Model-based Software Engineering
(02341, spring 2016)

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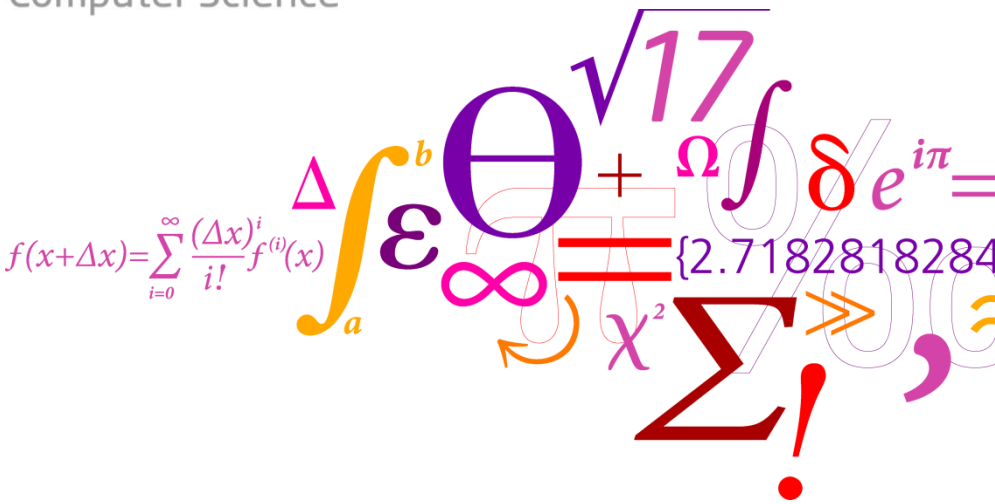

Meta-modelling and Domain Specific Languages (DSLs) and Outlook

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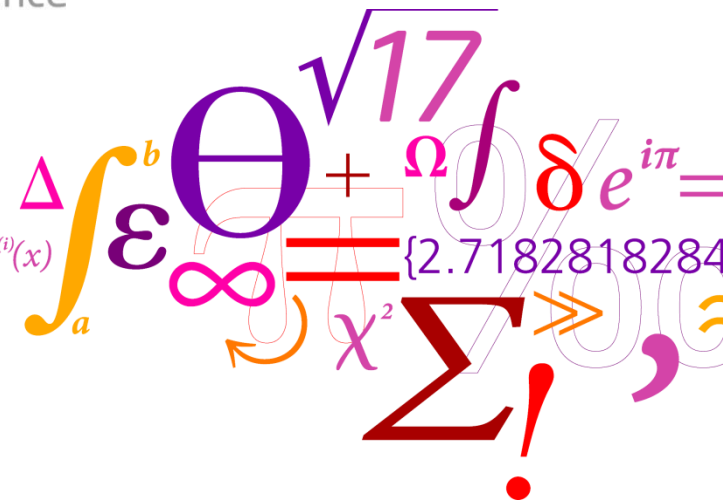
Recapitulation and more detailed discussion on "meta" in MOF (EMOF)



DSL(s)

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- DSL (singular):
  A single domain specific language,
  designed and realised according to some principles
  and for a specific purpose or a specific domain

- DSLs (plural):
  - Disipline and principles for designing and realising a DSL
  - A technology or set of technolgies for designing and realising a DSL (mostly from MBSE)
  - A way of ”thinking” software design (idioms)

Parts of a DSL definition

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- **Abstract syntax** (see L01):
  language concepts and their relation
  (*API / domain model / framework)*

- **Concrete syntax** (see L01):
  syntactical representation of concepts
  (graphical or textual)

Actually, there could be different concrete syntax for the same abstract syntax

- **Semantics** (what it does):
  Code generation or interpretation, which enacts what an instance of the DSL says

DSL Technolgies typically support the first two steps; and might help a bit with the last!

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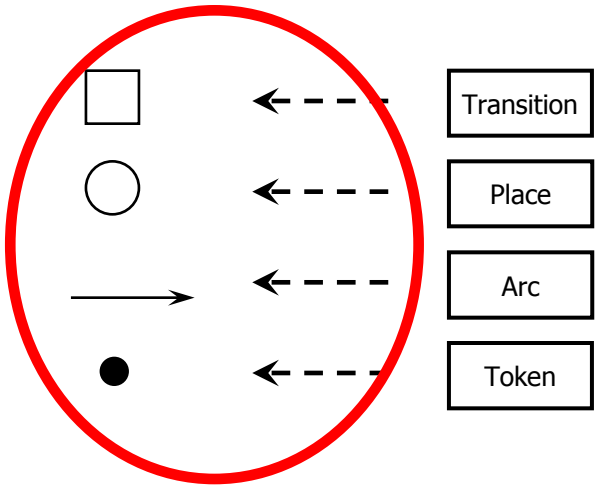
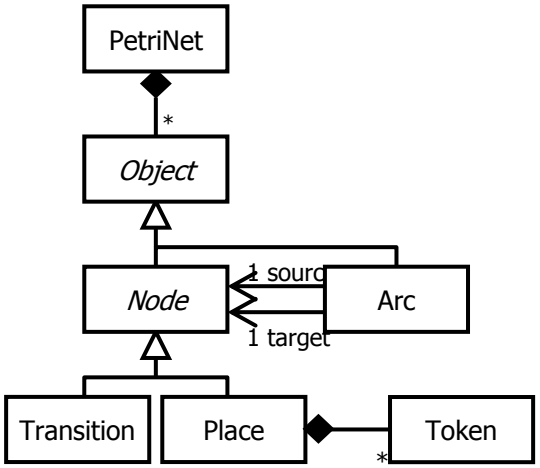
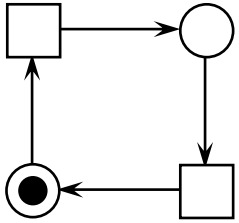
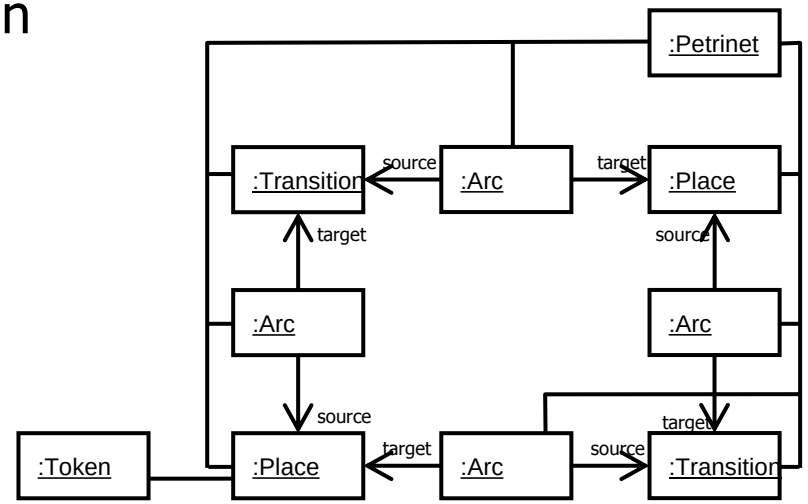




generate an editor





Philosophy

- A DSLs should help decrease redundancy and unnecessary work
- A DSL should help separating the variable or generic parts of a software product from parts which do not change
- A DSL should increase reuse
- A DSL should support abstraction form irrelevant technical details
- A DSL should emphasize the domain's idioms

