Model Driven Engineering: An Emerging Technical Space

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Introduction

Introduction

Model-**D**riven **E**ngeneering (MDE)

An attempt to solve the problem of complex and evolving software systems.

Introduction

Key ideas of MDE are relevant for many other approaches, such as:

- **D**omain-**S**pecific **L**anguage**s** (DSLs)
- **M**odel-**I**ntegrated **C**omputing (MIC)
- **M**odel-**D**riven **S**oftware **D**evelopment (MDSD)
- **S**oftware **F**actories (SF)
- ...

Basic Principles

Basic Principles - Model

A model in the MDE context is a graph based structure representing some aspects of a given system, which conforms to another graph called the metamodel. They are used to represent real-world situations.

Basic Principles - Model

MDE considers that:

- models are first class citizens
- everything is a model
- a model transformation is also a model

Basic Principles - Metamodel

Each model conforms to a metamodel, which describes the contained model elements and the way they are

- arranged
- related
- constrained

They are a language to describe models.

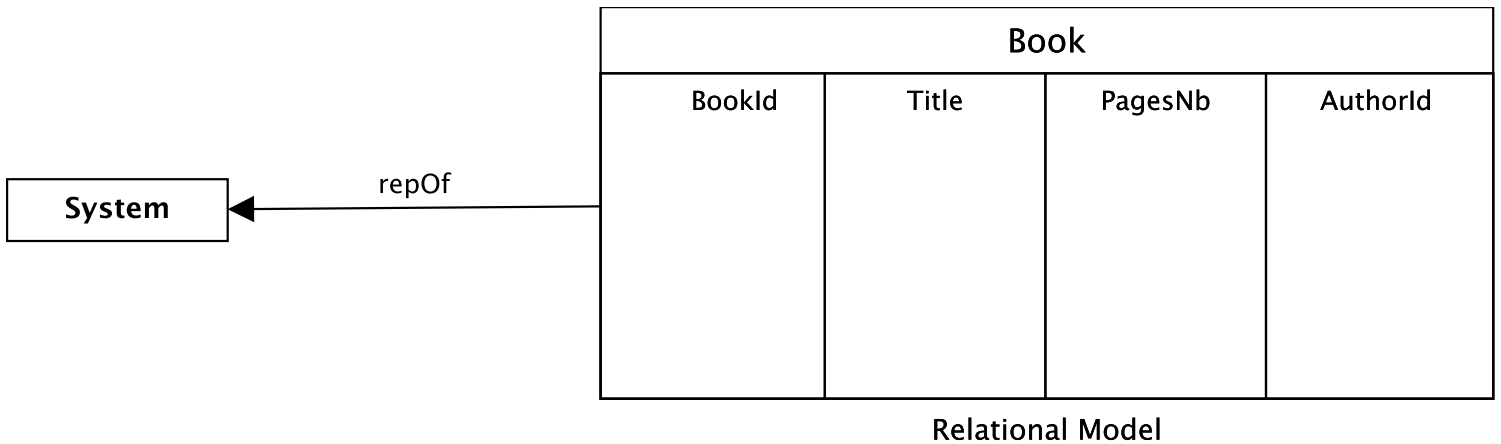
Basic Principles - Metametamodel

The same as the model conforms to a metamodel, each metamodel conforms to a metametamodel.

