

It's **Patterns** all the way down...

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**COMMODITY FUTURES TRADING
COMMISSION****SECURITIES AND EXCHANGE
COMMISSION**

[Release No. 34-63423; File No. 4-620]

**Acceptance of Public Submissions on
a Study Mandated by the Dodd-Frank
Wall Street Reform and Consumer
Protection Act, Section 719(b)**

AGENCY: Commodity Futures Trading
Commission; Securities and Exchange
Commission.

ACTION: Request for Comments.

SUMMARY: The Dodd-Frank Wall Street Reform and Consumer Protection Act (“Dodd-Frank Act”) was enacted on July 21, 2010. The Dodd-Frank Act, among other things, mandates that the Commodity Futures Trading Commission (“CFTC”) and the Securities and Exchange Commission (“SEC”) conduct a study on “the feasibility of requiring the derivatives industry to adopt standardized computer-readable algorithmic descriptions which may be used to describe complex and standardized financial derivatives.” These algorithmic descriptions should be designed to “facilitate computerized analysis of individual derivative contracts and to calculate net exposures to complex derivatives.” The study also must consider the extent to which the algorithmic description, “together with standardized and extensible legal definitions, may serve as the binding legal definition of derivative contracts.” In connection with this study, the staff of the CFTC and SEC seek responses of interested parties to the questions set forth below.

Current practices concerning standardized computer descriptions of derivatives:

7. Do you rely on a discrete set of computer-readable descriptions (“ontologies”) to define and describe derivatives transactions and positions? If yes, what computer language do you use?

8. If you use one or more ontologies to define derivatives transactions and

positions, are they proprietary or open to the public? Are they used by your counterparties and others in the derivatives industry?

9. How do you maintain and extend the ontologies that you use to define derivatives data to cover new financial derivative products? How frequently are new terms, concepts and definitions added?

10. What is the scope and variety of derivatives and their positions covered by the ontologies that you use? What do they describe well, and what are their limitations?

11. How do you think any limitations to the ontologies you use to describe derivatives can be overcome?

12. Are these ontologies able to describe derivatives transactions in sufficient detail to enable you to calculate net exposures to complex derivatives?

13. Are these ontologies able to describe derivatives transactions in sufficient detail to enable you to perform other analysis? What types of analysis can you conduct with this data, and what additional data must be captured to perform this analysis?

Semantic Interoperability is considered to be
the problem of this decade...[currently]
costing productivity, lives and billions of dollars
annually...the overall human and financial cost
to society from our ***failure*** to share and reuse
information is ***many times the cost of the
systems' operation*** and maintenance

**[OMG, SIMF -
Semantic Information Model Federation]**

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World Trade Centre insurance

Bad forms

After a rancorous trial, relief for many insurers of the twin towers

May 6th 2004 | From the print edition



IT WAS a \$3.5 billion question: was the crashing of two aeroplanes into New York's twin towers in September 2001 one event or two? One, many insurers are relieved to know. On May 3rd a jury ruled that Swiss Re, the world's second-largest reinsurer, which wrote about a quarter of the coverage for the World Trade Centre, was bound by a form that classed such attacks as a single occurrence. Last week the same jury had reached a similar verdict for several Lloyd's of London syndicates and seven other insurers. The loser was Larry Silverstein, the centre's leaseholder. He had argued that another form was valid, in the hope of claiming around \$7 billion for two events. Now he may get only half that.

In most disaster insurance, "occurrence" is carefully defined. Earthquake coverage typically treats all shaking

AP



Silverstein's the loser

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“In most disaster insurance, “**occurrence**” is carefully defined...”

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similar verdict for another insurer, American International Group, which had also written coverage for the towers. The jury's decision, which came after a trial that lasted more than two weeks, was a relief for many insurers. It meant that they would not have to pay out \$7 billion for two events. Now they may get only half that.

In most disaster insurance, “occurrence” is carefully defined. Earthquake coverage typically treats all shaking


Silverstein's the loserFollow *The Economist*

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World Trade Centre insurance

One into two

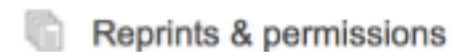
Having lost one legal case to insurers, the towers' leaseholder wins a second

Dec 9th 2004 | NEW YORK | From the print edition



SEVEN months ago, a jury in lower Manhattan ruled that under the forms covering insurance of the World Trade Centre, the striking of the twin towers by two aeroplanes constituted only one "occurrence". Consequently, Larry Silverstein, who had recently leased the Trade Centre complex, was entitled to one payment, not two—a difference of \$3.5 billion. On December 6th, in the same courtroom with the same judge presiding, another jury decided that under the documents used by nine other insurers the attacks were two events, thus qualifying for two payments. The verdict will provide Mr Silverstein with as much as \$1.1 billion extra for rebuilding the Trade Centre. It will also ensure that he remains in control of the project.

Why, after two weeks of deliberation, did the second jury come to a different conclusion from the first? The main reason lay in the preliminary paperwork signed by the underwriters. Because the Trade Centre had been leased to Mr Silverstein only weeks before the attack, the final insurance contracts had yet to be signed. The insurers in the first trial had signed a form with a much tighter definition of an "occurrence" than in the form signed by the nine insurers in the second trial. In addition, the insurance companies' claim that they always defined "occurrence" precisely may have been undermined by testimony that they had been flexible in other cases—for example, involving sequences of



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“The insurers in the first trial had signed a form with a **much tighter definition of “occurrence”**...the insurance companies' claim that they always defined **“occurrence” precisely**”

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Semantic Interoperability



relating different
worldviews, i.e., different
conceptualizations of
reality

The **Taxonomy** of Animals in *The Celestial Emporium of Benevolent Knowledge* (Borges)

- Those that belong to the emperor
- Those that resemble flies from a distance
- Those that have just broken a flower vase
- Embalmed ones
- Fabulous ones

“Those that resemble flies from a distance”

is a logically possible way to group objects, but it's not how we naturally make sense of the world. No real language would have a noun for such a category...Real nouns capture something deep; they refer to **kinds** of things that are thought to share deep properties...”

(Paul Bloom, *How Pleasure Works*, 2010)

“...As the evolutionary theorist Stephen Jay Gould put it, our classifications don't just exist to avoid chaos, they are ***“theories about the basis of natural order.”***”

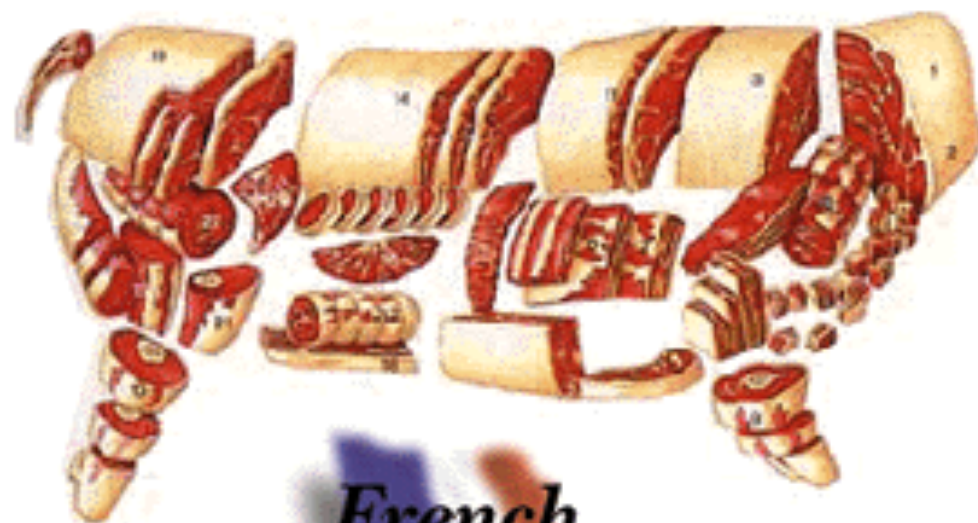
(Paul Bloom, How Pleasure Works, 2010)

Carving reality at its joints [Plato]:

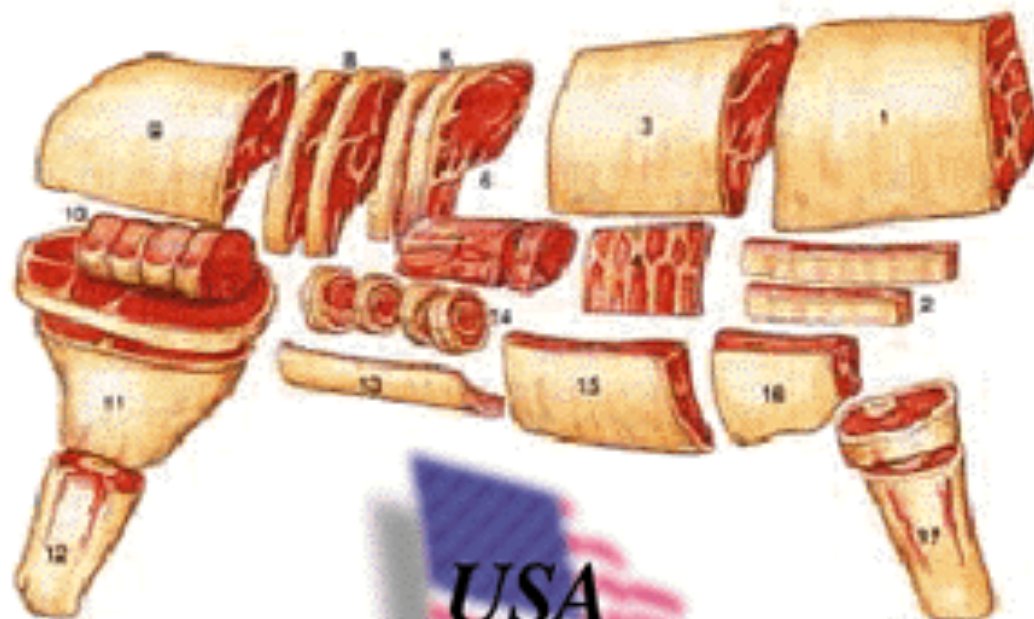




British



French



USA

“Carving up Reality”

We need to guarantee

Intra-worldview Consistency

and

Inter-worldview Interoperability

“Carving up Reality”

- There is not doubt about the brute reality. The issue is interpreting that part of reality according to a certain **system of categories**
- These categorization operations are in a sense **a prioristic**

“Carving up Reality”

- Formal semantics is not enough. Mathematics (Logics, Algebra, Set Theory) give us the tools to calculate the consequence of our **ontological choices** but not offer us any help in making those choices in the first place...

Ontology as a Calculus of Content

- For that we need a *a prioristic* system of categories and their ties addressing issues of Identity, Unity (Parts and Wholes), Individuation, Change, Classification and Taxonomic Structures, Dependence (Existential, Historical, Relational, Notional), Causality, Essential and Accidental Characterization
- We need **Formal Ontology** and **Ontological Analysis**

Ontology-Driven Conceptual **Modeling**

A discipline aiming at developing ontology-based methodologies, computational tools and **modeling languages** for the area of Conceptual Modeling

Another look at data

by GEORGE H. MEALY

Computer Consultant

Scituate, Massachusetts

INTRODUCTION

We do not, it seems, have a very clear and commonly agreed upon set of notions about data—either what they are, how they should be fed and cared for, or their relation to the design of programming languages and operating systems. This paper sketches a theory of data which may serve to clarify these questions. It is based on a number of old ideas and may, as a result, seem obvious. Be that as it may, some of these old ideas are not common currency in our field, either separately or in combination; it is hoped that rehashing them in a somewhat new form may prove to be at least suggestive.

To begin on a philosophical plane, let us note that we usually behave as if there were three realms of interest in data processing: the real world itself, ideas about it existing in the minds of men, and symbols on paper or some other storage medium. The lat-

particular ontology, we can avoid a quarrel by adopting the nominalist's position.

Our plan of attack is to indicate the nature of the theory of relations, based on the example of genealogical data. This will lead immediately to formulation of our notions about data in general, including rather precise definitions of concepts such as data structure, list processing, and representation. These notions are used in the second part of the paper as the basis for some remarks and suggestions concerning language and system design.

Toward a theory of data

Relations

To fix our ideas, consider the following example of genealogical data, taken from Reference 2:

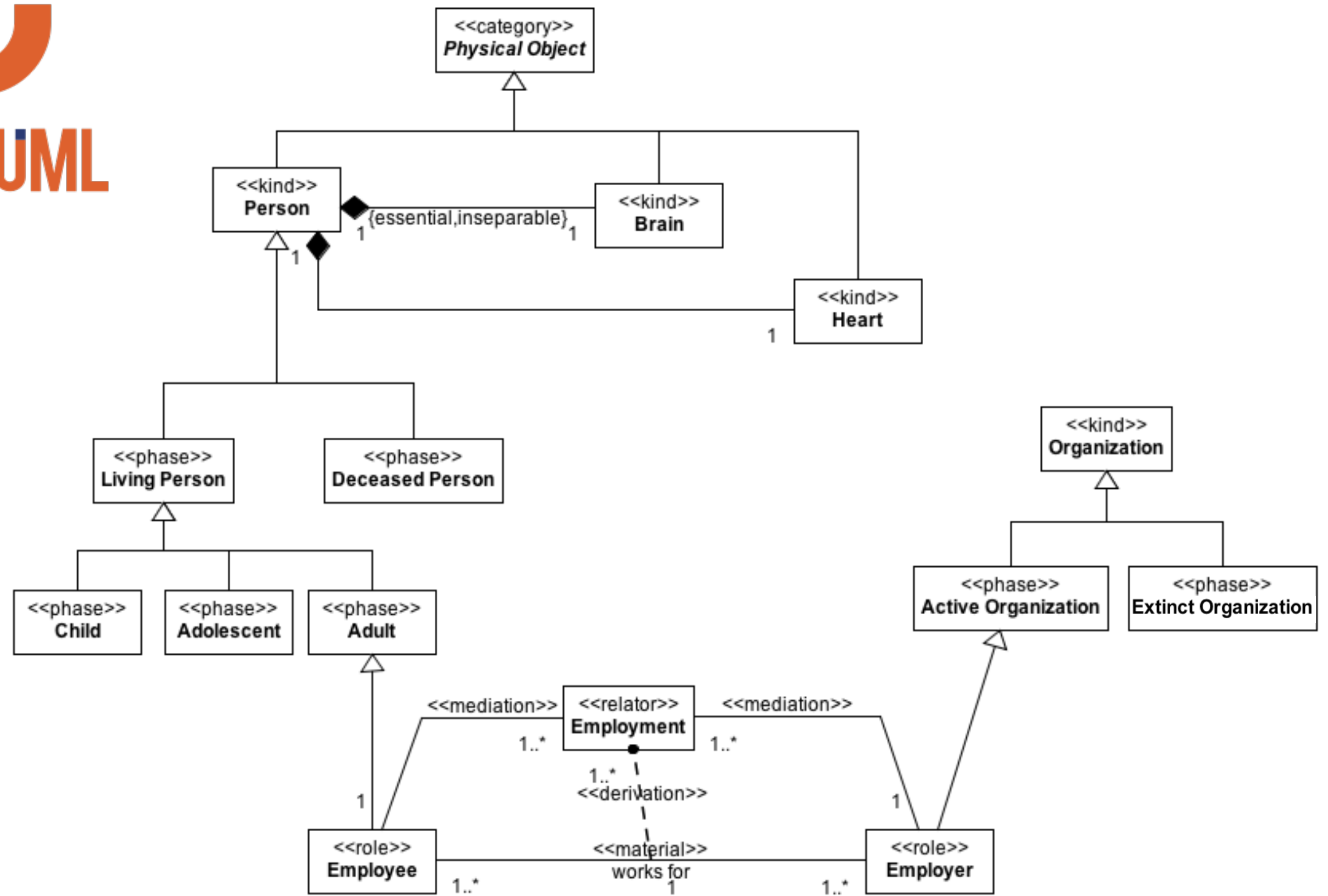
*“Three realms of interest in data processing: the real world itself, ideas about it existing in the minds of men, and symbols on paper or some other storage medium. The latter realms are, in some sense, held to be models of the former. Thus, we might say that **data are fragments of a theory of the real world**, and data processing juggles representations of these fragments of theory...**The issue is ontology, or the question of what exists.**”*

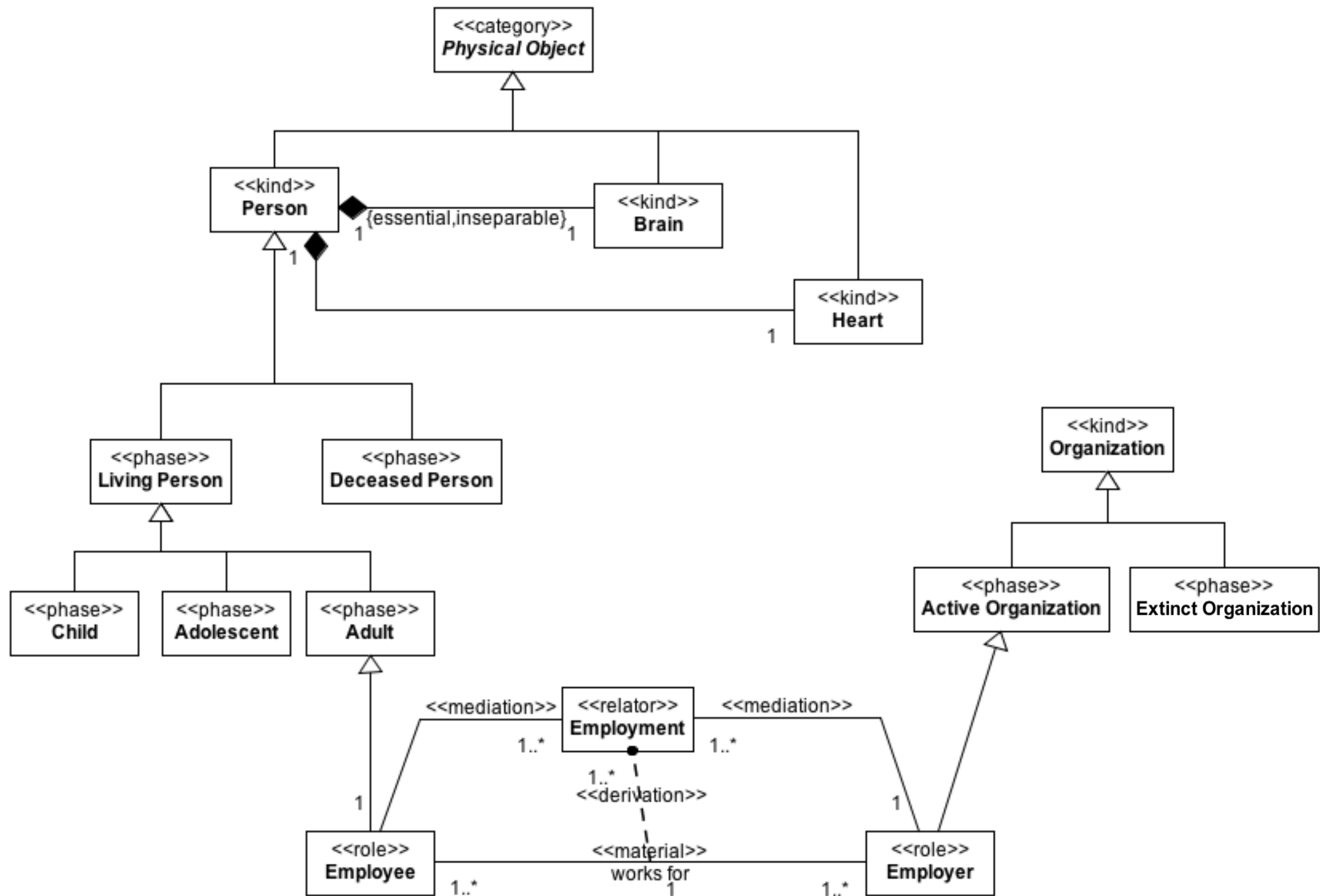
(G.H. Mealy, Another Look at Data, 1967)

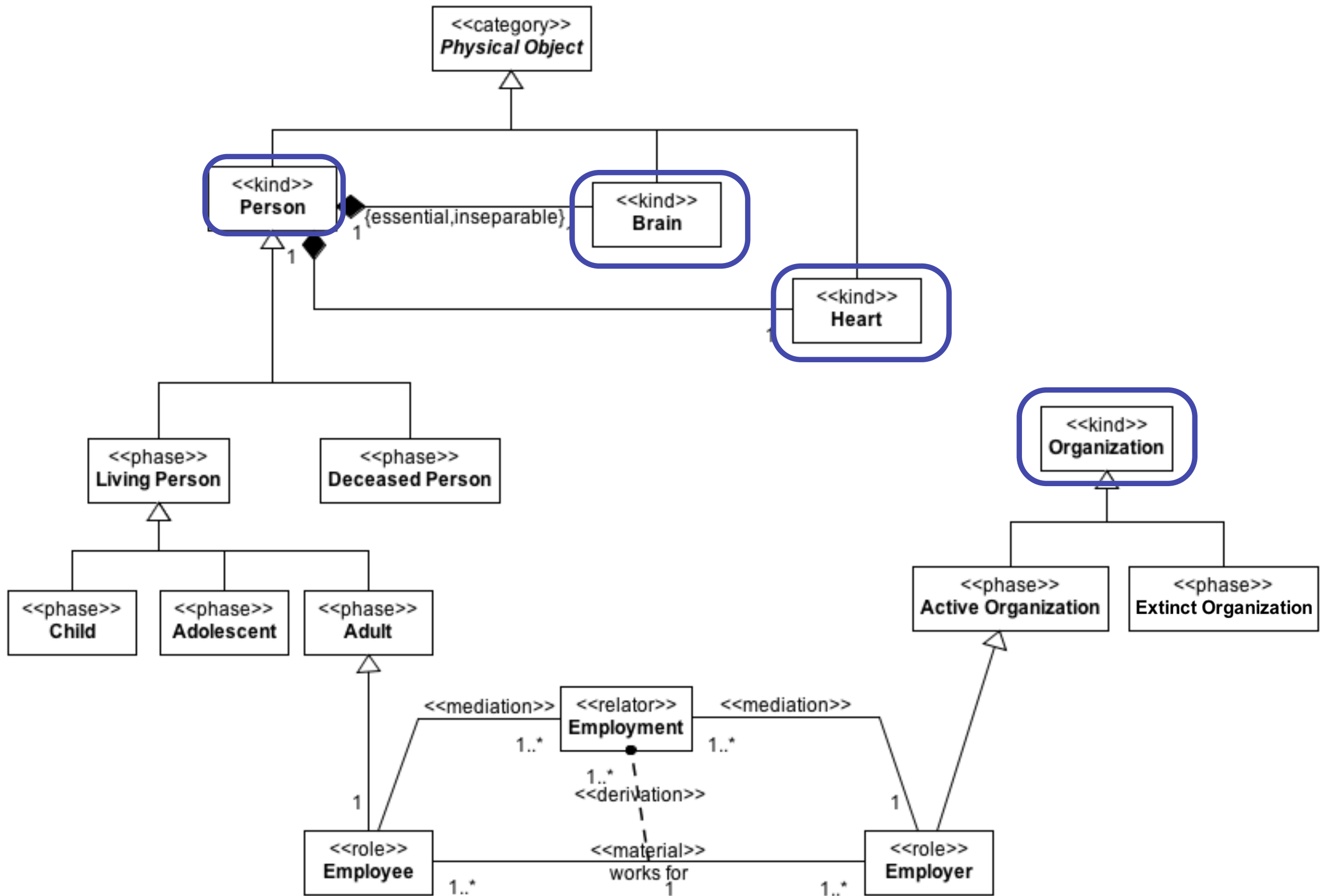
UFO

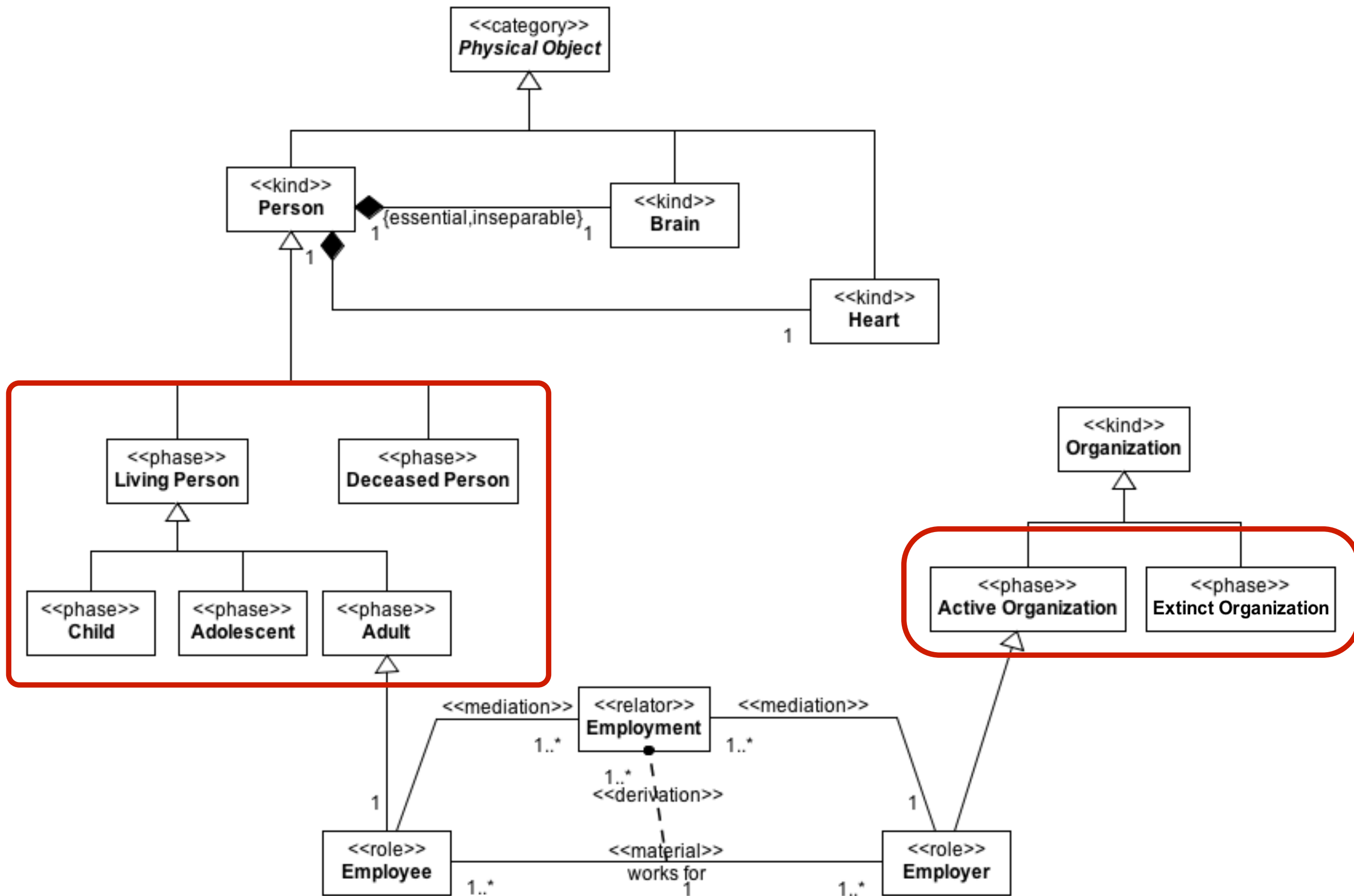
(Unified Foundational Ontology)