MBSE & DSLs

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- MBSE Technologies help implementing DSLs in a fast and efficient way (mostly concerning abstract and concrete syntax)

- Therefore, the terms MBSE and DSL are often used in the same context (and sometimes mixed up)

Meta-modelling (and MOF)

Meta-modelling is a core part of DSL design: Defining the abstract syntax

Class Diagrams are models too

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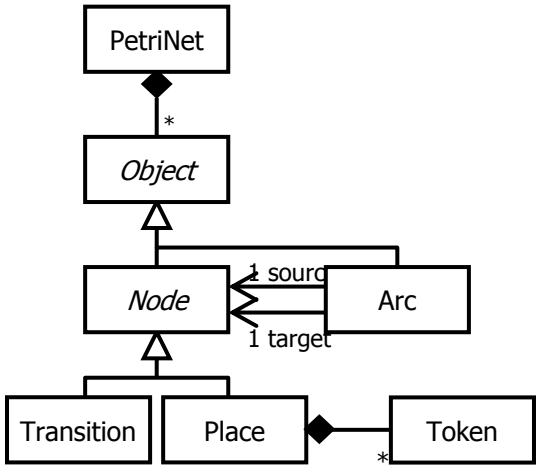
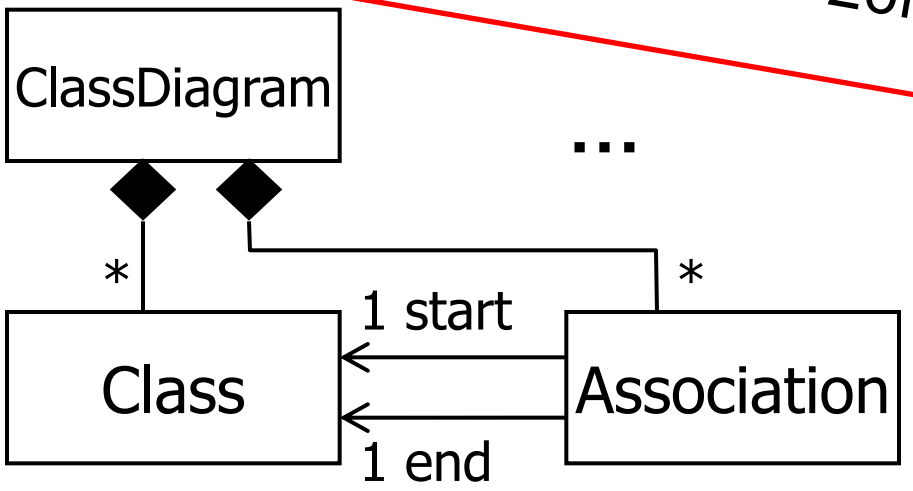
Note: We will see later that this is **much more** involved (slide 26ff)!



UML model



Meta-model for UML (class diagrams)

Now, the term “meta” model makes sense!

Meta-levels

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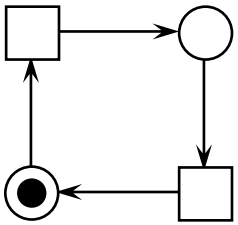

