ABSTRACT

Objective

The aim of this work is to investigate parallel implementations of neural networks in multiprocessor environment.

Actuality of the researches

Multiprocessor machines are becoming standard as the speed of individual processors is growing slower and slower. Today, more and more programs work with a certain amount of autonomous computers connected network, and are designed to provide an interface to access them as the combined computing facilities. Therefore, to improve performance, the program should work in parallel on multiple processors. Typically algorithms that take advantage of multiprocessor, are complex in their design and require more time for its implementation. Most applications still use only one processor core, resulting in multi-core machines, their work is not accelerated. Programs should be written taking into account the feature of multi-core processors and using their benefits. Therefore, finding ways to increase the productivity of well- known approaches in a parallel environment is an important task.

Neural networks are widely used for solving problems related to the recognition of images and sounds, prediction, classification, clustering, modeling of various processes, etc. Moreover, the list of industries that use a system based on neural networks is very large.

The main problem arises when using neural networks - a relatively low speed. This follows from the fact that the tasks associated with neural networks are usually resource intensive. After selection of the optimal neural network model is usually associated with the large number of experiments, the results of which can judge the

quality of individual models. Especially time-consuming process of neural network learning requires acceleration. To solve this problem, parallel algorithms of neural networks in multiprocessor environment can be applied.

The problems solved in the work

To investigate the possibilities of parallelization algorithms of neural networks, the basic models and algorithms that are used today are discussed in the thesis. Also existing sequential

learning algorithms and methods for their parallelization to speed up work in a multiprocessor environment are considered.

Parallel algorithms for calculation the outputs and parallel neural network learning algorithm are proposed and developed in the final part of the thesis. These developed programs were executed in the multiprocessor environment,

Achieved results

The result of the research is theoretical and practical consideration of neural networks parallelization. Implementation of the proposed algorithm for computing output of the neural network showed a significant acceleration only when the network is reused, since the initial weights broadcasting with a larger number of processors involved is wiping out gains from parallelization.

Implementation of the proposed learning algorithm of multilayer perceptron showed quite good results in the form of acceleration factor, which is close to the number of processors involved.

Scientific novelty

Scientific novelty of the work is in the development and implementation of neural networks parallelization techniques for effective work in a multiprocessor environment based on analysis of existing sequential approaches in this field.

Practical value

The practical value of the work lies in the possibility of applying the results to the effective functioning of neural networks in multiprocessor environment. And also, it should be noted that the proposed algorithm for parallelization of training neural networks, can be modified by using another method of optimization, which also requires the Jacobian matrix to calculate the deltas of weight coefficients.

Conclusions and recommendations

In this thesis the possibility of parallelization algorithms of neural networks, basic models and algorithms that are used today were considered. Also the existing sequential learning algorithms and

methods for their parallelization to speed up work in the multiprocessor environment were considered.

Based on the methods and approaches proposed in the reviewed publications on neural networks analysis, in the final part parallel algorithms for calculation of output and neural network learning algorithm on the example of a multilayer perceptron type network are proposed and developed. The testing of these algorithms in multiprocessor environment was done. The algorithms were implemented on the C++ programming language using the capabilities of MPI for interprocess communication.

The test launches were done on NTU "KPI" cluster. The results of the test launches are reflected in the form of parallel algorithms acceleration coefficients. These results have shown that the proposed algorithms of neural networks can be effectively used in a multiprocessor environment. The obtained speedup of the proposed parallel algorithms satisfies Amdahl's Law.

It should be noted that the proposed parallel algorithm for learning also has a good scalability - the effectiveness of parallelization of the algorithm does not depend on the number of training epochs.

Results approval

Report on the XII International scientific conference "System analysis and information technology". Topic: "Investigation of parallel implementations of neural networks in multiprocessor environment."

Publications

E-book "System sciences and cybernetics": the article "Parallelizing the process of neural network training using MPI».

Keywords

Neural network, parallel algorithm, training, multiprocessor computing MPI, back-propagation, NBN.

The paper contains 9 tables, 18 illustrations and two applications. The bibliography contains 27 different sources.