

CSSE 490 Model-Based Software Engineering: Introduction to MetaModels



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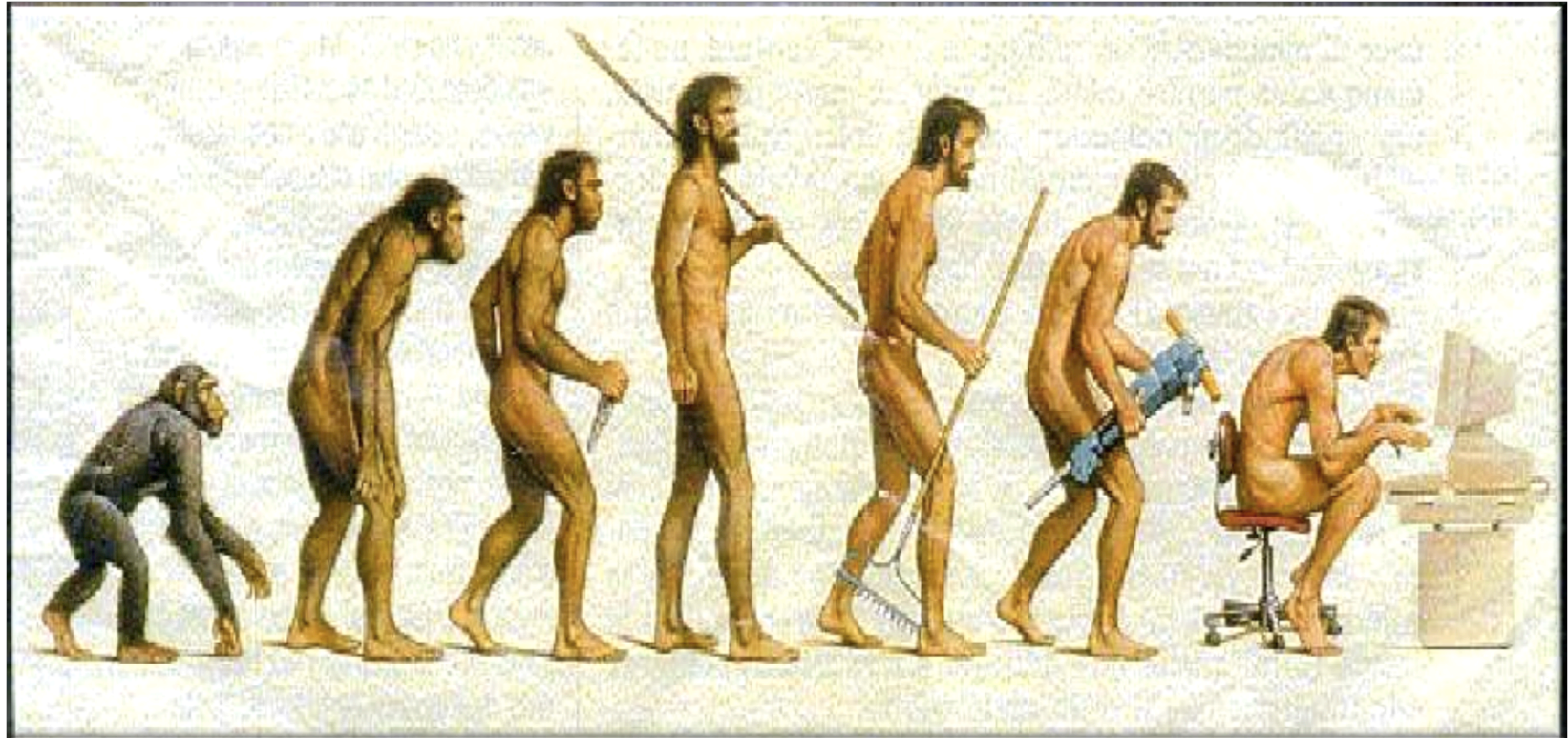
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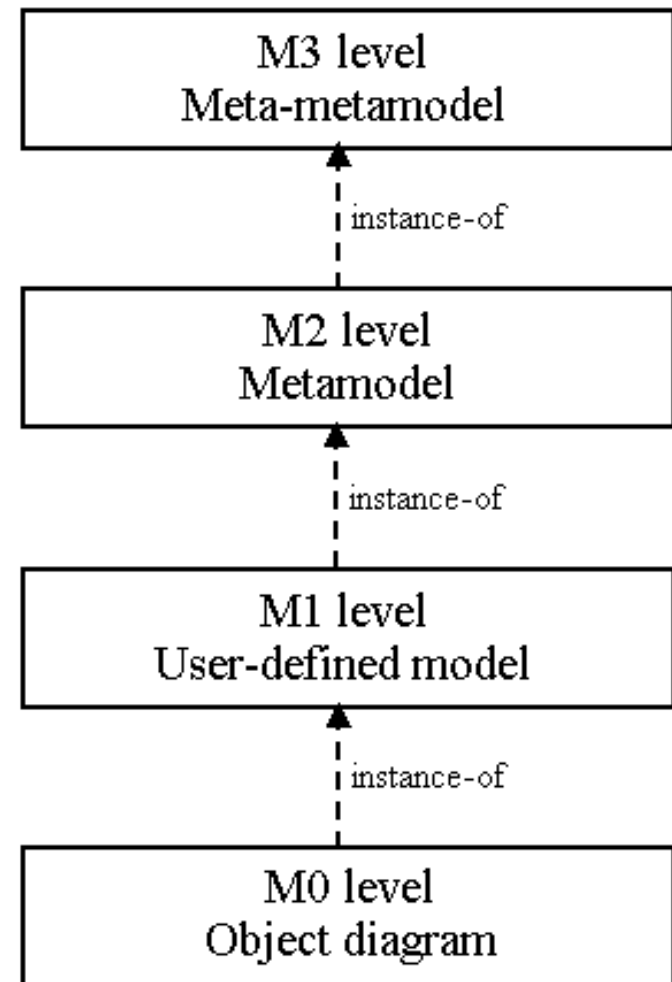
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Learning Outcomes: Metamodels

Design a metamodel for a model-based software system.

- Discuss Metamodel paper
- Outline OMG Metamodel
- Examine key elements of MetaObject Facility (MOF)
- Discuss limitations of MOF



Paper Discussion: Metamodel Paper

Model-Driven Development: A Metamodeling Foundation

- What are the main thrusts of the paper?
- What are the controversial points and your positions?
- What did you get out of reading about feature-based transformation approaches?

