

# Compiler tool development for statement merging on a function-level



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Applicable for students as HiWi, B.Sc. and M.Sc. Thesis

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## Introduction

Modern (numeric) C++ tools use expression templates for efficient code generation and to avoid, e.g., the creation of temporary objects when evaluating a statement. In a sense, long statements appear to be more optimal for expression templates.

## Task

A Clang-based tool should be developed which, based on data-flow restrictions, automatically merges statements on a function-level. The strategy aims to make the statements as long as possible without too many re-computations.

```
1  double foo(double a, double b) {
2      double phi = a * b;
3      double phi_s = phi * .5;
4      return phi_s;
5  }
```

```
double foo(double a, double b) {
    double phi_s = (a * b) * .5;
    return phi_s;
}
```

Figure 1: *Left*: Input function with two statements computing a value. *Right*: phi can be merged into the phi\_s statement.

## What you will be doing

- The Clang tool parses a function and generates a computational graph containing relevant values w.r.t. expression templates. The graph contains as nodes function-local values, and as edges the data flow between these values.
- The tool analyzes the graph to determine values that can be merged without breaking the existing semantics.
- It merges previously detected statements and expressions.
- Finally, you evaluate the approach w.r.t. performance and compiler impact.

## Qualifications

- Experience with modern C++ and the CMake build system.
- Basic knowledge of compilers and related techniques.
- Knowledge of the Clang tooling library [1].
- Optional: Experience with graph analysis.

## References

[1] <https://clang.llvm.org/docs/LibTooling.html>



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