TECHNISCHE UNIVERSITÄT DRESDEN

Technical University Dresden Department of Computer Science Chair for Software Technology

31. Role-based Generic Model Refactoring

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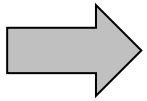
Agenda

1. From Code to Models
2. Related Work
3. Role-based Generic Model Refactoring
4. Evaluation
5. Contributions

An Example of Code Refactoring

Extract Method

```
1  public class HelloJava {
2
3      private static int i = 0;
4
5      public static void main(String[] args) {
6          System.out.println("Hello Java");
7          for (; i <= 10; i++) {
8              System.out.println("value: " + i);
9          }
10     }
11
12 }
```



```
1  public class HelloJava {
2
3      private static int i = 0;
4
5      public static void main(String[] args) {
6          System.out.println("Hello Java");
7          iterate();
8      }
9
10     private static void iterate() {
11         for (; i <= 10; i++) {
12             System.out.println("value: " + i);
13         }
14     }
15 }
```

Why is Refactoring needed for Models?

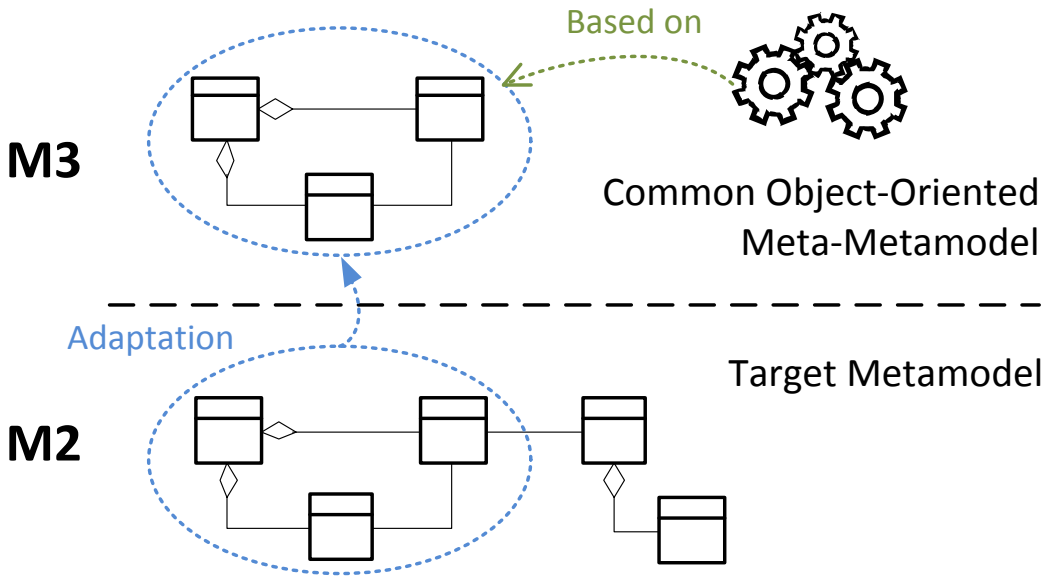
- Models are primary artefacts in MDSD
- Importance of design increases with model complexity
- Good model design is essential for understandability

Why should it be generic?

- Known code refactorings are transferable to many DSLs
- Core steps of refactorings are equal for different metamodels
- A lot of additional effort to specify refactorings from scratch