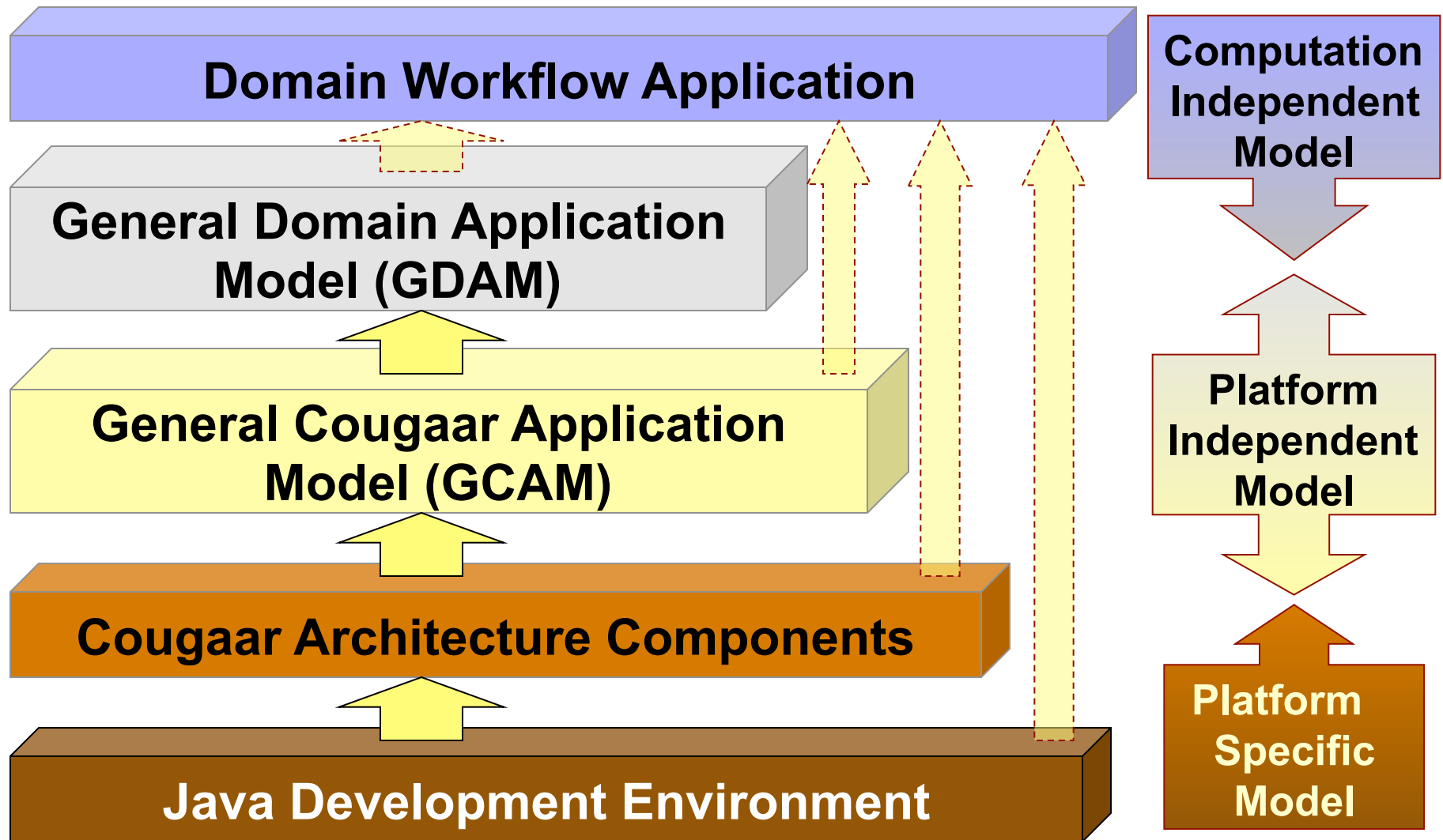


**“Model” is to “Metamodel”
as _____ is/are to _____?**

- **Again, think for 15 seconds...**
- **Turn to a neighbor and discuss it for a minute**

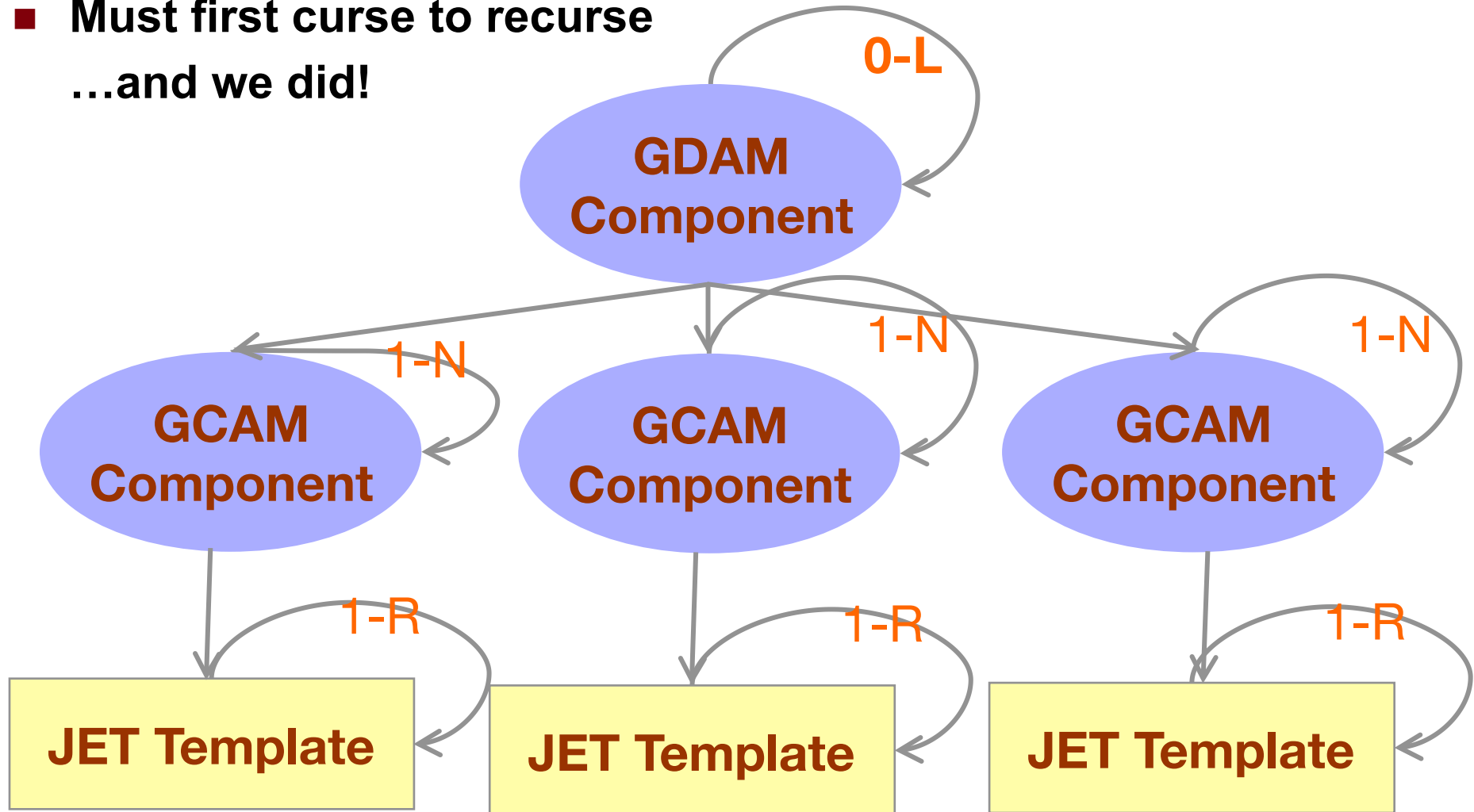


Cougaar Model Driven Architecture

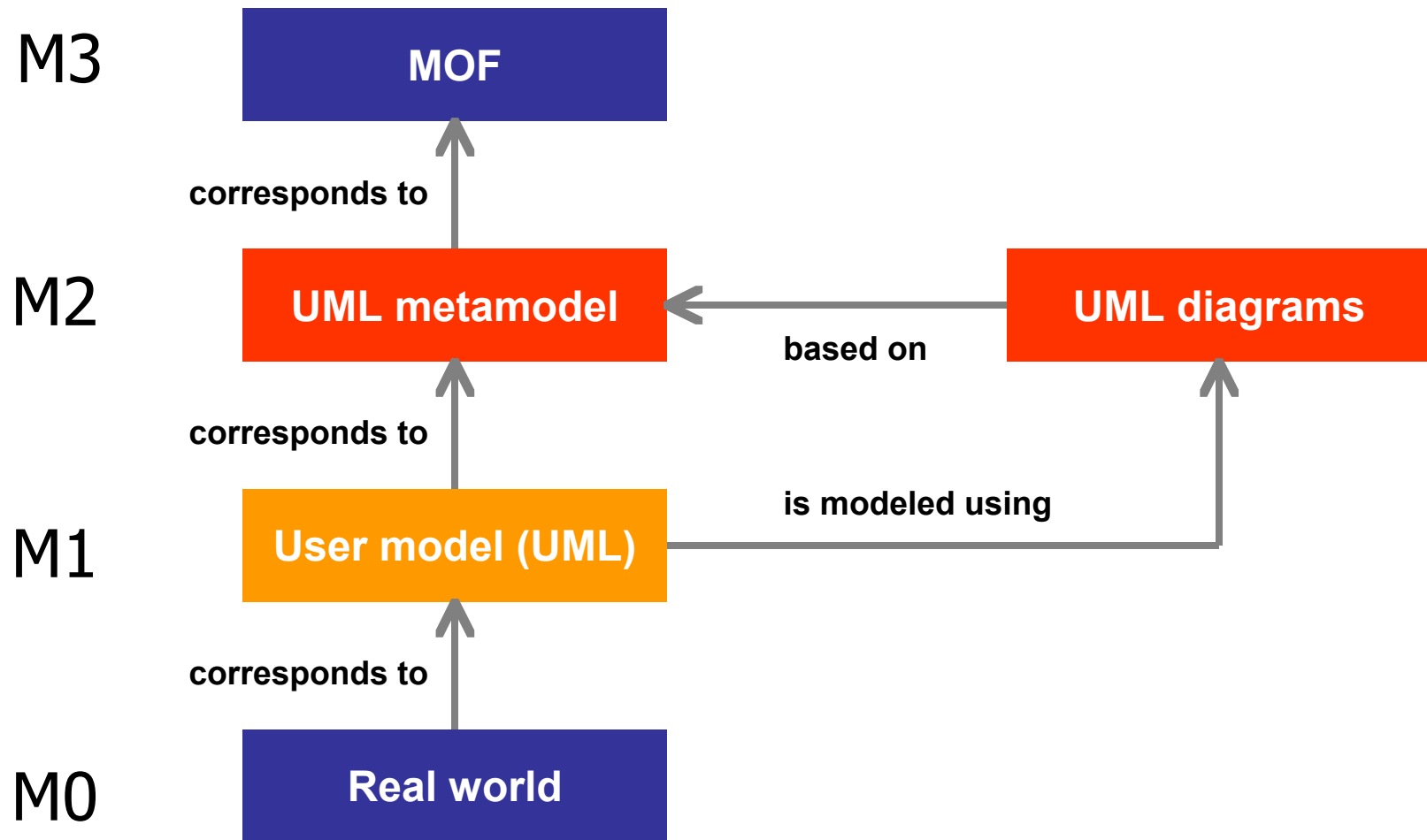


Meta-Model

- Must first recurse to recurse
...and we did!



