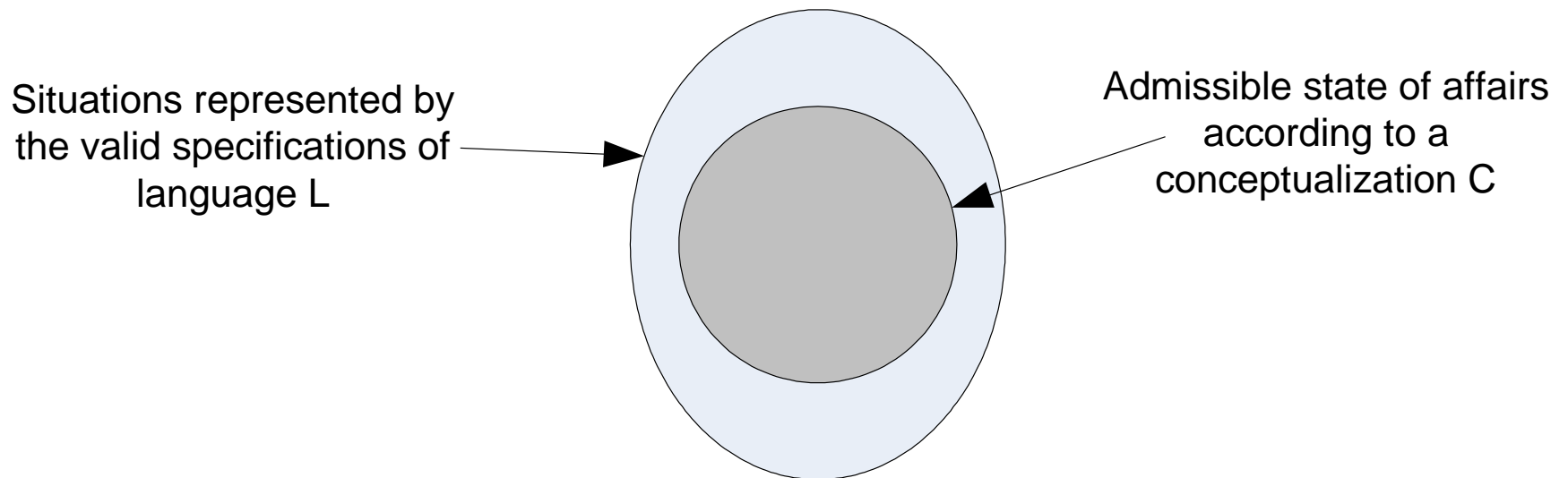


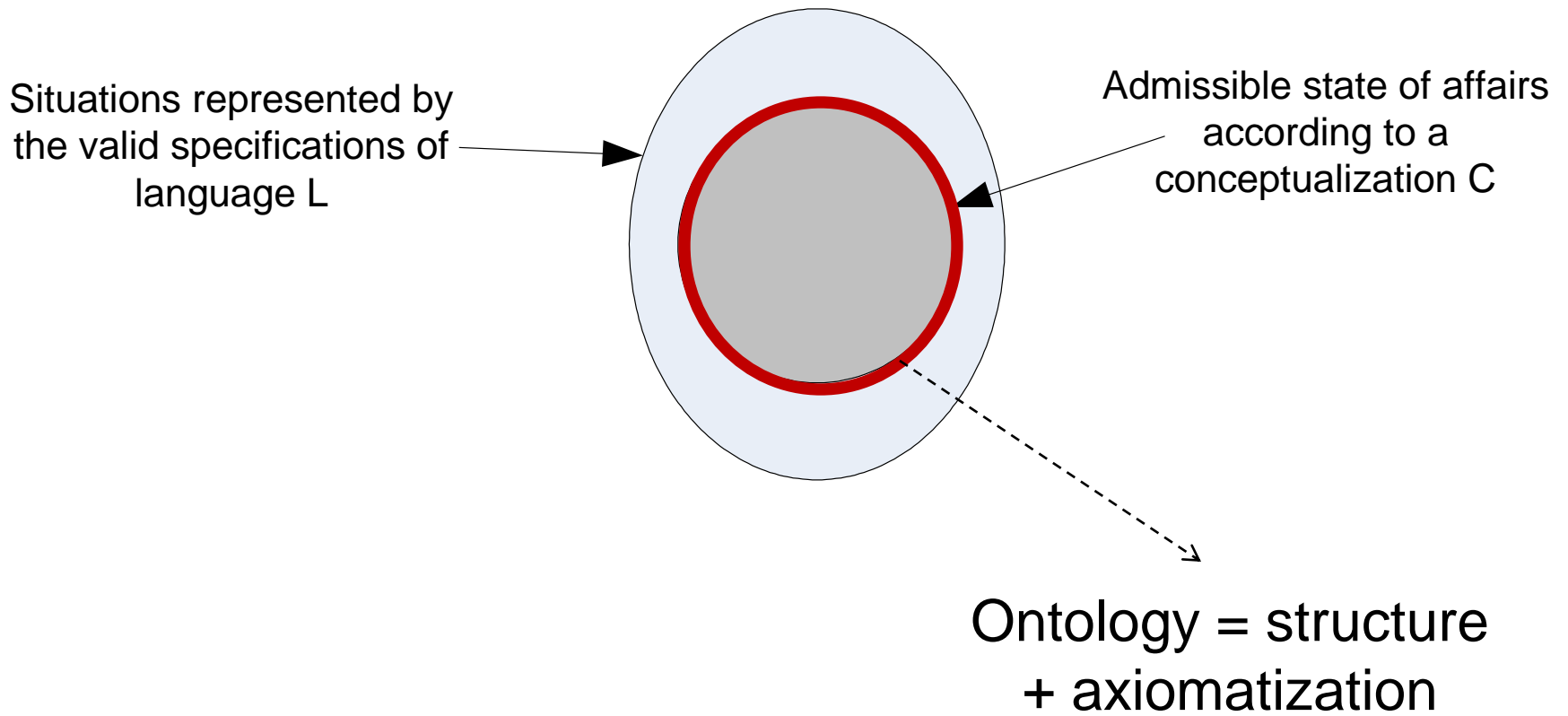


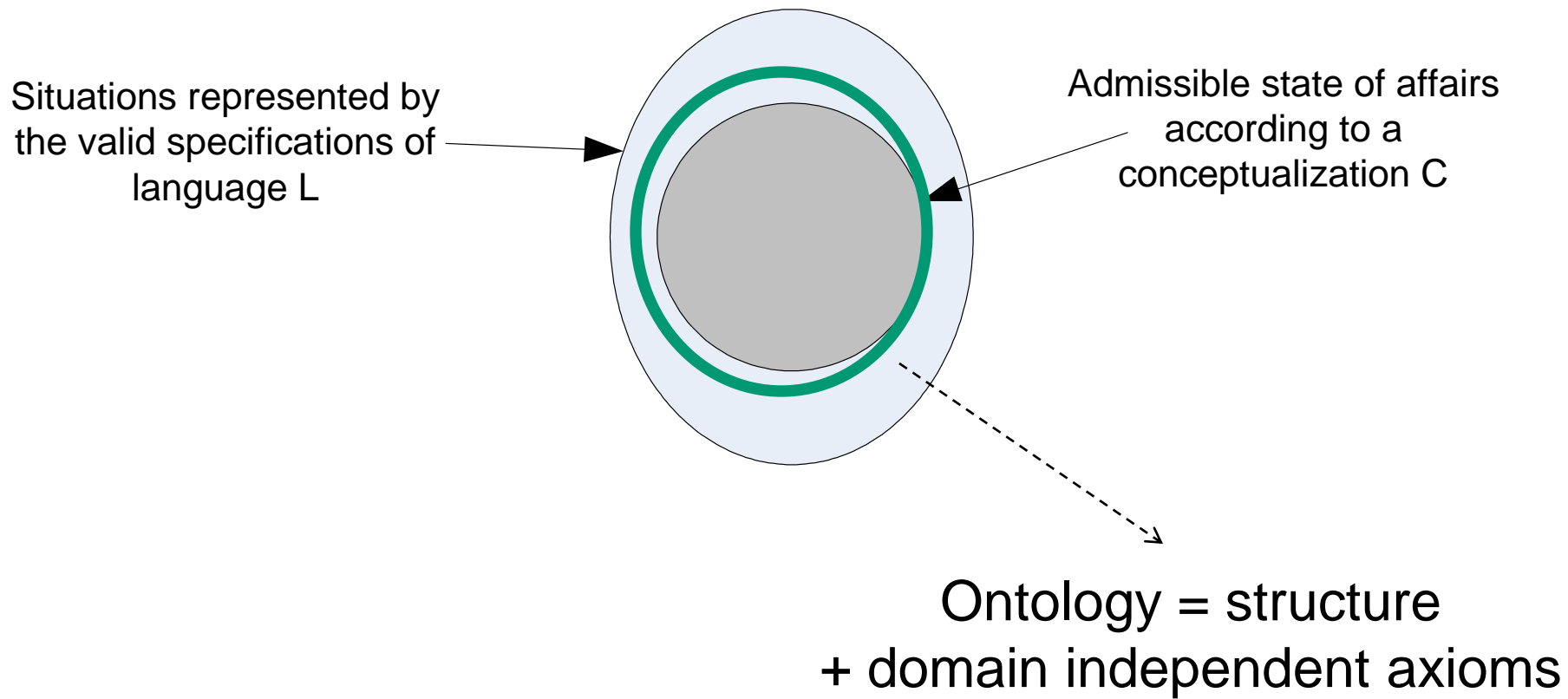
ONTOLOG 2012
Earth Science Ontology Dialog

Formal Ontology. (Anti-)Patterns and Model Simulation

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Formal Ontology

A discipline that deals with formal ontological structures (e.g. theory of parts, theory of wholes, **types** and instantiation, identity, dependence, unity) which apply to all material domains in reality.

