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ARTIFICIAL INTELLIGENCE LEARNING METHODS

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Annotation. The report focuses on artificial intelligence (AI) learning, focusing on three main categories: Supervised Learning, Unsupervised Learning and Reinforcement Learning. The differences, pros and cons of these methods, as well as the situations in which they are used, are described.

Keywords: artificial intelligence; Supervised Learning; Unsupervised Learning; Semi-Supervised Learning; Reinforcement Learning.

Introduction. Artificial intelligence (AI) is a direction of computer sciences, the purpose of which is to create systems performing tasks that require human intelligence, such as decision making, speech recognition and solving problems. AI can be defined as a computer's ability to imitate human activities, for example, solving problems and training. The main goal of AI is the creation of systems that can perceive the environment, process information and act on the basis of the data obtained. With the progress of the technology of AI, it becomes an important element of our daily life, finding use in various fields – from medicine to finance. In recent decades, AI has significantly evolved, which has allowed its widespread introduction into various industries. The key aspect of the development of effective and reliable systems is the understanding of the methods of learning AI, which allow them to adapt to changing conditions and requirements. AI learning methods can be categorized as follows: supervised learning, unsupervised learning, reinforcement learning, and others.

Main part. AI teaching primarily involves *Supervised Learning* and *Unsupervised Learning*. Supervised Learning trains models on labeled data to predict outputs for new data, exemplified by image classification where handwritten letters (input) are paired with their identities (output) to establish predictive patterns. Conversely, Unsupervised Learning analyzes unlabeled data to discover hidden structures, proving useful for unstructured data like images and audio, and enabling tasks such as clustering (grouping similar objects for analysis in social networks or image studies), dimensionality reduction (simplifying data while retaining key information, like PCA), and associative analysis (identifying relationships for recommendation systems and marketing insights). Real-world applications of Unsupervised Learning include anomaly detection in network security, grouping news articles by topic, and building personalized recommendation systems based on user behavior and preferences.

Differences of Supervised Learning and Unsupervised Learning. Supervised Learning has marked data at the entrance, and with high-quality marking has high accuracy. Unsupervised Learning works with unlabeled data and is looking for patterns on his own. Supervised Learning is used when the correct answers are known and high accuracy is needed, while training without a teacher is used when data marking is impossible or a study of their structure is required.

Disadvantages of Supervised Learning. The need for a large amount of the marked data. Machine learning algorithms with Supervised Learning require significant resources and time to collect and mark data, which can be expensive and difficult for many companies. Unable to all types of data. Supervised Learning suggests that the model will receive the same data as the training set of data, which often corresponds to the typical tasks of the classification. However, this approach may be ineffective when working with more complex and uncertain data and parameters.

Disadvantages of Unsupervised Learning. Incorrect selecting data blocks and incorrect combination of objects. Neural networks can be mistakenly identifying the connections between data that does not actually exist. From here there are «delusional» results. In addition, they can

group data on signs that do not matter for a specific task. For example, instead of sorting goods by volume of containers, the network can focus on their color.

A large amount of data and a lot of time for training is required. Machine learning algorithms in the realm of Unsupervised Learning require more data and iterations to develop the correct conclusions, which can increase the time needed for training and the resources consumed.

Semi-Supervied Learning combines the advantages of both Supervised Learning and Unsupervised Learning. It combines the marked and unreasonable data for teaching the model. This approach is useful when marking data of labor-intensive or road, allowing the use of large volumes of unprofitable data to improve the performance of the model.

There are several approaches to Semi-Supervied Learning: clastering-based methods and graf-based methods.

With clustering-based methods, the unreasonable data is first cluster, and then each cluster is assigned a class mark based on the available marked data. With graf-based methods, the data is presented in the form of a graph, where the nodes are examples of data, and the ribs are the connection between them. Then the methods of spreading marking are used to expand classes of classes based on existing ones.

The agent interacts with the environment and learns to make decisions, receiving remuneration or punishment for his actions. The goal is to maximize the accumulated remuneration by teaching the optimal behavior strategy. One of the most popular algorithms in *reinforcement learning* is the Q-learning method. In this method, the agent learns to evaluate and choose actions based on the value of the Q-functions, which represents the expected total reward for performing the action in a certain state. The Q-learning algorithm is based on the principle of iterate update of the Q-function value based on the accumulated reward and the subsequent choice of optimal actions. Reinforcement training has a wide range of applications in various fields. For example, in robotics, an agent can control the robot to overcome obstacles or complete tasks. In the game industry, reinforcement teaching methods are used to teach virtual characters or improve their strategies in games.

Beyond supervised and unsupervised learning, *Deep Learning*, applicable to both unsupervised and reinforcement learning, mimics human learning by using neural networks to refine data characteristics, excelling at extracting high-level features from complex data and improving fraud detection and automation accuracy, with potential in automotive maintenance. *Active learning* offers another approach by automatically selecting diverse and informative training data, significantly reducing the time needed for data collection compared to manual methods.

Current trends in artificial intelligence (AI) training are aimed at improving the efficiency of models, reducing dependence on large amounts of labeled data, and improving the interpretability of solutions. Hybrid approaches combining Supervised Learning, Unsupervised Learning, and Reinforcement Learning are being actively explored to create more versatile and adaptive algorithms. Considerable attention is paid to the development of energy-efficient models capable of operating on low-power devices. In the future, more autonomous systems are expected to be able to make decisions with minimal human intervention.

Conclusion. AI training methods, such as Supervised Learning, Unsupervised Learning and Reinforcement Learning, allow you to create intellectual systems that can adapt to new conditions and effectively solve various problems. It is important to consider the advantages and disadvantages of each of the teaching methods in order to choose the right one for a specific task. In the future, AI will continue to have a significant impact on our lives, discovering new opportunities for innovation and development.

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