Automated Refactoring of OCL Constraints with Search

Extended Abstract

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ABSTRACT[1]

Object Constraint Language (OCL) constraints are typically used for providing precise semantics to models developed with the Unified Modeling Language (UML). When OCL constraints evolve in a regular basis, it is essential that they are easy to understand and maintain. For instance, in cancer registries, to ensure the quality of cancer data, more than one thousand medical rules are defined and evolve regularly. Such rules can be specified with OCL. It is, therefore, important to ensure the understandability and maintainability of medical rules specified with OCL.

To tackle such a challenge, we propose an automated search-based OCL constraint refactoring approach (SBORA) by defining and applying three OCL quality metrics (*Complexity*, *Coupling*, and *Cohesion*) and four semantics-preserving refactoring operators (i.e., *Context Change*, *Swap*, *Split* and *Merge*) which are encoded as potential solutions for search algorithms. A solution is therefore an optimal sequence of refactoring operators, which are sequentially applied to the original set of OCL constraints to automatically obtain a semantically equivalent set of OCL constraints with better understandability and maintainability in terms of *Complexity*, *Coupling*, and *Cohesion*.

We evaluate SBORA along with six commonly used multi-objective search algorithms (e.g., Indicator-Based Evolutionary Algorithm (IBEA)) by employing four case studies from different domains: healthcare (i.e., cancer registry system from Cancer Registry of Norway (CRN)), Oil&Gas (i.e., subsea production systems), warehouse (i.e., handling systems), and an open source case study named SEPA. Results show: 1) IBEA achieves the best performance among all the search algorithms and 2) the refactoring approach along with IBEA can manage to reduce on average 29.25% *Complexity* and 39% *Coupling* and improve 47.75% *Cohesion*, as compared to the original OCL constraint set from CRN. To further test the performance of SBORA, we also applied it to refactor an OCL constraint set specified on the UML 2.3 metamodel and we obtained encouraging results. Furthermore, we conducted a controlled experiment with 96 subjects and results show that the understandability and maintainability of the original constraint set can be improved significantly from the perspectives of the 96 participants of the controlled experiment.

[1]The full version of the paper is published in IEEE Transaction on Software Engineering (TSE), on 17 November 2017 and can be accessed via the link: http://ieeexplore.ieee.org/document/8114267/.

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