Related Work - Limitations

M3 layer specification

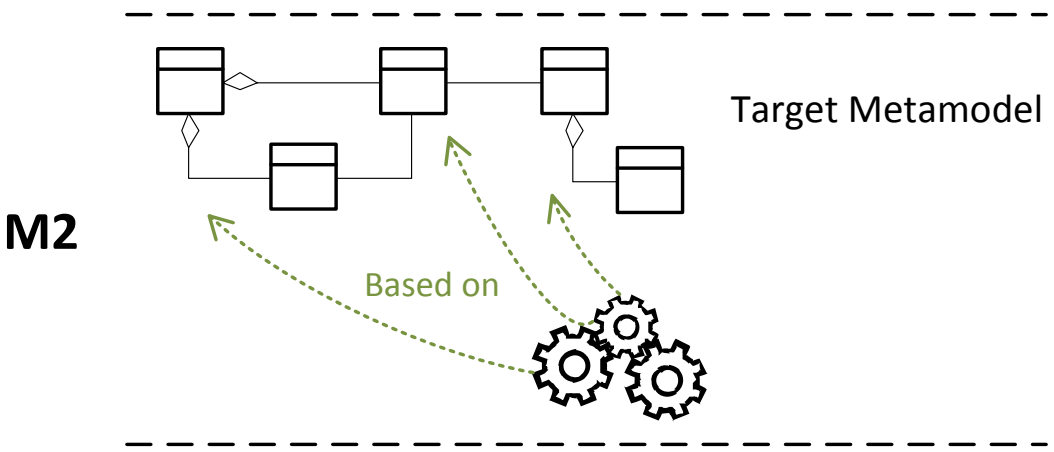


- Common meta-metamodel to static
- Lack of exact control of structures to be refactored

[Moha, Naouel, Vincent Mahé, Olivier Barais und Jean-Marc Jézéquel: *Generic Model Refactorings*, MODELS 2009]

Related Work - Limitations

M2 layer specification

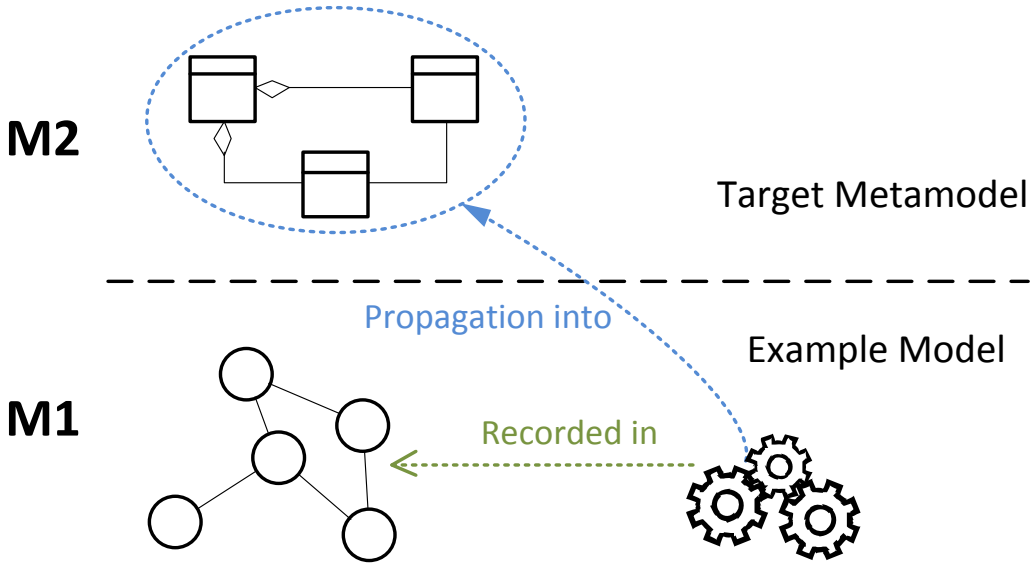


- No genericity
- No reuse

[Taentzer, Gabriele, Dirk Müller and Tom Mens: Specifying Domain-Specific Refactorings for AndroMDA Based on Graph Transformation, AGTIVE 2007]

