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Generative Programming

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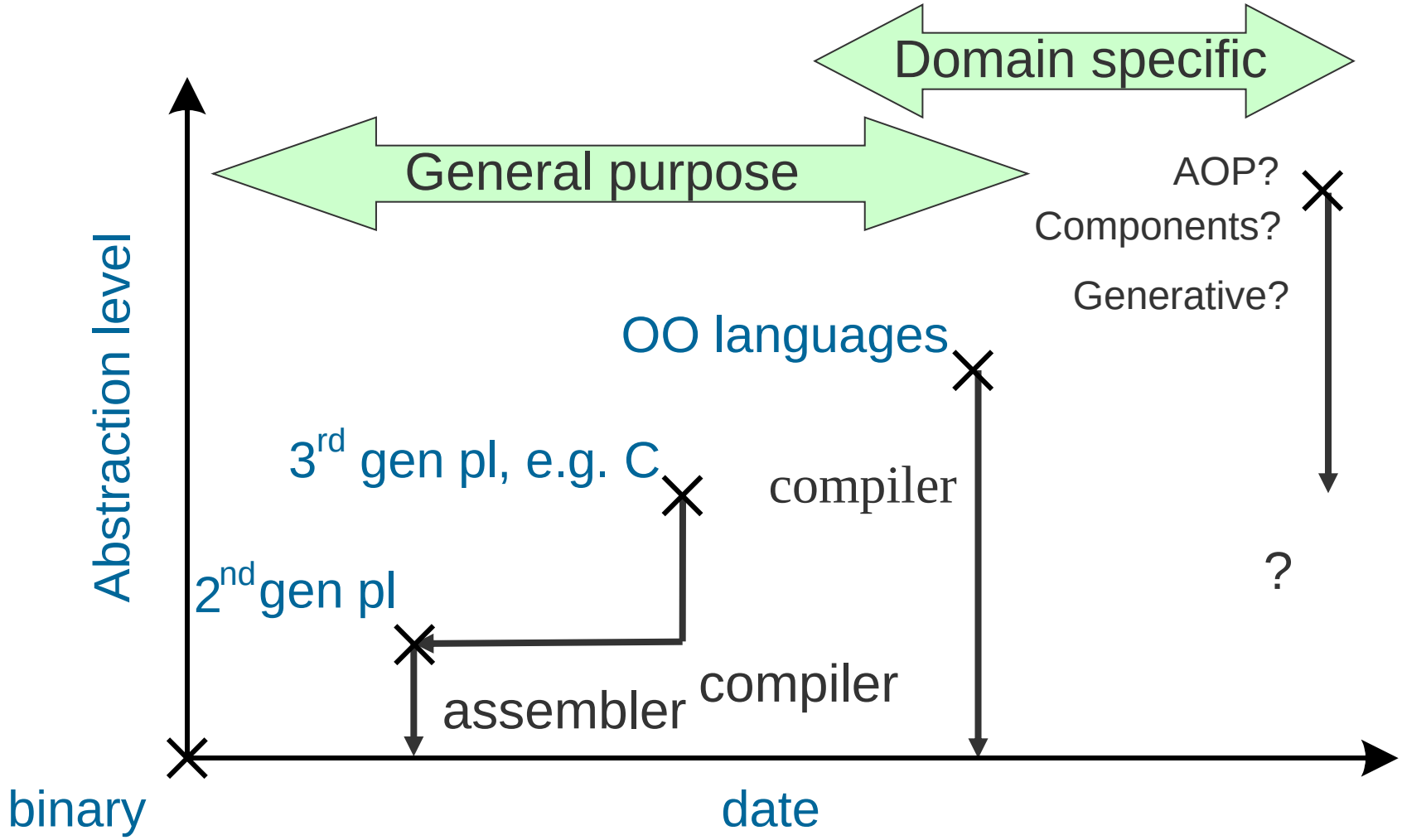
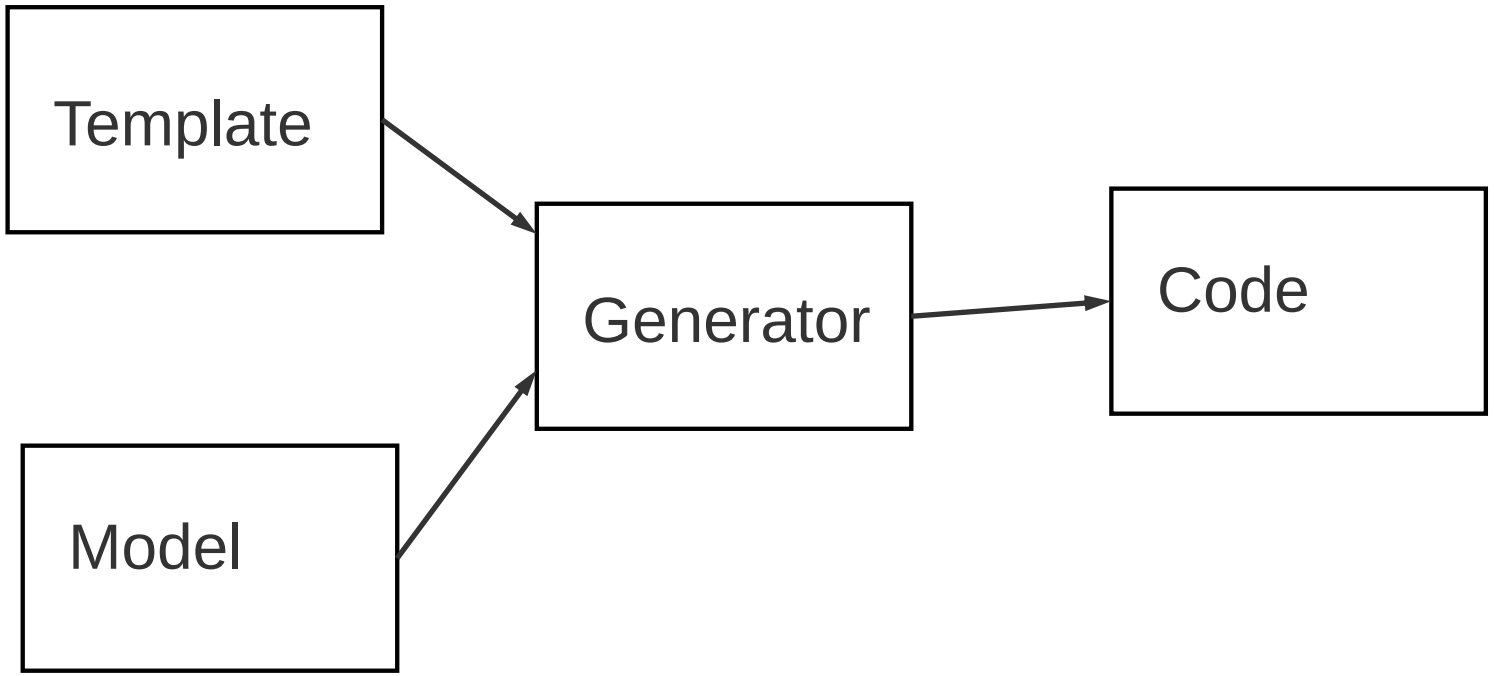
Abstraction in Software Development



