



31. Generic Refactoring for Programming and Modeling Languages

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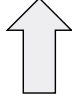
Version 11-1.1, 17.1.11

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



- Sander Tichelaar, Stéphane Ducasse, Serge Demeyer, and Oscar Nierstrasz. A meta-model for language-independent refactoring. In Proceedings of International Symposium on Principles of Software Evolution (ISPSE '00), pages 157-167. IEEE Computer Society Press, 2000.
 - doi:10.1109/ISPSE.2000.913233,
- MOOSE framework <http://www.moosetechnology.org/>
- Jan Reimann, Mirko Seifert, and Uwe Abmann. Role-based generic model refactoring. In Dorina C. Petriu, Nicolas Rouquette, and Øystein Haugen, editors, MoDELS (2), volume 6395 of Lecture Notes in Computer Science, pages 78-92. Springer, 2010. Best Paper Award.

```
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 }
```

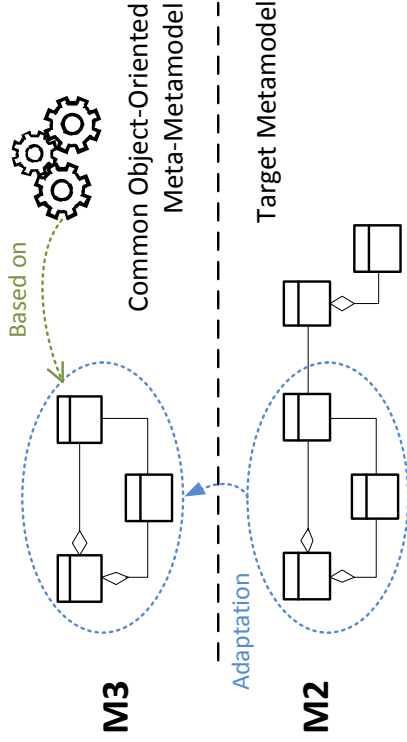
From Code to Models Why is Refactoring needed for Models?

- Model-Driven Software Development:
 - Models are partial code
 - Models are primary artefacts in MSD
 - Good model design is essential for understandability
 - Some models are domain-specific, and belong to **domain-specific languages (DSL)**

Why should it be generic?

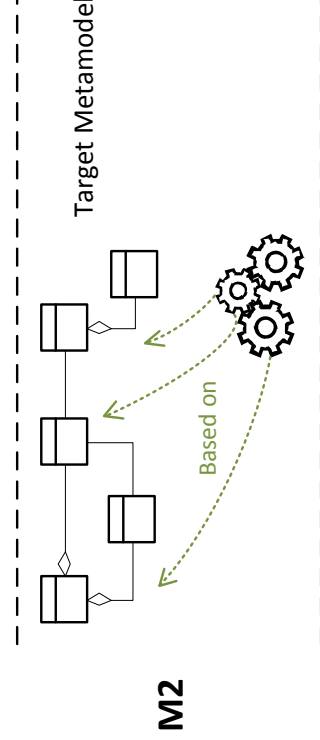
- Known code refactorings are transferable to many DSLs
- Core steps of refactorings are equal for different metamodels
- A lot of additional effort to specify refactorings from scratch

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



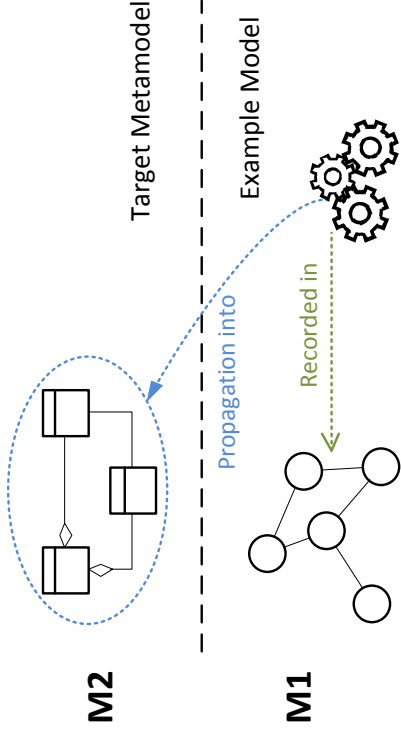
[Moha, Naouel, Vincent Mahé, Olivier Barais und Jean-Marc Jézéquel: *Generic Model Refactorings*, MODELS 2009]