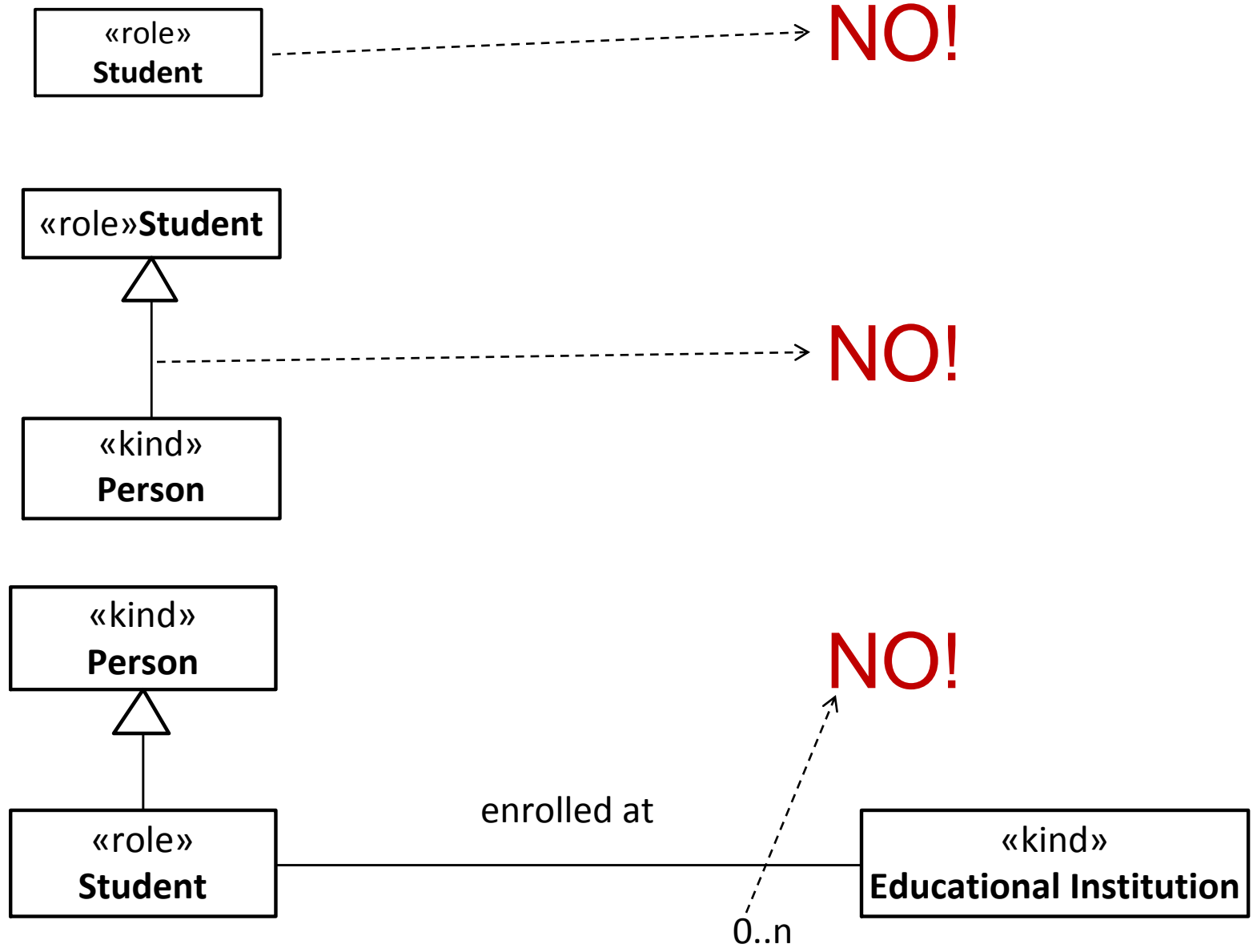
Ontological Distinctions among Types

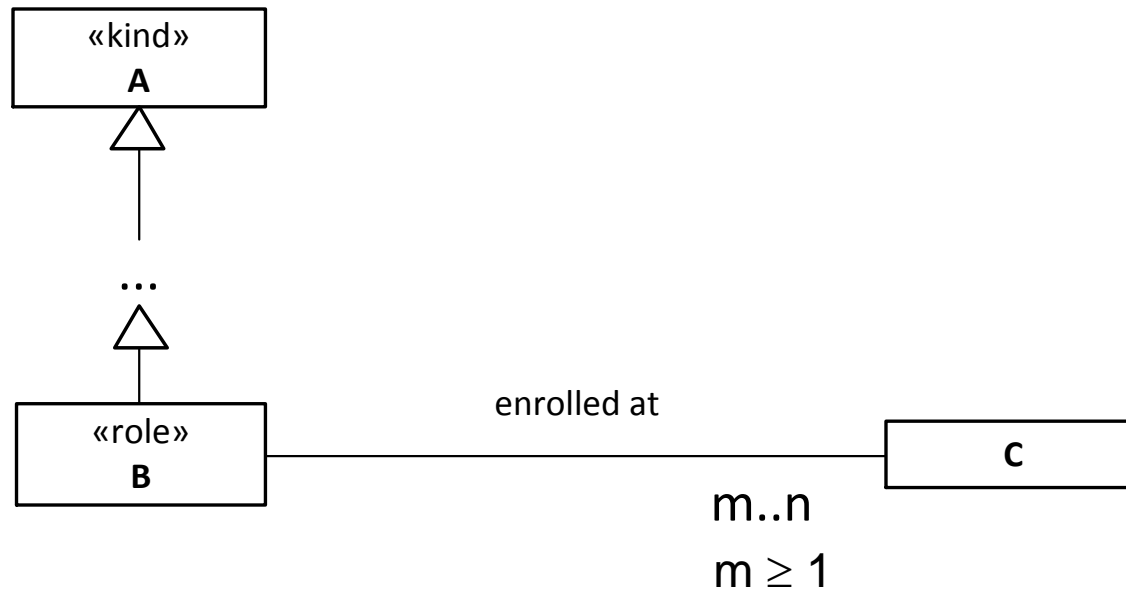


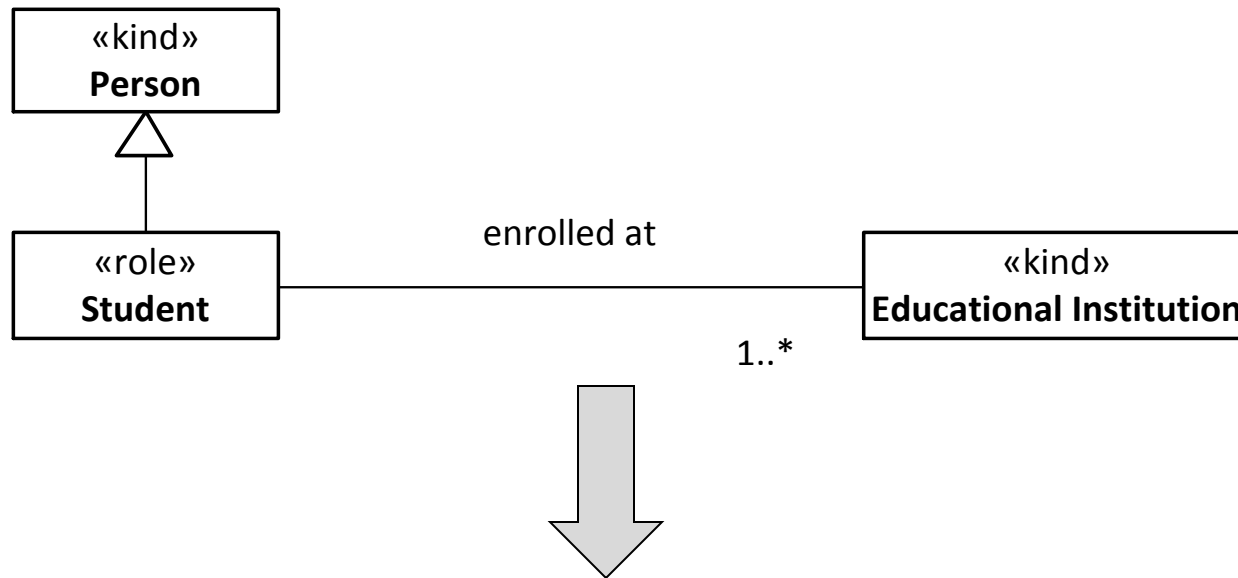
KIND: Every instance of a KIND is necessarily an instance of that KIND (e.g., Person)