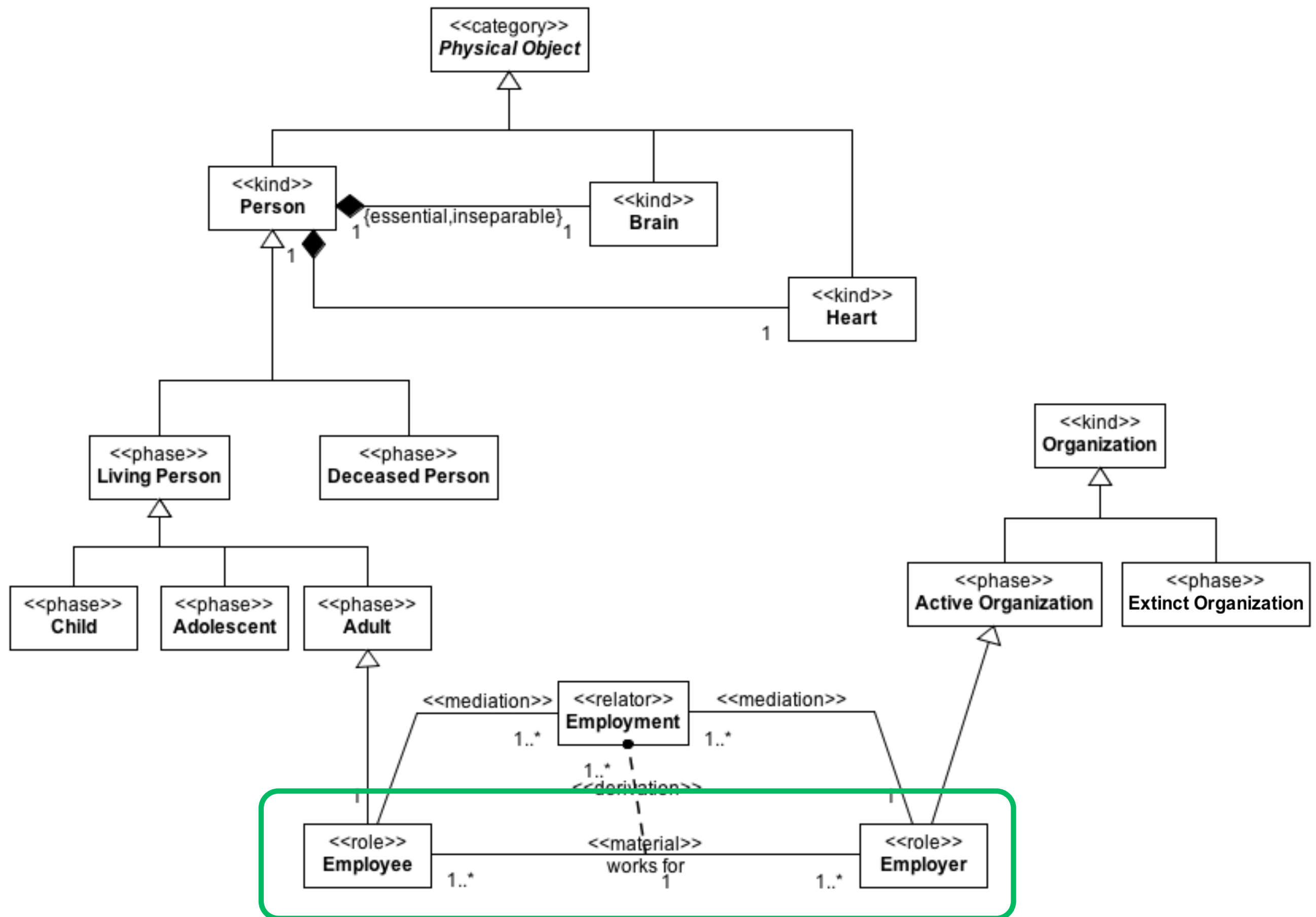
- Over the years, we have built a Philosophically and Cognitively well-founded Ontology to contribute to the general goal of serving as a Foundation for Conceptual Modeling
- This Ontology has been used to as a theory for addressing many classical conceptual modeling constructs such as Object Types and Taxonomic Structures (CAISE 2004, CAISE 2007, CAISE 2012), Part-Whole Relations (CAISE 2007, CAISE 2009, FOIS2010, CAISE 2011), Intrinsic and Relational Properties (ER 2006, ER 2008, ER 2011, CAISE 2015, DKE 2015), Weak Entities, Attributes and Datatypes (ER 2006), Events (ER 2013, BPM 2016), Multi-Level Modeling and Powertypes (JOWO 2015, ER 2015, DKE 2017), etc...

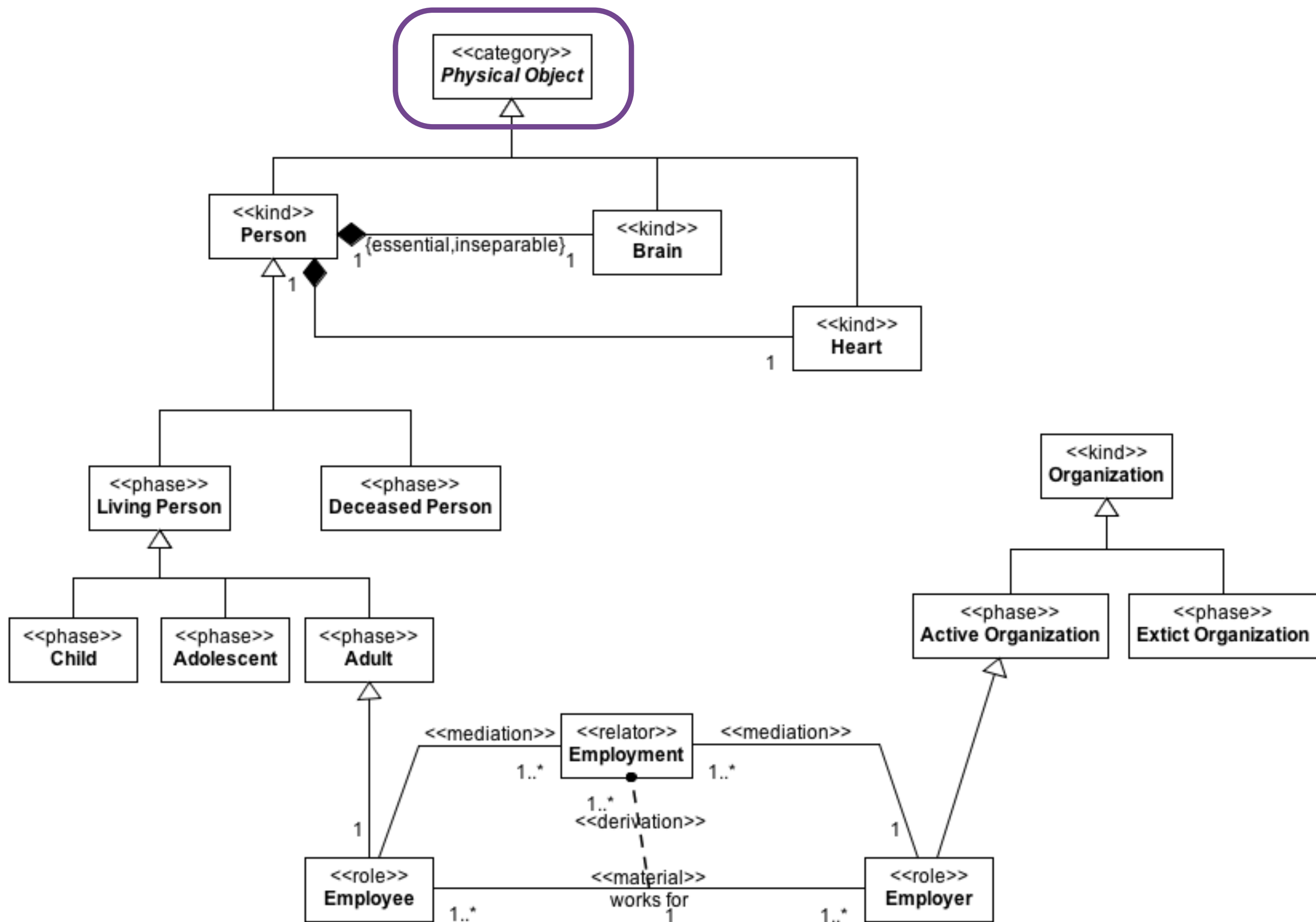


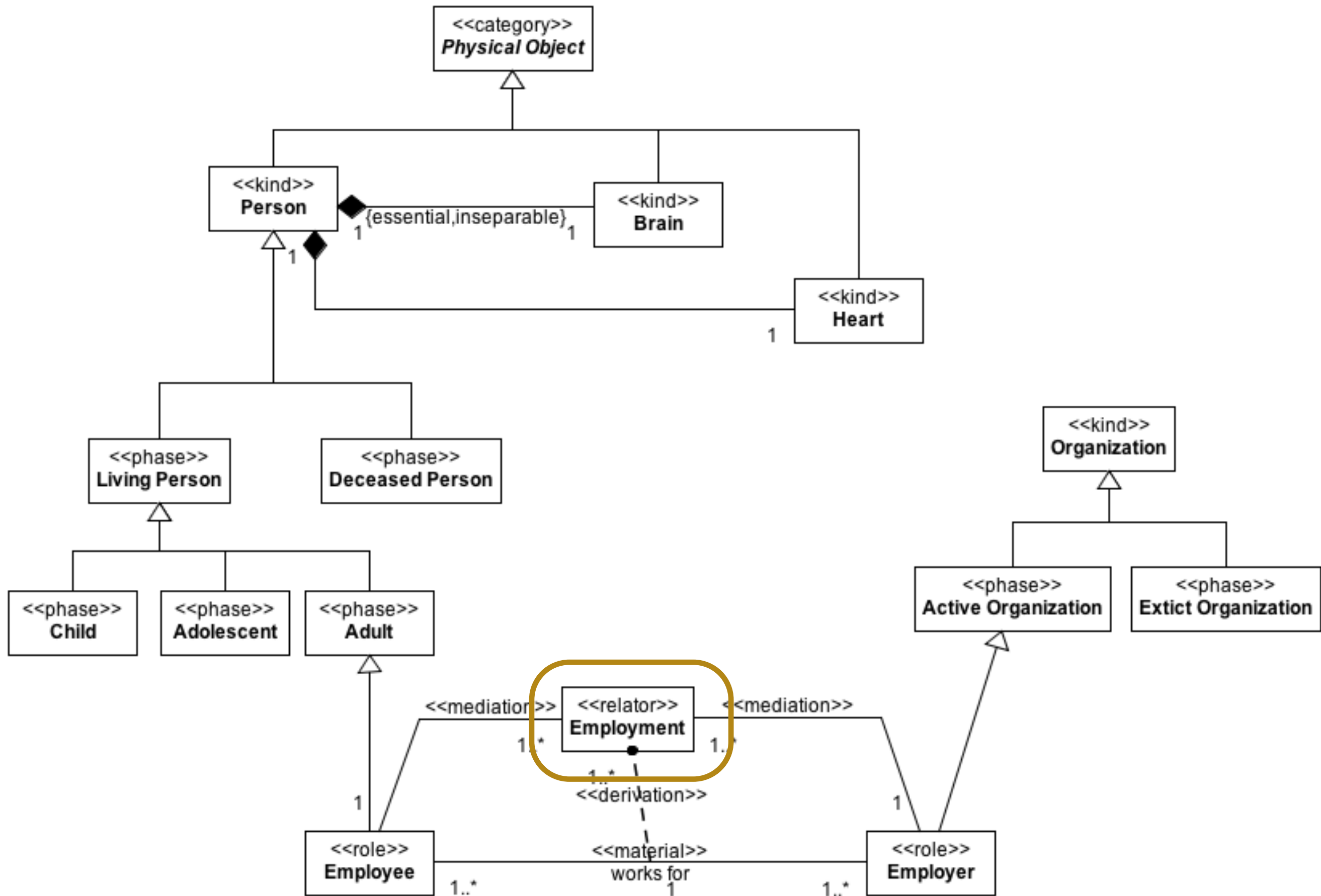


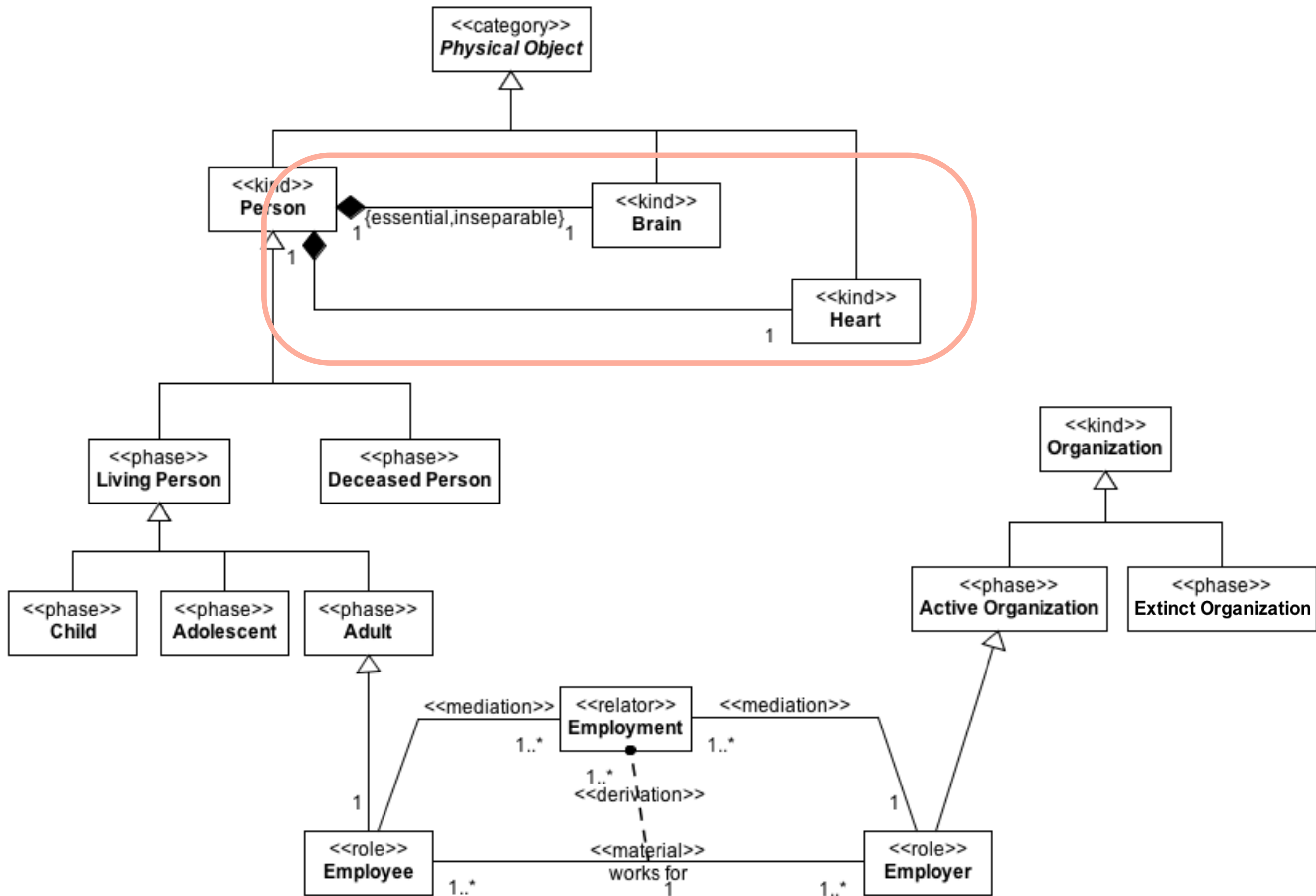




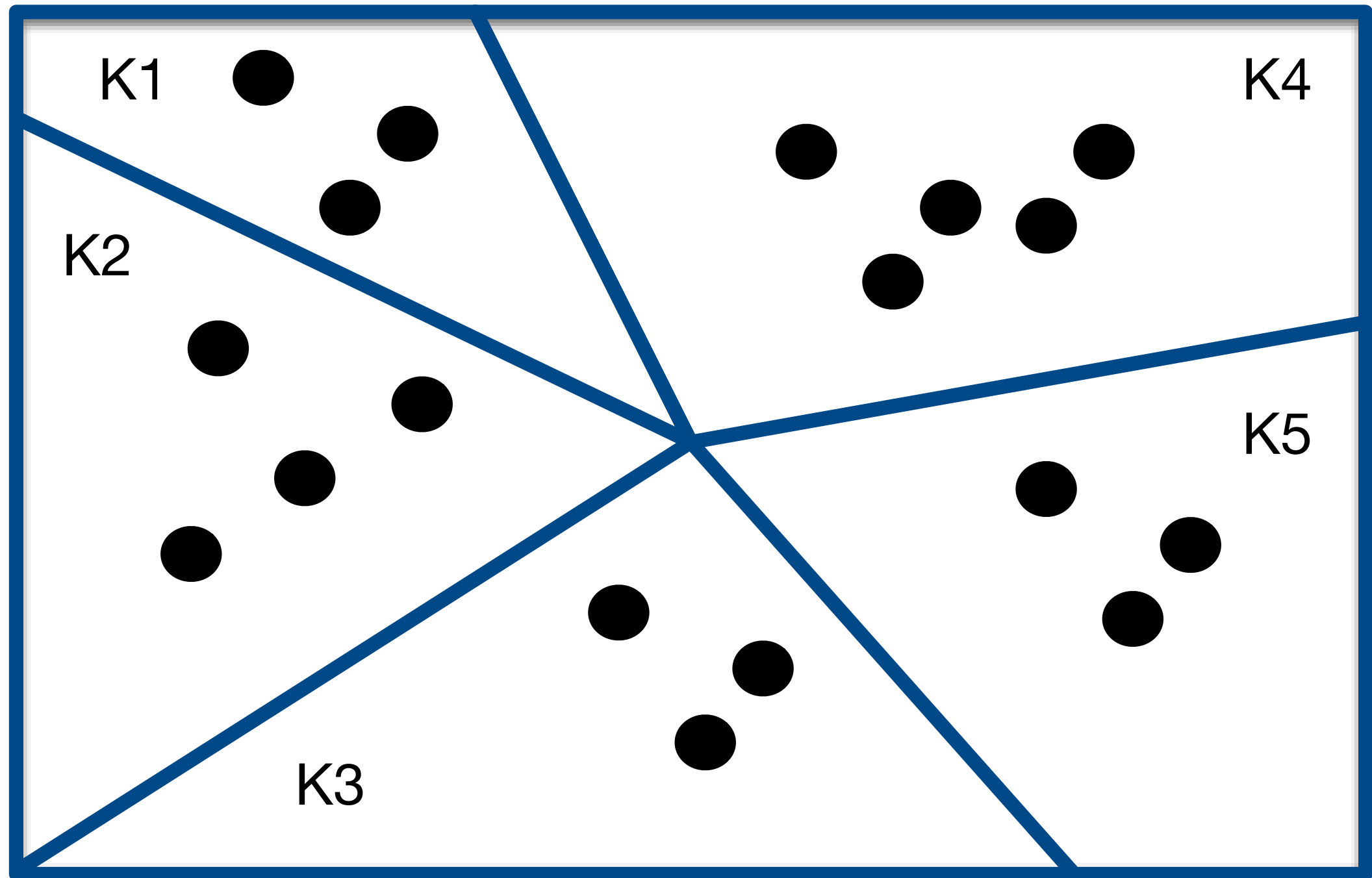




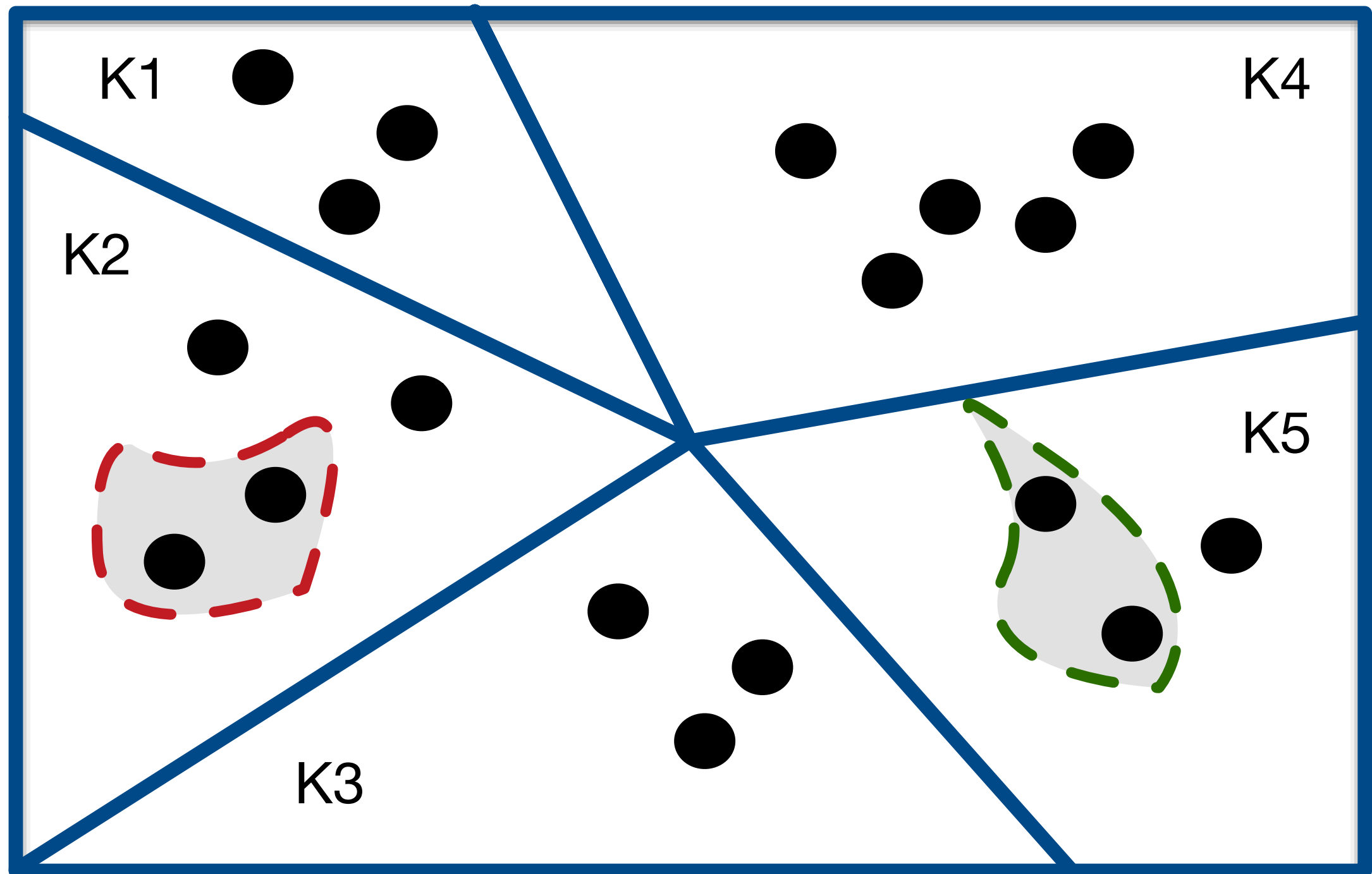




Kinds

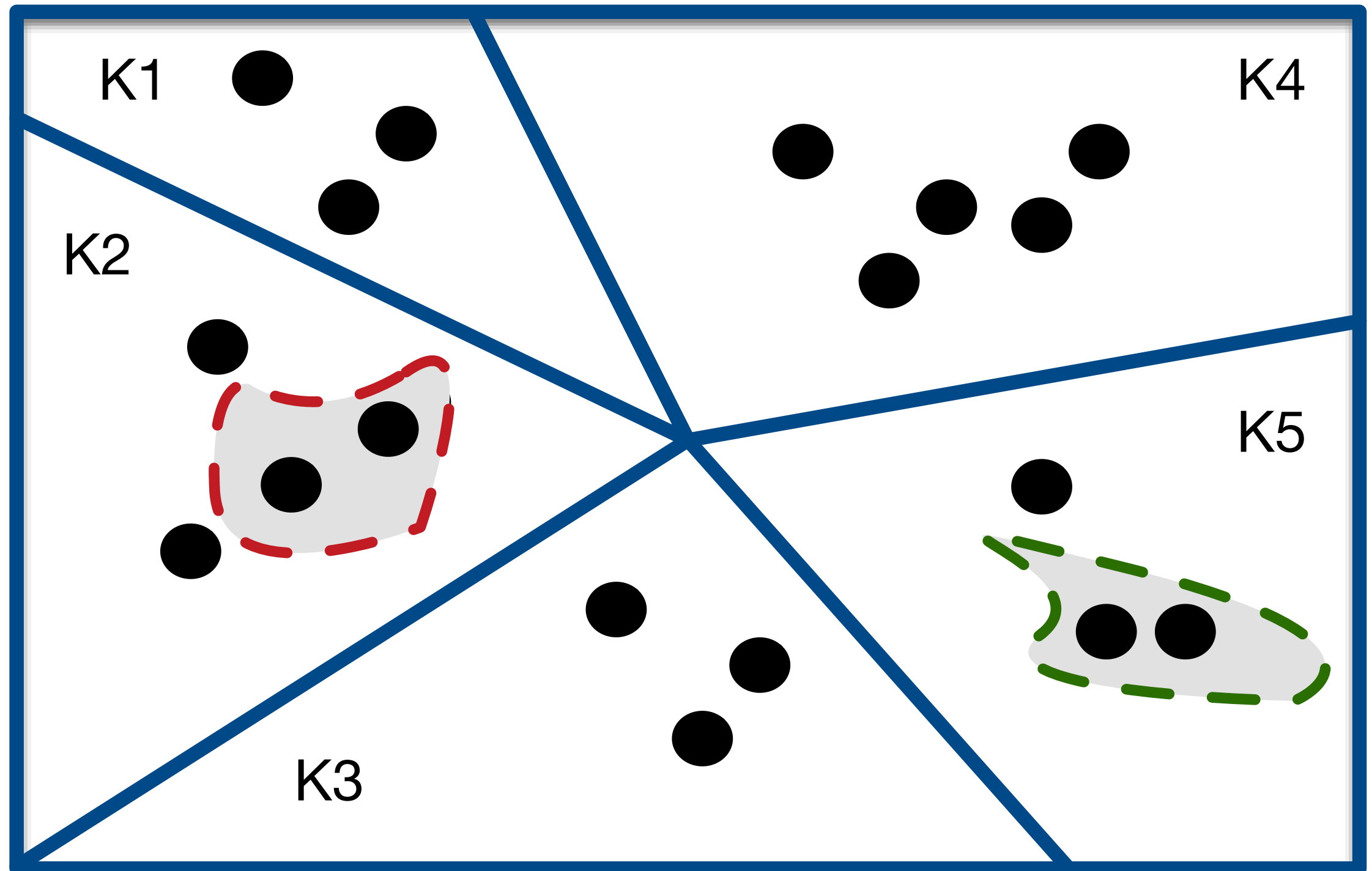


Anti-Rigid Sortals (**Roles** and **Phases**)

