SYLLABUS

Name: ***Classifiers (MakAu-DS>SM1CL19)***
Name in Polish:
Name in English: ***Classifiers***

Information on course:

Course offered by department: Faculty of Automatic Control, Electronics and Computer Science
Course for department: Silesian University of Technology

Default type of course examination report:

ZAL

Language:

English

Course homepage:

https://platforma2.polsl.pl/rau2/course/view.php?id=897

Short description:

The aim of the course is making students familiar with problems and methods related to supervised and unsupervised classification. The contents of the course are presented in the aspect of wide spectrum of applications, in particular in engineering, automatic control, electronics and information technologies.

Description:

ECTS: 3
Total workload: 90 hours (65 contact hours, 25 students' own work hours) Forms of contact hours:
Lecture 30h
Laboratory 30h
Other (e.g. test and reports revision and discussion) 5h
Students' own work: preparation for classes, elaboration results from classes, writing reports, preparation for final test

Lecture:
1. Introductory information. Supervised and unsupervised classifiers. Applications of classifiers in engineering, automatic control, electronics, information technologies and biocybernetics.
2. Bayes classification. A priori and a posteriori probability. Class-conditional density functions. Minimum error rate Bayes classifier. Bayes decision systems. Loss functions.
3. Methods for class-conditional density function estimation. Parametric and non-parametric methods. Naïve Bayes classifier.
4. Linear classifiers. Linear regression as a classifier. Artificial neuron as linear classifier. Perceptron algorithm. LMS algorithm. Linear regression. Fisher's linear discriminant analysis (LDA). Quadratic discriminant analysis (QDA).
5. Ensembles of classifiers. Bootstrap technique. Classification trees. Bagging, boosting Random Forests (RF).
6. Classification quality estimation. Measures of classification quality. Testing/validation scenarios. Source of bias and variance in classification quality estimation.
7. Support vector machines (SVM).
8. Information leak and its avoidance. Bias-variance trade-off in classifier model selection.
9. Neural networks. Back-propagation algorithm.
10. Unsupervised classification – clustering. K-NN method.
11. Hierarchical clustering. Kohonen neural networks.
12. Dimensionality reduction. Feature selection and feature extraction. Principal component analysis (PCA). Independent component analysis (ICA).
13. Deeplearning. Convolutional neural networks. Shallow and deep neural networks comparison.
14. Autoencoders as non-linear feature extraction method.

Laboratory:
1. Classification quality estimation
2. Bayes classifier
3. Discriminant Analysis
4. Data dimensionality reduction
5. Data clustering I
6. Data clustering II
7. Information leakage avoidance
8. Deep learning

Bibliography:

T. Hastie, R. Tibshirani, J. Friedman, (2008), The elements of statistical learning, Springer
S. Theodoridis, K. Koutroumbas, (2003), Pattern recognition, Elsevier.
R. Duda, P. Hart, D. Stork, (2000), Pattern classification, Wiley.
Goodfellow I., Bengio Y., Courville A., (2016) Deep learning, The MIT press.
Haykin S, (1993), Neural networks – a comprehensive foundation, Prentice Hall.

Learning outcomes:

Course-specific learning outcomes: at the completion of the course, student:

understands the concept of the classification task, understands the application of classification problems in engineering, automation, computer science, and electronics (final test) K2A_W02

understands differences between supervised and unsupervised classification tasks (final test) K2A_W02

knows how to use the existing tools for classification (lab report) K2A_W02

is able to construct, in scientific and engineering programming environments, some the most important classifiers (lab report) K2A_U17, K2A_U14

understands the problem of validation of classifiers and the information leakage phenomenon (final test) K2A_W02

is able to validate the classifiers (lab report) K2A_U07, K2A_U17, K2A_U18

Assessment methods and assessment criteria:

Course crediting rules
The course consists of two parts - lecture and laboratory. Each part is graded separately:

lecture - grade from the (written) test during the final class.
laboratory - reports from each of the 8 topics - the final mark is an average of all obtained grades. To obtain a passing grade from the laboratory, students must obtain a grade of minimum 2.5 for every topic, not just obtain a passing average grade.
The final grade from the course is a mean of the lecture and laboratory grades, but for a positive grade both parts must be passed (minimum passing grade is 3).

The syllabus is valid from academic year 2024/25 and its content cannot be changed during the semester.

Course credits in various terms:

<without a specific program>

Type of credits	Number	First term	Last term
European Credit Transfer System (ECTS)	3	2020/2021-L	