Karlsruhe Institute of Technology

Challenges in Evolving Metamodels

Misha Strittmatter, Robert Heinrich

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SOFTWARE DESIGN AND QUALITY GROUP
INSTITUTE FOR PROGRAM STRUCTURES AND DATA ORGANIZATION, FACULTY OF INFORMATICS

Why use Modeling / Metamodels?

- Model-driven Engineering (MDE)
  - Use domain-specific models
  - Raise the abstraction level
  - „Hide“ complexity behind tooling
  - Use models for analysis, simulation, code generation

Why use Modeling / Metamodels?

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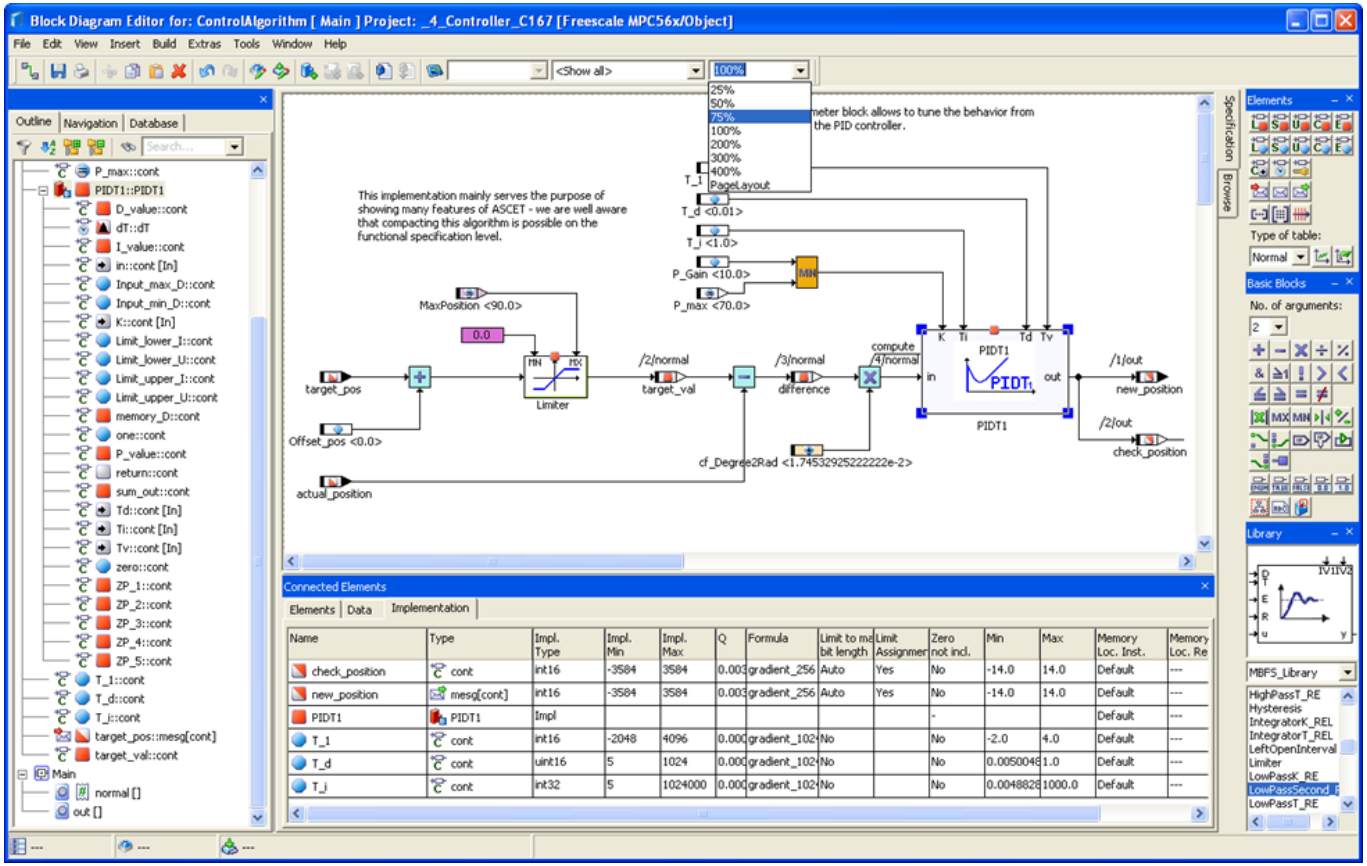
  - Use models for analysis, simulation, code generation
- Metamodel
  - Abstract syntax of a (modelling) language
  - Defines set of its instances (models)

Example: ASCET

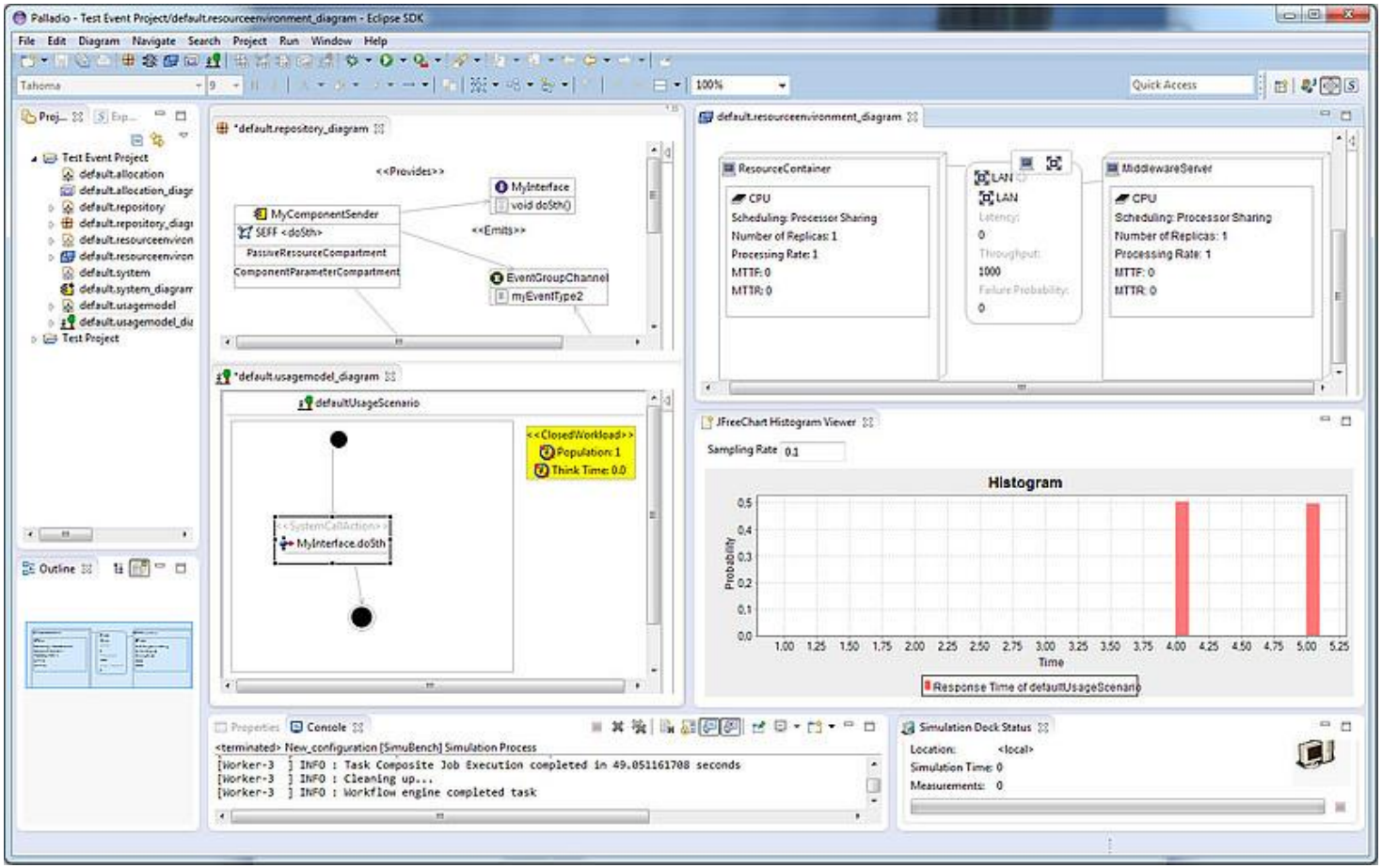
- **A**dvanced **S**imulation and **C**ontrol **E**ngineering **T**ool