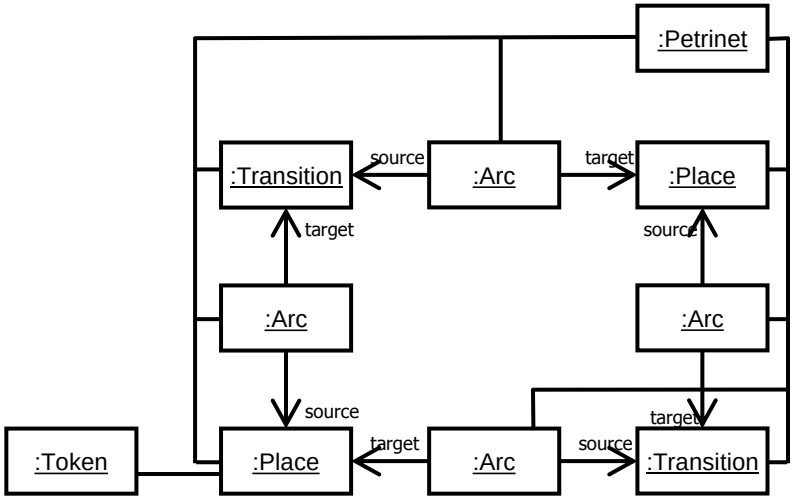

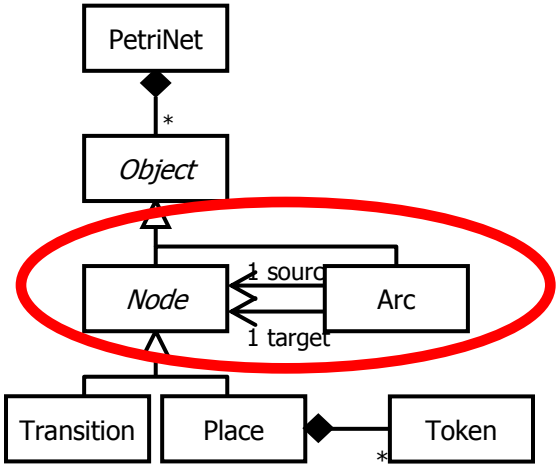

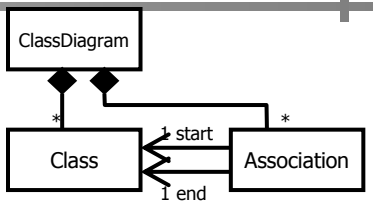

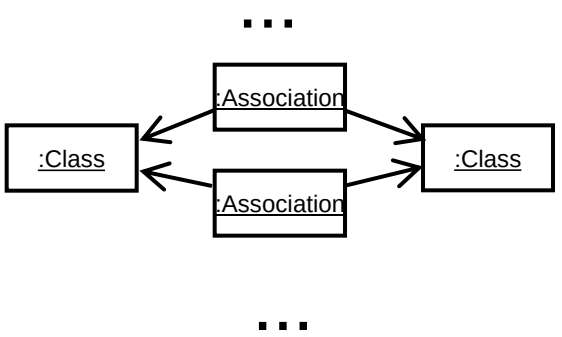

Levels of models

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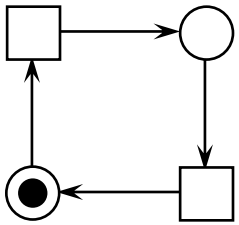
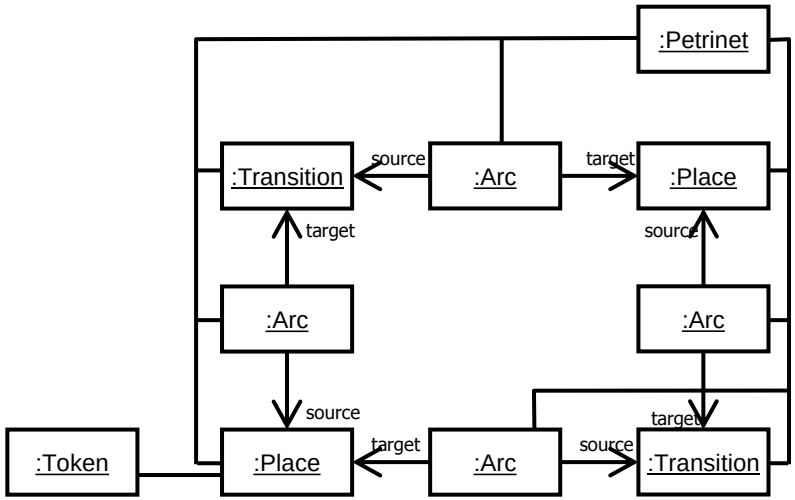
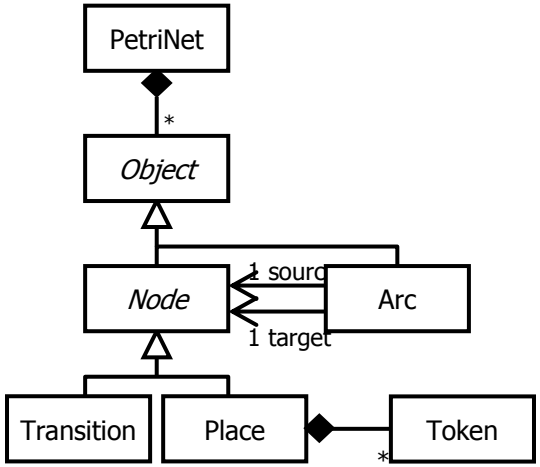
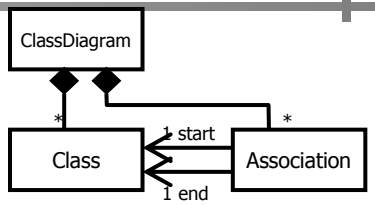
is an instance of

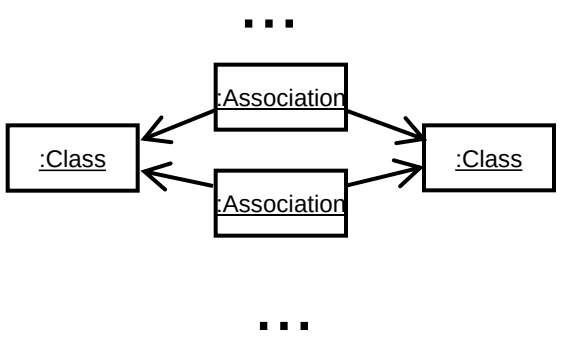
concrete syntax reprs. for











Outset

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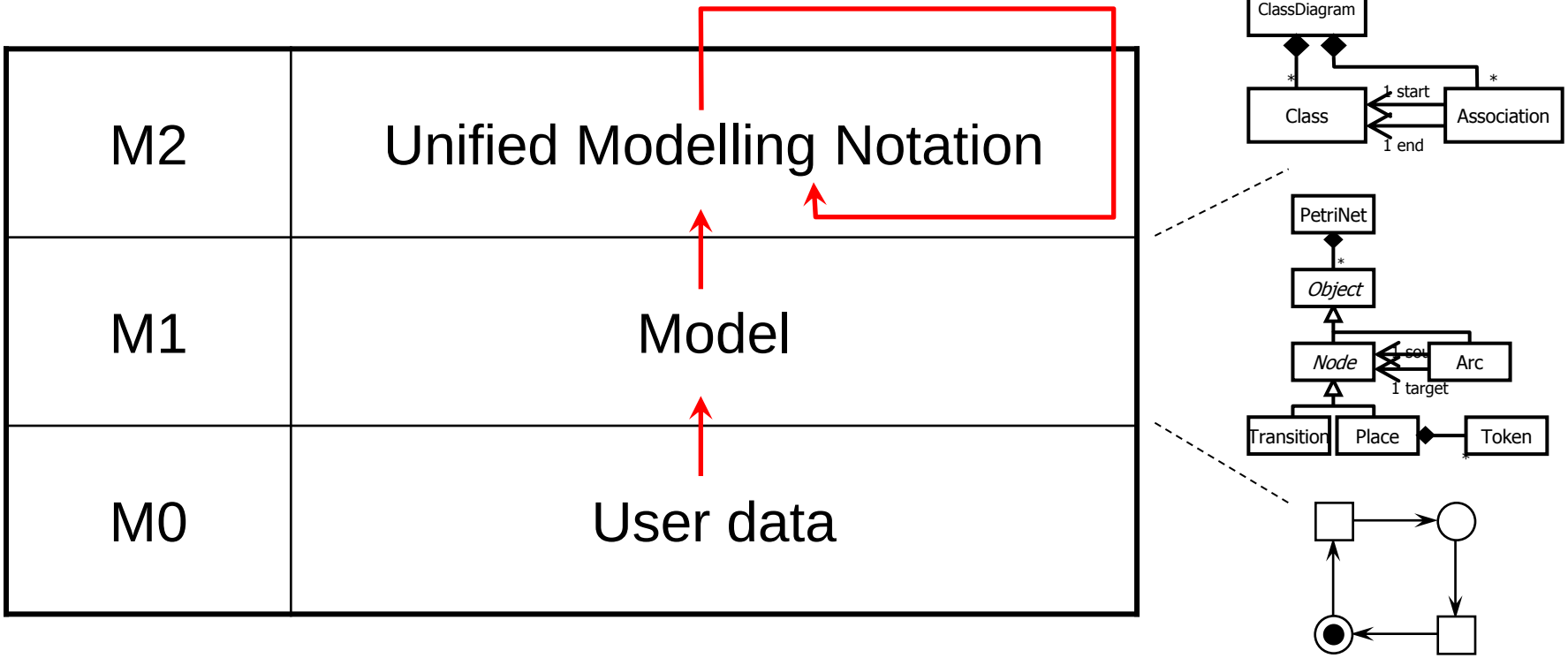

= conforms to / is instance of

Meta Object Facility (MOF)

