

Abstract

The topic of this thesis is to bridge the gap between formal and informal software specifications. Formal specifications are required for the use of formal methods to verify the correctness of software. If we expect formal methods to be used in realistic software development projects, we need to enable people with varying levels of familiarity with formal specification languages to understand, maintain and create formal specifications.

To address these problems, we provide a tool for translating specifications written in the formal language OCL, a substandard of UML, to natural language. We also provide a multilingual, syntax-directed editor where OCL and natural language specifications can be edited in parallel.

The implementation of our work is to a large extent based on the Grammatical Framework (GF). GF is a grammar formalism based on type theory, which provides a special purpose language for defining grammars, and a compiler for this language. We have developed a GF grammar for specifications in OCL and natural language. The grammar captures the OCL type system, its built-in constructions and the predefined types of the OCL library. It is dynamically extended with domain-specific concepts by generating GF grammar modules from UML class diagrams. The generated modules make use of a grammar-level API of common constructions, which means that these modules can be modified without requiring GF expertise. To improve the readability of the translation of OCL specifications, the grammar includes formatting of the produced natural language. Inspired by Natural Language Generation techniques like aggregation, we also apply transformations to abstract syntax trees using a program external to the GF grammar.

Our tool is a part of the KeY system, which integrates formal software specification and verification into the industrial software engineering processes. The tool has successfully been used for a non-trivial case study: translating the OCL specifications of the Java Card API into English.