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# MESTERSÉGES INTELLIGENCIA RENDSZEREK ALKALMAZÁSAI

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**Absztrakt**

Napjainkban a mesterséges intelligencia egy gyorsan fejlődő technológia, amely intelligens algoritmusok és tanulásra képes gépek fejlesztését foglalja magában. Ezért releváns és időszerű a téma vizsgálata. Ezek a mesterséges intelligencia algoritmusok és gépek képesek olyan feladatok elvégzésére, amelyek a múltban hagyományosan emberi intelligenciára támaszkodtak. Ez a tanulmány a mesterséges intelligencia rendszereinek és kulcsfontosságú összetevőinek mélyreható feltárását nyújtja. A mesterséges intelligencia rendszerek különféle aspektusait vizsgálja, beleértve a természetes nyelvi feldolgozást, a gépi tanulást, az észlelést és mintafelismerést, valamint a tudásreprezentációt és a mesterséges intelligencia rendszerek egyéb formáit. A természetes nyelvi feldolgozás lehetővé teszi a gépek számára, hogy megértsék és generálják az emberi nyelvet, míg a gépi tanulás lehetővé teszi a rendszerek számára, hogy tanuljanak az adatokból, és idővel javítsák teljesítményüket. A érzékelés és a mintafelismerés lehetővé teszi a mesterséges intelligencia rendszerek számára a komplex szenzoros bemenetek értelmezését és megértését, míg a tudásreprezentáció lehetővé teszi az információk tárolását és hasznosítását. Továbbá a mesterséges intelligencia rendszerek egyéb formáiról is szó lesz. Ez a tanulmány rávilágít a mesterséges intelligencia rendszerek alapvető elemeire, megnyitva az utat gyakorlati alkalmazásaik és fejlődésük előtt.

**Kulcsszavak:** mesterséges intelligencia, gépi tanulás, természetes nyelvi feldolgozás

# APPLICATIONS OF ARTIFICIAL INTELLIGENCE SYSTEMS

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**Abstract**

Nowadays artificial intelligence is a rapidly developing technology that encompasses the development of intelligent algorithms and machines capable of learning. Therefore, it is relevant and timely to examine the topic. These artificial intelligence algorithms and machines have the ability to perform tasks that traditionally relied on human intelligence in the past. This study provides an in-depth exploration of artificial intelligence systems and their key components. It examines various aspects of artificial intelligence systems, including natural language processing, machine learning, detection and pattern recognition, and knowledge representation and other form of artificial intelligence systems. Natural language processing enables machines to understand and generate human language, while machine learning empowers systems to learn from data and improve their performance over time. Detection and pattern recognition allow artificial intelligence systems to interpret and understand complex sensory inputs, while knowledge representation enables the storage and utilization of information. Furthermore, other form of artificial intelligence systems will be also discussed. This study sheds light on the fundamental elements of artificial intelligence systems, paving the way for their practical applications and advancements.

**Keywords:** artificial intelligence, machine learning, natural language processing

## INTRODUCTION

This research on the diverse applications of artificial intelligence, specifically in the areas of natural language processing, detection and pattern recognition, as well as planning, decision-making, learning, manipulation and movement, problem solving, knowledge representation, social intelligence, emotional intelligence, and creativity. As the use of artificial intelligence technology continues to grow, there is increasing interest in understanding how these capabilities can be utilized to advance various aspects of our lives. I will examine the key features and functions of natural language processing and how it can be used to improve communication and language translation. Detection and pattern recognition will be explored in the context of identifying patterns and predicting outcomes.

Planning and decision-making capabilities will be discussed, including how they can be utilized to optimize scheduling plus other organizational tasks. The role of learning in artificial intelligence will be explored, as well as how it is used to contin-

uously improve the performance of artificial intelligence systems. I will also examine how manipulation and movement capabilities can be used to control and interact with various devices and machines. Problem-solving and knowledge representation will be discussed in the context of analyzing complex situations and providing creative solutions.

Furthermore, I will delve into the areas of social intelligence, emotional intelligence, and creativity, exploring how artificial intelligence can be programmed to understand and interact with humans in a way that is natural and intuitive. The reasoning capabilities of artificial intelligence will also be examined, including how it can be used to analyze and evaluate different arguments and draw logical conclusions based on available evidence. I formulated two hypotheses in my research.

