

ABSTRACT

Master's Thesis: 89 pp., 22 fig., 21 tab., 1 app., 41 sources.

Topicality. The development of parallel programs is a topical area in programming. Each software product should be tested during the many stages of implementation (from prototype to finished product) in order to evaluate the efficiency and quality of its functioning. However, multithreaded programs differ in their stochastic behavior and are highly dependent on the computational resources they are running on. Therefore, to test a parallel program, you need to run it many times on different resources. Unfortunately, traditional testing methods are not able to take into account all the features of running parallel algorithms and to test a multi-threaded program properly, assuming all possible scenarios for its implementation. In addition, during the development of information technology using parallel computing, there are also questions about the correctness of the use of a multithreaded tool, and about the necessity of parallelizing the algorithm at all. This paper proposes a method to test a multithreaded program by modeling it with stochastic Petri nets to analyze the efficiency of using parallel computations in the program. This method takes into account the non-deterministic order of instructions executed by the threads and the amount of computing resources.

Relationship of work with scientific programs, plans, themes. carried out at the Department of Automated Systems for Information Processing and Management of the National Technical University of Ukraine «Igor Sikorsky Kyiv Polytechnic Institute» by the topic of “Methods of visual programming of Petri-object models” (№ 0117U000918).

The aim of the research is to increase the efficiency of using parallel computing in information technology.

To achieve this goal the following tasks must be accomplished :

- to analyze modern tools and methods of testing and analyzing the effectiveness of multithreaded programs;
- to develop models of basic low- and high-level multithreading tools based on stochastic Petri nets:
 - creation of the thread, beginning and end of its work;

- thread blocking;
 - threads synchronization;
 - threads access to shared data;
 - thread pool.
- to determine the rules for transforming the Java code fragments into the Petri net;
 - to develop a library of basic fragments of multithreaded program which is based on the software DESS (Discrete Event System Simulation);
 - to develop a component to animate the functioning of the Petri-object model;
 - to determine the dependence of the efficiency of a particular multithreading tool on its parameters using the developed models.

The object of study is the process of developing parallel computing in information technologies.

The subject of study is methods of efficiency analysis of parallel computing in information technologies.

Research methods – methods of simulation modeling and mathematical statistics, the Petri-object simulation method.

Scientific novelty of the obtained results:

- first developed a Petri-object simulation method for parallel computing that reduces time, financial and resource costs when testing parallel algorithms;
- for the first time proposed a criterion for evaluating the efficiency of parallel multi-core computing in information technology, which takes into account computational resources, and provides an opportunity to evaluate the necessity of using certain multithreading tools in the program.

Approbation of the thesis results. The research results included in the thesis were published at the international scientific conferences ICCSEEA2018 and ICCSEEA2019.

Publications. The results of the work are published in the book series “Advances in Intelligent Systems and Computing” (volume 754[35], volume 938[39]), which is indexed in the Scopus database, in the theses of the Twelfth[31] and Thirteenth[33] international scientific-practical conference “Mathematical modeling and simulation of systems.

MODS”(2017, 2018), in the article of the professional journal “Visnyk NTUU “KPI”. Informatics, Management and Computer Engineering” (Issue 66)[25], in the theses of the Fifth International Scientific and Practical Conference “Management of Technology Development”[32], and in the theses of the Third All-Ukrainian Scientific and Practical Conference of Young Scientists and Students “Information Systems and Management Technologies”(ISTU-2019)[41].

PARALLEL COMPUTING, STOCHASTIC PETRI NETS, MULTITHREADED PROGRAMMING, PETRI-OBJECT APPROACH, SIMULATION, EFFICIENCY