- No genericity
- No reuse



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

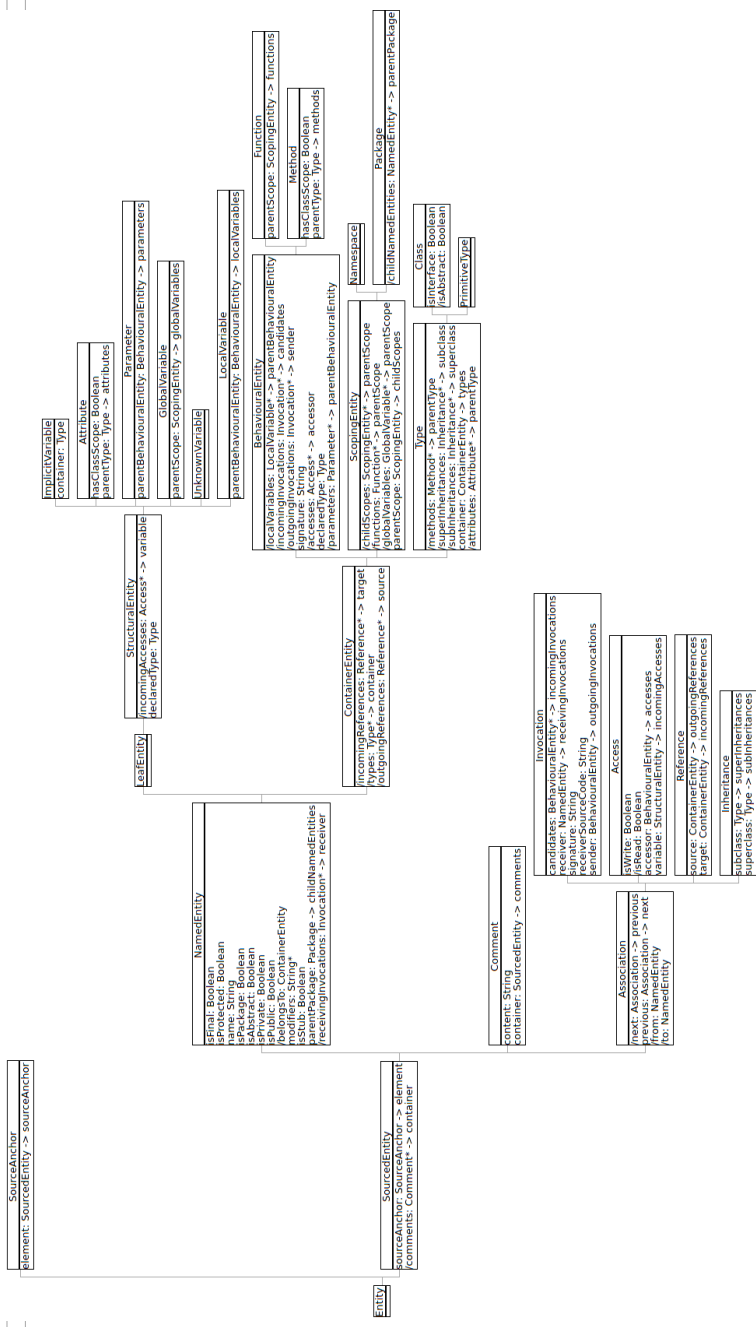
- No genericity
- No reuse



[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]



FAMIX Upper Metamodel



http://www.moosetechnology.org/?_s=5k2-x-GDJjd2YIX

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Role-based Generic Model Refactoring

Folie 9 von XYZ



- The FAMIX upper metamodel
 - Enables generic refactoring for all entities *above methods*, class restructurings, etc.
- The MOOSE framework supplies basic graph algorithms for reengineering and refactoring:
 - Strongly connected components
 - Dominance
 - Kruskal spanning trees
- Concept recognition in texts
- Formal concept analysis

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Role-based Generic Model Refactoring

