**"Performance Optimization of a Lisp-like Language through Constant Propagation, Inlining, and Peephole Optimizations"**
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This project, implemented as a part of CSCI 1260 (Compilers and Program Analyses), focuses on improving the performance of a Lisp-like language (developed as a part of the class) by implementing three optimization techniques: constant propagation, inlining, and peephole optimizations. Similarly to the compiler, my optimizations were developed in OCaml.
The constant propagation optimization replaces static expressions in the inputted code with constant values, reducing the number of computations in the final program. Inlining aims to reduce the cost of functions' invocations by replacing the call sites with the functions' bodies when appropriate. Lastly, the peephole optimization targets directly the assembly code generated by the compiler by replacing certain patterns of instructions with more efficient alternatives. In particular, my implementation of the peephole optimization focuses on optimizing type-checking and redundant copy instructions.
The constant propagation and inlining optimizations operate directly on AST expressions, into which the inputted code is parsed by the language's parser. The peephole optimization works directly with the assembly instructions outputted by the compiler, which are handled through an OCaml library.
The optimizations' efficiency was measured on a comprehensive set of benchmark programs and compared to the original compiler without any optimizations. Overall, the results were very satisfactory. On average, running the inlining optimization (separately) reduced the time necessary to complete a benchmark program by more than 14%. The peephole optimization reduced the time by more than 11% and the constant propagation optimization by more than 8%. Running all of the optimizations at once reduced the average time necessary to complete a benchmark program by approximately 18%. My optimizations, therefore, had a significant positive effect on the speed of programs produced by the compiler for the Lisp-like language.