(Wikipedia)

Example: PCM

- **P**alladio **C**omponent **M**odel



(http://www.palladio-simulator.com/)

Further (Industry Relevant) Examples

- UML
- AADL, AMALTHEA, EAST-ADL (automotive)
- ArchiMate
- Simulink
- Rapide
- …

(partly from a study about most used architecture description languages in industry [1])

Further (Industry Relevant) Examples

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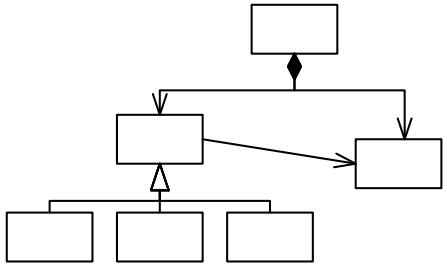
Examples for modeling languages (not necessarily metamodeled)

(partly from a study about most used architecture description languages in industry [1])

Metamodels

- Our focus: EMOF based metamodels (or similar)
- Classes, attributes, associations, inheritance, containment

Metamodel



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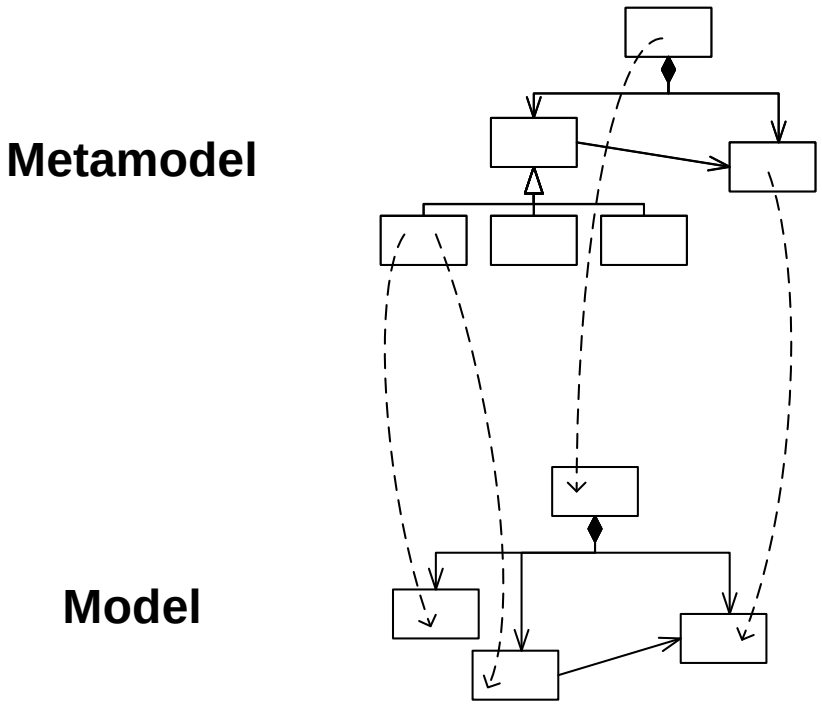
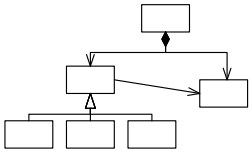
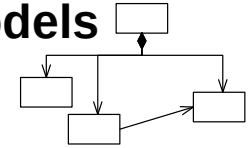


Usage



Metamodel

Models



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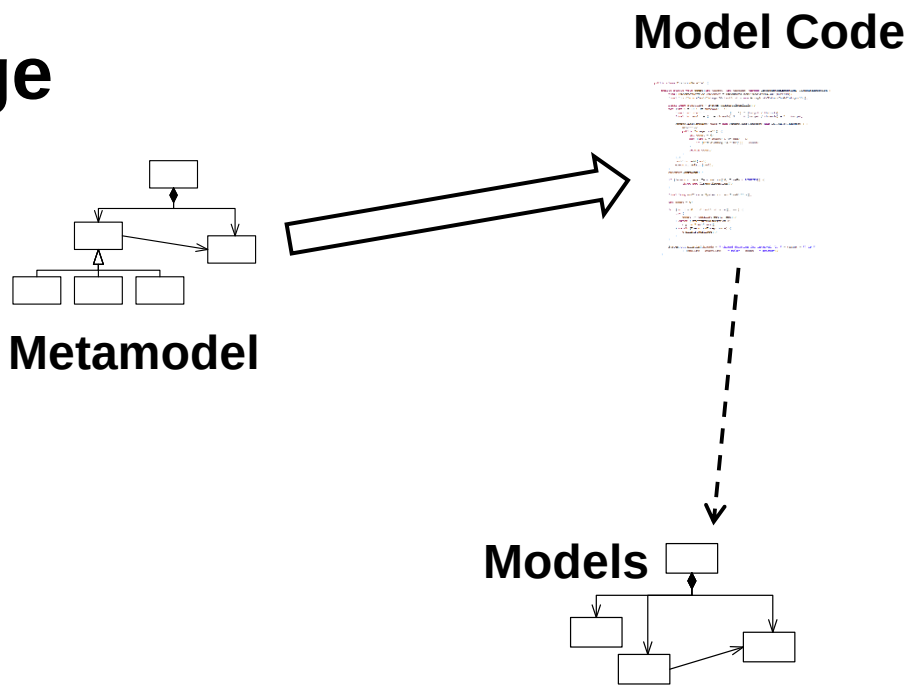