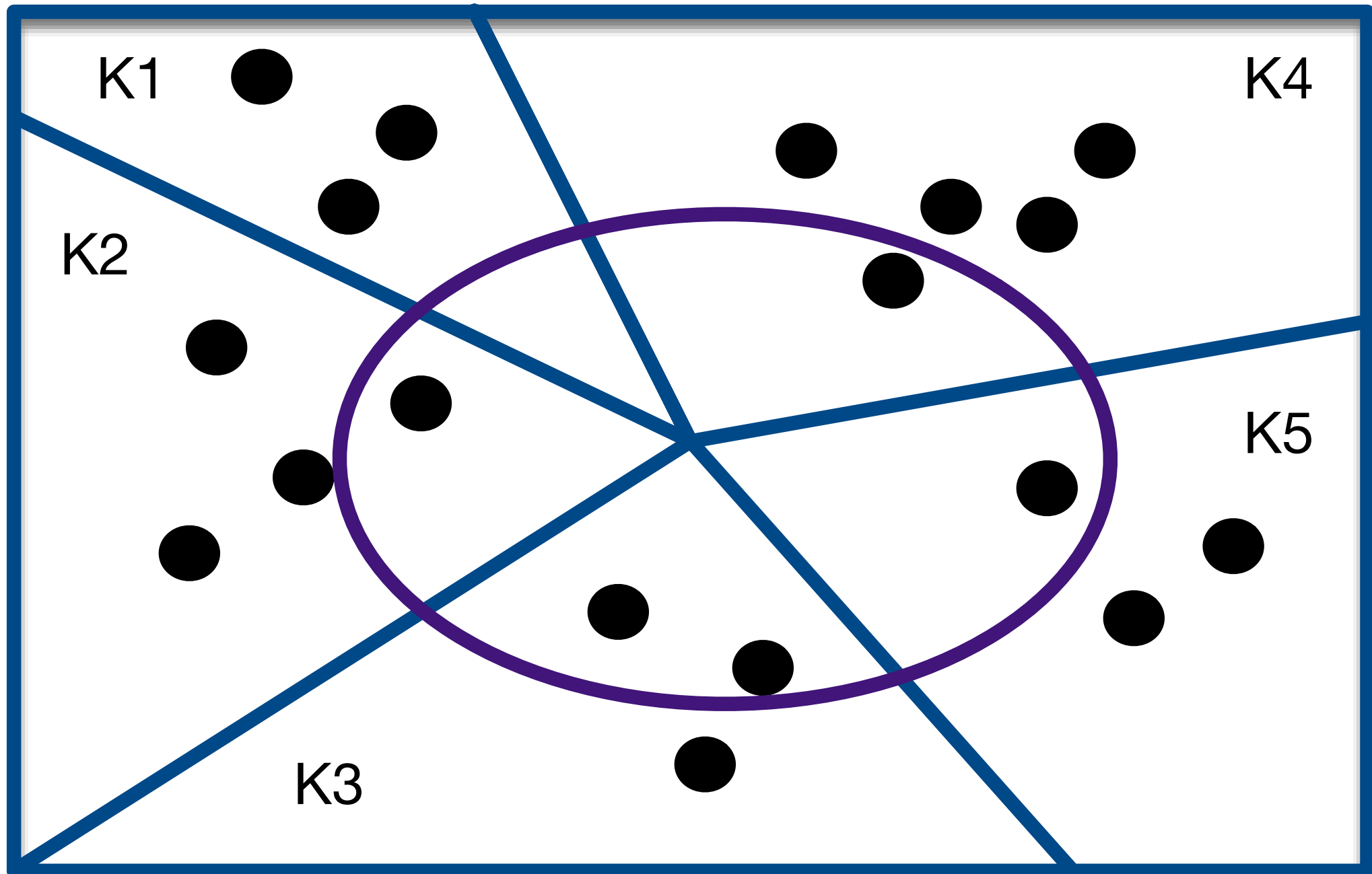


Anti-Rigid Sortals

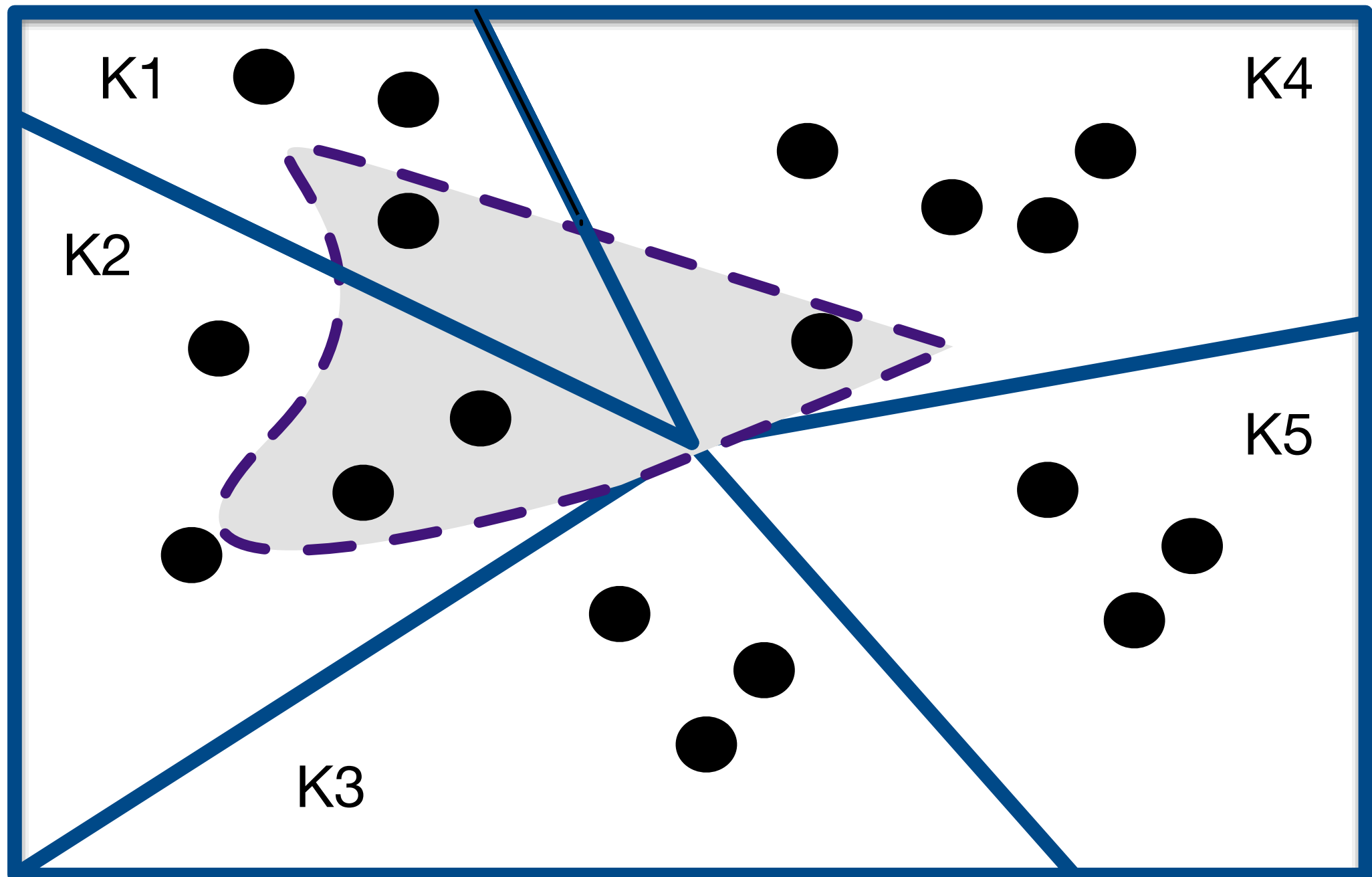
(**Roles** and **Phases**)



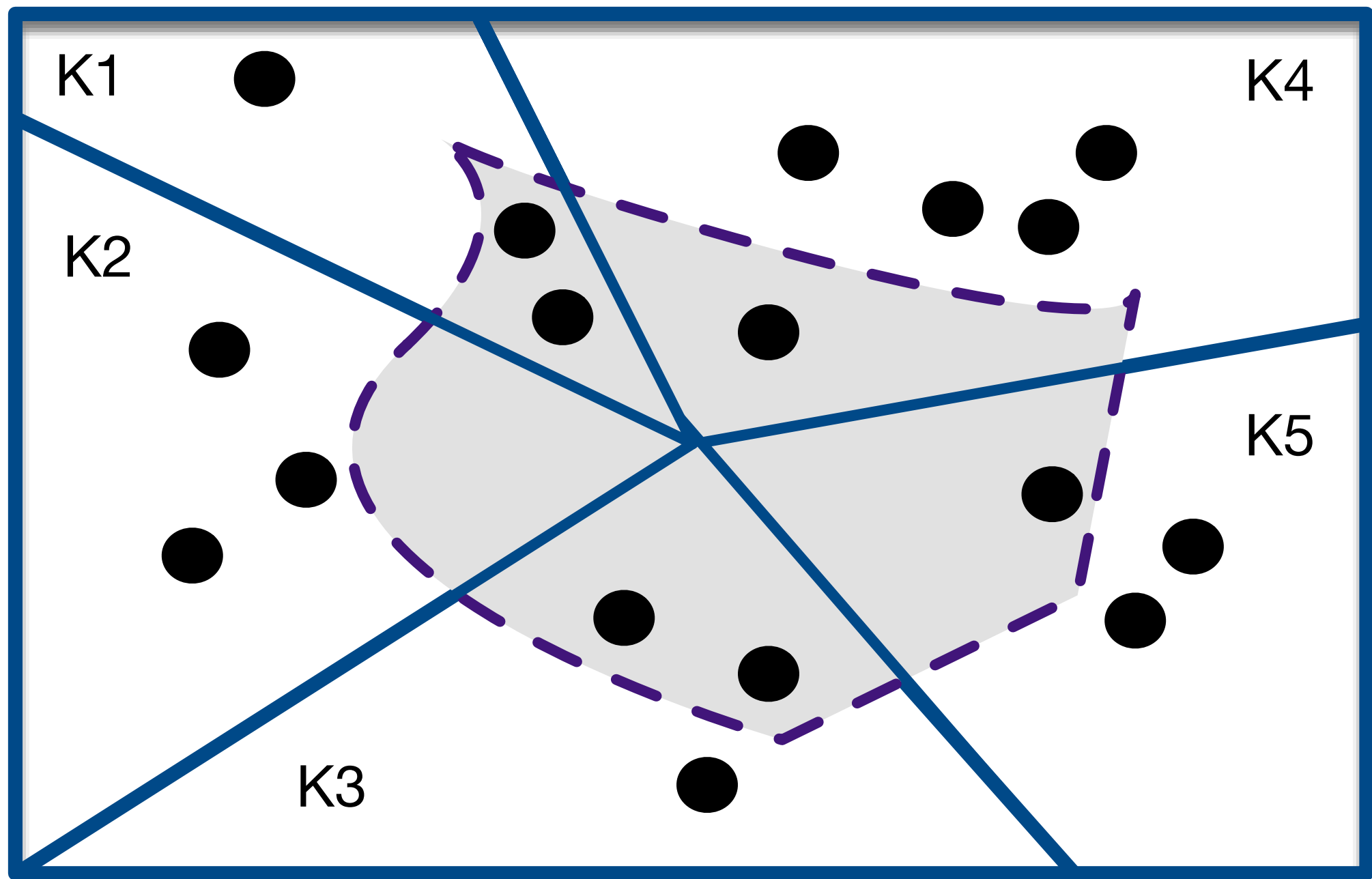
Rigid Mixins

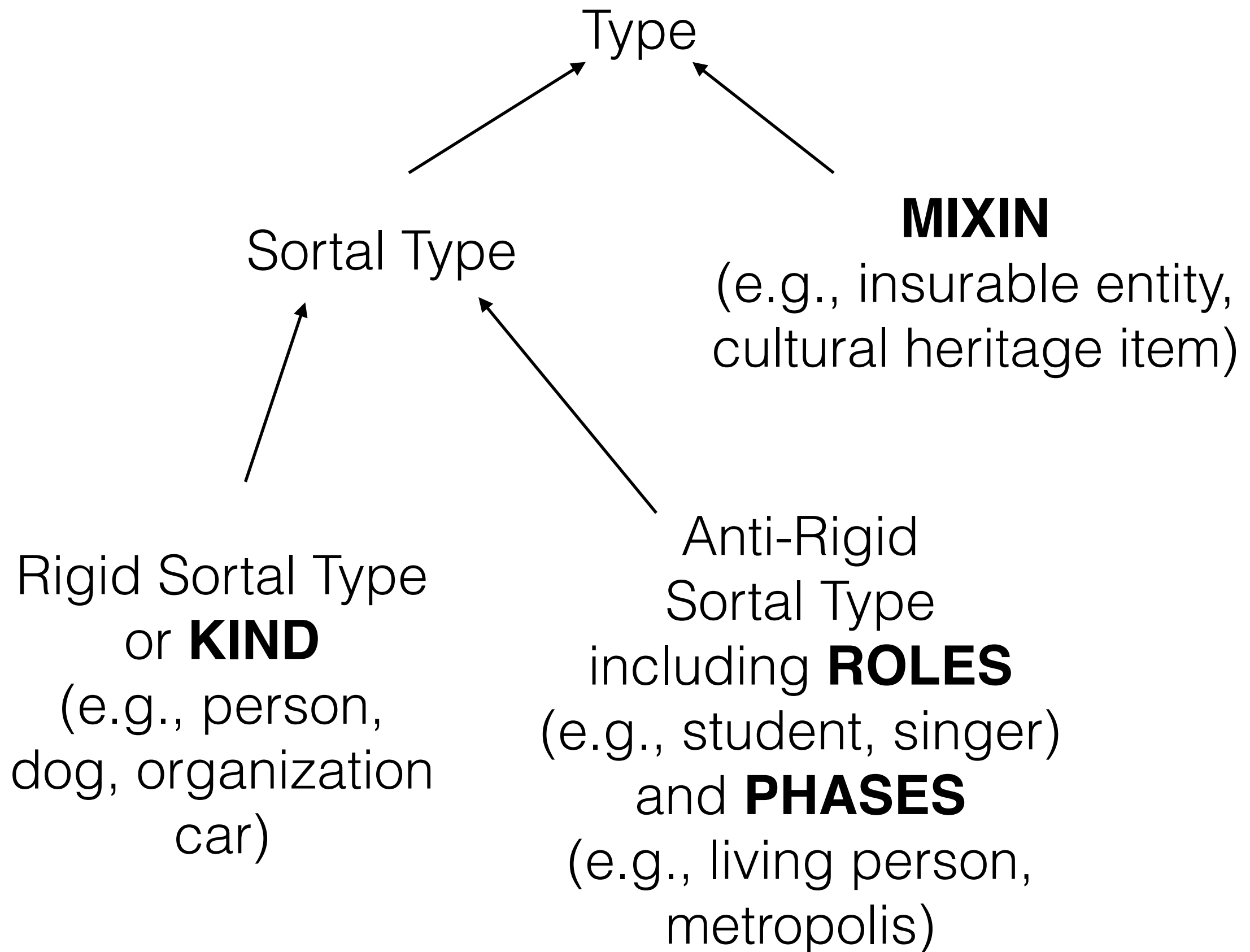


Anti-Rigid Mixins



Anti-Rigid Mixins



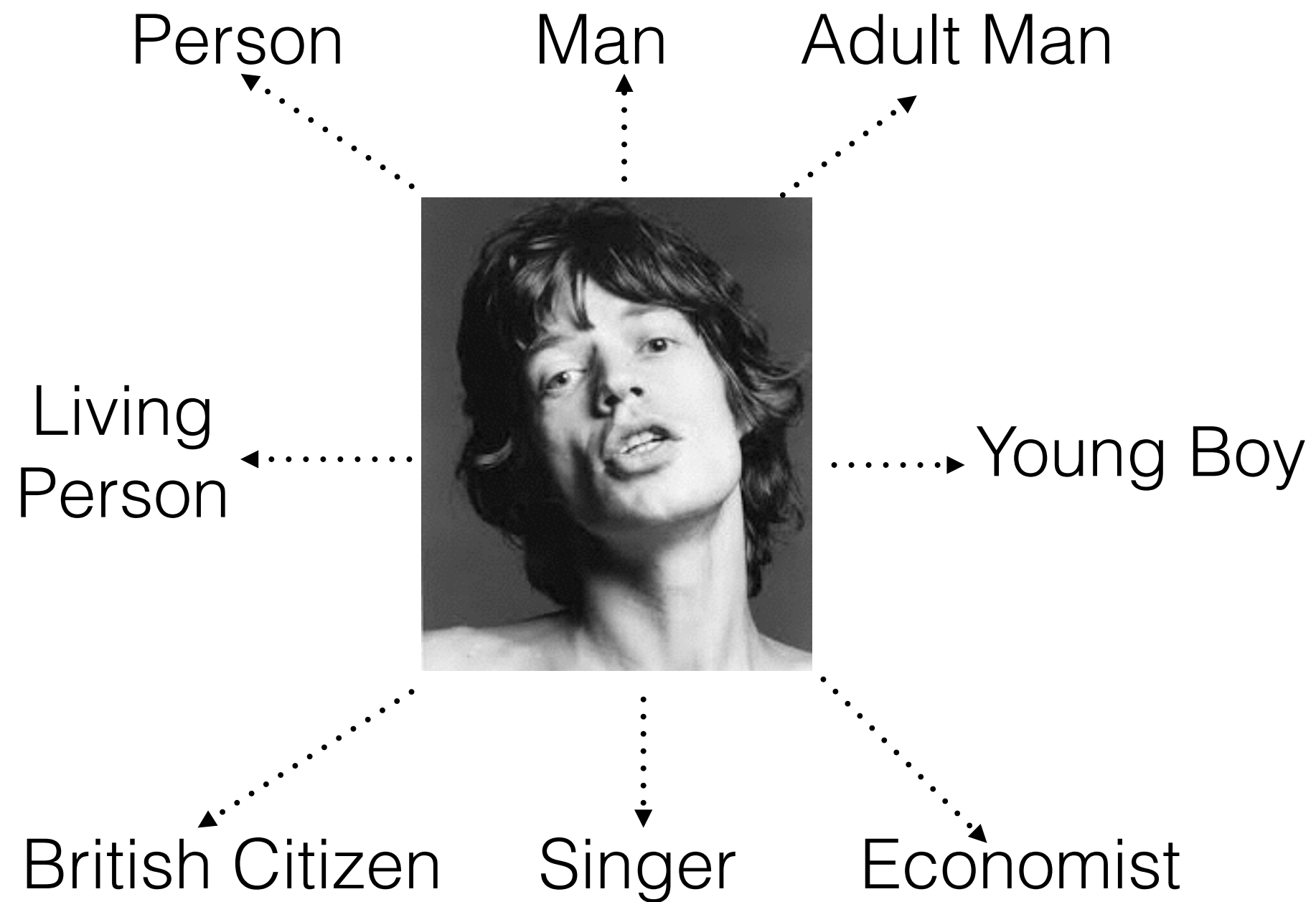












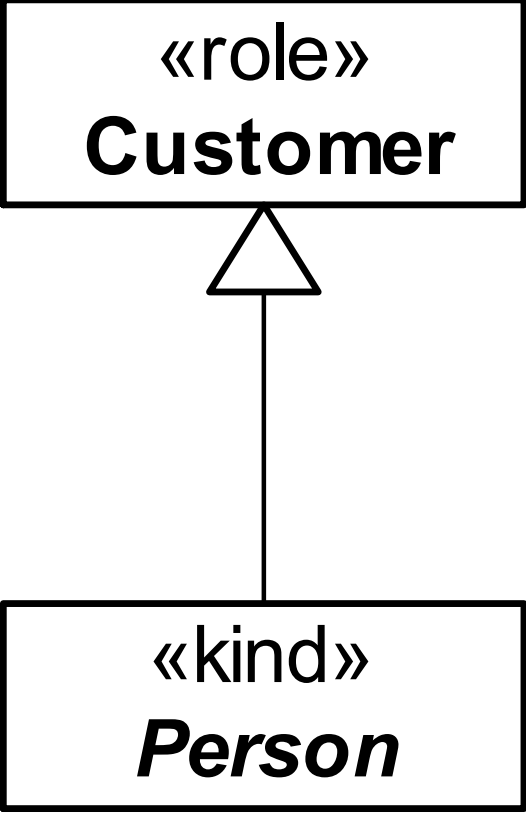
Solution

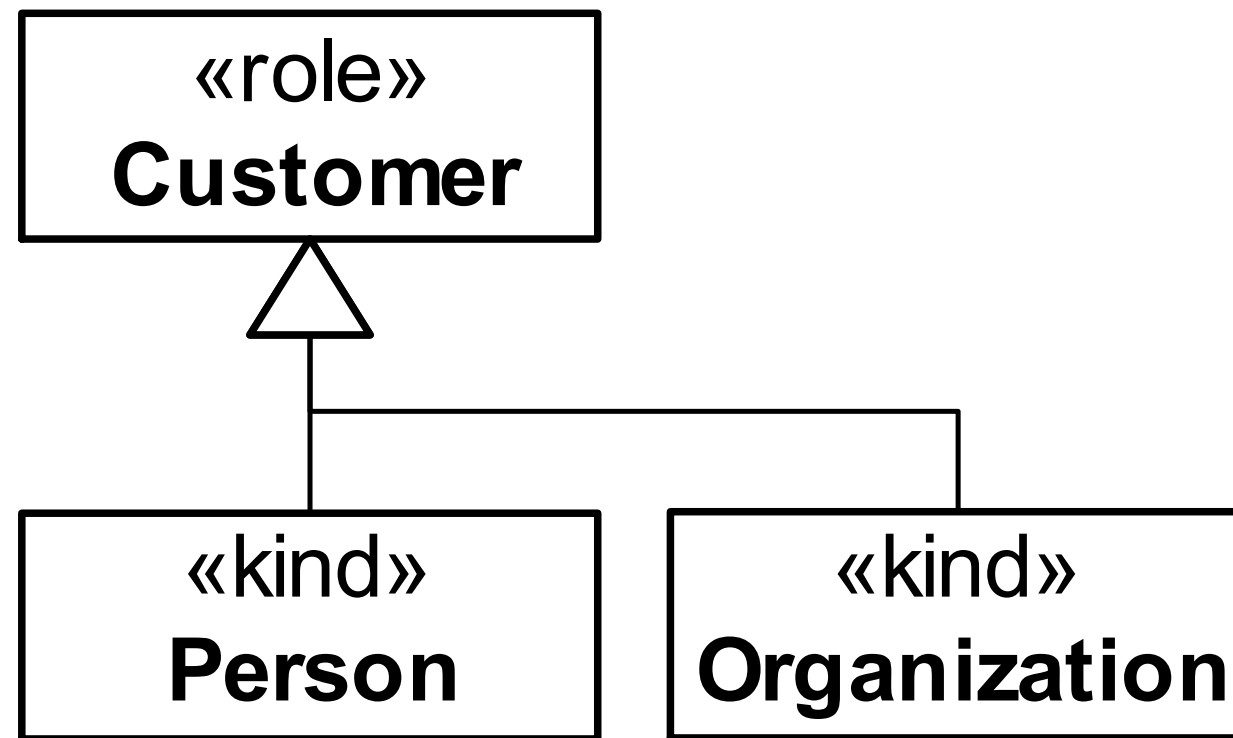
1. Characterizing the difference between:

- NATURAL TYPE/KIND (e.g., **PERSON**) = **RIGID SORTAL**
- ROLE (e.g., **SINGER, ECONOMIST, BRITISH CITIZEN, KNIGHT OF THE BRITISH EMPIRE**) = **ANTI-RIGID + RELATIONALLY DEPENDENT SORTAL**
- PHASE (e.g., **LIVING PERSON, ADULT MAN**) = **ANTI-RIGID + RELATIONALLY INDEPENDENT SORTAL**
- MIXIN (e.g., **CULTURAL HERITAGE ENTITY, PHYSICAL ENTITY, INSURABLE ITEM**)? = **MIXIN**

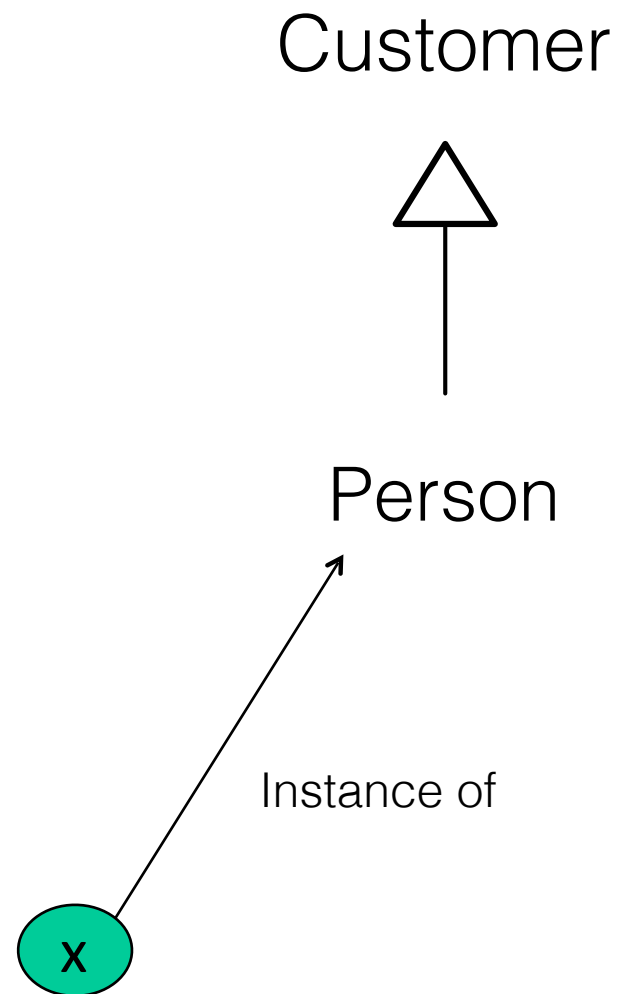
Role

- All instances of a given ROLE are of the same KIND (e.g., all Students are Person)
- All instances of a ROLE instantiate that type only contingently (e.g., no Student is necessarily a Student)
- Instances of a KIND instantiate that ROLE when participating in a certain RELATIONAL CONTEXT (e.g., instances of Person instantiate the Role Student when enrolled in an Educational Institution)
- **A ROLE cannot be a supertype of a Rigid Type**

