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# NEURAL NETWORKS AND FACE RECOGNITION OF PEOPLE USING NEURAL NETWORKS

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*The article considers artificial neural networks and some of their architectures. The process of recognizing people by their face with their help is considered. Areas of application of this technology are determined.*

**Introduction.** At all times a person tries to simplify his life. In the pre-computer era, this was expressed in the improvement and invention of new devices. Now the human is trying to create artificial intelligence, to completely exclude the participation of man in a variety of spheres of life. However, artificial intelligence has not yet been created. But artificial neural networks through which developers are trying to create artificial intelligence are now used to solve many problems.

**What is a neural network**? The neural network is a sequence of neurons connected by synapses. The structure of the neural network has come to the programming world straight from biology. Thanks to this structure the machine is able to analyze and even memorize various information. Neural networks are also able not only to analyze incoming information, but also to reproduce it from their memory. In other words, a neural network is a machine interpretation of the human brain, in which there are millions of neurons transmitting information in the form of electrical impulses.

**What are neural networks for?** Neural networks are used to solve complex problems that require analytical computations like those that the human brain does. The most common applications of neural networks are:

Classification – the distribution of data by parameters. For example, the entrance is given to a set of people and you need to define those of them to give credit to and those whom not. This work can be done by a neural network analyzing information such as age, financial solvency, credit history, etc.

Prediction is an opportunity to predict the next step. For example, the increase or decrease of shares based on the situation on the stock market.

Recognition is, at present, the widest application of neural networks. Used in Google when you are looking for a photo or in camera phones, when it determines the position of your face and highlights it and much more.

**What is a neuron?** A neuron is a computing unit that receives information, performs simple calculations on it, and passes it on. They are divided into three main types: input (blue), hidden (red), and output (green). There is also a displacement neuron and a contextual neuron, which we'll talk about in the next article. In the case where a neural network consists of a large number of neurons, the term layer is introduced. Accordingly, there is an input layer that receives information, n hidden layers (usually there are not more than 3 of them) that process it and an output layer that outputs the result. Each of the neurons has 2 basic parameters: input (input data) and output data (output data). In the case of the input neuron: input = output. In the rest, the total information of all neurons from the previous layer gets into the input field, after which it is normalized using the activation function (so far, just imagine it f (x)) and gets into the output field.

It is important to remember that neurons operate with numbers in the range [0,1] or [-1,1]. And how then, you may ask, to handle the numbers that come out of this range? At this stage the simplest answer is to divide 1 by this number. This process is called normalization and it is very often used in neural networks.

**Areas of practical application of artificial neural networks.** In each subject area, upon closer examination, one can find problem statements for neural networks. Here is a list of individual areas where the solution of such problems has practical importance right now.

- **Economics and business**: forecasting time series, automatic trading, assessing the risks of credit default, prediction of bankruptcies, real estate valuation, identifying overvalued and undervalued companies, rating, optimizing commodity and cash flows, reading and recognizing checks and documents, security of transactions on plastic cards.
- **Medicine and health care**: patient diagnosis, treatment of medical images, cleaning of instrument readings from noise, monitoring the patient's condition, predicting the results of different treatment methods, analyzing the effectiveness of the treatment.
- **Avionics**: trained autopilots, recognition of radar signals, adaptive piloting of heavily damaged aircraft, unmanned aerial vehicles.

• **Communication**: compression of video information, fast coding / decoding, optimization of cellular networks and packet routing schemes.

• **Internet**: associative information search, electronic secretaries and autonomous agents on the Internet, filtering and blocking spam, automatic columning of messages from news tapes, targeted advertising and marketing for electronic commerce, captcha recognition.

• **Automation of production**: optimization of production process regimes, product quality control, monitoring and visualization of multidimensional dispatch information, prevention of emergency situations.

• **Robotics**: recognition of the scene, objects and obstacles in front of the robot, laying the route of movement, manipulator control, maintaining balance.

• **Political and sociological technologies**: predicting election results, analyzing polls, predicting the dynamics of ratings, identifying significant factors, clustering the electorate, researching and visualizing the social dynamics of the population.

• **Security, security systems**: face recognition; identification of a person by fingerprints, voice, signature or person; recognition of car registration numbers, monitoring of information flows in a computer network and detection of intrusions, detection of counterfeits, data analysis from video sensors and various sensors, analysis of aerospace images.

• **Input and processing of information**: recognition of handwritten texts, scanned postal, payment, financial and accounting documents; recognition of speech commands, speech input of the text into the computer.

• **Exploration**: analysis of seismic data, associative methods of searching for minerals, evaluation of resources of deposits.

• **Computer and board games**: the creation of neuro-players in drafts and chess (confirmed by playing with people's ratings - at the level of masters and international masters), winning in Go from European and world champions, on average better than a man, the passage of almost fifty old classic games with Atari.

**The application of neural networks for face recognition.** Currently there are about a dozen types of neural networks. One of the most widely used options is a network built on a multi-layer perception, which allows you to classify the input image / signal in accordance with the pre-setting / learning network.

Neural networks are trained on a set of learning examples. The essence of training is reduced to tuning the weights of inter-neural connections in the process of solving the optimization problem by the method of gradient descent. In the process of training neural networks the key features are automatically extracted, their importance is determined, and the relationships between them are constructed. It is assumed that the trained neural network will be able to apply the experience gained in the learning process to unknown images due to generalizing abilities.

The best results in the field of face recognition (based on the analysis of publications) were shown by Convolutional Neural Network or convolutional neural network, which is a logical development of the ideas of such neural network architectures as cognition and neocognition. The success is due to the possibility of taking into account the two-dimensional topology of the image, in contrast to the multilayer perception.

Distinctive features of a convolutional neural network with them are local receptor fields (provide local two-dimensional connectivity of neurons), common weights (provide detection of certain features anywhere in the image) and hierarchical organization with spatial sampling (spatial subsampling). Thanks to these innovations the convolutional neural network provides partial resistance to scale changes, displacements, rotations, angle and other distortions.

Testing with convolutional neural networks on the basis of ORL data, containing images of individuals with small changes in lighting, scale, spatial turns, position and various emotions, revealed a 96% recognition accuracy.

The convolutional neural networks were developed by DeepFace, which was purchased by Facebook to recognize the faces of users of its social network. All the features of the architecture are of a closed nature.

Disadvantages of neural networks: adding a new reference person to the database requires a complete retraining of the network on the entire set available (a sufficiently long procedure, depending on the sample size from 1 hour to several days). Problems of a mathematical nature associated with training: getting into the local optimum, choosing the optimal optimization step, retraining, etc. It is difficult to formalize the stage of choosing the network architecture (the number of neurons, layers, the nature of the connections). Summarizing all of the above, we can conclude that the neural network is a "black box" with hard-to-interpret results.

**The conclusion.** This article presents a brief description of neural networks. Also the use of neural networks for face recognition is described. Despite some disadvantages, they can be eliminated by changing the approach to the use of neural networks in face recognition.

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