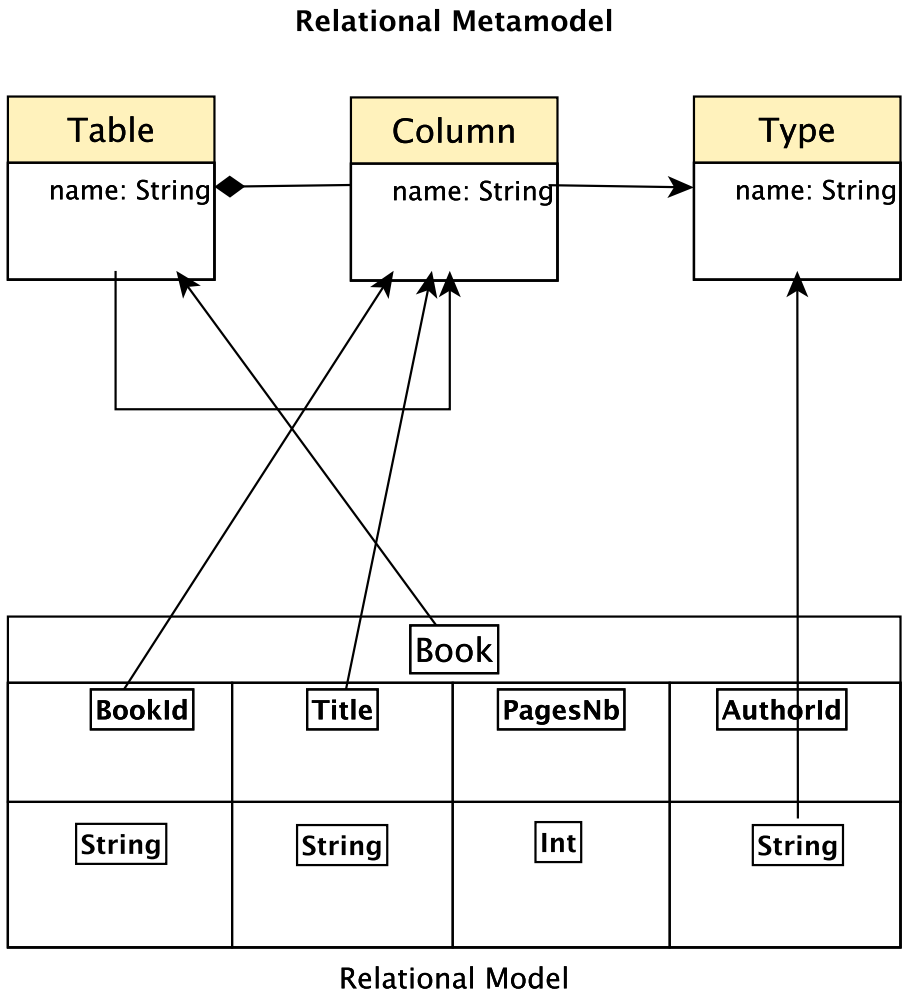
Basic Principles - Elements

A modelelement is typed by its metalement and the model only conforms to a metamodel if and only if each modelelement is typed by a metaelement in this metamodel.
This also applies to the metalement and the metametaelement.

