

C++ Concept Refactorings

Students



Vina Zahnd



Jeremy Stucki

Introduction: With C++20 template parameter constraints were introduced that allow to specify the expected functionality of template parameters. Clangd is a language server that is part of the open source project LLVM. It provides features like refactorings and code completion. These features provide little support for template parameter constraints as of December 2023.

Definition of Task: The aim of this project was to analyze whether common refactoring features can be applied to concepts or if any such features already exist.

New refactoring features should be implemented to support the use of template parameter constraints. Ideally, the new refactorings are submitted upstream to clangd to support the C++ community as well as helping the clangd language server grow.

Result: Two new refactoring operations were implemented and the resulting patches have been submitted to the LLVM project. As of December 2023, the pull requests opened to merge the implemented refactoring operations into the LLVM project are awaiting review.

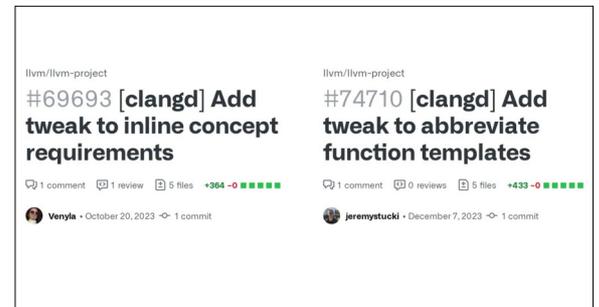
Once approved they will become available to all development tools using clangd, including VS Code, NeoVim and JetBrains CLion.

The first refactoring, "Inline Concept Requirement", inlines type requirements from requires clauses into the template definition, thus eliminating the requires clause.

The second refactoring, "Abbreviate Function Template", eliminates the template declaration by using the auto keyword for the parameter types.

Screenshots of pull requests to LLVM

Discord Image Preview



Capabilities of the two refactoring operations

Own presentation

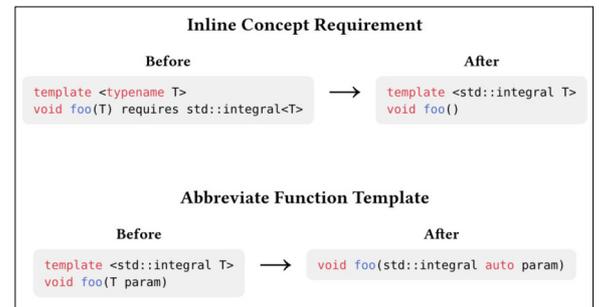
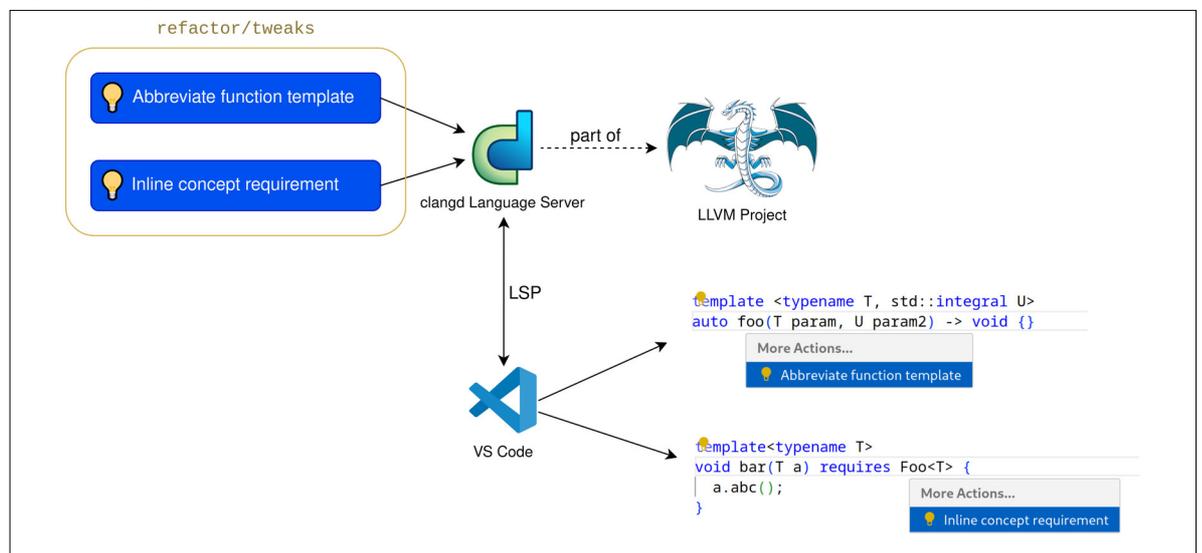


Diagram showing integration of implemented refactoring operations

Logos from clangd, LLVM and VS Code



Advisor
Thomas Corbat

Subject Area
Software