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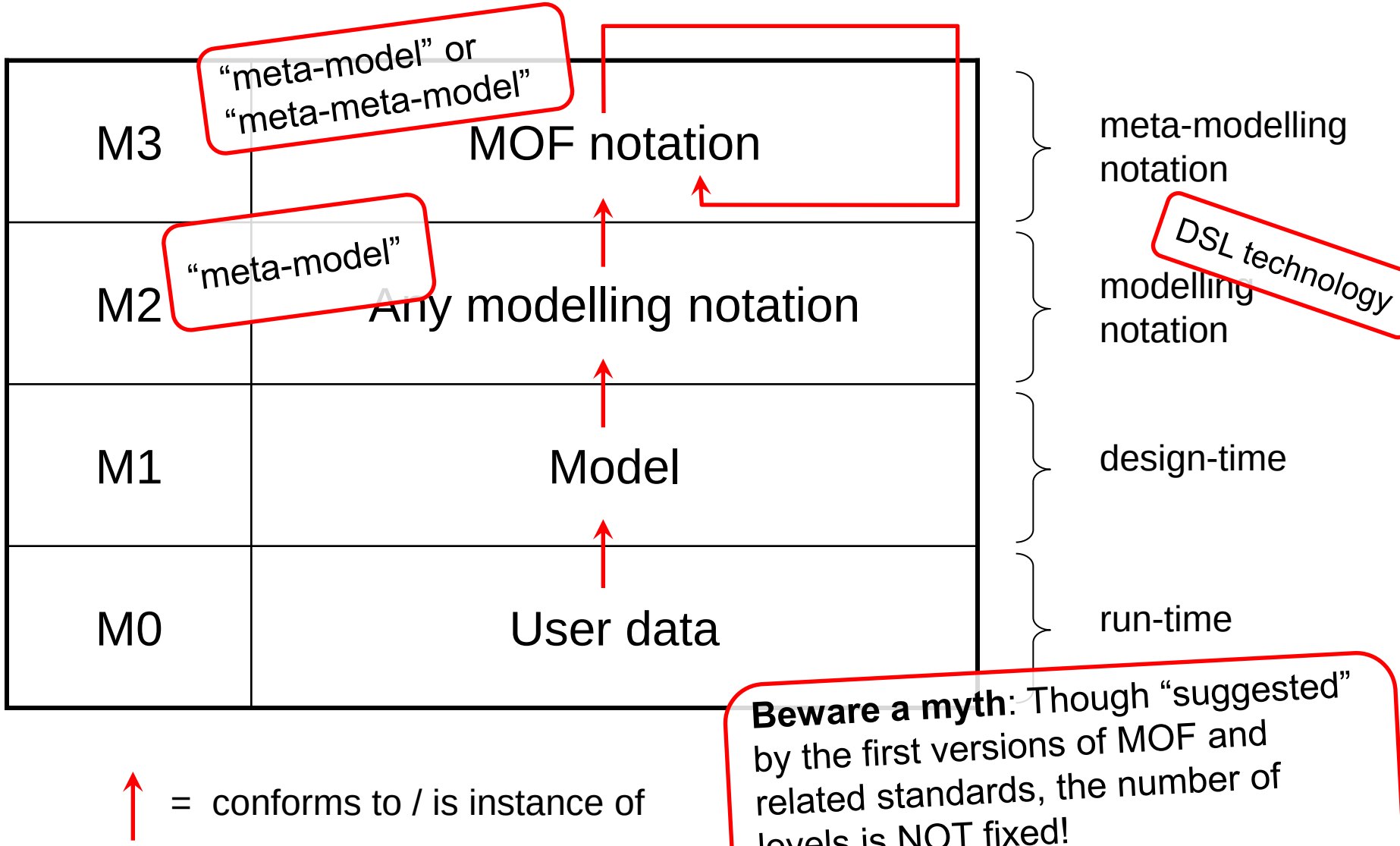

The Meta Object Facility

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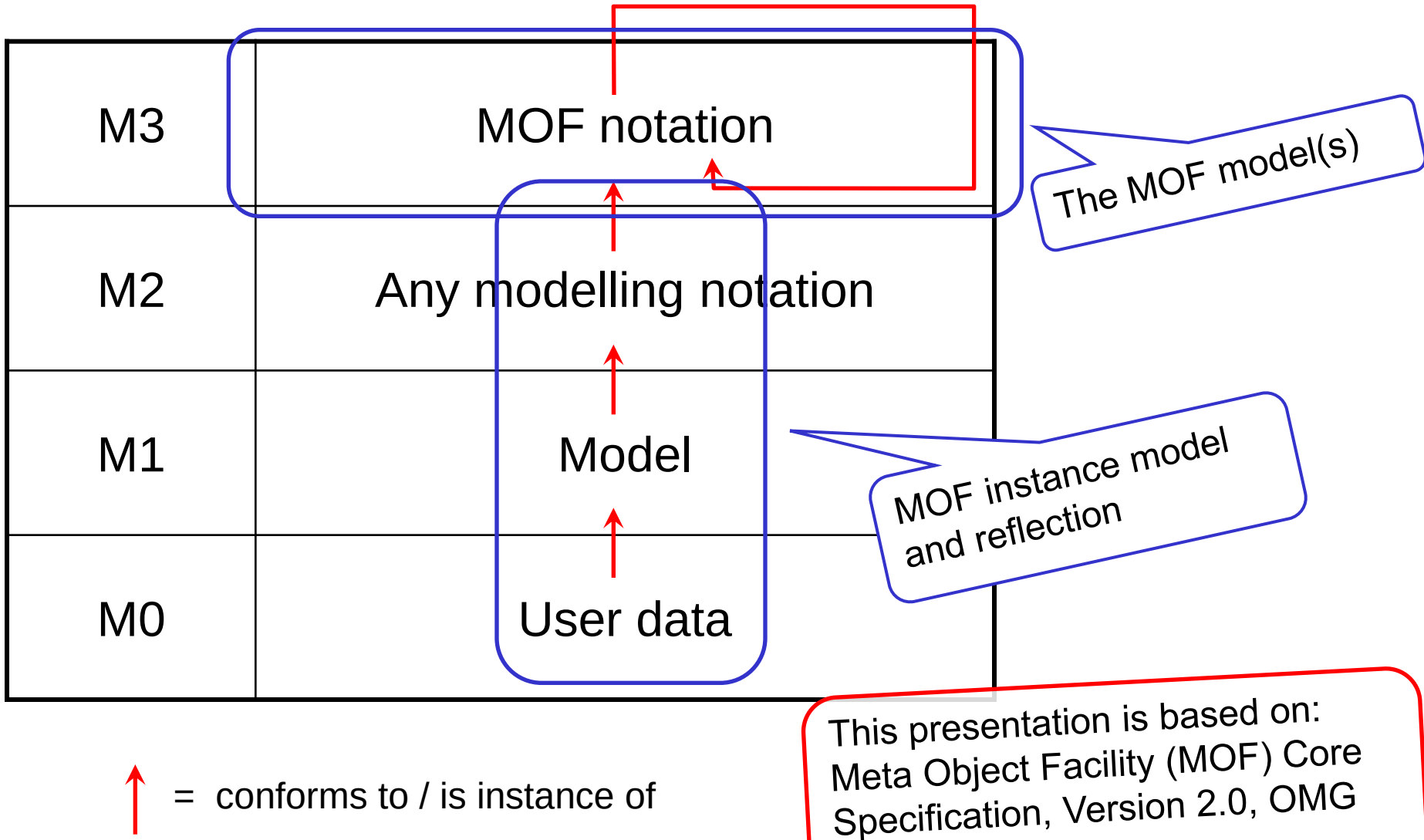

Discussion: meta

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- EMOF as instance of itself

