Families of Languages for Families of Systems (FLFS), ANR Programme Blanc, 2006

AML: A Domain Specific Language to Manage Software Evolution

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The FLFS project

FLFS involves three INRIA research teams: ASCOLA, AtlanMod, and Phoenix. Its purpose is to place domain expertise at the centre of software development process. FLFS addresses the current limitations of software engineering with regarding large-scale software production, robustness, reliability, maintenance, and evolution. Our main contribution is to parameterize software development process with a specific domain of expertise. This approach covers all the stages of software development and combines the following three emerging paradigms:

- Domain-Specific Modelling, also known as Model Driven Engineering.
- Domain-Specific Languages (DSL), instead of General-Purpose Languages.
- Generative Programming (GP), in particular Aspect-Oriented Programming as a mean to transform models and programs.

This poster presents one of the FLFS contributions: AML, a DSL for expressing matching algorithms, and its application to software evolution.

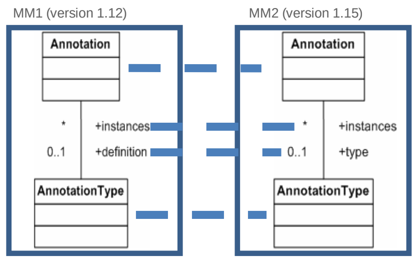
A Software Evolution Problem

Let us illustrate an instance of the software evolution problem. The Netbeans Java API evolve from version 1.12 to version 1.15. Programmers have to adapt their programs to the new API. How can programmers get out of the tedious refactoring task?

A Solution Integrating Models, GP, and DSL

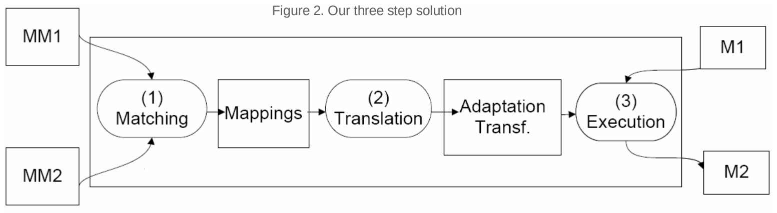
We represent software artifacts (e.g., programs) using models. The models conform to a metamodel (e.g., the Netbeans Java API).

Figure 1. Metamodels representing Netbeans Java API versions



Then, we apply a three-step solution (Figure 2). Firstly, a matching algorithm computes the mappings and changes (blue dotted lines in Figure 1) between MM1 and MM2.

Figure 2. Our three step solution



Users verify and refine the algorithm result if necessary. Secondly, an adaptation transformation is derived from the discovered mappings and changes. Finally, This transformation brings M1 in conformance with MM2, and persists the result in M2.

The bulk of this work is devoted to the Matching step. A challenge is to make matching algorithms much more generic, i.e., independent of their application domain: software evolution, database integration, ontology development, etc.

The AtlanMod Matching Language (AML) [Garces, IDM, 2009]

AML is a DSL that facilitates:

- **Simple development of matching algorithms.** There is not an unique algorithm that matches all models perfectly. In practice, given a pair of models, programmers have to change a matching algorithm in order to get accurate results. AML allows to adapt matching algorithms in a straightforward way.
- **Reutilization of matching techniques.** Matching algorithms often combine two kinds of matching techniques:
  - Generic techniques base their judgments on standard kinds of features, e.g., labels.
  - Narrowed techniques refer to a particular domain and improve the results of generic techniques.

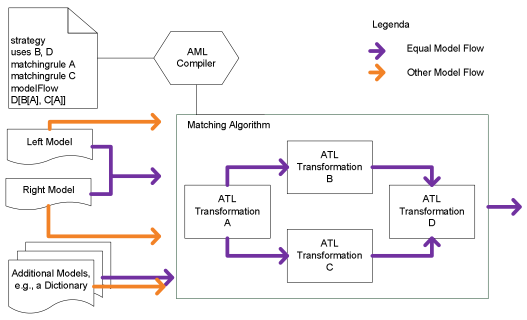
  AML enables to develop both Generic and Narrowed techniques. Generic techniques can match models related to any application domain.

Fundamentals behind AML

In runtime, an AML algorithm is a chain of model transformations (Figure 3). Each transformation:

- Instruments a matching technique.
- Takes as input a set of models: the models to be matched (i.e., Left Model and Right Model), an *Equal model* that refers to Left and Right model, and a set of additional models.
- Yields an *Equal model*. Each *Equal model* basically contains a set of mappings.

Figure 3. AML Constructs



AML Results on Software Evolution [Garces, ECMDA, 2009]

We have validated our solution on two concrete examples:

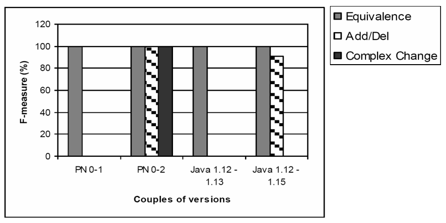
- A Petri Net metamodel from the research literature: 6 versions.
- The Netbeans Java metamodel: 8 versions.

Accuracy
Figure 4 shows that AML achieves a high accuracy. The percentage of correct mappings (or equivalences) and changes ranges from 99%-100%, and 90%-100%.

Performance
Petri Nets: ~1s
Netbeans Java: ~10s

In the Java scenario, we have used the adaptation transformation to migrate the source code of GNU Classpath. The transformation generates a model with 69791 lines, and takes 38 s.

Figure 4. Accuracy results



AML Tools

- AML main page, http://wiki.eclipse.org/AML
- The software evolution use case, http://www.eclipse.org/m2m/atl/usecases/ModelAdaptation