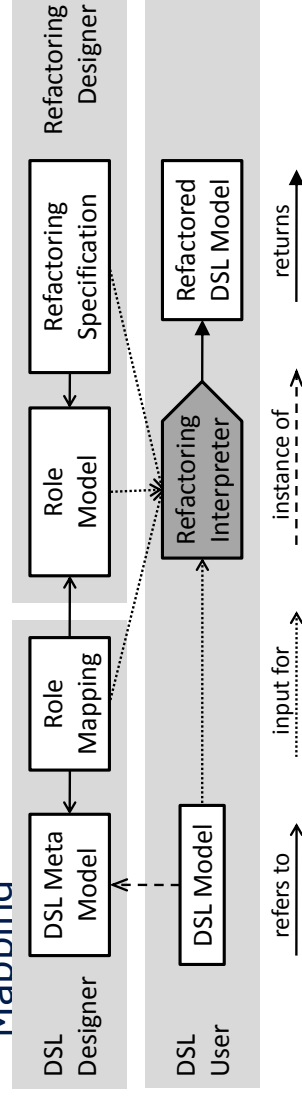
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31.2 Refactory

The generic refactorer of TU Dresden
Jan Reimann

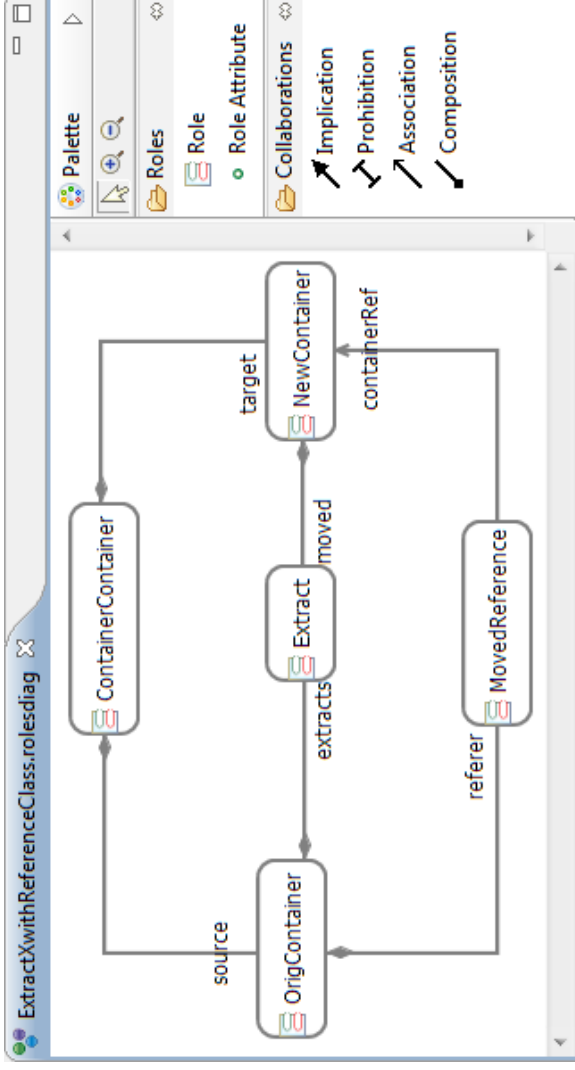
Role-based Design (Reenskaug, Riehle & Gross)