- Where are the different features of the EMOF model represented in EMOF

EMOF Types

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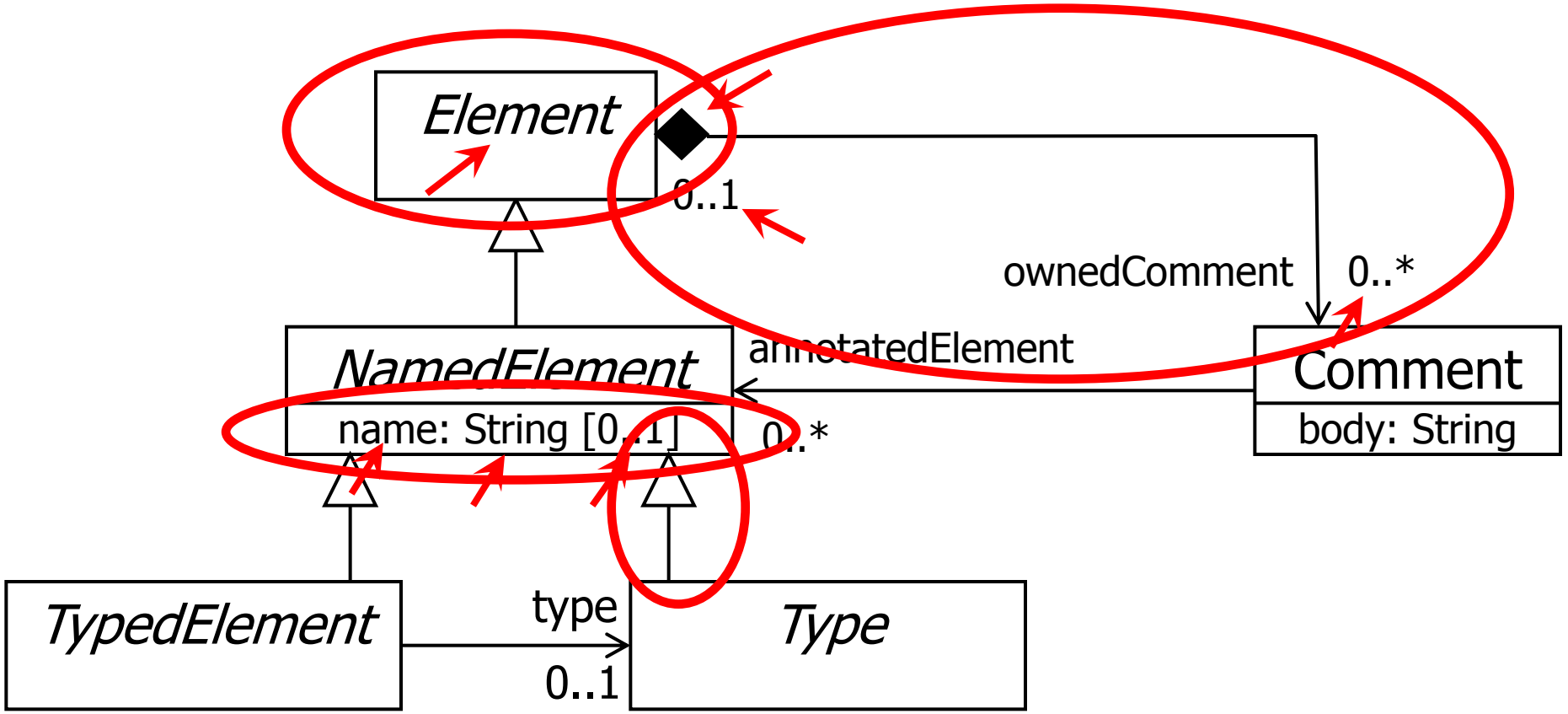
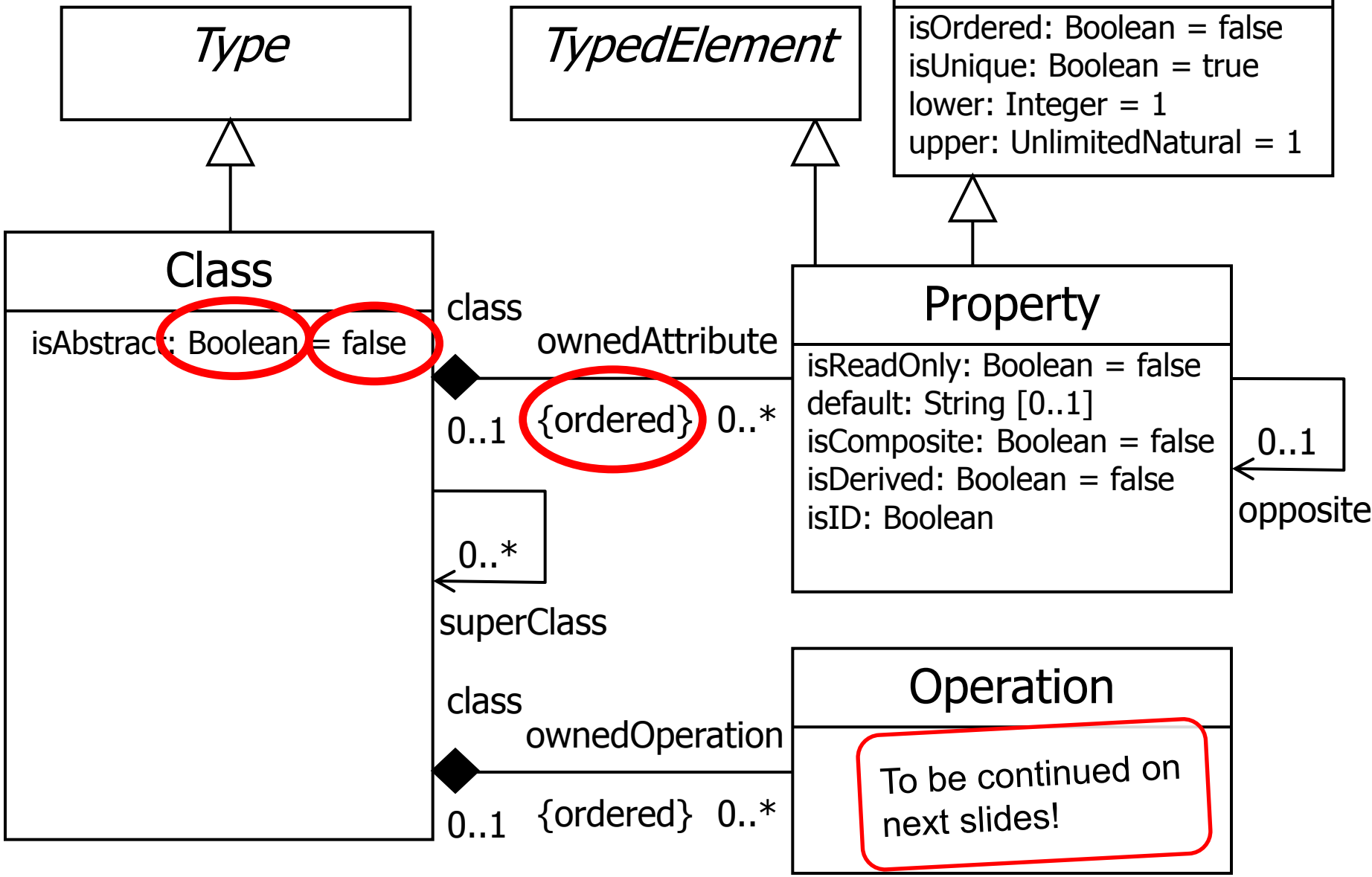


EMOF Classes



EMOF Classes (cntd.)

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Additional constraints (e.g.):

- opposite properties are properly paired
- no cycles in inheritance structure
- an object can be contained in at most one container

EMOF Classes (cntd.)