Principle



SASS

```
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$primary-color: #333;

body {
  font: 100% $font-stack;
  color: $primary-color;
}
```
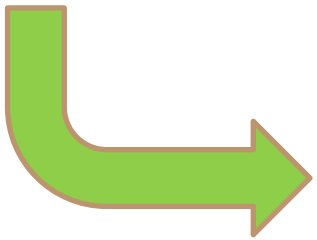
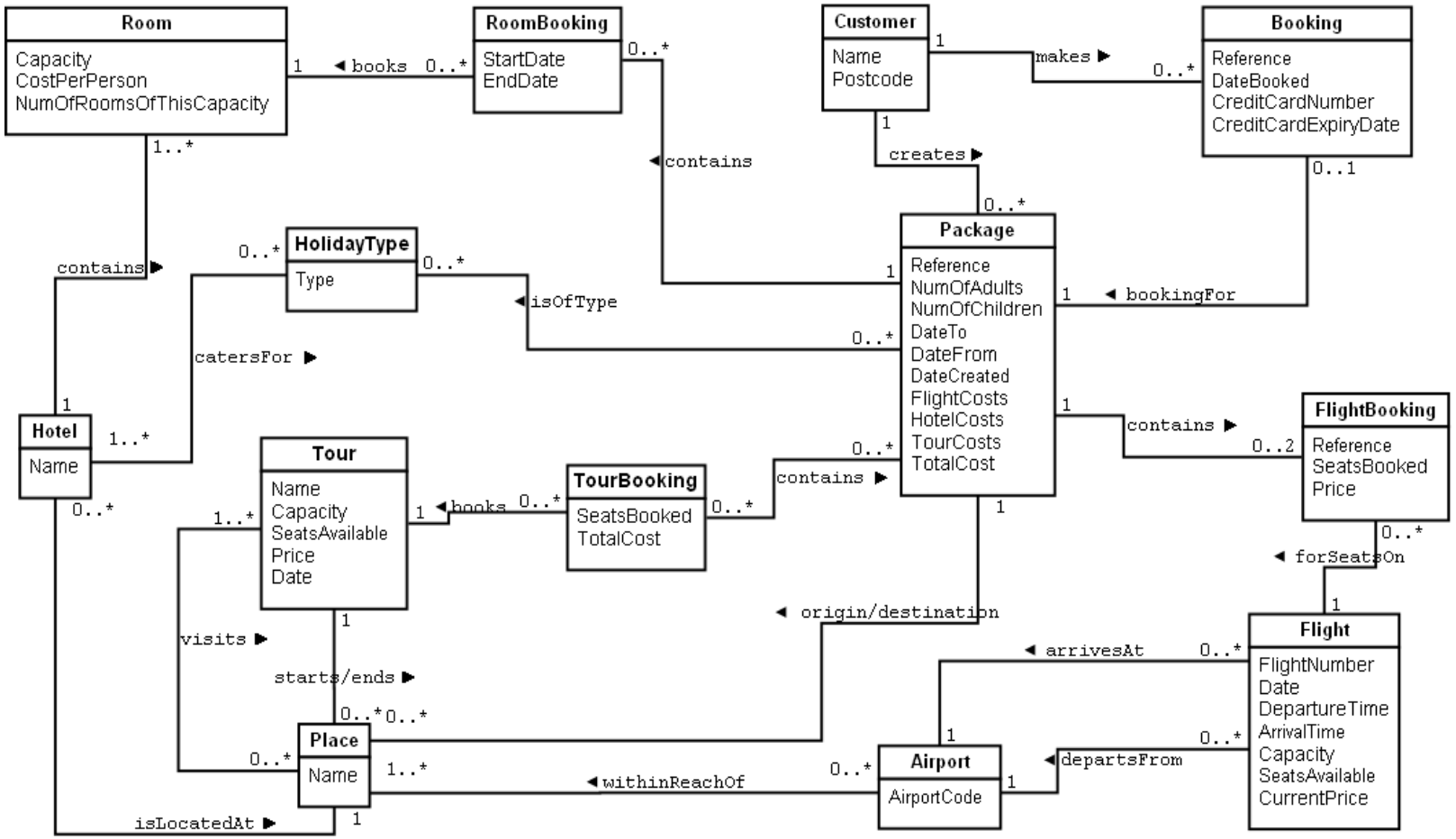



```
body {
  font: 100% Helvetica, sans-serif;
  color: $primary-color;
}
```

Model Example



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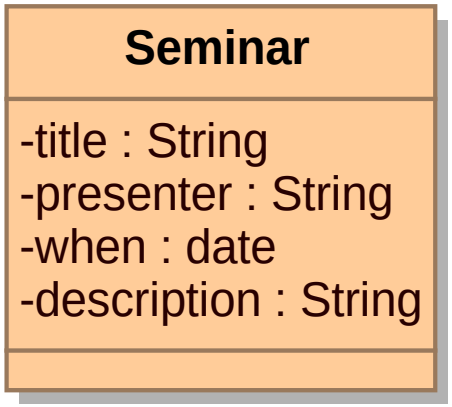
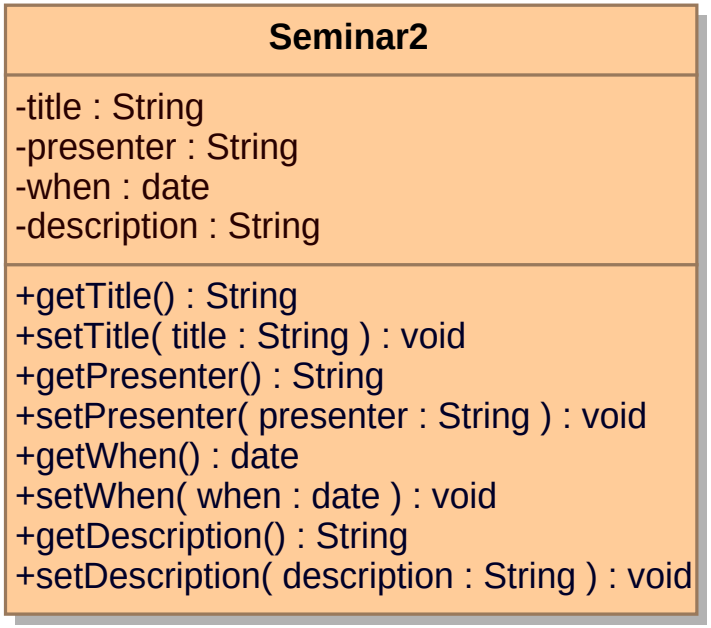
Implementation of Class Diagram

Types of Implementations

PIM



PSM



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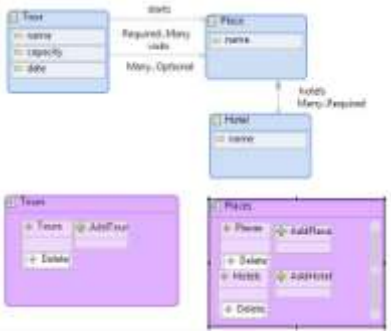
Implementing Design Patterns