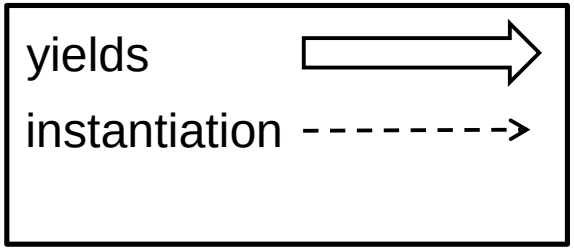

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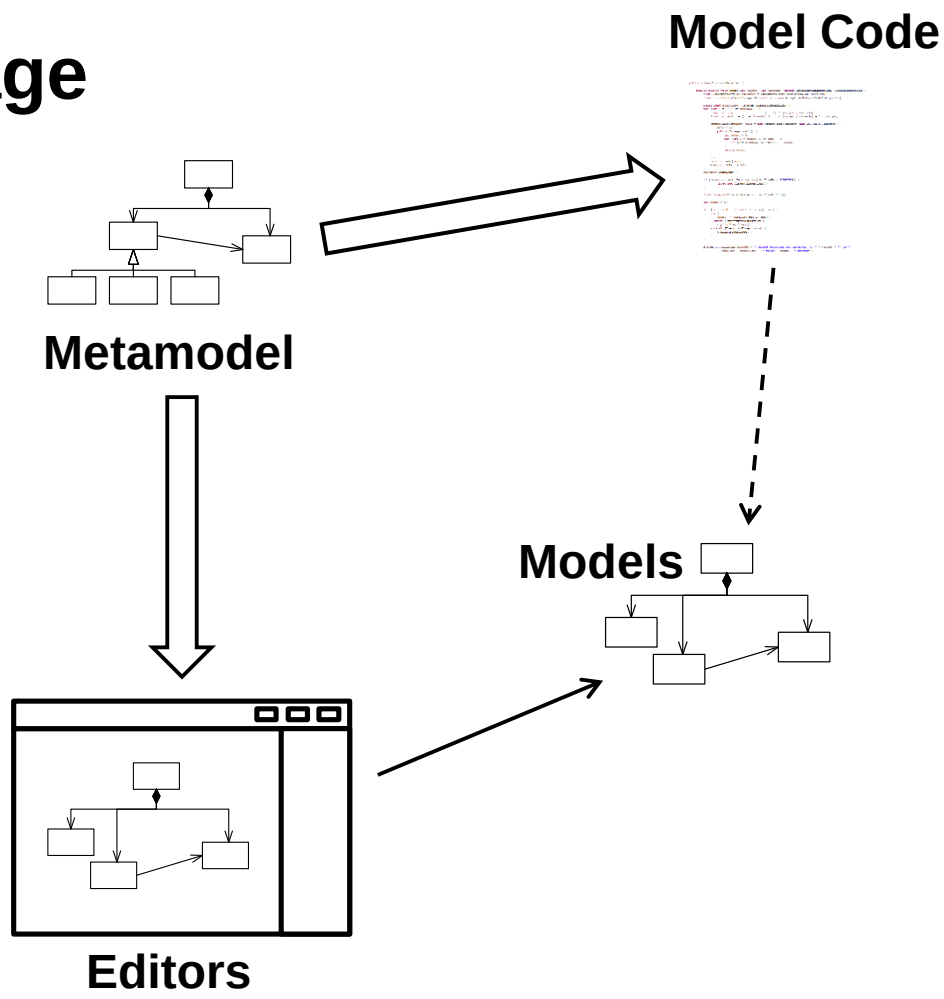
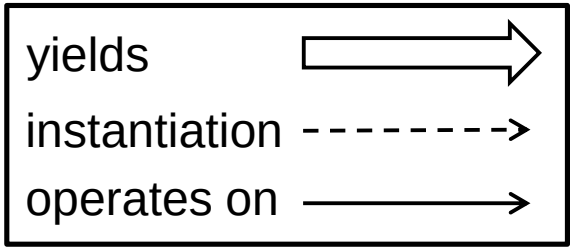