ROLE (e.g., Student):

- 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)







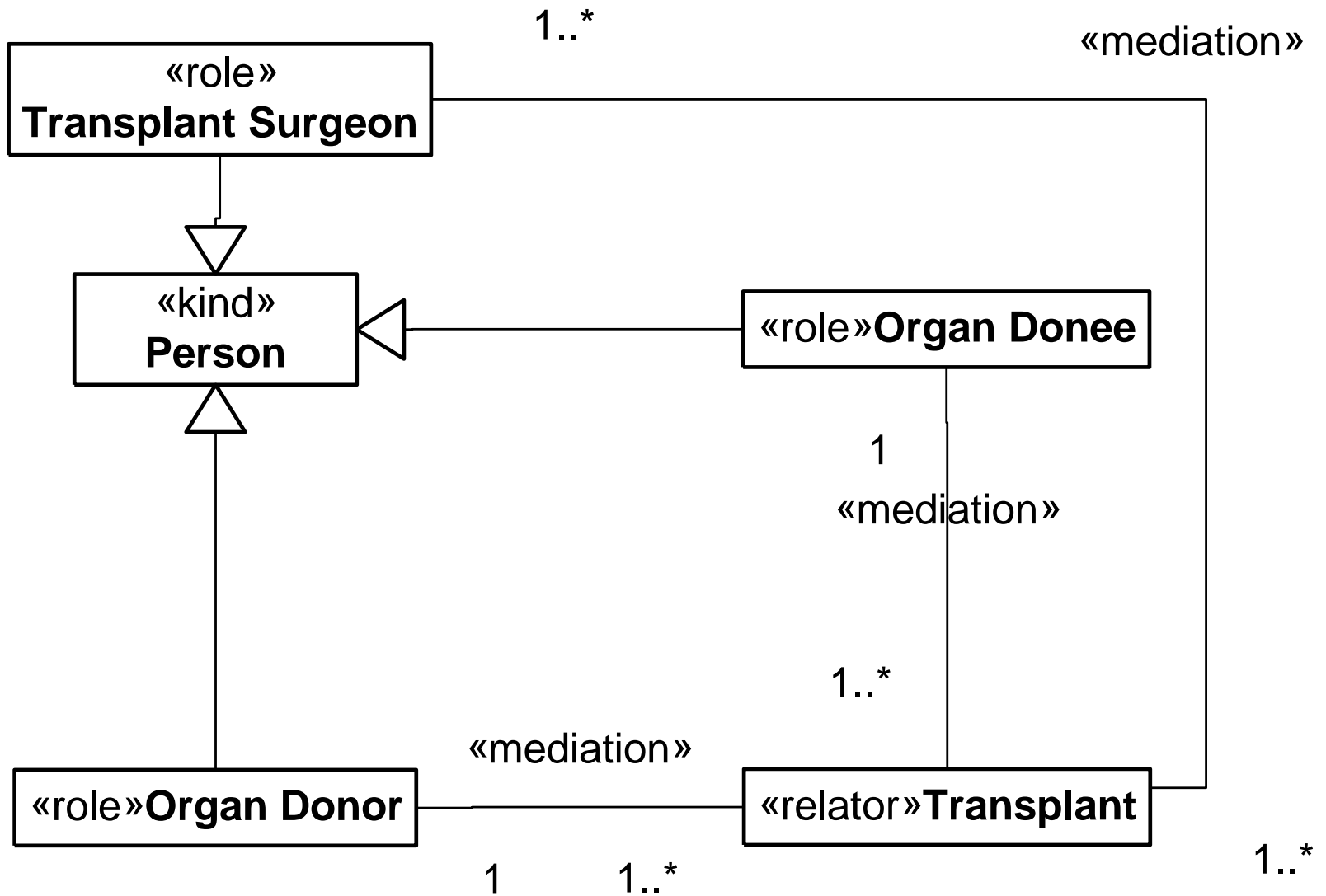
$\Box(\forall x \text{ Person}(x) \rightarrow \Box(\text{Person}(x)))$

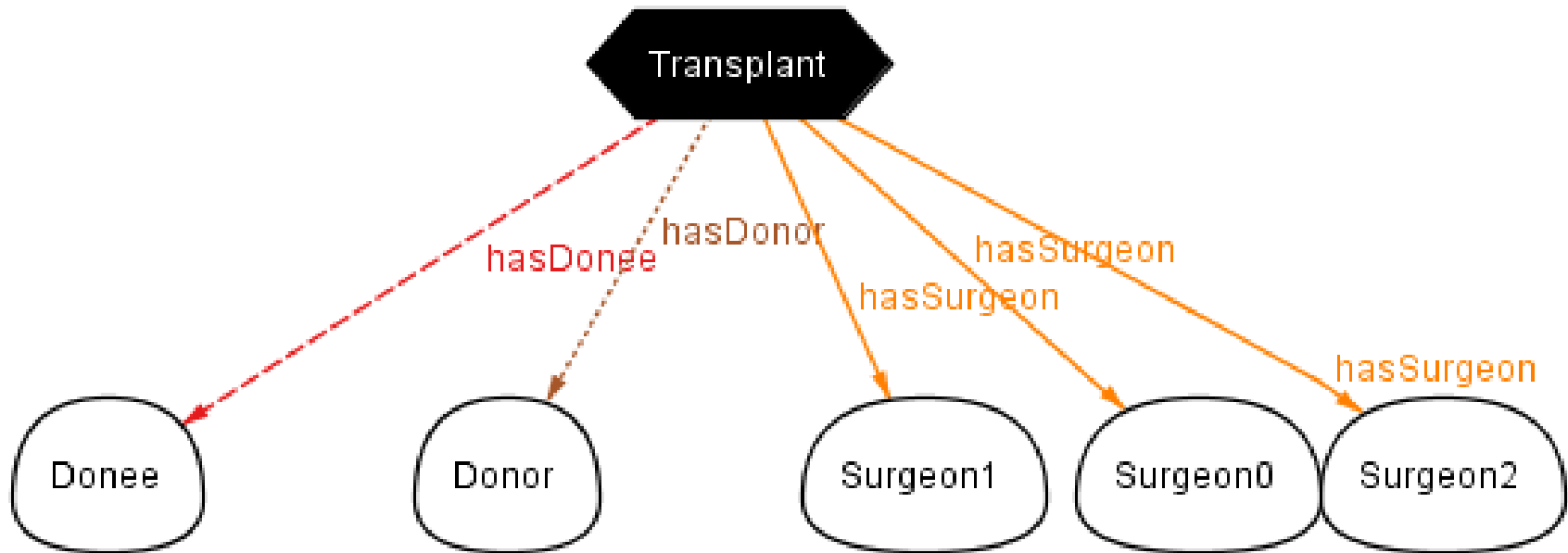
$\Box(\forall x \text{ Student}(x) \rightarrow \Diamond(\neg \text{Student}(x)))$

