

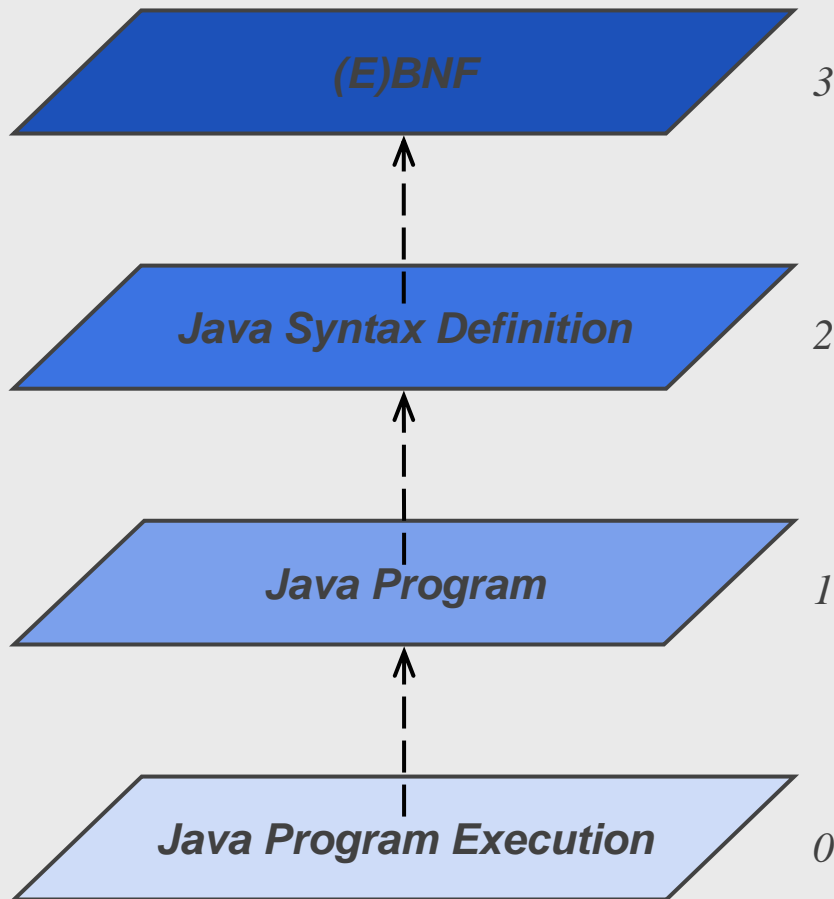
# Bits and Pieces about Metamodeling and Language Engineering

Thomas Kühne  
Darmstadt University of Technology





# (E)BNF as a Metalanguage

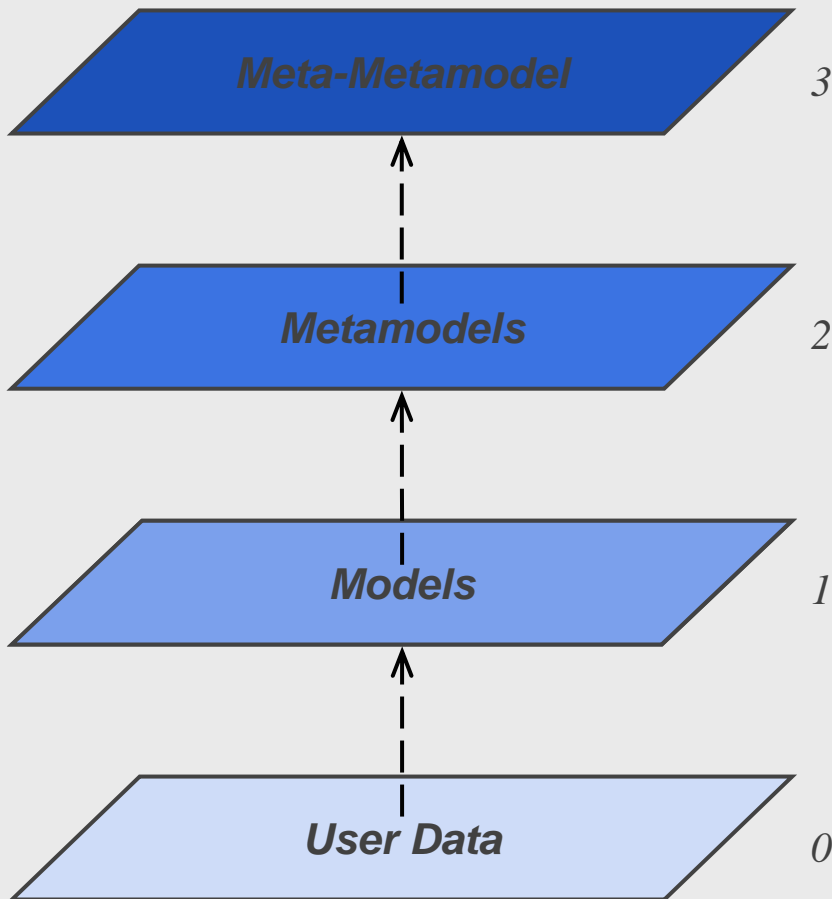


- Level transitions  $1 \rightarrow 2$  and  $2 \rightarrow 3$  are of the same kind
- Level transition  $0 \rightarrow 1$  can be also regarded as “described by”, but is different in nature



# CDIF (case data interchange format)

inspired by IRDS (Information Resource Dictionary System)



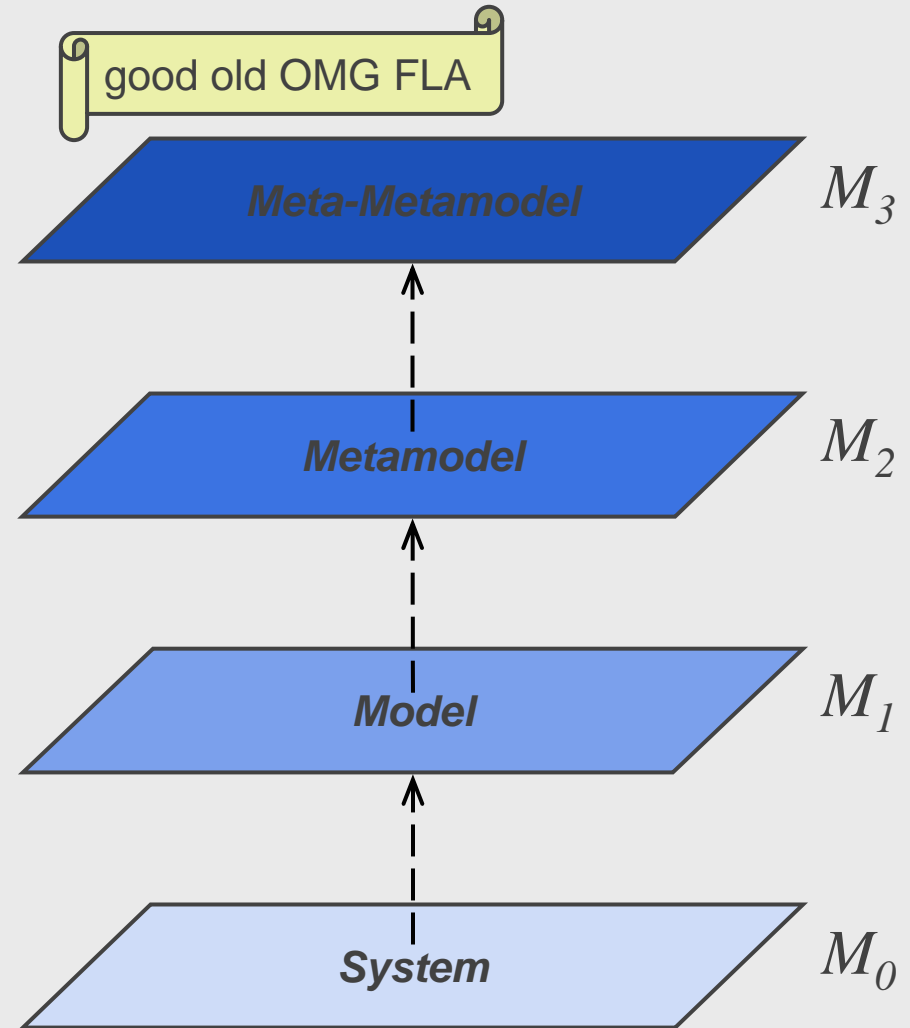
*CDIF is not concerned about the ,0‘ layer which would be the result of instantiating a model*