Model Code
Metamodel
Models
Editors


yields
instantiation
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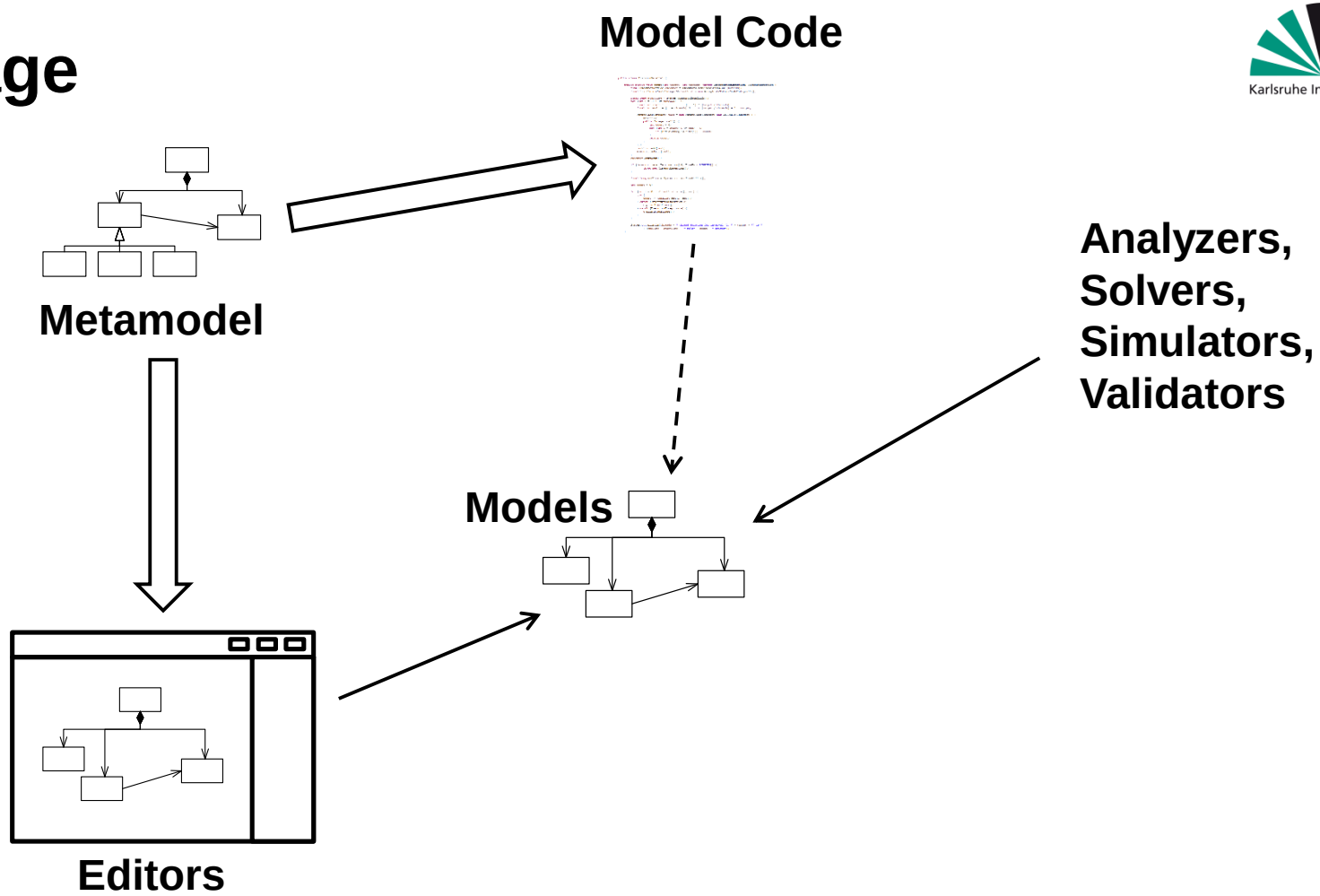
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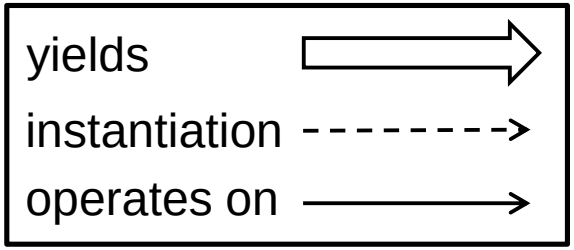
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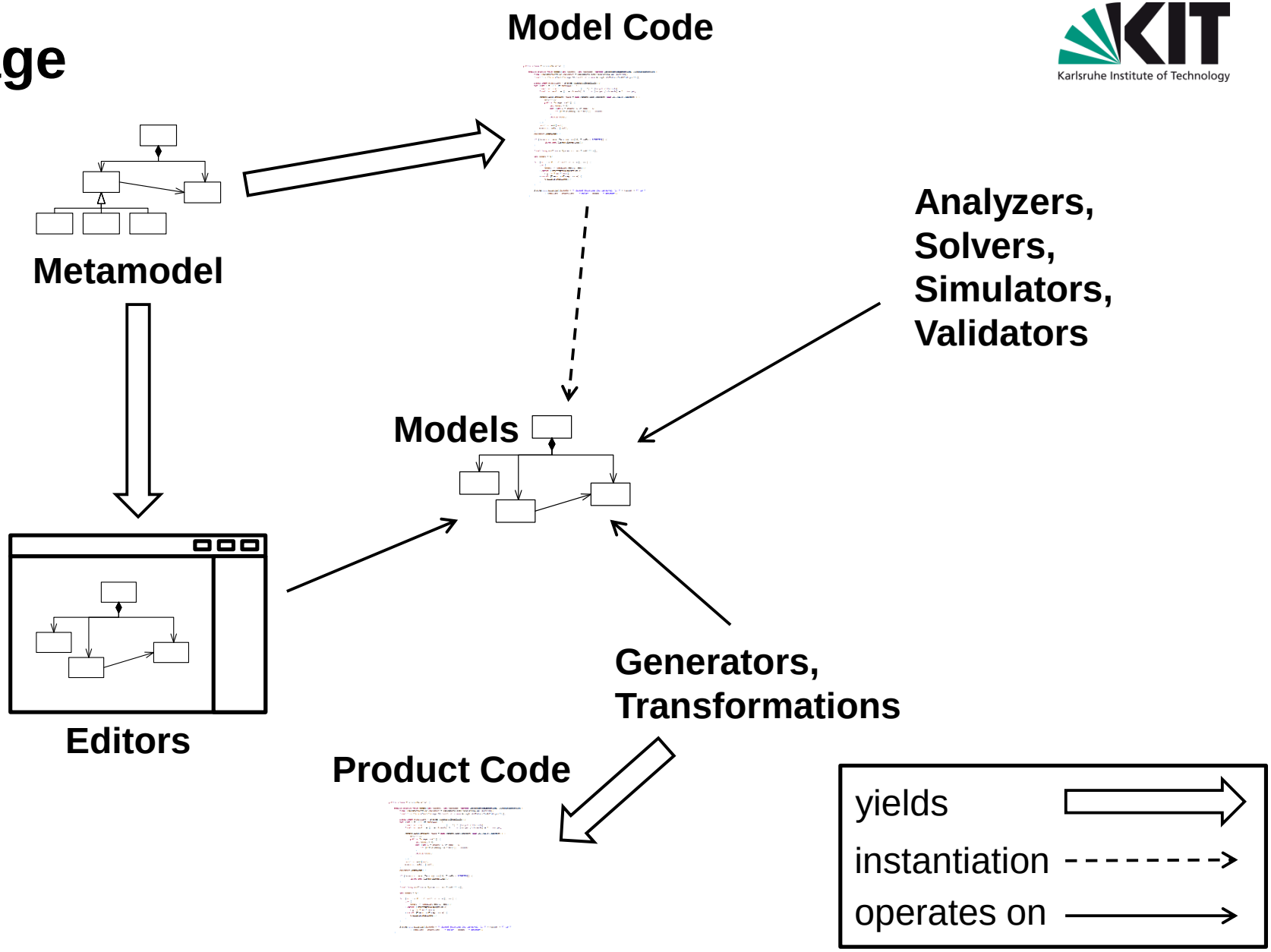
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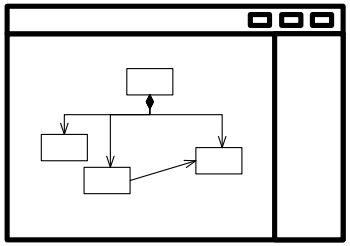
Metamodel-centric Software Systems



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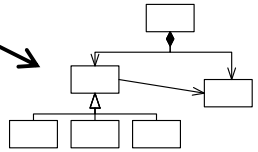
Analyzers, Solvers, Simulators, Validators



Metamodel

Product Code

Model Code

Generators, Transformations

depends on ⟶

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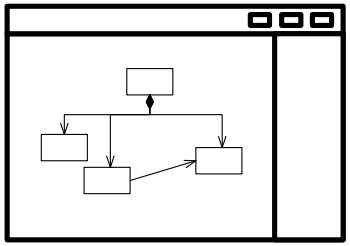

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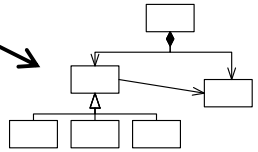