- 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-based Metamodeling

- Refactory sees a role model (a view) of the metamodel



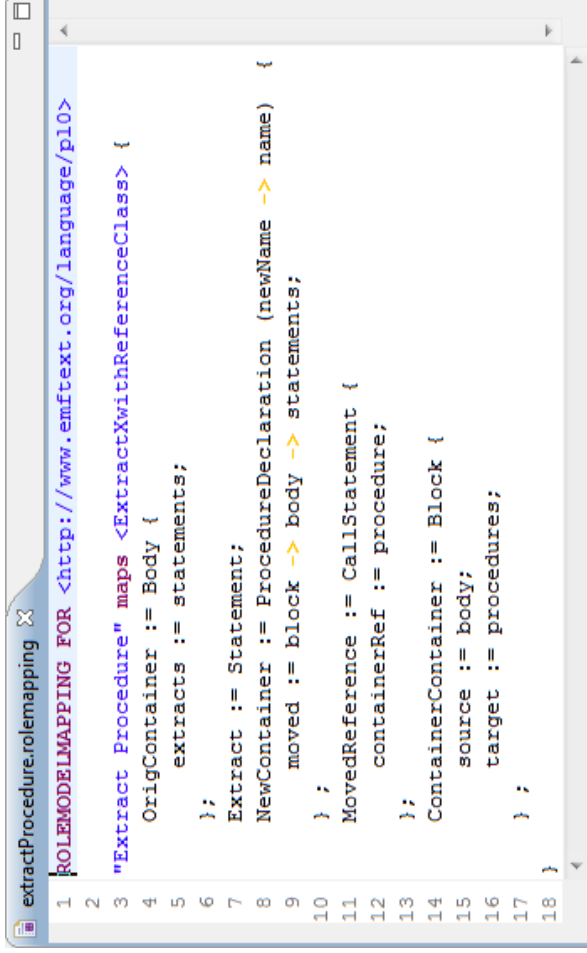
Refactoring Specification on Role Model

- The roles of this role-metamodel can be used to write refactoring scripts and operators

```
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 extractIndex := first (INPUT);
7
8   create new nc:NewContainer in containerContainerObject;
9   assign nc.newName;
10  move OrigContainer.extract to nc;
11  create new mr:MovedReference in origContainerObject at extractIndex;
12  set use of nc in mr;
13 }
```

Role Mapping to Specific DDL

- A **mapping** maps roles to metaclasses in a concrete metamodel



```
extractProcedure.rolemapping X
1  ROLEMODEL MAPPING 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 }
```

Starting point

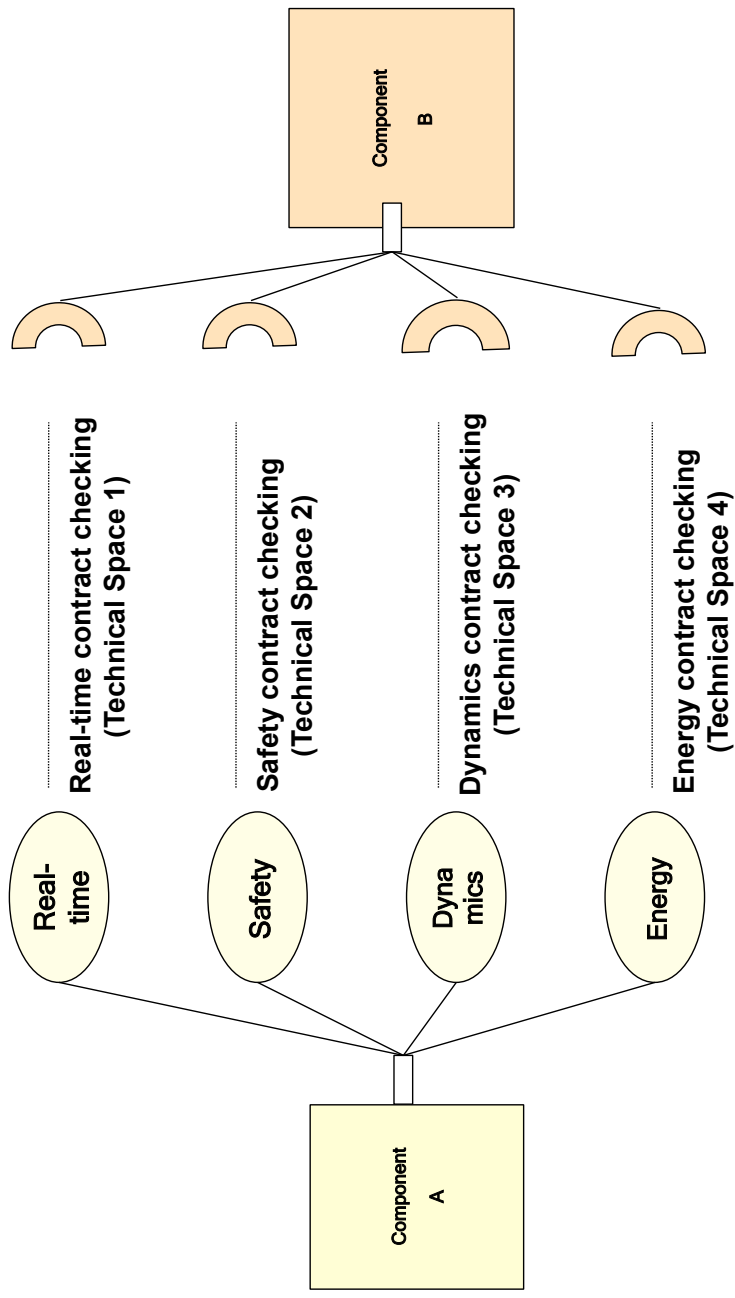
- 16 target metamodels of different complexity (Java, UML, Ecore...)
- 53 concrete model refactorings

