Chapter 3
Biological Neural Circuits as Applications in Business and Engineering as a New Approach in Artificial Intelligence

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ABSTRACT

The chapter describes the new approach in artificial intelligence based on simulated biological neurons and created neural circuits which represent the next generation of computing systems and artificial intelligence for business applications. Unlike existing technical devices for implementing a neuron based on classical nodes oriented to binary processing, the proposed path is based on bit-parallel processing of numerical data (synapses) for obtaining result. The proposed approach of implementation a neuron can serve as a new elementary basis for the construction of neuron-based computers with a higher processing speed of biological information and good survivability. The research demonstrates the developed nervous circuit constructor and its usage in building of the nervous circuits of biological creatures and simulation of their work and how it could be used in the next generation of the computing systems.

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INTRODUCTION

The development of the new computer technologies is a necessary task and we can see it on a daily basis. The development of technologies led to computer modeling of different processes and systems. Modeling is one of the most effective ways of research.

A model approach to research allows us to overcome the limitations and difficulties that arise when setting up a laboratory experiment, due to the possibility of conducting so-called numerical experiments, and to study the response of the system under study to changes in its parameters and initial conditions.

In this regard, computer simulation is widely used in the natural science. Neuroscience or the science of the brain, whose task is to study the functioning of the brain and the nervous system. The brain is a complex object consisting of a large number of different types of cells, including the main signal cells - neurons (cells that generate and transmit electro-chemical impulses that can form networks through contacts called synapses), glial cells that regulate metabolism, blood vessel cells, etc. Modeling such the systems, complex from the viewpoint of internal connections and large from the viewpoint of the number of elements, using modern personal computers is extremely difficult, due to the large th computing capacity derived models.

However, the use of supercomputer technologies allows the usage of more diverse modeling methods. One of such the methods is called large-scale modeling. Large-scale modeling is one of the directions in supercomputer modeling. This method is intended for the development and conducting of numerical experiments with global computer models of multidimensional systems in which have integrated macro and micro models that simulate the interconnected functioning of multilevel systems. This direction arose relatively recently due to significant progress in the technology of manufacturing microcircuits, parallel computing, and the increased processing power of supercomputer systems, which became available with the advent of specialized software. Large-scale modeling is based on the principle of hierarchical reduction, which assume that any complex system consists of hierarchically subordinate subsystems (levels of organization). A high-level organization system consists of lower-level systems, and a combination of low-level organization systems forms a higher-level system. Application of this principle for modeling in neuroscience allows us to represent the brain in the form of several 4 interacting independently described subsystems. The hierarchy of the model allows you to achieve the level of detail required by research, by increasing or decreasing the number of organization levels considered. However, with the increasing of the number of organization's levels, the number of parameters describing the system gets increased, which greatly complicates the task of creating a realistic model that reproduces the phenomena observed in a