Generate Alternatives

Entities

Associations

Pages Units



JSF/Facelets

JPA

Validation

Caching

Spring

Resource Bundles

PHP

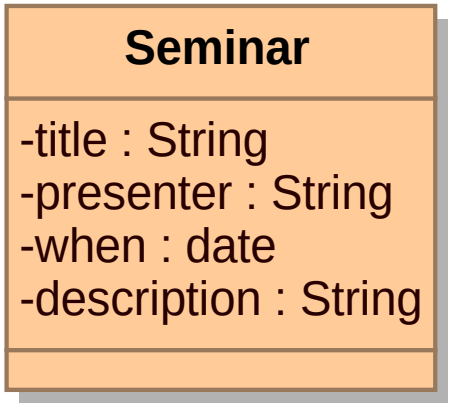
CakePHP

Validation

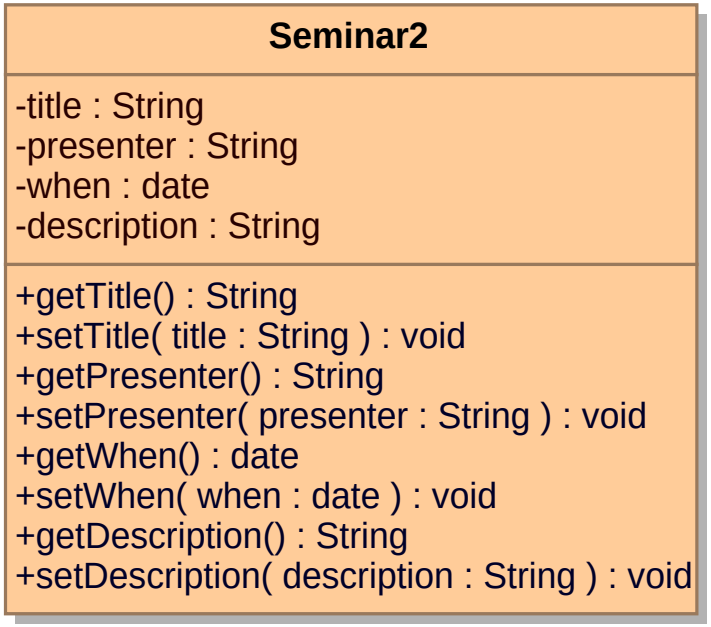
Types of Models

- Platform Independent Models (PIMs)
  - no implementation details
- Platform Specific Models (PSMs)
  - have implementation details
- Transformations to convert PIMs into PSMs