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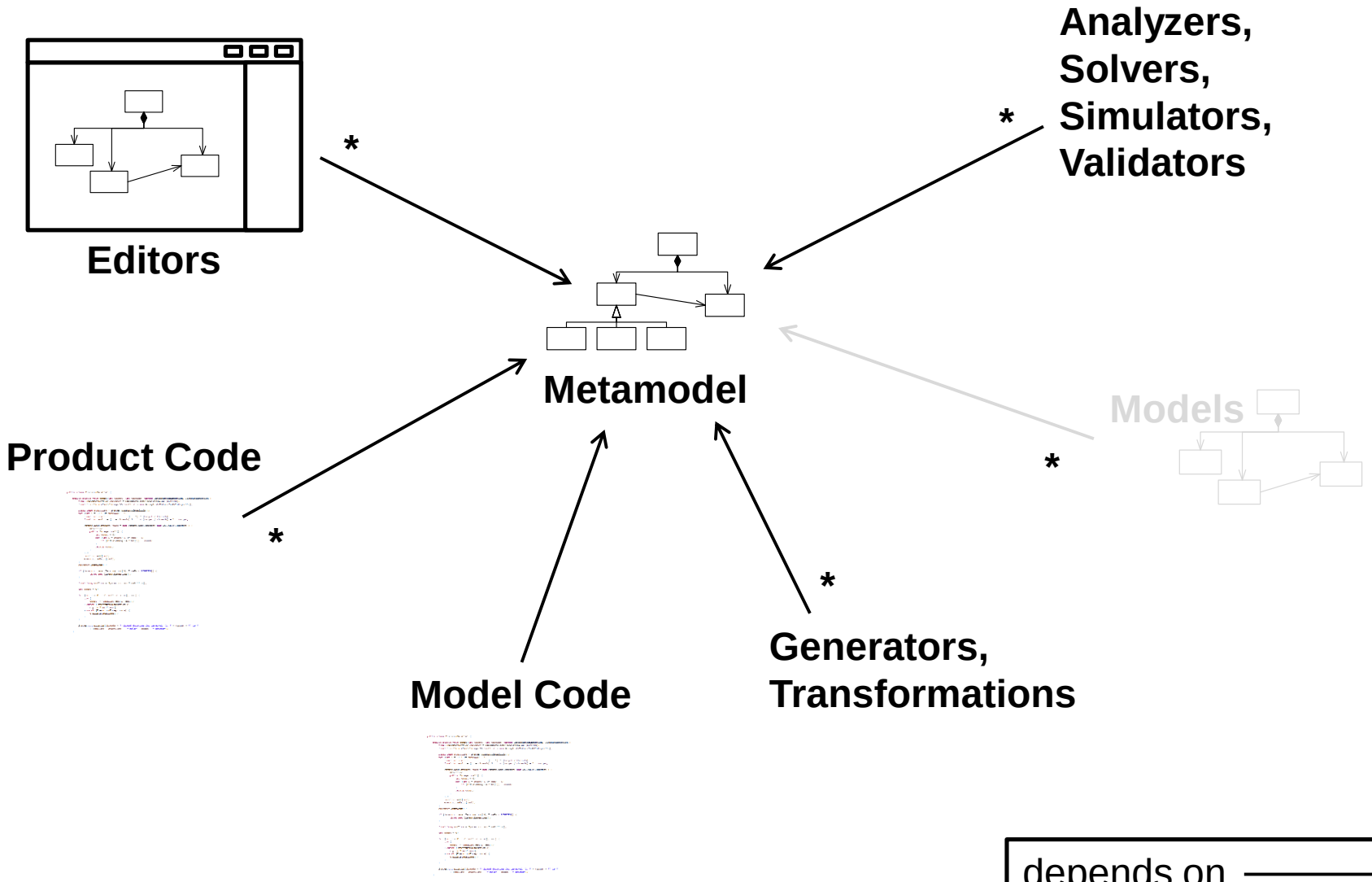

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- Reasons
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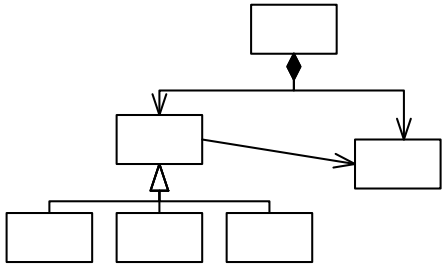

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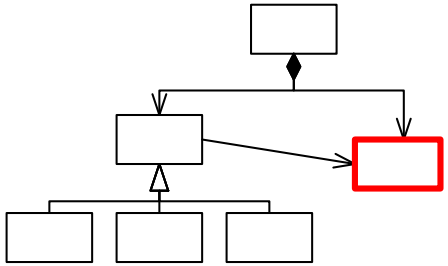

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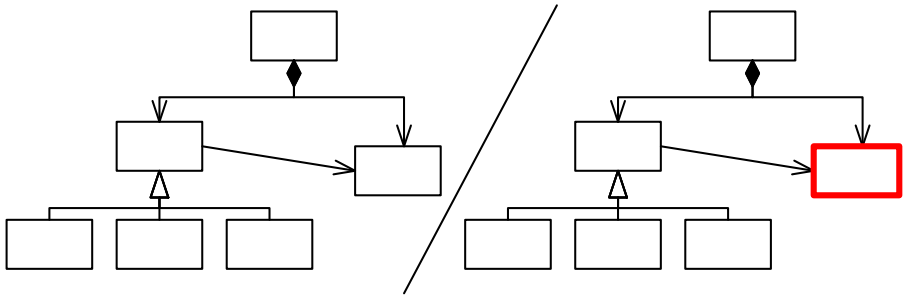

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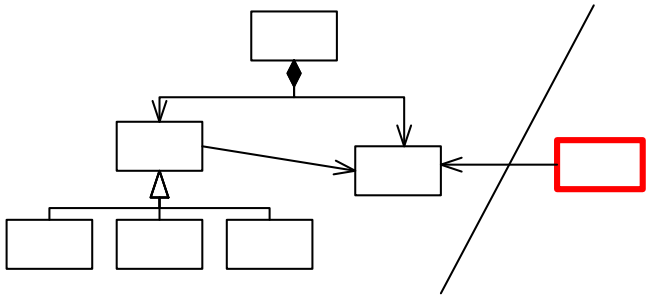
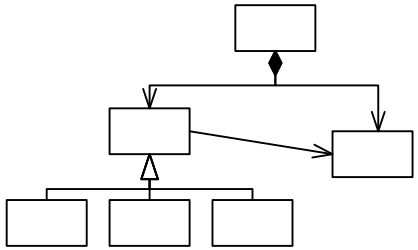


Challenges: Tight Coupling

Dependent Software



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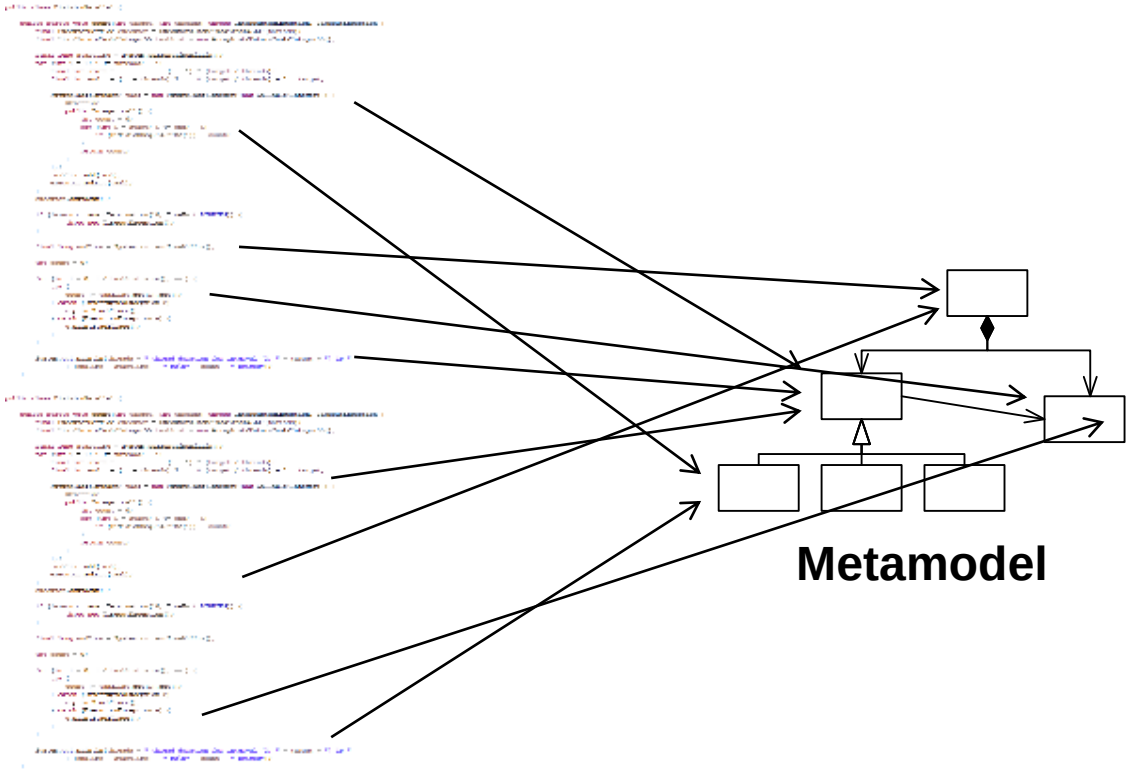

