Metamodelling and Model-Driven Engineering

Department of Informatics
University of Oslo

Friday 28th of March 2014

Outline

- Metamodelling
- Model-Driven Engineering (MDE)
- Reasons to use metamodelling and MDE
- Challenges

Metamodelling

What is metamodelling?

- Analysis and construction of artefacts and concepts for modelling a predefined class of problems
- Metamodelling results in a metamodel
- A metamodel is an abstraction of the properties of conforming models
- Hence, a metamodel reflects a problem domain

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- A metamodel primarily describes the legal structure of models
- Typically defined as a class model
- Resembles a grammar specification to some extent
- Semantics (both static and behavioural) may be seen as part of the metamodel (broader view)

1. *program* → *declaration-list*
2. *declaration-list* → *declaration-list declaration* | *declaration*
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4. *var-declaration* → *type-specifier* **ID** **;** | *type-specifier* **ID** **[** **NUM** **]** **;**
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7. *params* → *param-list* | **void**
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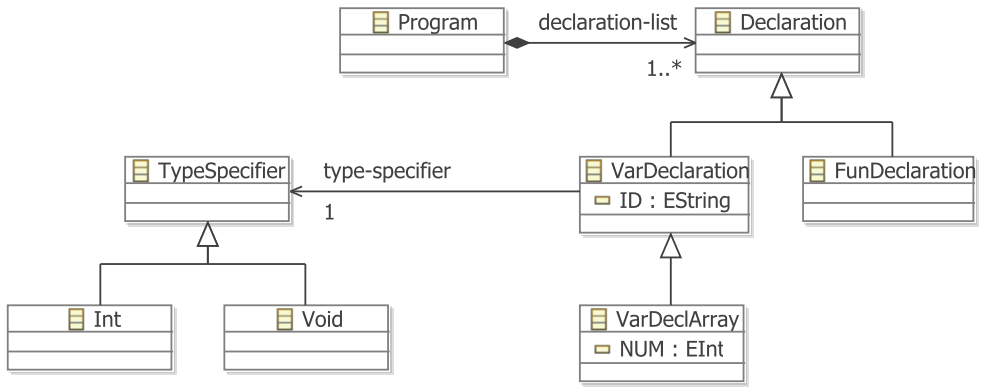

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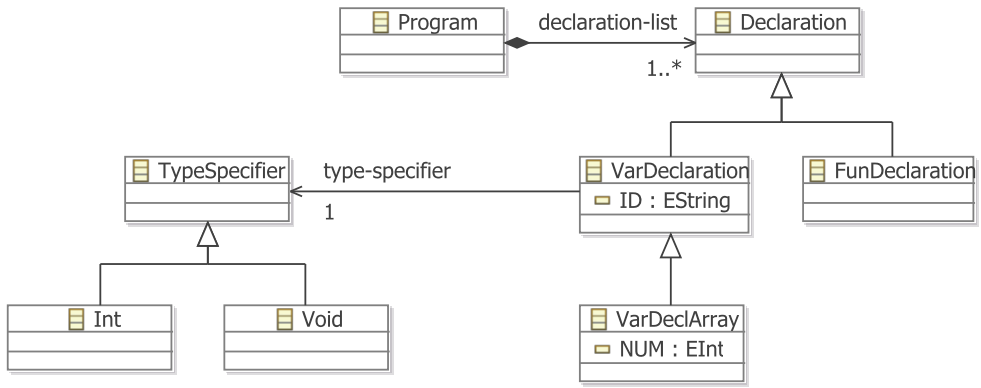

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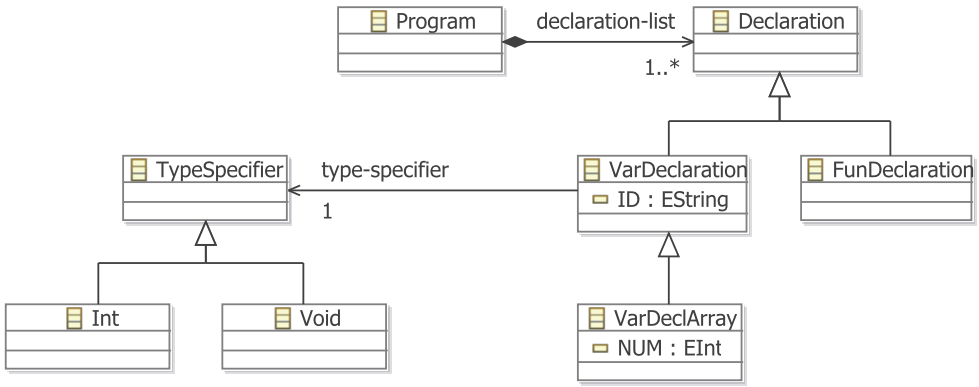

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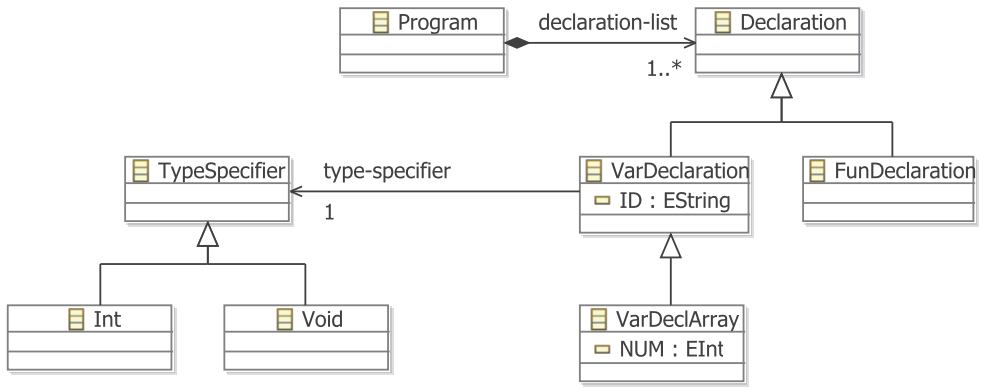

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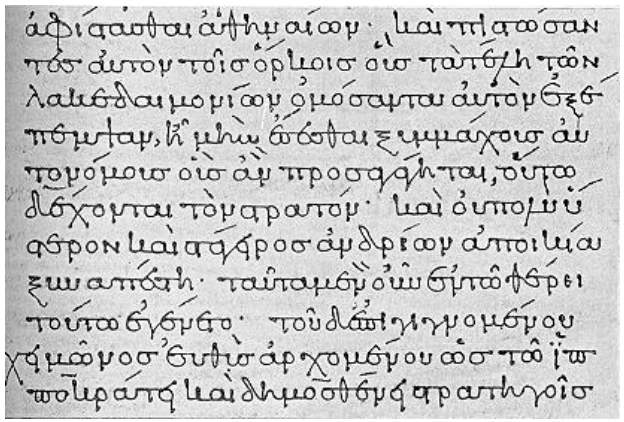
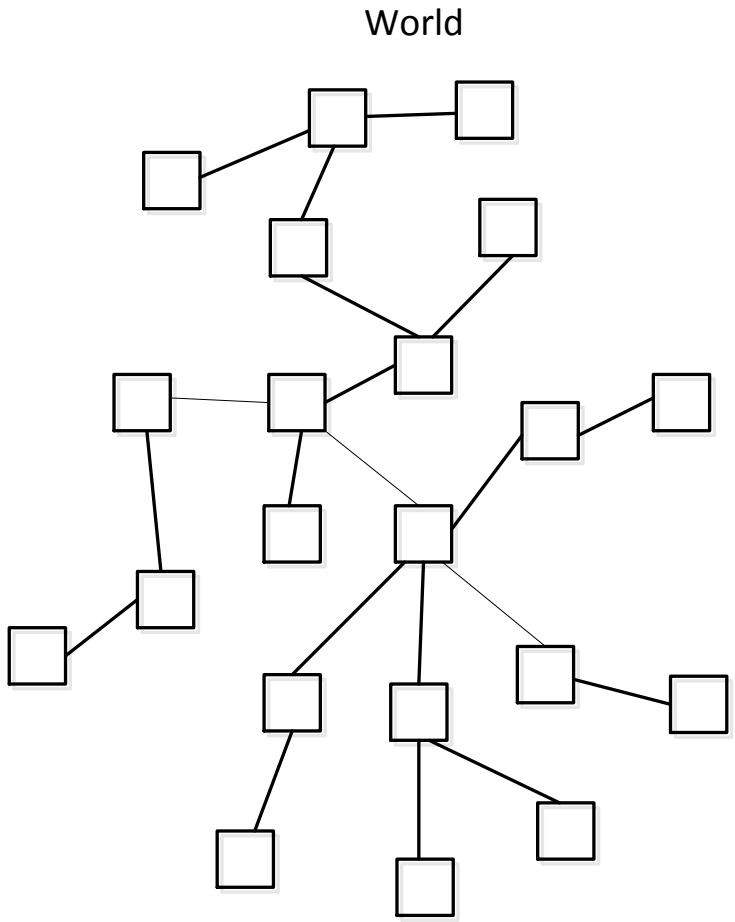
Domain-Specificity