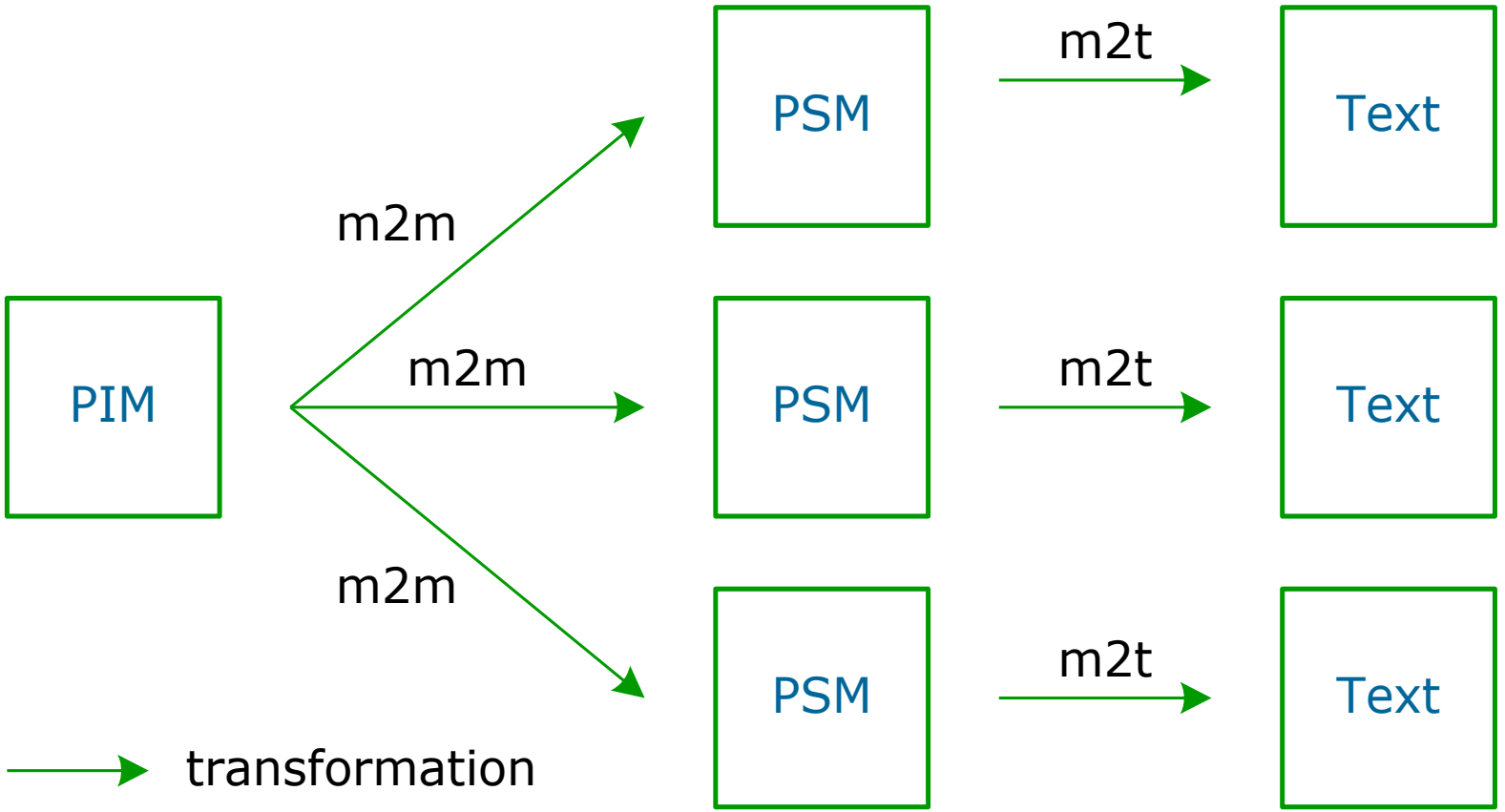
PIM



PSM

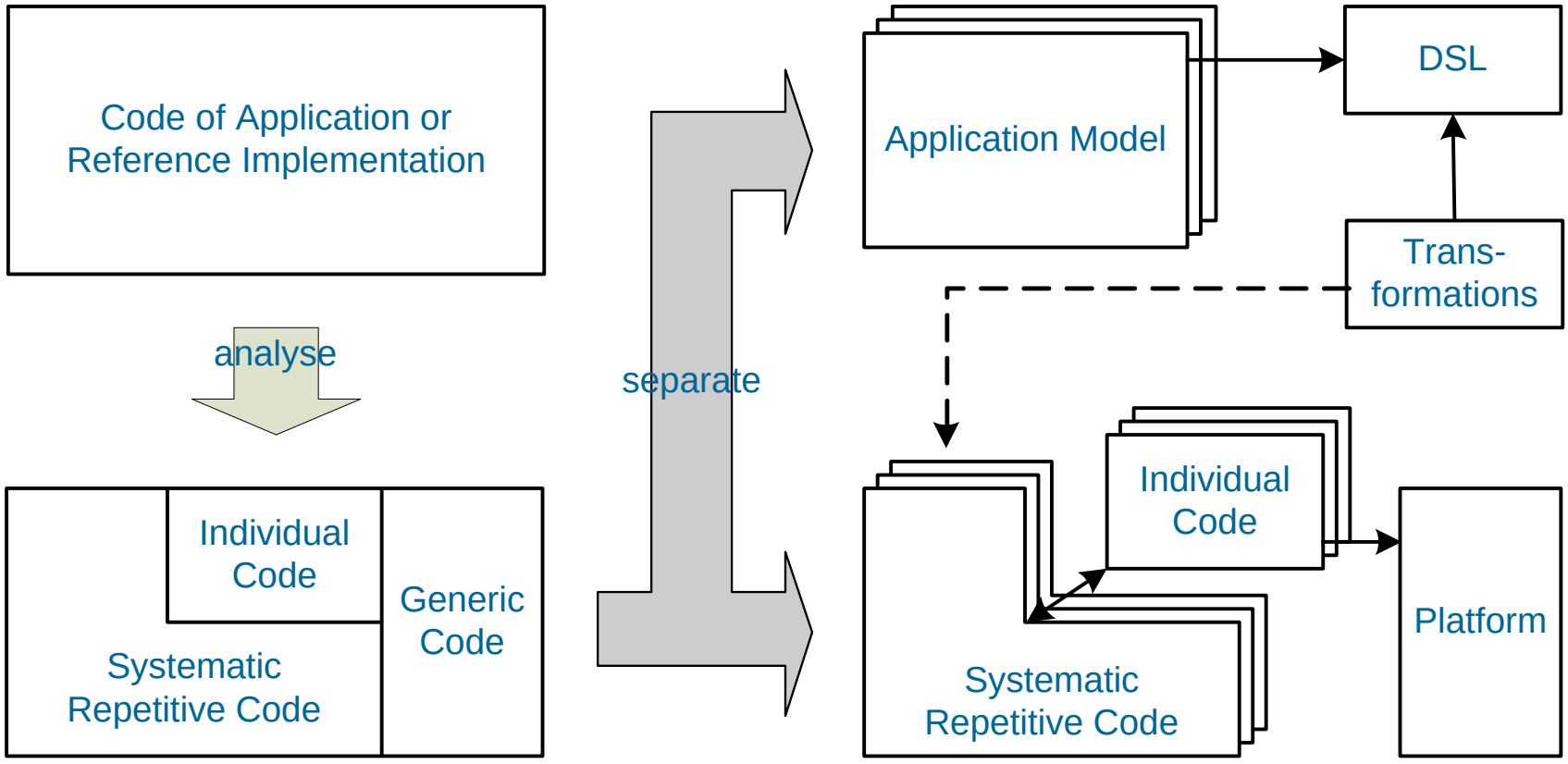


MDSD Development Flow



Model 2 text (m2t)
Model 2 model (m2m)
Text 2 model (m2t)

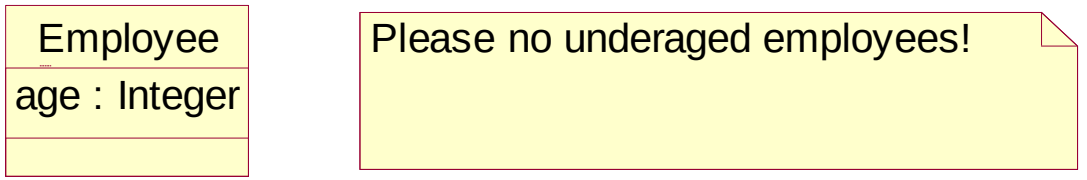
Use of Models



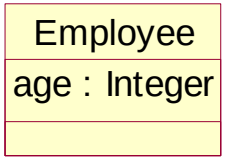
MDSD Figure 2.1

Validation

- Annotations in natural language:
  - ambiguous, imprecise,



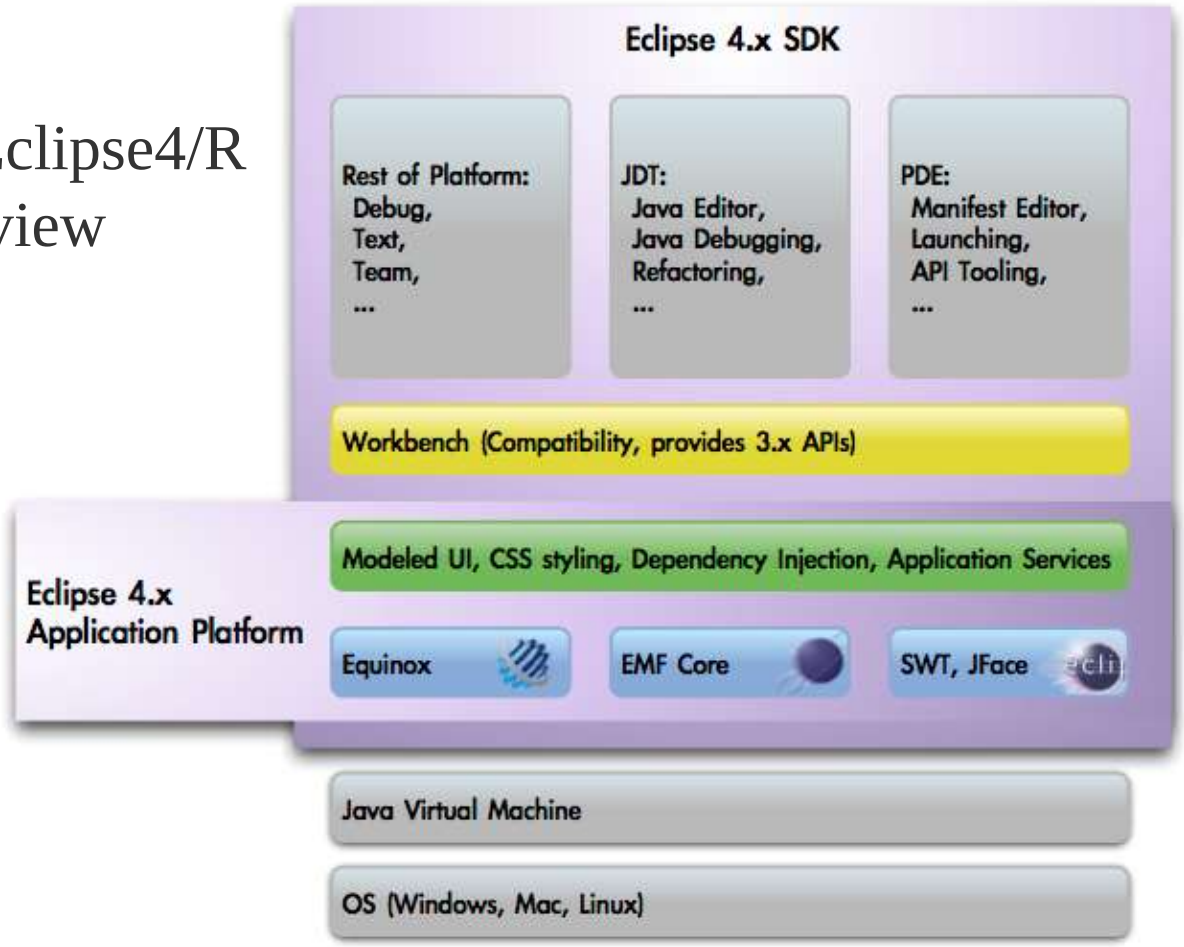
  - not automatically checkable
- Traditional formal languages, e.g. Z:
  - require good understanding of mathematics
  - do not scale to large systems
- Object Constraint Language (OCL):
  - formal, precise, unambiguous
  - tool support is available