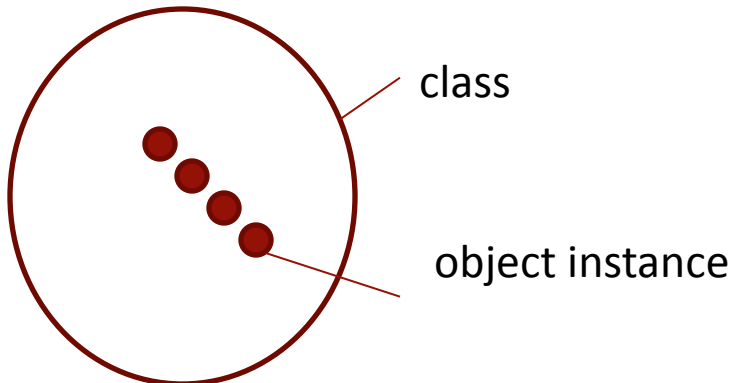
UML and the OMG 4 Layer Metamodel



So, How do we define an Object?

Reality

Set: Employees of company A



Class Emp={ people | people working for company A}

M0 Layer

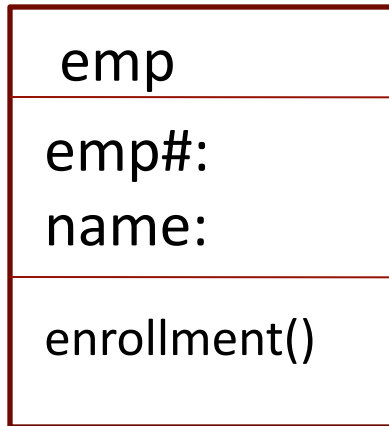
emp #	Name		
0800101	Fred Flintstone		
0800102	Barny Rubble		
0800103	Dino Flintstone		



Object Concept and Metamodel

M1 Layer

Class

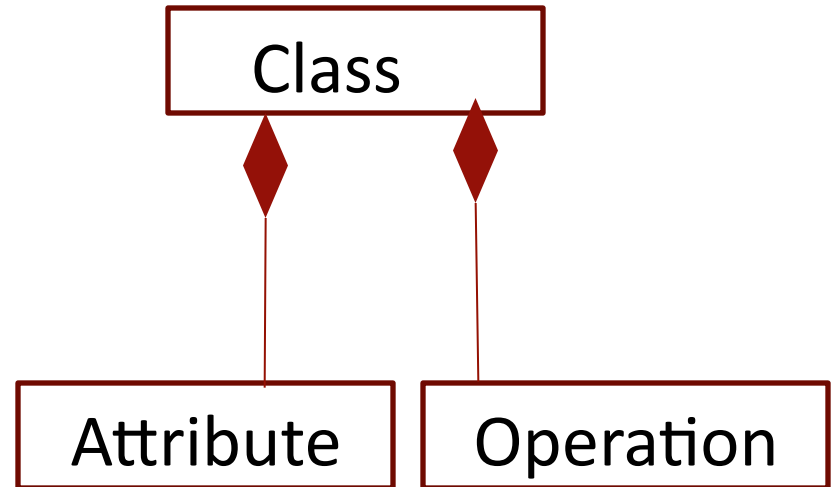


Class name

attribute

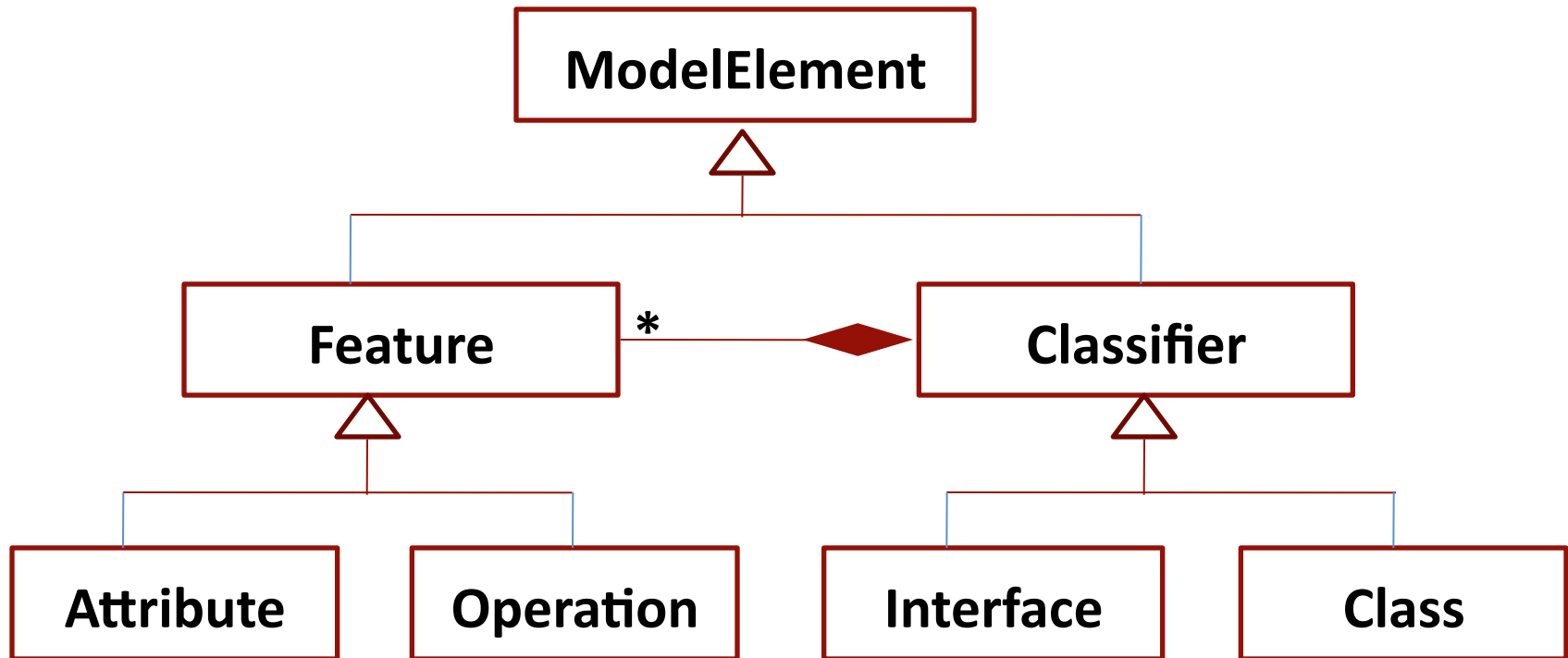
operation

M2 Layer

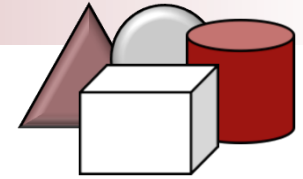




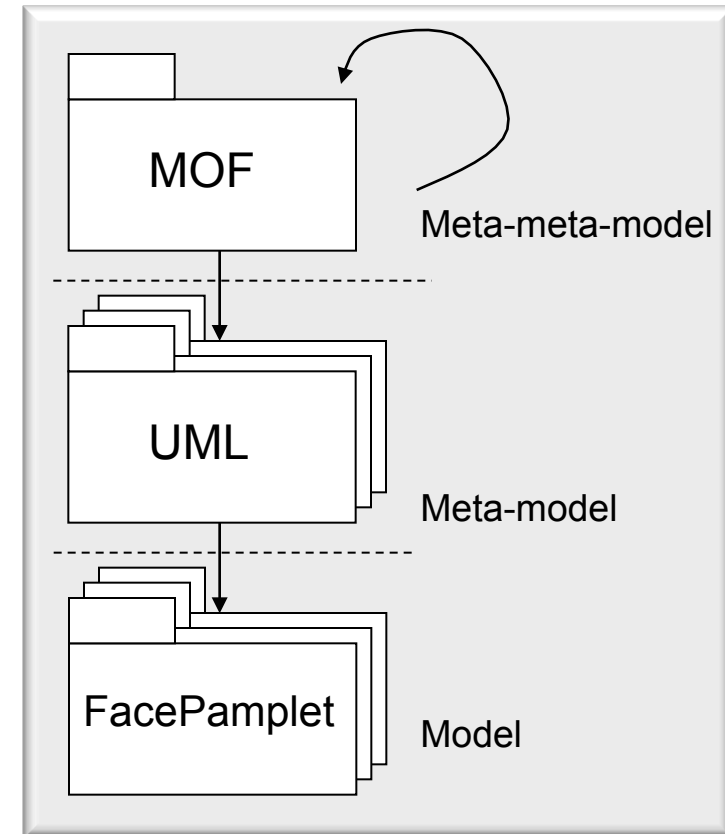
M3 Layer



Meta-Layers



- M_{n+1} defines the structure of M_n
- But, M_{n+1} is not an abstraction of M_n
- Meta-layer relationships are similar to grammar-layer relationships
 - E.g., BNF, or XML Schema



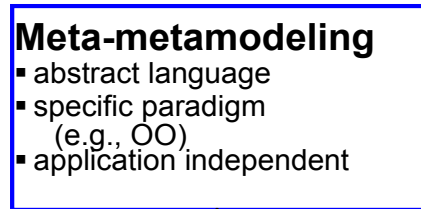


Getting a bit of keyboard time....

