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**SECTION 4. Computer science, computer engineering and automation.**

## ARTIFICIAL NEURAL NETWORK FEATURES

**Abstract:** The article describes how the theory of artificial neural networks is rapidly developing, which has worked well in the field of management, where the use of human intelligence is essential.

**Key words:** neural networks, artificial intelligence, information systems.

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### Introduction

Time - this is one of the most interesting concepts that interest people since Ancient times. Mankind has always sought to understand and subjugate time because knowledge of the future gives unprecedented power of decision-making in various fields of human activity. The question of determining the future was and remains relevant today. Of great interest are the problems of weather forecasting based on the results of appropriate atmospheric measurements, selection of new species of plants and animals, determining the capabilities of individuals in certain areas with the help of an appropriate system of control tests, etc. Particular importance is forecasting in such areas as industry, Economics, Commerce (forecasting economic indicators, price dynamics for a particular product, the rate of shares for some time ahead, etc.).

However, to create a time machine man cannot, we know that it was in the past, but it is precisely to assert the state of things in the future is not given to any of us. Despite this, people have always sought to predict the future, using a variety of ways: in the common people for a long time popular folk signs, mathematicians use more formal methods and methods of forecasting, they use statistical and probabilistic characteristics, which is possible with a certain probability to say that the future event will happen or not.

Along with the traditional methods of forecasting, the theory of artificial neural networks is

rapidly developing, which has proven itself in the field of management, where it is necessary to use human intelligence, in particular in solving forecasting problems. This scientific direction was born at the junction of such Sciences as neurobiology, chemistry, physics, mathematics, computer science, philosophy, psychology, etc. Interest in neural networks was caused by both theoretical and applied achievements in this field. Neural networks have suddenly opened up the possibility of using computing in areas previously related only to the field of human intelligence, the possibility of creating machines, the ability to learn and remember in an amazing way reminiscent of human thought processes.

### Materials and Methods

Artificial neural networks consist of elements, the functionality of which is similar to most of the elementary functions of a biological neuron. These elements are then organized in a way that may or may not correspond to the anatomy of the brain. Despite this superficial similarity, artificial neural networks exhibit a surprising number of properties inherent in the brain. For example, they are trained on the basis of experience, generalize previous precedents to new cases and extract essential properties from the incoming information containing unnecessary data.

Despite this functional similarity, even their most optimistic defender will not assume that in the near future artificial neural networks will duplicate the functions of the human brain. The real "intelligence"

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demonstrated by the most complex neural networks is below the level of the earthworm, and enthusiasm should be moderate in line with modern realities. However, it would also be wrong to ignore the surprising similarities in the functioning of some neural networks with the human brain. These capabilities, however limited today, suggest that a deep penetration into human intelligence, as well as a host of revolutionary applications, may be just around the corner.

Artificial neural networks can change their behaviour depending on the external environment. This factor is more responsible than any other for the interest they generate. After the input signals are presented (possibly together with the required outputs), they are self-tuned to provide the required response. Many training algorithms have been developed, each with its own strengths and weaknesses. There are still problems as to what the neural network can learn and how the training should be conducted.

The network response after training can be somewhat insensitive to small changes in the input signals. This inherent ability to see an image through noise and distortion is vital for pattern recognition in the real world. It overcomes the strict precision required of an ordinary computer and opens the way to a system that can deal with the imperfect world in which we live. It is important to note that an artificial neural network makes generalizations automatically due to its structure, rather than through the use of "human intelligence" in the form of specially written computer programs.

Some of the artificial neural networks have the ability to extract the essence from the input signals. For example, a network can be trained on a sequence of distorted versions of the letter "A". After appropriate training, the presentation of such a distorted example will lead to the fact that the network will generate a letter of perfect form. In a way, she'll learn to produce something she's never seen. This ability to extract the ideal from imperfect inputs raises interesting philosophical questions. It resembles the concept of ideas put forward by Plato in his "Republic". Anyway, the ability to extract perfect prototypes is a very valuable quality in humans. Artificial neural networks are not a panacea. They are obviously not suitable for tasks such as payroll. It seems, however, that they will be preferred in a large class of problems of pattern recognition, forecasting, the creation of associative memory, Economics, management of objects that are poorly or not cope with conventional computers.

Climate change on Earth may not only be gradual. A catastrophic shift is also possible, which will require emergency, including military, response measures. This is the main conclusion of the report "The Weather Report: 2010-2020", prepared by professional futurists commissioned by the US

Department of Defense. According to experts, global climate change can completely destabilize the political situation on the planet. Among the "plausible" scenarios are the famine in Europe and the rivalry of nuclear powers over scarce water resources. In their forecasts, the authors-Peter Schwartz and Douglas Randall-proceed from the possibility that as a result of natural changes in completely different laws will suddenly live the world ocean. Europe, Asia and North America than lose the usual heat. And in the southern hemisphere, on the contrary, will become hotter. According to scientists, the Earth has already experienced something similar 8200 years ago. Mankind is known, in particular, very recent historical phenomenon - a Small glaciation. It lasted from about 1300 to 1850. Because of the deteriorating weather conditions, Europeans had to leave Greenland, the Viking civilization faded. Only with 1315g. by 1319, the famine had wiped out tens of thousands of people, the report says. But then humanity was much smaller. Despite the huge increase in scientific and technical weapons, man is now extremely vulnerable to the forces of nature. The world's population is enormous, with a large proportion living in poverty, as well as in areas that are "at risk" from a natural point of view. In the event of a catastrophic climate change, food, water, and strategic minerals (not least oil) are the main threats. All this creates the ground for wars. The proliferation of nuclear weapons also appears to be "inevitable".