General purpose versus domain-specific (a class of problems)



亞物瑪利亞。滿被額
辣濟亞者。主與爾偕
馬。女中爾為讚美。爾
胎子耶穌。併為讚美
天主聖母瑪利亞。為
我等罪人。今祈天主。
及我等死候。
亞孟

Domain-Specificity



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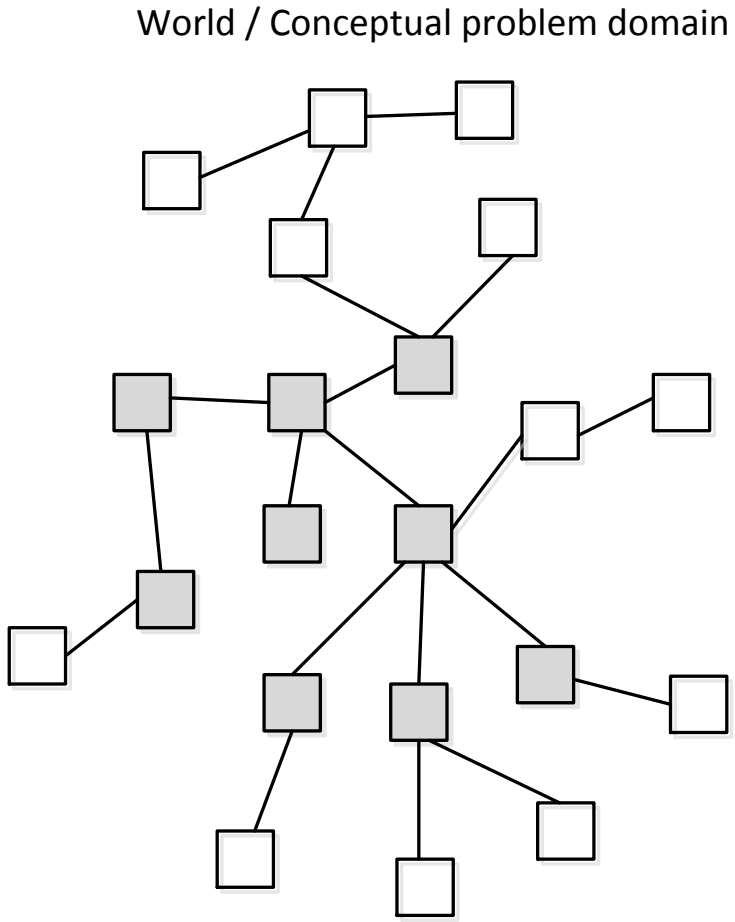

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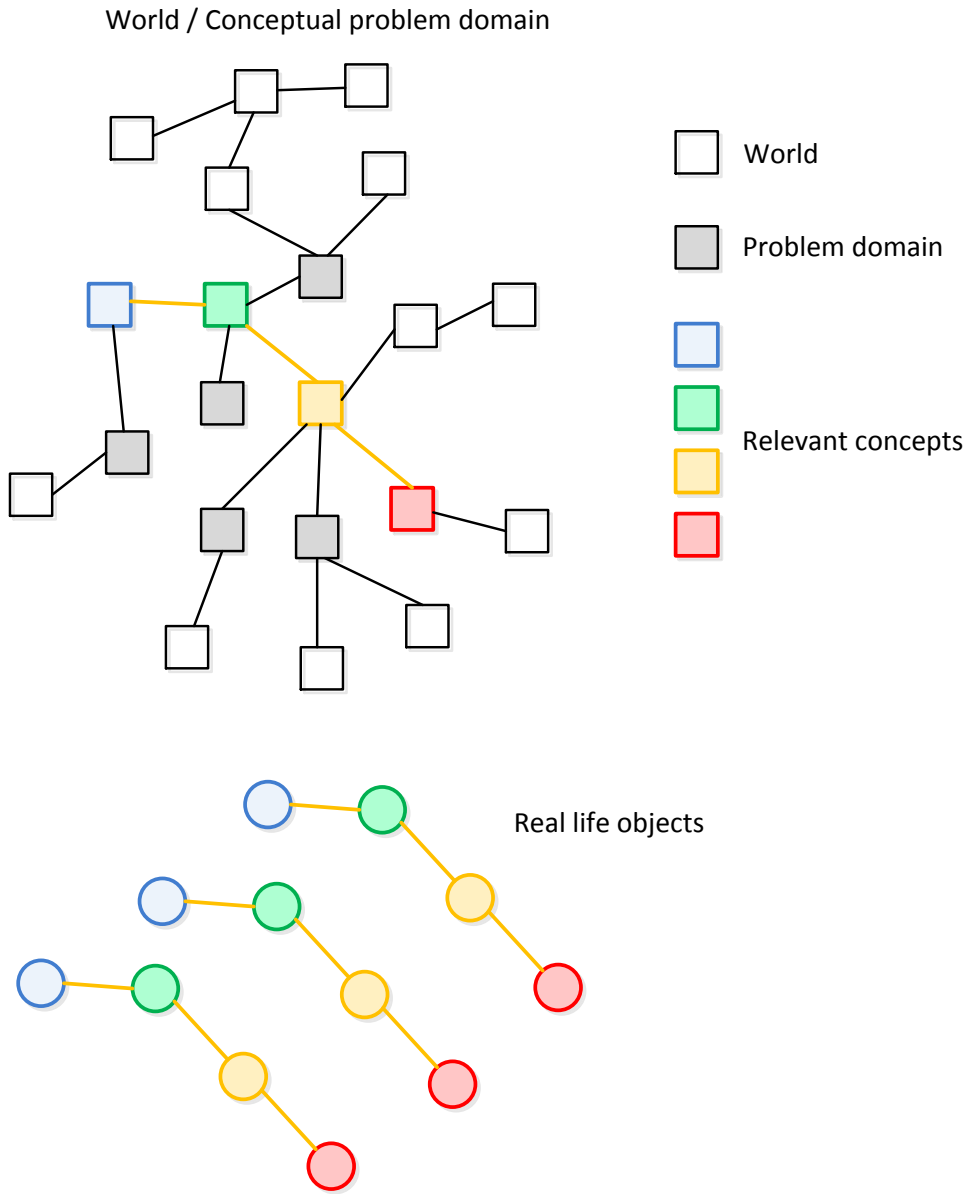

