

Optimizing Parallel Computing Systems: A Java-Based Approach to Modeling and Performance Analysis

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Abstract : The purpose of the study is to develop optimal solutions for models of parallel computing systems using the Java language. During the study, programmes were written for the examined models of parallel computing systems. The result of the parallel sorting code is the output of a sorted array of random numbers. When processing data in parallel, the time spent on processing and the first elements of the list of squared numbers are displayed. When processing requests asynchronously, processing completion messages are displayed for each task with a slight delay. The main results include the development of optimisation methods for algorithms and processes, such as the division of tasks into subtasks, the use of non-blocking algorithms, effective memory management, and load balancing, as well as the construction of diagrams and comparison of these methods by characteristics, including descriptions, implementation examples, and advantages. In addition, various specialised libraries were analysed to improve the performance and scalability of the models. The results of the work performed showed a substantial improvement in response time, bandwidth, and resource efficiency in parallel computing systems. Scalability and load analysis assessments were conducted, demonstrating how the system responds to an increase in data volume or the number of threads. Profiling tools were used to analyse performance in detail and identify bottlenecks in models, which improved the architecture and implementation of parallel computing systems. The obtained results emphasise the importance of choosing the right methods and tools for optimising parallel computing systems, which can substantially improve their performance and efficiency.

Keywords : algorithm optimisation, memory management, load balancing, performance profiling, asynchronous programming.

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