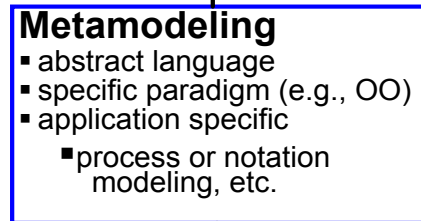


Could we create a new UML?

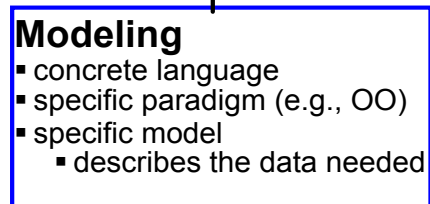
Metamodel Architecture



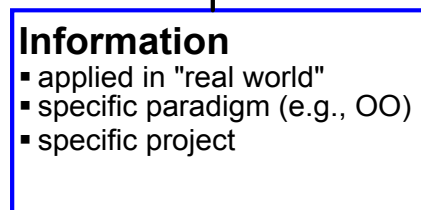
M3



M2

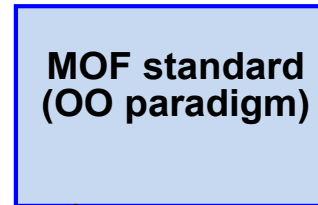


M1

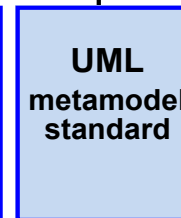
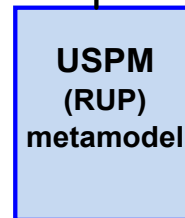


M0

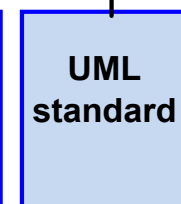
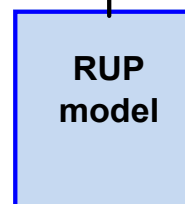
Example



... MetaClass, MetaAttribute, MetaOperation



... Class, Attribute, Operation, Component



... stockShare, owner, askPrice



... GartnerShare99, Bohner, 61.12

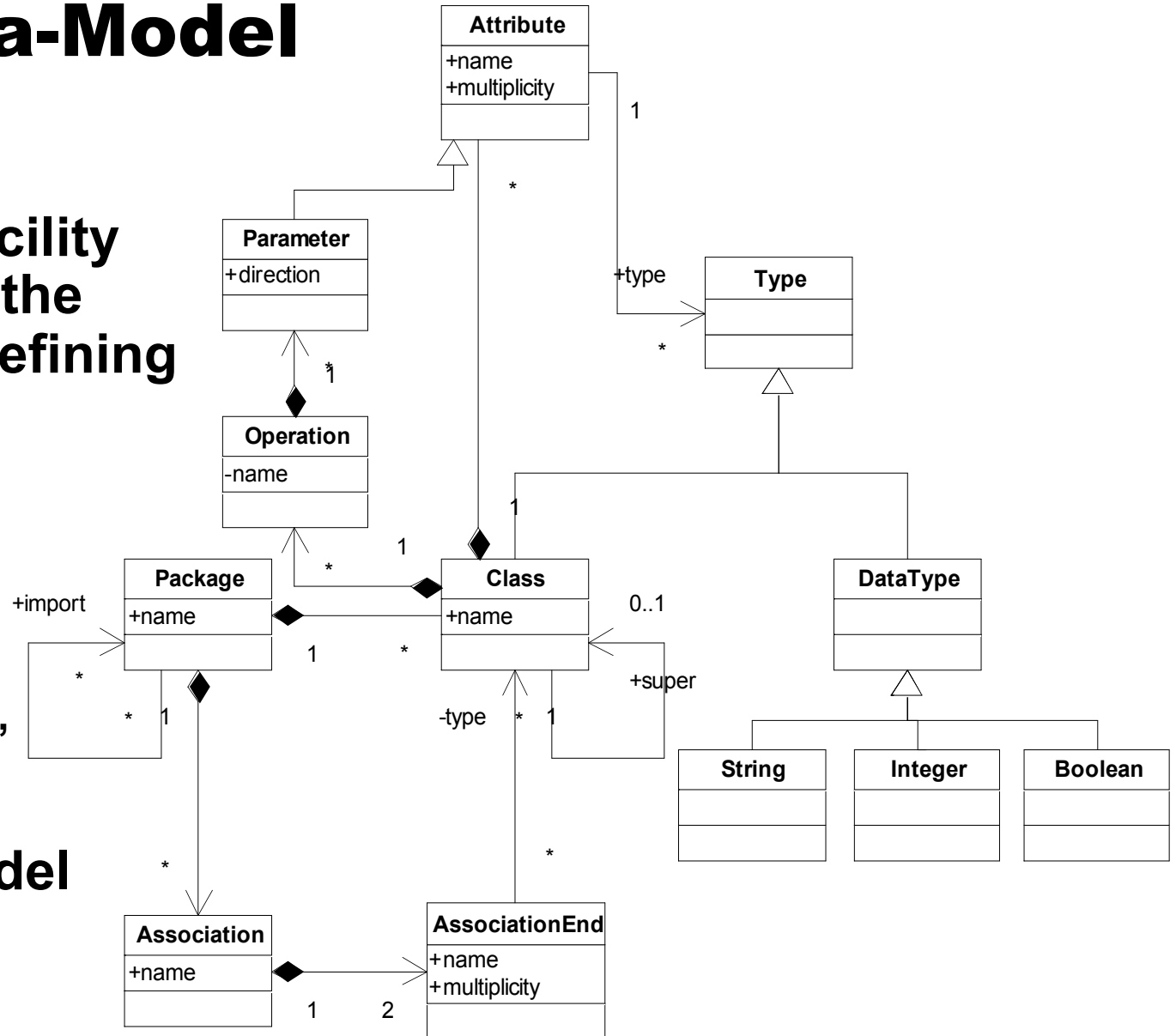
Meta-Meta-Model

- **MetaObject Facility (MOF) defines the language for defining meta-models**

- **MOF concepts**

- meta-class,
- meta-attribute,
- meta-association, etc.