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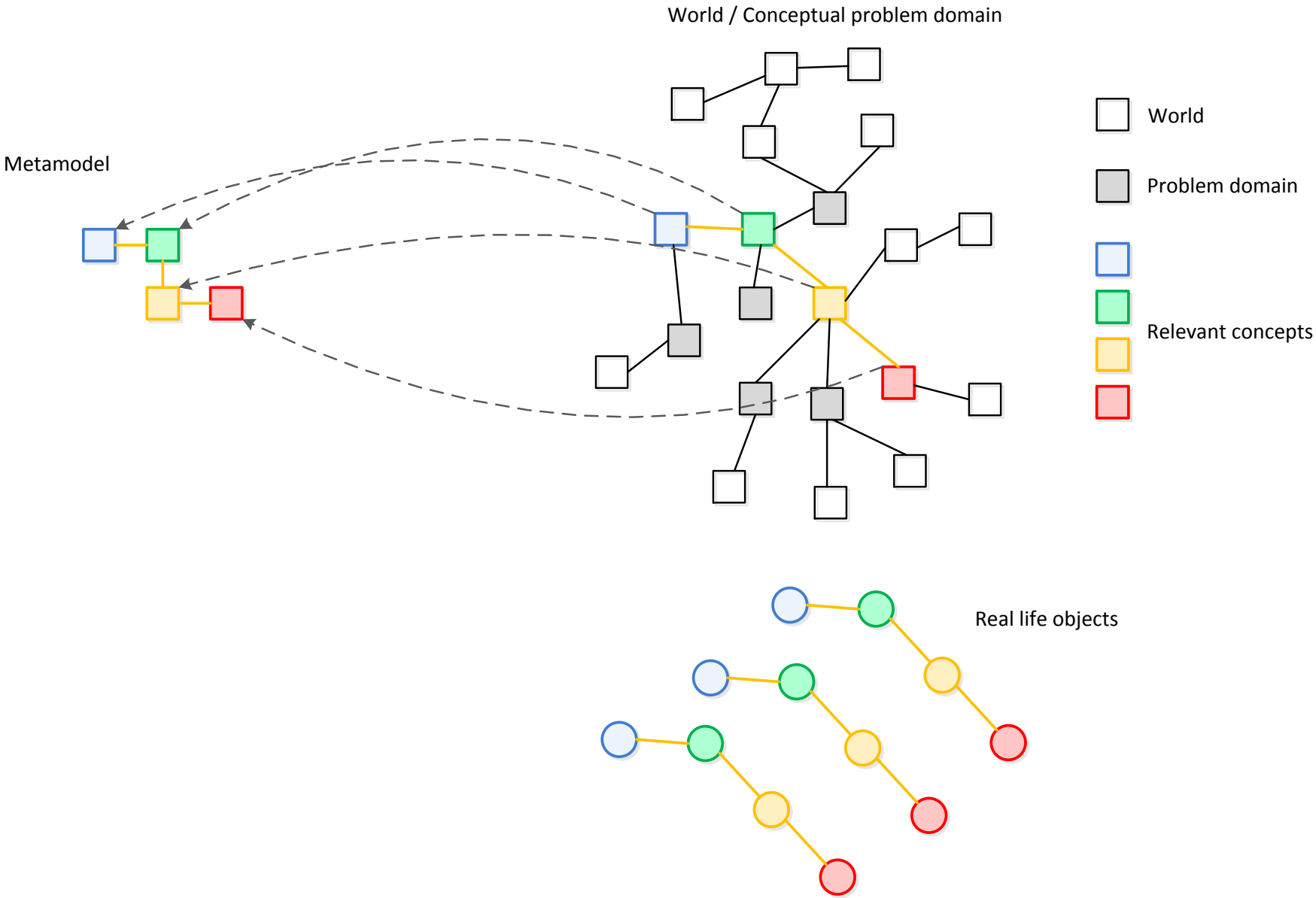

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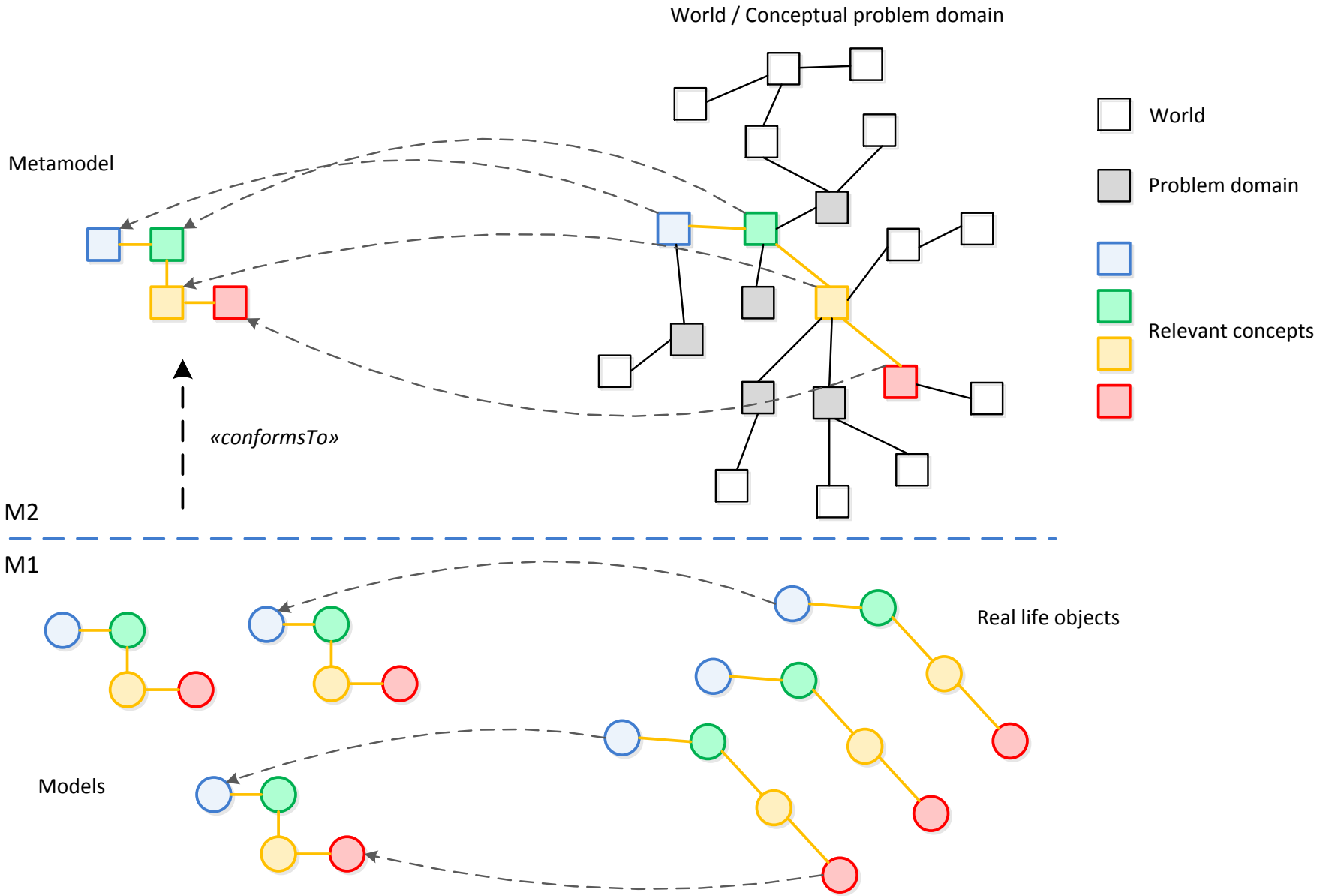
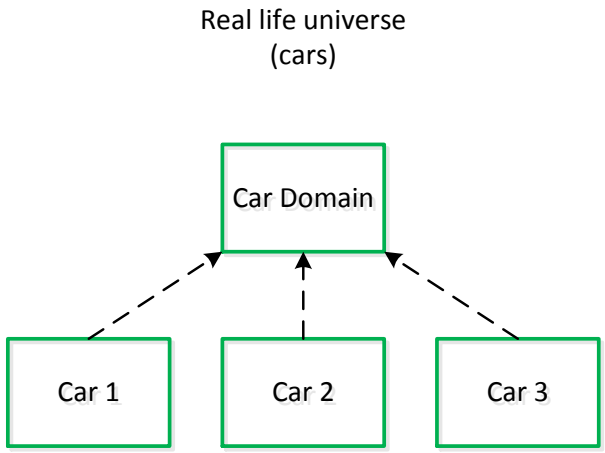


