COURSE DESCRIPTION CARD - SYLLABUS

Course name
Artificial intelligence [N1ZiIP2>SzI]

Course

Field of study
Management and Production Engineering

Year/Semester
3/6

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
part-time

Requirements
elective

Number of hours

Lecture
8

Laboratory classes
8

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

Lecturers

Prerequisites

Basic knowledge of mathematics and computer science

Course objective

Transfer of knowledge related to the basics of artificial intelligence methods, machine learning methods and neural networks.

Course-related learning outcomes

Knowledge:
The student knows the concepts of artificial intelligence and machine learning. The student has knowledge of the directions of development of artificial intelligence and its practical applications. The student knows the basic algorithms for unsupervised, semi-supervised and supervised methods of machine learning, reinforcement learning, operation and application of artificial neural networks.

Skills:
The student is able to process data, use ready-made tools for training neural networks and other learning systems in data clustering, data classification and regression applications. Is able to visualize, analyze data and interpret the obtained results.

Social competences:
The student understands the importance of computerization, including data mining and artificial intelligence, in the modern economy. He can participate in it creatively. The student sees the need for continuous education, which results from the very rapid development of artificial intelligence methods.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: Assessment based on a test in the form of closed questions, the passing threshold is 50% of the maximum points.
Assignment of grades to percentage ranges of results: <90-100> very good; <80-90) good plus; <70-80) good; <60-70) satisfactory plus; <50-60) satisfactory; <0-50) unsatisfactory.
Laboratory: Assessment on the basis of reports on tasks related to data analysis carried out during classes
Assignment of grades to percentage ranges of results: <90-100> very good; <80-90) good plus; <70-80) good; <60-70) satisfactory plus; <50-60) satisfactory; <0-50) unsatisfactory.

Programme content

Basic theoretical issues of artificial intelligence methods. Solving practical problems of modeling, approximation and prediction using artificial intelligence methods

Course topics

Lecture:
General concepts of artificial intelligence and machine learning, including supervised, semi-supervised, unsupervised, and reinforcement learning. Concepts of classification, clustering, estimation, prediction, association, data transformation. Preparing data for further processing, including: centering, normalization, standardization, whitening, transformations and reductions of feature dimensionality (PCA, t-SNE, factor analysis, ICA analysis, SSA), coding of categorical features, discretization, filling in missing data. General algorithm for building and testing the model, including hold-out test, repeated hold-out, k-fold validation, leave-one-out method. Linear, non-linear, multiple and simple regression. Loss functions, least squares method, Huber function and others. Regularization methods including ridge regression, LASSO method, flexible net method. k-NN regression, regression using binary tree and random forest. Building a model for many dependent variables. Regression model evaluation. Prediction of values and assessment of ex-ante and ex-post prediction errors. Trade-off between model variance and bias. Classification - general concepts. Binary and multi-class classifiers, OvA and OvO methods, single- and multi-label classification, multi-output and multi-class classification. Loss functions in classification. Quality assessment of binary and non-binary classifiers. Methods: logistic regression, k-NN, LDA, naive Bayes classifier, SVM classifier, non-linear SVM classifier, classification using binary and non-binary trees, ensemble learning, bagging, pasting, boosting, random forests, extra-trees method. Application and development of methods based on artificial neural networks. Construction of artificial neural networks. Deep neural networks. Network training. Machine vision. Natural language processing. GANs. Deep reinforcement learning. Regression using a neural network. Application of neural networks for classification. Data clustering methods: k-means algorithm, hierarchical algorithm, fuzzy grouping. Distance measures between vectors and clusters. Measures of clustering quality.
Laboratory:
1.Use of Python and Pandas, Numpy, Matplotlib modules for loading and pre-processing, cleaning, discretization and visualization of data. Searching for correlations. Illustration of how scaling, basic data transformations work.
2. Using the Scikit-Learn module. Reducing the dimensionality of feature space. Separation of the test set.
3. Training a multiple linear regression model using the least squares method and regularization methods. Selection of independent variables to build the model using a validation set and cross-validation test. Establishing model hyperparameters using cross-validation. Assessment of model fit. Model evaluation using a test set - assessment of the quality of ex-post predictions.
4. The use of an artificial neural network for the problem of time series approximation and prediction. Using the TensorFlow library
5. Construction of classifiers on the example of the k-NN classifier, SVM. Establishing hyperparameters using cross-validation. Selection of the method of scaling and transforming data based on tests.

Classification and visualization of results. Comparison of classifiers.
6. Use of CART tree and random forest for classification. Establishing hyperparameters using cross-validation. Classification and visualization of results. Assessment of the usefulness of individual features.
7. Classification using an artificial neural network and the Keras module. Selection of network structure using the grid search method. Used TensorFlow libraries to build a convolutional network for data classification.
8. Data grouping using the Scikit-Learn library

Teaching methods

Lecture: Multimedia presentations illustrated with examples in Python related to data processing and analysis using artificial intelligence methods, including machine learning.
Laboratory: Computer classes on the application of neural networks and other machine learning methods to selected issues based on the Python library

Bibliography

Basic:
Leszek Rutkowki, Metody i techniki sztucznej inteligencji, PWN, Warszawa, 2012
Jon Krohn i inni., Uczenie głębokie i sztuczna inteligencja, Helion, Gliwice 2022
Aurelien Geron, Uczenie maszynowe z użyciem Scikit-Learn i TensorFkow, Helion, Gliwice 2018
Stanisław Orłowski, Metody i narzędzia eksploracji danych, BTC, Legionowo 2013
Daniel T. Larose, Odkrywanie wiedzy z danych, PWN, Warszawa 2006
Wes McKinney, Python w analizie danych, Wydanie II, Helion, Gliwice 2018

Additional:
Mark Lutz, Python, wprowadzenie, Helion, Gliwice 2013
Michael Dawson, Python dla każdego, podstawy programowania, Wydanie III, Helion, Gliwice 2014
Claus O.Wilke, Podstawy wizualizacji danych, Helion, Gliwice 2020
Douwe Osinga, Deep Learning, Receptury, Helion, Gliwice 2019
David Foster, Deep learning i modelowanie generatywne, Helion, Gliwice, 2021
Michał Białko, Sztuczna inteligencja i elementy hybrydowych systemów ekspertowych, WUPK, Koszalin 2005
Marcin Szeliga, Data Science i uczenie maszynowe, PWN, Warszawa 2017
Jacek Kornacki, Jan Ćwik, Statystyczne systemy uczące się, WNT, Warszawa 2005
Daniel T. Larose, Metody i modele eksploracji danych, PWN, Warszawa 2008
Mirosław Krzyśko i inni, Systemy uczące się, WNT, Warszawa 2008
Giuseppe Bonaccorso, Algorytmy uczenia maszynowego, Helion, Gliwice 2019

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	16	0,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	34	1,50