University of Zurich
Department of Informatics

Master's Thesis Proposal

in the Requirements Engineering Research Group

Topic / Working Title

Semi-Automated Aspect Extraction (Unweaving) of Features in Product Line Requirements Engineering

Content

This thesis work integrates with our previous and current work within the projects ADORA[1] and SPREBA[2], where we

- utilize aspects to modularize variability in product line requirements engineering,
- build an experimental implementation of our research approach with the ADORA language and tool,
- use a boolean decision modeling concept to handle the variability details and relationships.

As a result of this thesis we expect that such an semi-automated ‚unweaving' of aspects or variants eases refactoring of a conventional reference model into a product line domain model and also helps significantly in developing a product line model from scratch. For example, when a new product line is created, a modeler in domain engineering can simply start with modeling one single product instance first, and afterwards select all the optional and product-specific feature elements of the model to automatically separate them as variants. This way we expect that the product line model can be created more easily and naturally from a modeler's point of view.

The main tasks to be performed within this thesis will be the following:

1. Initially, the basic concepts and the relevant literature for this thesis need to be studied. This can roughly be divided into two parts:
   - First of all, a literature study needs to be performed on how models are created from any other kinds of documents in industrial projects, generally. In the industrial and governmental sectors, requirements are still mostly described with text-based documents. Studying the creation of models from other, textual requirements is thus an essential prerequisite for the applicability of the ADORA language and tool in this context.
   - Secondly, with regards to product line requirements, it has to be studied how the typical variants of a product line system look like. For example, of which views they consist and how and where they typically impact the system. The results of this study will provide the necessary information for an optimized modularization and weaving semantics of variable features in a product line.
2. Based on these results, an in-depth analysis on how our current solution with modeling aspects in ADORA can be applied for the typical variants that occur in industrial practice has to be performed. Therefore, your advisers will provide you with two current real-world requirements specification exemplars. One of them is from the area of industrial au-

[1] http://www.research-projects.uzh.ch/p622.htm
[2] http://www.research-projects.uzh.ch/p12003.htm

tomation devices and another one deals with governmental decision support systems. Based on these examples the suitability of the ADORA language and generally the creation of ADORA models from existing documentation has to be examined critically. Insufficiencies and new requirements for our project shall be documented.

3. A new concept and technique for an efficient semi-automated extraction of feature aspects from the product model has to be built. This will be done by elaborating, deciding and implementing one of the following solutions:
    a. Re-engineering and/or generalizing our aspect weaving semantics to be usable for both (i) modualization of crosscutting concerns and (ii) modularization of variability.
    b. Creating a solution which completely builds on our existing aspect weaving semantics, but at the same time is capable of extracting and modularizing all the different kinds of ‚feature realisations' possible. Exploiting ADORA's capabilities of hierarchically structuring multiple aspects and using multiple join relationships for one variant will be the basic ideas here.

    Generally, in this step a new mechanism for semi-automated feature unweaving will be defined and implemented. For an ideal solution it needs to be evaluated if either solution a., or solution b., or a compromise between them needs to be chosen.
4. A validation on how this new solution can efficiently be used to create a product line domain specification from a single reference specification has to be performed. This demonstration shall preferably be done with both of the two real-world requirements exemplars already mentioned in step 2. Your advisers will establish the necessary contacts and provide the relevant data for you. This validation has to show a significant increase in efficiency (e.g. considerably less time spent for graphic re-modeling of variants) and customer satisfaction for specifying variants in a product line requirements specification.
5. The master's thesis has to be written. It shall report the results of all the previous steps and give an outlook how this new solution for semi-automated feature unweaving can improve the current and future practice in requirements engineering for product lines. Also difficulties found within this thesis shall be documented and discussed.

The main deliverables after successful completion will be

- an extensive survey on creating models from typical software requirements documents and how variable features are typically manifested in such models,
- new concepts + tool implementation for semi-automatically extracting existing features from a product model to create new product variability (feature unweaving),
- a validation on two current real-world exemplars, which demonstrates the new concepts and their impact, applicability and usability in real-world situations,
- and the final written thesis which describes and reports all the essentials of this work.

The evaluation of the thesis will consider the state-of-the-art of the existing concepts and implementations, the extent and quality of the new concepts for improvements, the implementation of these concepts, and the thoroughness and coherence of the validation.

Literature

Important and relevant literature has to be identified autonomously and taken into account for elaborating this thesis. Your advisers can assist you with reviewing your proposed literature and give constructive critique. The literature needs to cover both general literature on requirements modeling, product line requirements engineering and reports on recent industrial experiences,

and our work on the ADORA approach, including the newer extensions for aspect-oriented modeling and product line requirements engineering.

Prerequisites

- ✓ Interst in applying novel technologies from research within industrial and governmental practice
- ✓ Experience and joy in Java programming and Eclipse plug-in development
- ✓ Good general knowledge in requirements engineering (further, knowledge of the ADORA language and tool is beneficial)

How to proceed

We suggest the following steps to proceed when elaborating this thesis:

- Study of existing literature and experience reports (ca. 10%),
- Study of the ADORA language and tool and its product line engineering capabilities, with a special focus on its feasibility and applicability for real-world product lines (ca. 15%),
- Development and implementation of a new concept to enable a semi-automated feature unweaving of variability within the ADORA language and tool; with a focus on the real-world needs in this area (ca. 40%),
- Application and validation of this novel implementation with the two proposed industrial exemplars; and optimizations (ca. 15%),
- Thesis writing (ca. 20%).

Duration: 6 months full-time, 30 ECTS

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