A Simple Example

A Domain-Specific Language (DSL) for modelling of cars



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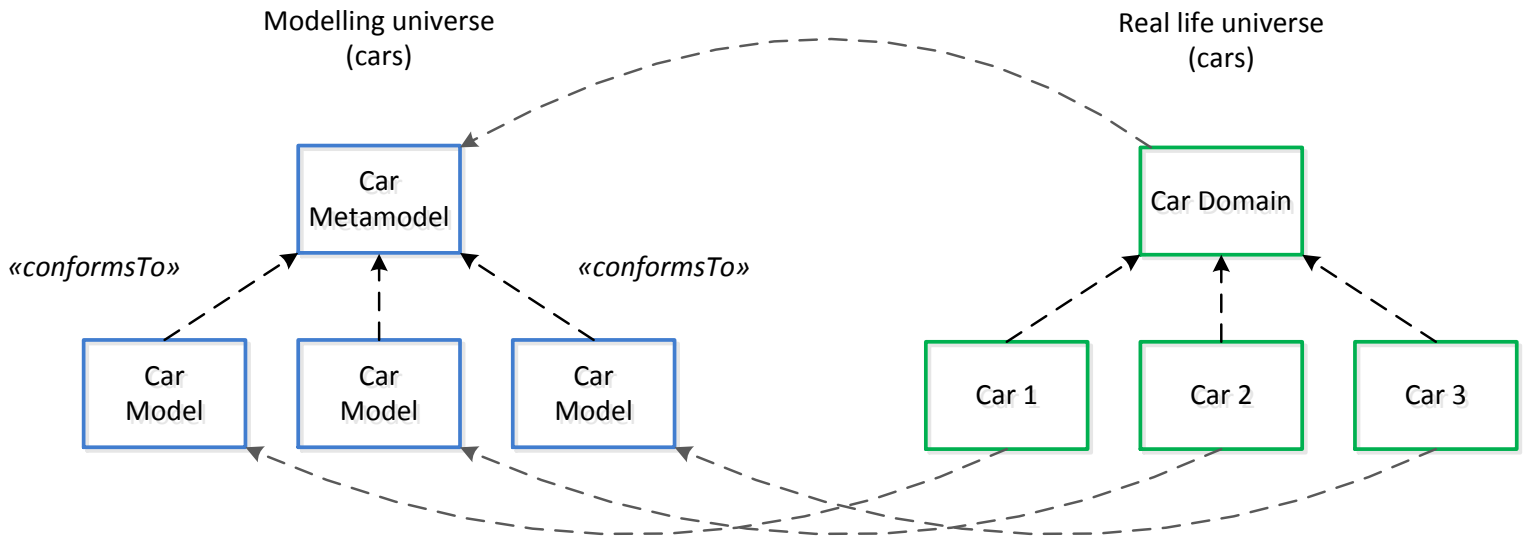

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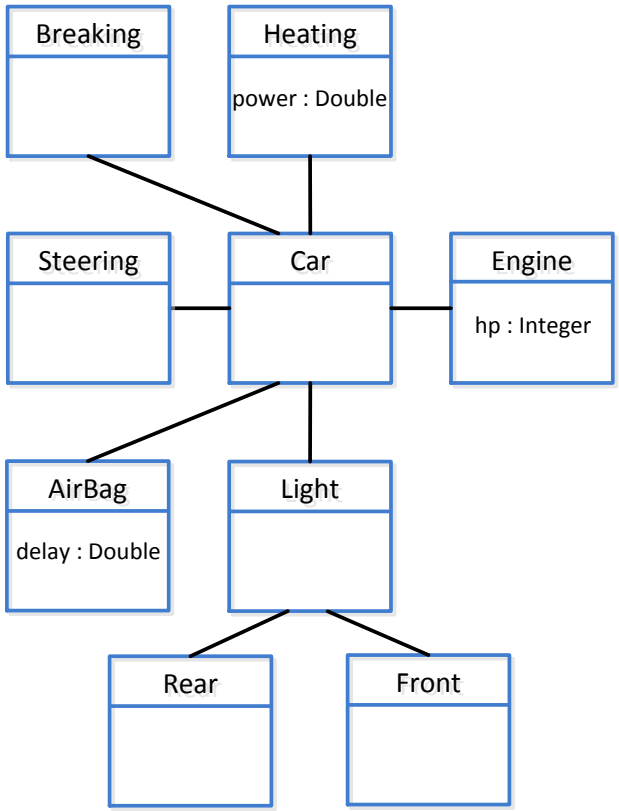

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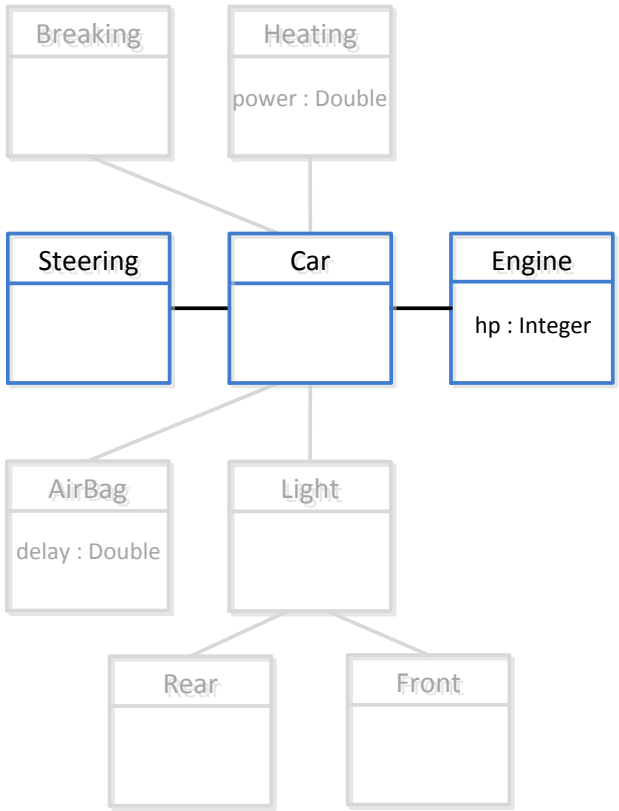
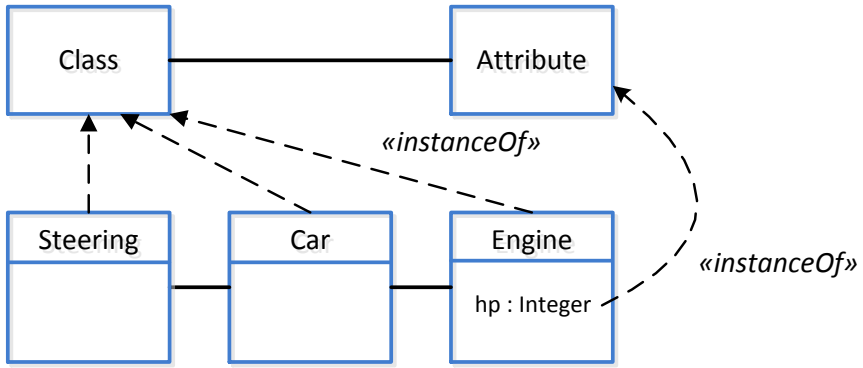


Metamodelling Architecture

MetaObject Facility (MOF)