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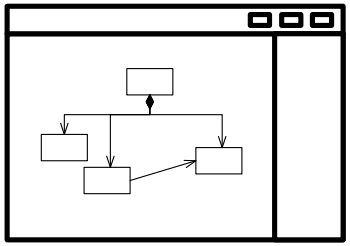
Challenge: Much Dependent Software



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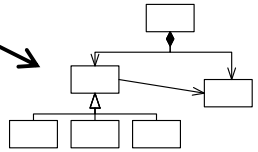

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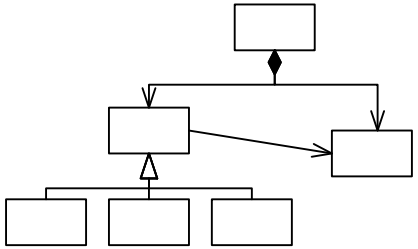

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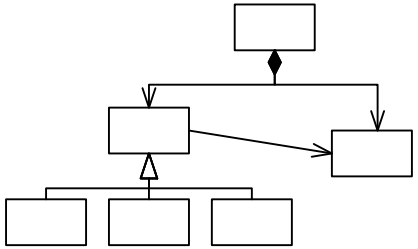

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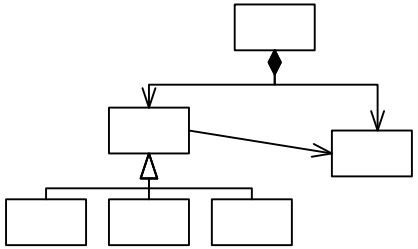

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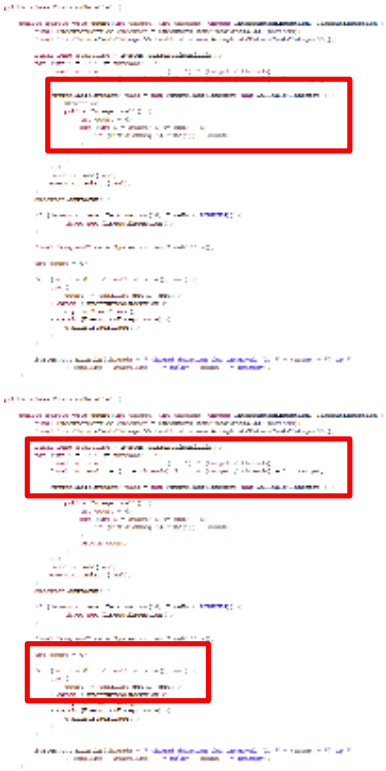

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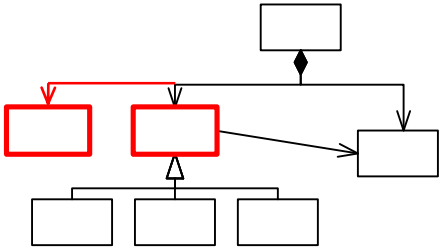

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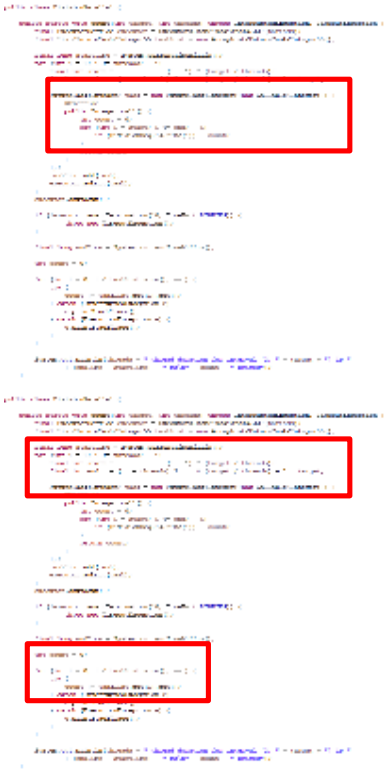

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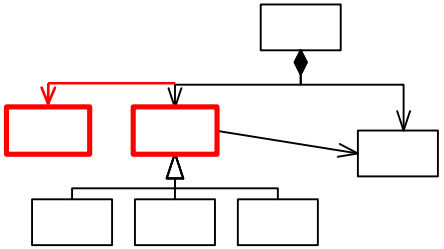

Metamodel

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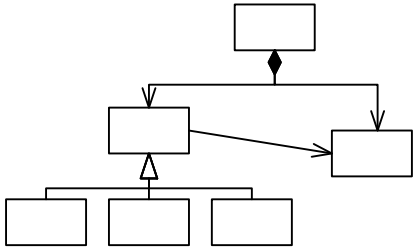
Challenge: Regeneration Remnants



Metamodel

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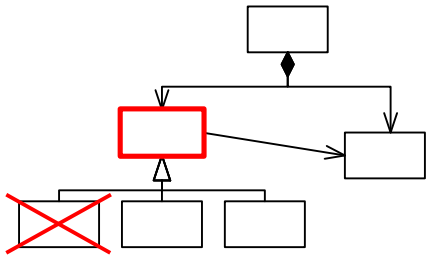

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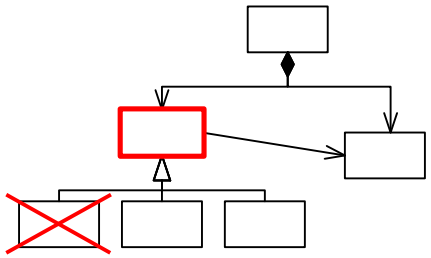