→ three level architecture



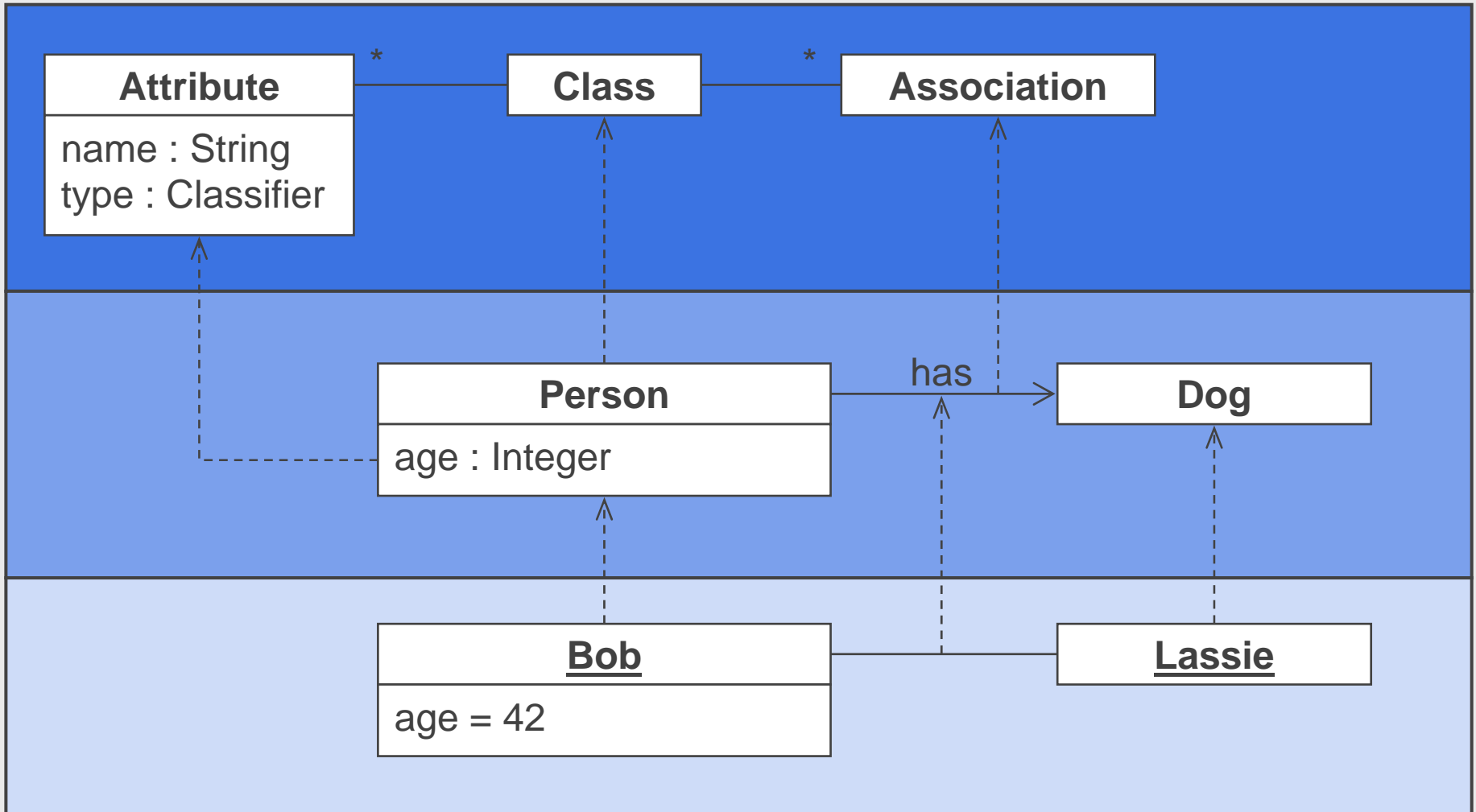
# Four Layer Architecture

- MOF
  - » defines language for formulating metamodels with
- UML, CWM, ...
  - » languages for creating user models
- User Models
  - » describing the system
- Systems
  - » user objects





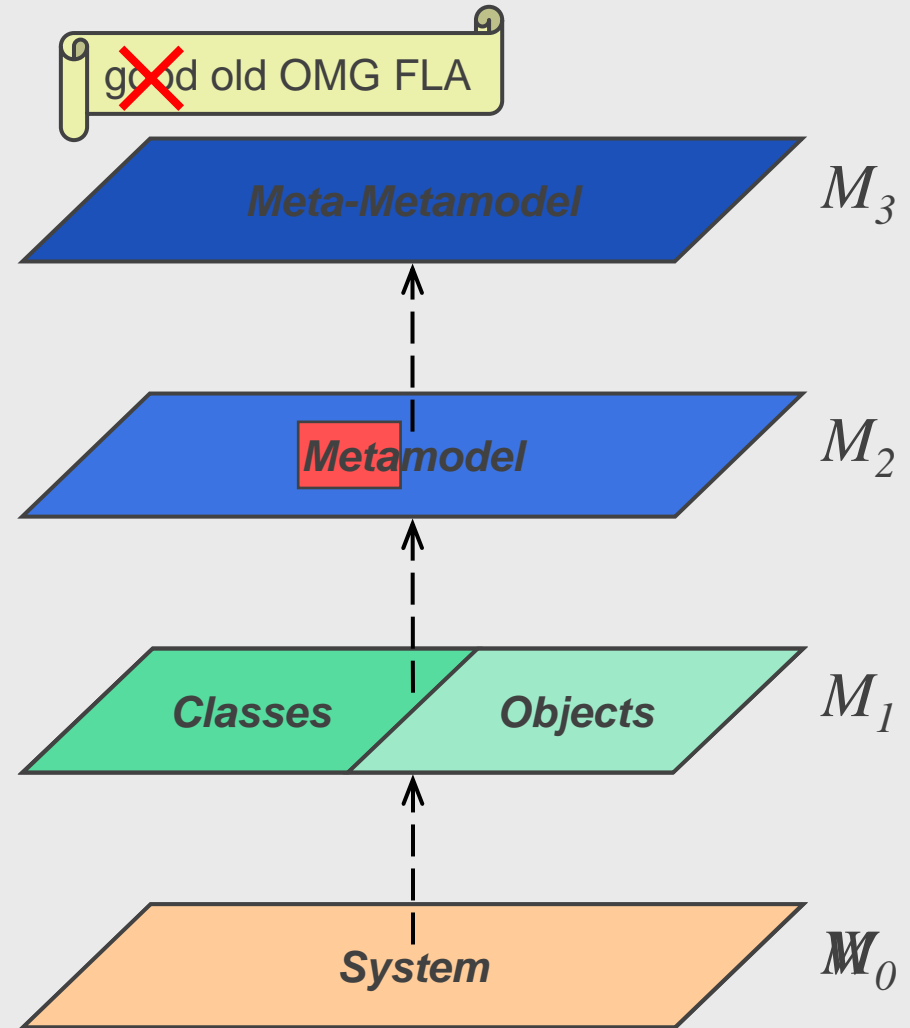
# UML Metamodeling





# Four Layer Architecture

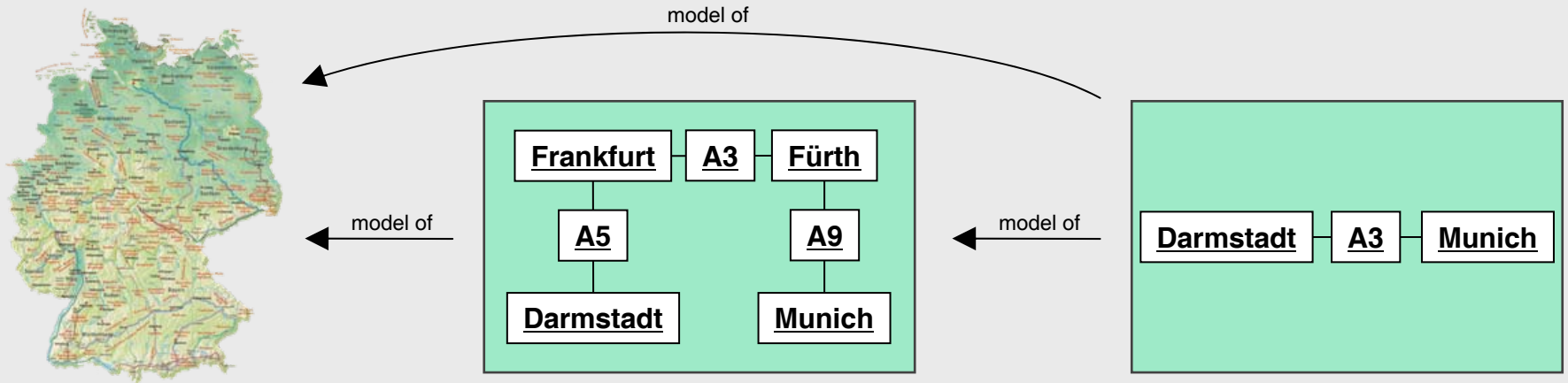
- MOF
  - » defines language for formulating metamodels with
- UML, CWM, ...
  - » languages for creating user models
- User Models
  - » describing the system
- Systems
  - » modeling target / user domain





# Models & Metamodels

- When is a model a metamodel?
  - » metamodel = model of a model?