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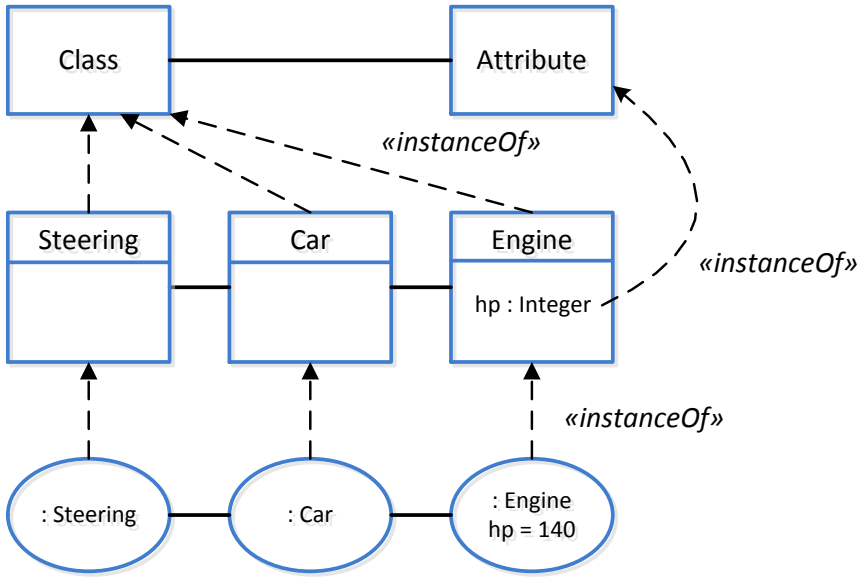

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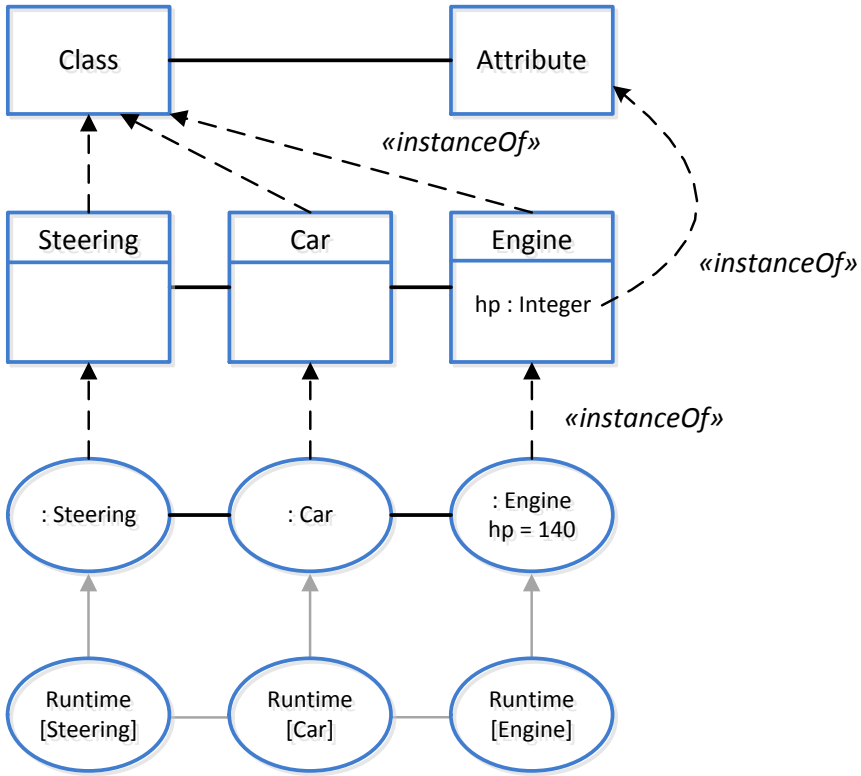

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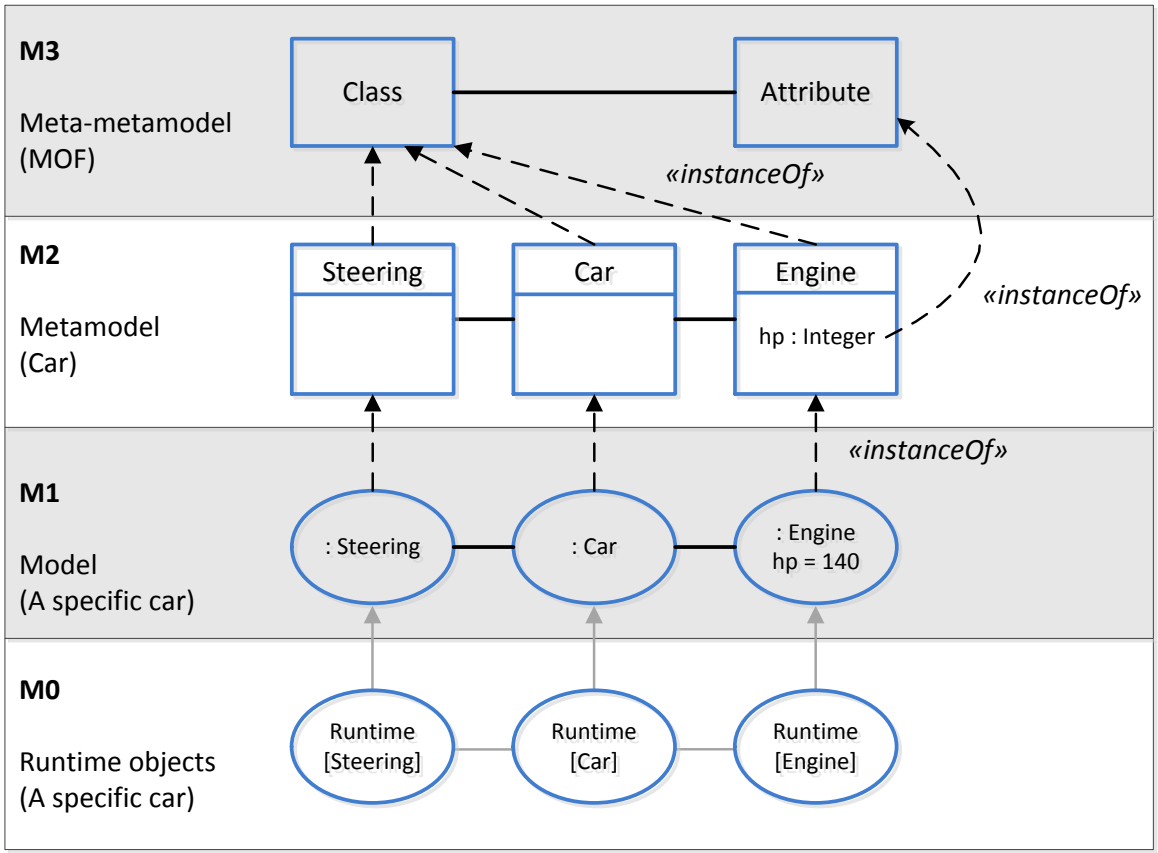