Artificial neural network (-s) - a mathematical model, as well as its software or hardware implementation, built on the principle of the functioning of biological neural networks—networks of nerve cells of a living organism. This concept arose in the study of processes occurring in the brain, and in an attempt to simulate these processes. After the development of training algorithms, the obtained models were used for practical purposes: in forecasting problems, for pattern recognition, control problems, etc.

Ins is a system of connected and interacting simple processors (artificial neurons). Such processors are usually quite simple (especially compared to the processors used in personal computers). Each processor on such a network deals only with the signals it periodically receives and the signals it periodically sends to other processors. And, nevertheless, being connected to a sufficiently large network with controlled interaction, such separately simple processors together are able to perform quite complex tasks.

Neural networks are not programmed in the usual sense of the word, they are trained. The possibility of learning is one of the main advantages of neural networks over traditional algorithms. Technically, the training is to find the coefficients of connections between neurons. In the learning process, the neural network is able to identify complex

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relationships between input and output data, as well as perform generalization. This means that if the training is successful, the network will be able to return the correct result based on the data that was not in the training sample, as well as incomplete or "noisy", partially distorted data.

During the learning process, the network views the training sample in a specific order. The order can be sequential, random, etc. Some network studying without a teacher looking at a sample only once. Other networks that study with the teacher view the sample multiple times, with one full pass through the sample called the learning age. When training with a teacher, the set of initial data is divided into two parts — the actual training sample and test data; the principle of separation can be arbitrary. The training data is fed to the network for training, and the test data is used to calculate the network error (the test data is never used to train the network). Thus, if the error on the test data is reduced, then the network does perform a generalization. If the error on the training data continues to decrease and the error on the test data increases, then the network has stopped generalizing and simply "remembers" the training data. This phenomenon is called network retraining or overfitting. In such cases, training is usually discontinued. In the process of learning can manifest other problems, such as paralysis or the ingress of the network into a local minimum of surface errors. It is impossible to predict in advance the manifestation of a problem, as well as to give clear recommendations for their resolution.

All of the above applies only to iterative algorithms for finding neural network solutions. For them, really nothing can be guaranteed and it is impossible to fully automate the training of neural networks. However, along with iterative learning algorithms, there are non-iterative algorithms that have very high stability and allow to fully automate the learning process.

Even in the case of successful, at first glance, a learning network is not always taught exactly what it wanted from the Creator.

Testing the quality of neural network training should be carried out on examples that did not participate in its training. At the same time, the number of test cases should be higher, the higher the quality of training. If neural network errors have a probability close to one billion, then a billion test cases are needed to confirm this probability. It turns out that testing well-trained neural networks becomes a very difficult task.

There are two directions of Artificial Intelligence (AI) development:

The decision of the problems connected with the approach of specialized AI systems to

human capabilities, and their integration, which is realized by human nature. Creating an artificial intelligence that represents the integration of already created

AI systems into a single system capable of solving the problems of mankind (*see*: Strong and weak artificial intelligence).

But at the moment in the field of artificial intelligence, there is the involvement of many subject areas that have more practical relation to AI, rather than fundamental. Many approaches have been tried, but no research team has yet approached the emergence of artificial intelligence.

An artificial neuron simulates in the first approximation the properties of a biological neuron. At the input of an artificial neuron receives a set of signals, each of which is the output of another neuron. Each input is multiplied by a corresponding weight, similar to the SYNOPTIC force, and all products are summed, determining the level of activation of the neuron. For rice.1 a model implementing this idea is presented.

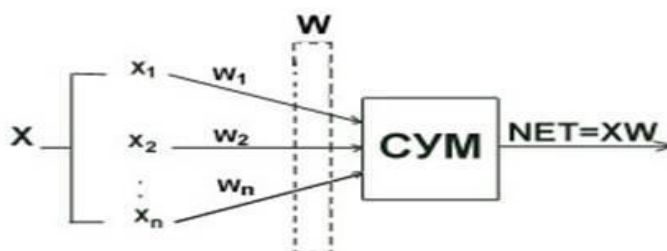


Figure 1. Artificial Neuron

### Conclusion

Although network paradigms are very diverse, almost all of them are based on this configuration. There are many inputs denoted by  $x_1, x_2, x_3, \dots, x_n$ , is fed to the artificial neuron. These input signals,

collectively denoted by the vector  $X$ , correspond to signals coming into the synapses of a biological neuron. Each signal is multiplied by the corresponding weight  $w_1, w_2, w_3, \dots, w_n$ , and is supplied to the summing unit, indicated SUM. Each weight corresponds to the "strength" of a single biological

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synaptic connection. (The set of weights is collectively denoted by the vector  $W$ ). The summing block corresponding to the body of the biological element adds the weighted inputs algebraically, creating an output.

The development of neural networks has caused a lot of enthusiasm and criticism. Some comparative

studies have been optimistic, others pessimistic. For many tasks, such as pattern recognition, dominant approaches have not yet been developed. It is necessary to try to understand the possibilities, prerequisites and scope of different approaches and to make maximum use of their additional advantages for the further development of intelligent systems.

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