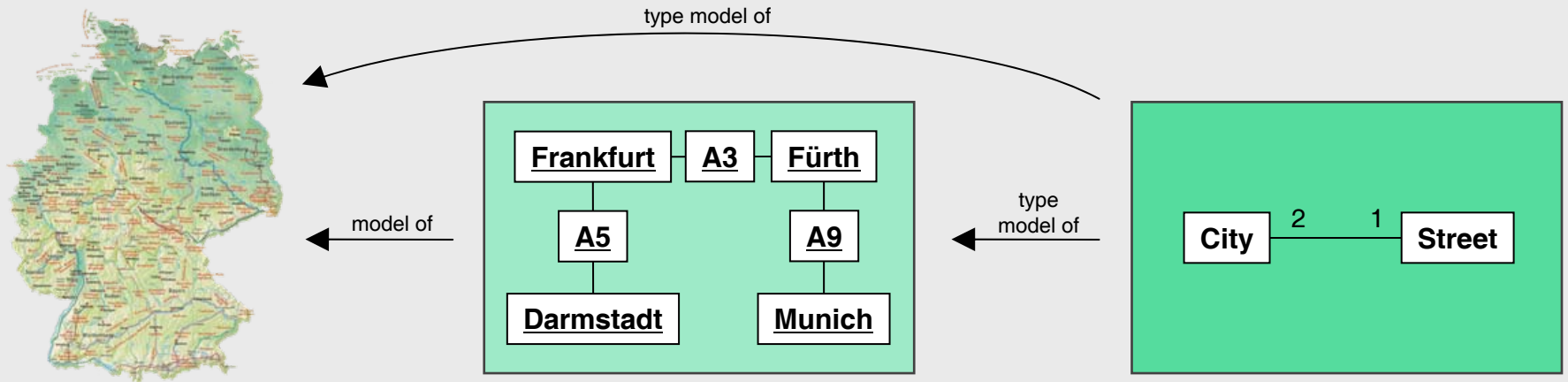


- anti-transitivity required



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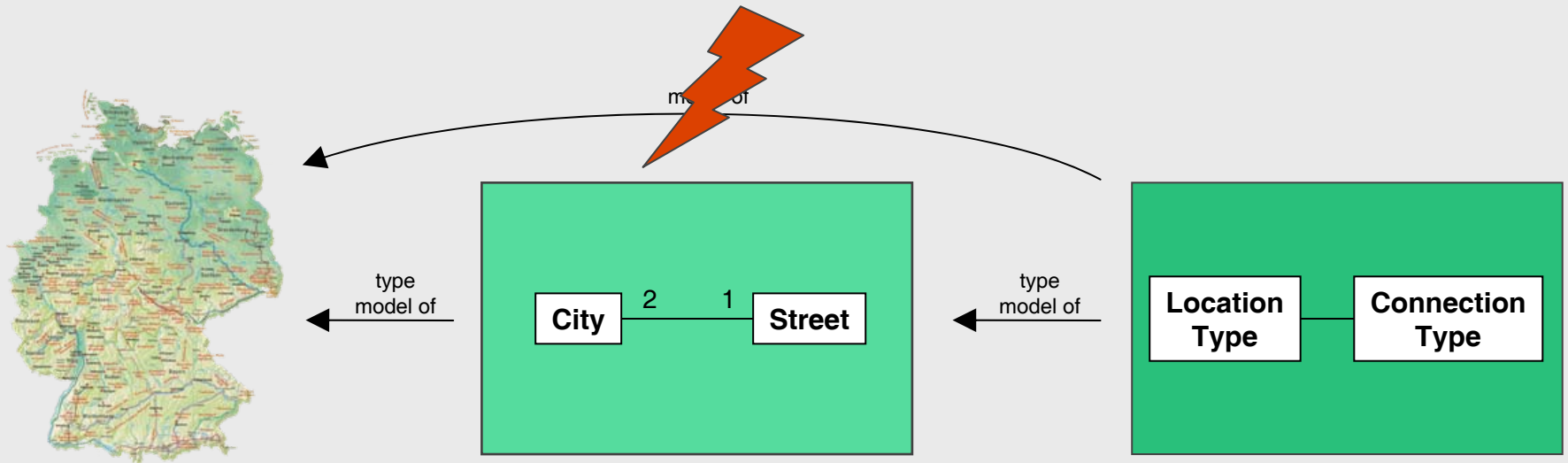
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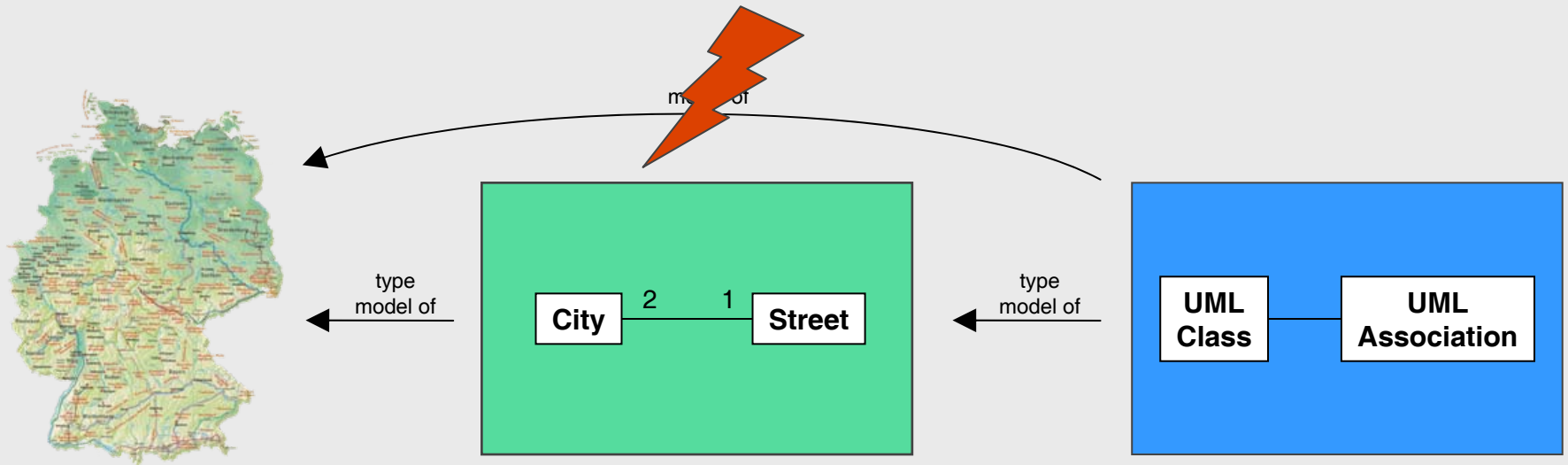


- anti-transitivity through double classification



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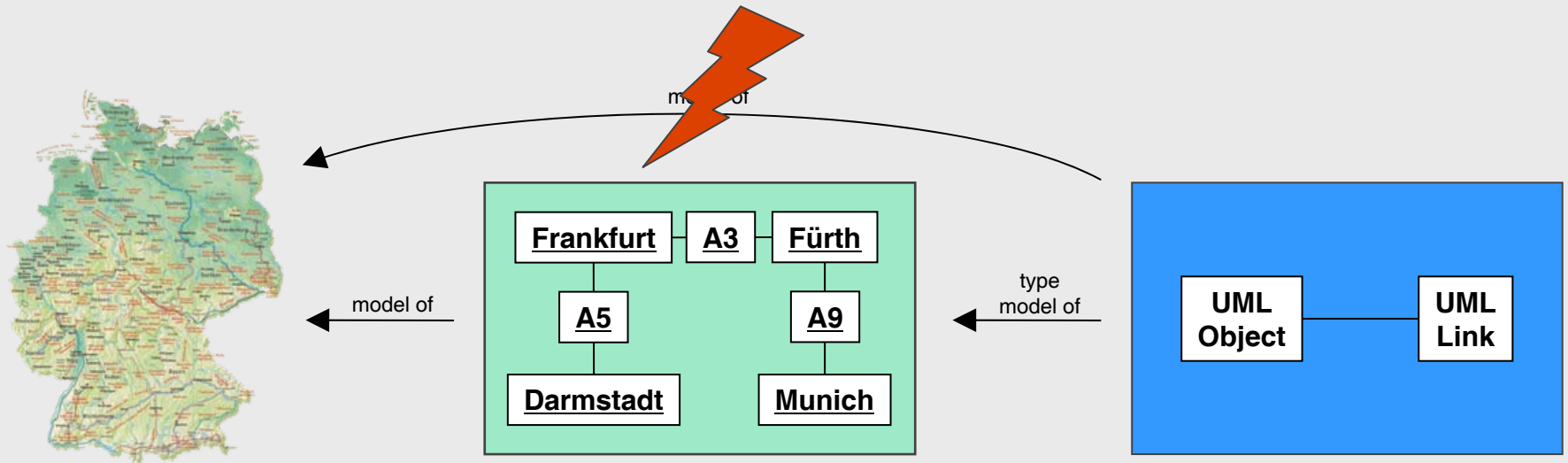


- anti-transitivity through linguistic types



# Models & Metamodels

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- anti-transitivity through linguistic types



# Meta-Relation Requirements

- a relation  $R$  is capable of erecting meta-hierarchies, if it has the following properties

» irreflexive

$$\neg \exists e : e R e$$

» anti-cyclic

$$\forall n, m, e_1, e_2 : e_1 R^n e_2 \rightarrow \neg (e_2 R^m e_1)$$

» anti-transitive

$$\forall n \geq 2 : R^n \cap R = \emptyset$$

» level-respecting

$$(\exists e_1, e_2, n, m : e_1 R^n e_2 \wedge e_1 R^m e_2) \\ \rightarrow n=m$$

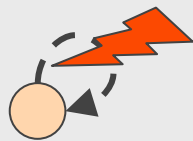


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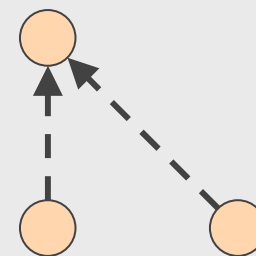
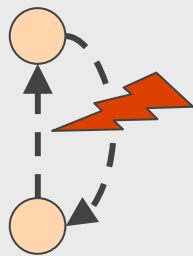


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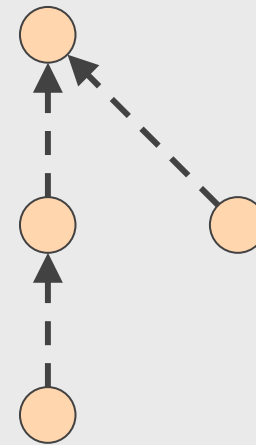
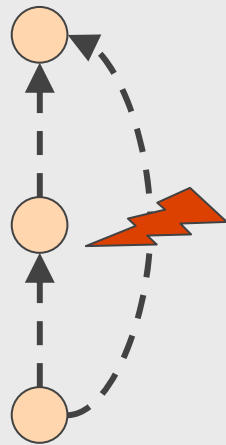