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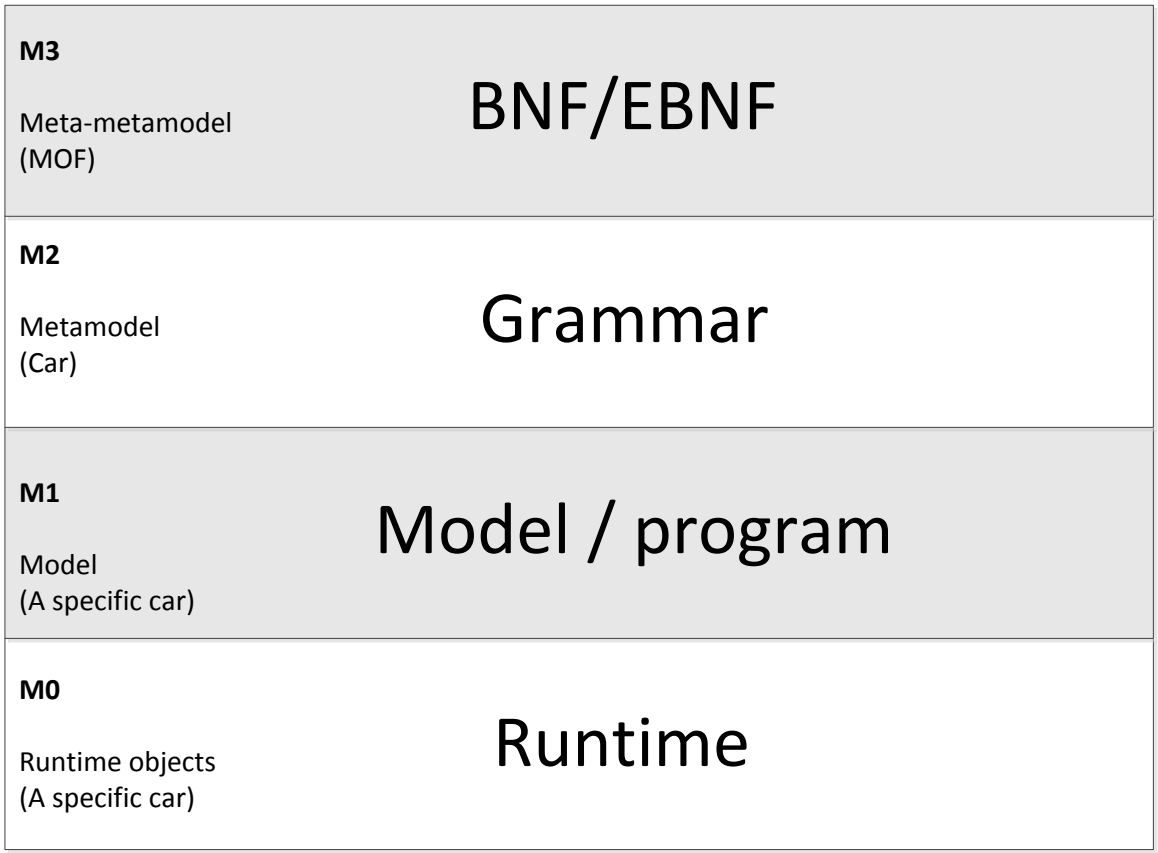
MOF versus BNF/EBNF



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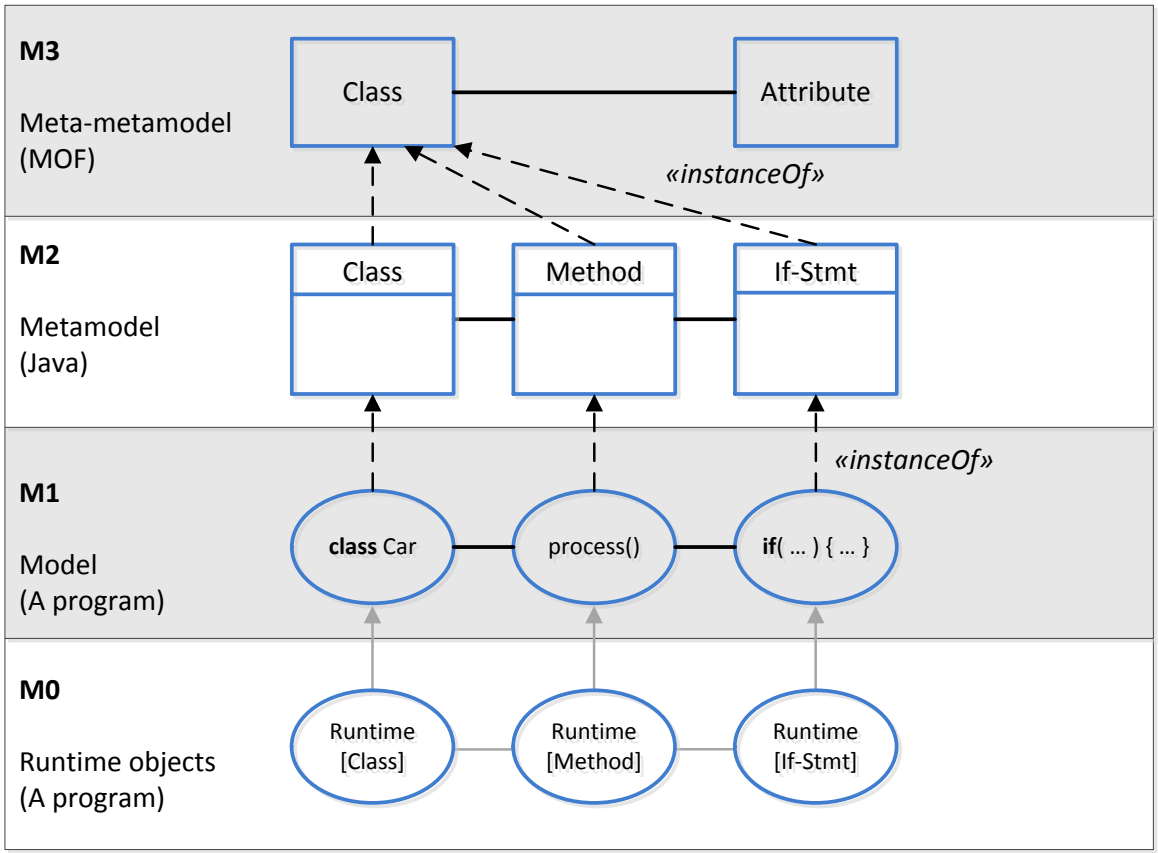
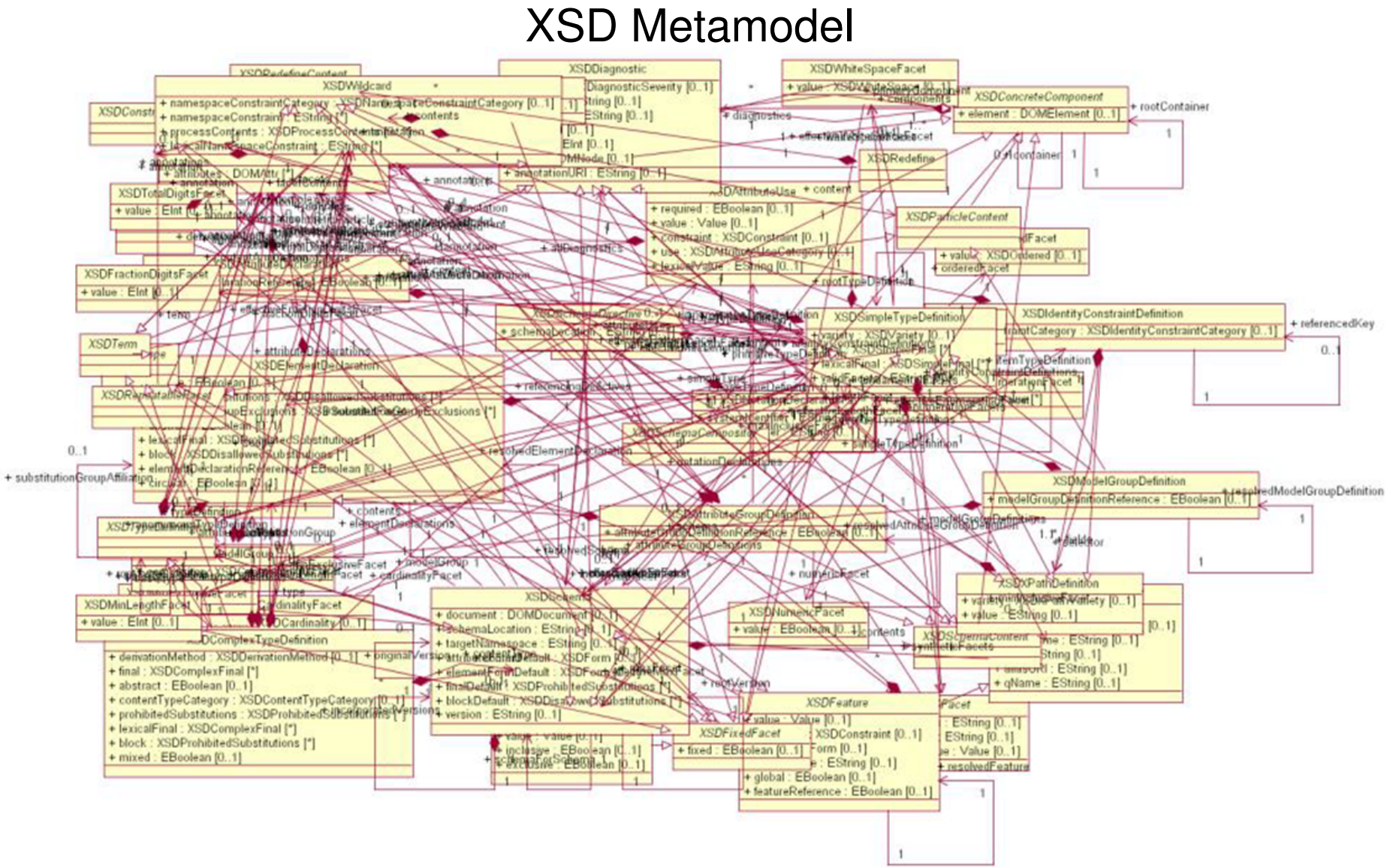
MOF GPL example



