

ON SOME ISSUES RELATED TO MACHINE LEARNING IN 2022

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Introduction. Many difficulties and tasks related to the epidemic, whether they are directly or indirectly related to the synthesis of vaccines and drugs, the analysis of x-rays, the distribution of patients and resources, and so on, can only be solved rapidly and easily with the use of sophisticated computer technologies and tools [Ashinov, 2020]. One of the key factors for developing such effective technologies and tools is machine learning [Vorobeva, 2020]. However, for its successful implementation, as a rule, numerous and diverse data are required, which in many cases may be difficult to collect and prepare [Tsogoeva, 2020]. In this regard, the search for ready-made data acquires a special role.

Economic significance. Machine learning enables economists to solve significant issues faster by processing of large datasets. Indeed, the impact of machine learning on the economy is already being seen, so some of the effects may not be difficult to anticipate. Machine learning is reshaping the world, transforming industries such as health-care, education, transportation, food, entertainment, and various assembly lines, among others. It will have an impact on almost every aspect of life, including housing, cars, shopping, ordering food, and so on.

Methodology. Machine learning refers to methods that use a dataset to predict behavior [Bryukhina, 2020], is one of the fastest growing areas of information technology. Previously, this area was considered fantasy. However, now machine learning is applied in real industries. In 2021, the latest innovations in this field have made it possible to solve many problems more efficiently and accurately than ever before. The term “machine learning” refers to artificial intelligence methods, one of which is the solution of a task through learning based on the application of the results of similar tasks. Mathematical statistics, numerical methods, mathematical analysis, optimization methods, graph theory, and techniques for working with data in digital form are used to create such algorithms. Strict formulas are not used to determine the solution, but rather the established relationship of the results with certain features and their values.

Literature review. The article by D. Yu. Sakhanevich explores the approaches and methods of applying artificial intelligence and machine learning in socio-economic pro-

cesses. The goal of this article is to categorize and systematize aspects of machine learning in order to accelerate the development and implementation of artificial intelligence and machine learning algorithms in order to improve management efficiency in socioeconomic processes. In addition, the article discusses mathematical and statistical methods for developing algorithms and learning machines. Statistical methods based on the construction of classification and regression algorithms; pattern recognition method; prediction method; exponential mixing method; method for constructing an online multivariate regression algorithm; based on the use of an aggregating algorithm; methods related to game and probability theories were used to apply this classification. It would be easier to build AI [Sakhanevich, 2020].

In the article of Ekaterina V.O. decision-making methods for managing credit resources using machine learning and optimization have been studied. This article talks about credit operations, which mainly rely on the activities of banks and provide a significant share of their income. The main goal of the author is to substantiate and develop new technologies and models of bank lending management that reduce credit risks and increase lending efficiency. Methods of system analysis, control theory, statistical methods, optimization methods and machine learning were used [Ponyrko, 2020].

In the article of Ponyrko R.M. “The impact of the digital economy on the processes of the banking sector”, the leading directions in the development of the mechanism of digitalization of the economy are analyzed. As a result of the study, the importance of digital technologies in the value chain is highlighted. The results of the study can be applied in the formation of the strategy of business entities [Baryshnikov, 2018].

In the article by S. Russell, R.V. Klimenko, P. Norviga, M.Yu. Openkova and others, approaches to creating algorithms in machine learning were identified, similar in terms of research topic, but different in the way of classifications (articles or books are divided by subject, as well as similar courses) and the form of representation of their essence [Sidorov, 2017]. There are many areas of use of machine learning, such as medicine, financial institutions, manufacturing, and other areas of human activity.

Scientific novelty. Understanding the possibilities and latest innovations in machine learning is critical for businesses to chart a course for the most efficient ways to conduct business. It is also critical to maintain industry competitiveness, therefore, deep understanding of this topic is required. Before using machine learning to create a tool or conduct research on it, one should have a good understanding of its benefits and drawbacks. This paper is based on conducted research on those types and provided information on which one fits in the solution of various types of problems.

Analysis. There are two types of machine learning:

1. Inductive (according to precedents). It is based on the discovery of patterns observed in the input data.

2. Deductive machine learning, which includes the formalization and transformation of expert knowledge into digital form as a knowledge base.

Because the second type is commonly referred to as expert systems, "machine learning" can be used interchangeably with "inductive learning." Use cases are a collection of input objects and their associated results. The goal is to develop an algorithm that can produce accurate results for any input. The decision is based on an examination of previous experience. Simultaneously, the learning system's ability to generalize is critical; it should normally respond to data that is not included in the training sample. There are three types of inductive learning: supervised learning (supervised), unsupervised or unsupervised learning, and reinforcement learning. In addition, other learning methods are being developed, for example: active, multitasking, transfer, etc. Recently, "deep learning" has begun to develop most strongly, combining algorithms for both learning with a teacher and without a teacher. Data and data-related labels are used in supervised machine learning. For instance, we can see a pear in one image and an apple in another. After placing the markers, the person acts as a teacher for the machine. The machine determines the features that allow it to distinguish between images with pears and images with apples based on the data and markers. Thus, an algorithm is created that produces a result based on the description of the data. Once an algorithm has been chosen, it can be used to label other previously unknown data. Supervised learning includes classification tasks and regression tasks [Maisuradze, 2019]. Unsupervised machine learning means an iterative process of analyzing data without any markers and finding relationships between them without human intervention. Such models include problems of clustering, searching for association rules, and dimensionality reduction. Clustering algorithms serve to isolate individual groups of data. Dimension reduction algorithms, on the other hand, are designed to search for more compressed data representations. We can see examples of algorithms based on unsupervised learning in social networks when selecting recommendations or when issuing search results in search engines. There are also non-classical but quite popular machine learning methods such as reinforcement learning and deep learning. Reinforcement learning is a subset of supervised learning in which the "teacher" is the environment. At the same time, the machine does not have a reference set of data and information about the environment to begin with, but it can perform actions within it. As a result, the environment's reactions to actions will be information for the machine, which it will use to develop an algorithm. This training method is used for more complex tasks, such as a robot navigation system. Deep learning, on the other hand, is always associated with big data, which suggests that it is impractical to process such an array of information with one machine. Therefore, artificial neural networks (ANNs) are used. They are a network of artificial neurons. Neurons play the role of