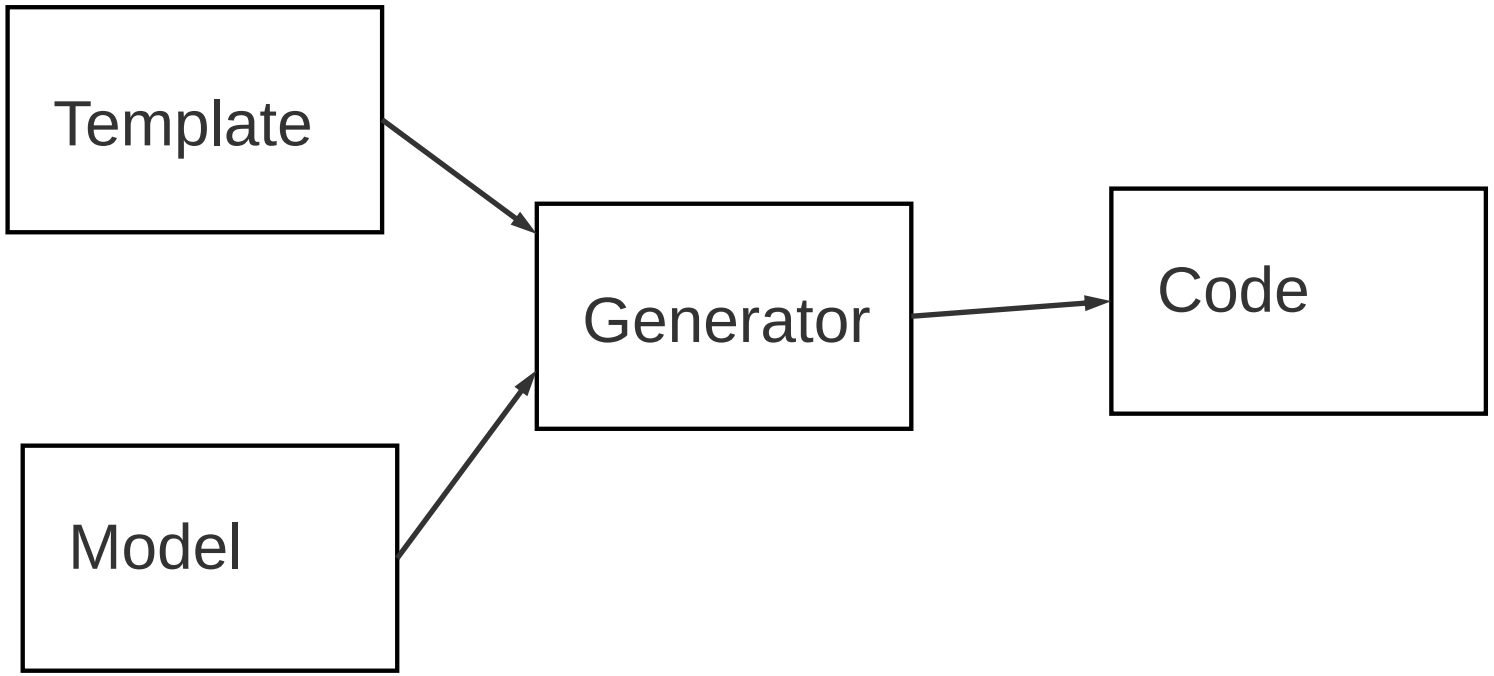

```
context Employee inv:
self.age > 18
```