Metamodel for XSD



Model-Driven Engineering (MDE)

- Models and metamodels are central artefacts
- Metamodels used to, e.g. formalise languages (modelling and programming) and domain knowledge
- Tools and editors are defined relative to a metamodel
- Transformations are defined relative to one or more metamodels
- Important principles are automatic code generation, abstraction of details and robustness through reuse
- Composition of metamodels is required for code generation, consistency checking, addressing evolution and reuse

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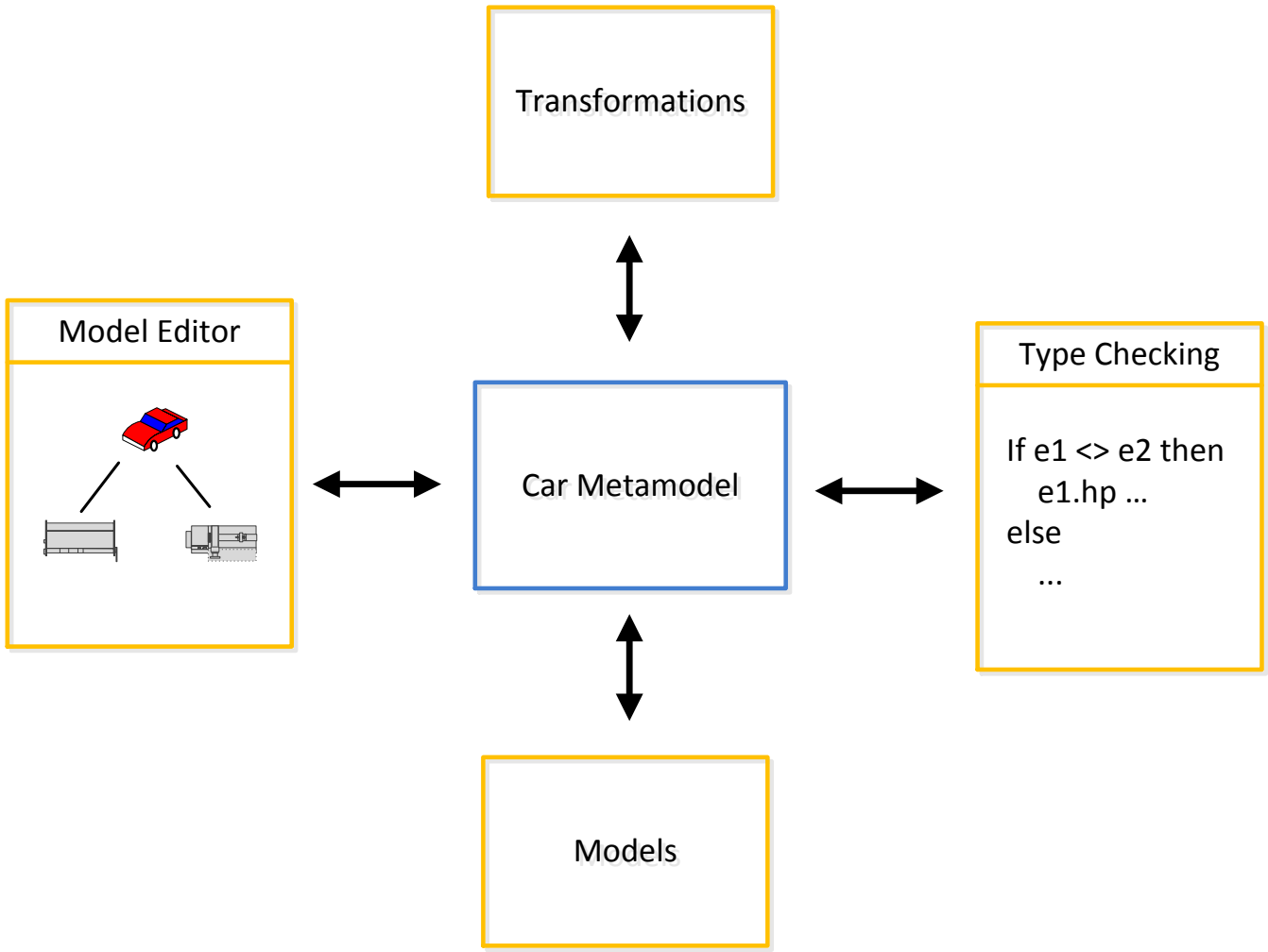
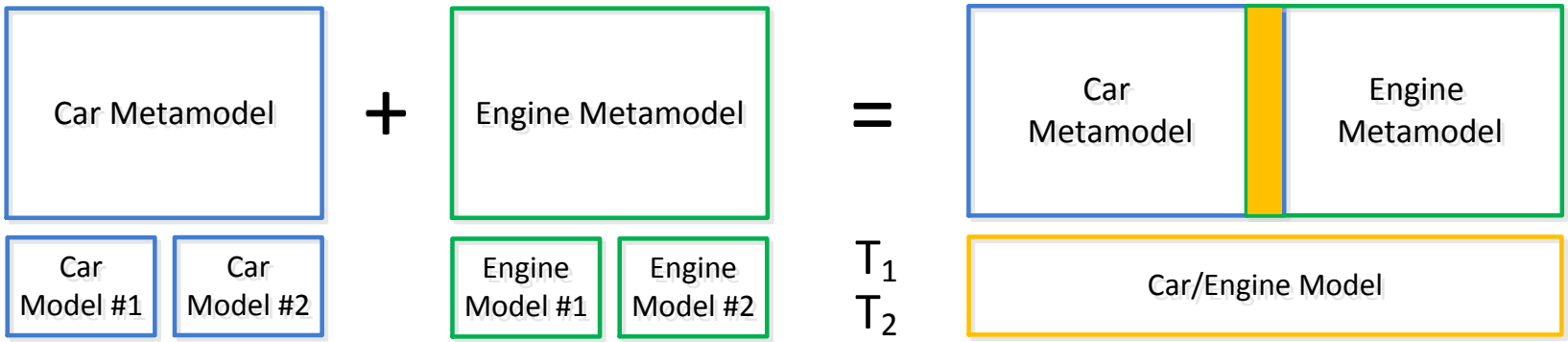
Artefacts in MDE

Metamodels, models and tools



Operations in MDE

Composition/weaving and transformations, etc.



Language Artefacts

- Language structure (constructs)
  - Abstract syntax
  - Static semantics, e.g. OCL constraints
- Presentation (interface)
  - Graphical symbols (concrete syntax)
  - Textual concrete syntax
- Meaning (semantics)
  - Behavioural semantics (e.g. in the form of methods or operations)
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Why use metamodelling, DSLs and MDE?