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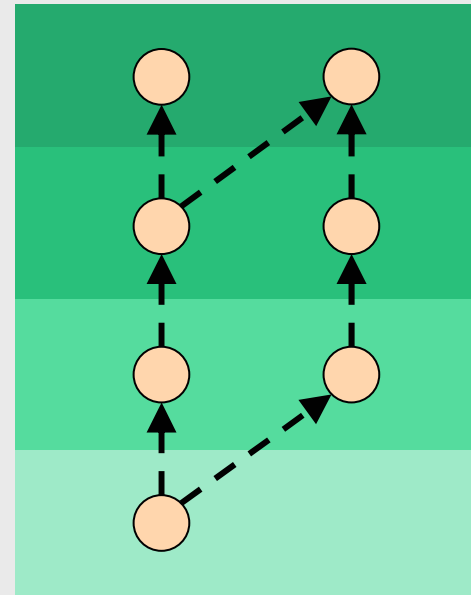
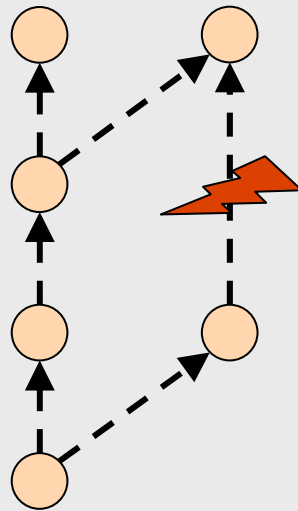




# Meta-Relation Requirements

- a relation **R** is capable of erecting meta-hierarchies, if it has the following properties

» level-respecting  $(\exists e_1, e_2, n, m : e_1 \mathbf{R}^n e_2 \wedge e_1 \mathbf{R}^m e_2) \rightarrow n=m$





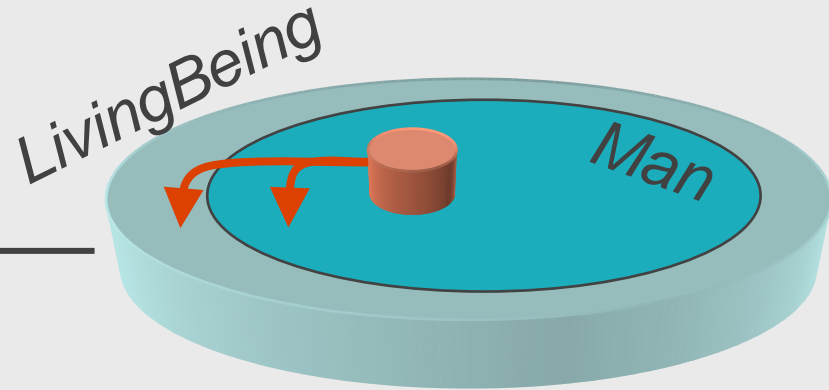


# Why Anti-Transitivity?

- *Man is a LivingBeing*
- *Aristoteles is a Man*

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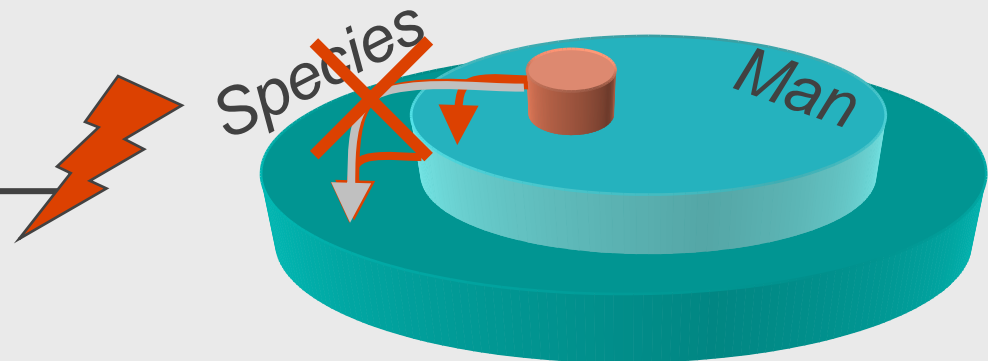
- *Aristoteles is a LivingBeing*