The first hypothesis is that the diverse capabilities of artificial intelligence, when effectively utilized, will greatly improve various aspects of human life, including problem-solving and performance optimization in different fields. The second hypothesis says that, integrating artificial intelligence with social intelligence, emotional intelligence, and creativity will enable artificial intelligence systems to interact with humans naturally and intuitively, leading to enhanced communication, personalized experiences, and improved decision-making processes.

Overall, this research aims to provide answers to my hypotheses and give a comprehensive overview of the diverse capabilities of artificial intelligence and their potential applications in various fields.

## TECHNOLOGICAL APPLICATIONS

The main areas of application of artificial intelligence systems are:

- Natural language processing,
- Detection and pattern recognition,
- Planning,
- Learning,
- Decision-making,
- Manipulation and movement,
- Problem solving
- Knowledge representation,
- Social intelligence, emotional intelligence and creativity,
- Reasoning (Flasiński, 2016).

## NATURAL LANGUAGE PROCESSING

In order to gain adequate insight into the application areas of artificial intelligence systems, it is worth taking a look at the above-mentioned points. Natural language processing is a subfield of artificial intelligence that focuses on understanding the interactions between machines, algorithms and human language. Part of the process

is the processing and analysis of large amounts of human, natural language data. In this case, the main goal is to create a computer or algorithm that can understand the content of a linguistic text taking into account a certain context. Different language barriers can be the biggest problem in organizations that use natural language processing, for example, on a website, in the person of an online assistant (Chowdhary, 2020).

Natural language processing can be used by organizations for keyword search, user sentiment analysis, topic detection, language and speech recognition. However, the practical application of a speech recognition system in the organization must be carefully planned and properly regulated. The general basic application of a speech recognition system requires significantly less knowledge than, for example, maintaining the system in operation. Therefore, in the case of speech recognition systems, we need to distinguish between the maintainer, the system operator and the user. The maintainer of the speech recognition system is required if there is no one in the staff of the operating organization who has the digital literacy skills to carry out the periodic review of the speech recognition system. In this case, it is most expedient to conclude a maintenance contract with an organization supplying and maintaining a speech recognition system. However, if a business has a staff member with such a high degree of digital literacy who, with the right preparation and documentation, can operate or oversee the speech recognition system, then this person is known as the system operator. The system operator is able to provide adequate assistance to everyday users in case of possible problems (Négyesi, 2017).

## DETECTION AND PATTERN RECOGNITION

In order to understand the detection and pattern recognition of artificial intelligence, the perception factors of human intelligence must be taken into account. Without our senses, especially when it comes to perception and recognition, without our eyes, we would not be able to receive signals from the environment. But the signal or stimulus waiting to be processed passes through several stages before it reaches the processing center of the brain and becomes consciously perceptible to us. However, in the case of artificial recognition, we need to use the tools of artificial intelligence, which include precise mathematical solutions for soft computational methods. Soft computational methods include fuzzy logic, also known as the logic of blurry sets. The essence of this is that, unlike the usual systems, they do not operate exclusively on the basis of yes and no, 1 and 0 or on and off, but a definable intermediate value, such as 0.7, i.e. substantially, 0.5, i.e. half, 0.2 a little. This makes hard-to-define values more definable (Zadeh, 1988; Kahneman, 2011; Werner & Hanka, 2016).

Soft computational methods also include artificial neural networks and genetic algorithms, which can be used appropriately to model certain parts of cognitive thinking and human perception and recognition (Werner & Hanka, 2016).

**LEARNING**

An artificial neural network is a network of which machine learning is a significant part, which is a branch of artificial intelligence that deals with systems that can learn and generate knowledge from experience. This means that based on the collected data, the system is able to independently detect regularities without human intervention and learn from them. At the end of their studies, they should be able to make independent decisions (Dietterich, 1990).

Neural networks are usually made up of at least three structurally and functionally distinct parts. The first is the input layer. Which passes the input data to other members of the network without modification. The next layer is the hidden layer, which occurs between input and output and its function is to transform and encode information. Then comes the output layer, where the encoded information reaches (Sun-Chong, 2003).

The Figure 1 shows a three-layer, 5-3-2 neuron count and fully connected artificial neural network.