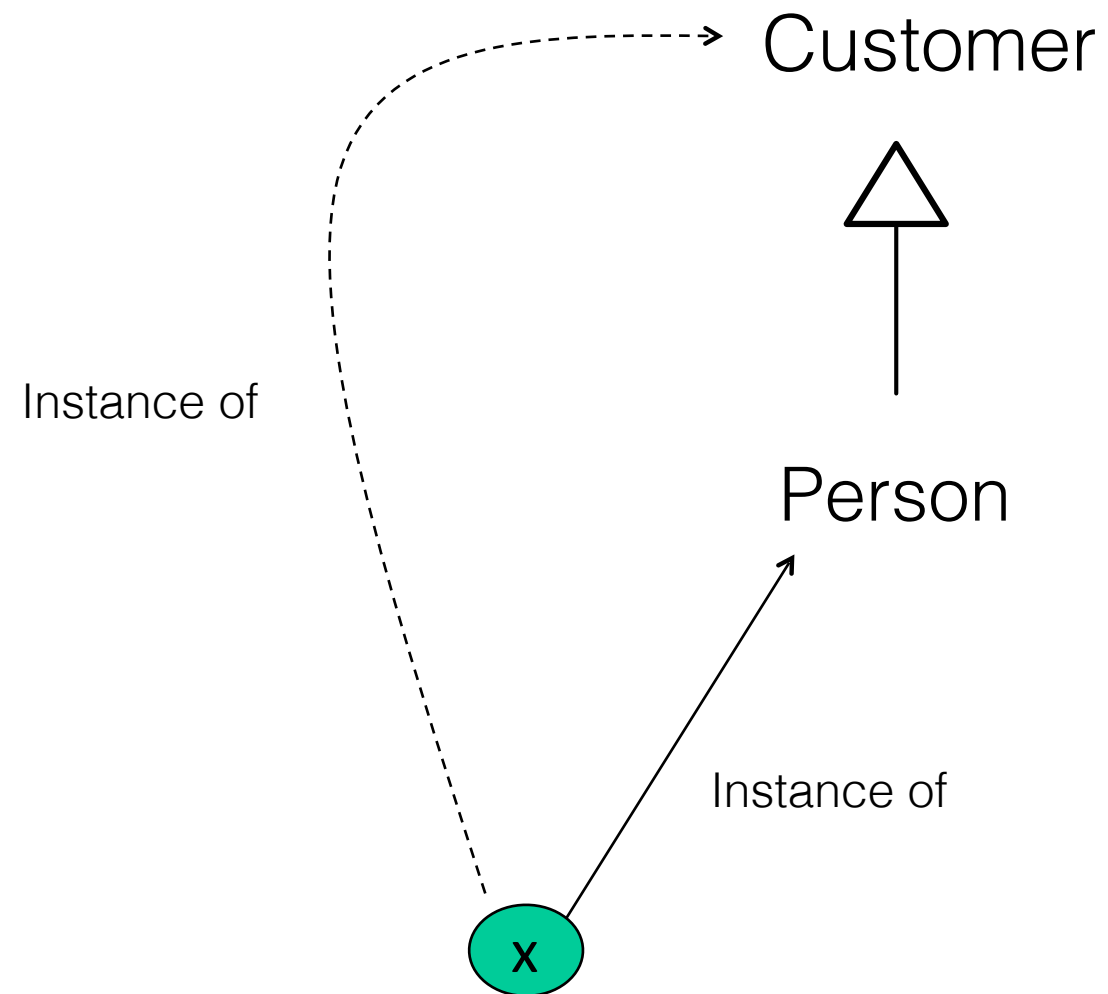




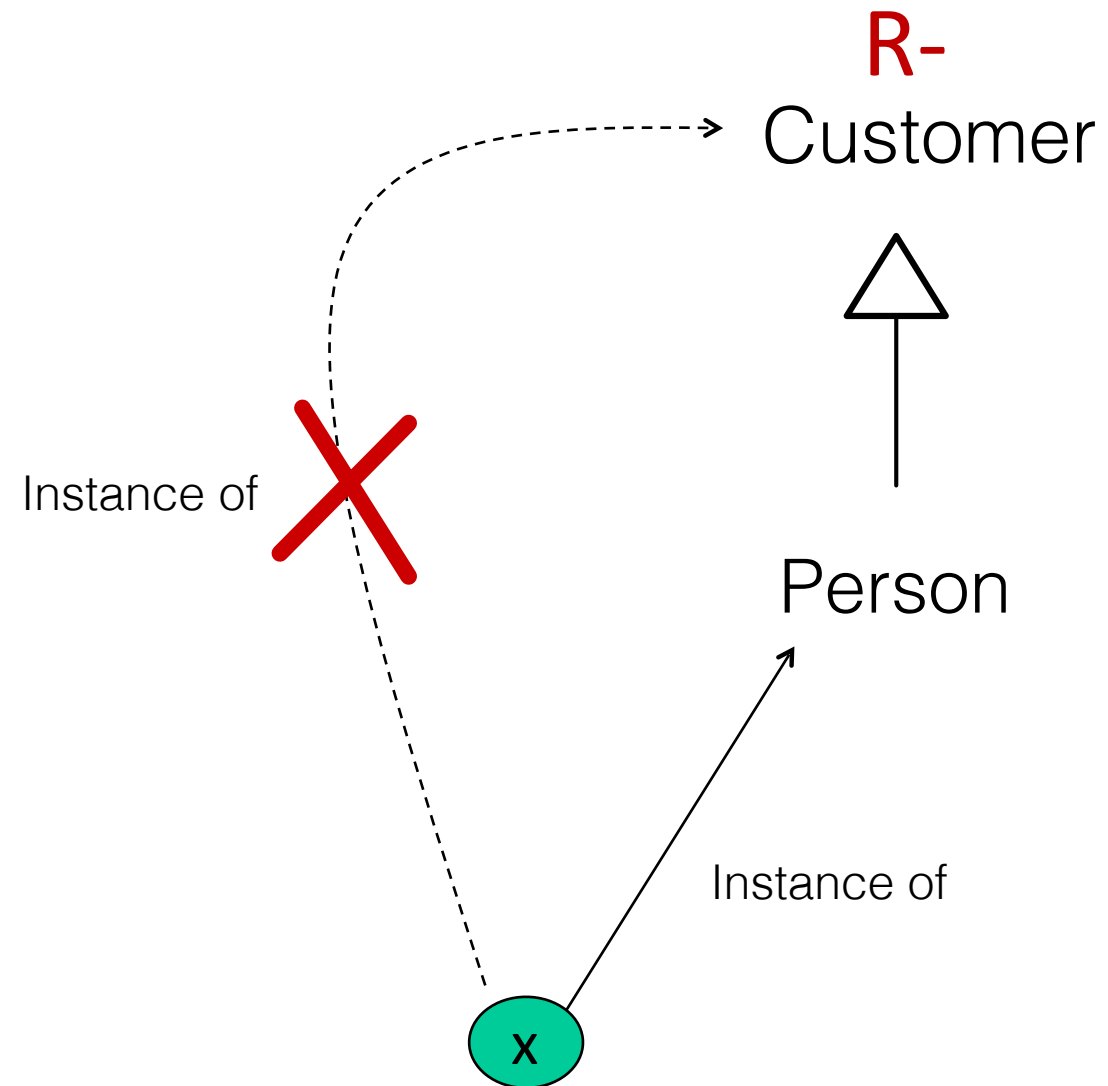
WORLD W



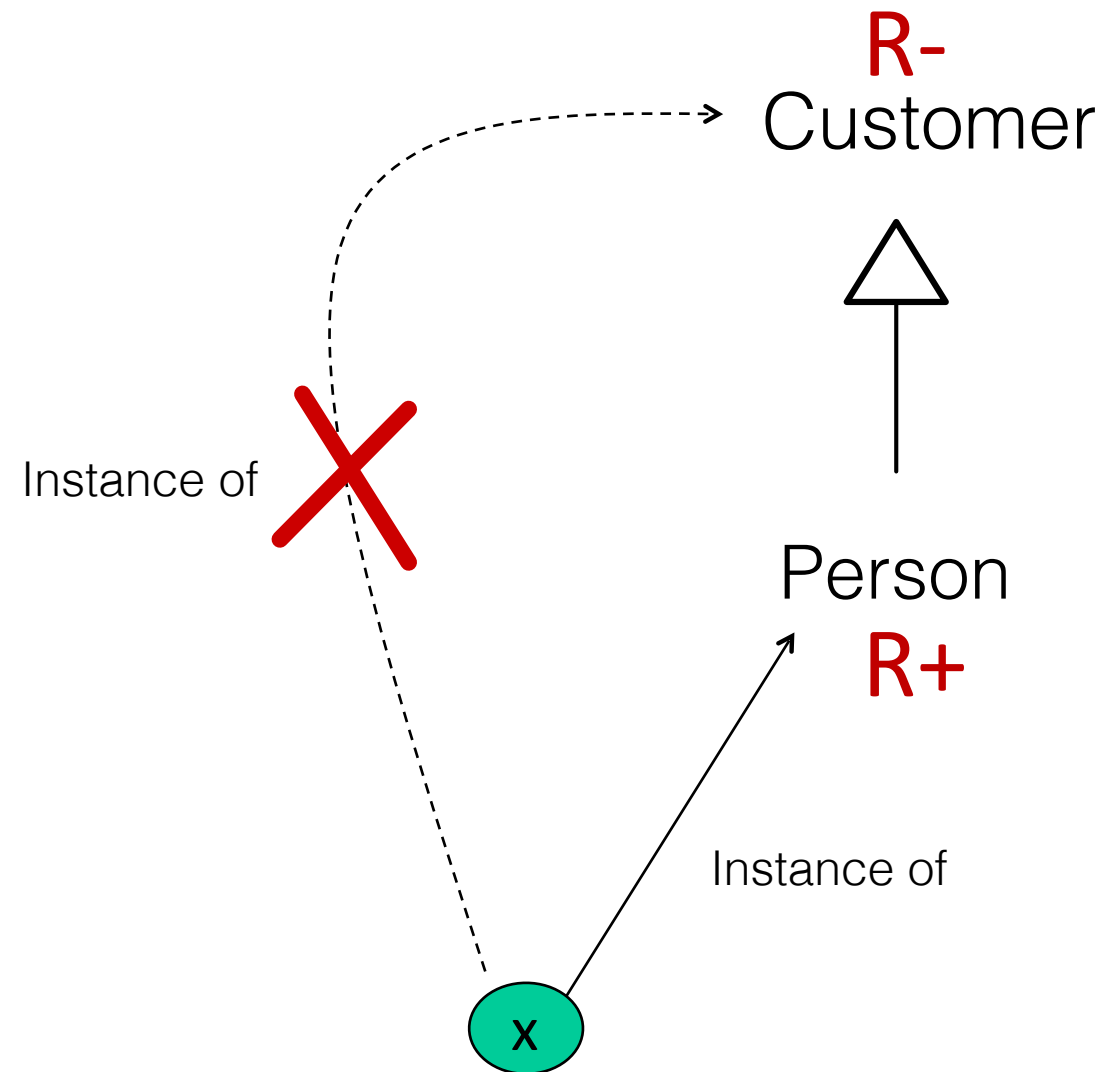
WORLD W



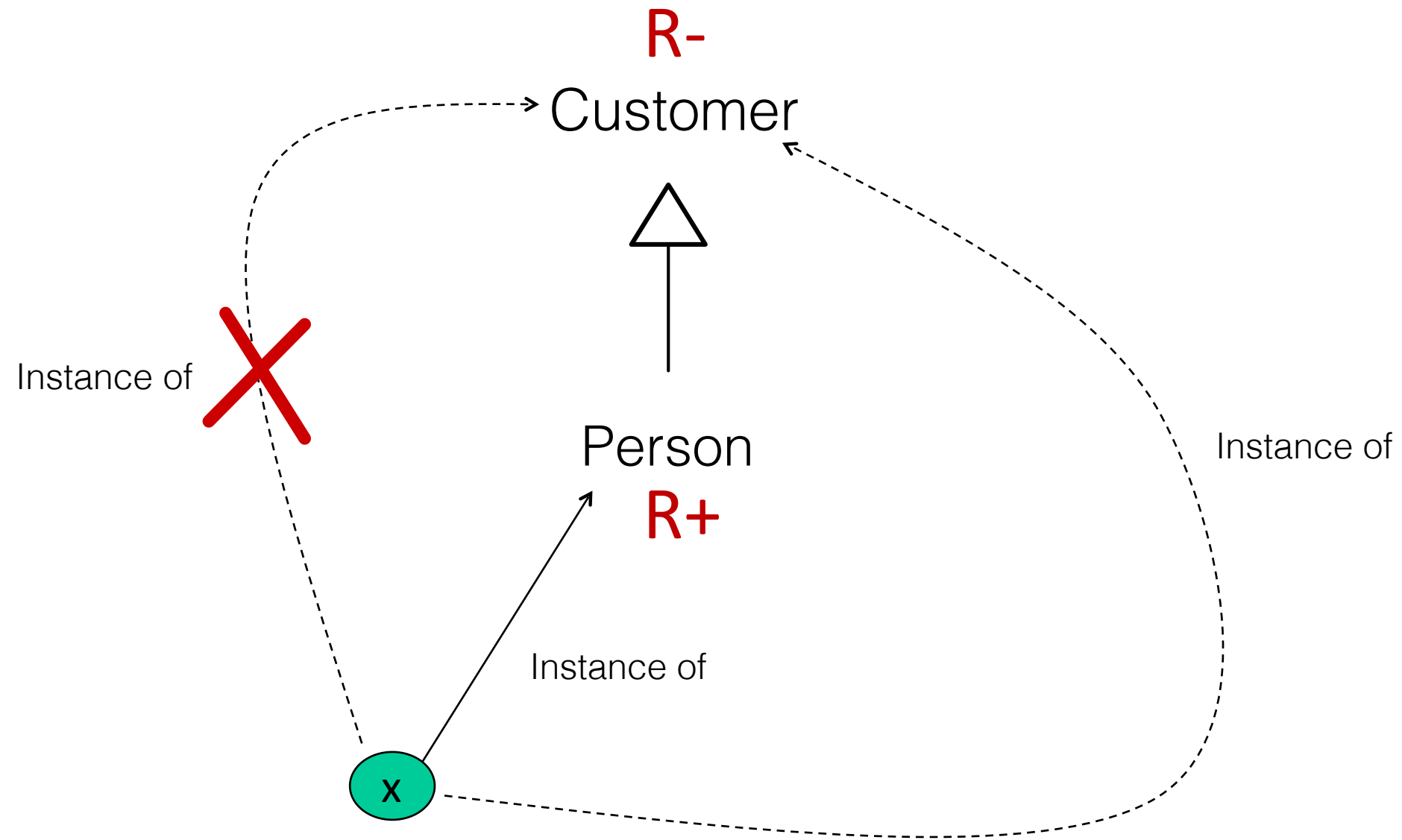
WORLD W'



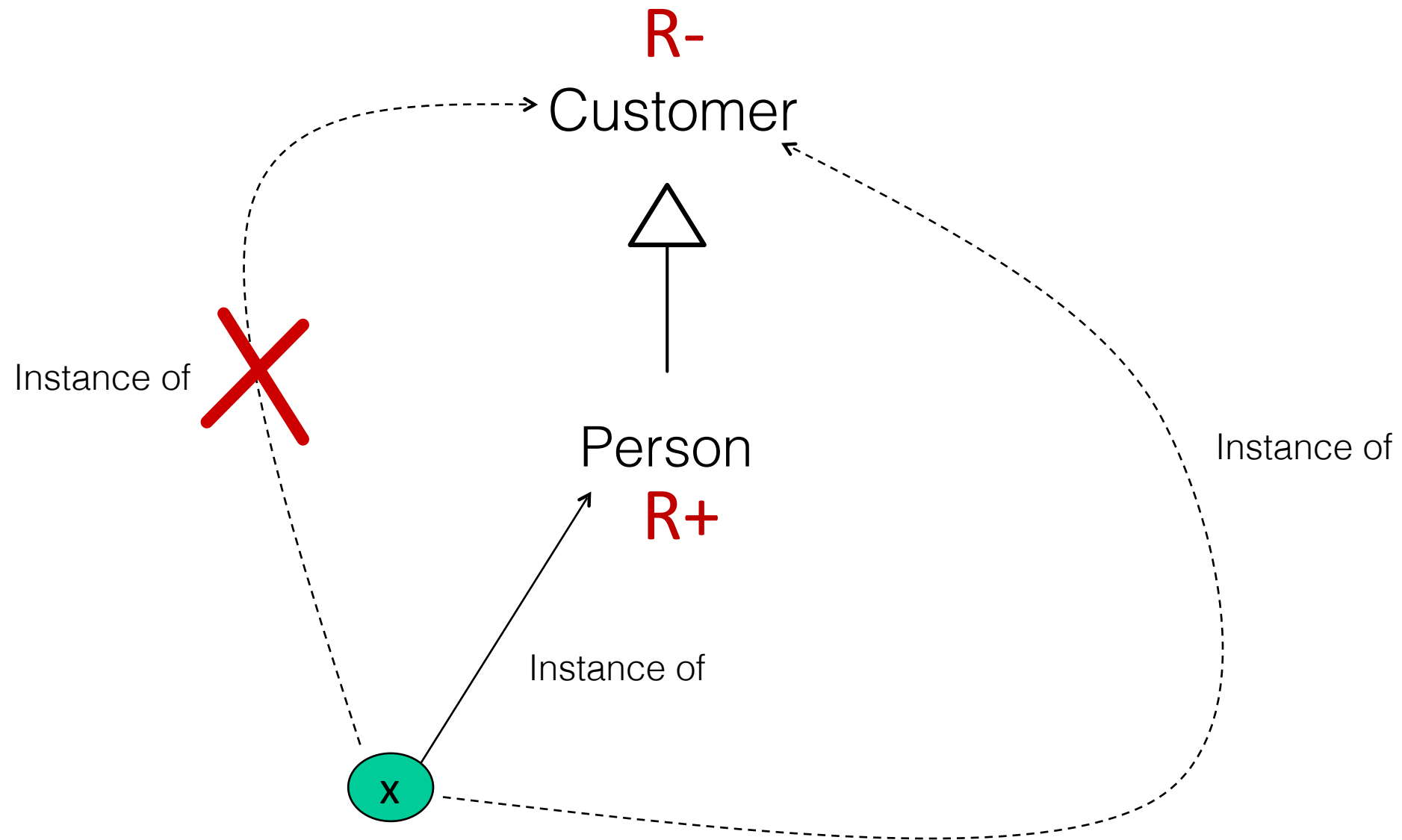
WORLD W'



WORLD W'



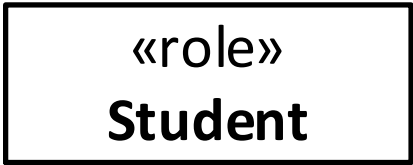
WORLD W'



We run into a logical contradiction!

Role

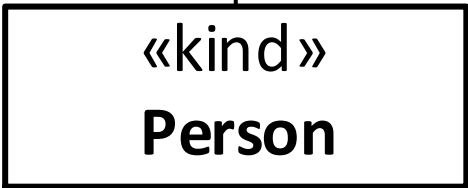
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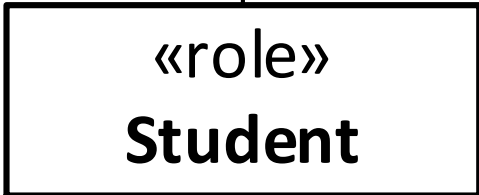
NO!



NO!



NO!



enrolled at



0..n



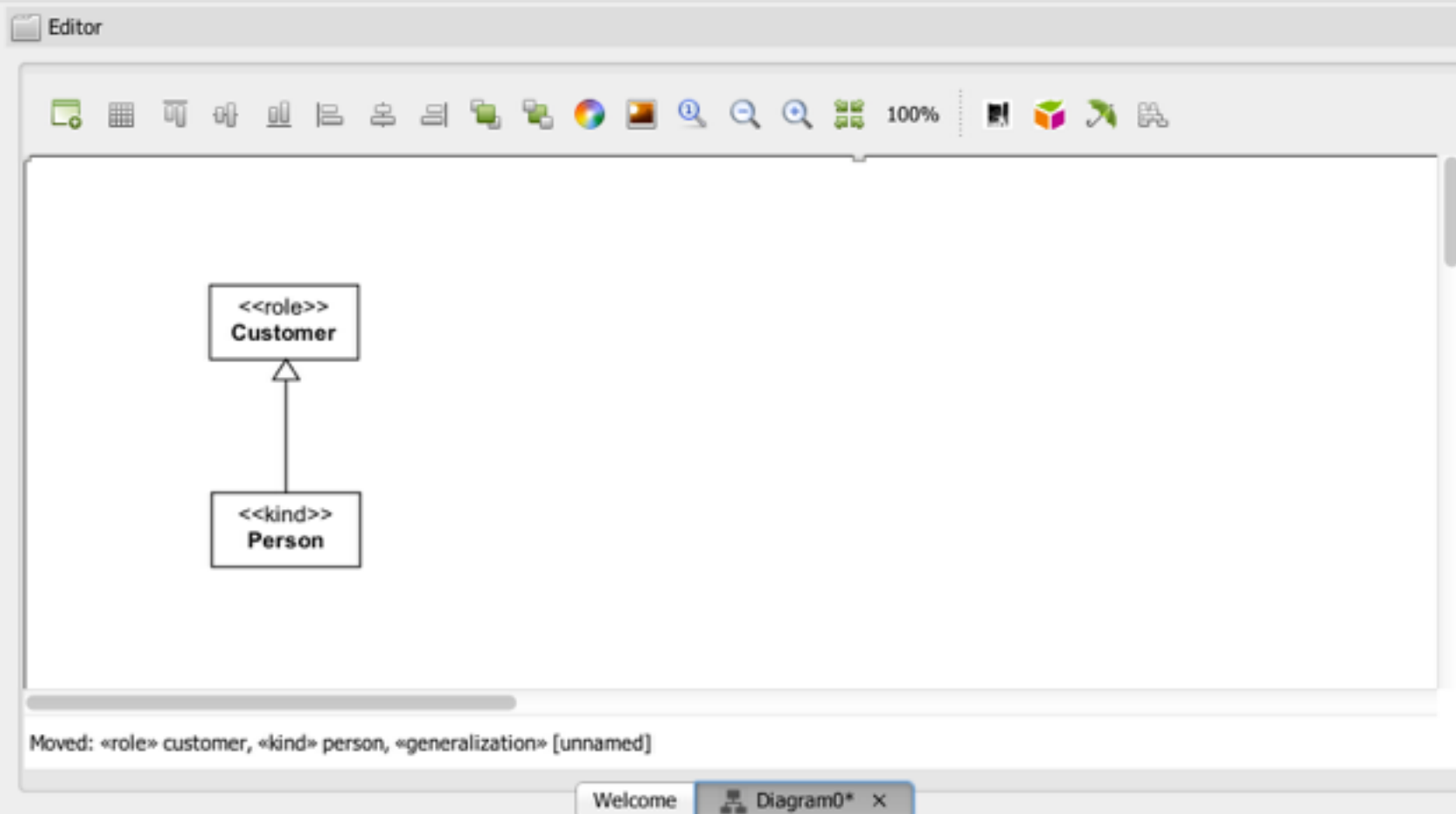
Toolbox

Elements

- Nominal Quality
- Non Perceivable Quality
- Perceivable Quality
- Phase
- Primitive Type
- Quantity
- Relator
- Role
- Role Mixin
- SubKind
- Association
- Characterization
- ComponentOf
- Derivation
- Formal
- Generalization
- Material
- Mediation
- MemberOf
- Structuration
- SubCollectionOf
- SubQuantityOf

Patterns

Derived Patterns



Information Footer

Type	Description	Stereotype	Element	Location
Syntactical	01. A RigidSortalClass cannot have an Anti-Rigid parent (role, phase, role...	Kind	Person	Model::Person
Syntactical	02. A Role must be connected (directly or indirectly) to a Mediation	Role	Customer	Model::Customer
Syntactical	03. Every non abstract Sortal must have a Substance Sortal ancestor (or be...	Role	Customer	Model::Customer

Model verified in 1,874 ms, 3 error(s) found

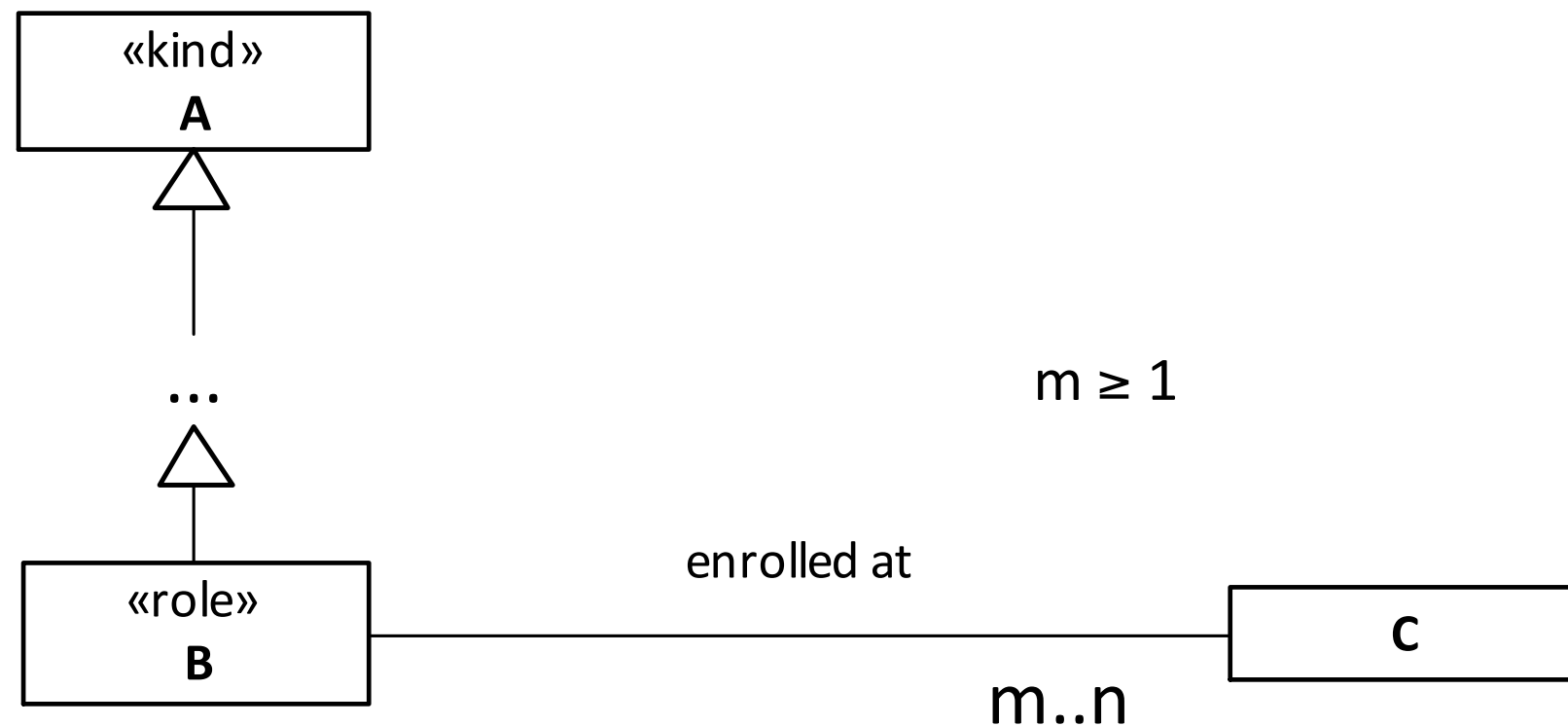
Messages Console Problems x Warnings x

Project Browser

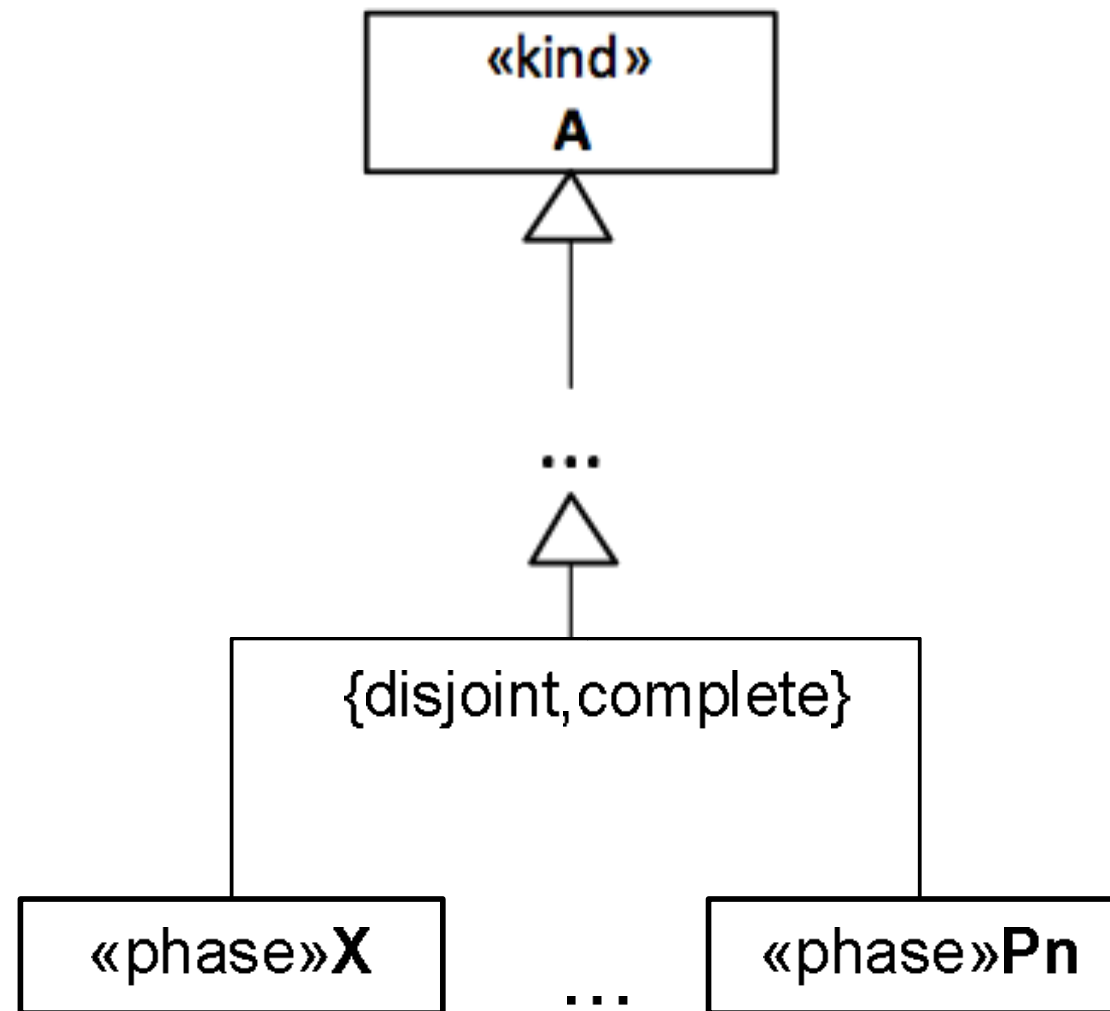
- OLED Project
 - Diagrams
 - Constraints
 - Model
 - «Role» Customer
 - «Kind» Person
 - Generalization Customer