- **Meta-meta-model is self defined**



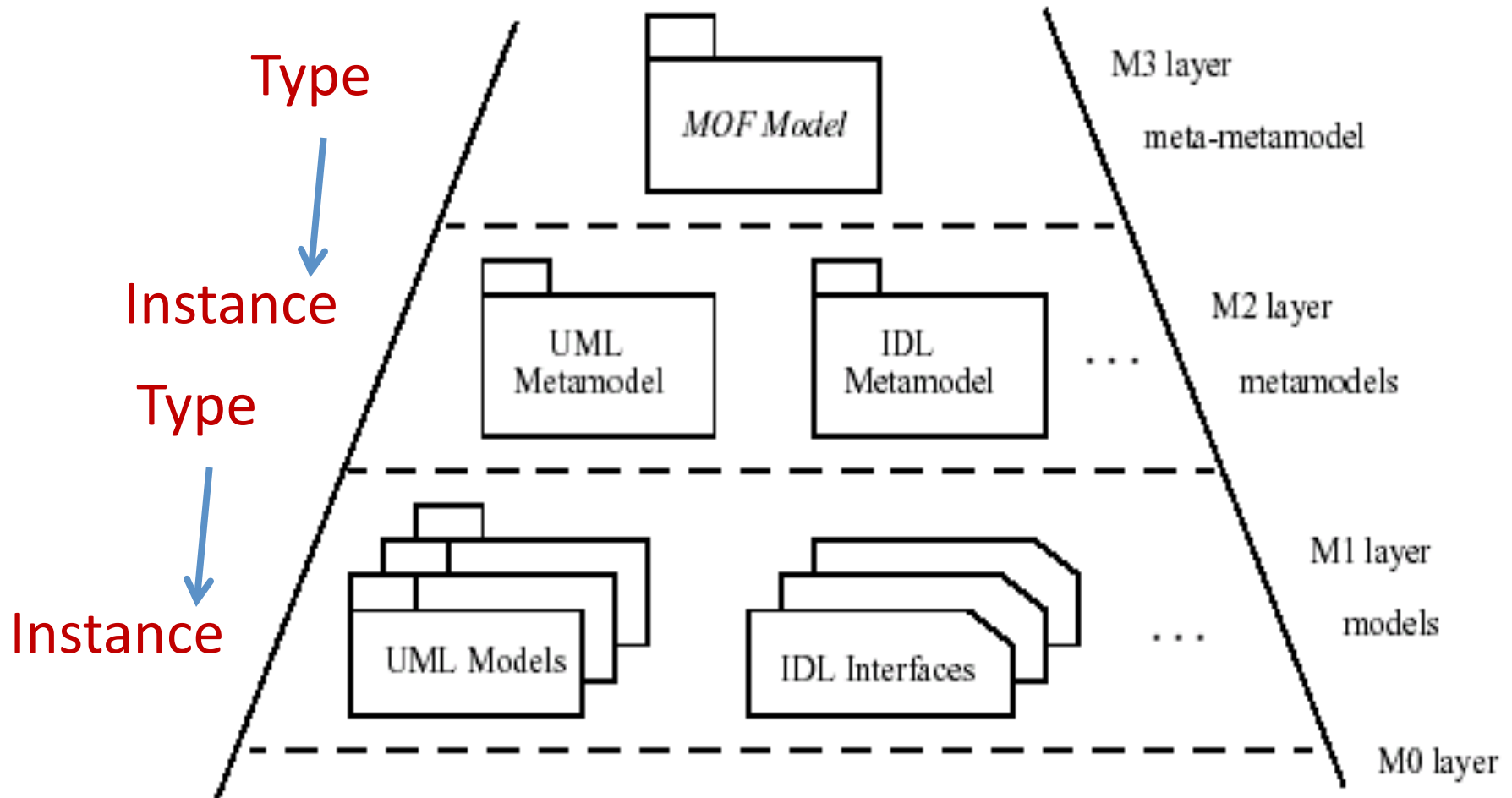


What is MOF?

- **MetaObject Facility (MOF) is OMG's adopted technology for defining metadata and representing it as objects using UML**

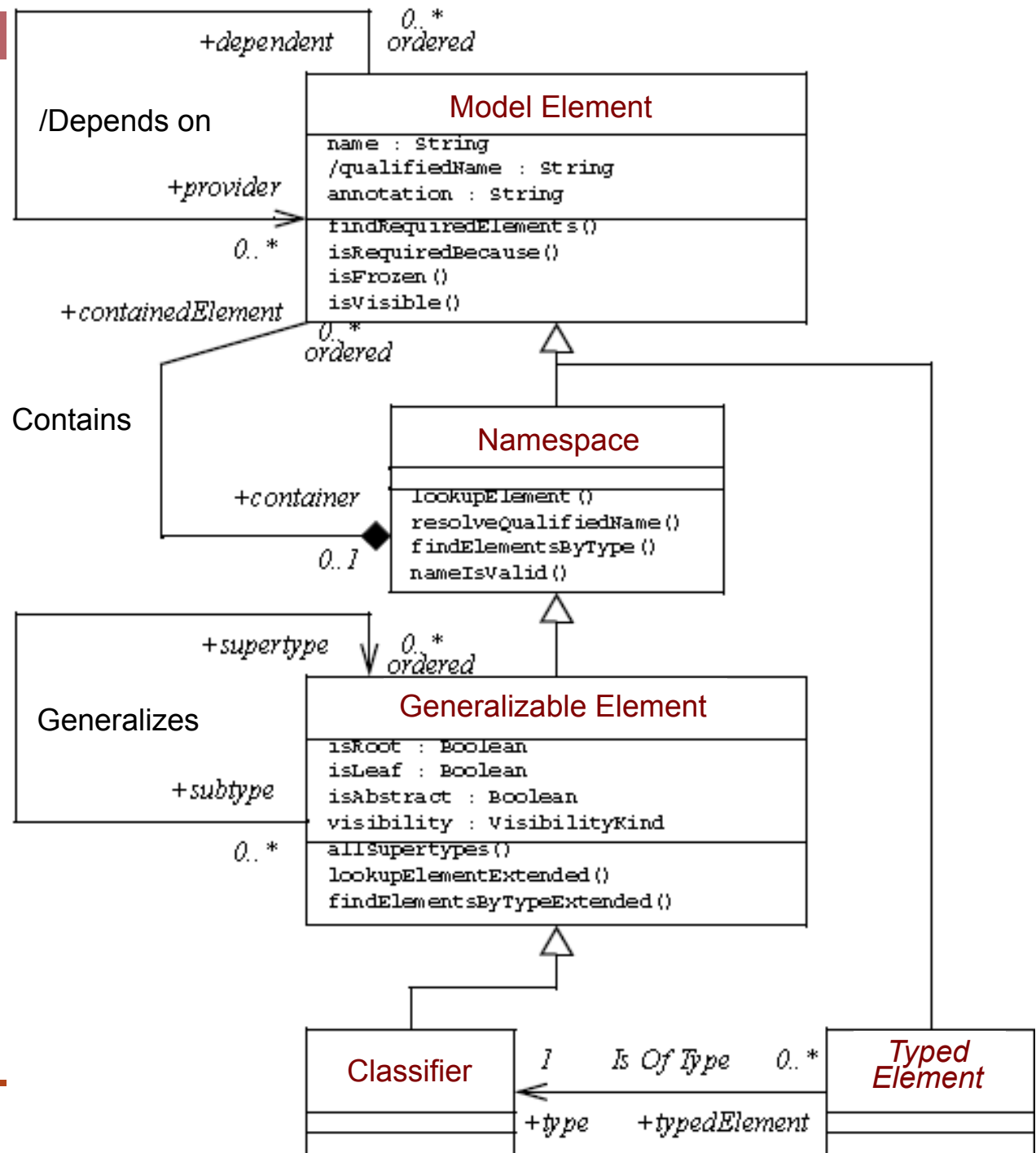
- **A MOF metamodel defines the abstract syntax of the metadata representation of a model**
 - **Describes an abstract syntax for representing a model which describes an object concept - called “the MOF model”**
 - **MOF is situated at the M3 (Meta-Meta) layer**