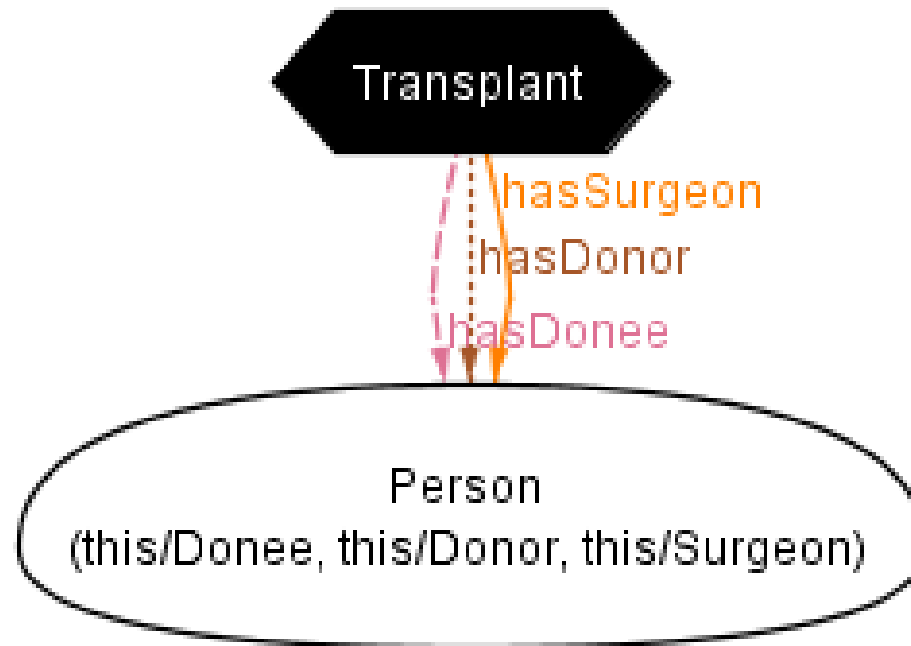
$\Box(\forall x \text{ Student}(x) \rightarrow \text{Person}(x))$

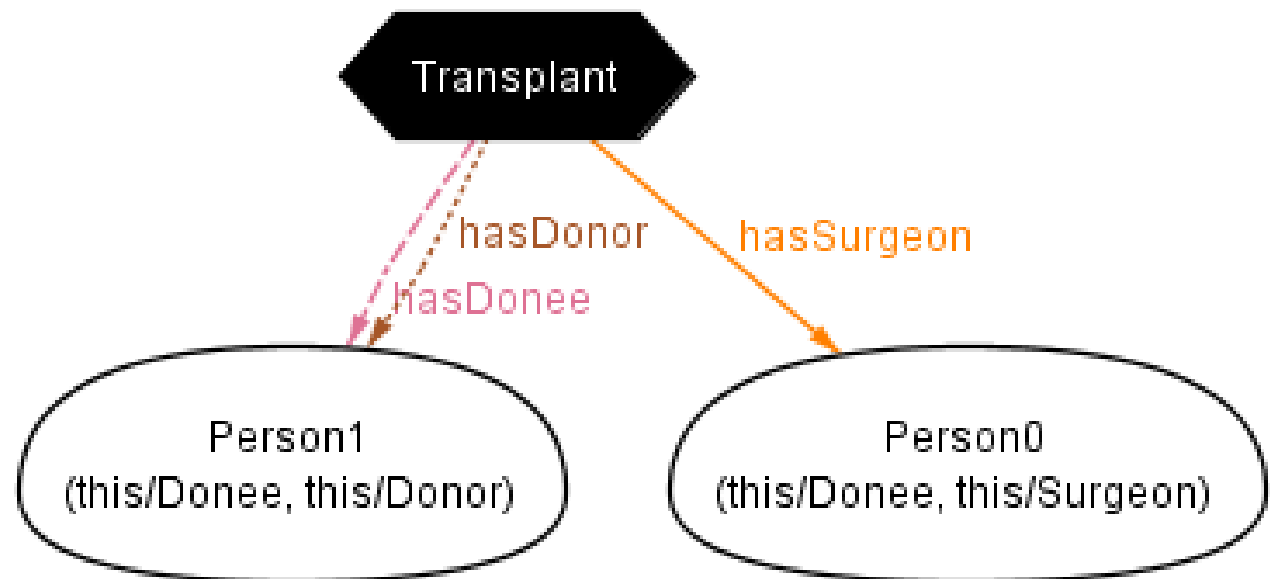
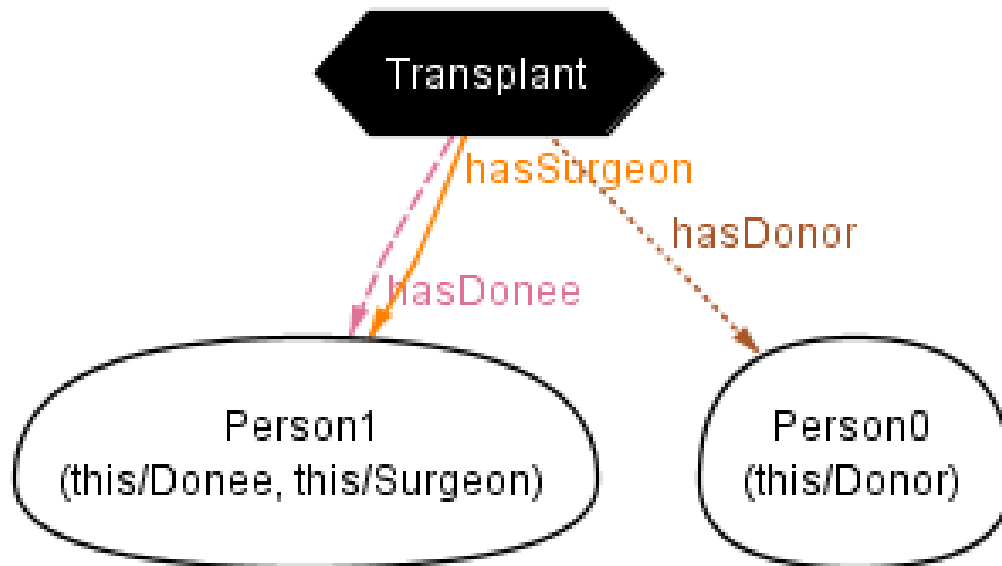
$\Box(\forall x \text{ Student}(x) \rightarrow \exists y \text{ Educational Institution}(y) \wedge \text{Enrolled-at}(x,y))$