Result

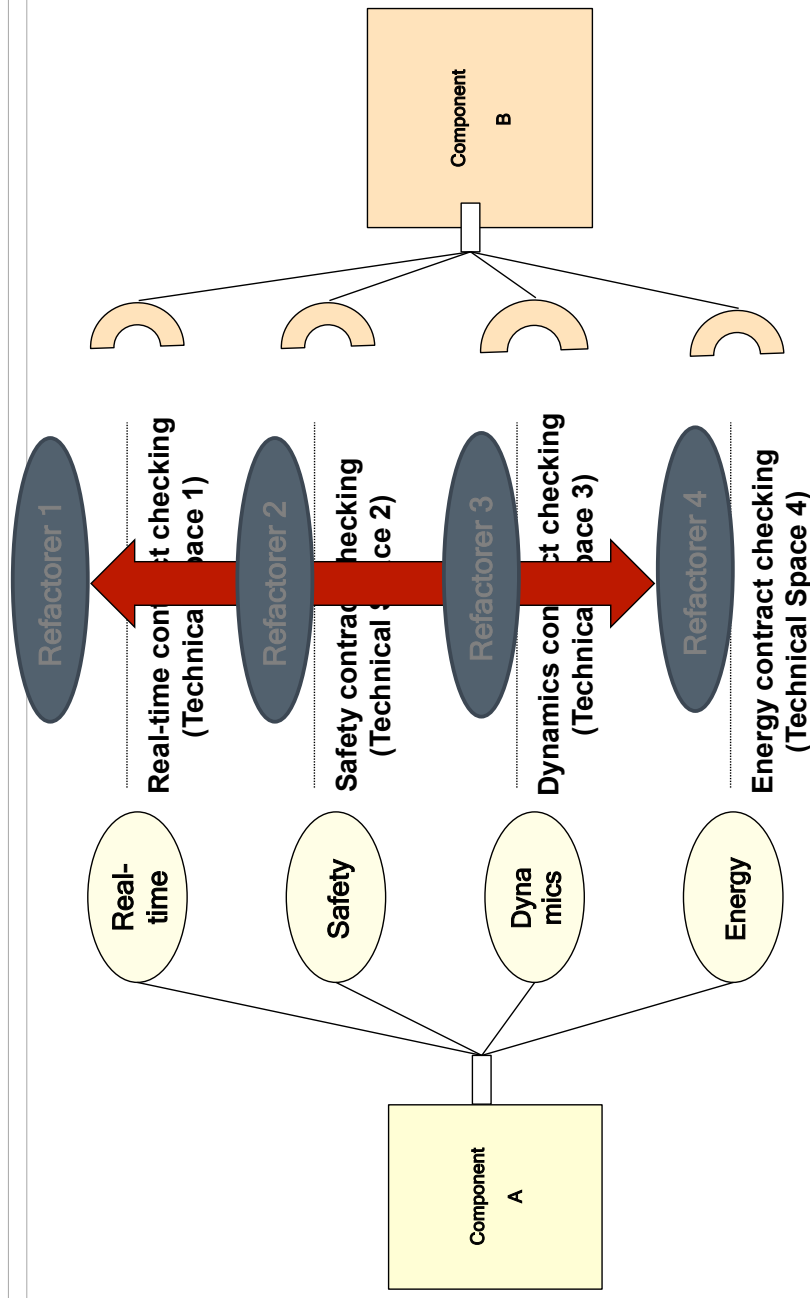
- 9 generic model refactorings
- 6 metamodel specific extensions were needed
- 7 metamodels are multiple target of same model refactoring
- 2 metamodels are at least target of every model refactoring