devices built on the foundation of relatively simple processors. Deep learning divides a large amount of information into smaller pieces, and the processing and analysis of these data fragments is delegated to other devices. This type of learning is only applicable to more complex neural networks with multiple levels. Each next level of the ANN searches for the relationship in the previous one. Thus, more complex neural networks can find both simple relationships and relationships between relationships.

Given the long path of development of the field, we will consider the specific, most relevant machine learning technologies in 2022. The most developed technologies are AutoML, TinyML and QuantumML. Below is a description of each technology, as well as the scope of its application.

AutoML (Automated Machine Learning). The demand for labeled data has resulted in the establishment of a data labeling industry staffed by human annotators. Because of the risks associated with using offshore labor, the market has sought alternative methods to avoid or minimize this part of the process. Improvements in semi- and self-paced learning are assisting businesses in reducing the amount of manually labeled data. By automating the work of choosing and tuning a neural network model, artificial intelligence becomes cheaper, and new solutions take less time to enter the market.

In the general case, AutoML can be considered, regardless of whether classifiers or training regressions are built, as a generalized search concept with specialized algorithms for finding optimal solutions for each component of the machine learning pipeline [Evsyukov, 2020]. By building a system that automates just three key elements—feature engineering, hyperparameter optimization, and neural architecture discovery—AutoML promises a future where democratized machine learning becomes a reality.

Since automated machine learning can solve several problems at once, several strategies for using it have emerged. There is currently a focus on improving solutions such as PlatformOps, MLOps and DataOps. This group of solutions is called XOps and allows you to create an enterprise technology stack that provides automation and reduces the duplication of technologies and processes.

TinyML (Tiny Machine Learning). TinyML is a rapidly evolving approach to developing artificial intelligence and machine learning models that run on devices with limited hardware, such as microcontrollers used to power cars, refrigerators, and utility meters. TinyML is a rapidly evolving approach to developing artificial intelligence and machine learning models that run on devices with limited hardware, such as microcontrollers used to power cars, refrigerators, and utility meters.

Tiny machine learning is the next logical step in every organization's journey to becoming a digitally intelligent enterprise that connects data with company-wide actions. Hardware partners such as Dell support TinyML with specialized hardware that

hosts and integrates intelligent data at the edge. Not only does this help provide an intelligent platform for analysis, but it also opens the organizational doors for modern architectures while supporting industry standards including 5G and Wi-Fi 6. Moreover, TinyML can improve privacy by processing data on the device and transmitting only what what is important.

TinyML algorithms are expected to be increasingly used for localized parsing of simple voice and gesture commands; identifying common sounds such as gunshots or baby crying; analysis of environmental conditions and vital signs. Companies are already considering adopting new approaches to the development, security, and management of TinyML.

QuantumML (Quantum Machine Learning). Quantum computing holds great promise for creating more powerful artificial intelligence and machine learning models. The technology is still out of reach in practice, but the tide is starting to change: Microsoft, Amazon, and IBM are making quantum computing resources and simulators readily available through cloud models.

The intersection of quantum computing and machine learning could bring huge benefits to companies, allowing them to potentially solve problems that are not being solved today. The developers of QuantumML recommend that companies start exploring the potential impact of quantum computing on their industry now and adapt their AI strategies to enable resources to explore quantum computing and machine learning when platforms (expected in the next two to three years).

Conclusions. Every year, industries advance due to advancements in data science and machine learning. In some cases, this forces businesses to employ machine learning in order to remain competitive. However, the use of this technology on its own can only benefit businesses. Some businesses must innovate in order to achieve goals and gain a prominent position in the market, as well as enter a new future that was once considered science fiction.

Each goal necessitates a different approach. Discussing what is best for a specific company with experts will help you understand which technologies, such as machine learning, can improve business performance.

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The advent of the Internet and faster computers has made the transition faster, and the world has moved to an automated and digitized format, which has led to the introduction of advanced technologies into everyday life. Currently, humanity is actively using technology in personal and professional activities, which mainly includes communication and business transactions. A variety of technologies and tools based on artificial intelligence are becoming more widespread and become more significant not only in various fields of science, technology, economics and production, but also in the everyday life of ordinary people. The global pandemic of the coronavirus COVID-19 has demonstrated the vulnerability of mankind not only to epidemic threats and related problems, but also in terms of the long-term consequences and restrictions they cause. At the same time, the pandemic has once again shown and confirmed that it is possible to deal with emerging difficulties successfully, effectively and efficiently in various fields of activity by using computer tools and information technologies, including those related to the field of artificial intelligence. The article discusses trends and ways to apply the main approaches and methods of machine learning.