Neural networks and artificial intelligence as trends for the development of the future

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Abstract. This article discusses neural networks and artificial intelligence from the prospects for the future life of humanity. Neural networks and artificial intelligence are also presented as a tool for conducting almost all types of business, production, medicine (medical imaging). Neural networks perform the tasks of identifying objects of research, semantic segmentation, recognition of faces, recognition of parts of the human body, semantic determination of boundaries, highlighting objects of attention in the image and highlighting normals to the surface, automating and optimizing processes implemented in the format of manual labour. Prospects for the implementation of neural networks and artificial intelligence should be considered not as a substitute for a person, but rather as a support system for decision-making, in which the final choice is left to the person.

1. Introduction
A 2013 study at Oxford Martin School found that 47% of all jobs could be automated over the next 20 years. The main factor in this process is the use of artificial intelligence, which works with big data as a more effective human substitute.

Machines can now solve more and more processes for which people were previously responsible. Besides, they do it better and, in many cases, even cheaper. German Gref, in an interview with students from the Kant Baltic Federal University, expressed his point of view on the modern approach to machine work: "We stop hiring lawyers who do not know what to do with the neural network. <...> You are students of yesterday. Comrade lawyers, forget your profession. Last year, the 450 lawyers who are preparing lawsuits in our country have been cut back. Our neural network prepares statements of claim better than lawyers prepared by the Baltic Federal University. We definitely will not hire them."

The important question is, what is the difference between artificial intelligence, machine learning and neural networks, and is everything terrible in terms of replacing human jobs with robotic ones?

A neural network is one of the ways to implement artificial intelligence [7].

There is a massive area in the development of artificial intelligence – machine learning. Machine learning is studying methods for constructing algorithms that can be mastered independently [5]. Machine learning is necessary if there is no final solution to any problem. In this case, it is easier not to look for the right solution, but to create a mechanism that suggests a method for finding it.
Many articles contain the term deep learning. Deep learning is understood as machine learning algorithms that use many computing resources. In most cases, they can be realized as "neural networks."

In order not to get confused in the concepts of "artificial intelligence", "machine learning" and "deep learning", we suggest looking at the visualization of their development (Fig. 1).

![Figure 1. Visualization of the development of artificial intelligence, machine and deep learning](image)

There are two types of artificial intelligence: weak (narrowly focused) and strong (general) types of artificial intelligence. Weak artificial intelligence is designed to perform a small list of tasks. Examples are Siri and Google Assistant voice assistants and all the other examples that will be given below. Strong artificial intelligence, in turn, can fulfill any human task. At the moment, it is impossible to achieve a strong artificial intelligence; this is a utopian idea.

How does a neural network work?

A neural network imitates the functioning of the human nervous system, which is characterized by the ability to learn according to previous experience. Thus, each time the system makes a fewer number of errors.

Like our nervous system, a neural network consists of separate computing elements – neurons located in several layers. Data received at the input of a neural network is processed sequentially at each level of the network. Besides, each neuron has specific parameters, which can vary depending on the results obtained – this is network learning.

Suppose the task of a neural network is to distinguish cats from dogs. For configure the neural network, a vast array of signed images of cats and dogs is fed. The neural network analyzes the signs (including lines, shapes, their size and colour) in these images. It creates such a recognition model that minimizes the percentage of errors compared to the reference results.

Figure 2 shows the operation of a neural network, the task of which is to recognize the handwritten digit of a zip code.
Figure 2. The operation of a neural network whose task is to recognize the handwritten digits of a zip code

Even though neural networks have come into the limelight recently, this is one of the oldest machine learning algorithms. The first version of a formal neuron, a neural network cell, was proposed by Warren McCulloch and Walter Pitts in 1943. Moreover, already in 1958, Frank Rosenblatt developed the first neural network. Despite its simplicity, it could already distinguish, for example, objects in two-dimensional space.

The first successes attracted increased attention to technology, but then other machine learning algorithms began to show better results, and neural networks faded into the background. The next wave of interest came in the 1990s, after which almost no one had heard of neural networks until 2010.

Until 2010, there was simply no database large enough to properly train neural networks to solve specific problems, mainly related to image recognition and classification. Therefore, neural networks were often mistaken: they confused a cat with a dog or, even worse, an image of a healthy organ with an image of an organ affected by a tumour.

However, in 2010, ImageNet appeared, containing 15 million images in 22 thousand categories. ImageNet was many times the size of existing image databases and was accessible to any researcher. With such volumes of neural network data, one can learn to make decisions with virtually no errors.

Before this, another, no less important problem faced the development of neural networks: the traditional teaching method was ineffective. Although the number of layers in a neural network plays an important role, the method of training the network is also essential. The reverse encryption method used earlier could effectively train only the latest levels of the network. The learning process was too long for practical use, and the hidden layers of deep neural networks did not work correctly.