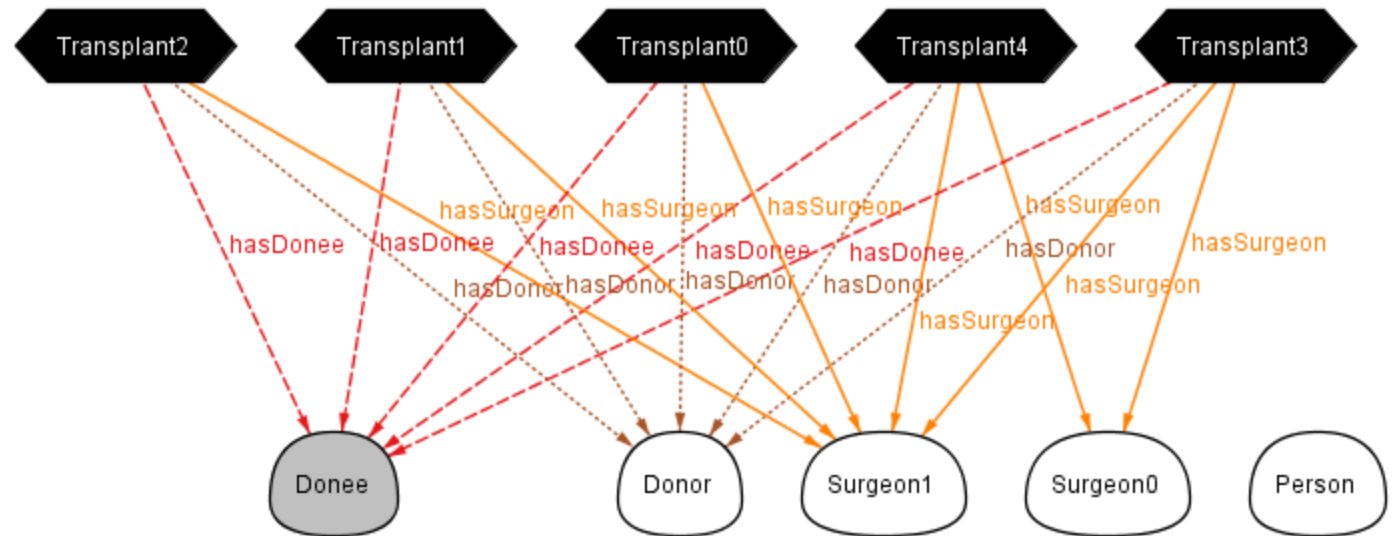
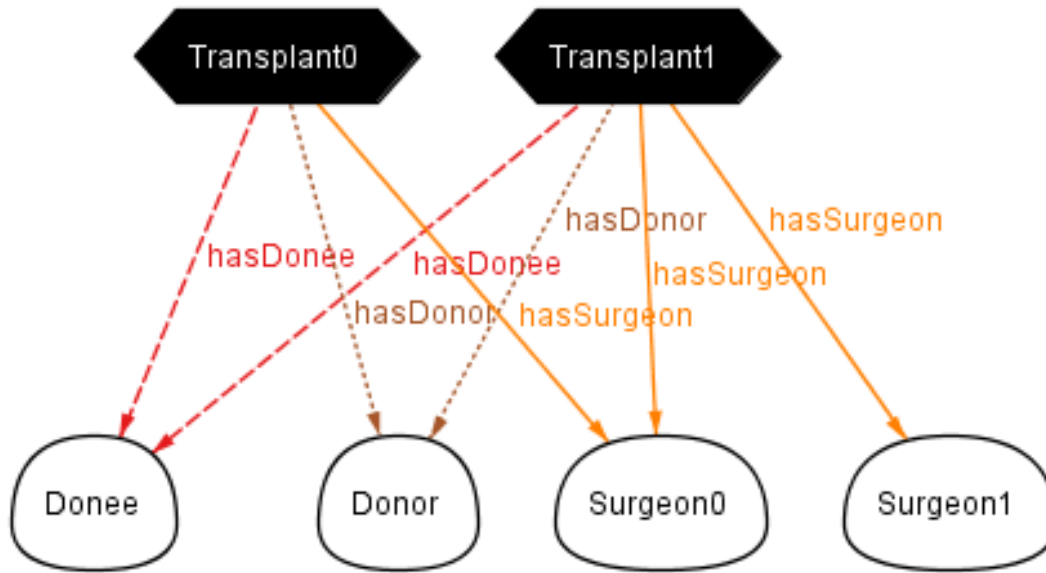
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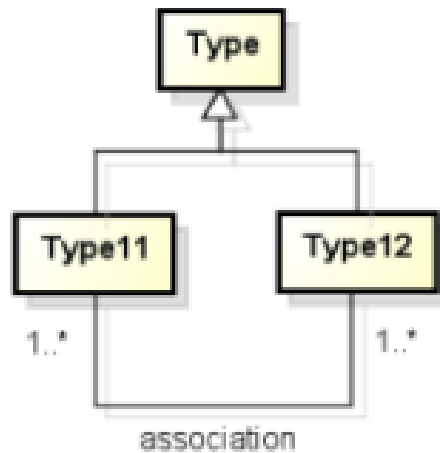