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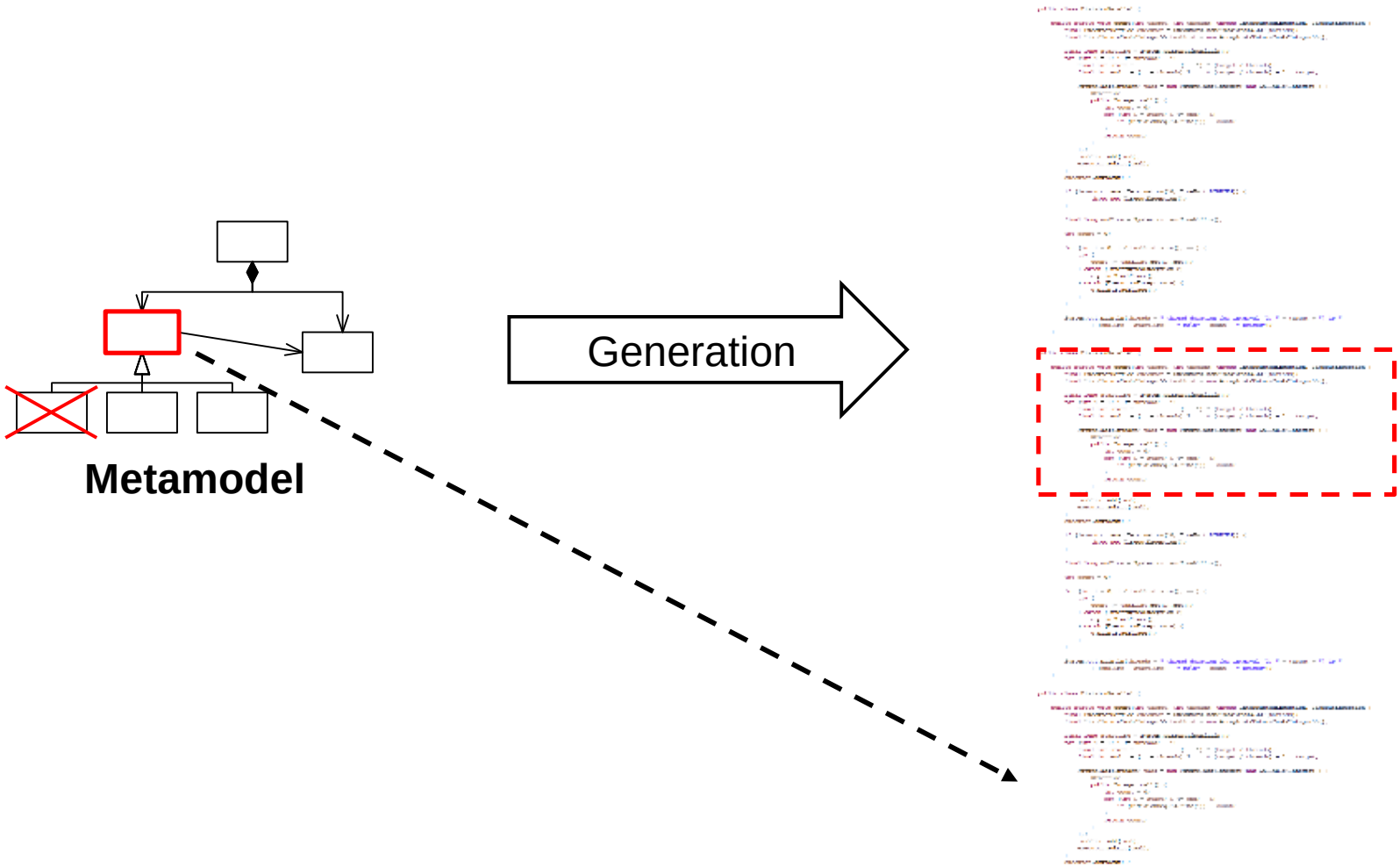

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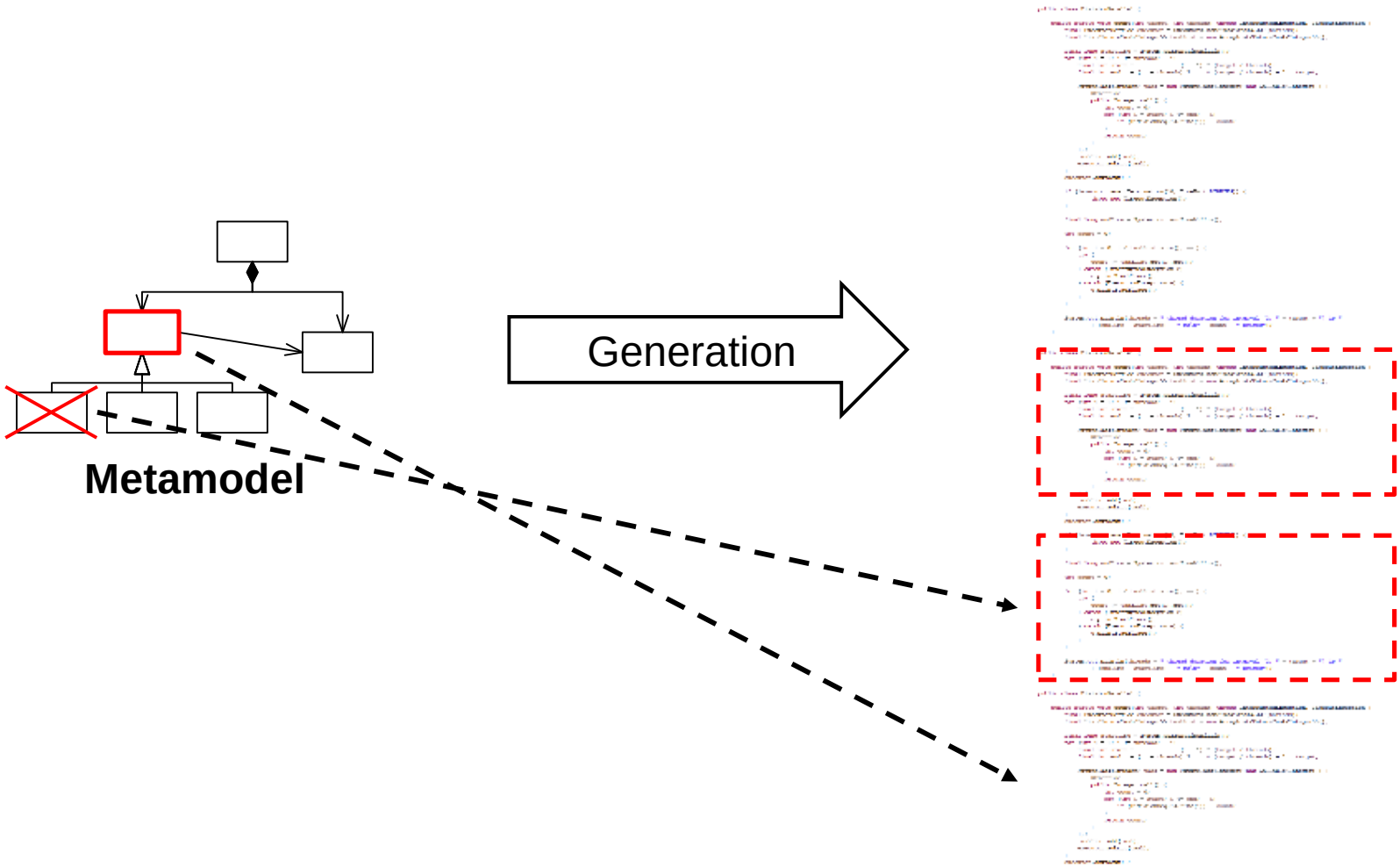

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} (also in design)

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Meta-model specific

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Meta-model specific

Further challenges? Challenges from similar domains?

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Solutions: Prescriptive

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3. Good documentation

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Further solutions?

