), feature engineering, model tuning, and principles of interpretability and ethics in ML. The course includes an overview of key tools and frameworks used in machine learning.

Course topics

History and concepts of machine learning
Mathematical foundations of machine learning
Machine learning pipeline and the problem of overfitting
Linear regression - mathematical model and optimization
Logistic regression - theory and mathematics

Regularization in regression - Lasso and Ridge
Decision trees - mathematics of data splitting
k-NN and similarity-based methods
Support Vector Machines (SVM) - theory and mathematical foundations
Ensemble learning methods (bagging and boosting)
Clustering methods - mathematics of clustering algorithms
Hierarchical clustering methods
Density-Based Clustering (DBSCAN)
Dimensionality reduction and Principal Component Analysis (PCA)
Feature selection and feature engineering
Model validation methods and hyperparameter tuning
Model interpretability and ethics in ML
Overview of ML tools and frameworks

Teaching methods

Lectures: Problem-based lecture, case study presentation
Laboratories: Problem-solving tasks, case study analysis, group workh

Bibliography

Basic:
Geron, A. (2023). Uczenie maszynowe z użyciem Scikit-Learn, Keras i TensorFlow, Helion
Gallatin, K. (2024). Uczenie maszynowe w Pythonie. Receptury. Od przygotowania danych do deep learningu, Helion

Additional:
Hurbans, R. (2020) Algorytmy sztucznej inteligencji. Ilustrowany przewodnik, Helion
Raschka, S., Mirjalili, V. (2019). Python. Uczenie maszynowe. Wydanie II, Helion
Nowak, M., & Pawłowska-Nowak, M. (2024). Dynamic Pricing Method in the E-Commerce Industry Using Machine Learning. Applied Sciences (2076-3417), 14(24).
Nowak, M. (2024). Prediction of voluntary employee turnover using machine learning. Scientific Papers of Silesian University of Technology. Organization & Management/Zeszyty Naukowe Politechniki Slaskiej. Seria Organizacji i Zarzadzanie, (201).

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,00
Classes requiring direct contact with the teacher	62	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	63	2,50