ABSTRACT

Explanatory note size – 135 pages, contains 12 illustrations, 52 tables, 2 applications, 26 references.

Topicality. JavaScript is one of the most popular programming languages for developing web applications, owing to its widespread use on both the client and server sides. With the advancement of modern web technologies, the demands for performance and efficiency in web applications are continuously increasing. This is particularly critical for complex and resource-intensive applications that require high levels of performance.

One of the challenges faced by interpreted languages like JavaScript is their limited performance compared to compiled languages. Interpreted code is typically executed more slowly, which can result in application delays, especially when processing large amounts of data or performing complex computations.

To address this issue, various methods for optimizing JavaScript code are employed. One promising direction is the use of the WebAssembly virtual machine. WebAssembly is a modern technology that allows code to execute with performance levels close to those of low-level languages such as C, C++, or Rust.

The advantages of using WebAssembly include the ability to compile code from various programming languages into a fast and compact format that can run directly in the browser. This significantly improves the performance of web applications, providing users with a smoother and faster experience.

However, the potential of WebAssembly has not yet been fully realized. There is a need for further development of optimization methods that leverage WebAssembly to ensure maximum efficiency and performance for modern web applications.

This work examines existing methods for optimizing JavaScript code using WebAssembly, their advantages and disadvantages, and proposes new approaches to improving the performance of web applications.

The aim of the study is to enhance the computational performance of applications through the use of compilation into WebAssembly code.

To achieve the stated goal, the following **tasks** need to be completed:

– analyze existing methods for optimizing JavaScript code;

– explore the capabilities of the WebAssembly virtual machine for optimization;

– develop methods for computational optimization based on WebAssembly;

– define criteria for evaluating the effectiveness of optimization with WebAssembly;

– conduct experimental assessments of the developed optimization methods on real web applications;

– compare the results of optimization with WebAssembly with other optimization methods;

– develop recommendations for implementing computational optimization methods based on WebAssembly in practical projects.

The object of the research is the process of using the WebAssembly virtual machine to improve the performance of computations.

The subject of the research is the methods and software tools for utilizing compiled code in the WebAssembly format.

The scientific novelty of the master's dissertation results lies in the proposal of an adaptive compiler for the first time, which, unlike existing solutions, dynamically selects the execution platform – JavaScript or WebAssembly – based on an analysis of the computational complexity of the code to enhance the execution performance of computations.

The practical value of the obtained results lies in the fact that the developed optimization methods can be integrated into the development process of web applications to improve their performance. This optimization system can be utilized by developers of JavaScript applications.

Relationship with working with scientific programs, plans, topics. Work was performed at the Department of Computer Science and Software Engineering of the National Technical University of Ukraine «Igor Sikorsky Kyiv Polytechnic Institute».

Approbation. The scientific provisions of the dissertation were tested at the Seventh International Scientific and Practical Conference of Young Scientists and Students "Software Engineering and Advanced Information Technologies (SoftTech-2024)".

Publications. The scientific provisions of the dissertation were published in:

1) Karimov A.V., Stetsenko I.V. Methods for Optimising Computations Based on the WebAssembly Virtual Machine. Software Engineering and Advanced Information Technologies (SoftTech-2024): proceedings of the Seventh International Scientific and Practical Conference of Young Scientists and Students, 20-22 November, 2024, Kyiv, National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", FICT, p. 39-43.

Keywords: JavaScript, WebAssembly, optimization, performance, web applications.