Three independent groups of scientists achieved the results in solving this problem in 2006. First, Jeffrey Hinton conducted a preliminary training of the network using the Boltzmann machine, training each layer separately. Secondly, Jan LeCan suggested using a convolutional neural network to solve image recognition problems. Finally, Joshua Benggio developed an automatic cascade encoder that enabled all layers in a deep neural network.

2. Examples of successful application of neural networks in business

**Medicine.** A team of researchers from the University of Nottingham has developed four machine learning algorithms to assess the risk of patients with cardiovascular disease, for training data were used 378 thousand British patients. Trained artificial intelligence determined the risk of heart disease more effectively than real doctors. The accuracy of the algorithm is from 74 to 76.4 % (the standard
eight-factor system developed by the American College of Cardiology provides an accuracy of only 72.8 %).

**Finance.** Japanese insurance company Fukoku Mutual Life Insurance signed a contract with IBM, according to which the IBM Watson Explorer AI system will replace 34 employees of the Japanese company. The neural network will analyze tens of thousands of medical certificates and take into account the number of visits to the hospital, operations performed and other factors to determine the conditions of client insurance. Fukoku Mutual Life Insurance is confident that using IBM Watson will increase productivity by 30 % and will be rewarded in two years.

Machine learning helps identify potential cases of fraud in various areas of life. For example, PayPal uses a similar tool – as part of the fight against money laundering, the company compares millions of transactions and detects suspicions between them. As a result, PayPal fraudulent transactions represent 0.32 %, while the default in the financial sector is 1.32 %.

**Commercial activity.** Artificial intelligence has significantly improved recommendation mechanisms in online stores and services. Machine learning-based algorithms analyze site behaviour and compare it with millions of other users – everything to determine which product is most likely to buy a person.

This recommendation engine provides Amazon with 35 % of sales. The Brain algorithm used by YouTube for recommending content allowed almost 70 % of the videos viewed on the site being found by people using recommendations (instead of links or subscriptions). WSJ reported that the use of artificial intelligence for recommendations is one of the factors that have affected 10-fold population growth over the past five years.

The Yandex Data Factory algorithm can predict the effect of promotions on the sale of goods. The history of sales, as well as the type and assortment of the store, the algorithm gave 87 % of accurate (accurate to the box) and 61 % ultra-precise (accurate to the packaging) forecasts.

Natural language analysis neural networks can be used for creating chat robots that allow customers obtaining the necessary information about company products. This process reduces the cost of call centre teams. A similar robot is already working in the reception room of the Moscow government and processes about 5 % of requests. The bot can tell, including the location of the nearest MFC and a schedule for turning off the hot water.

Albert is also based on neural network technology. It is a full-cycle marketing platform that independently performs almost all operations. Cosabella, the lingerie manufacturer that uses it too, eventually dissolved the marketing department and completely relied on the platform.

**Transport.** Uncrewed vehicles – a concept that most large companies are working on, as well as technology companies (Google, Uber, Yandex and others) and startups that use neural networks for their work. Artificial intelligence is responsible for recognizing surrounding objects – whether it be another car, a pedestrian or another obstacle.

The potential of artificial intelligence in this area is not limited to autopilot. A recent IBM poll found that 74 % of car managers expect smart cars to hit the streets by 2025. Such cars, which are integrated into the Internet of things, collect information about the preferences of passengers and automatically adjust the temperature in the cabin, the radio volume, the seat, and other parameters [8]. In addition to piloting, the system also provides information about problems that arise (and even tries to solve them yourself) and traffic situations.

**Industry.** A neural network developed by Mark Waller of Shanghai University specializes in the development of synthetic molecules.

The algorithm was a six-step synthesis of a benzopyran sulfonamide derivative (necessary for the treatment of Alzheimer's disease) in just 5.4 seconds.

Yandex Data Factory tools help in steel production: the metal scrap used in steel production often has a heterogeneous composition. In order for steel to meet standards, it is always necessary to take into account the peculiarities of scrap during its melting and introduce special additives. Usually, this is done by specially trained technologists. However, since these industries collect much information about the incoming raw materials, the additives used and the result, the neural network can process
this information with greater efficiency. According to Yandex, the introduction of neural networks can reduce the cost of expensive ferroalloys by 5%.

Also, a neural network can help in the processing of glass. Today it is a loss-making, albeit a useful, business that needs government funding. Using machine learning technologies will significantly reduce costs.

In mining, when developing mineral deposits, the underground method of machine learning can optimize the movement of vehicles, as well as take on piloting with mining machines without direct human intervention [4, 10].