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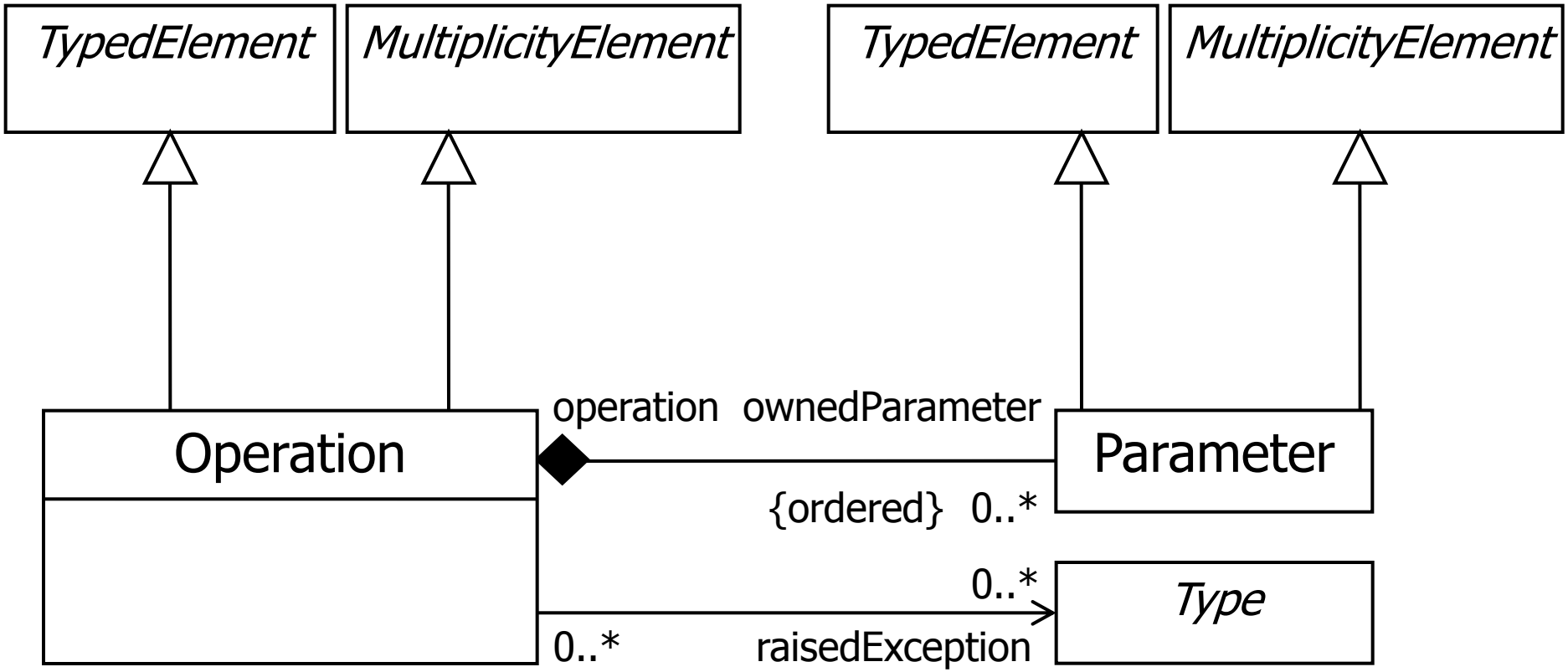

EMOF Data Types

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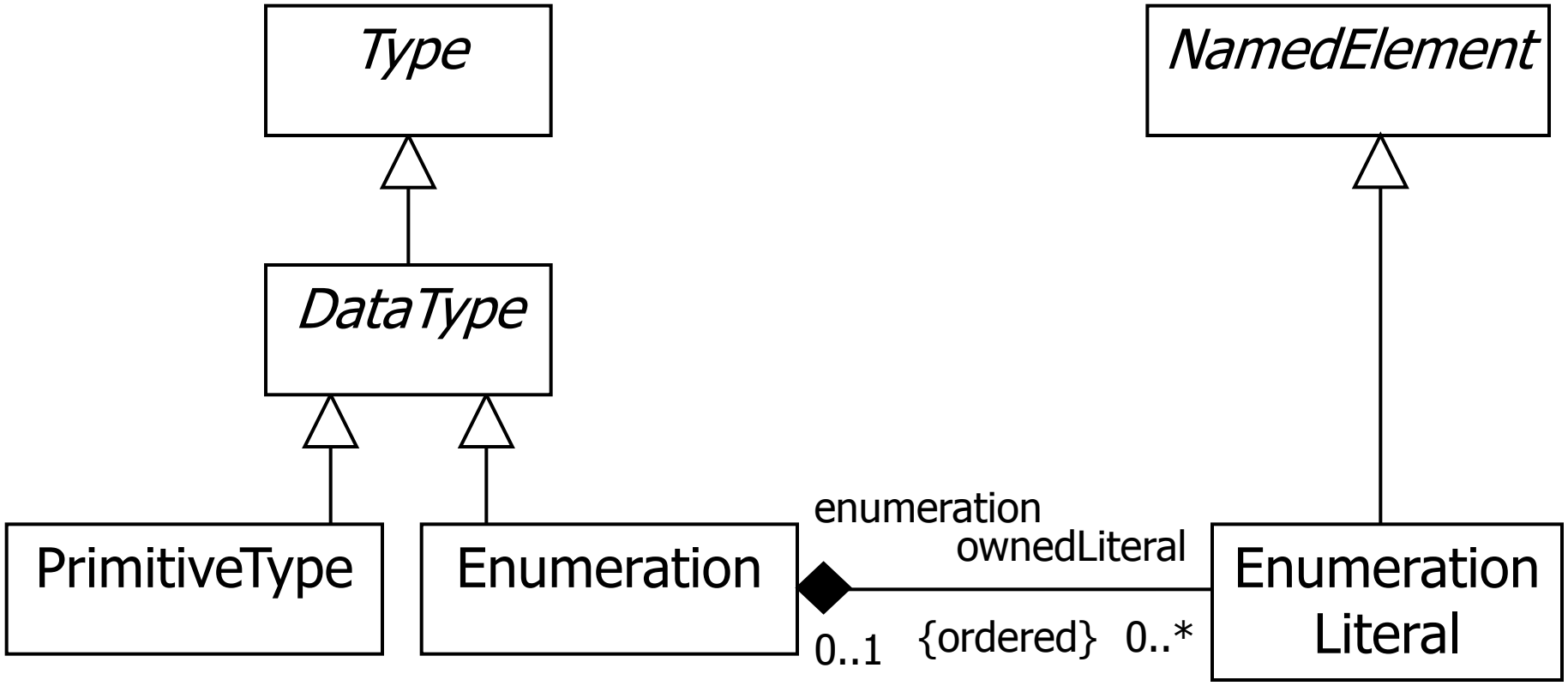

EMOF Primitive Types

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- Boolean
- String
- Integer
- UnlimitedNatural (* for ”infinity”)