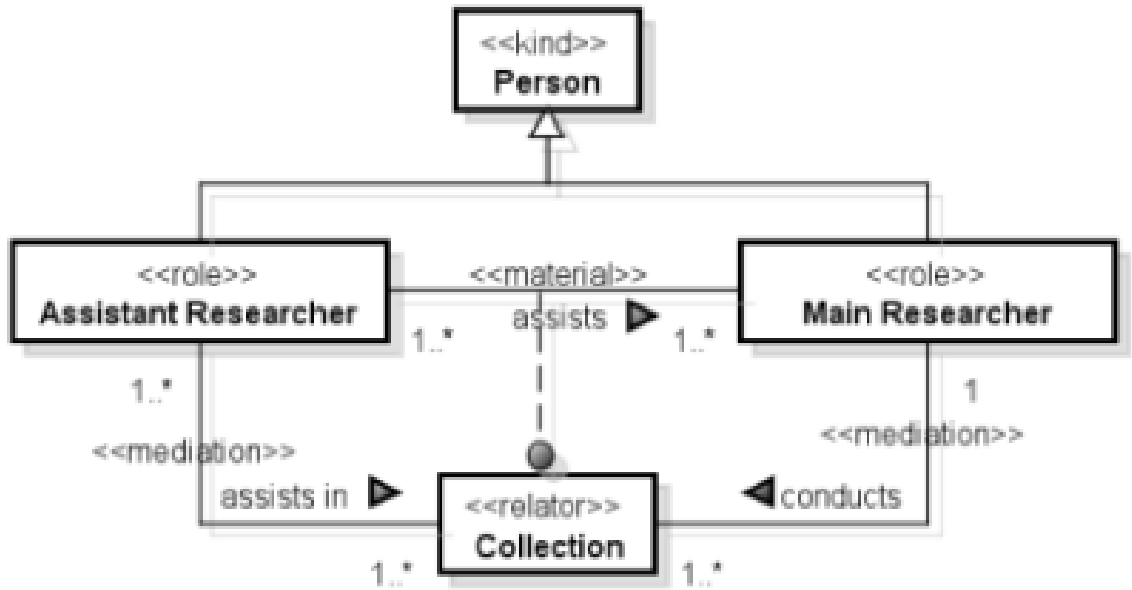




Relation between Overlapping Sybtypes (ROS)

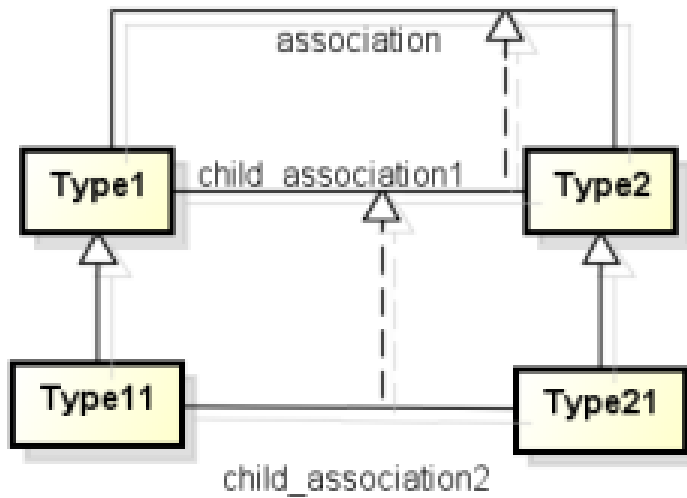


(a)

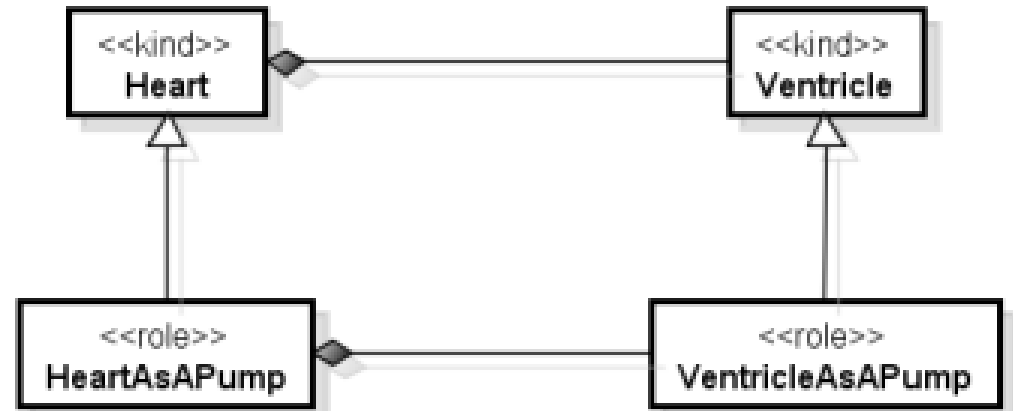


(b)

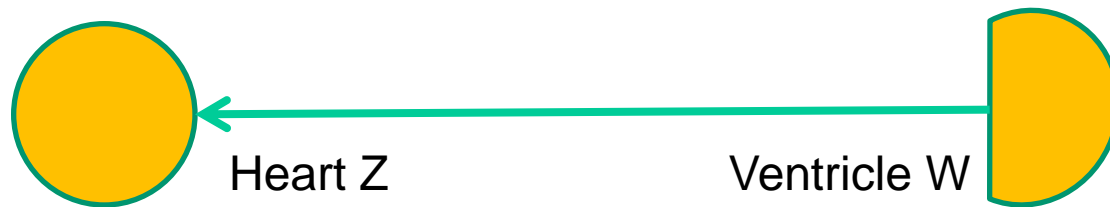
Relation Specialization (RS)