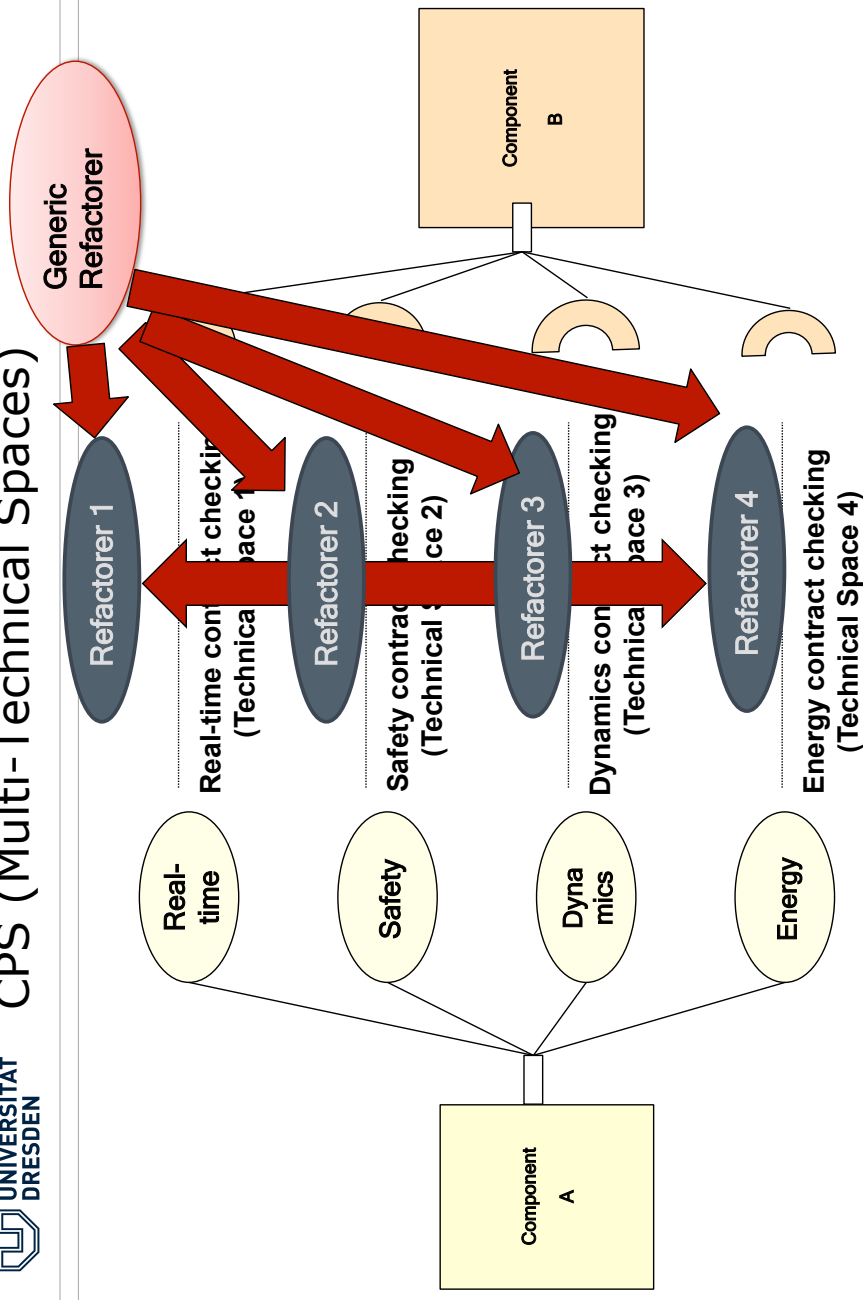
New: Multi-Quality Contracts in CPS (Multi-Technical Spaces)



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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 applicable to at least two metamodels

- 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 multi-quality specifications

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

<http://www.emftext.org/refactoring>



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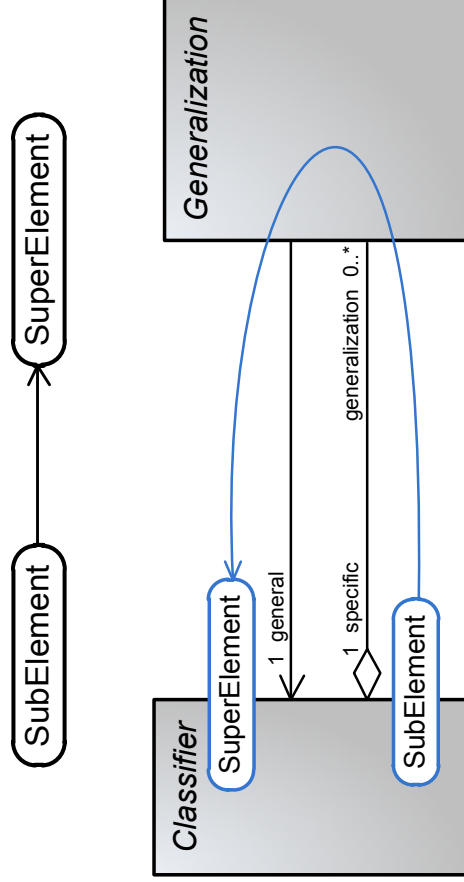


Role-based Generic Model Refactoring

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Slide 2:

Mapping to Paths



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