*Figure 1.*

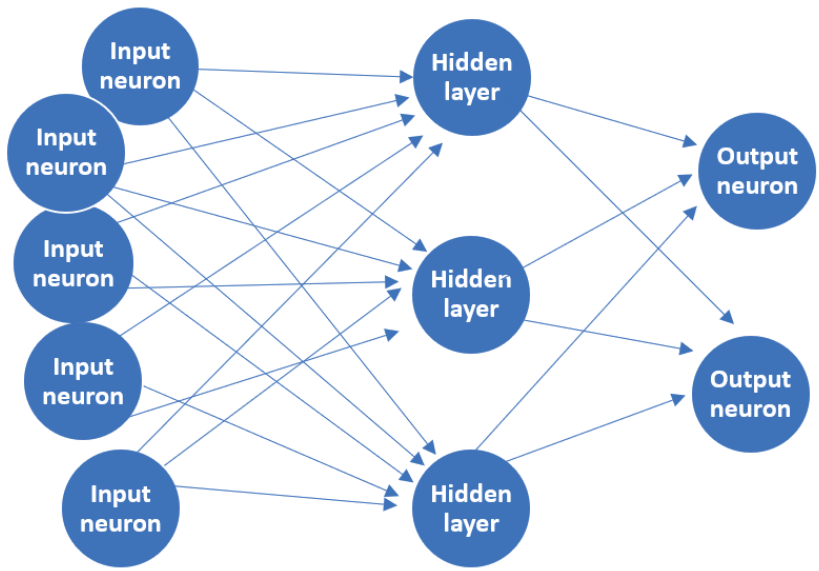


*Figure 1: The structure of neural networks*
*Source: own editing*

The last mind of soft computational methods is the genetic algorithm, that is, the computational model of biological evolution. Genetic algorithms are search techniques used to search for an element with a certain property and solve a problem. Genetic algorithms are stored in computer memory as dual-state strings and change

from time to time as populations of individuals would evolve through natural selection. Although computational values are very simplified compared to the human world, genetic algorithms are capable of developing surprisingly complex and interesting structures (Forrest, 1996).

## PLANNING

The next element of artificial intelligence application area is planning. The essence of planning consists in defining a sequence of activities that should lead to the achievement of a predetermined goal. Simulating this intellectual ability may seem difficult for artificial intelligence. It contains a prediction of the possible consequences of certain actions. This task is especially difficult when performed in real time mode and in a changing environment, however, it is usually typical in practical applications. The system then needs to quickly modify an already prepared plan in order to keep up with the changing environment (Flasiński, 2016). The continuous development of artificial intelligence technology gives researchers the opportunity to create advanced machines, so artificial intelligence can perform more complex tasks and make decisions. More complex tasks require cognitive abilities, such as sensing emotions, making tacit judgments, and leading processes that previously seemed impossible for a machine (Mahroof, 2019).

## DECISION-MAKING

Supporting the decision-making process was one of the first applications of artificial intelligence systems. In expert rule-based systems, a natural approach based on simulation by a human expert is used to determine the next steps in the decision-making process. Rule based systems are effective for systems that cannot be easily algorithmized (Flasiński, 2016).

Artificial intelligence is used in different fields and in many situations. They are used to describe artificial intelligence decision-making systems, they include:

- knowledge-based systems,
- expert systems,
- intelligent software agent systems,
- intelligent execution systems,
- intelligent decision support systems (Flasiński, 2016).

## MANIPULATION AND MOVEMENT

When defining manipulation and movement used in artificial intelligence systems, it is important to mention that we do not use manipulation in the negative sense of deception known to humans, but in the positive, helping sense of the word. For example, the helping influence of certain robots and algorithms, for example, on physical things to achieve a specific goal. Manipulation and movement skills depend

heavily on the functionality of other systems, such as detection and pattern confirmation systems and problem-solving systems or design systems. The manipulative and movement capabilities of robots depend on the technological capabilities of execution devices, such as effectors or actuators. We can observe that we do not always want to simulate human capabilities. For example, if we want to simulate the power of a locomotive or artificially create the abilities of certain animals, they have a clear advantage over human abilities (Duan et al., 2019; Mahroof, 2019).

## PROBLEM SOLVING

Many artificial intelligence problem-solving tasks require a large amount of processing energy due to the large amount of so-called search space where you have to investigate during problem solving. This is especially true for tasks involved in interpreting real speech perception data, which are usually very noisy and require a lot of filtering to solve problems. For example, a speech comprehension system capable of reliably understanding related speech must have an extremely high vocabulary because, computational power requires between 10 and 100 million instructions per second (Fennell & Lesser, 1977).

