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INTELLIGENT SYSTEMS FOR ENHANCED DECISION-MAKING

They are interactive computer programs designed to collect, process, and analyze huge amounts of data necessary to point the way to the best solution. Based on the knowledge gained from experts in different fields, an intelligent expert system based on built-in inference algorithms which simulate human thinking processes its knowledge (accumulated in the system and obtained from a user who consults such a system) in order to obtain new knowledge, i.e. make a decision.

The expert system, as the name already suggests, is a type of tool or software that simulates an expert in a particular field. It is designed to support humans in decision-making and can even replace an expert in certain circumstances, if necessary. This is usually the case when the expertise is needed in many places at the same time or when access to an expert or specialist in a given field could be too expensive. There are many applications of such systems, they can be found in practically every area of life; in the form of simple assistance applications, operating on travel agency websites, in banks, or in medicine.

Expert systems are also used in so-called intelligent buildings. Systems implemented there are designed to ensure savings, safety, and a sense of comfort based on certain external, internal, and functional information of the building. They check the closing of gates, doors, or windows, manage lighting, power, heating equipment, air conditioning, and respond in case of fire. A human could perform all these tasks on a daily basis, but their automation definitely increases the comfort of life and allows to supply

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a greater number of persons with the same type of functionality.

The intelligence of expert systems is made possible by translating the knowledge of domain experts into the knowledge base of the system and implementing inference algorithms which simulate the human reasoning process. In such a process, on the basis of certain sentences called premises (conditions), the truthfulness of other sentences called conclusions (decisions) is recognized. In other words, the inference process, both in our case and in the case of machines, translates into if-then chains such as: "If CONDITION, then DECISION." Depending on the task assigned to the expert system, we can distinguish two types of inference algorithms: forward inference (data/facts driven) and backward inference (goal driven). The first one allows, on the basis of input data (observations/facts), to derive new knowledge from the system by activating rules with premises we consider true. The second types allows to confirm the truth of a certain hypothesis by confirming the truth of the premises defining that hypothesis.

A much more obvious application of artificial intelligence systems is recommendation systems. Recommendations are commands which result from the collection of vast amounts of data and from the repetition of certain outlines or purchasing patterns. A recommendation system allows, therefore, to match the proposed content to the user's taste.

It is also important not to forget about medical systems where expert systems are very important. They are used, for example, for medical imaging. A doctor, even if he or she is a specialist in a given field and has extensive experience, is not able to quickly analyze thousands of medical imaging photos and detect certain symptoms, e.g. cancer symptoms, in a short time – as quickly as a machine.

The sources of recommendation are machine learning algorithms which improve automatically through experience. The more representative data are gathered, the better the quality of knowledge provided to the system. Machine learning algorithms build a mathematical model from sample data to make predictions or decisions without direct human programming.

We are living in the time of big data. The term means a variety of data generated from different sources, at high speed, and in large quantity. Therefore, the word "big" refers not only to the quantity, but also to the variety and structure of data as well as to the relationship between them. Nowadays, big data is of key importance in all areas of the economy – from transport and logistics, through banks, medicine, telecommunications, to profiling the behavior of Internet users.

However, technological development must be followed by hardware progress that will allow to collect huge amounts of data. The cost of their maintenance is equally important, and another important factor is the issue of data management. Data warehouses or huge data repositories use special software, so-called data mining algorithms. They are used to explore and manage data as well as to extract useful knowledge from huge amounts of data.

The range of data mining algorithms to choose from is very wide. The best known of them are association rule algorithms (e.g., in online stores), which allow to create shopping patterns by finding associations between the products purchased by clients. Another important algorithm is the clustering (or cluster analysis) algorithm. It looks for similarities between the analyzed objects and divides them into groups in which the objects are as similar to each other as possible, and as different as possible from objects belonging to other groups. This algorithm makes it possible to perform a task in segments and works well, for example, when segmenting customers characterized by e.g. a similar shopping profile. Another noteworthy method of machine learning are artificial neural networks. These networks are analytical techniques based on the learning process in the cognitive system and the neurological functions of the brain. They are capable of predicting new observations on the basis of other observations following a learning process performed on existing data.

Assoc. Prof. Agnieszka Nowak-Brzezińska, Professor of the Faculty of Science and Technology at the University of Silesia, researches decision support systems, mainly knowledge mining algorithms. One of the tools she uses are cluster analysis algorithms. They are applied e.g. in the financial industry: in banking transactions or credit decision support as well as in the detection of fraud and suspicious operations. In medical systems, they are useful in searching for unusual disease symptoms.