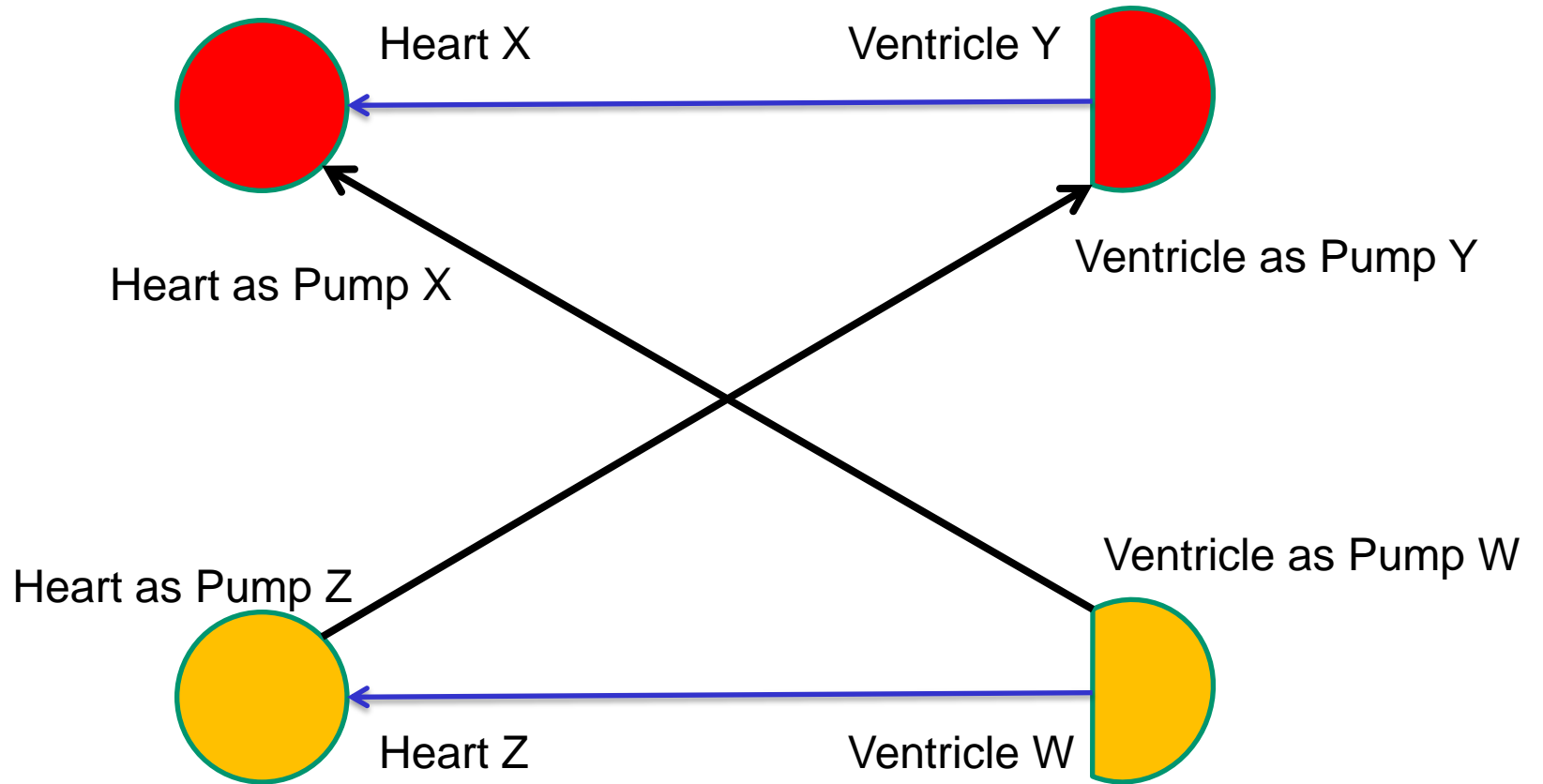


(a)



(b)





Sample of Ontologies Analyzed

1. A Conceptual Model that describes a Brazilian Health Organization
2. A Conceptual Model that describes the Organizational Structure of Brazilian Federal Universities
3. A Conceptual Model that describes a Domain of Online Mentoring Activities
4. An Ontology representing the domain of Transport Optical Network Architectures
5. An Ontology in the Biodiversity Domain
6. A Heart Electrophysiology Reference Ontology
7. An Ontology in the Domain of Normative Acts
8. An Ontology of Public Tenders
9. An Ontology in the Domain of Brazilian Federal Organizational Structures

Ontology	#GC	#RBOS	#RS	#IA	#TRR	#PAR
1	1	1	0	1	0	0
2	1	1	1	3	0	0
3	3	2	0	1	0	0
4	9	1	3	3	4	1
5	2	2	11	3	3	0
6	2	0	2	2	0	2
7	8	3	0	3	0	0
8	2	4	1	0	0	0
9	2	0	2	1	2	1
Total	30	14	20	17	9	4
Percentage	100%	77.78%	66.67%	88.89%	33.33%	33.33%

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**. When you simulate a partial model, you **see examples immediately** that **suggest new constraints to be added**. Then the sense of **humiliation** sets in, as you discover that **there's almost nothing you can do right**.

Daniel Jackson

References



- GUIZZARDI, G., Theoretical Foundations and Engineering Tools for Building Ontologies as Reference Conceptual Models, Semantic Web Journal, Editors-in-Chief: Pascal Hitzler and Krzysztof Janowicz, IOS Press, Amsterdam, 2010.
- BRAGA, B., ALMEIDA, J.P.A., GUIZZARDI, G.; BENEVIDES, A.B. Transforming OntoUML into Alloy: Towards Conceptual Model Validation using a Lightweight Formal Method, Innovations in System and Software Engineering (ISSE), Springer-Verlag, 2010.
- SALES, T.P., BARCELOS, P.P.F., GUIZZARDI, G.: Identification of Semantic Anti-Patterns in Ontology-Driven Conceptual Modeling via Visual Simulation, 4th International Workshop on Ontology-Driven Information Systems (ODISE 2012), Graz, Austria, 2012 (together with the 7th International Conference on Formal Ontology in Information Systems – FOIS 2012).
- GUIZZARDI, G.; GRAÇAS, A.P., GUIZZARDI, R.S.S., Design Patterns and Inductive Modeling Rules to Support the Construction of Ontologically Well-Founded Conceptual Models in OntoUML, 3rd International Workshop on Ontology-Driven Information Systems (ODISE 2011), London, UK (together with the 23rd International Conference on Advanced Information System Engineering - CAiSE'11).



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