- Man is a Species*
- Aristoteles is a Man*

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- Aristoteles is a Species*



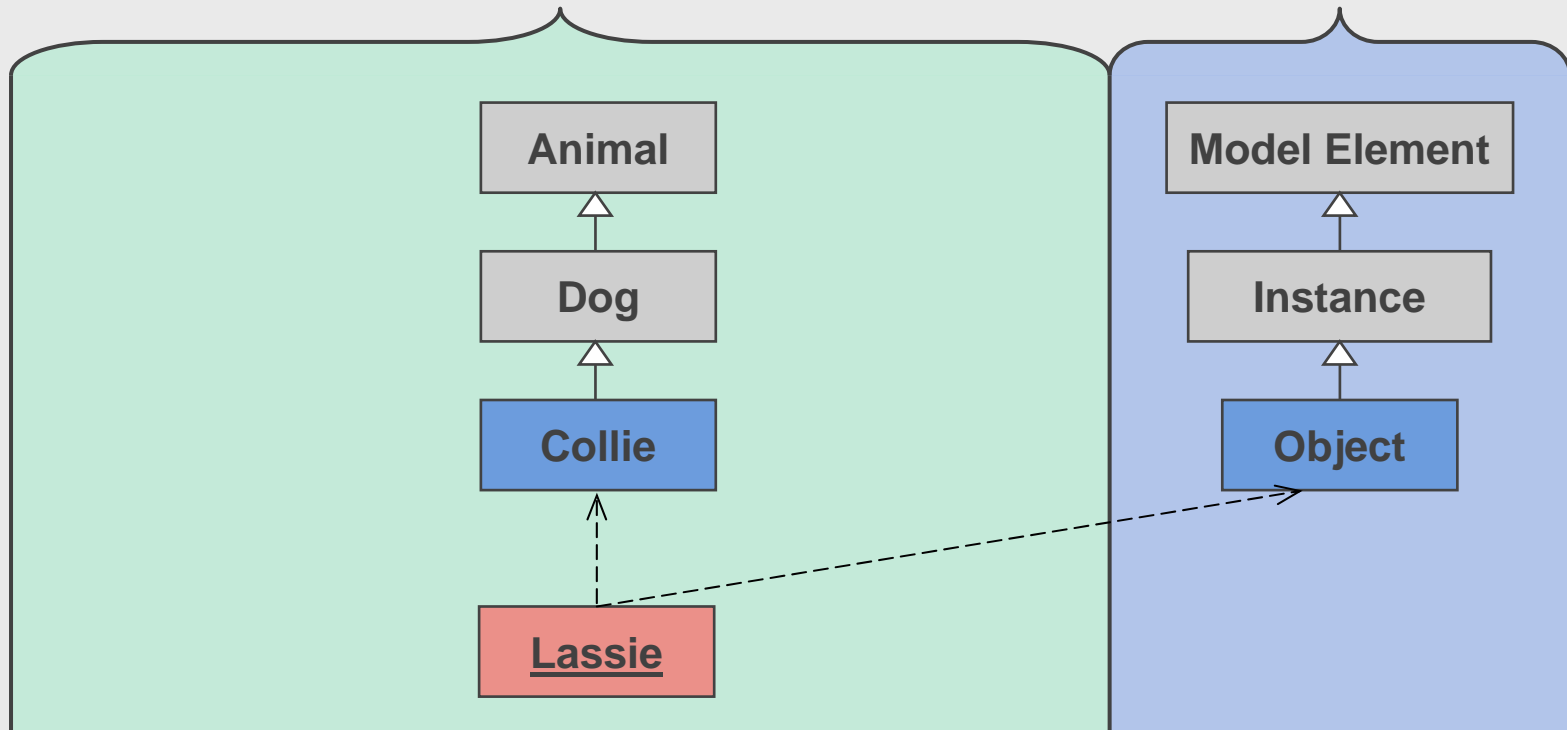


# Linguistic and Ontological Types

## Two Dimensions of Classification

**Ontological Classification**  
(domain types)

**Linguistic Classification**  
(representation form)





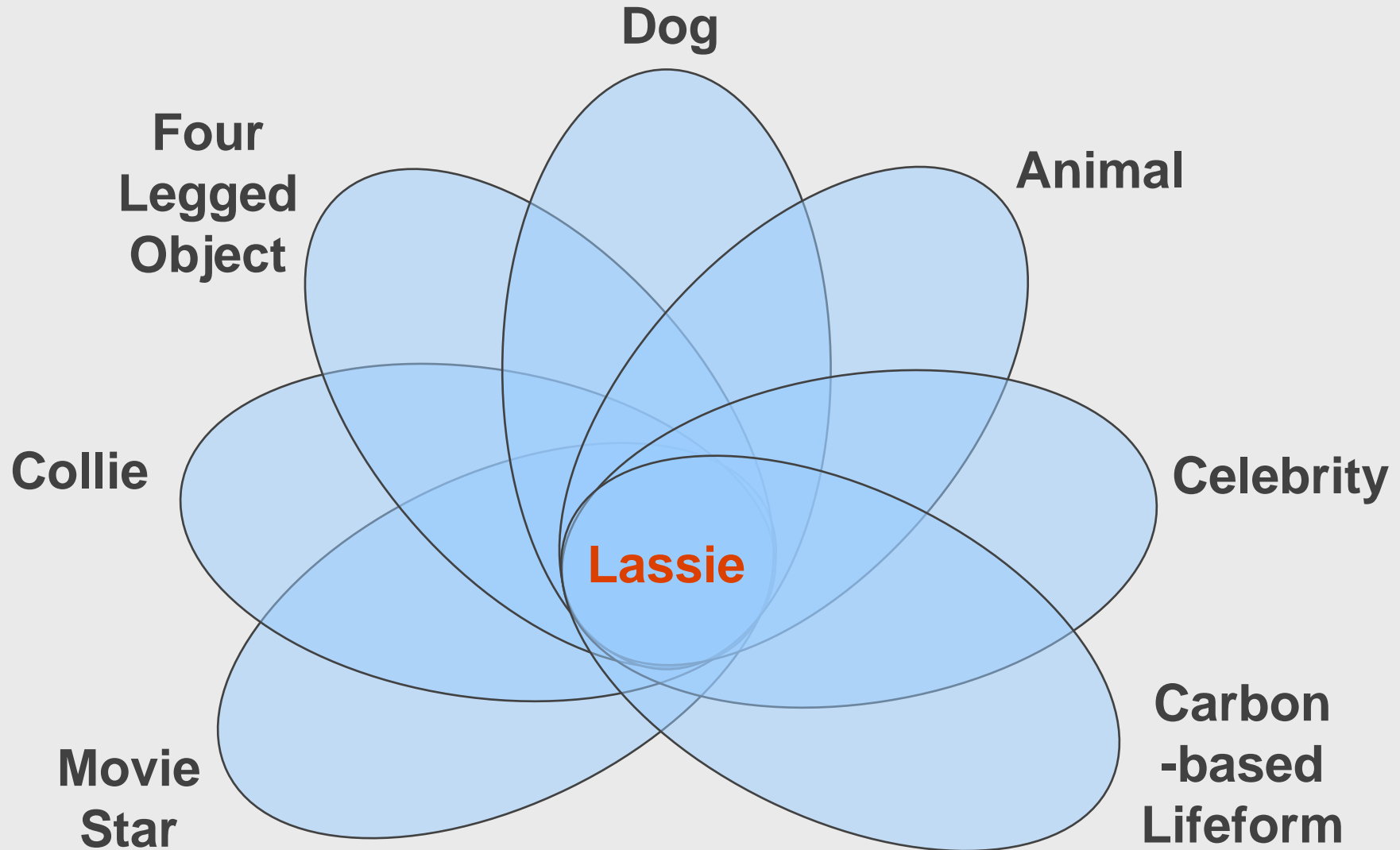
# Usage versus Mentioning

## The Case for Quotation Marks

- when we **use** a word we refer to its meaning
  - » Lassie  $\varepsilon$  Dog
  - » Love is an Emotion
- when we **mention** a word, we refer to the word itself
  - » "Lassie"  $\varepsilon$  Word
  - » "Love" is a Four Letter Word
- whenever we **mention** words only, we should use quotation marks

