

## ARTIFICIAL NEURAL NETWORKS AND THEIR CURRENT LEVEL OF DEVELOPMENT

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### Анотація

*В роботі розглянуто нейронні мережі як один з провідних сучасних напрямків розвитку інформаційних технологій. Представлено загальну концепцію нейронної мережі, основні різновиди таких мереж та їх сучасний рівень розвитку.*

**Ключові слова:** *нейронна мережа, навчання нейронних мереж, типи нейронних мереж.*

### Abstract

*Neural networks, as one of the leading modern areas of information technology development, are reviewed in this work. The general concept of the neural network, the main types of them, as well their current level of development are presented.*

**Keywords:** *neural network, learning neural networks, types of Neural Networks.*

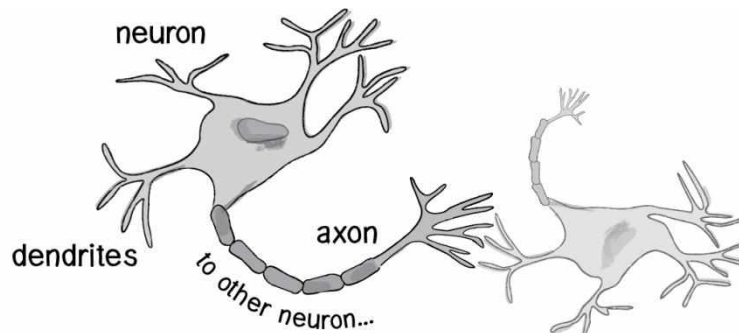
### The conception of Neural Network

Every year information technology is increasingly developing. They are gradually extend to all areas of human life. Today it is hard to imagine a life without technology: it is introduced in manufacturing, used in education, various researches, occupy a large niche in the market by developing software products that use various information technologies; we use computers and telephones every day - our lives without them is already impossible.

One of the most global information technologies is the usage of neural networks. They emerged only in the last century, but managed to reach rather a high level of development.

Artificial neural network (ANN) is a “connectionist” computational system. The information in neural network is processed collectively, in parallel throughout a network of nodes (the nodes, in this case, being neurons).

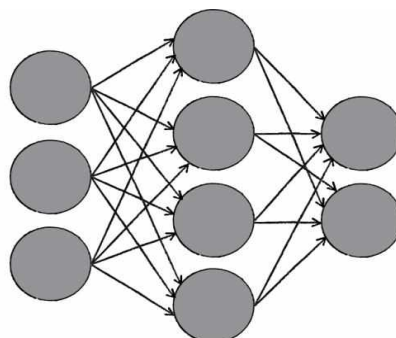
A neural network is based on a conception of the human brain. The human brain can be described as a biological neural network – an interconnected web of neurons transmitting elaborate patterns of electrical signals. Dendrites receive input signals and, based on those inputs, fire an output signal via an axon (pic. 1).



Picture 1 – The structure of the brain neuron

An artificial neural network has the similar structure, represented in picture 2. The individual elements of the network, the neurons, are simple. They read an input, process it, and generate an output. A network of many neurons, however, can exhibit incredibly rich and intelligent behaviors.

One of the key elements of a neural network is its ability to learn. A neural network is not just a complex system, but a complex adaptive system, meaning it can change its internal structure based on the information flowing through it. This is typically achieved through the adjusting of weights. Picture 2 demonstrates that each line represents a connection between two neurons and indicates the pathway for the flow of information. Each connection has a weight, a number that controls the signal between two neurons. If the network generates a “good” output, there is no need to adjust the weights. However, if the network generates a “poor” output – an error – then the system adapts, altering the weights in order to improve subsequent results [1].



Picture 2 – The structure of the artificial neural network

## **Training of artificial neural networks**

A neural network has to be configured in such a way that the application of a set of inputs produces the desired set of outputs. Various methods to set the strengths of the connections exist. One way is to set the weights explicitly, using a priori knowledge. Another way is to “train” the neural network by feeding it teaching patterns and letting it change its weights according to some learning rule [2].

We can categorize the learning situations in two distinct sorts. They are:

- Supervised learning or Associative learning in which the network is trained by providing it with input and matching output patterns. These input-output pairs can be provided by an external teacher, or by the system which contains the network;
- Unsupervised learning or Self-organization where an output unit is trained to respond to clusters of pattern within the input. In this paradigm, the system is supposed to discover statistically salient features of the input population [2].

Among them, we can use such algorithms of training as steepest descent, quasi-Newton, evolutionary methods, gene expression programming, simulated annealing, expectation-maximization, non-parametric methods etc.

## **Types of neural networks**

There are different types of artificial neural networks, depending on the task they are solving and the type of learning they are using.

The most common tasks represented by neural networks are: computer vision, speech recognition, machine translation, social network filtering, function approximation, classification, robotics, playing board and video games and medical diagnosis etc.

Based on this, we can define the following types of neural networks as perceptron, Radial basis function Network, Recurrent Neural Network, Spiking Neural Networks, Neocognitron etc. [3].

## **The level of development**

The discovering of neural networks has begun almost a century ago. By this time, they achieved a very high level of development so they are implemented almost in all areas of life.

Some companies are working on creating a "silicon compiler" to generate a neural network Application Specific Integrated Circuit (ASIC). These ASICs and neuron-like digital chips appear to be the wave of the near future. Ultimately, optical chips look very promising.

Beside this, such projects were developed: AlphaGo, net-player in go by Google; a number of services for identifying images by Microsoft; start-ups MSQRD and Prisma; Quick, Draw! by Google; NIMA by Google; Memristor-based neural networks etc.

AlphaGo is the first computer program to defeat a professional human Go player, the first program to defeat a Go world champion, and arguably the strongest Go player in history. DeepMind, an AI division of Google based in London, has developed an improved version of the AlphaGo program, which was famous for its victory over the champion in the game of Li Sedol in the game last year. Engineers rewrote the algorithms of the neural network, making it completely self-learning: AlphaGo Zero is able to "train" itself, without any involvement from the person. As a result, it became the perfect algorithm.

MSQRD, or Masquerade, is the video and photo-selfie application developed by the Belarusian company Masquerade Technologies. Its goal is to create video and photo-self, imposing on the face of the user various masks in real time.

Prisma transforms your photos and videos into works of art using the styles of famous artists: Van Gogh, Picasso, Levitan, as well as world famous ornaments and patterns. A unique combination of neural networks and artificial intelligence helps to turn memorable moments into timeless art.

Quick, Draw! is a neural network, which can recognize doodling.

NIMA is a Neural Image Assessment. It can foresee how much you might like some photo.

Memristor-based neural networks refer to the utilization of memristors, the newly emerged nanoscale devices, in building neural networks. Memristors, short for memory-resistor, have a peculiar memory effect that distinguishes them from resistors. Such networks can predict what you can say in the next second.

This is a small part of the newest neural networks researches. In the nearest future, they may be a common thing. Artificial Intelligence is supposed to be the basic information technology.

Therefore, artificial neural networks are the powerful technology, which provides a very effective and rapid method of problem solving. They are continuously evolving, offering useful and interesting solutions, which can change our lives. They give us a new view on many problems and things, making our life more comfortable and brighter. I consider that the future is behind artificial neural networks and artificial intelligence.

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