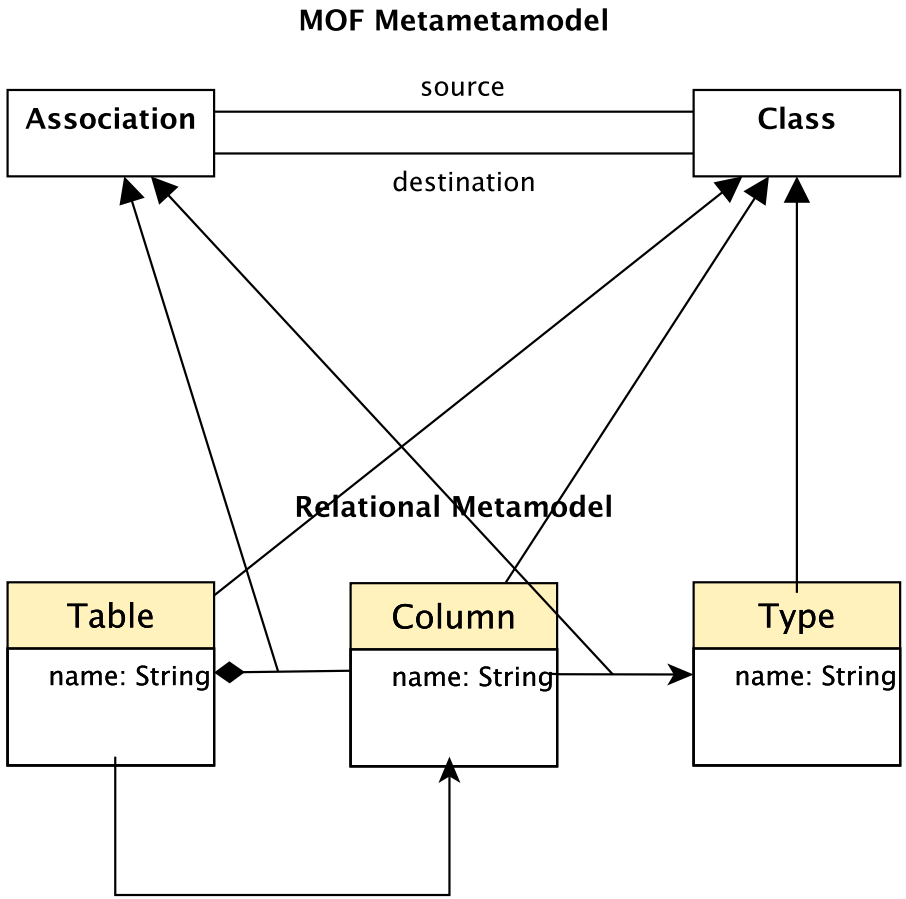
Basic Principles - Meta-Object Facility



Basic Principles - Meta-Object Facility



Basic Principles - Meta-Object Facility



Basic Principles - Structure

Metamodels bring engineering facilities, which are used for defining languages (DSLs) and formalisms.
Decorating a model (e.g.: associate with additional properties) with another one based on a different metamodel allows to achieve seperation of contents from presentation as well as modularity and reusability.

The Technical Space

The Technical Space

A **T**echnical **S**pace (TS) is a

- set of associated concepts
- body of knowledge
- tools
- required skills
- possibilities

and also a model management framework based on a algebraic structure.

The Technical Space

A formal description of a TS is quite hard, but they are easy to recognize, e.g.

- XML
- MDA
- ...

So we can say that a Java-Program is a Java-Model and a XML-Document is a XML-Model.

The Technical Space

To get a synergy between different TSs, conceptual and operational bridges are created, e.g.

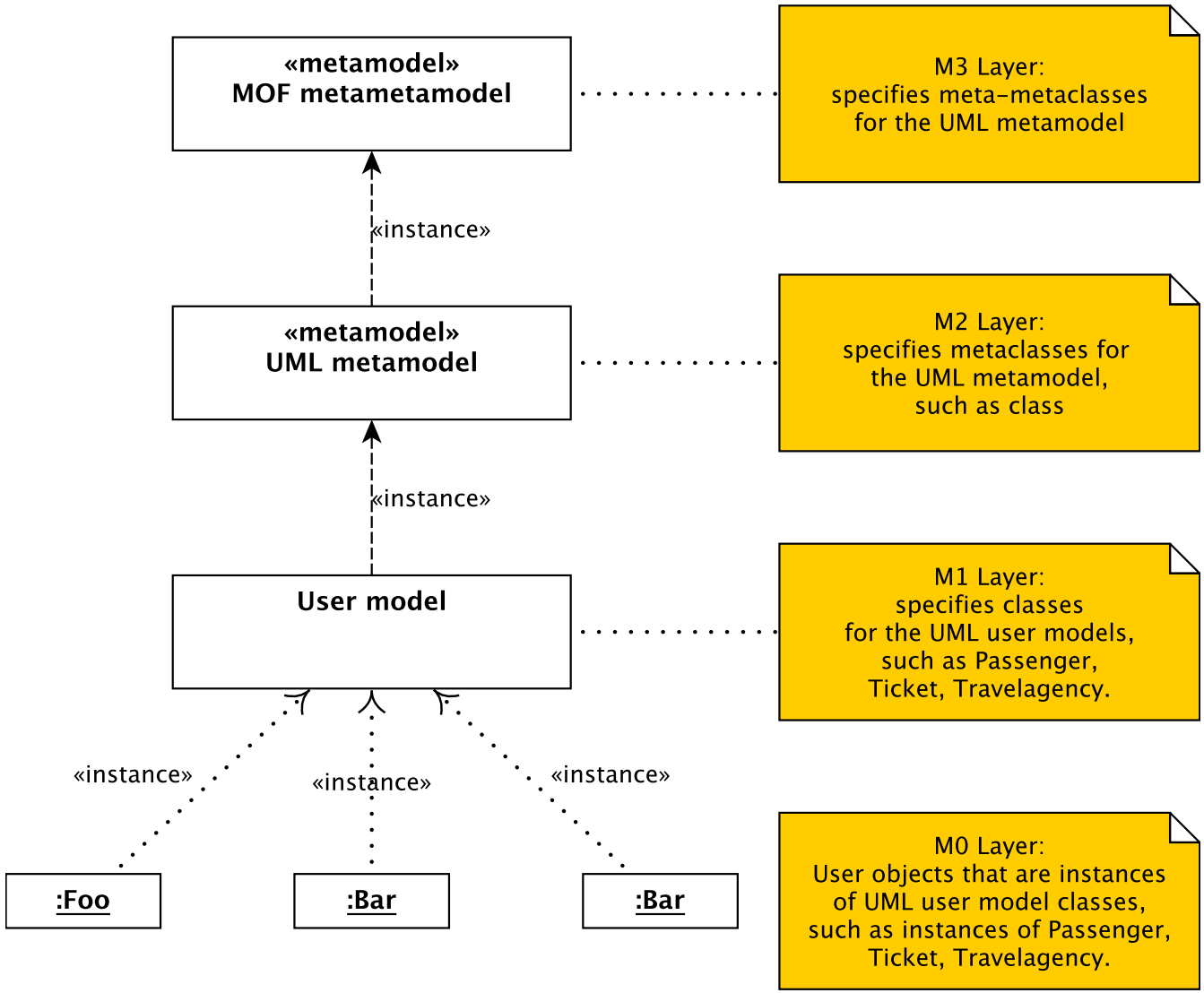
- **X**ML **M**odel **I**nterchange (XMI)
- **J**ava **M**odel **I**nterchange (JMI)
- **C**ORBA **M**odel **I**nterchange (CMI)
- ...