Transfer from other domains? (e.g. database schema evolution)

Validation

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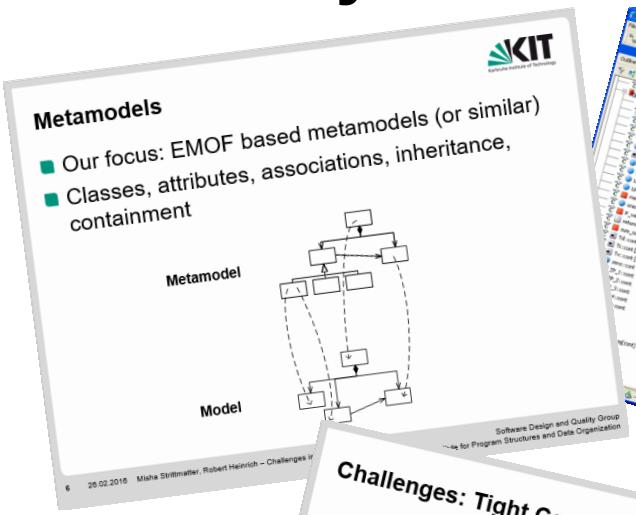
Validation approaches?

Questions

1. Are there further solutions?
2. How can the solutions be validated?
3. Are there further challenges?

Summary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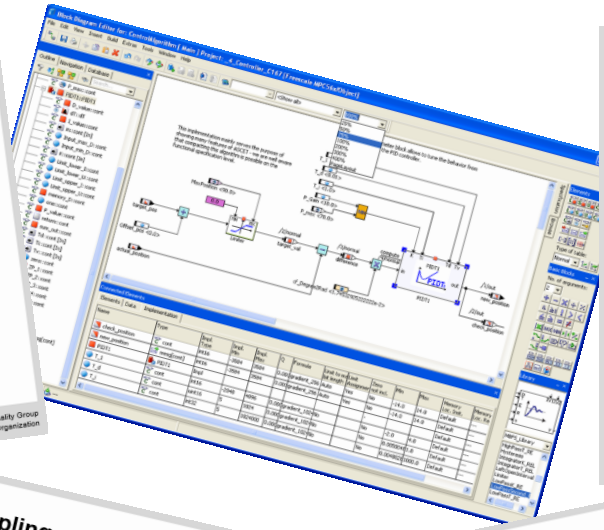
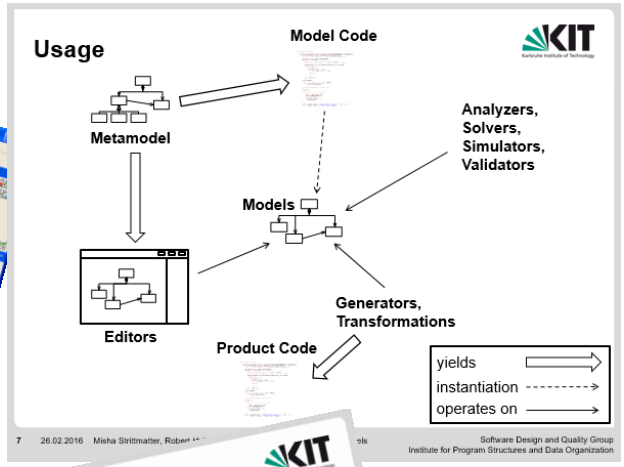
Metamodel
Model

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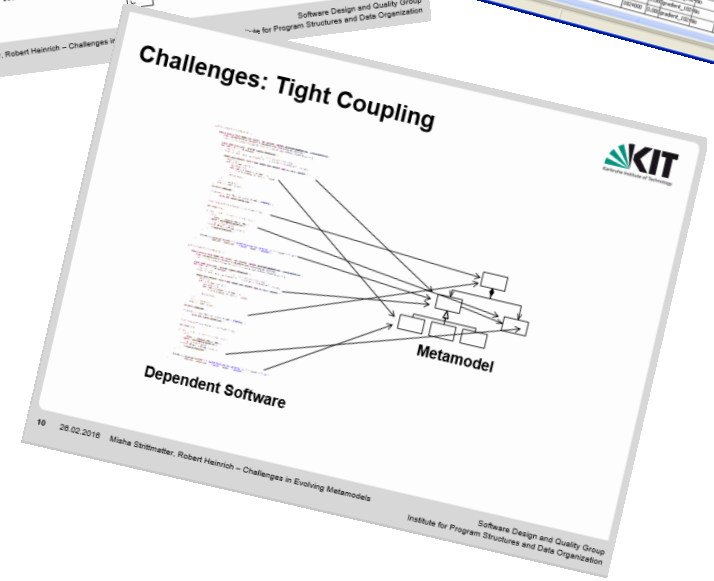
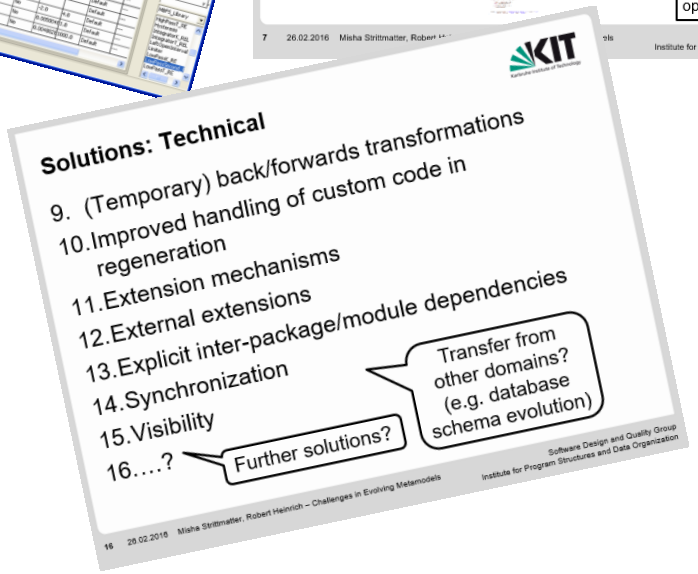
operates on


Challenges: Tight Coupling
Metamodel
Dependent Software


Solutions: Technical
9. (Temporary) back/forwards transformations
10. Improved handling of custom code in regeneration
11. Extension mechanisms
12. External extensions
13. Explicit inter-package/module dependencies
14. Synchronization
15. Visibility
16. ...?
Transfer from other domains? (e.g. database schema evolution)
Further solutions?

BACKUP

Solutions

1. Good initial design
2. Proper assessment of requirements
3. Good documentation
4. Conventions
5. Best practices
6. Metrics
7. Modularity
8. Explicit structure / reference structures
9. (Temporary) back/forwards transformations
10. Improved handling of custom code in regeneration
11. Extension mechanisms
12. External extensions
13. Explicit inter-package/module dependencies
14. Synchronization
15. Visibility

Basic Modifications

- Add, remove
  - Class, attribute, containment, inheritance, association, package, enum
- Change
  - Name, type, cardinality, property, …
- Move (into other package)
  - Class, package, enum

State of the Art

- Evolution of metamodels
- Co-evolution of models and metamodels
- Change impact prediction
- Rule-based evolution support tool

References

[1] Ivano Malavolta, Patricia Lago, Henry Muccini, Patrizio Pelliccione, and Antony Tang. 2013. What Industry Needs from Architectural Languages: A Survey. IEEE Trans. Softw. Eng. 39, 6 (June 2013), 869-891.