# Study of pattern identification processes in highly productive human synaptic networks

Khodakovskyi N. I., Zolot A. I., Merjvinskyi P. A.

*Institute of Cybernetics by Glushkov NAS of Ukraine,*
*03687, Av. Glushkov, 40, Kyiv-187, Ukraine*

nhodak@ukr.net

## 1 Introduction

When using distributed computing technologies to solve large computationally complicated problems, a number of issues, related to the coordination of a huge number of interacting computers and data flow between them, arise. One solution to these problems is the system of meta-computing as a software tool, designed to organize distributed heterogeneous computing environments and perform calculations in such environments [1].

The basic components of the system are the task server and the client. Task server is responsible for splitting the particular application task into independent computing portions, their distribution into computational nodes and combining the results.

Due to the high-speed nature of computations, similar to the ones produced by brain, it is possible to use a highly parallel architecture for artificial highly productive synaptic networks using neuromorphic chips [2].

## 2 Use of neuromorphic chips in bionic highly productive synaptic networks

Silicon chips, whose work can be controlled as well as the vital activity of neurons, can be used as neuromorphic chips. Such chips, consisting of individual neuro modules, have their own memory and other characteristics of living neurons. The need for such chips arose from the fact that modern microprocessors with Boolean logic mishandle emulation of “neurons” and require resources of a supercomputer to simulate operation of the brain of bio systems at the level of insects.

On the crystal of neuromorphic chip electronic analogs of neurons are implemented. Using all available designs of artificial "neurons", we managed to build subdivided neural networks, which for their work require not only computational abilities, but also two types of memory, long-term and short-term [2]. Such neuromorphic approach allowed to give the chip analytical capabilities and implement truly intelligent algorithms of decision making, that cannot be or are very difficult to obtain, using the principles of linear logic upon which all programs for microprocessors are based.

Let us consider the possibilities of using the considered chips in personal computers of sixth generation, which constitute an integrated system, the hardware components of which are completely based on artificial neural networks (ANN).

Accelerators of computation here contain standard reprogrammable processors, improved performance of which is provided by paralleling of computing repetitive operations with help of ANN. Required training for this is a process of self-organization of distributed computing environment - "neural" ensembles. In distributed "neural" networks parallel information processing takes place, which is accompanied by constant training, driven by the results of this processing.

The main thing that unites the brain and neurocomputers - focus on processing images. Let us consider biological prototypes and focus on the basic principles of distributed data processing.

Let us consider what the effect of back propagation of error in training of bionic neural networks gives. It is known that the basis for training of neural networks is the gradient optimization method - the iterative change of synaptic weights, gradually lowering error of processing of training examples by the neural network [3].

Weight changes occur due to local gradient of the error function. Effective method of finding the gradient is the algorithm of back propagation of error. Differences of the neural network responses from the correct responses are determined on the output layer of "neurons" and are distributed across the network towards the stream of signals.

Massive parallelism of neurocomputing, required for effective image processing, is provided by locality of information processing in neural networks. Each "neuron" responds only to information, supplied to it by the associated neurons, without an appeal to the general plan of calculations for conventional ECM [4]. Therefore neural network algorithms are local, and "neurons" can operate parallely.

Absence of a global plan of computations in neural networks involves special type of their programming. Each "neuron" changes its adjustable parameters in the form of synaptic weights according to the incoming local information. This information is determined by the outputs of the network and reflects the effectiveness of its work as a whole. It

extends from the outputs to the inputs, towards the stream of input signals. Therefore, the basic algorithm of training networks is called back propagation of errors. Since the error passes through the same synaptic links between "neurons", the greatest signal about error is obtained by "neurons", which gave the greatest contribution to the wrong answer.

As a result, such least trained "neurons" are trained the most. This is a very simple and effective training principle. Therefore, in the process of self-teaching, biological neural networks use such effective sensory processing algorithms [5].

# 3 The role of software agents of synaptic human networks in the formation of molecular storage objects in the brain cortex

Let us consider memorizing process that occurs in nerve cells by increasing effectiveness of connections, called synapses. In the case of short-term memory effect only lasts for minutes or hours. In the case of long-term memory, synaptic connection is increased for a long time.

Memory is formed as a consequence of the signals passing through the synapses. In the synapse, which got enough stimulation, molecules of signal substance are produced. Once the synapse efficiency is improved, it can maintain the memory for a certain time until the signal substance is located on the way to the nucleus of the nerve cell.

This substance activates certain genes there, which are necessary for the synthesis of proteins that strengthen synaptic connection for a long time. Thus the transcription factor CREB was discovered and described, as this signal substance described above, that performs the key role in converting short-term memory into long-term [3].

From the viewpoint of molecular cybernetics, such transcription factor is a software agent in implementing the "software" of the neuron cell and synaptic network in processing external information by the latter.

Software agents are essentially complexes of sequences of the DNA genetic information, connected with specific proteins. Such complexes are able to manage processes in the cell nucleus when searching specific DNA sequences, and connect to them. In practice, they are switches that control the transcription of genes. Therefore, activation of such software agents in a neuron leads to gene activation that leads to the production of proteins that intensify synaptic connection, and conversion of short-term memory into long-term memory.

In this work we show the role of software agent in the processing of information in the synaptic human networks. Thus, when fixing the input signal at the input membrane of the synapse, software agent passes synapse, output synapse membrane and is transferred into the nucleus of the neuron.

After receiving information from DNA structures in the nucleus of the neuron, the software agent is combined with the template RNA and is transferred to the ribosome of the neuron, where the synthesis of proteins, transferred into the synapse to intensify synaptic connections, is provided. And, accordingly, this completes the creation and preservation of the storage molecular object in this synaptic network.

# 4 Conclusion

In this study realization principles of highly productive processes of pattern identification in human synaptic networks are analyzed. It is shown that such processes are implemented using different software agents and methods to provide information processing with a high degree of paralleling.

On basis of bionic approach to explaining the formation of molecular memory in synaptic human networks, we can suggest ways to use software agents in artificial neural networks of new generations of neurocomputers. For work and life using the Internet, a new approach to software development is required.

Personal assistants to help organize personal information filtering are required. In place of the passive object interface, you can use the active agent's interface. The distinguishing feature of such software agents, as well as in natural synaptic networks – the urge to better understand what is required of them. Therefore neural networks, capable to generalize examples by training discussed above are completely natural component of software agents.

Very high-performance computers, on which it will be possible to implement high-tech artificial intelligence systems, and that will continue to work even in case of failure of some components of the computer, can be the result of the appliance of neuromorphic chips, as well as in the human brain, which functions, losing approximately one million neurons every day.

# Literature

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