The Emerging **Role** Pattern



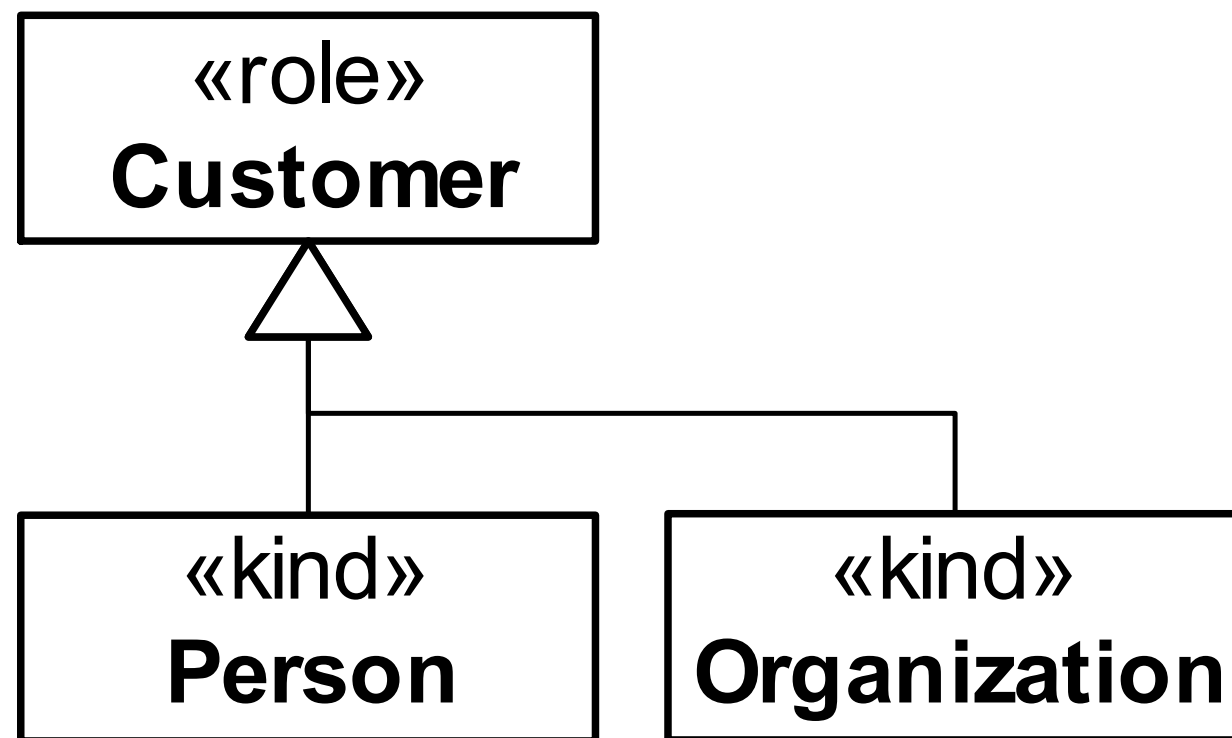
The Emerging **Phase** Pattern

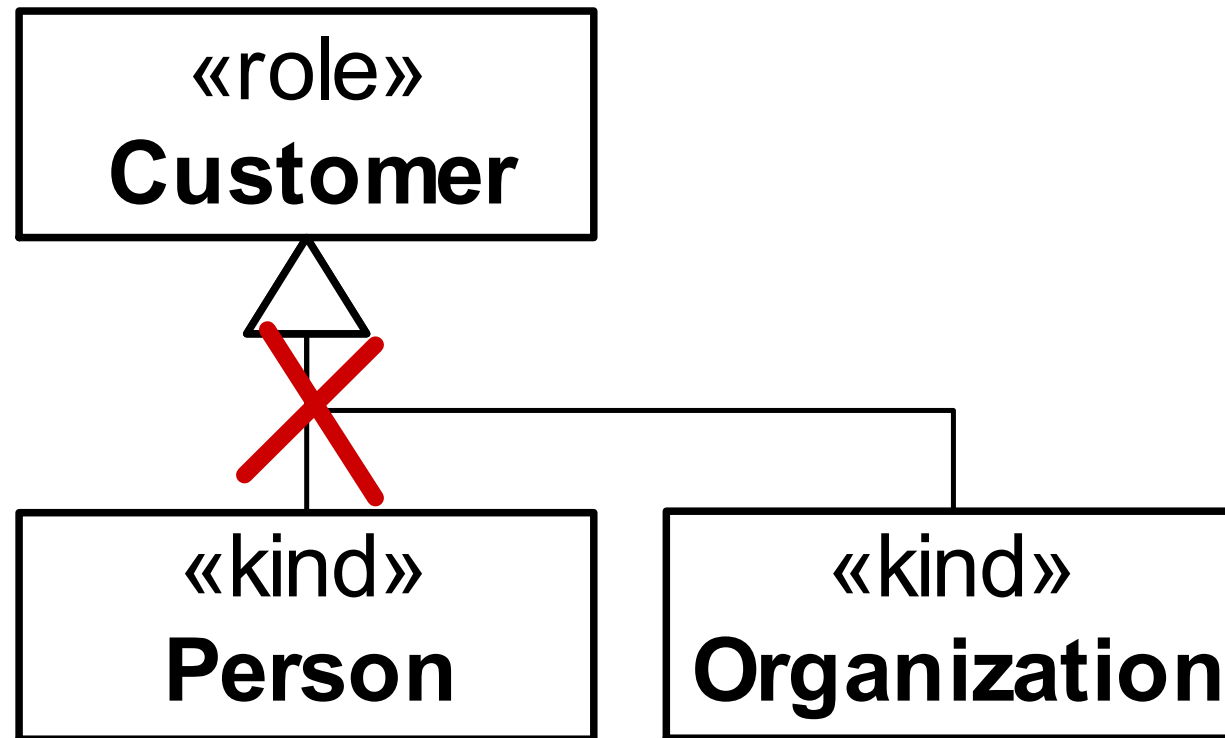


Problem (2)

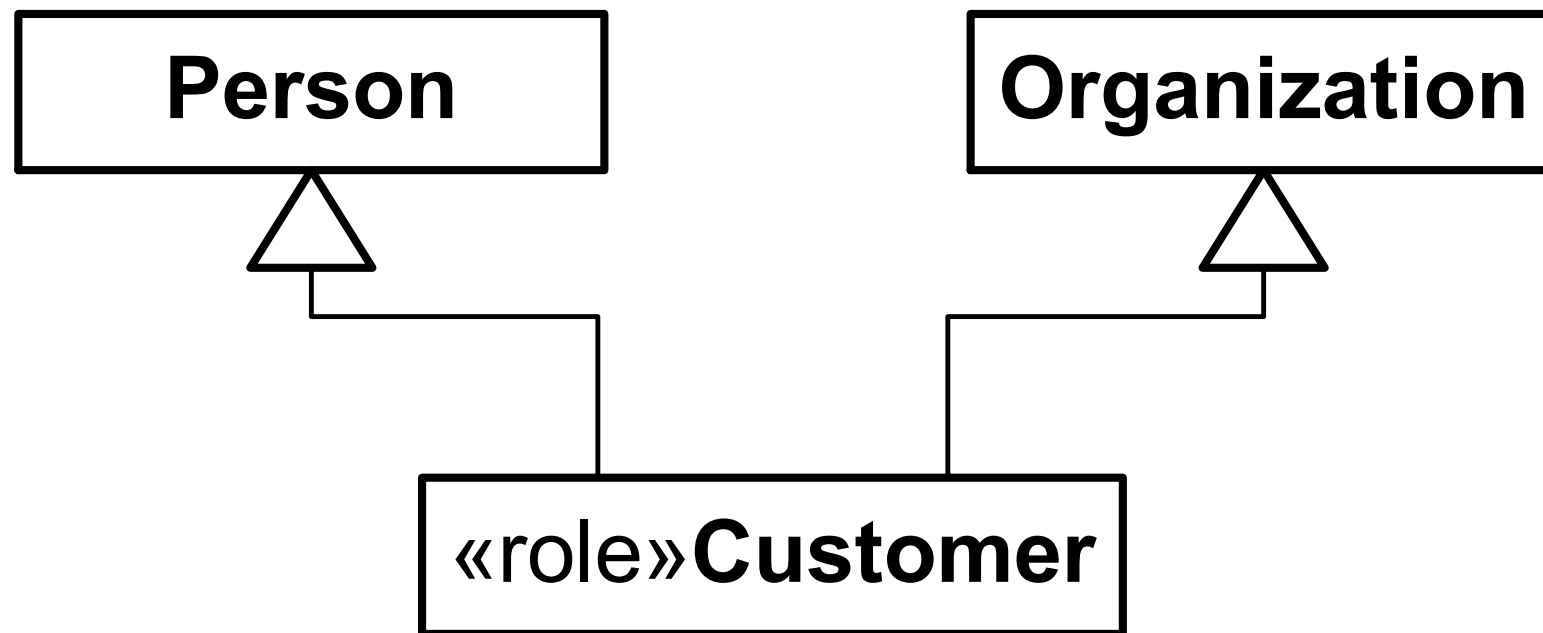
1. Suppose that I want to represent that the ROLE Customer can be played by entities of different KINDS, namely, People and Organizations. How to relate the ROLE and its *allowed types* using subtyping relations?

A Classic Problem

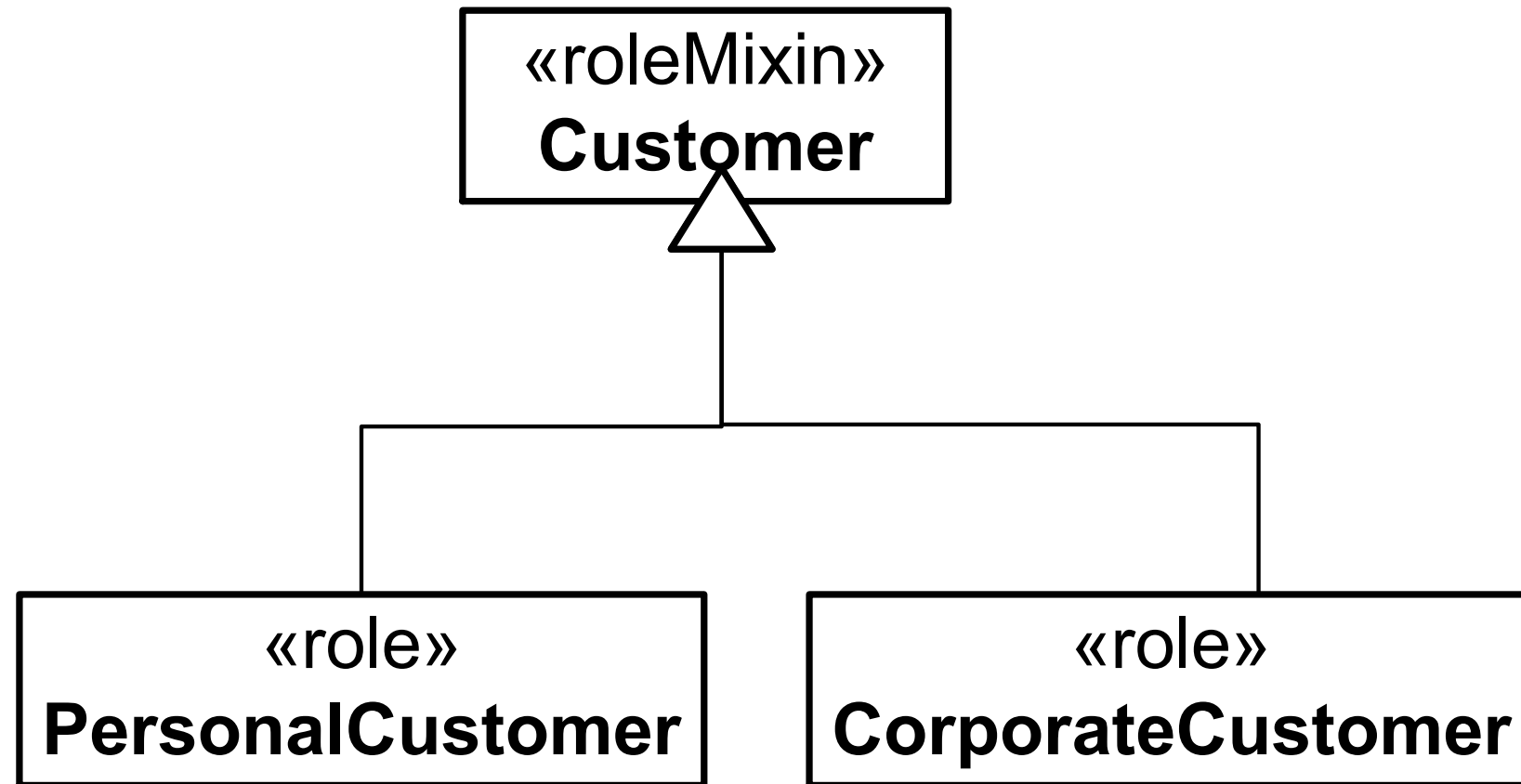


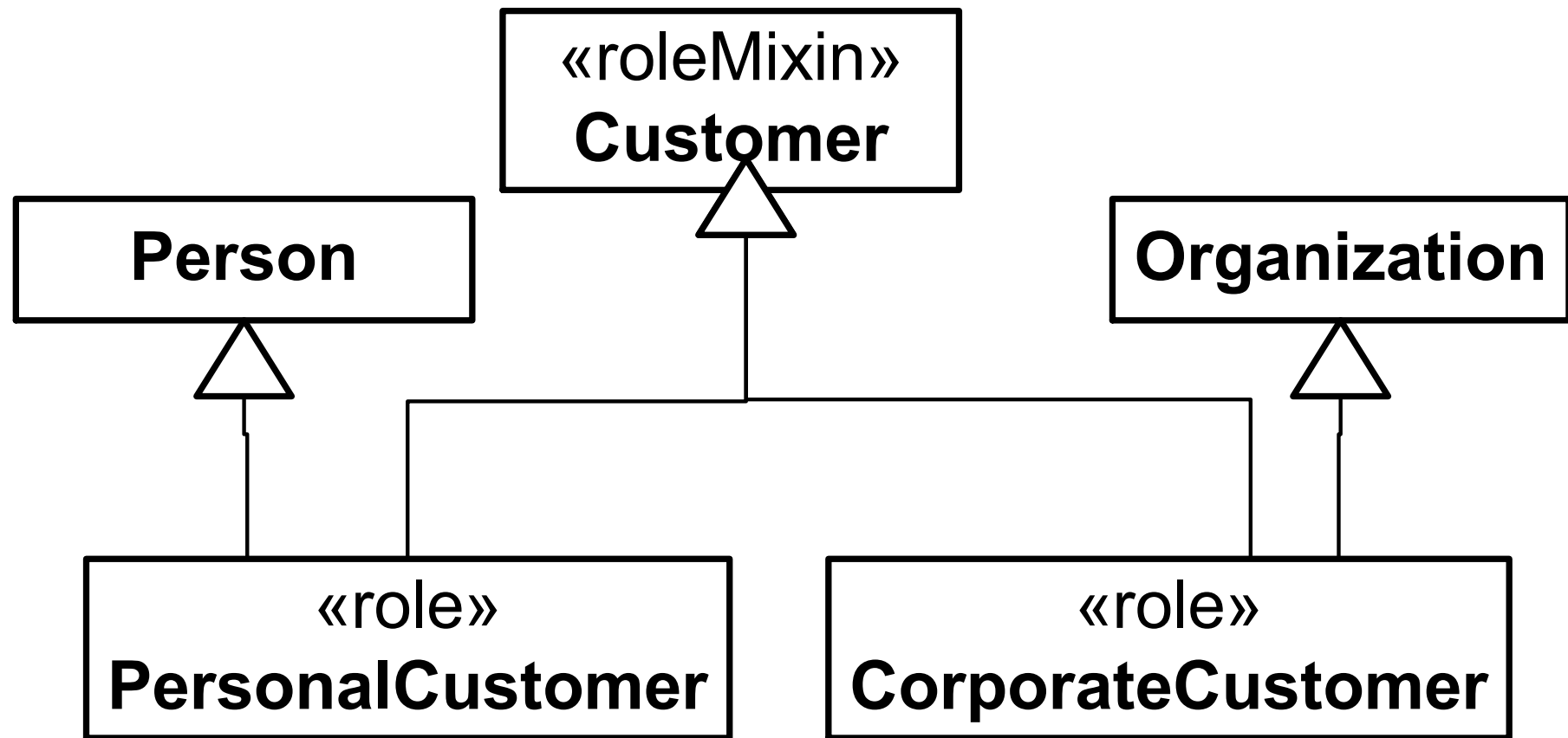


A Possible Alternative?