A typical process in a variety of professions, including health, banking, and business consulting, entails acquiring data, processing it, interpreting the results, choosing a suggested plan of action, and carrying it out. The first two competencies, data gathering and analysis, may now be carried out more effectively by automated systems thanks to the development of artificial intelligence and machine learning. Our capacity for keeping up with knowledge's rapid expansion is constrained by human limits, prejudices, and reliance on personal experiences. Humans are superior at judgment, decision-making, and negotiating challenging situations despite the fact that machines can digest enormous volumes of information. Workers will need to modify their skill sets as these professions develop in order to complement artificial intelligence's capabilities (Beck, Libert, 2017).

## KNOWLEDGE REPRESENTATION MODELS

The issue of adequate representation of knowledge in the field of artificial intelligence has been of paramount importance since the beginning of developments. An intelligent system must be able to adapt to its environment. Thus, it must also be able to acquire knowledge describing the environment, that is, to acquire declarative knowledge. This knowledge is then stored in a form that allows for a quick and adequate intelligent response to any stimulus generated by the environment. Such response patterns, represented as procedural knowledge, should also be stored in the system. The taxonomy of knowledge representation models can be defined according to two basic criteria: the form of knowledge representation and the way knowledge is

acquired. According to Flasiński's 2016 research, based on the first criterion, knowledge representation models can be divided into the following three groups:

- Explicitly formulated models of symbolic knowledge representation. Within the basic models of this group, conceptual dependency graphs, semantic networks, and scripts can be defined.
- Explicitly formulated models of symbolic-numerical knowledge representation.

These models are used when the concepts underlying the representation model are vague, that is, ambiguous or imprecise. Examples include Bayesian networks or models based on fuzzy sets.

- Implicitly formulated models of knowledge representation. This form is used when knowledge is represented in a numerical way. It is characteristic of pattern recognition methods and neural networks. Such representations are clusters of vectors, parameter sets in pattern recognition and weight vectors (Flasiński, 2016).

As for the second criterion, that is, the method of obtaining knowledge, representational models can be divided into the following two groups:

- Models in which knowledge can be obtained automatically by the system. This group primarily includes implicitly formulated models of knowledge representation. Both pattern recognition methods and neural networks can be self-learning for unsupervised learning techniques.
- Models in which the representation of knowledge is determined by a knowledge engineer and entered into the system. Most explicitly formulated models of knowledge representation belong to this group.

Summarizing knowledge representation, in models based on symbolic knowledge, automatic knowledge acquisition is the decisive issue in this area. Here, automatic conceptualization is the main problem, which has not been satisfactorily solved so far (Sharma, Garg, 2021).

## SOCIAL INTELLIGENCE, EMOTIONAL INTELLIGENCE AND CREATIVITY

With regard to the social intelligence factor of artificial intelligence, it is important to mention that a robot that has repetitive, long-term and physically close relationships with humans, e.g. helping humans with rehabilitation and therapy, will need different social skills than a robot that has little and only short-term interaction with humans. For example, a robot who cleans an office building at night. The functionality, environment and context of the robot determine the social intelligence and social skills required. Robots are not humans, and although robots are given human-like interaction and communication capabilities, humans adapt to interact and communicate with them. Perceptions and attitudes towards robots are shaped by expectations, based on experiences with other machines, computers, and inspiration from science

fiction films and novels, but expectations will change over time and as knowledge about robots increases. Thus, currently adequate artificial intelligence and so-called robot designs may seem inadequate in 100 years' time. It became clear that new designs, methods were needed for the research area of the emerging human-robot interaction (Lungarella et al., 2007).

Emotional intelligence is substantially related to social intelligence. It is defined as a set of abilities that allow other individuals to perceive their emotions, control their own emotions and use those emotions in mental processes and problem solving. Recently, there has been a demand for the implementation of artificial intelligence systems that simulate human creativity. For example, musical or visual creativity. These systems try to simulate creative abilities in order to develop an original idea, visual art or solutions (Flasiński, 2016).