MOF Metamodel Architecture

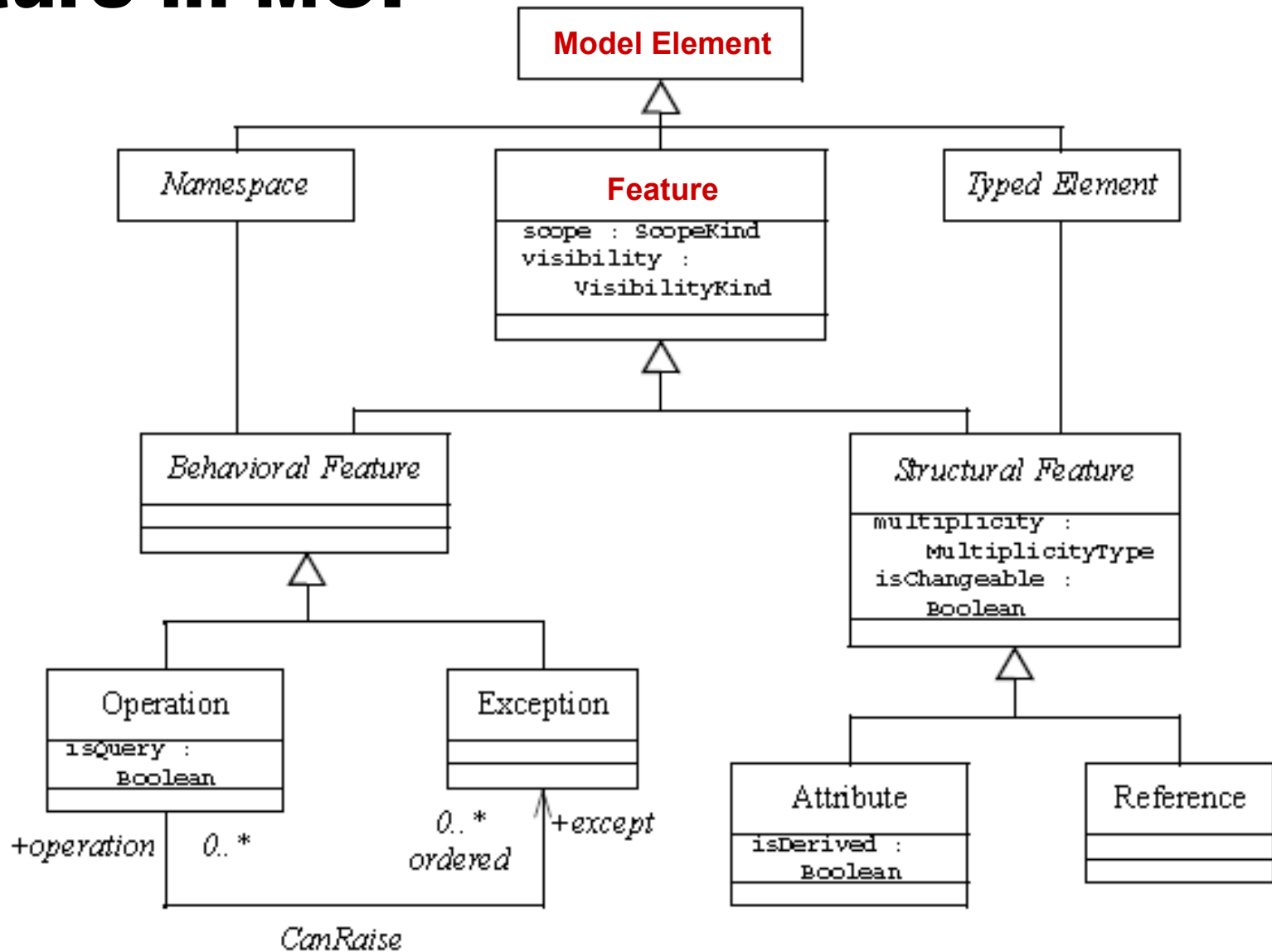


Key MOF Abstractions

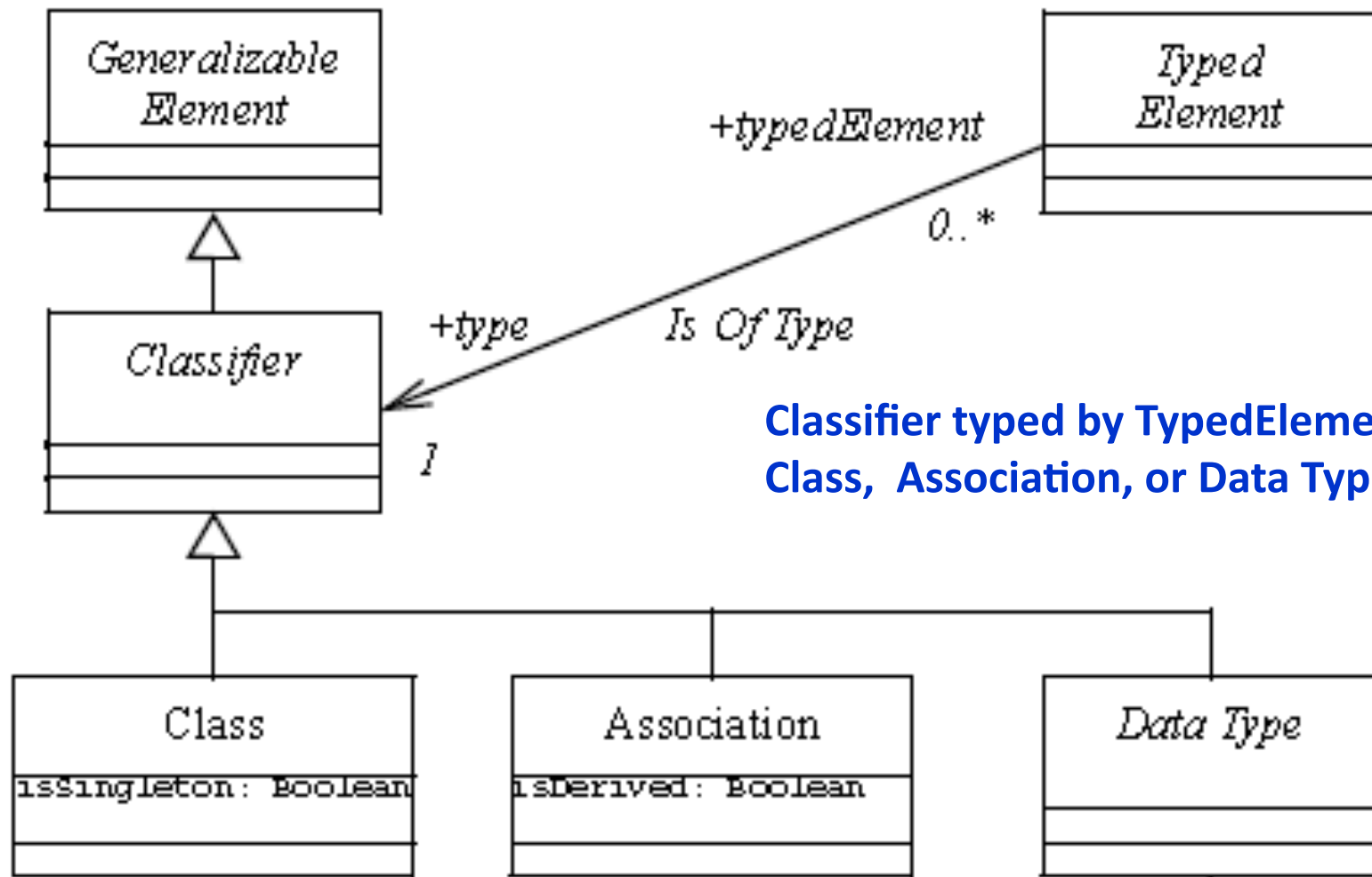
- Element
- Namespace
- Generalizable Element



