Computer science – basic lectures

A summer school student is required to attend all lectures in his or her primary discipline.

Contents

1.   Unsupervised machine learning algorithms for complex data

Agnieszka Nowak-Brzezińska, PhD, MSc, Assoc. Prof.

As part of the workshop, participants will be familiarized with the field of artificial intelligence and machine learning, unsupervised learning. In practical applications, using this learning method is much more often necessary. We do not know how to classify data (texts, images, sounds), and we analyze data in terms of, among others, similarities by creating structures that allow you to identify the group to which the recognized object belongs quickly. The topics discussed during the workshop will include methods such as cluster analysis and outlier mining. An essential part of the workshop will be a comparative analysis of various cluster analysis algorithms regarding the type of data analyzed and input parameters affecting the final result, i.e., the created group structure. The student will learn the methods of data similarity analysis and the methods of creating representatives of the created groups. Then he will learn about the methods of searching the structures of clusters of objects. The result of the work will be a cluster analysis using different algorithms and different datasets to show which algorithms are suitable for analyzing a particular data type.

2.   Statistical Analysis in Machine Learning Research

Małgorzata Przybyła-Kasperek. PhD, MSc, Assoc. Prof.

In research, the ability to justify the statistical significance of the formulated hypotheses is essential. The lecture aims to familiarize students with the basic concepts of statistical inference and the available software for performing statistical tests. Another goal is to teach students how to choose the appropriate test depending on samples and hypotheses and interpret the obtained results. When selecting the test, the dependency/independence of samples, number of samples, normality of distributions and homogeneity of variances will be considered. The test types considered will include: Z-test, t-test, Wilcoxon test, McNemar test, analysis of variance F test, Friedman test, Cochran test, Welch test, Mann-Whitney test, Kruskal-Wallis test, Chi^2 test.

3.   Modern Programming Languages: Trends and Applications

Kornel Chromiński, PhD

Knowledge of at least one programming language is an indispensable element of knowledge that every IT specialist should have. Current trends in the development of programming languages, apart from improving code efficiency and increasing the possibilities, are also aimed at facilitating the writing of programs. A simplification for programmers is the simplification of programming languages, and the possibility of using numerous frameworks. One of the languages that from the beginning was focused on the ease of writing programs and simplified the structure of the code is Python. During the lectures, students will be introduced to the basics of this language. The lectures will also discuss the advantages of the Python language and its possibilities, both in terms of creating advanced desktop programs and web applications. Additional possibilities of the Python language, such as the possibility of data analysis and presentation, will also be discussed.

4.   Classification of difficult data

Tomasz Orczyk, PhD, Eng.

During the three-hour module, students will be introduced to the challenges that can arise in data used in machine learning for model training and testing/validation. Issues related to incomplete, imbalanced, non-Euclidean (categorical, angular) data,

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and concept drift will be addressed. Examples of using this type of data in machine learning will be presented.

5. Combinatorial machine learning

Beata Zielosko, PhD, MSc, Assoc. Prof.

The subject matter will concern the discussion and application of reducts (tests) as well as decision trees and rules in data analysis. During the course, examples of problems that can be represented in the form of a decision table will be presented, as well as the use of decision trees, decision rules and reducts as tools (algorithms) to solve these problems. Issues related to supervised machine learning, i.e. the use of trees, rules and reducts in data classification and knowledge representation will be presented.

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