In their research, Kaplan and Haenlein (2019) divided artificial intelligence into analytical, human-inspired and humanized artificial intelligence. Analytical artificial intelligence uses cognitive intelligence and learning, i.e. historical data, to guide future decisions and is applied in a variety of scenarios. Human-inspired artificial intelligence has cognitive and emotional intelligence. This type of artificial intelligence system is able to understand human emotions and incorporate them into the decision-making process (Kaplan, Haenlein, 2019). Human-inspired artificial intelligence is on the rise, for example, US multinational retail and wholesale company Walmart has used facial recognition tools, in other words, human-inspired artificial intelligence to identify unhappy customers waiting at checkout. It then reacts immediately, using intervention tools, for example, to open new cash desks. Humanized artificial intelligence expected to possess cognitive, emotional, or social intelligence and be fully aware of interactions with others (Prentice et al., 2019).

## REASONING

In the reasoning of artificial intelligence systems, so-called multi-agent systems will function as artificial intelligence economies, where individual systems can transact with other artificial intelligence systems, as well as with companies and people. Systems populated by artificial intelligence technology may exhibit new economic phenomena, so as a result, they need new science to understand how they work and how they are designed. As human cognitive barriers limit the design of current markets, systems designed for artificial intelligence can afford more complex interfaces and perform more complex calculations, but they also require more attention. At the same time, new challenges may arise as the behavior of artificial intelligence systems differs from that of humans (Parkes, Wellman, 2015).

For example, if we want a glimpse into the future of economic artificial intelligence, a good example is artificial intelligence pricing systems. Such systems, for example, books and products in certain web shops, but even when setting fares for certain air-

lines, this system is used. Such artificial intelligence systems can increase efficiency, but a lack of common sense and the fact that designers do not foresee interactions can lead to millions of dollars in books, products, ticket prices that will no longer be in demand. However, there are much more sophisticated artificial intelligence strategies that are likely to have a more closely controlled influence on financial markets, as automated trading algorithms are estimated to account for more than 70% of trades on US exchanges (Hendershott et al., 2011; Parkes & Wellman, 2015). Given the implications, it is important to understand the impact of ubiquitous automated agents on the performance of economic systems. The argument is shifting from humans to artificial intelligence, which aims to understand our preferences, overcome our decision biases, and make complex cost-benefit trade-offs. Thus, the question may arise as to how economic institutions intermediating everyday transactions should also change (Parkes, Wellman, 2015).

## SUMMARY

This research explores the different aspects of artificial intelligence, including natural language processing, pattern recognition, planning, decision-making, learning, manipulation, problem-solving, knowledge representation, social and emotional intelligence, creativity, and reasoning. Natural language processing uses algorithms and machine learning to analyze human language, improving communication and language translation in healthcare and education. Detection and pattern recognition help machines identify patterns in data and make predictions, while planning and decision-making enable machines to make optimal choices, improving organizational efficiency and productivity. Machines can continuously learn and adapt to new environments, improving their performance. Manipulation and movement capabilities allow machines to control and interact with devices and machines, useful in manufacturing and robotics. Problem-solving and knowledge representation analyze complex situations and provide creative solutions. Social and emotional intelligence, creativity, and reasoning involve programming machines to understand and interact with humans naturally, providing personalized and engaging experiences.

The first hypothesis was confirmed because the effective utilization of the diverse capabilities of artificial intelligence, such as natural language processing, detection and pattern recognition, planning and decision-making, learning, manipulation and movement, knowledge representation will significantly enhance problem-solving, language translation, pattern identification and will optimize the performance. The reason for that is, these can lead to continuous performance improvement, like outcome prediction, scheduling optimization, organizational tasks. It can also help in device and machine control, complex situation analysis, and creative problem-solving in various fields.

The second hypothesis proved because it can be mentioned that the successful in-

tegration of artificial intelligence with social intelligence, emotional intelligence, and creativity will enable artificial intelligence systems to understand and interact with humans in a natural and intuitive manner. Moreover, for improvements it can be mentioned that it is facilitating effective communication, personalized experiences, and enhanced decision-making processes. Additionally, the reasoning capabilities of artificial intelligence, when applied to analyze and evaluate arguments based on available evidence, will contribute to logical conclusions and improved decision-making outcomes.

Overall, this research provides insight into the capabilities and potential applications of artificial intelligence, allowing organizations and individuals to harness the technology to improve their efficiency, productivity, and quality of life.

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