Related Work - Limitations

M1 layer specification

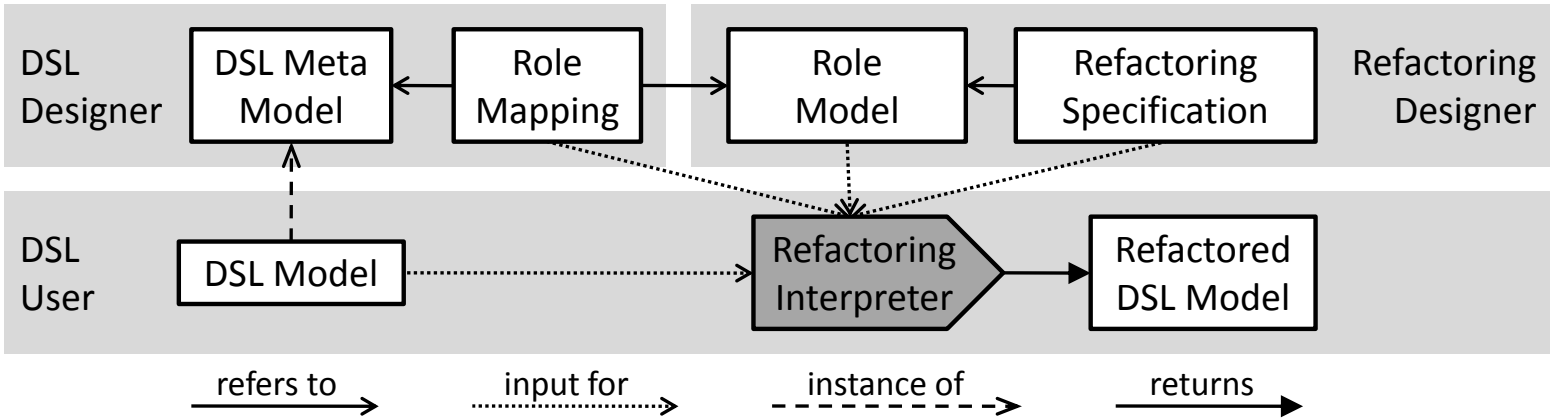


- No genericity
- No reuse

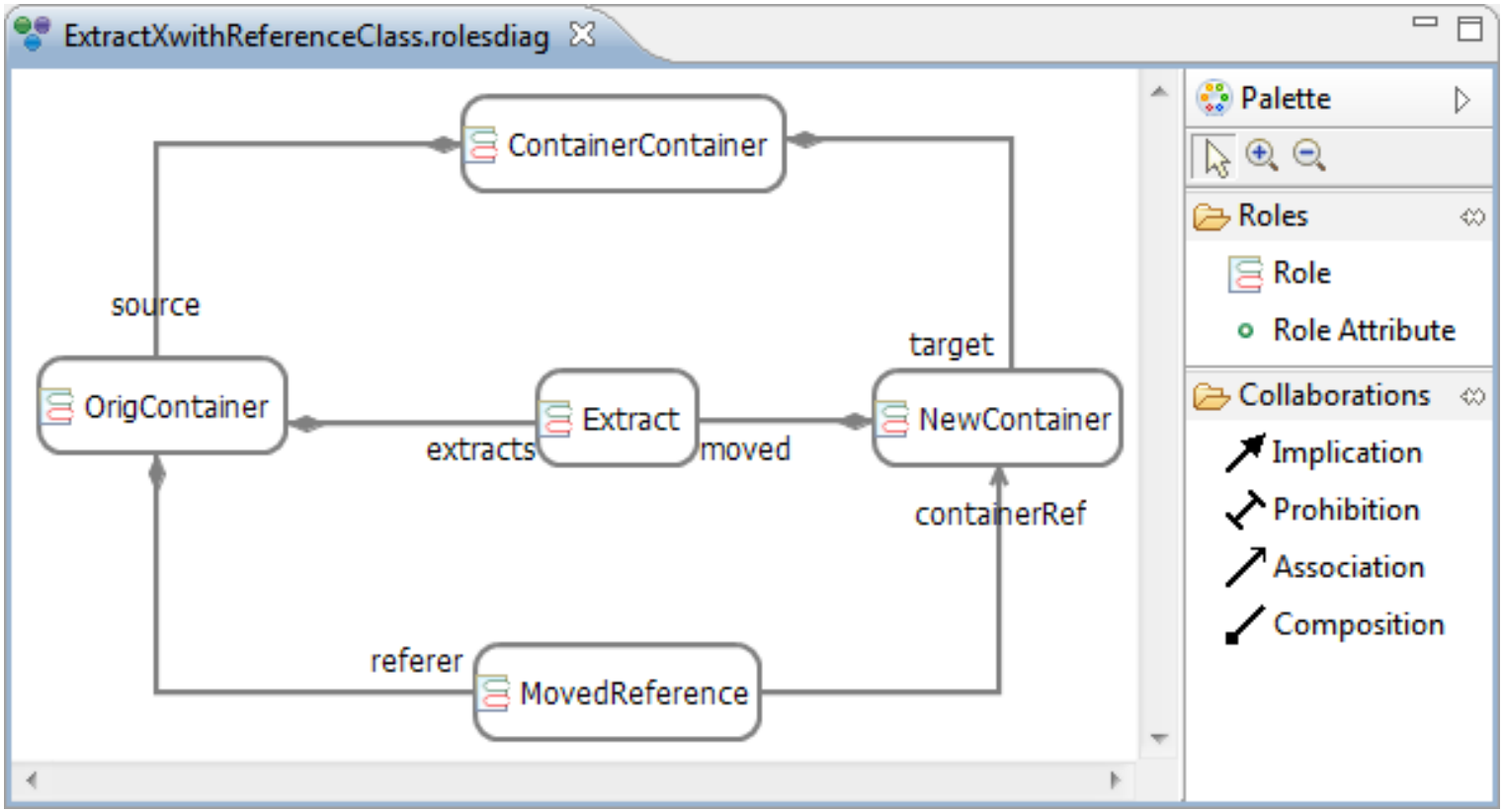
[Brosch, Petra, Philip Langer, Martina Seidl, Konrad Wieland, Manuel Wimmer, Gerti Kappel, Werner Retschitzegger and Wieland Schwinger: *An Example is Worth a Thousand Words: Composite Operation Modeling By-Example*, MODELS 2009]

