DSM Working Group: Composition and Integration of DSMs
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Issues

• No explicit definition of interfaces. Don’t know which elements to extend, the semantics might break.

• Stay within the language, migrate to the new model is a problem. Possible solution: patching problems, new version contains patching modules, contains the deltas.

• Patches might be difficult due to links to the meta-levels which change. Can ship transformations with the changes. Difficult to do.
Problems

• When a DSL is designed, don't have extensibility in mind. One shot solution. A Solution might be to identify the variation points at the beginning. Problem: how to build extensibility into a language.

• Extensibility via interfaces – how to do that in language design.

• Example from WebDSL: attaching behaviour to text, was not envisaged originally need to go into the code and add this.
Language Extension Strategies

• Principles for designing-in extensibility.
• Monticore holes in the grammar – extension points for syntax. Editors are defined separately then combined at run-time in to the tool for the language. Also for code generation.
• UML left open the action language – OMG left a placeholder for action languages. To do this need a component and interface model for combining language elements.
Language Decomposition and Extensions

• Is it possible to have a standard library for example an expression language that can be reused in new languages. For example, OCL has been decomposed like this.

• Extension Strategies:
  – Use 1 language and then adapt it to produce a new language. For example UML profiles.
  – Use several languages (could be independent) and then merge.
  – A (possibly incomplete) language with extension points.

• Should a language know that it is being extended?
Semantics

- When integrating multiple independent languages there are problems due to semantic integration. Often the semantics is informal and cannot easily be combined.
- Need a way to standardize on the language semantics to facilitate language combination.
- Approaches:
  - Common language
  - Pair to pair transformations
  - Proxies or middleware
- An approach: use proxies over independent language definitions. E.g. C++ with templates and Java.
- Semantics is key to language integration.
- Possibly project the semantics of languages into a common representation to perform combination.
- Common meta-meta-models have been tried before. Perhaps agreeing on such a thing would be a solution (the MOF++ approach).
Integration

• Integration approaches:
  – One language references another
  – Java syntax embedded in the new language
  – Common Semantics.
    • Code generator
    • Interpreter.
• Take 2 independent languages and construct a meta-model that covers both for integration.
• Adding a new language must involve the constraints and requirements that must be met by composition.
• Be clear about the requirements for combination: do you want a single tool for the merged language or continue with the original tool-set.
• Are there patterns for language integration that can be identified and documented?
• Currently integration is performed manually. Can language components be integrated automatically? What does this requirement mean for the models used to express language interfaces etc.
• Problem: integrating many special purpose languages can end up with a single GPL.
Language Components and Interfaces

• Problem: what does an interface for a language look like?
• Problem: There is no component model for languages.
• Start with a base module and define the interfaces for future extensions.
• Languages are defined as a core and extension modules.
• Interfaces should include requirements and guarantees for use and combination of the language component.
• Example: build an expression language, plug-in the expression language to several new languages. Question: what interface should the expression language have to support insertion and combination.
• Aim: How to achieve a product-line approach to language definition.
• Type systems are going to be part of the interface of a language component. Type systems need to be integrated (or mapped) when language components are integrated.
• Problem: When defining interfaces how to anticipate all possible future extensions and combinations of the language.
Language Tools

• Problem: how to combine existing tools (compilers, editors etc) when combining existing languages into a new DSL.

• How to reuse tools when defining a modification of an existing language.
Guidelines

• DSL designers need to be aware of where the extension points are.
• Possible to leave plug-points in a language.
• Look to produce and use a library of reusable components.
• Standardize and define the semantics for language combination.
• Common Meta-models makes life easier.
• Designing language components for reuse is easier than reusing an existing language.
• The abstract syntax and the semantics seems core the notion of languages and integration.