Static Analysis Based Automatic Parallelization

CS4560 - Parallel and Concurrent Programming

February, 2026

Project description

[1]

In this project, you will develop an advisor tool for loop parallelization in LLVM.

Background Information

LLVM

LLVM compiler also introduces the same accesses to compile C11 in its intermediate representation (IR). It is possible to analyze and transform LLVM IR by inserting new instructions.

Note: *feel free to use any other compiler if you like.*

Projects

In this project, you will analyze programs in LLVM automatically and suggest a parallelization strategy. If you find multiple strategies then suggest so. Next, change the source program to its parallel version using available language constructs or libraries such as Julia, OpenMP, and so on. Finally, experiment with the performance improvements for different parameters.

Roadmap for the project:

The project involves the following steps:

- Set up the LLVM compiler. It is available at `https://github.com/llvm/llvm-project`.
- Understand the internals of the LLVM compiler.
- Develop the algorithms for automatic parallelization analysis.
- Implement the algorithm inside LLVM.
- Based on the suggestion change the source code.
- Evaluate the benchmarks of your own choice.

You may consider other compilers as well.

Note

- Build LLVM with clang/clang++ for compiling C/C++ programs.

References

[1] The project description is subject to small changes and updates. Please get in touch with the TAs and the teachers if you have any questions.