Eclipse 4

http://wiki.eclipse.org/Eclipse4/RCP/Architectural_Overview



Principle



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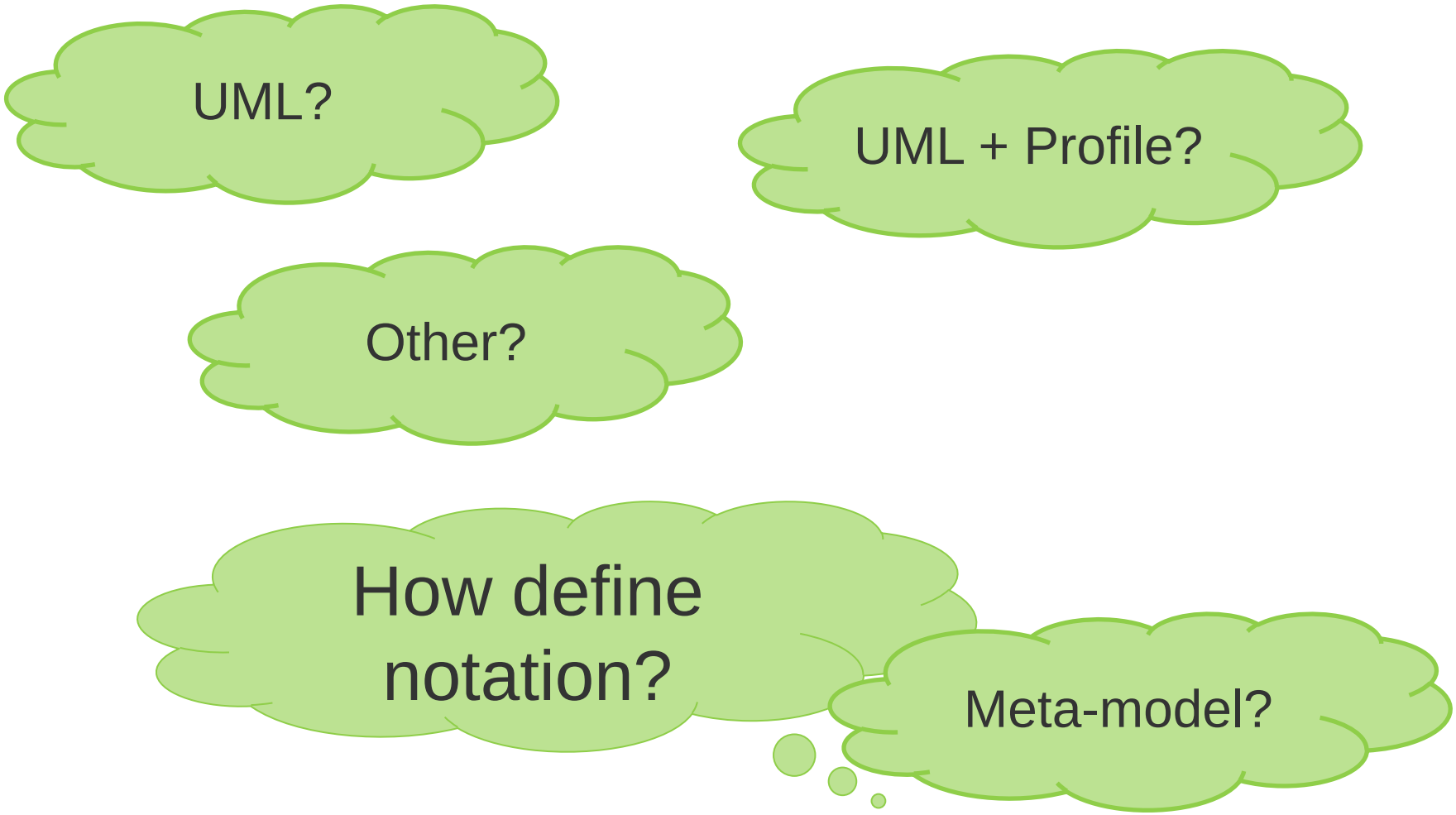
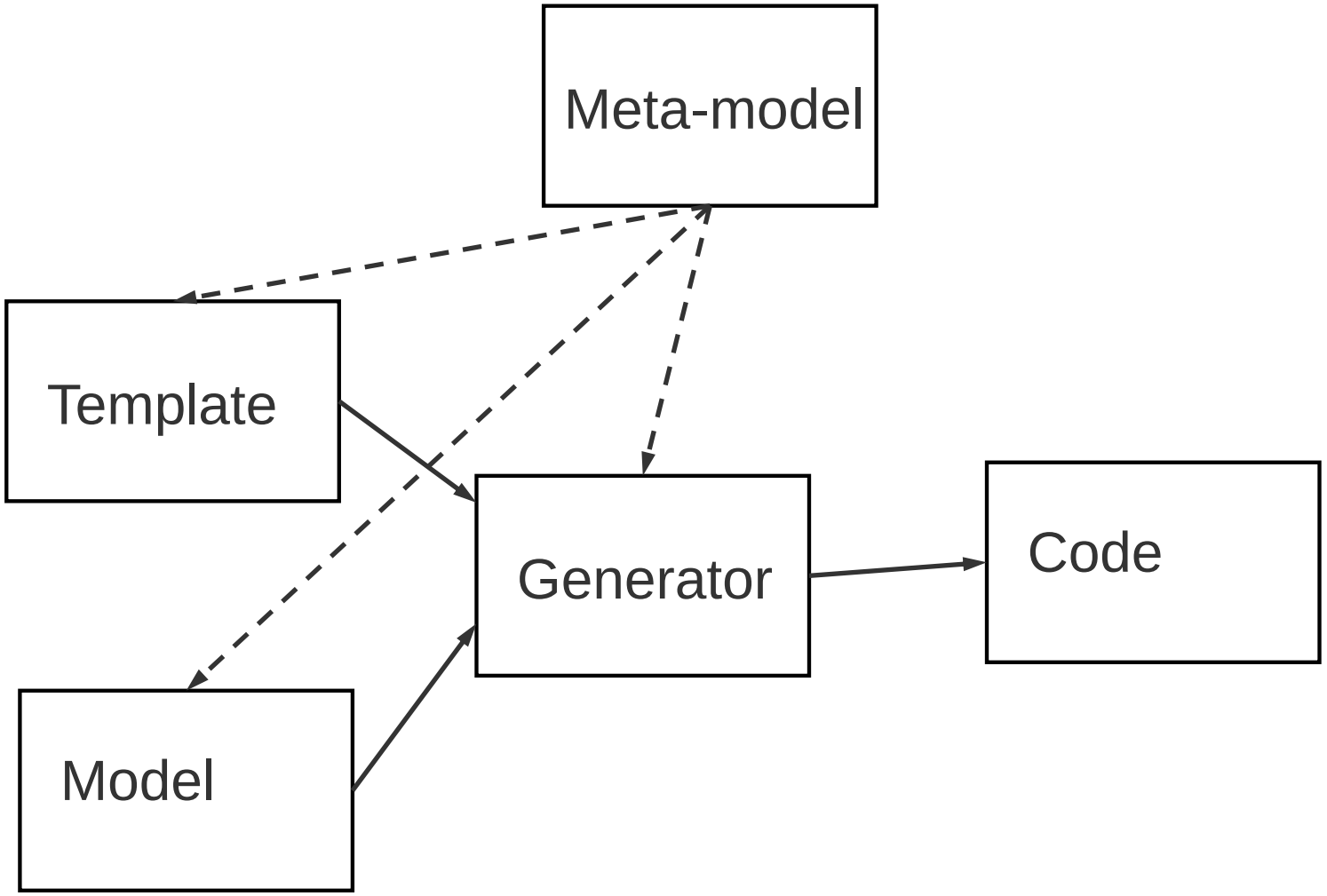
What is needed?

- Modelling paradigm (DSL)
  - Modelling language with elements that have defined semantics; e.g. class in UML class diagram is container with attributes that have type
- Target platform
  - Programming language, software libraries,
  - Hardware
- Generator for transforming model to target
  - able to read and understand model
  - able to read and process template

