Moscow Institute of Physics and Technology

Bachelor Thesis Proposal

Research and development of an analysis and warning system to improve the performance of source code in a high-level programming language

Student of group B01-008
Lirisman K.
Supervisor
Gavrin E.

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1 Motivation Problem Statement

In modern programming, high-level programming languages are particularly significant, as they allow developers to focus on application logic rather than memory management details or other low-level tasks. However, such languages often encounter performance issues, especially in the context of large and complex projects. This compels people to create new high-level programming languages.

In this work, we are exploring a new programming language that is actively developing as a fast alternative to the widely used TypeScript. The main goal of developing this language is to create an extended and more performant version of TypeScript. It is important to maintain compatibility with TypeScript to facilitate the transition of existing projects and the training of new developers.

2 Aim of the work

The goal of this Bachelor thesis is to develop a code analysis and warning system for the selected high-level programming language to enhance its performance and speed up the execution of applications written in it. Additionally, to implement a system analogous to Clang Tidy for selectively disabling selected checks directly in the source code.

Research Tasks:

1. Study of existing solutions.
2. Development of a code analysis system at the compilation stage.
3. Analysis of the current specification of the target programming language for potentially slow language constructs and functionality, data collection for further testing.
4. Provide a correction option that speeds up the application, correct from the perspective of the selected programming language, for each language unit among the proposed ones.
5. Test each proposal: measure the application's performance before and after the proposed corrections.
6. Implement the corresponding verification in the analysis system after confirming positive test results.
7. Develop a system for selectively and collectively disabling checks selected by the developer, supporting the most popular usage scenarios based on data obtained from studying existing solutions.
8. Support the ability to analyze in a multi-file build system.

The research objectives are considered achieved when at least five proposals are identified and implemented, speeding up the application by an average of at least 5%. Additionally, the development of a check disabling system, successful support of project build, and passing testing consisting of some potential scenarios of applying the proposed solutions are required.