Feature in MOF

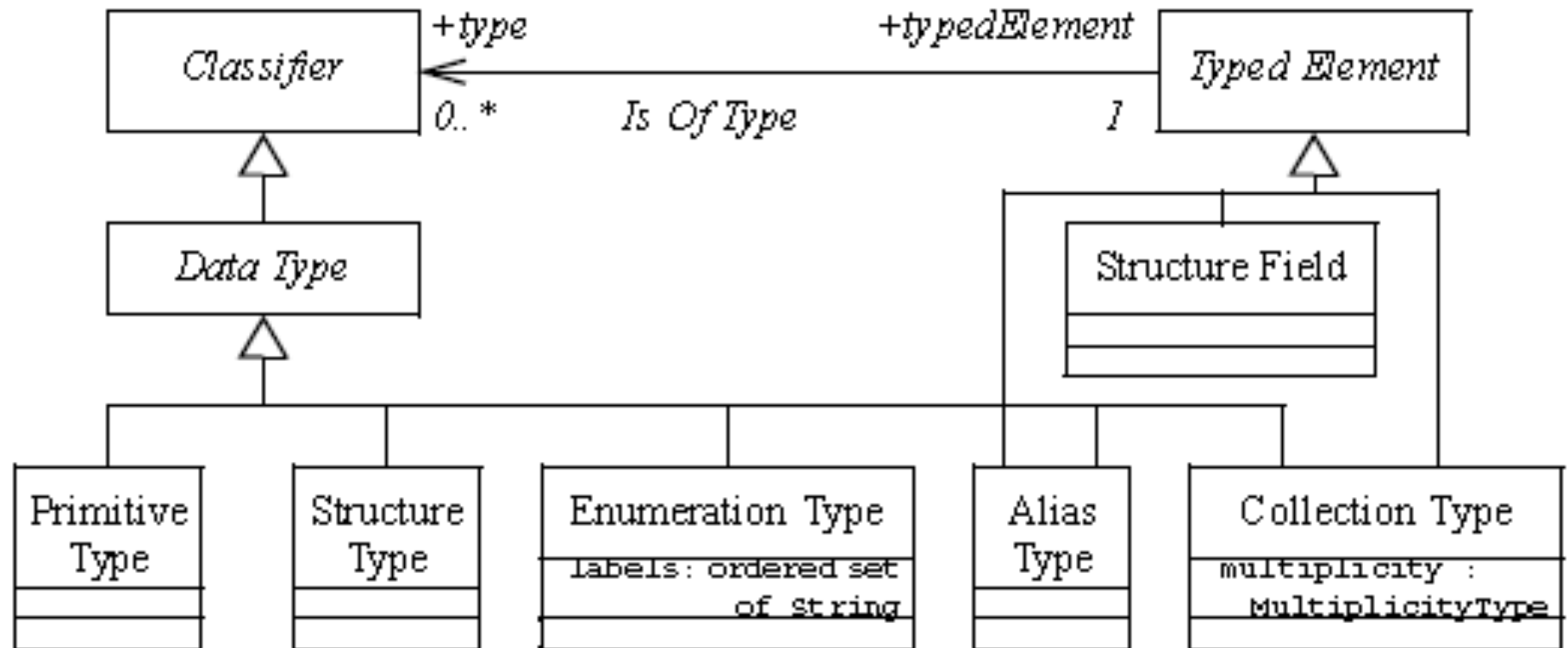


MOF Model Elements for Typed Element

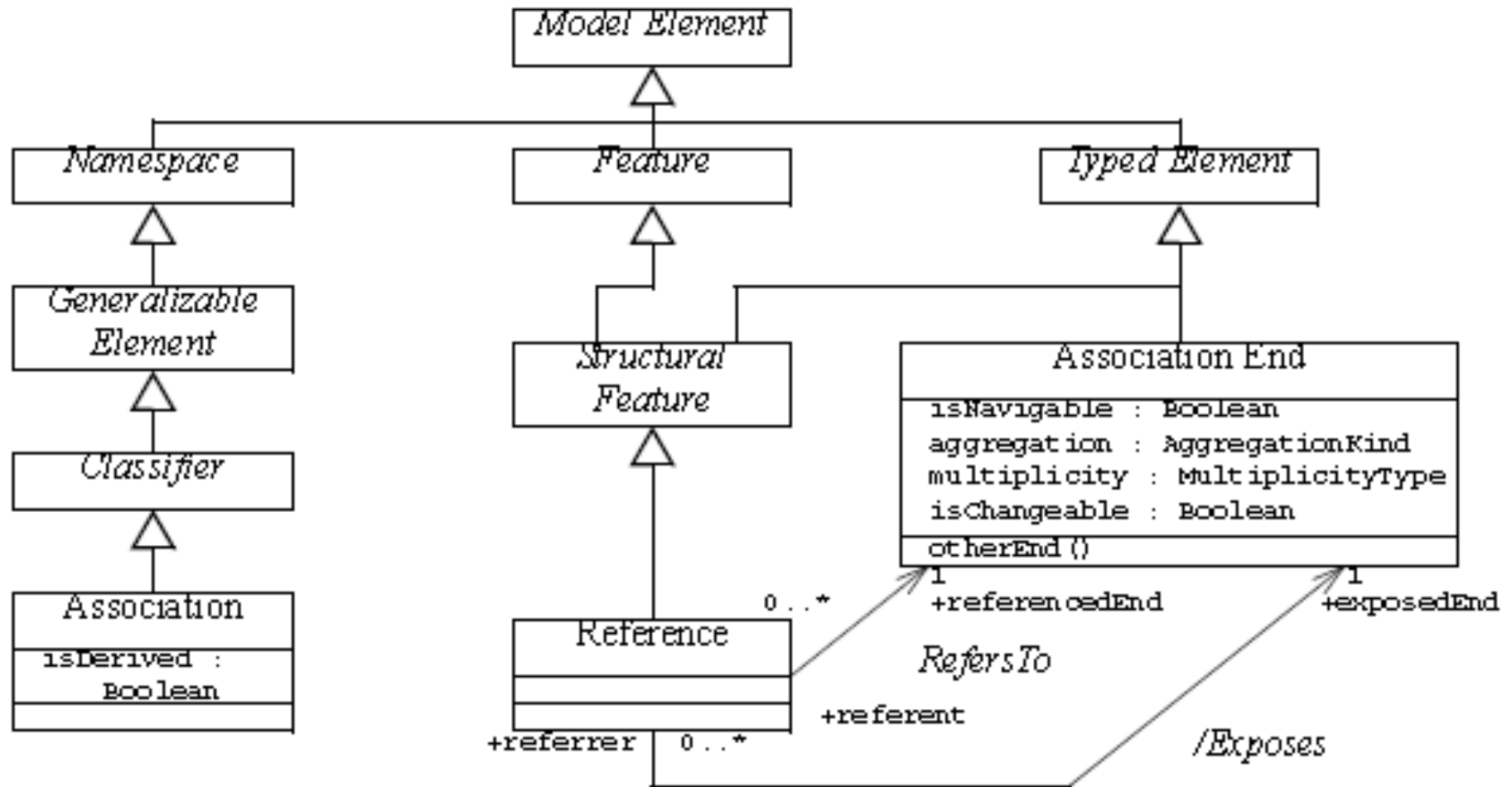


Classifier typed by TypedElement is a Class, Association, or Data Type

MOF Model Elements for Data Type



MOF Model Elements for Association



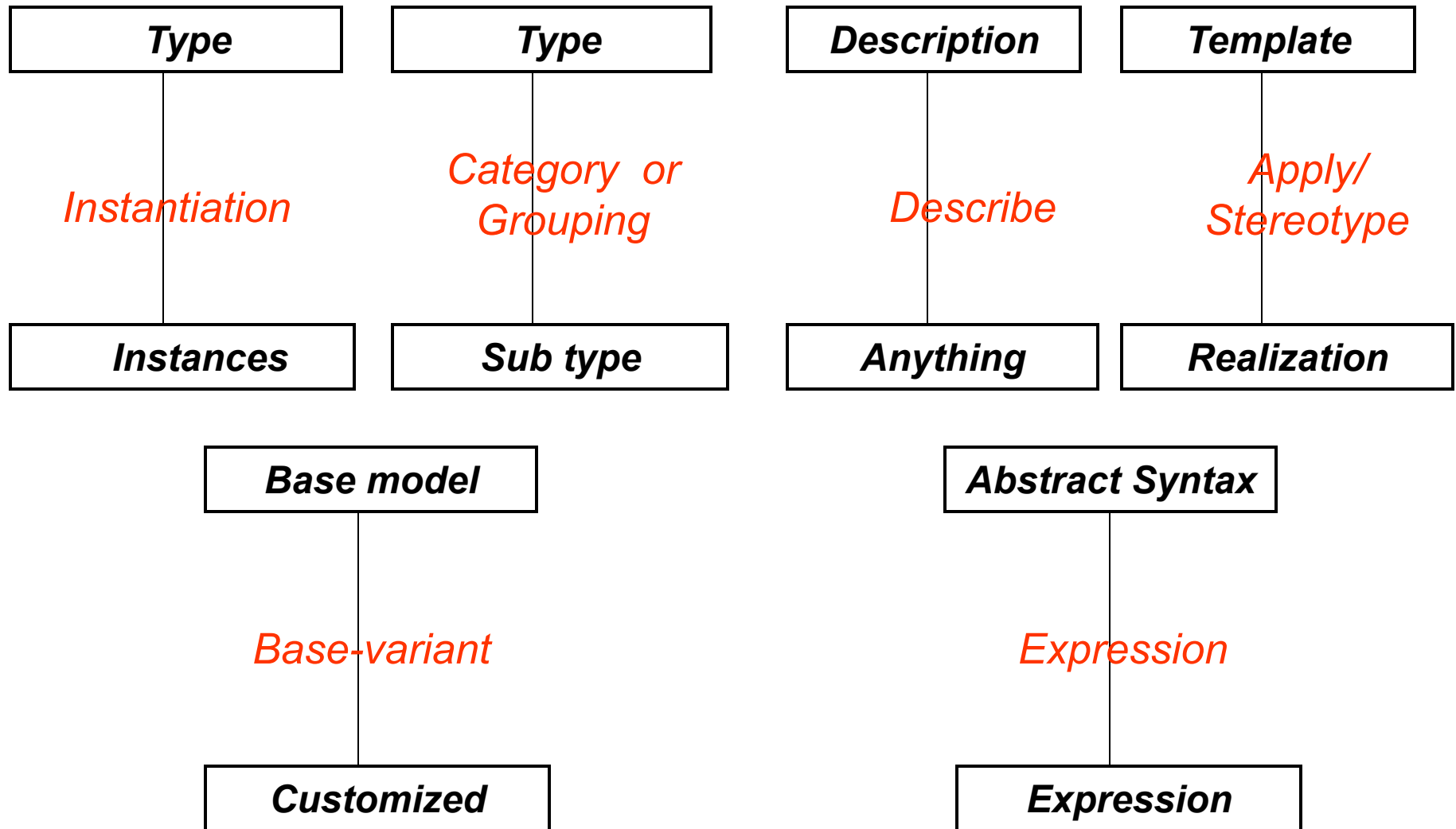
Association between classes

Multilevel Metamodel Challenges

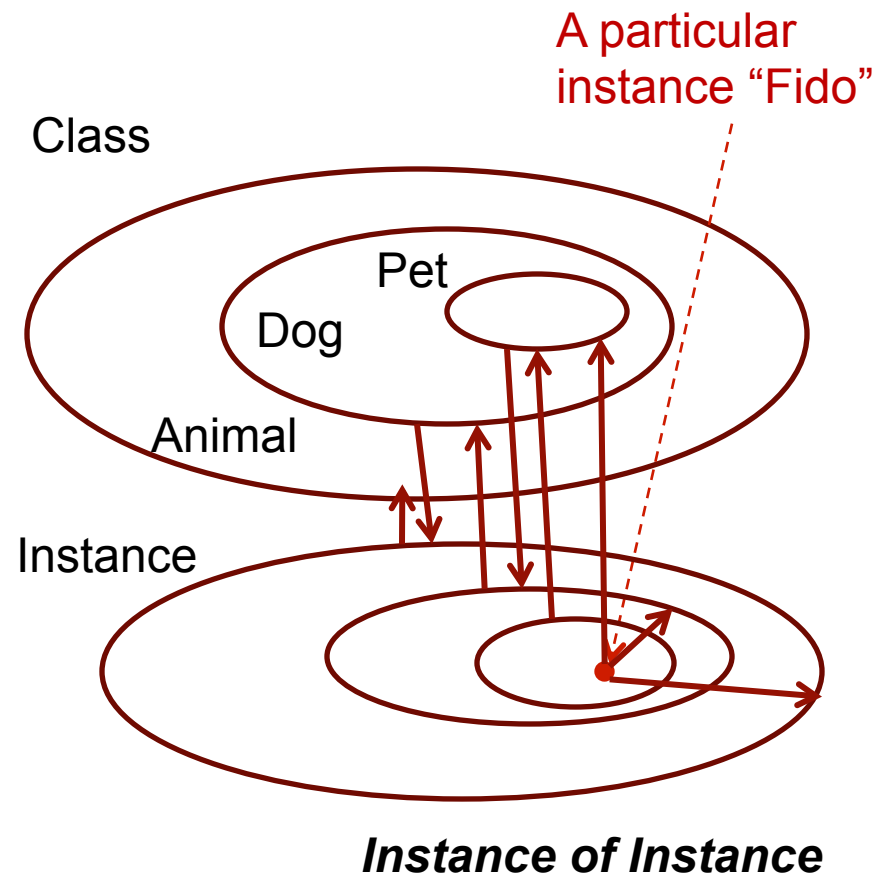
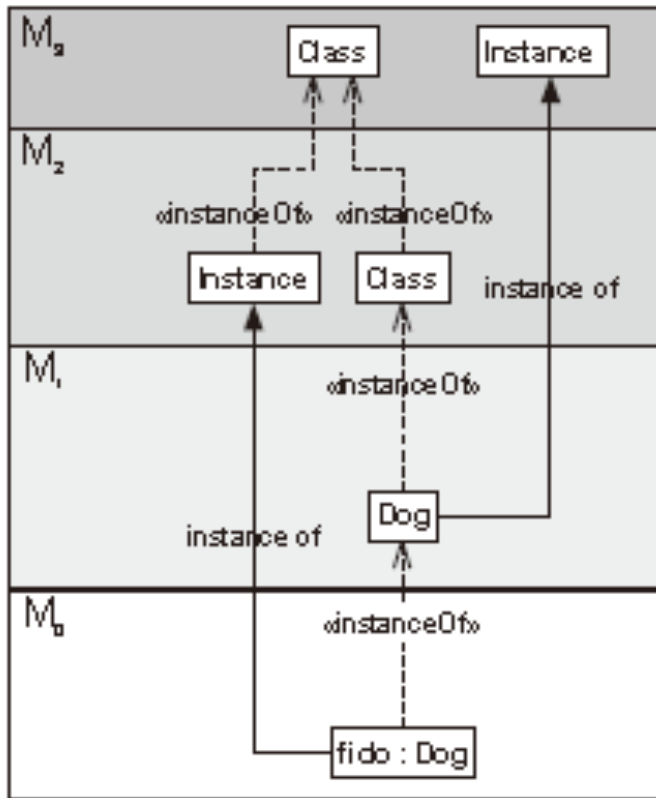
- Diversity of “Meta concept”
- “Ambiguous Classification”
- “Replication of Concept”
 - Shallow Instantiation
 - Deep Instantiation



Diversity of Meta Concept