Model Notation




Meta-model
Template
Generator
Code
Model

Eclipse Modeling Tools

Model-Driven Software Development

Model-Driven Engineering

Model-Driven Architecture

lopment

Software Fac

About using models to simplify software development

gn

Model-Driven

Model-Driven Software Development

Model-Driven Development

Everything is a Model

Ecore model

UML model

ER model

Source code

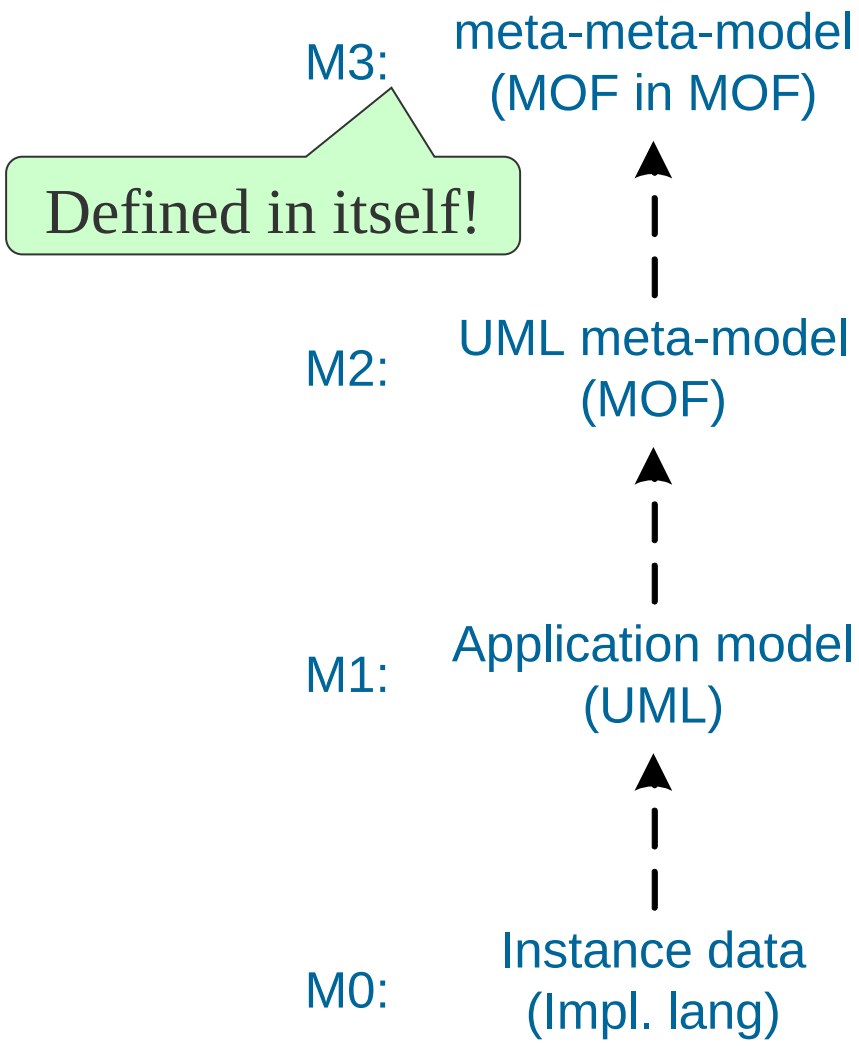
XML schema

Application instance data

XML

MDA Modelling Levels

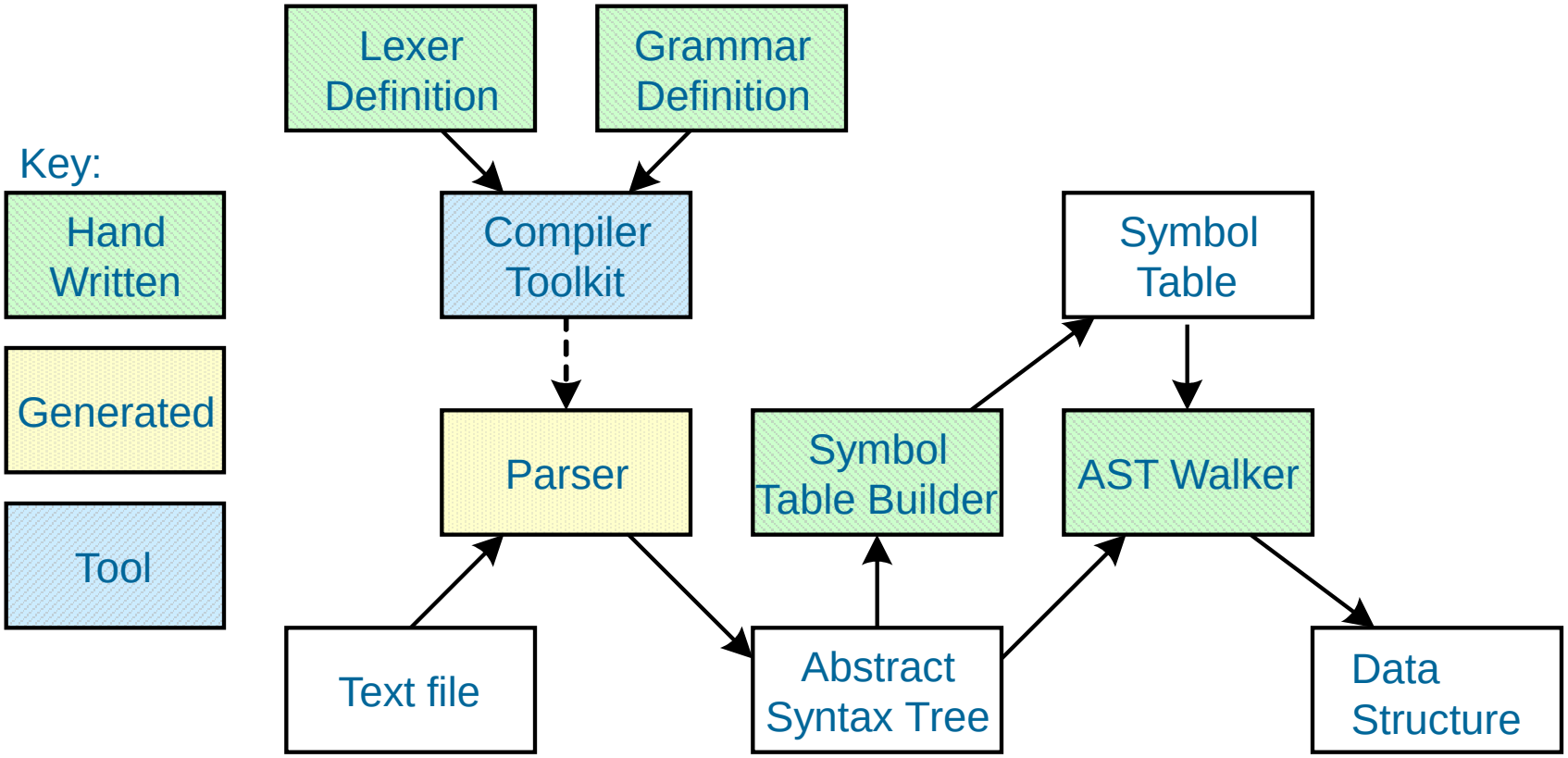
- M1: model of application
  - e.g. UML model, definition of Java class
- M2: model of modelling notation (meta-model)
- M3: model of meta-model (meta-meta-model)
- M0: application instance data
- Say model conforms to (is instance of) meta-model