Role-based Design (Reenskaug, Riehle & Gross)

- Definition of collaborations of objects in different contexts
- Here: Context = model refactoring
- Participants play role in concrete refactoring → Role Model
- Role-based transformation → Refactoring Specification
- Application to desired parts of metamodel → Role Mapping



Role Model


ExtractXwithReferenceClass.rolesdiag
ContainerContainer
source
target
OrigContainer
Extract
NewContainer
extracts
moved
containerRef
referer
MovedReference
Palette
Roles
Role
Role Attribute
Collaborations
Implication
Prohibition
Association
Composition

Role-based Generic Model Refactoring

Refactoring Specification on Role Model

ExtractXwithReferenceClass.refspec

```
1  REFACTORING FOR <ExtractXwithReferenceClass>
2
3  STEPS {
4      object containerContainerObject := ContainerContainer from uptree(INPUT);
5      object origContainerObject := OrigContainer as trace(INPUT);
6      index extractsIndex := first(INPUT);
7
8      create new nc:NewContainer in containerContainerObject;
9      assign nc.newName;
10     move OrigContainer.extracts to nc;
11     create new mr:MovedReference in origContainerObject at extractsIndex;
12     set use of nc in mr;
13 }
```

Role-based Generic Model Refactoring

Role Mapping to Specific DDL

extractProcedure.rolemapping

```
1  ROLEMODELMAPPING FOR <http://www.emftext.org/language/pl0>
2
3  "Extract Procedure" maps <ExtractXwithReferenceClass> {
4      OrigContainer := Body {
5          extracts := statements;
6      };
7      Extract := Statement;
8      NewContainer := ProcedureDeclaration (newName -> name)  {
9          moved := block -> body -> statements;
10     } ;
11     MovedReference := CallStatement {
12         containerRef := procedure;
13     };
14     ContainerContainer := Block {
15         source := body;
16         target := procedures;
17     } ;
18 }
```

Evaluation

Results

Starting point

- 16 target metamodels of different complexity (Java, UML, Ecore…)
- 53 concrete model refactorings

Result

- 9 generic model refactorings
- 6 metamodel specific extensions were needed
- 7 metamodels are multiple target of same model refactoring
- 2 metamodels are at least target of every model refactoring

Lessons Learned

- Refactorings generically specifiable if abstractable and structurally transferable
- Metamodel-specific refactorings possible
- Design decisions
  - ”Specific” generic refactoring
  - Metamodel-specific extension or
  - Implementation of metamodel-specific refactoring (Java)
- Reuse beneficial if model refactoring appliable to at least two metamodels

Conclusion

- Generic refactoring works!!

- Definition of generic model refactorings based on roles
- Role models form a dedicated context for every model refactoring
- Approach allows both for genericity and control of the structures to be refactored
- Control is achieved by mapping of role models into arbitrary sections of the target metamodel
- Interpretation by resolving roles and collaborations into the target metamodel

Outlook

- Pre- and postconditions with role-based OCL interpreter
- Preservation of behavior with formalization of semantics
- Specification of model smells
- Co-Refactoring
- Automatic mapping to metamodels

Students looked for in Resubic Lab

Co-Refactoring of mulit-quality specificatios

http://resubic.inf.tu-dresden.de

http://www.emftext.org/refactoring

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Mapping to Paths