EMOF Packages

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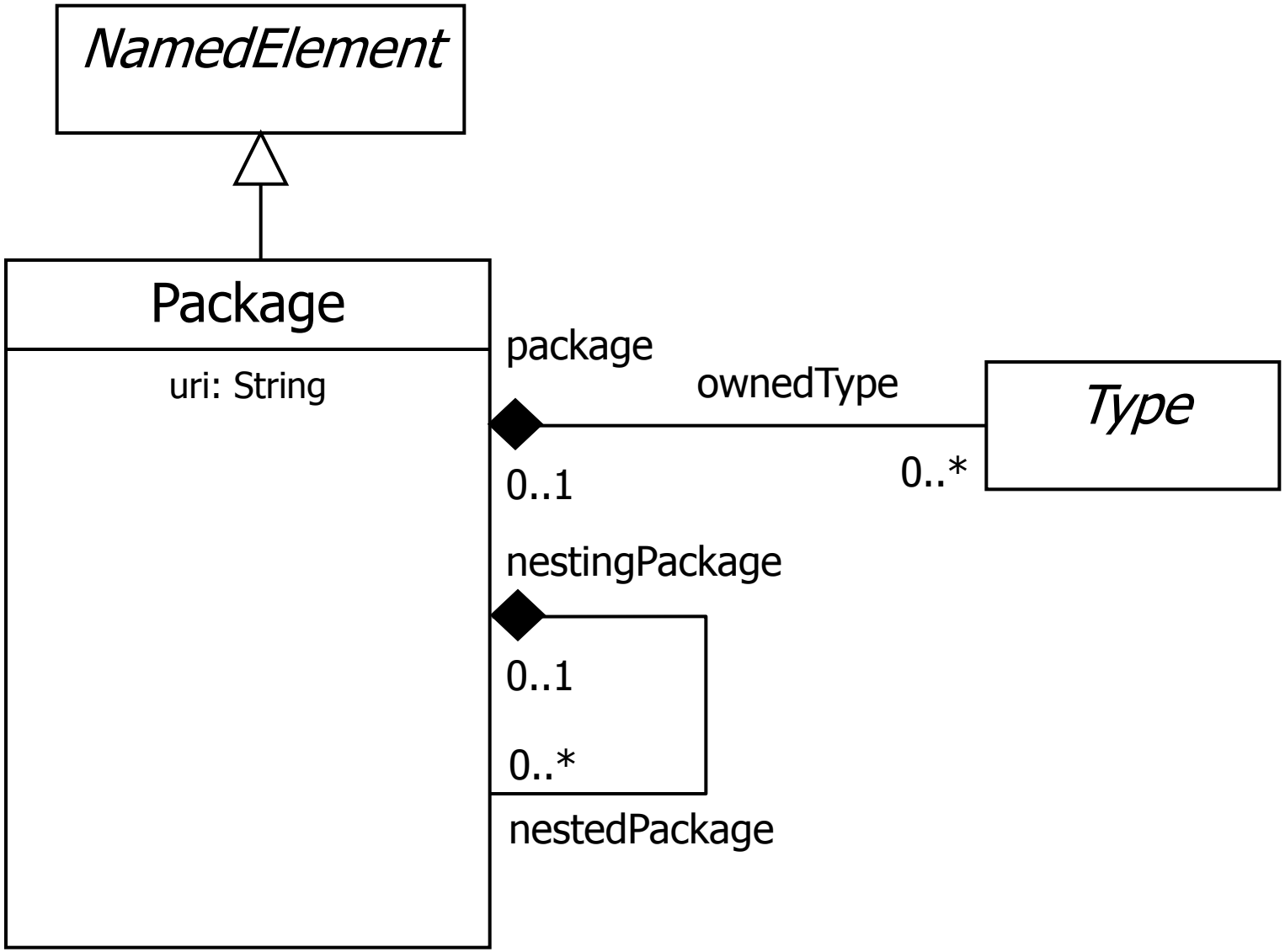

Reflection package

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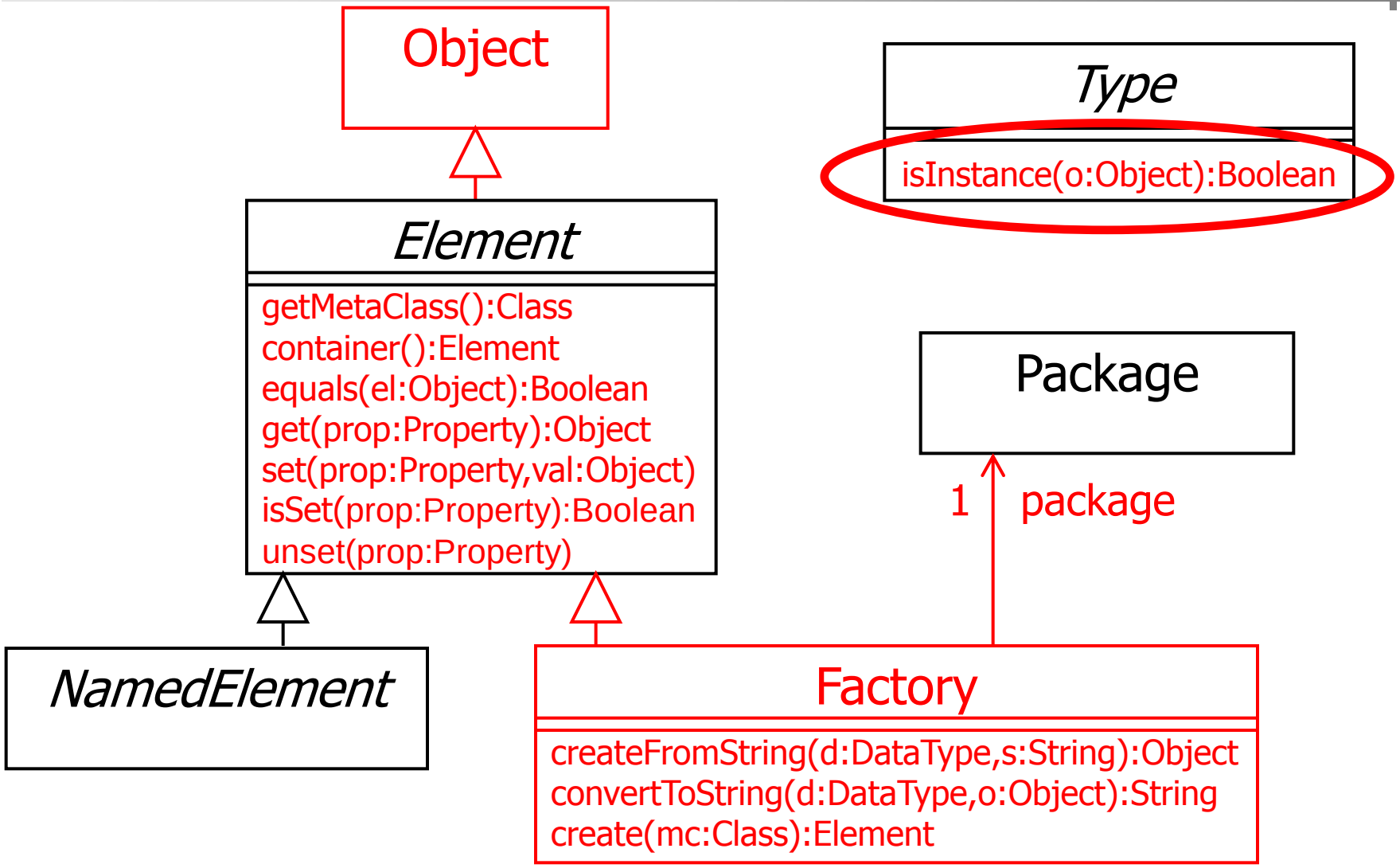

For properties with more than one value, there exist ReflexiveCollection and ReflexiveSequence (similar to Java Collections)!