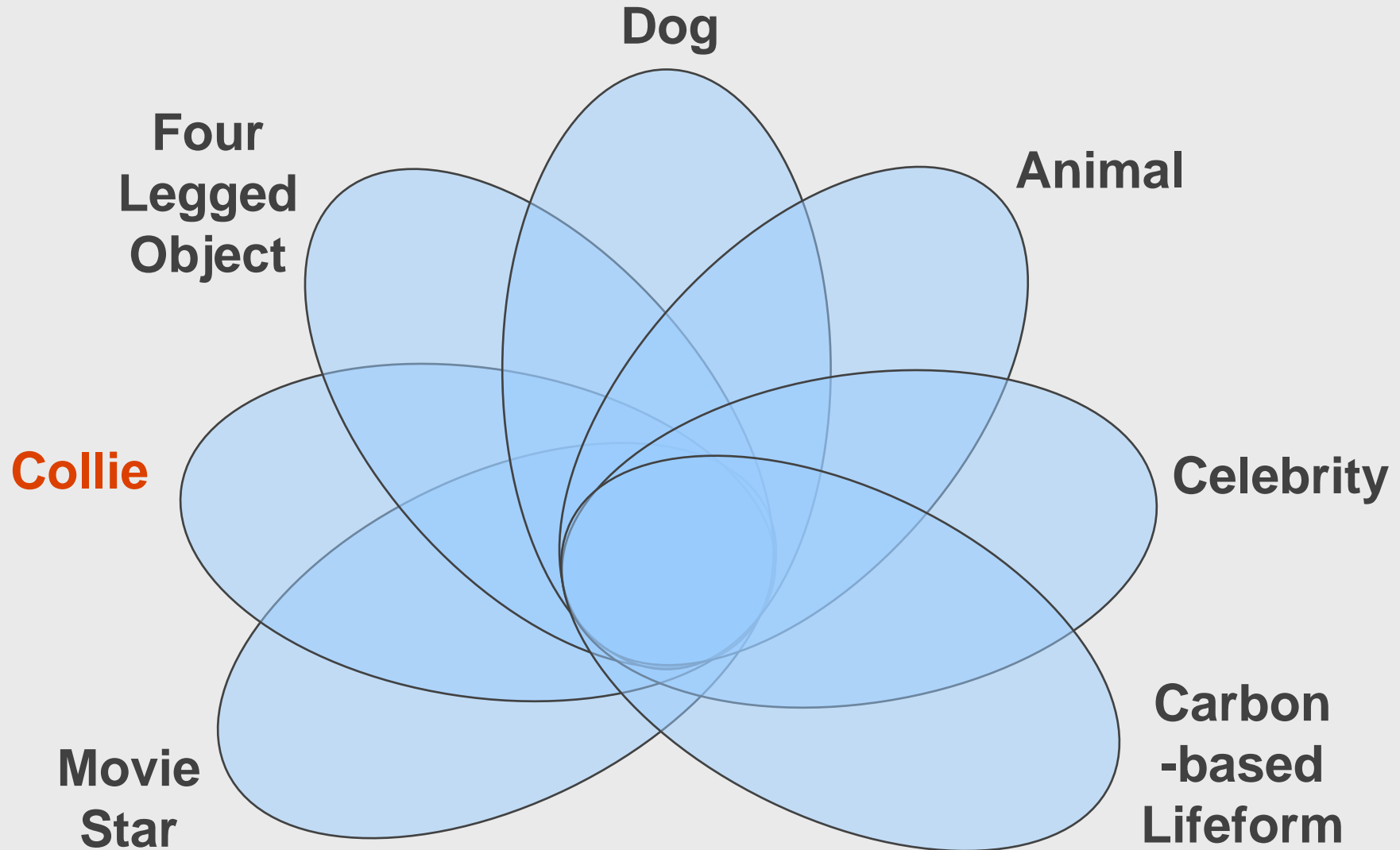


# Example Classification



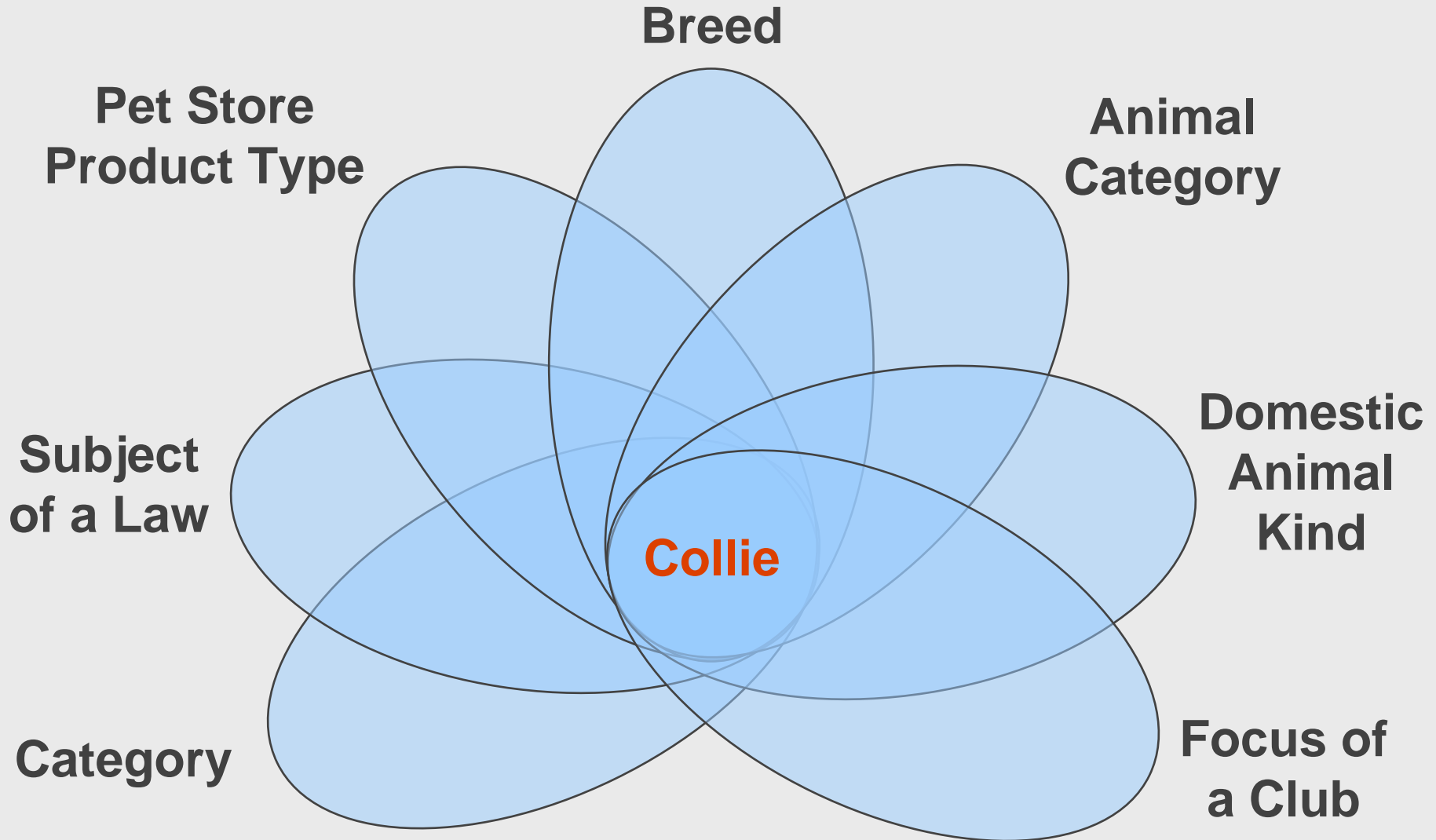


# Example Classification





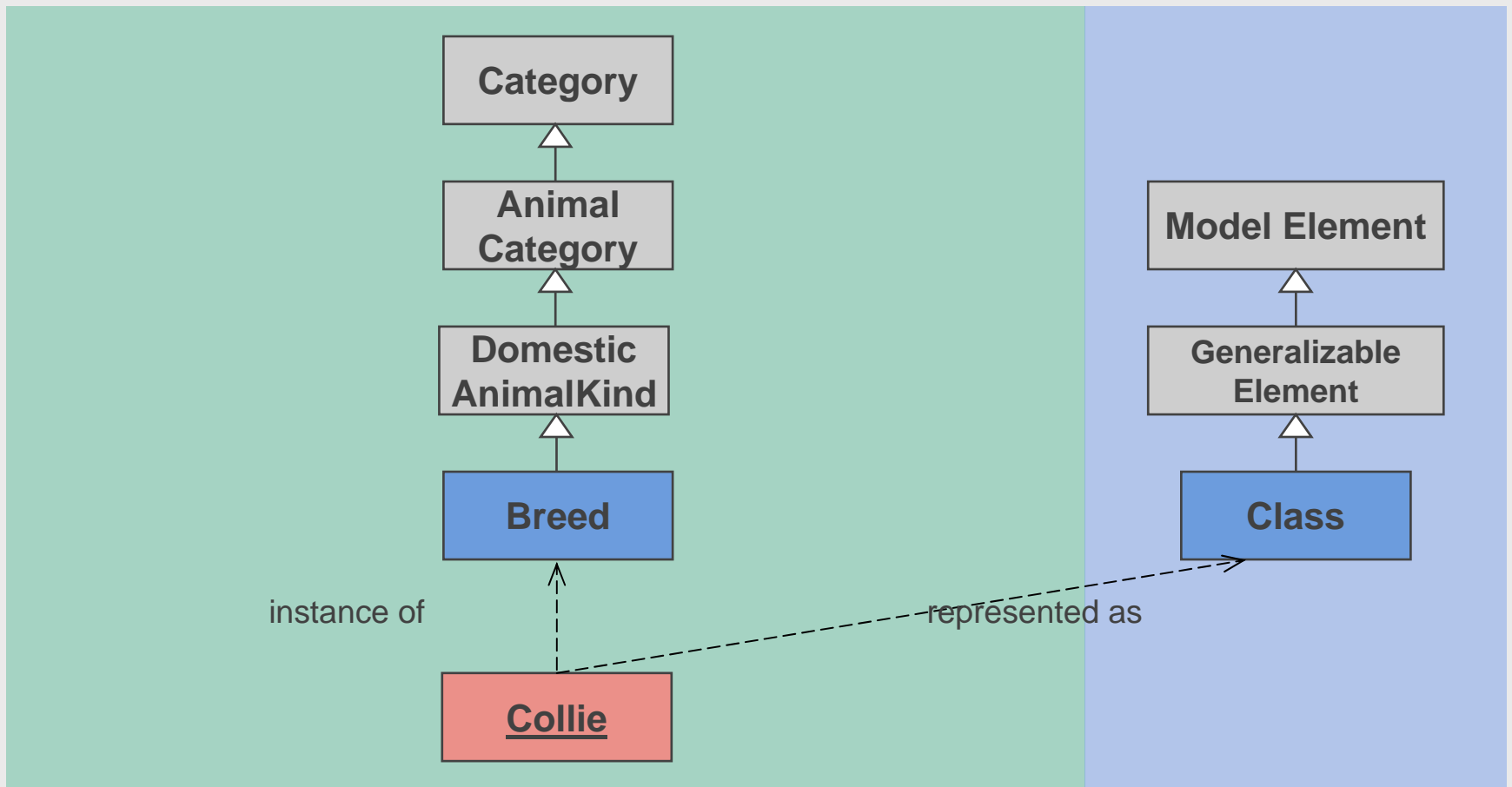
# Type Classification





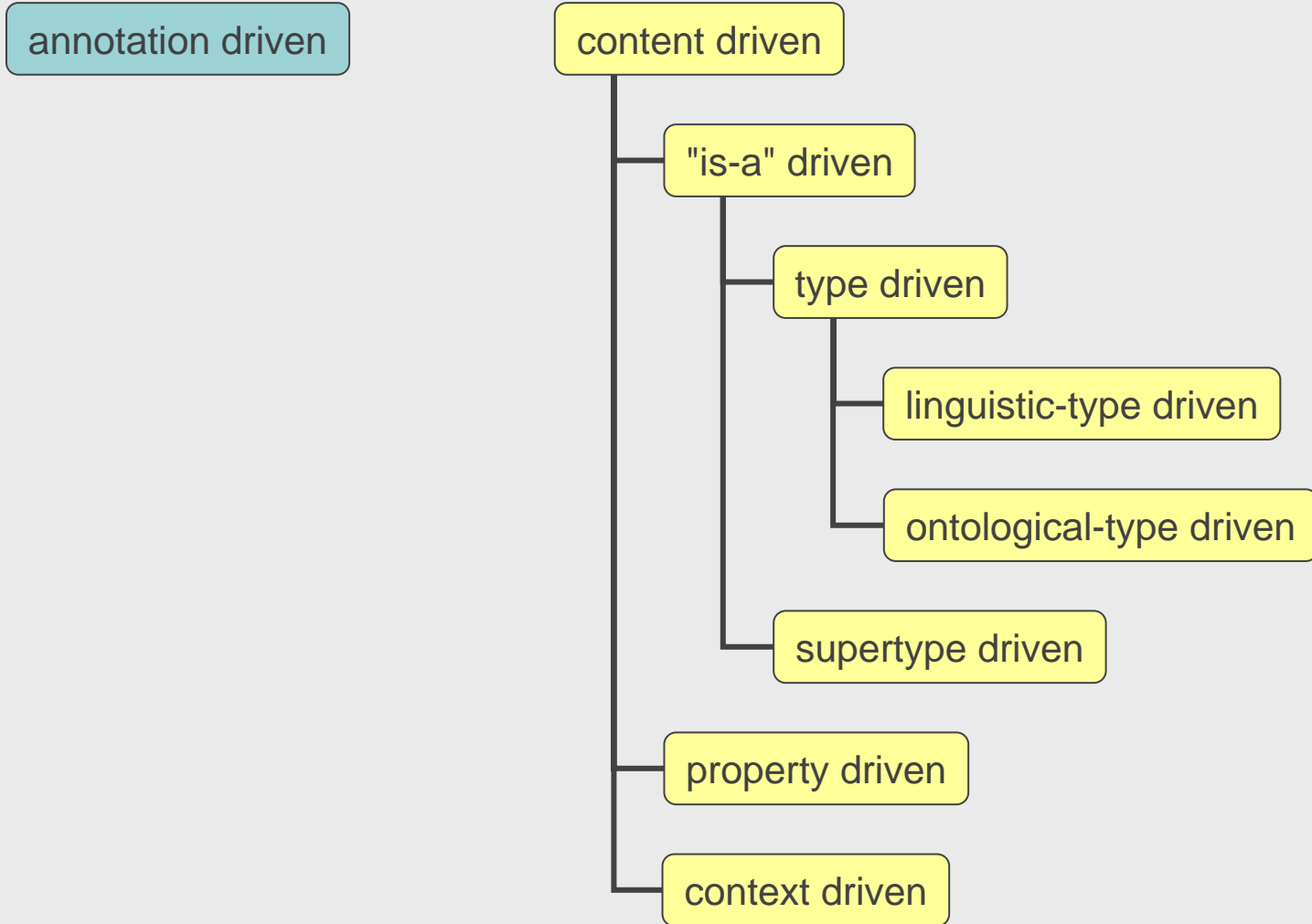
# Linguistic and Ontological Metatypes

## Again, two Dimensions of Classification





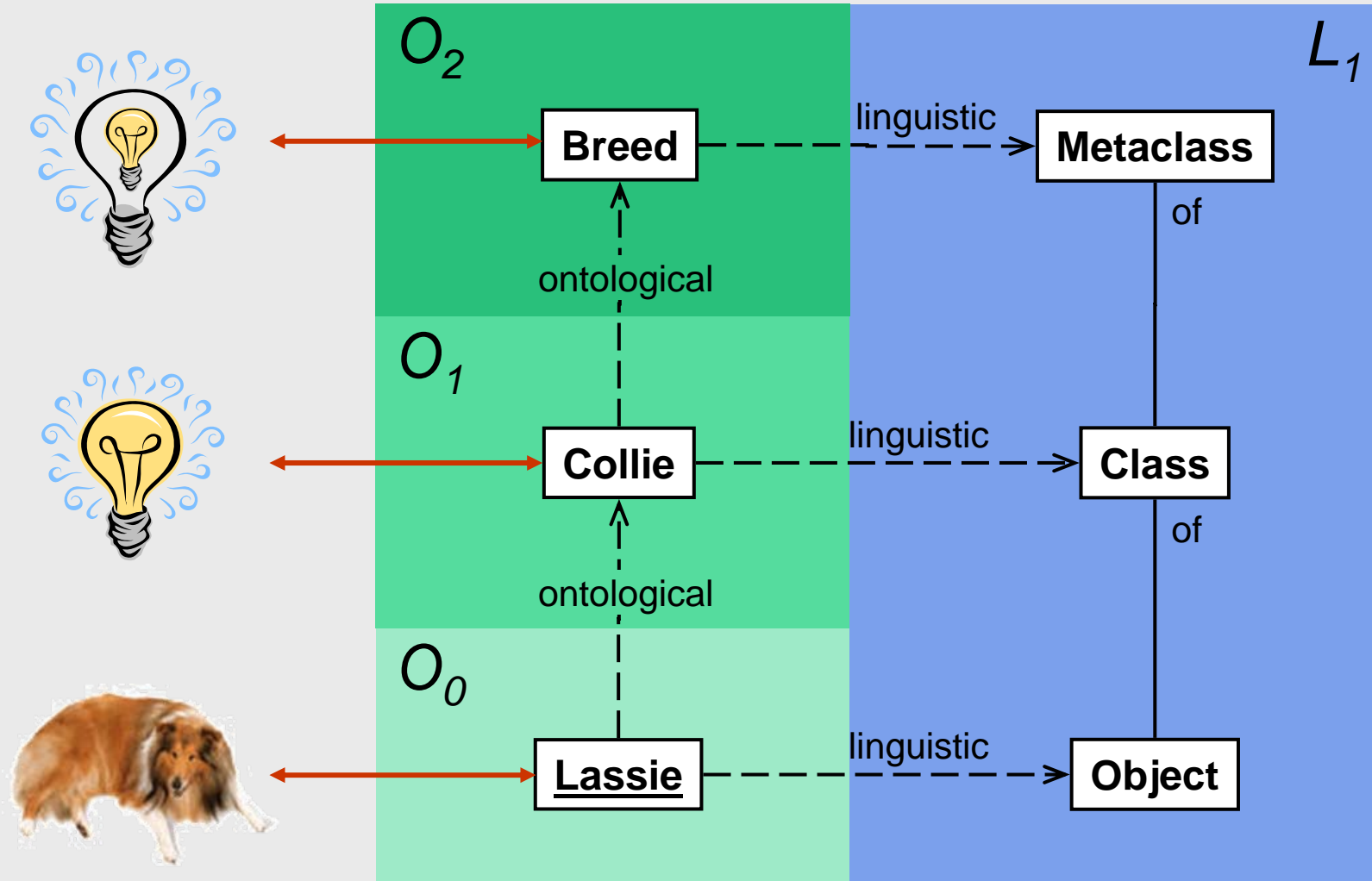