Agriculture. Microsoft engineers and ICRISAT scientists use artificial intelligence to determine the ideal sowing time in India. An application using the Microsoft Cortana Intelligence Suite also monitors soil conditions and selects the required fertilizer. Initially, only 175 farmers from 7 villages participated in the program. They started to sow only after the corresponding SMS notification. As a result, they collected 30-40% more than usual.

Entertainment and art. Last year, applications appeared that used neural networks for process photos and videos: they immediately became popular: MSQRD from Belarusian developers (later the service was acquired by Facebook), as well as Russian Prisma and Mlvch. Another service, Algorithmia, colours black and white photographs.

Yandex has also successfully experimented with music: the neural networks of the company have already recorded two albums: in the style of Nirvana and Civil Defense. Moreover, the song, written by a neural network under the direction of the classical composer Alexander Scriabin, was performed by a chamber orchestra, which makes us think again about whether the robot can compose a symphony. Bach inspired the neural network created by Sony employees.

The Japanese algorithm wrote the book, The Day the Computer Wrote a Novel. Even though people helped an inexperienced writer with characters and storylines, the computer did a great job – as a result, one of his works passed the qualification stage of a prestigious literary award. Neural networks also wrote sequels for Harry Potter and Game of Thrones.

In 2015, the Alpha Go neural network, developed by the Google Deep Mind team, was the first program to defeat a professional Go-player. Furthermore, in May this year, the program hit the world's strongest Go-player Ke Ke. This process was a breakthrough since for a long time. It was believed that computers lacked the intuition necessary for the game.

Security. A development team from the University of Technology in Sydney introduced drones to patrol the beaches. The main task of drones is to look for sharks in coastal waters and warn people on the beaches. Video data analysis is carried out by neural networks, which significantly affected the results. In essence, the developers say that the probability of shark detection and identification can reach 90%. In comparison, the operator who watches a video from drones can successfully recognize sharks only in 20-30% of cases.

Australia ranks second in the world after the United States in the number of cases of shark attacks on humans. In 2016, 26 cases of shark attacks were recorded in this country, two of which resulted in deaths.

In 2014, Kaspersky Lab reported that its antivirus software logs 325,000 new infected files daily. At the same time, DeepInstinct research showed that new versions of viruses are practically no different from previous ones – the change is from 2% to 10%. The self-learning model developed by DeepInstinct and based on this information can detect infected files with high accuracy.

Neural networks can also search for information storage patterns in cloud services and report detected anomalies that can lead to security breaches.

In 2016, an engineer from NVIDIA, 65, Robert Bond, faced a problem: nearby cats regularly visited his site and left traces of his presence, which annoyed the gardener's wife. Bond immediately ceased the overly hostile idea of setting traps for uninvited guests. Instead, he decided to write an algorithm that would automatically activate water sprinklers in the garden as cats approached.

Robert was faced with the task of identifying cats in a video stream from an external camera. For this, he used a system based on the popular Caffe neural network. Each time the camera watched a
change in the situation on the site, she took seven photos and transmitted them to neural networks. After that, the neural network had to determine if the cat was present in the frame, and if so, turn on the sprinklers.

Before starting work, the neural network was trained: Bond “fed” it with 300 different photographs of cats. By analyzing these photos, the neural network has learned to recognize animals. However, this was not enough: in only 30% of cases, she correctly identified cats and confused Bond with a cat, which made him wet.

The neural network worked better after additional training with many photos. Bond warns, however, that the neural network may be overloaded. In this case, an unrealistic stereotype develops. For example, if all the images used for training are taken from one angle, artificial intelligence may not recognize the same cat from a different angle. Therefore, it is vital to choose the right series of training data.

After some time, cats that did not study in photographs, but in their skin, stopped visiting the Bond site.

3. Conclusion
Neural networks, technologies of the middle of the last century, are now changing the work of entire industries [9]. The public reaction is mixed: some of the capabilities of neural networks delight, while others doubt whether they use them as specialists. Modern technologies are developing in close connection with science, which stimulates the innovative orientation of science itself and leaves an imprint on the development of all areas of society, including the training of modern specialists [1].

However, not everywhere where there is machine learning, it crowds out people. If the neural network makes a diagnosis better than a living doctor, this does not mean that in the future, we will only be treated by robots. Most likely, the doctor will work with the neural network. Just like the IBM DeepBlue supercomputer, which won chess at Garry Kasparov in 1997, but the chess players did not go anywhere, and the outstanding grandmasters still fall on the covers of glossy magazines.

It is also necessary to study the system by means of system analysis, mathematical modeling and programming [2, 3, 6]. Knowledge of the laws of changing the main technological parameters [11].

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