Generative Matching Between Heterogeneous Meta-Model’ Systems Based on Hybrid Heuristic

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ABSTRACT

Nowadays, designing and building computer systems has become increasingly difficult; this is essentially due to the great number of existing solutions. This article proposes a hybrid heuristic allowing the connection between meta-models of different systems, which will allow the generation between models conforming to these connected meta-models. First, this article presents the architecture of the generative matching approach named generative automatic matching (GAM), then is introduced an important part of this approach, a hybrid heuristic allowing the matching between the meta-models. Finally, the authors conclude by a multiple criteria evaluation of this approach.

KEYWORDS

Domain Specific Languages, Generative Automatic Matching, Hybrid Heuristic, Matching, Meta-Models, Multiple Criteria Evaluation

INTRODUCTION

The use of model driven engineering MDE has made a significant contribution to today’s global software engineering. In fact, the model is currently at the heart of the development cycle, yet there are still many challenges that need to be addressed. As a matter of fact, the application of the MDE leads to the creation of a large number of DSLs (Batouta, 2015), however in the absence of a universal consensus that governs their creation, several meta-models are created with similar or complementary uses and objectives. Hence the need to achieve an approach that makes it not only possible to automatically match all these heterogeneous meta-models, but also to automate generation between these meta-models. To achieve this, we propose the approach that we have called generative automatic matching (GAM). The goal of this approach is therefore to allow the automatic generation of a global system consisting of different DSLs based on the matching (i.e. the correspondence through relationships and links) between the different meta-models comprising the system.

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In our previous paper we presented an approach called tertiary and systematic mapping review (TSMR) (Batouta, 2016), one of the results found is that between 49% and 85% of the studies offer their own code generation platforms by creating new DSLs. This alarming finding shows even more the urgency and the need to propose an approach that combines both matching the meta-elements of distinct and heterogeneous meta-models as well as the automatic generation of models conforming to these linked meta-models.

This paper is organized as follows: we start by describing the proposed architecture of GAM that allows generative matching between distinct meta-models; Then, we detail our approach mathematical formalism basis. After that, we propose a hybrid heuristic that aims to calculate the matching between the different elements of the meta-models; Next, we present related work and evaluation of our approach. Finally, we finish our paper with a conclusion and present some perspectives of our research.

**GENERATIVE AUTOMATIC MATCHING APPROACH**

This notion of generative matching or generative automatic matching has never been used before in the literature; Indeed, most of the approaches that have dealt with the problem of heterogeneities of the meta-models dealt only with the matching part between the models or even the meta-models, without treating the generation component between the models conforming to these meta-models, which presents the strong point of our approach. In this section, we will present our new approach GAM that addresses the problem of increasing heterogeneity of solutions. The aim of this approach is to allow the automatic generation of a system based on the matching between the different meta-models constituting the system, this approach is compose of two phases:

- The first step of our approach allows the linkage between completely heterogeneous meta-models, not just the linkage between Level 1 schemes or instances and models or even meta-models dealing with the same domains or representing different meta-models of the same version as is the case for traditional matching approaches, for example this approach encompasses the alignment between database meta-models (relational or big data), and meta-models representing schemas as XML meta-models and meta-models of different object-oriented languages like c# or java;
- The second step of our approach is the treatment of a second essential component, namely automatic generation between models; Indeed, the result of the matching is exploited to generate models called target of a final system from source models and that based on the automatic matching found in the first step.

Figure 1 shows the overall architecture of our approach.

As shown in Figure 1, the set of platforms are seen as a heterogeneous global system, consisting of exogenous meta-models representing various domains. The first step of the approach is to constitute a universal virtual meta-model consisting of source meta-models SMM1 … SMMi, which will be matched with TMM1 … TMMj target meta-models. The resulting matching will allow descending to layer 1; Indeed, the approach will allow, from source input models SM1 … SMI compliant with the source meta-models, to generate target models TM1 … TMj conforming to the target meta-models. The following section explains the process of our approach.

**GAM Meta-Model**

To realize our approach, it is essential to design a meta-model that will make it possible to identify the basic concepts that will be treated by our approach. For example, the concept of elements constituting source and target meta-models, the relations between them, the types of links and correspondences possible between two or more elements of the different meta-models, the management of the versions of the correspondences and also of the history of pairing (matching between two meta-models).
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