# Transformation Kinds







# Two-Dimensional Framework





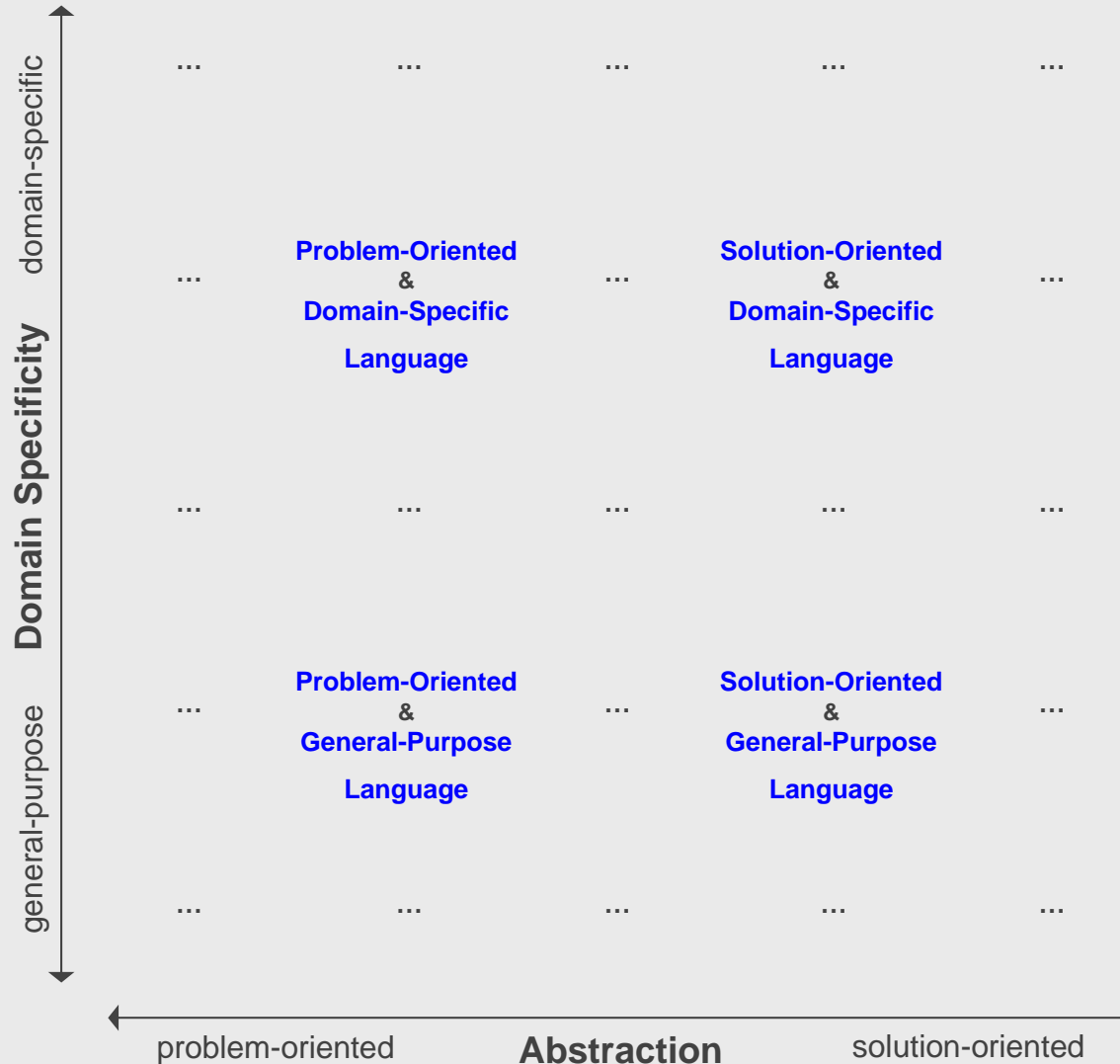
# Metamodeling Summary

## Definitions

- Basic Relationships in Modeling
  - » representation
  - » classification (linguistically & ontologically)
  - » generalization
- Metaness
  - » repeated application of an operation giving rise to anti-transitive relationships
  - » transfer of this definition to models, with a relaxed interpretation for allowing established terminology