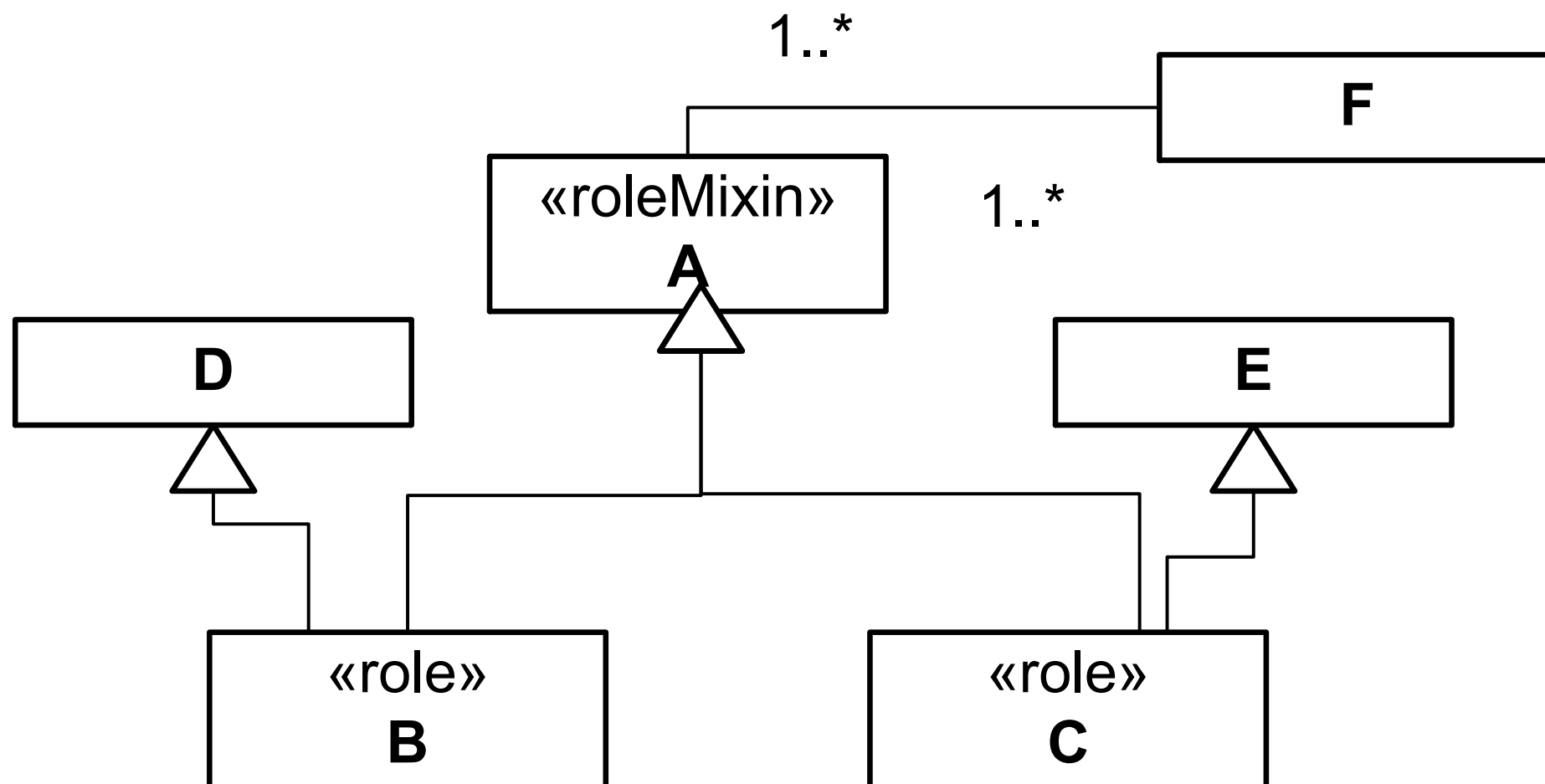


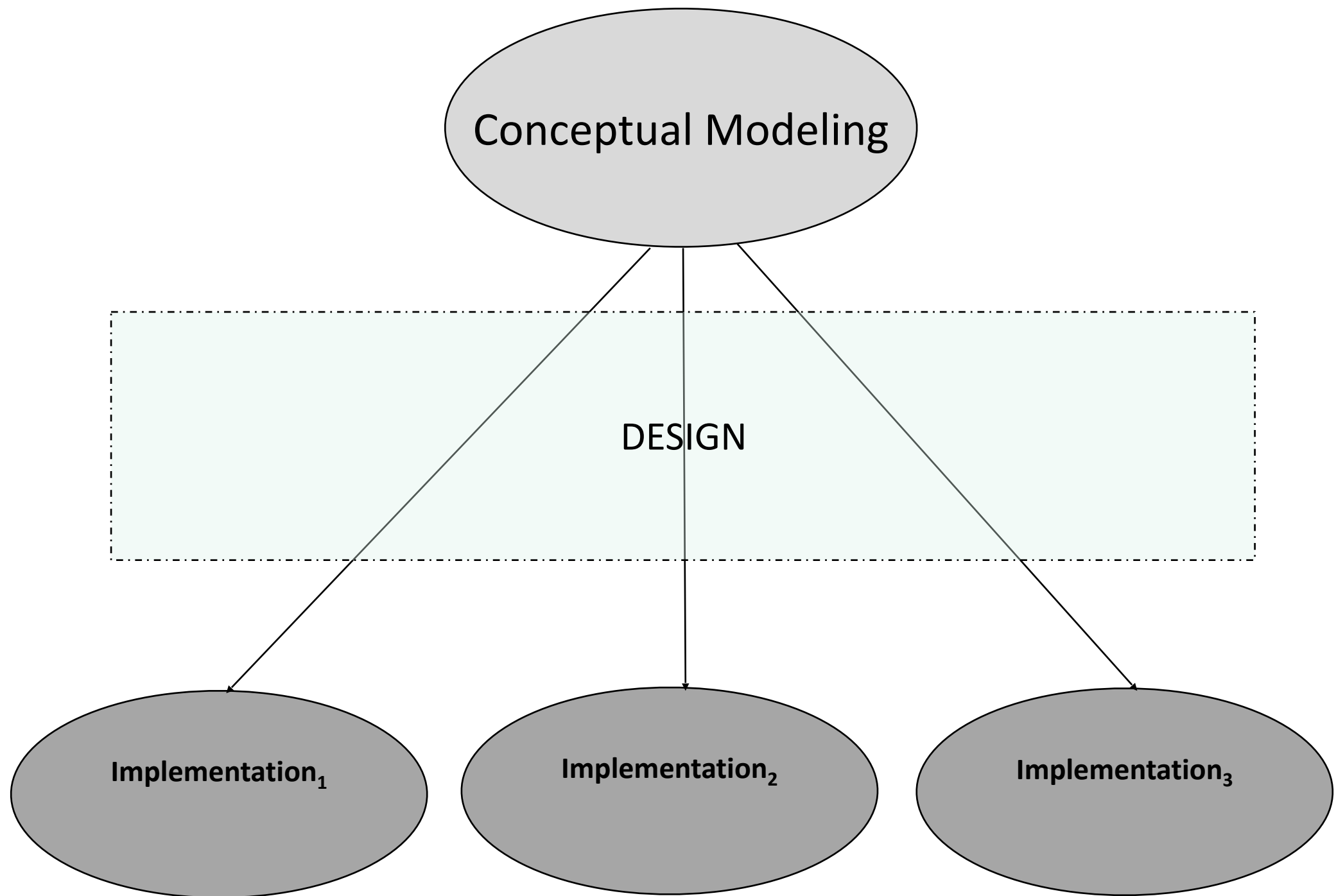
«roleMixin»
Customer

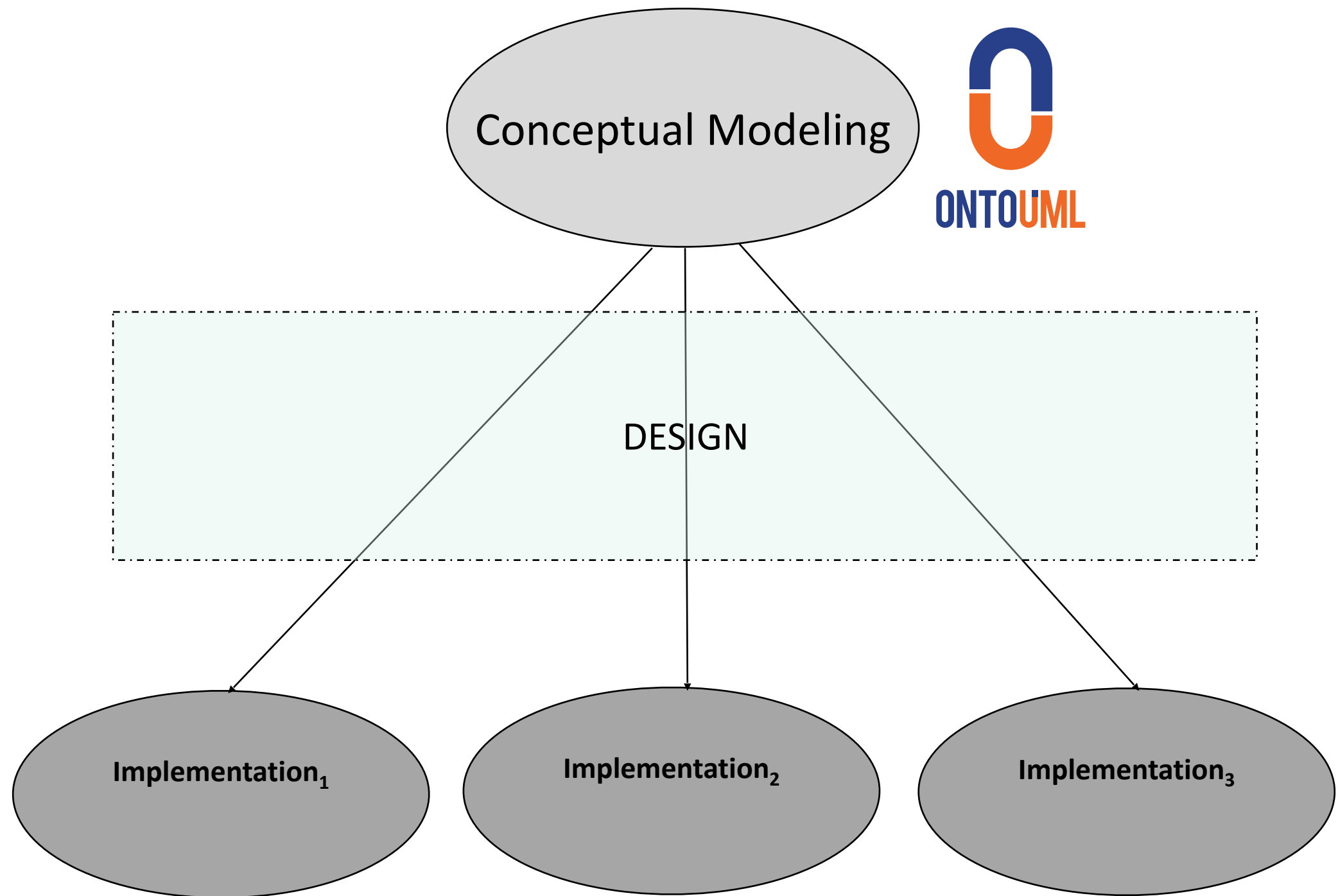


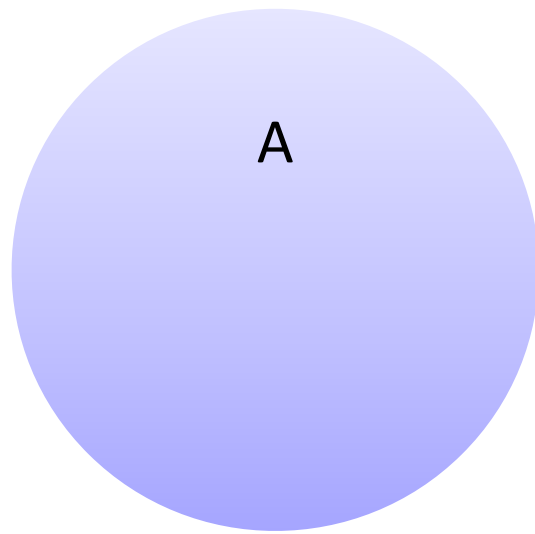


The emerging **RoleMixin** Pattern

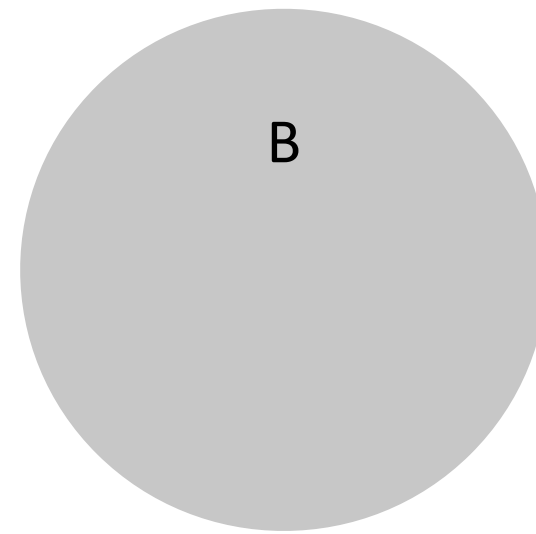






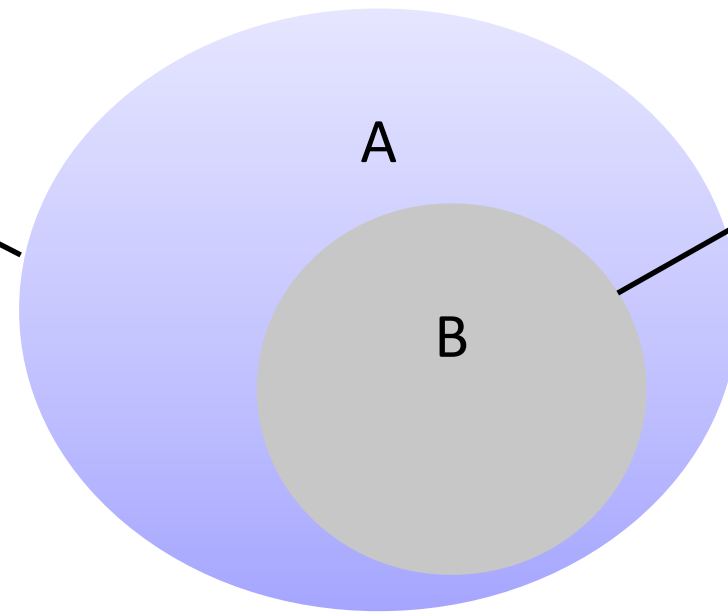


Valid state of affairs
according to the representation



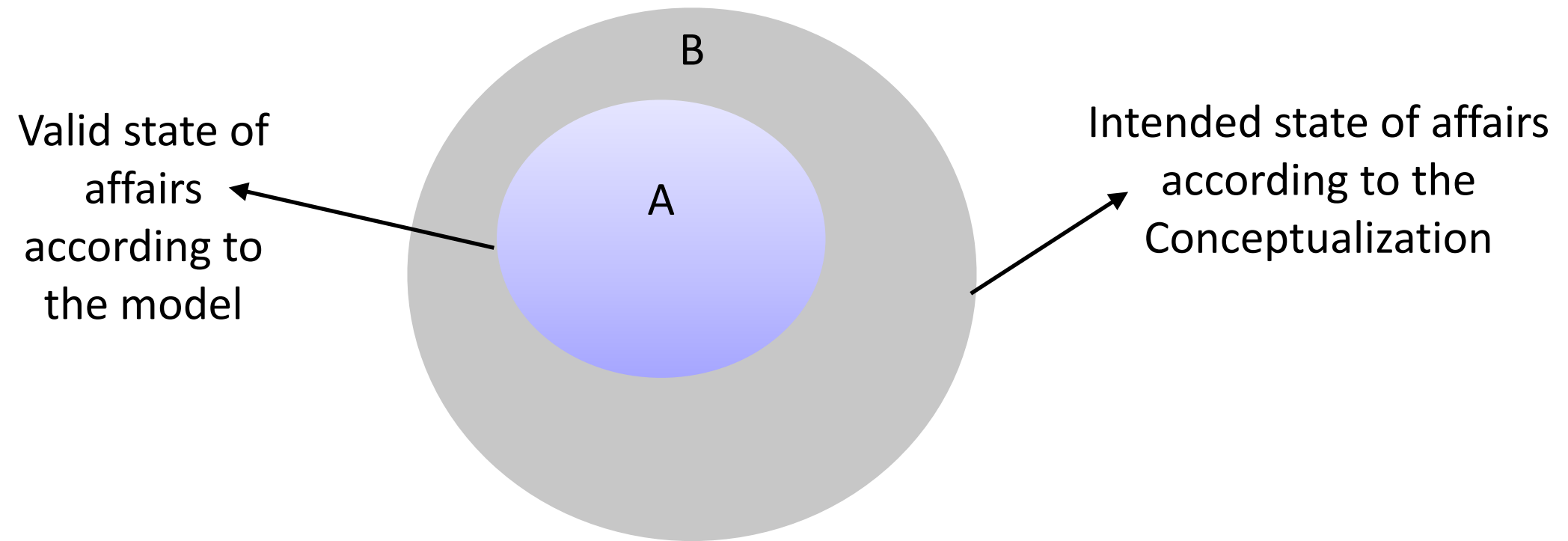
Intended state of affairs
according to the Conceptualization

Valid state of
affairs
according to
the model

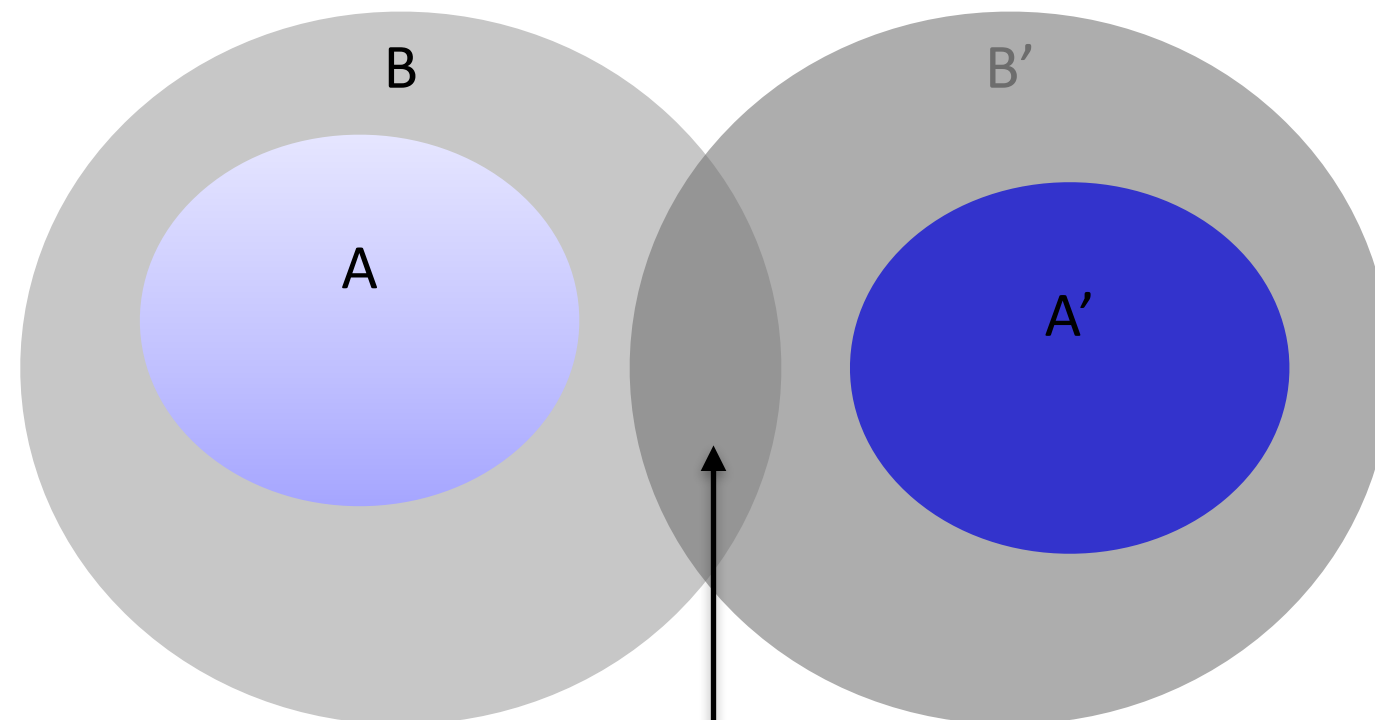


Intended state of affairs
according to the
Conceptualization

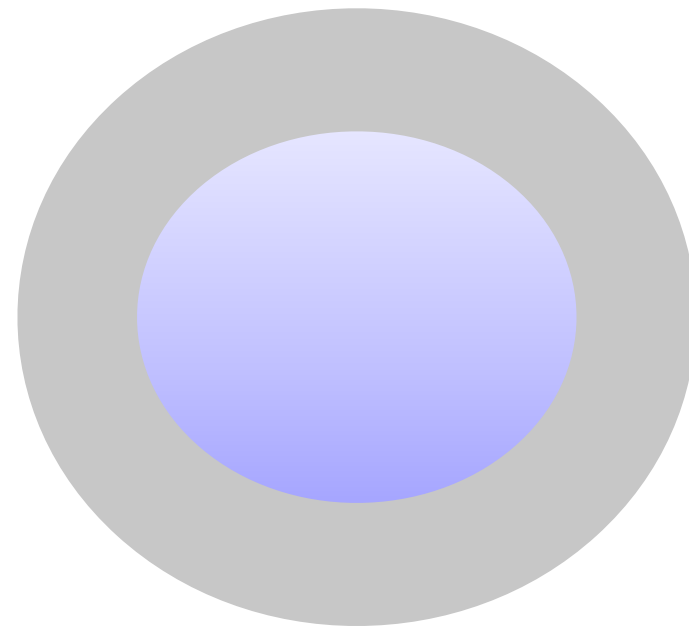
Under-constraining



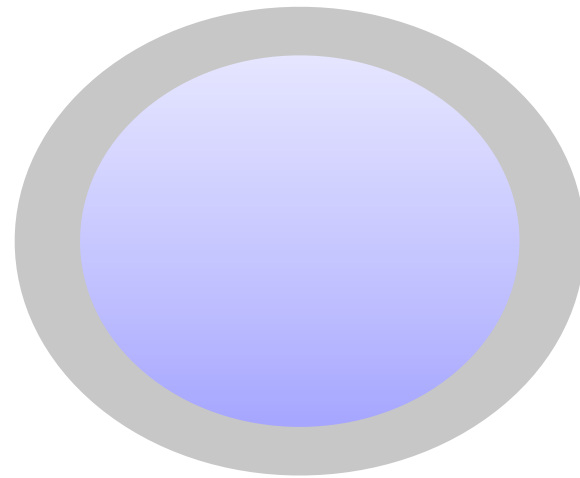
Over-constraining



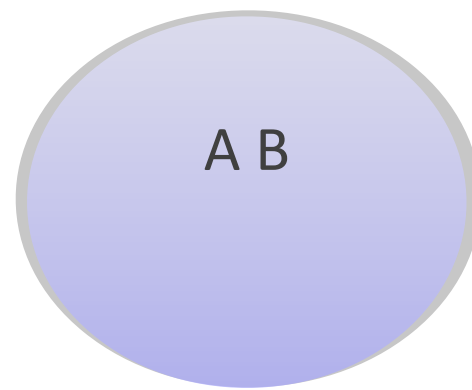
False Agreement



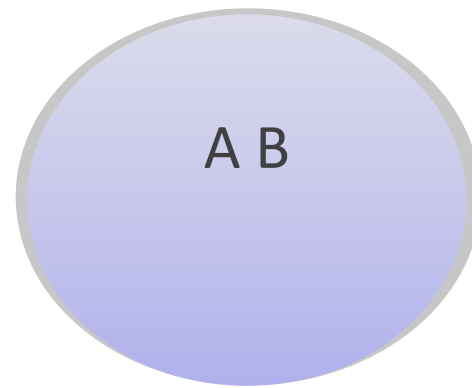
Constraints



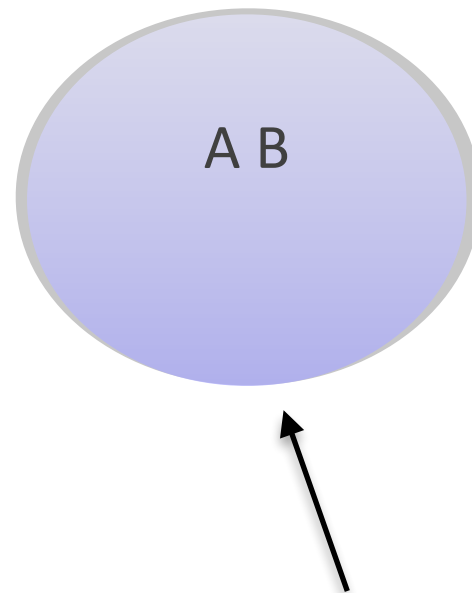
Constraints



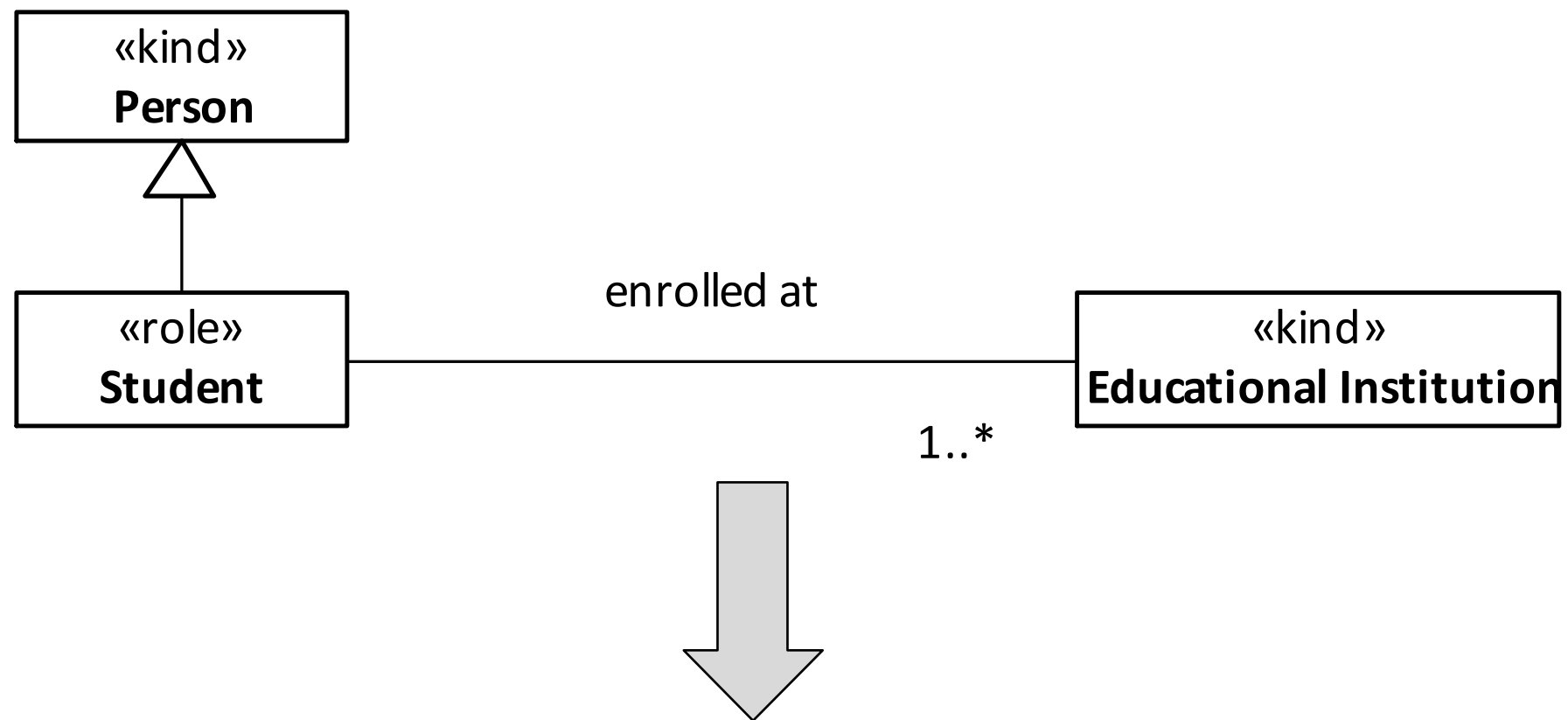
Constraints



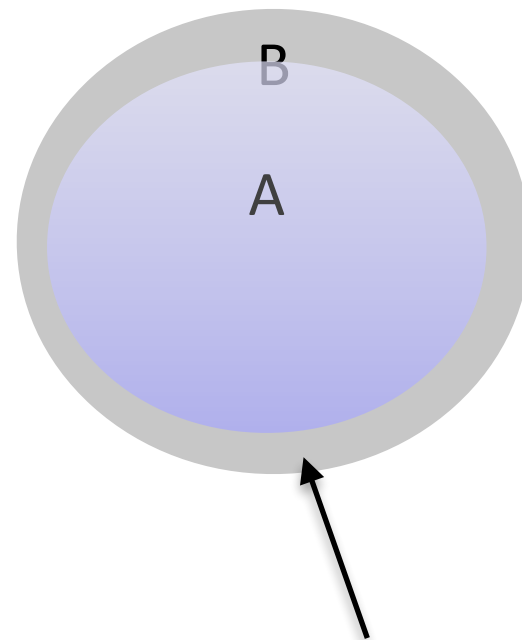
Conceptual Model = Structure + Axiomatization



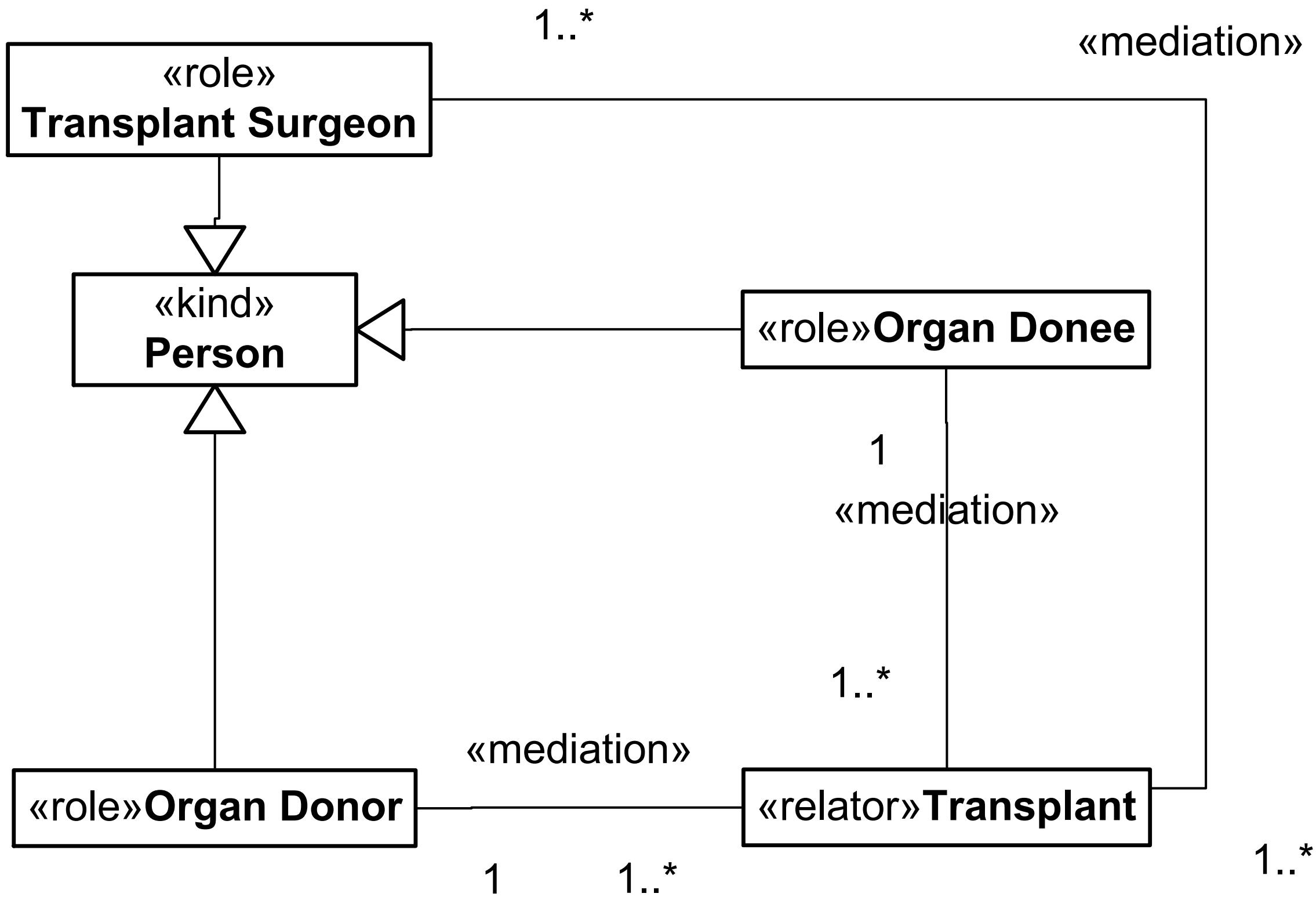
Conceptual Model = Structure + Axiomatization
(Ontological Commitment)

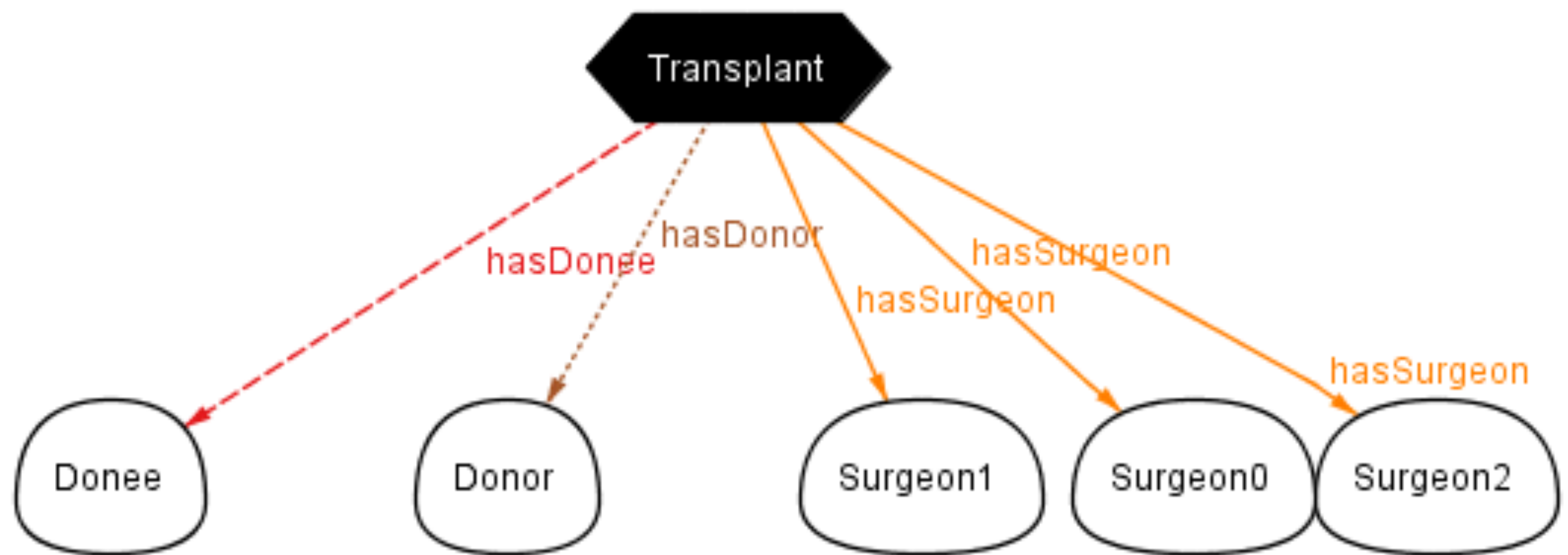


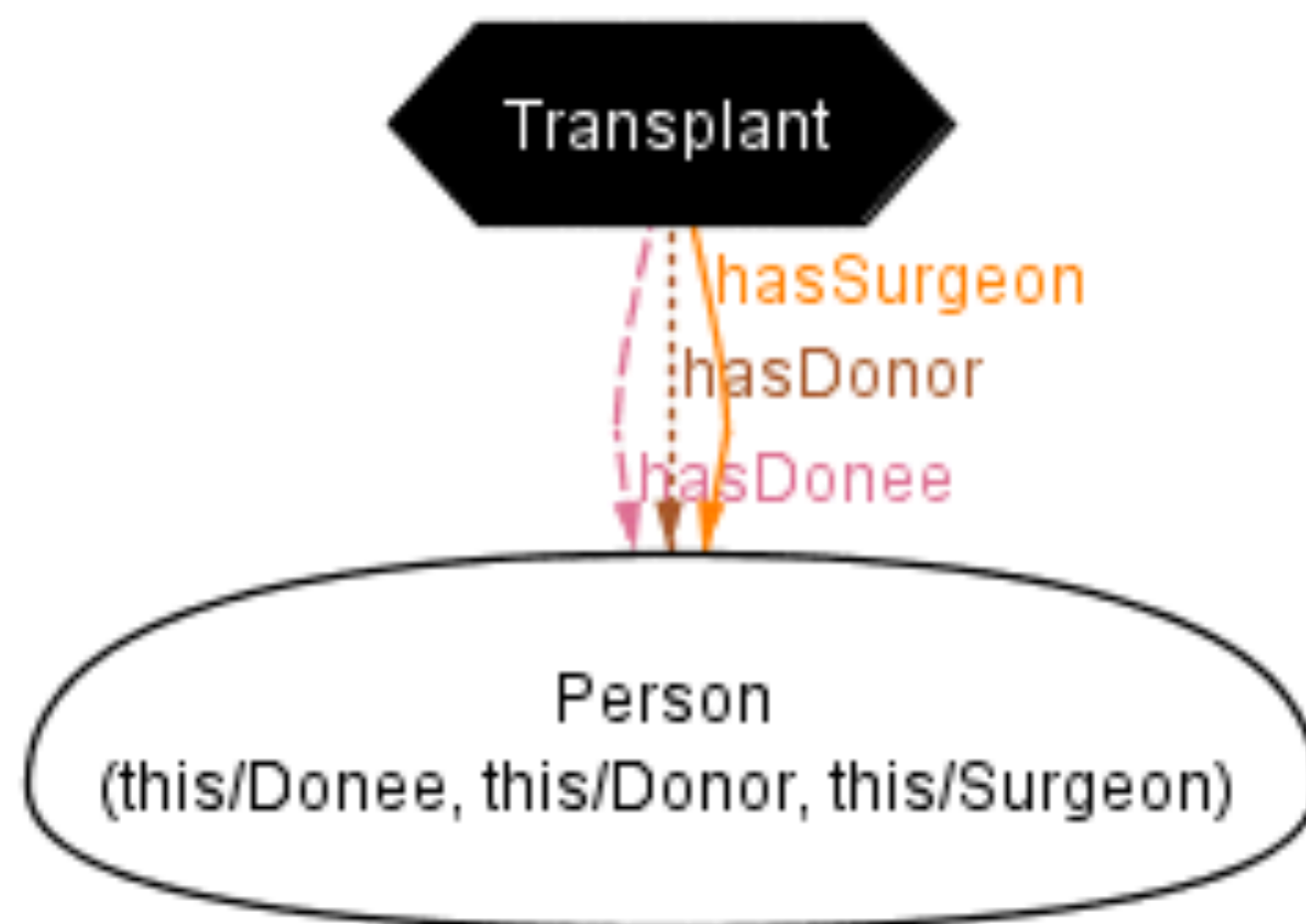
- (∀x **Person**(x) → □(**Person**(x)))
- (∀x **Student**(x) → ◇(¬**Student**(x)))
- (∀x **Student**(x) → **Person**(x))
- (∀x **Student**(x) → ∃y **Educational Institution**(y) ∧ **Enrolled-at**(x,y))
- ...