MOF in our project

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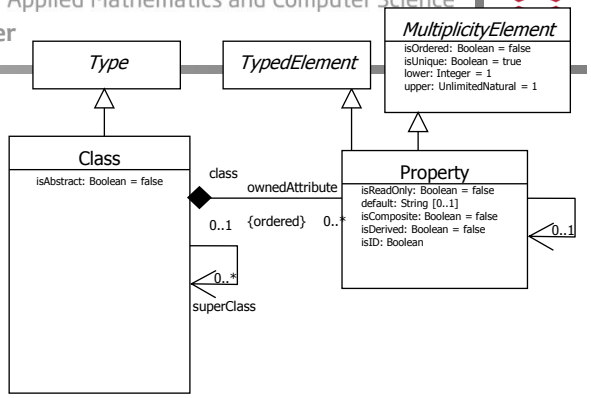
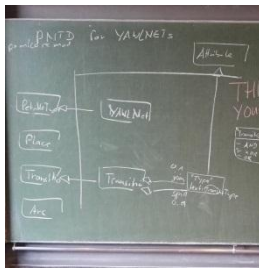
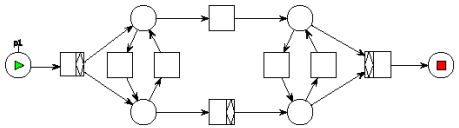
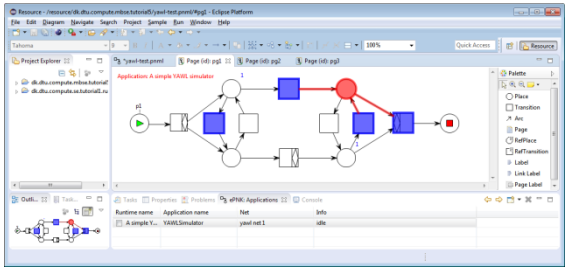


M3	Ecore (~ EMOF)	
M2	ePNK and YAWL meta models	+ Annotation model (runtime simulator)
M1	YAWL model	
M0	YAWL case (instance of a simulation)	







= conforms to / is instance of

MOF in our project

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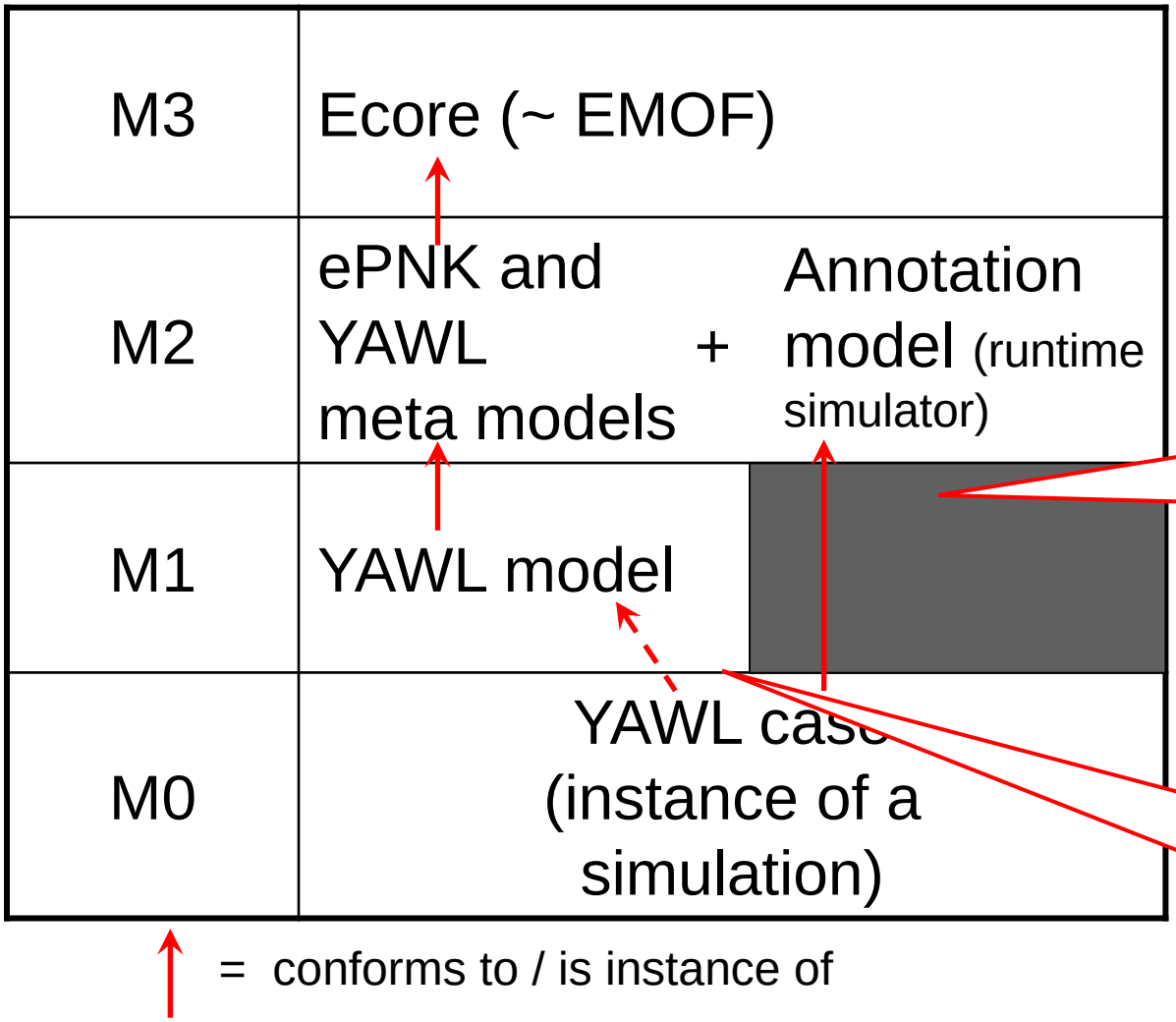

Technically the runtime model instances jump one conceptual level

Not a technical (Java / OO) instance; just a conceptual instance of YAWL

MBSE

Feel the consequences of wrong models.

In addition to models and automatic code generation,

MBSE provides techniques for structuring/extending (big) software (framework behind the scenes):

- Factories
- Interfaces
- Listeners / observers
- Commands
- Handlers
- Extension points

MBSE: Not covered

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- Customizing code generation
- Defining own code generators
  (defining model to text transformations M2T)
- Transforminga model into another model
  (class diagram to database scheme, M2M)
- Other MBSE technologies (e.g. Microsofts Entity Framework)
- Techniques for developping embedded DSLs

Tomorrow

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- Guest lecture by Rasmus Petersen from Netcompany:

  How does Netcompany use models