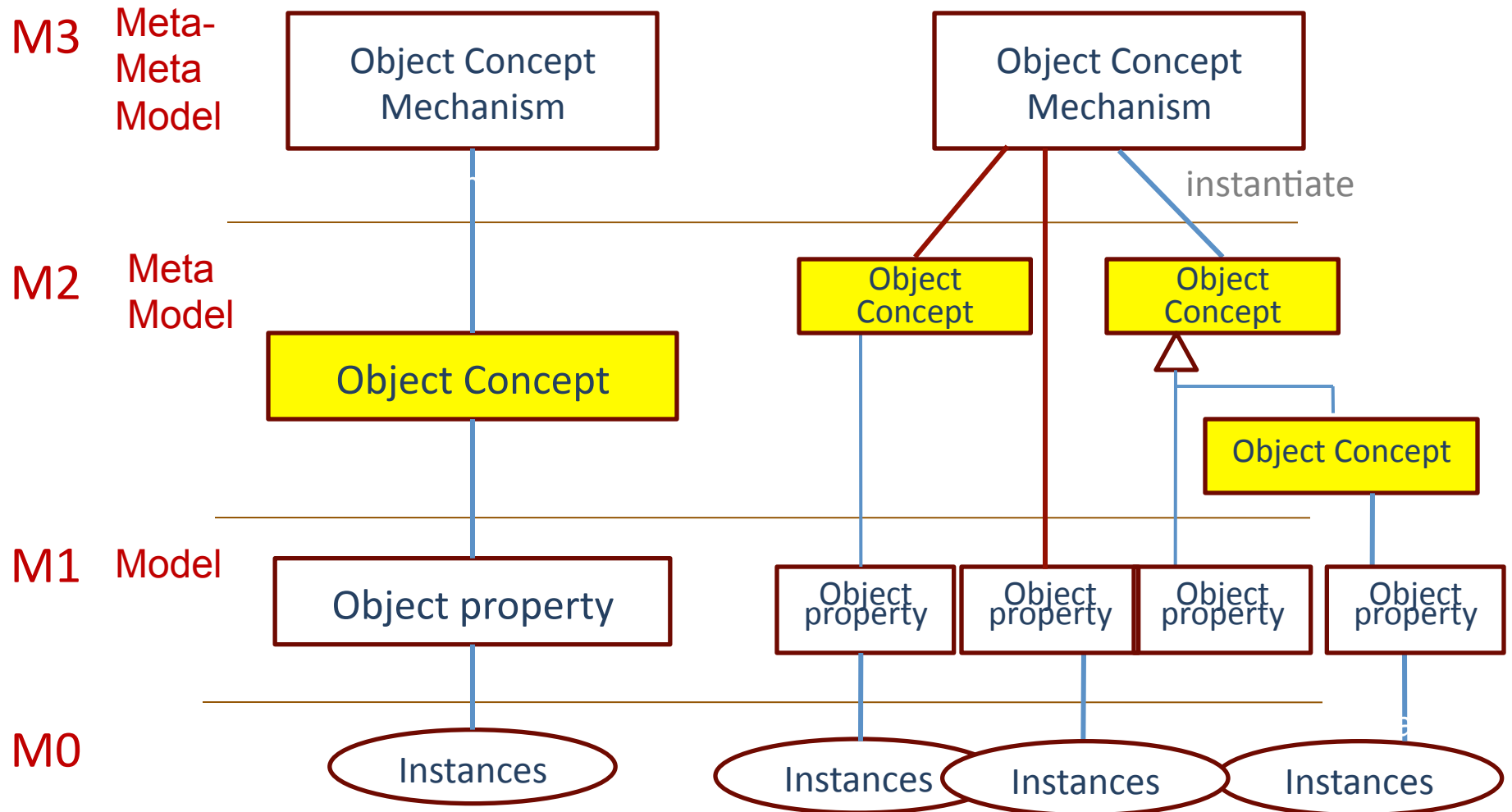
Ambiguous Classification: Replication of Concept



Shallow and Deep Instantiation

Shallow Instantiation

Deep Instantiation





Homework and Milestone Reminders

- **Bring Laptop on Thursday for Plus/Delta**
- **Read DSL Survey Paper entitled, “When and How to Develop Domain-Specific Languages” by Mernik et al.**
 - Be prepared to discuss and even lead the discussion
 - Write a brief summary of observations on the paper
- **Milestone 2: Establish a repository and structure for assembling components for your FacePamphlet application**
 - Due by 11:55pm Friday, April 1st, 2011 (no foolin’!)