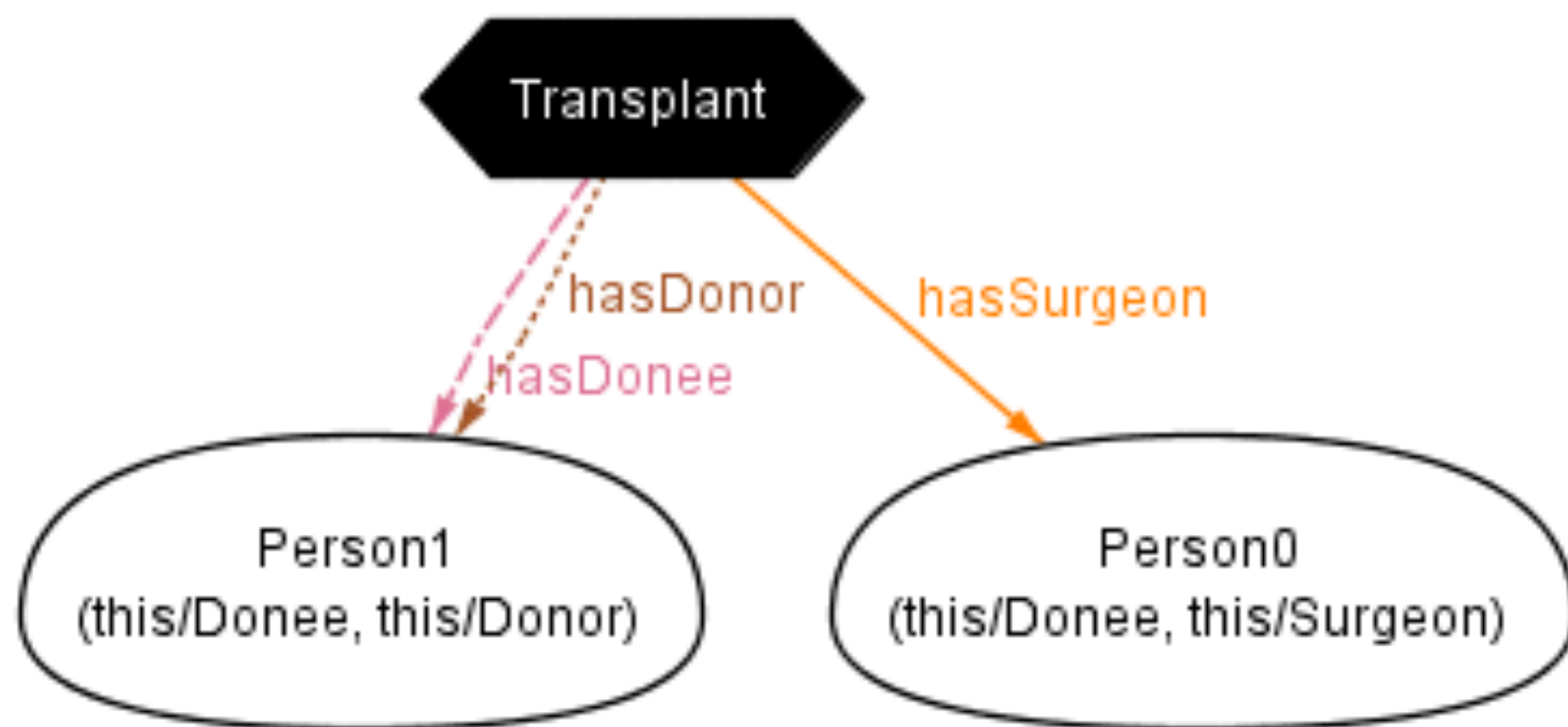
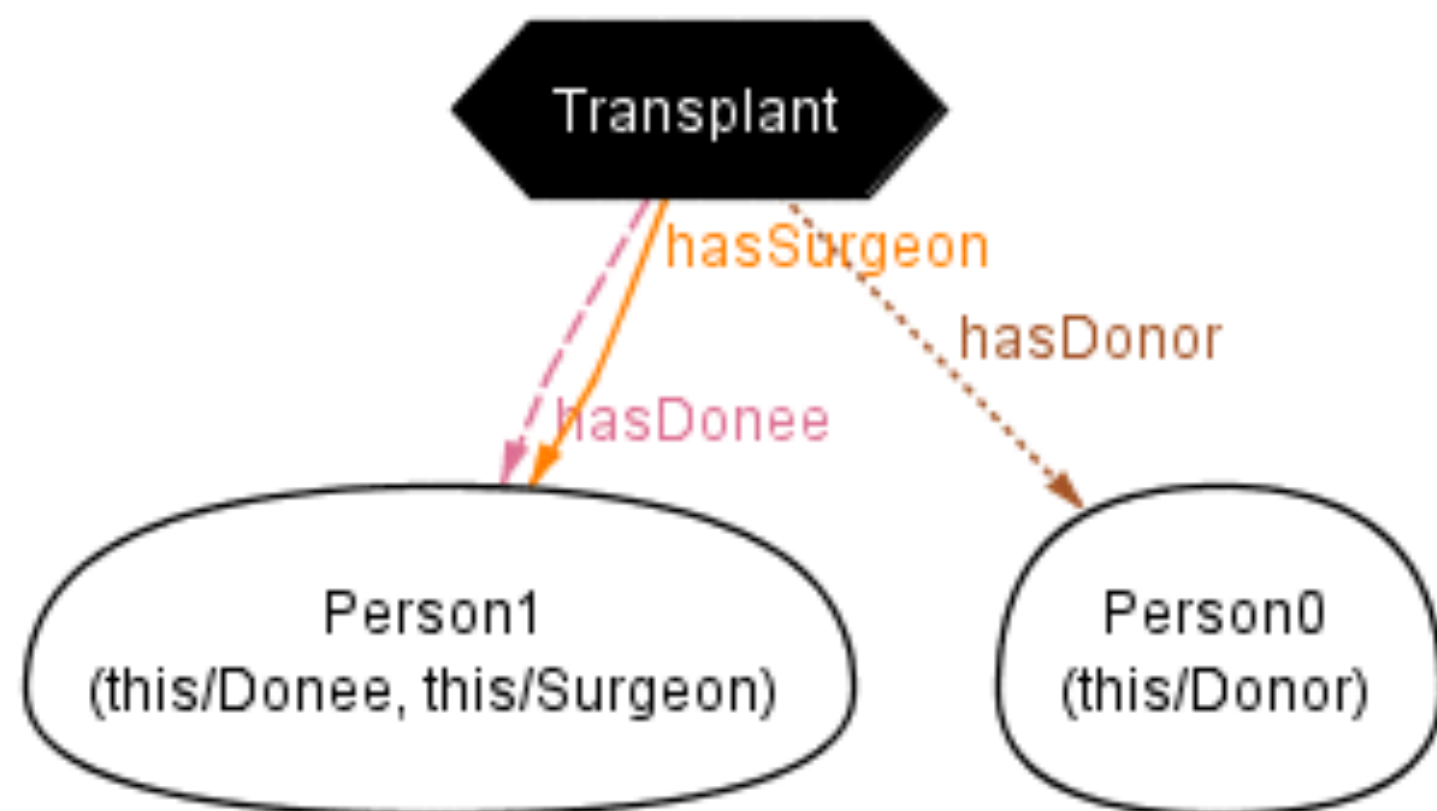


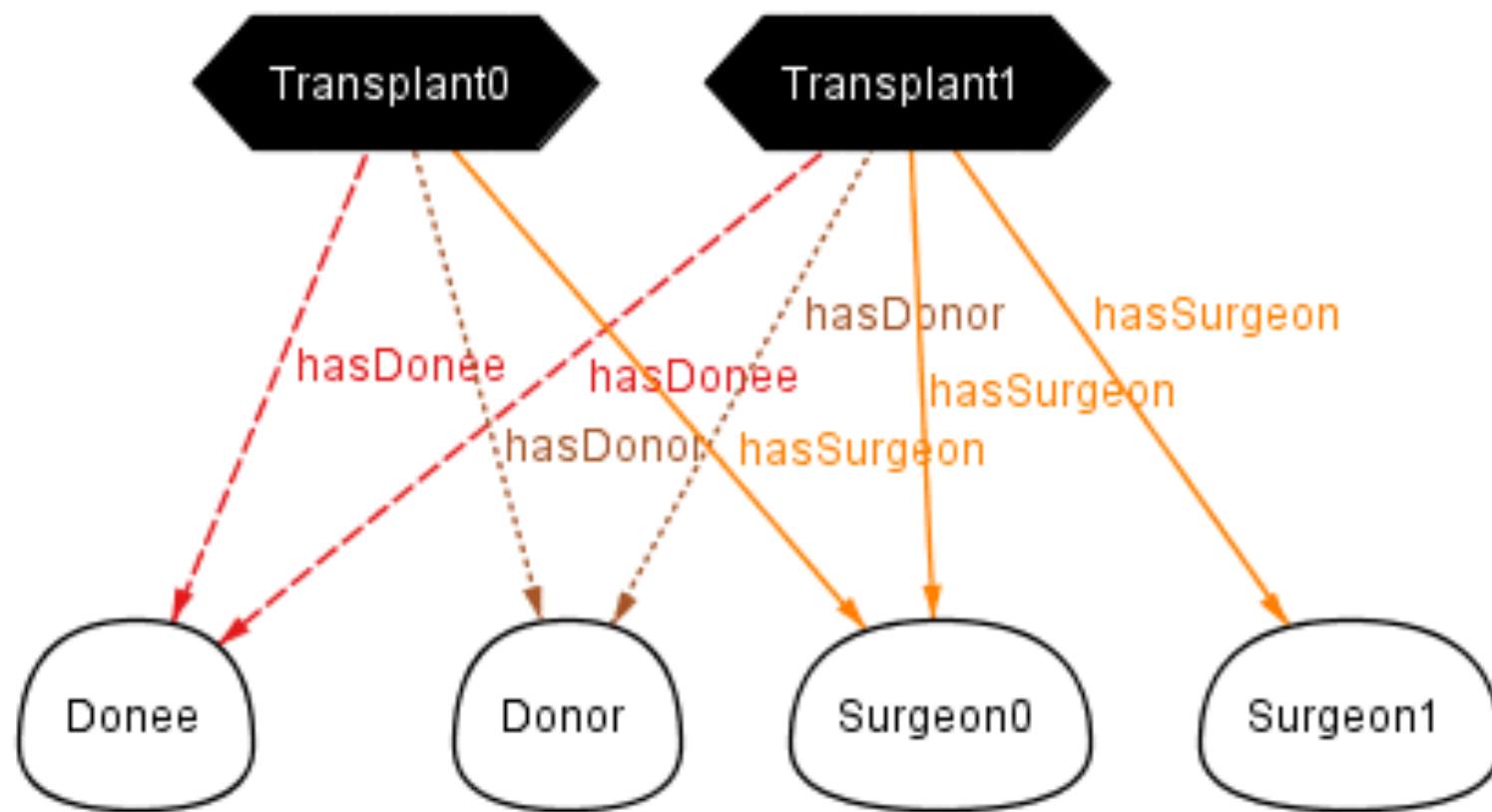
Conceptual Model =
Structure + Domain-Independent Axioms +
Domain-Specific Axioms



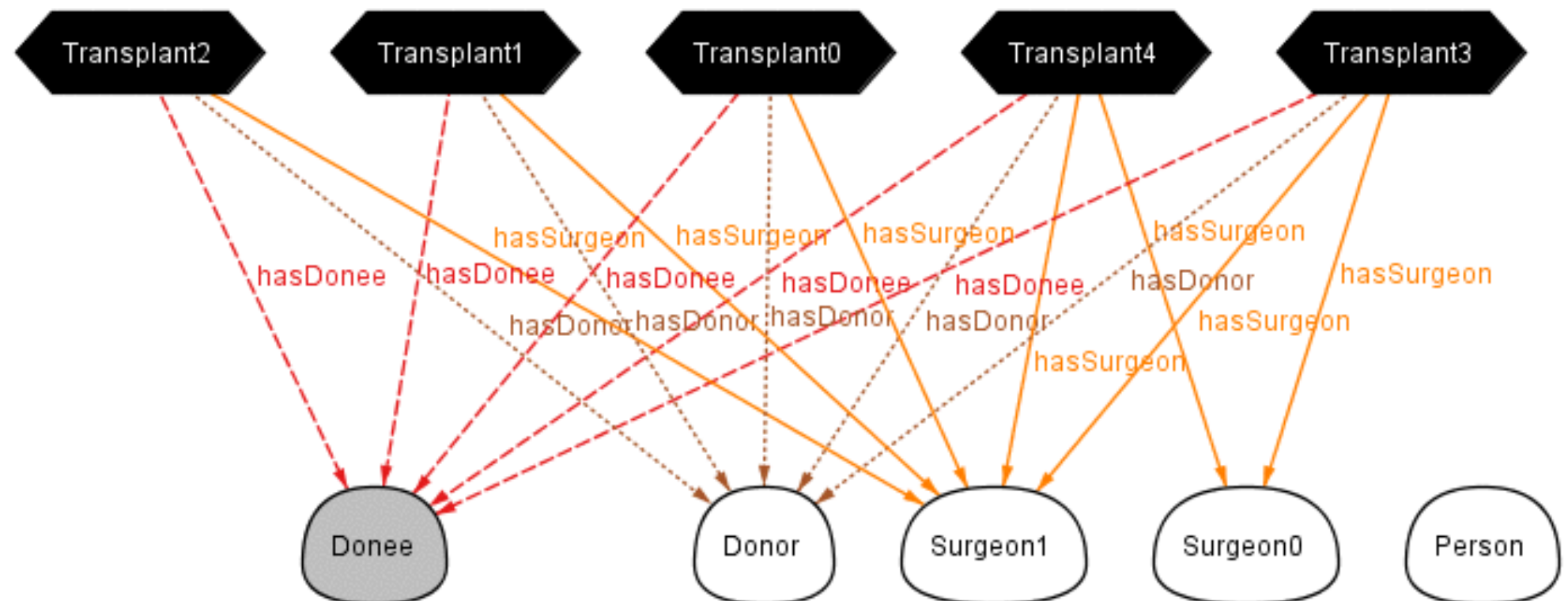








Real-Word Semantics





Data Modeling Guide (DMG) For An Enterprise Logical Data Model (ELDM)

Version 2.3

March 15, 2011

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Data Modeling Guide (DMG) For An Enterprise Logical Data Model, V2.3; 15 March 2011

Preface

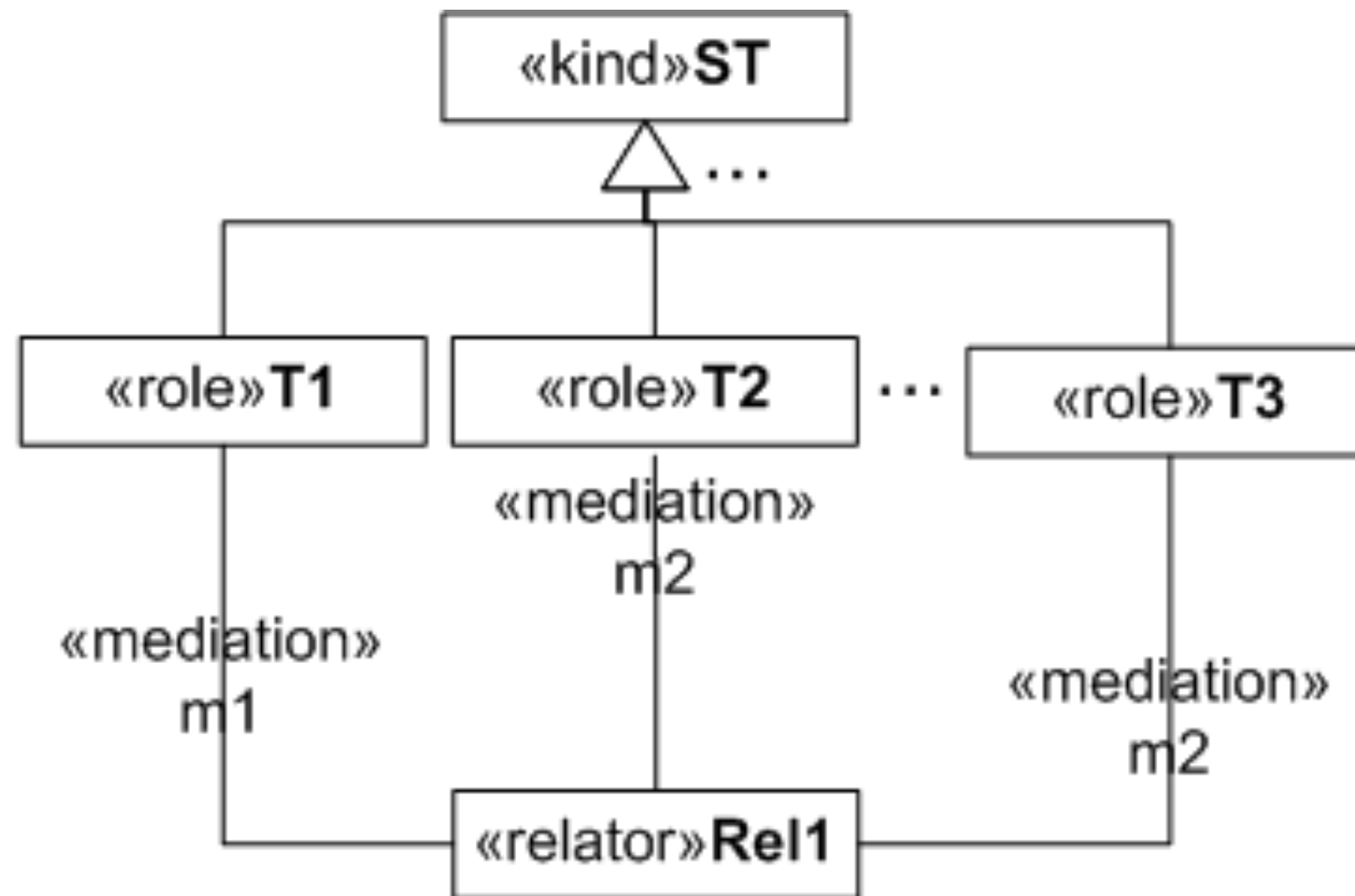
The success of this Data Modeling Guide for an Enterprise Logical Data Model could not have been possible without the inspired and exhaustive research of Giancarlo Guizzardi, notably his “Ontological Foundations for Structural Conceptual Models,” published in 2005 in association with the Centre for Telemetrics and Information Technology, which provided the theoretical foundation for the methodologies describe within, and from which real world, practical implementations have already ensued.

At the core of Guizzardi’s modeling paradigm are the principles of Rigidity, Uniform Identity and Existential Dependence. From those foundational tenets he extrapolates the concepts of SortalUniversal (Unified Principle of Identity), MixinUniversal (Disparate Set of Concepts), and finally the constructs of SubstanceSortal (Kind, Quantity, and Collective), Subkind, Phase, Role, Category, RoleMixin and Mixin. In short, the total package offered to us by Guizzardi contained a complete and fully integrated set of concepts and constructs that left us wanting for nothing.

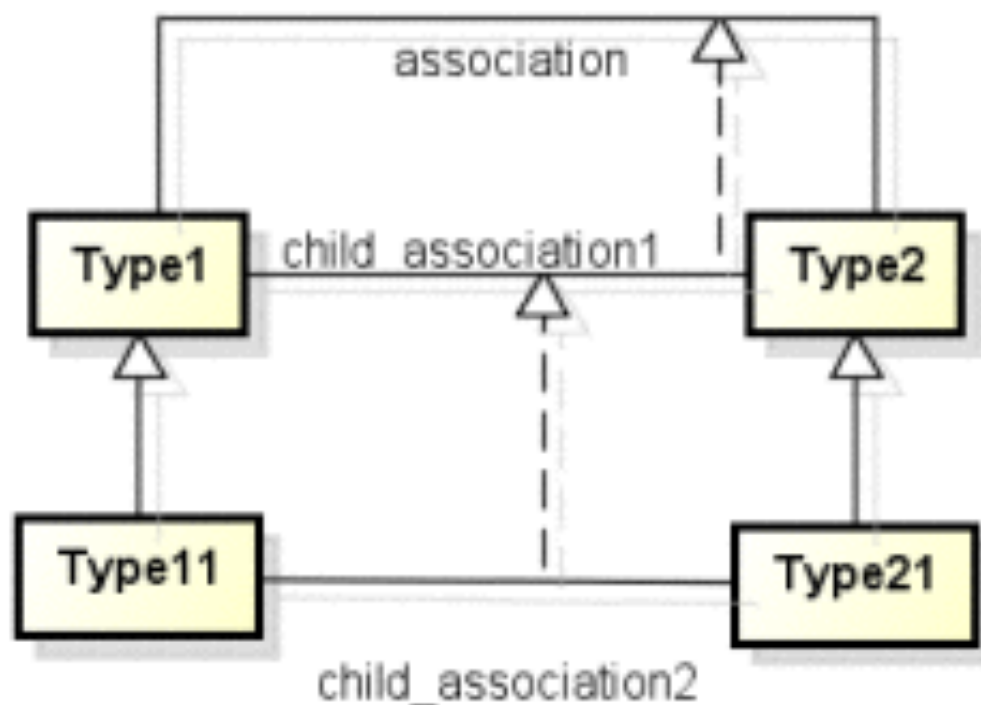
OntoUML Model Benchmark

- Model benchmark with 56 models
- Models in domains such as Provenance in Scientific Workflow, Public Cloud Vulnerability, Software Configuration Management, Emergency Management, Services, IT Governance, Organizational Structures, Software Requirements, Heart Electrophysiology, Amazonian Biodiversity Management, Human Genome, Optical Transport Networks, Federal Government Organizational Structures, Normative Acts, and Ground Transportation Regulation

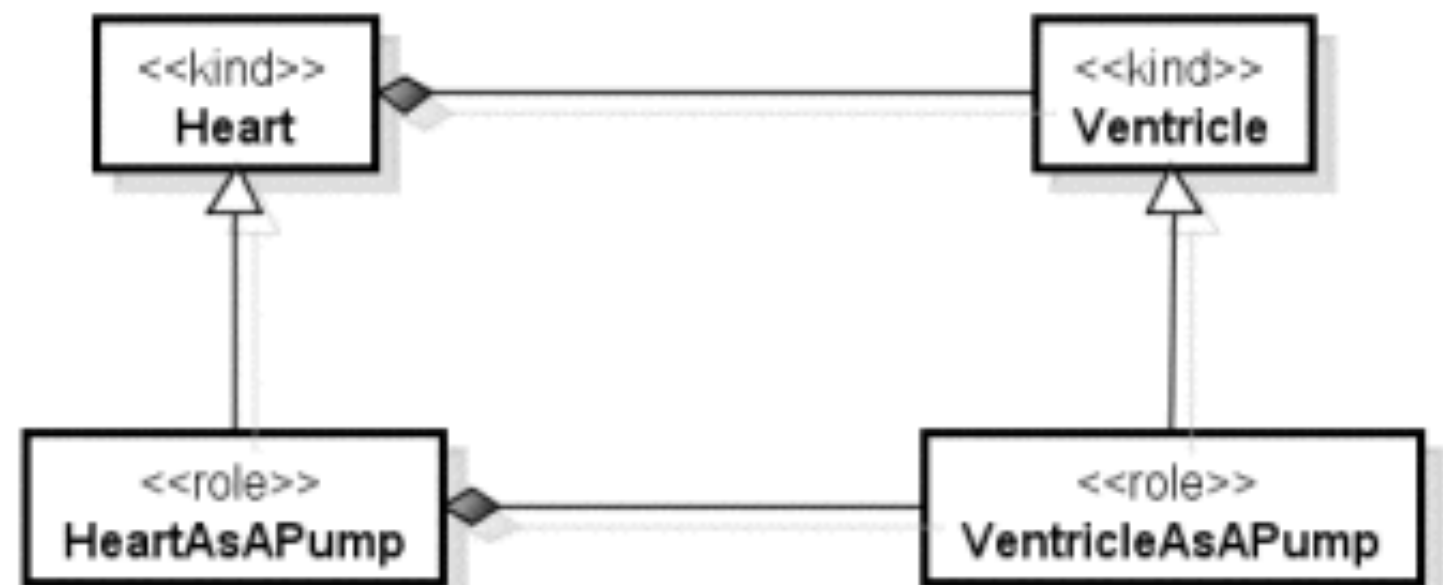
The Emerging Anti-Pattern: Relation Between Overlapping Types (**RelOver**)