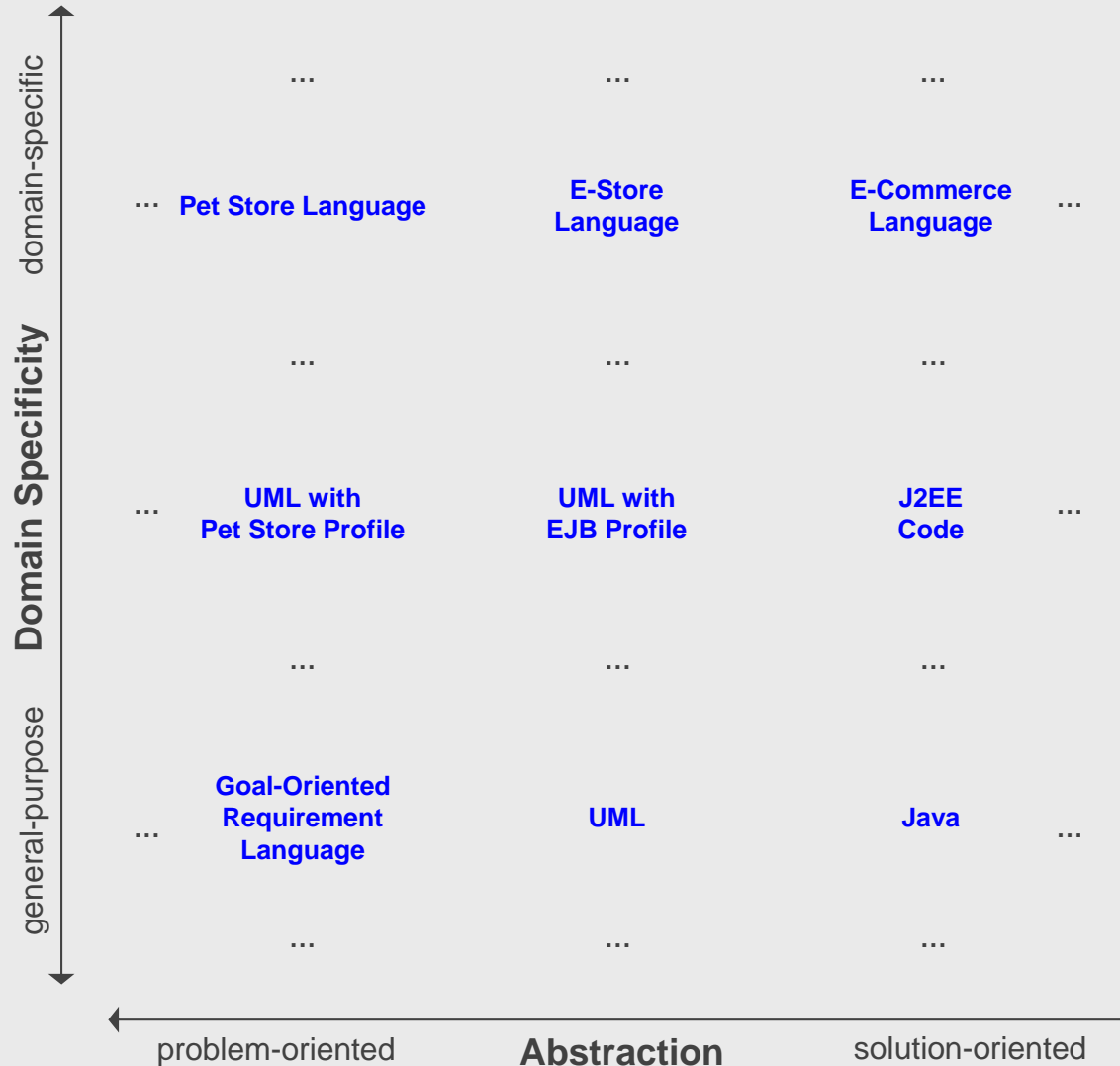


# Specificity vs Abstraction



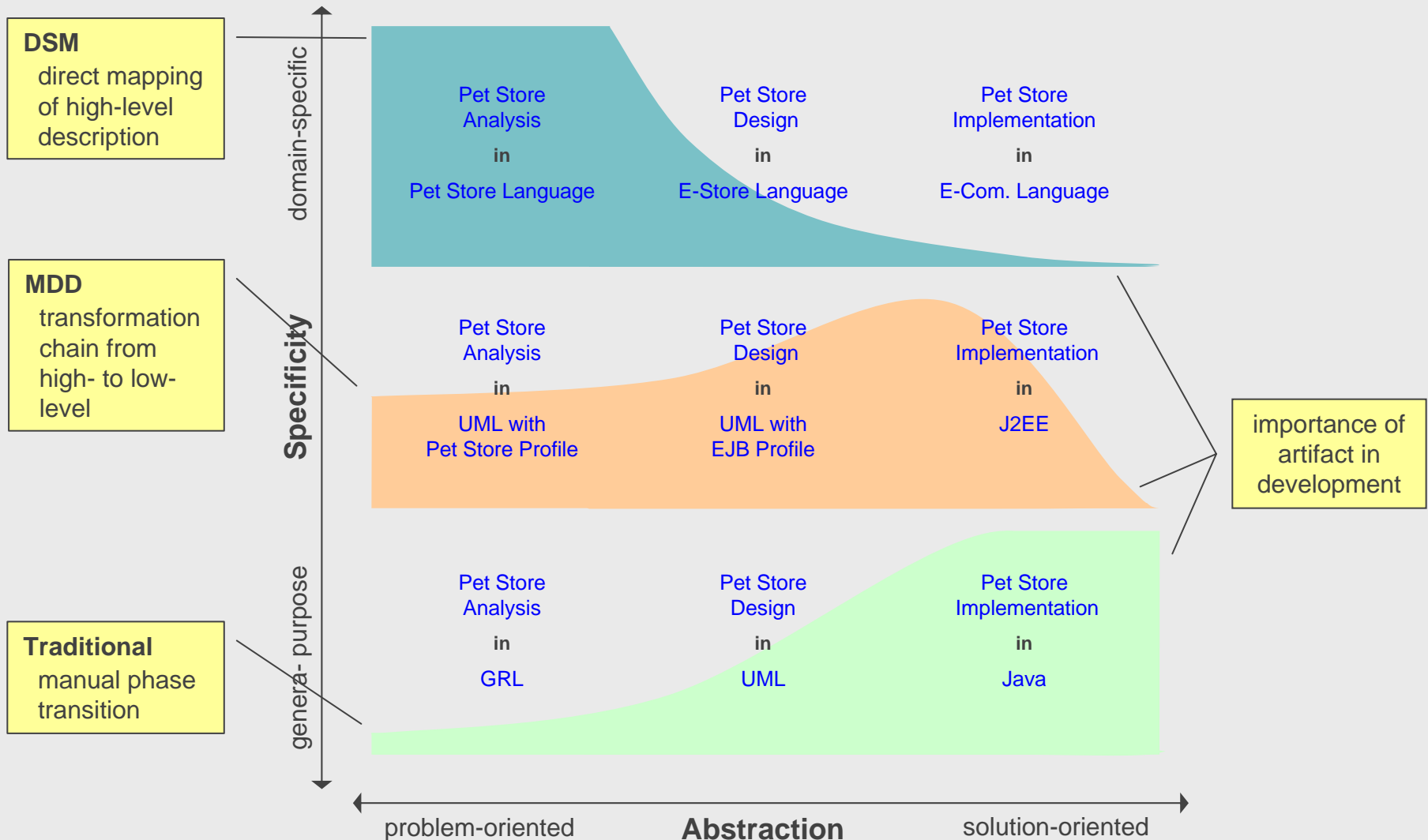


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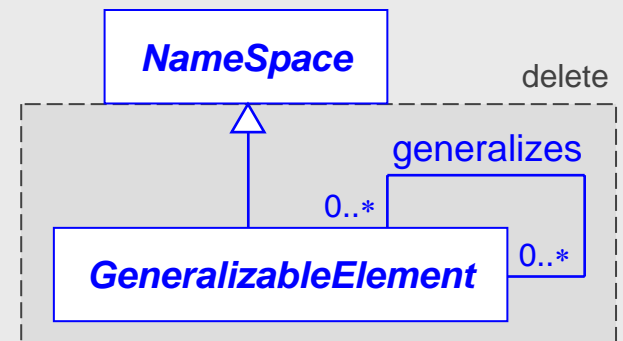
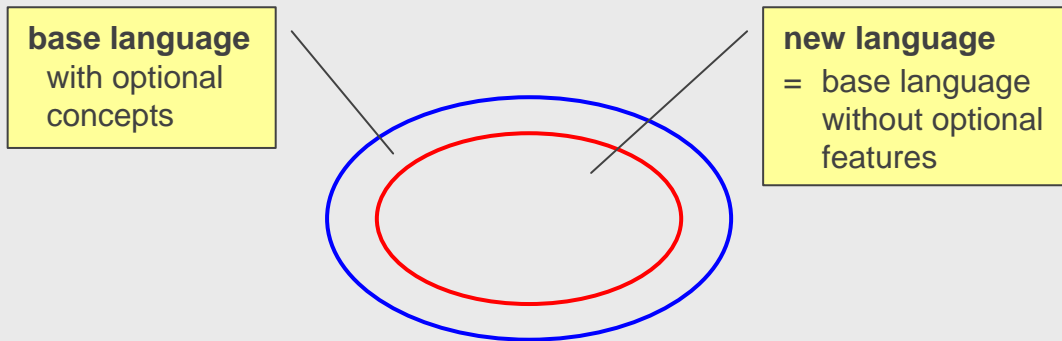
# Models and Development





# Language Customization

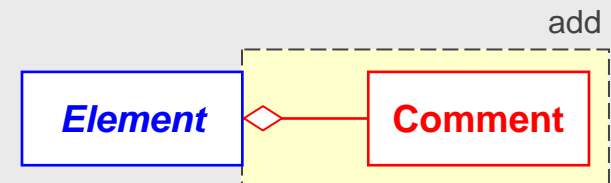
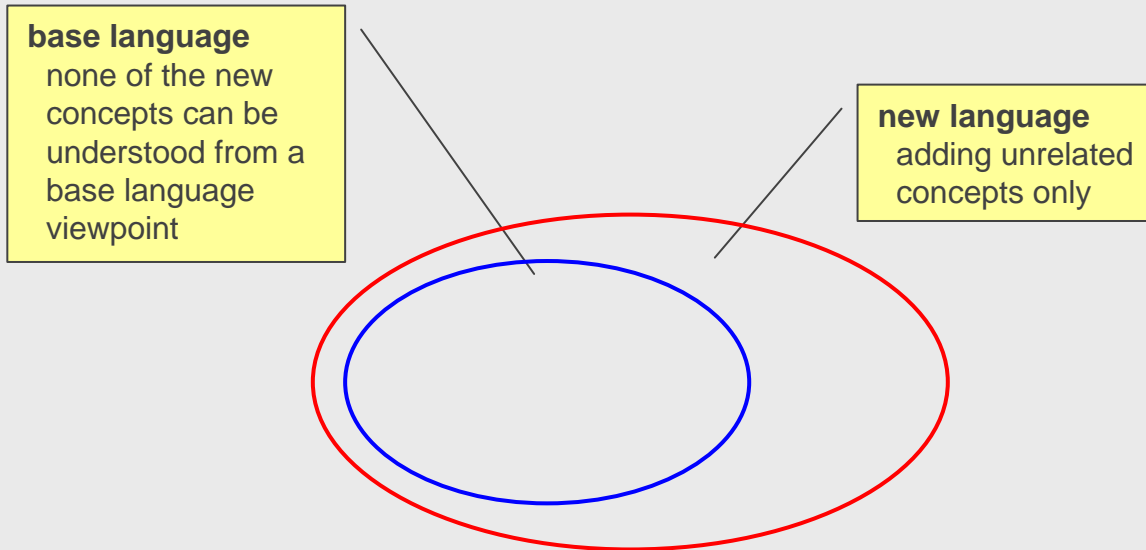
## Reduction





# Language Customization

## Disjoint Specialization





# Language Customization

## Additive Specialization