- Small languages - possible to focus on aspects or system concerns separately
- Higher abstraction level
- High degree of automation, e.g. code generation
- Rise in productivity
- Easier communication between stakeholders (model as a communication device)
- Object-oriented definition of structure
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- Challenge: how to address evolution, where existing models, tools and transformations can be reused (e.g. by automatic revision)
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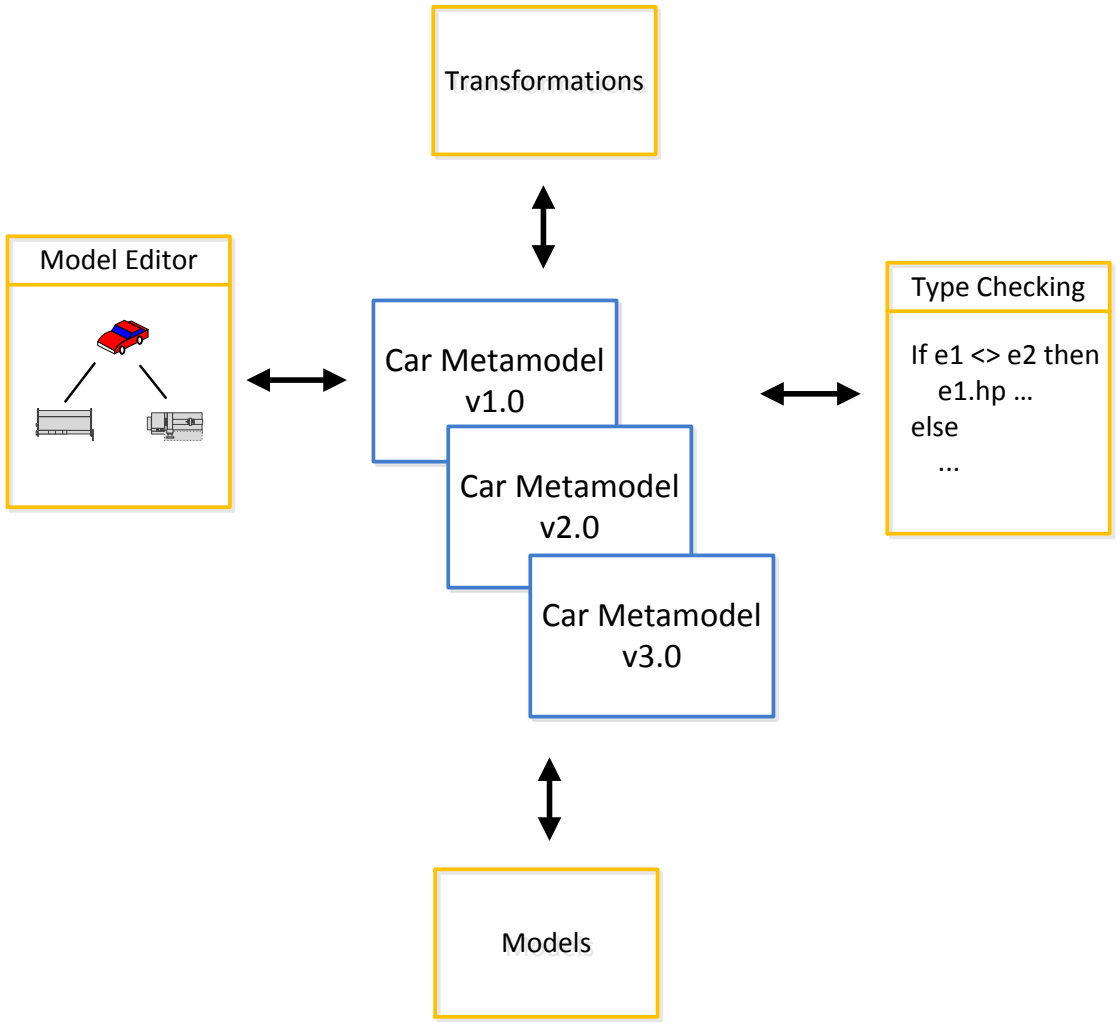
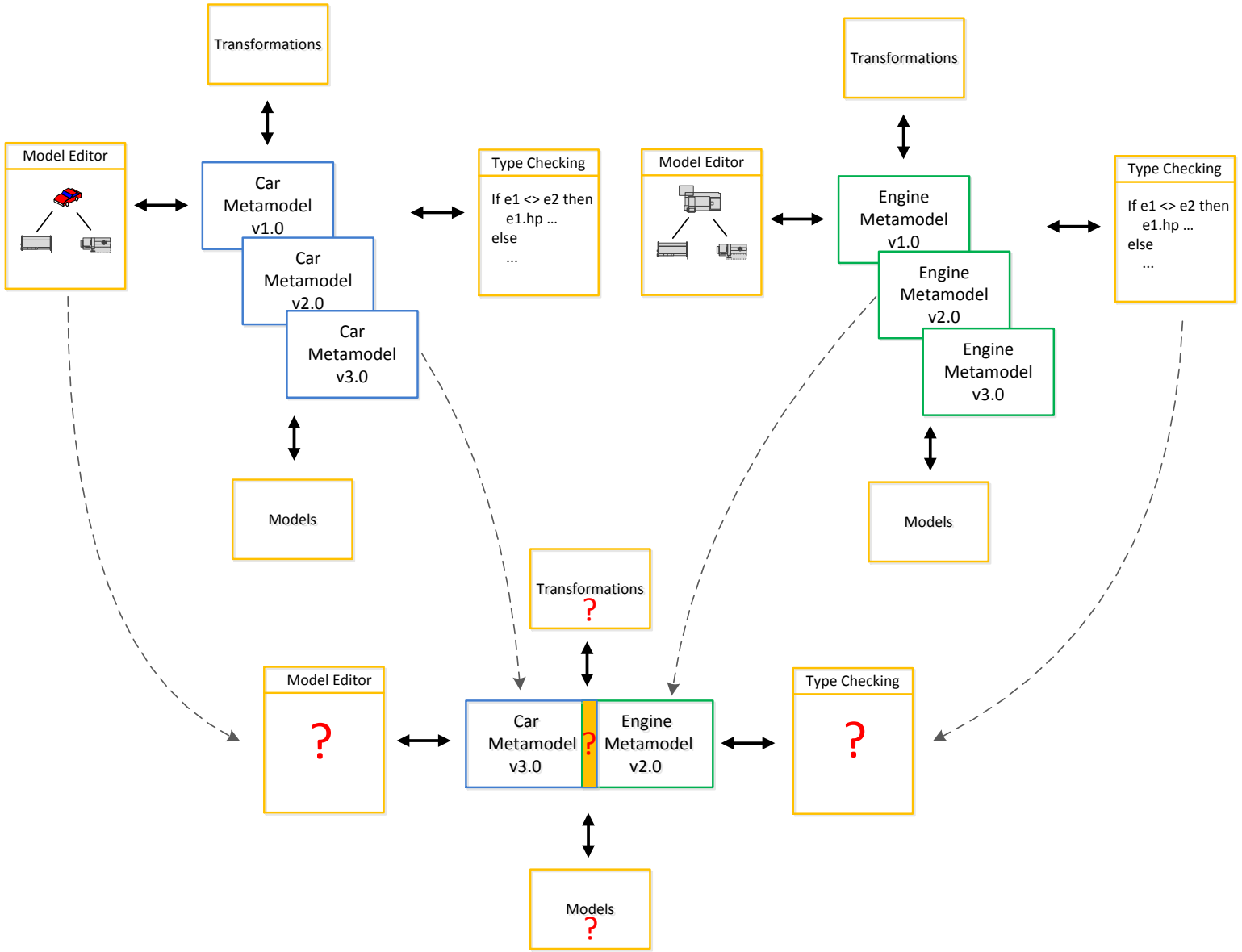
Challenge: changing metamodels

Including composition and weaving



Challenge: addressing evolution and tool reuse



Summary

- A metamodel describes or formalises a language (broader view: semantics included as part of metamodel)
- A model conforms to its metamodel
- Models are either executable or transformed/mapped to entities defining the semantics
- Metamodels and models are key artefacts in MDE together with tools
- Metamodelling and MDE support describing problems at higher abstraction levels - using models
- Advantages are increased productivity and reuse

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