The Emerging Anti-Pattern: Relation Specialization (**RelSpec**)

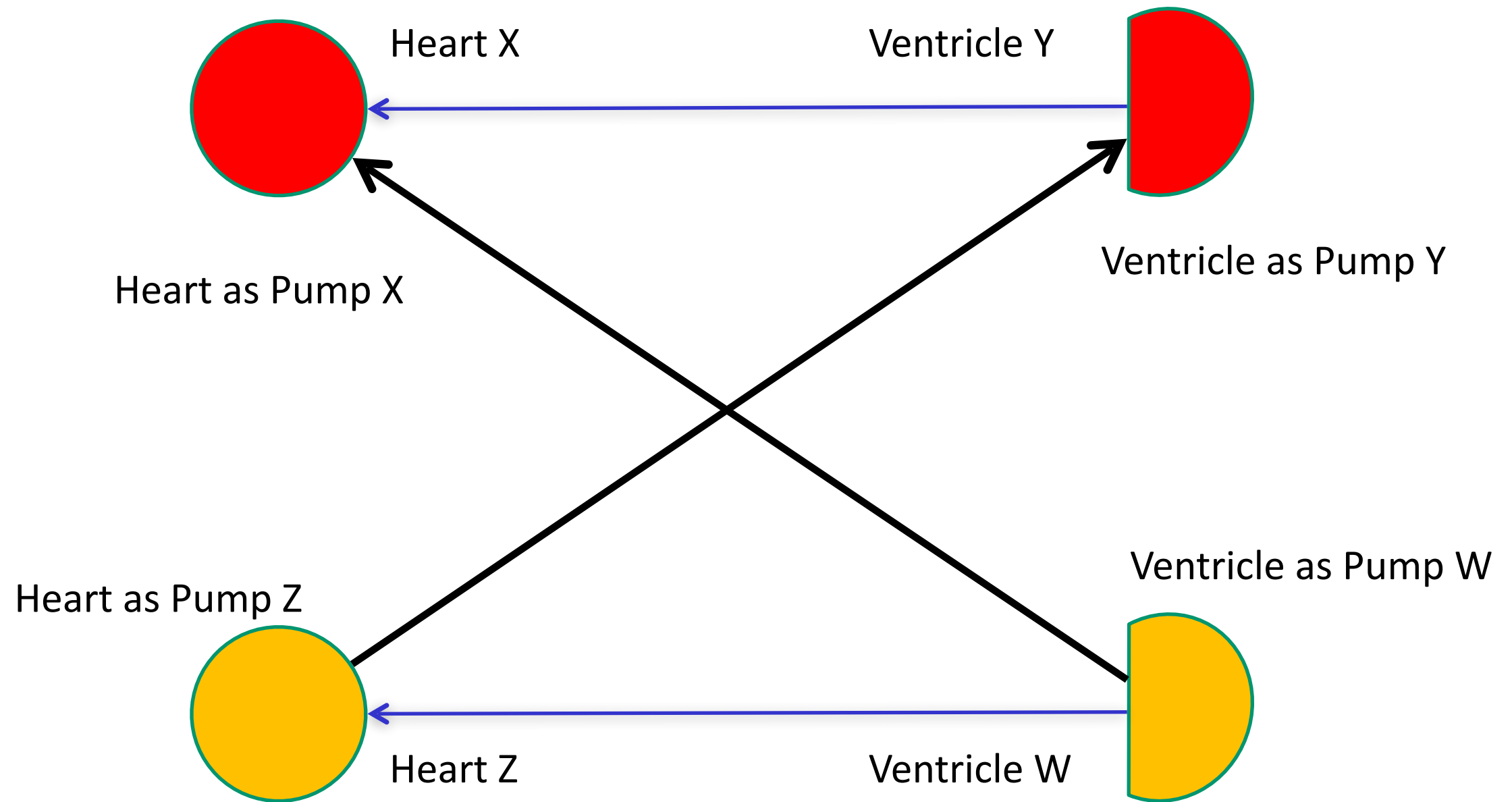


(a)



(b)





Anti-Pattern Catalogue

- Association Cycle
- Binary Relation Between Over. Types
- Deceiving Intersection
- Free Role Specialization
- Imprecise Abstraction
- Multiple Relational Dependency
- Part Composing Over. Roles
- Whole Composed by Over. Parts
- Relator Mediating Over. Types
- Relation Composition
- Relator Mediating Rigid Types
- Relation Specialization
- Repeatable Relator Instances
- Relationally Dependent Phase
- Generalization Set With Mixed Rigidity
- Heterogeneous Collective
- Homogeneous Functional Complex
- Mixin With Same Identity
- Mixin With Same Rigidity
- Undefined Formal Association
- Undefined Phase Partition

Anti-Patterns (AP)	AP Occurrences	Relevant Model Construct (RMC)	RMC /AP Ratio	% of Qualified Models with AP Occurrence
RelSpec	817	Association	4.92	48.15%
ImpAbs	758	Association	5.30	72.22%
AssCyc	1809	Association	2.22	92.59%
RelOver	149	Relator	8.08	25%
RepRel	319	Relator	3.77	64.58%
BinOver	224	Association	17.93	48.15%

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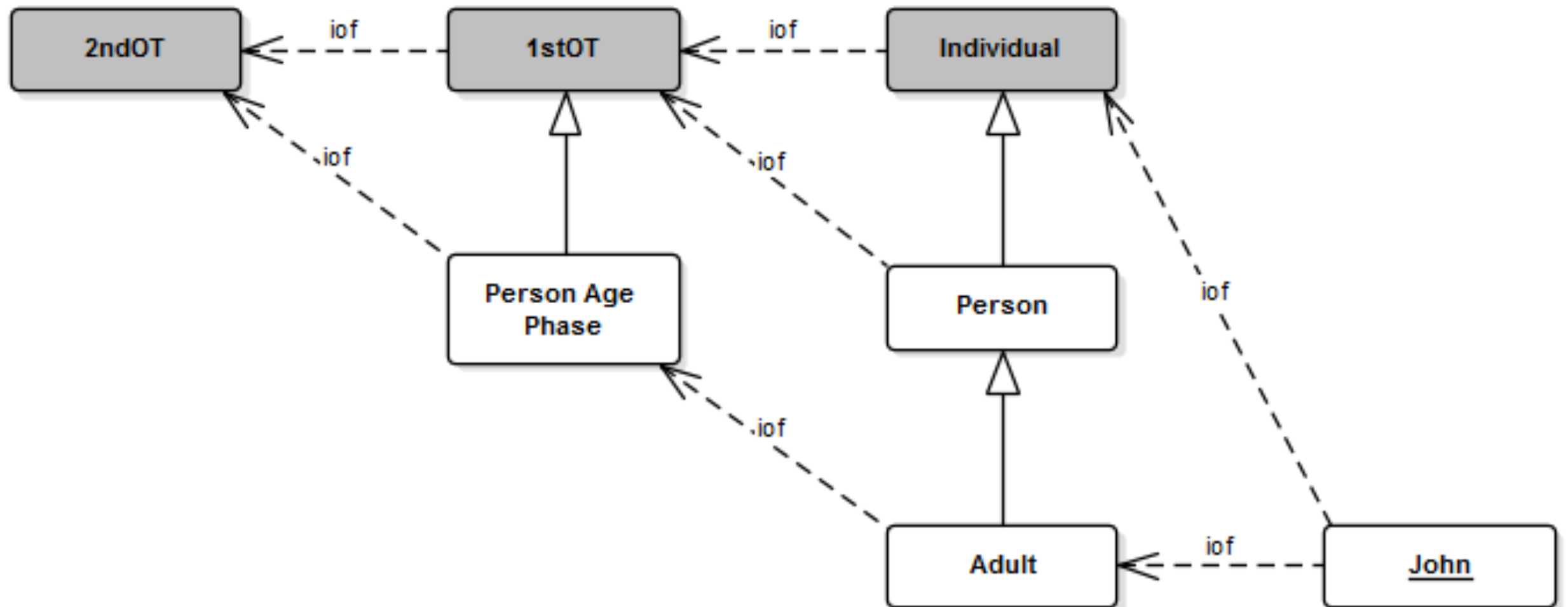
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Anti-Pattern	#Occ.	#Error	#Error / #Occ.	#Refac. /#Error
RelSpec	315	279	88.6%	97.1%
RepRel	221	57	25.8%	84.2%
RelOver	124	70	56.5%	77.1%
BinOver	74	31	41.9%	74.2%
AssCyc	20	14	70.0%	71.4%
ImpAbs	125	11	8.8%	27.3%
Total	879	462	52.56%	88.53%

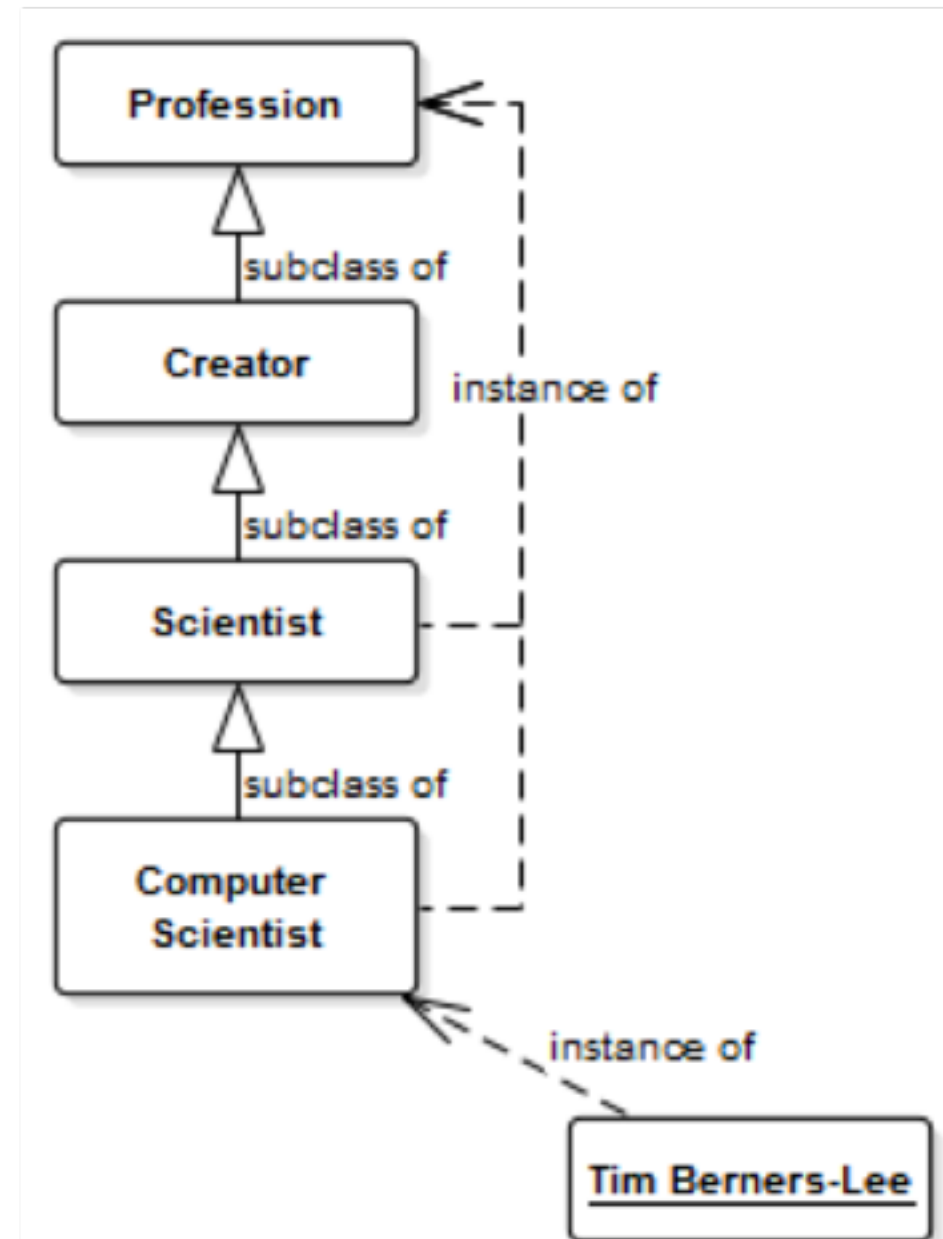
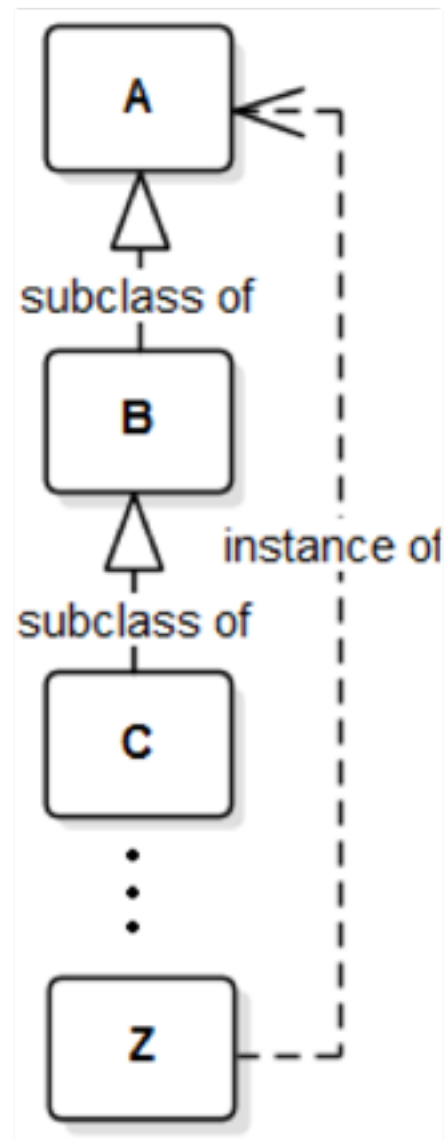
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What if we go big...
(searching for Anti-
Patterns on WikiData)

Multi-Level Modeling



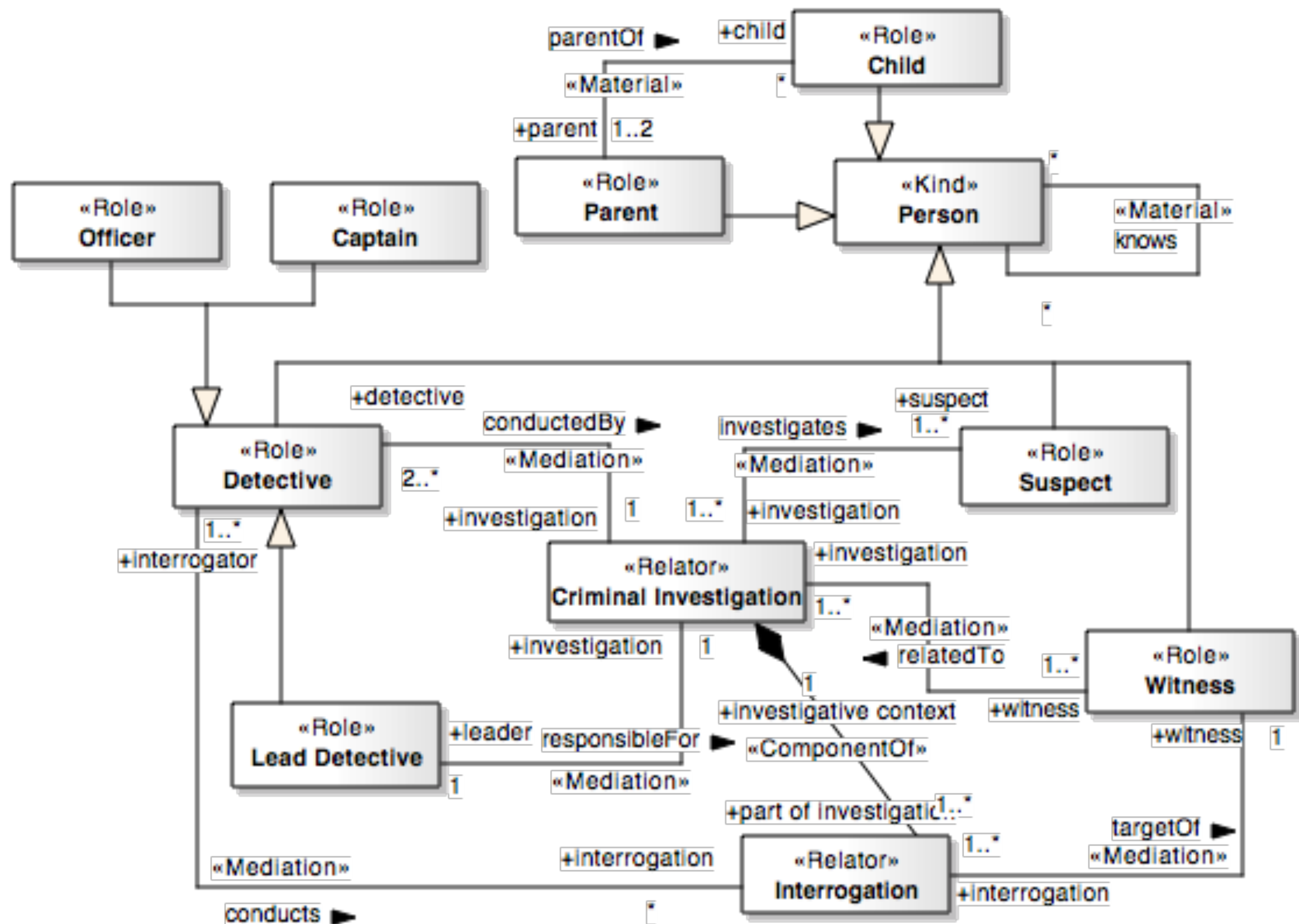
Multi-Level Modeling

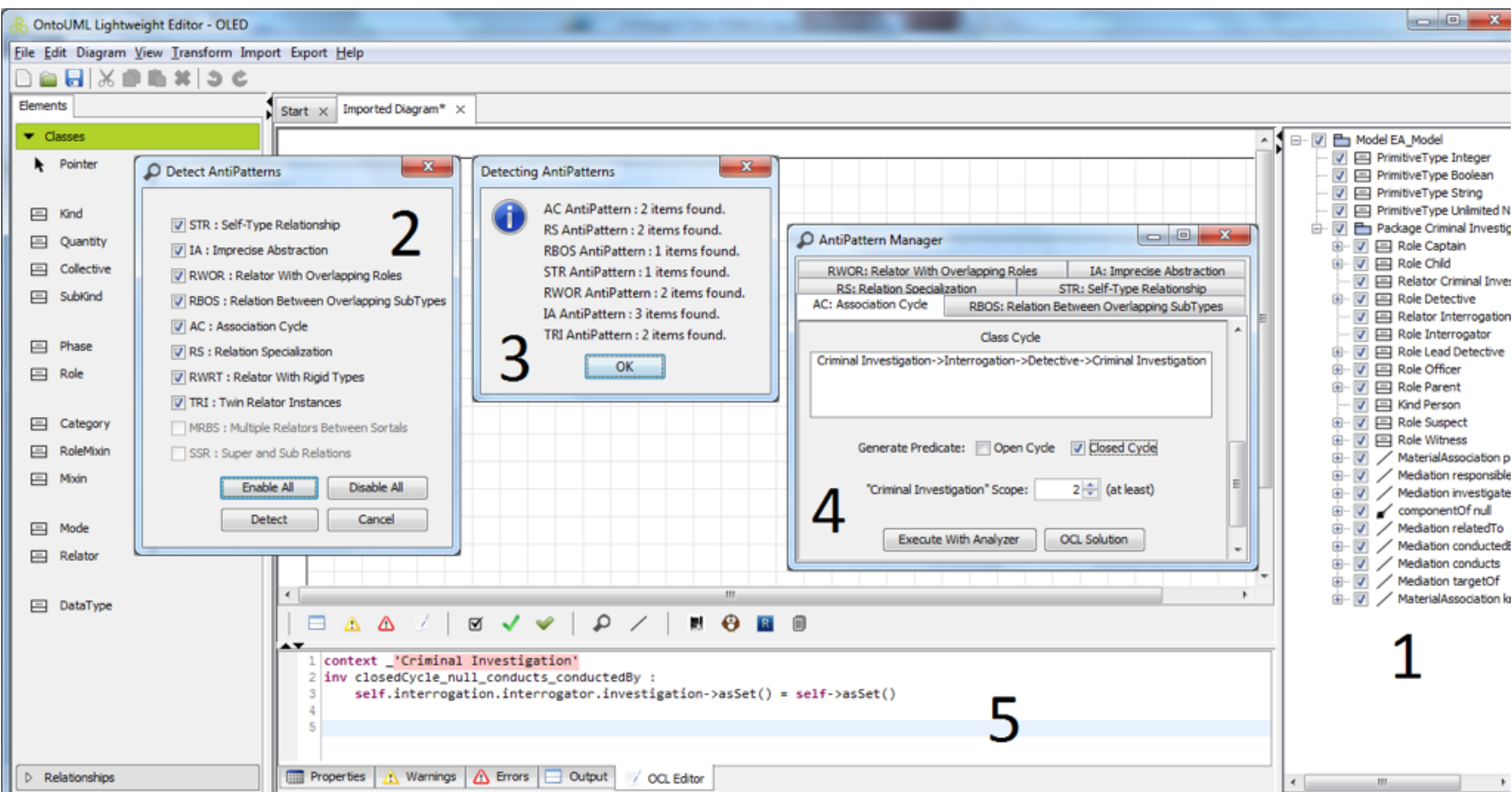


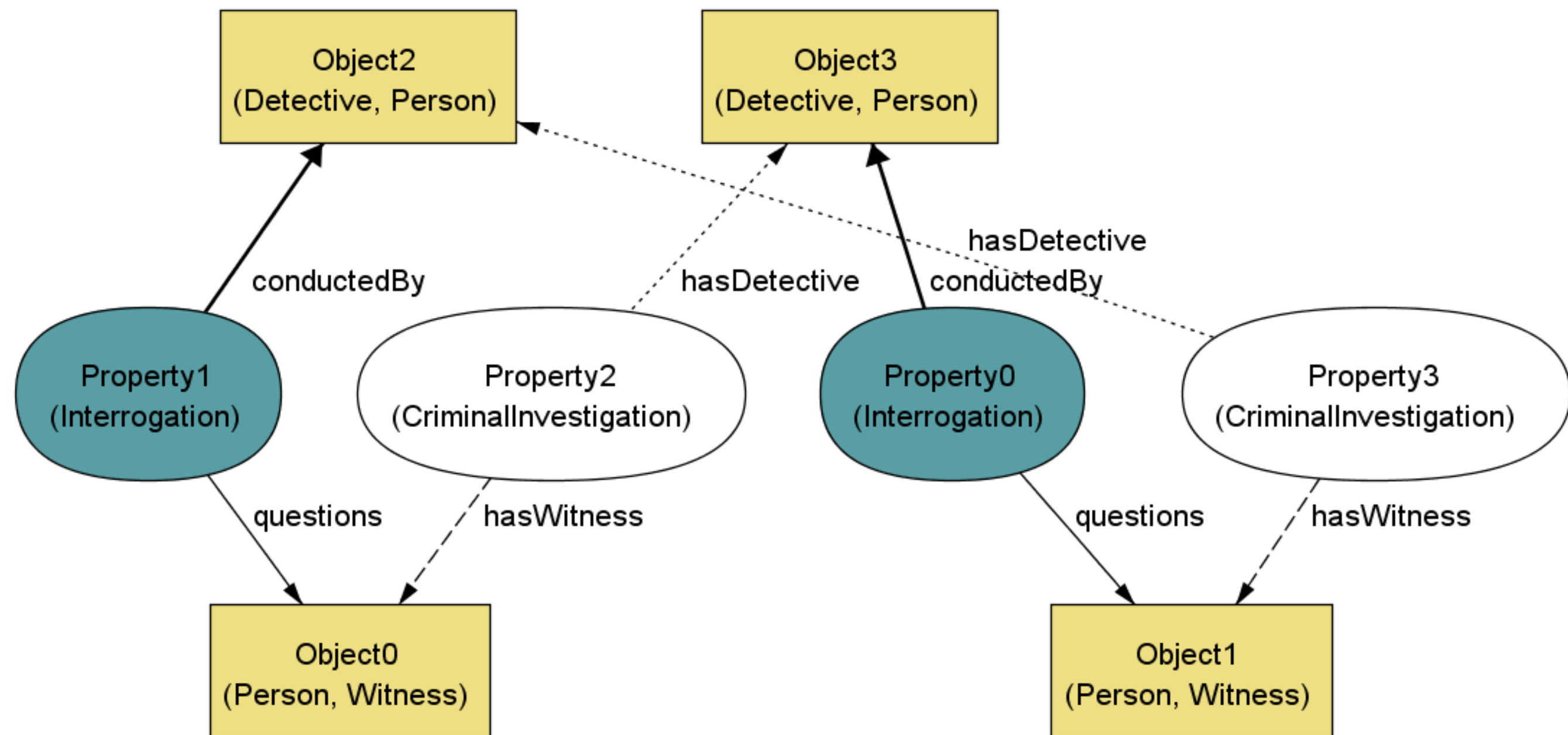
What if we go big...

Number of classes in any taxonomic hierarchy	337,102
Number of classes in taxonomic hierarchies spanning more than one level	17,819
Number of classes involved in AP1	15,177

OntoUML Criminal Investigation







Relator With Overlapping Roles

Relator: Criminal Investigation

Customizing Disjoints Roles:

Add

Lead Detective	Witness	Detective	Suspect
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

☐ Exclusive

☒ Exclusive from Table

☐ Overlapping

☐ Disjoint

☒ Disjoint from Table

"Criminal Investigation" Scope: 2 (at least)

Execute With Analyzer

OCL Solution

```

1 context _'Criminal Investigation'
2 inv: self.witness.oclAsType(Person)->asSet()->intersection(self.detective.oclAsType(Person)->asSet())->size()=0
3
4 context _'Criminal Investigation'
5 inv: self.witness.oclAsType(Person)->asSet()->intersection(self.suspect.oclAsType(Person)->asSet())->size()=0
6
7 context _'Detective'
8 inv: not self.oclIsTypeOf(Suspect)
9

```

Properties

Warnings

Errors

Output

OCL Editor

“Few modelers, however, have had the experience of subjecting their models to continual, automatic review. Building a model incrementally with an analyzer, **simulating** and checking as you go along, is a very different experience from using pencil and paper alone. The first reaction tends to be amazement: modeling is much more fun when you get instant, **visual feedback**. Then the sense of **humiliation** sets in, as you discover that **there’s almost nothing you can do right.**”

(Daniel Jackson, Software Abstractions : Logic, Language, and Analysis, 2006)

The Humble **Ontologist**

[What] I have chosen to stress in this talk is the following.
We shall do a much better **ontology** job in the future, provided
that we approach the task with a full appreciation of its
tremendous complexity,...,provided we respect the intrinsic
limitations of the human mind and approach the task a Very
Humble **Ontologist**

(paraphrasing Dijkstra's Humble Programmer, 1972)

References



**ONTOLOGICAL
FOUNDATIONS
FOR STRUCTURAL
CONCEPTUAL
MODELS**

GIANCARLO GUIZZARDI

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