These bridges are defined to communicate with other TSs.

The Technical Space - Projectors

To transform from one to another TS a projector is needed. These projectors are used when building in one TS is too costly. There are two kinds of projectors, injectors and extractors, depending on the direction of transformation.
(Often a couple of injectors/extractors are needed to solve a problem).

The Technical Space - The MDA OMF TS



The Technical Space - Other TSs

There are many other TS's, e.g.

- **E**clipse **M**odeling **F**ramework (EMF) TS
- Microsoft DSL Tools TS
- XML Document Space

Architectural Style of the AMMA platform

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The **A**TLAS **M**odel **M**anagement **A**rchitecture (AMMA) makes use of the architectural style of MDE. The AMMA platform is composed of:

- Model Transformation (ATL)
- Model Weaving (AMW)
- General Model Mangement (AM3)
- Model projection to/from other TS (ATP)

AMMA is build on top of the EMF.

Architectural Style of the AMMA platform - ATL

The **A**tlas **T**ransformation **L**anguage (ATL) transformation language, where every transformation is a model.

A transformation from Model a to Model b is reprensented by:
$M_b \leftarrow f(MM_a, MM_b, M_t, M_a)$

Architectural Style of the AMMA platform - AMW

The **A**tlas **M**odel **W**eaver is a tool for establishing relationship between models. Those links are also stored in a model, called the weaving model, which conforms to a weaving metamodel.

Architectural Style of the AMMA platform - AM3

The **A**tlas **M**ega**M**odel **M**anagement tool (AM3) records all available resources, e.g.

- models
- metamodels
- services
- ...

Aswell this megamodel conforms to a specific metamodel.

Architectural Style of the AMMA platform - ATP

The **A**tlas **T**echnical **P**rojectors define a set of injectors and extractors, which are capable of being import and export facility between the MDE TS and other TSs.

e.g.
An extractor is needed to make use of XMI in the Java TS, because the Java Compiler can't read XMI, Java code must be generated (model extraction).

The End

Sources:

- http://userpages.uni-koblenz.de/~laemmel/gttse/2005/pdfs/41430036.pdf
- http://wiki.eclipse.org/AMMA
- http://wiki.eclipse.org/ATL