A Meta-Model Defines a DSL

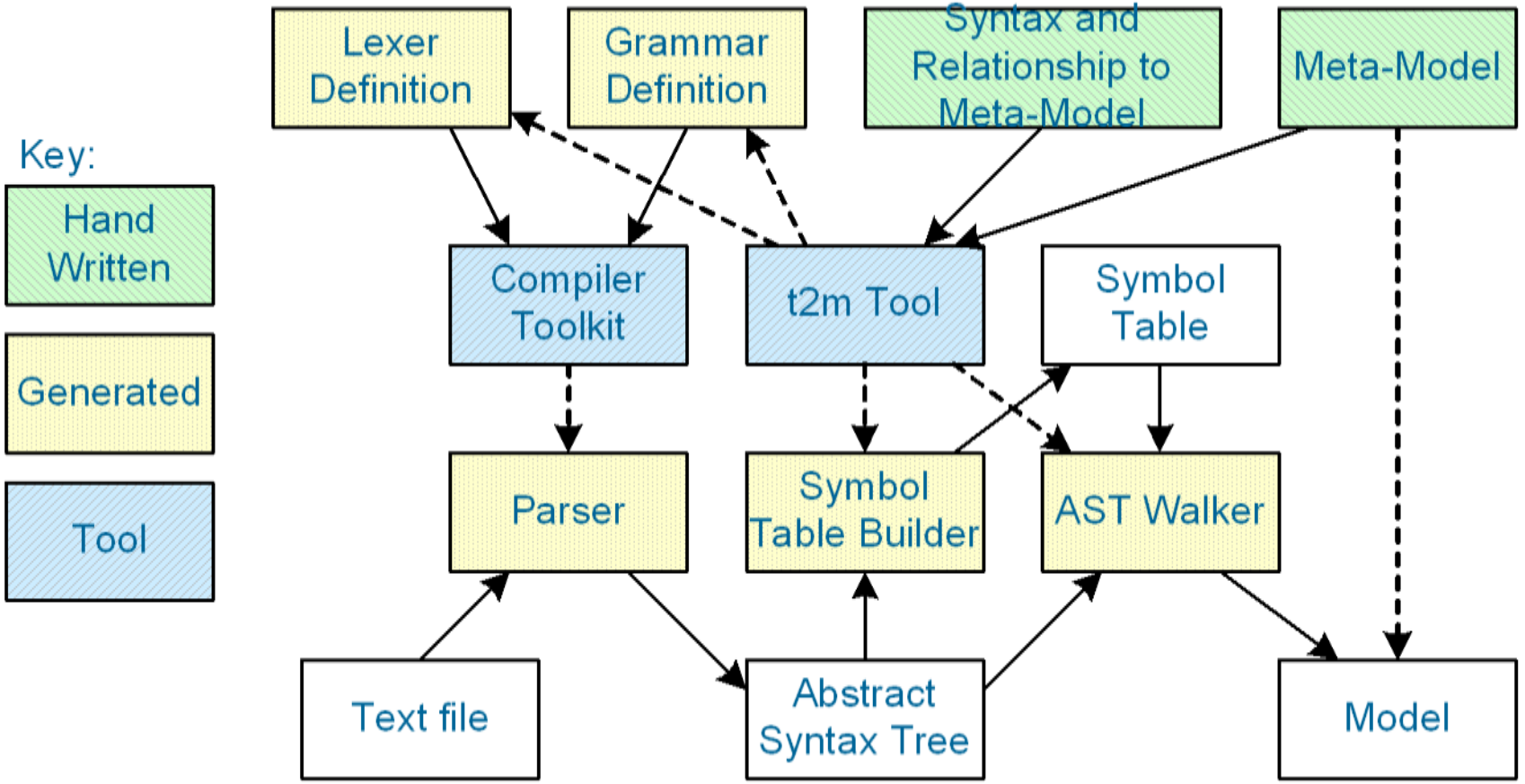
Textual Implementation of DSL

- Load instance of meta-model from textual syntax
- Implementation without any modelling tools:



Textual Implementation of DSL

- Aim with tool



Graphical Implementation of DSL

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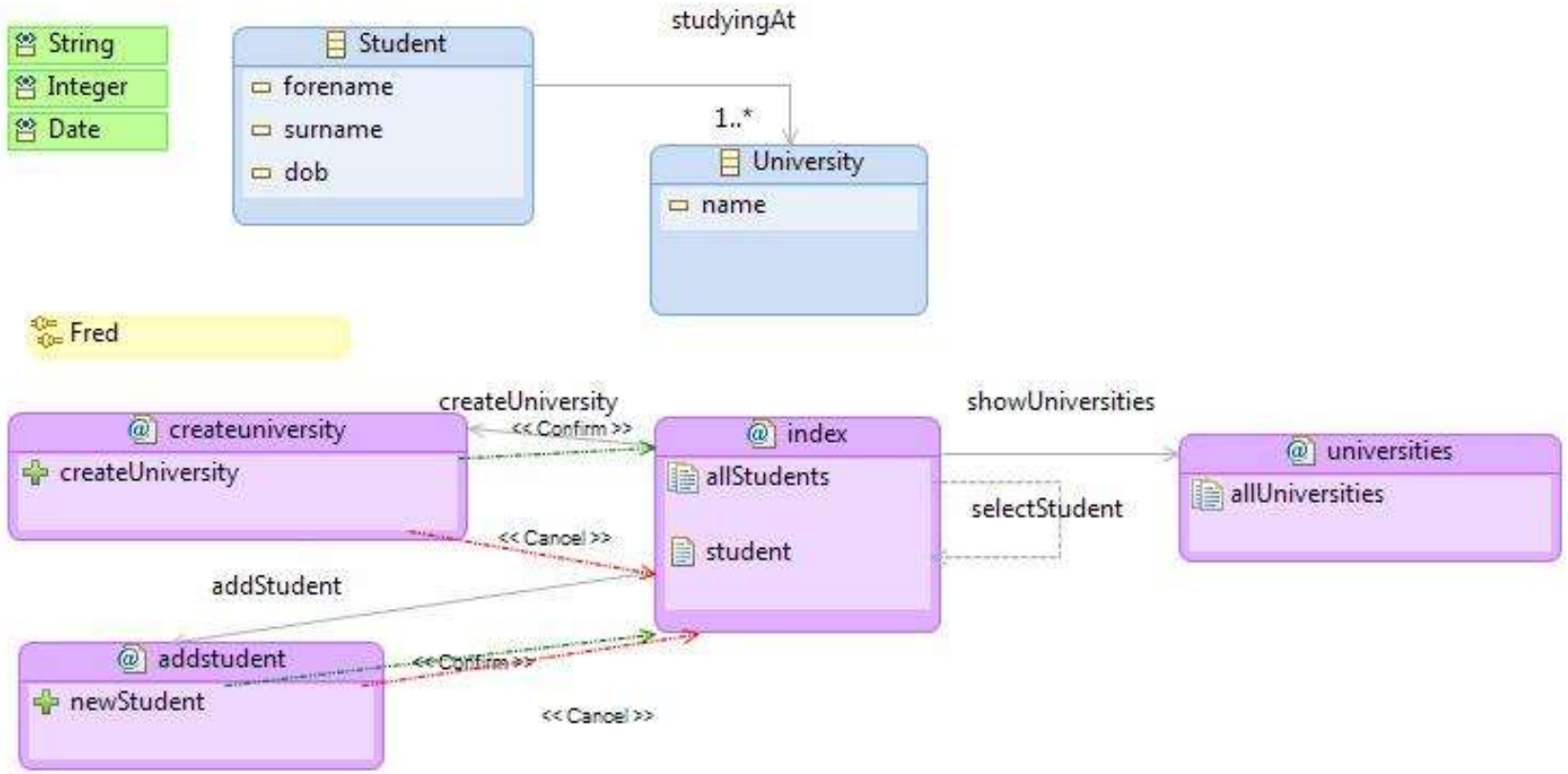
Use of DSL

Development Times

- Learning curve to use hard-crafted approach
- Learning curve to use model-driven approach
  - bigger for simple technology
- What about when target complex technology?
- Still need to understand target
  - artefacts will be reflected within model
- For experience modeller targeting complex technology, model-based approach faster
- Real benefit when target upgraded technology

Web Model


String
Integer
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Student
forename
surname
dob
studyingAt
1..*
University
name
Fred
createUniversity
<< Confirm >>
createuniversity
createUniversity
<< Cancel >>
index
allStudents
student
showUniversities
universities
allUniversities
selectStudent
addStudent
addstudent
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newStudent
<< Cancel >>