Laboratory for Applied Ontology

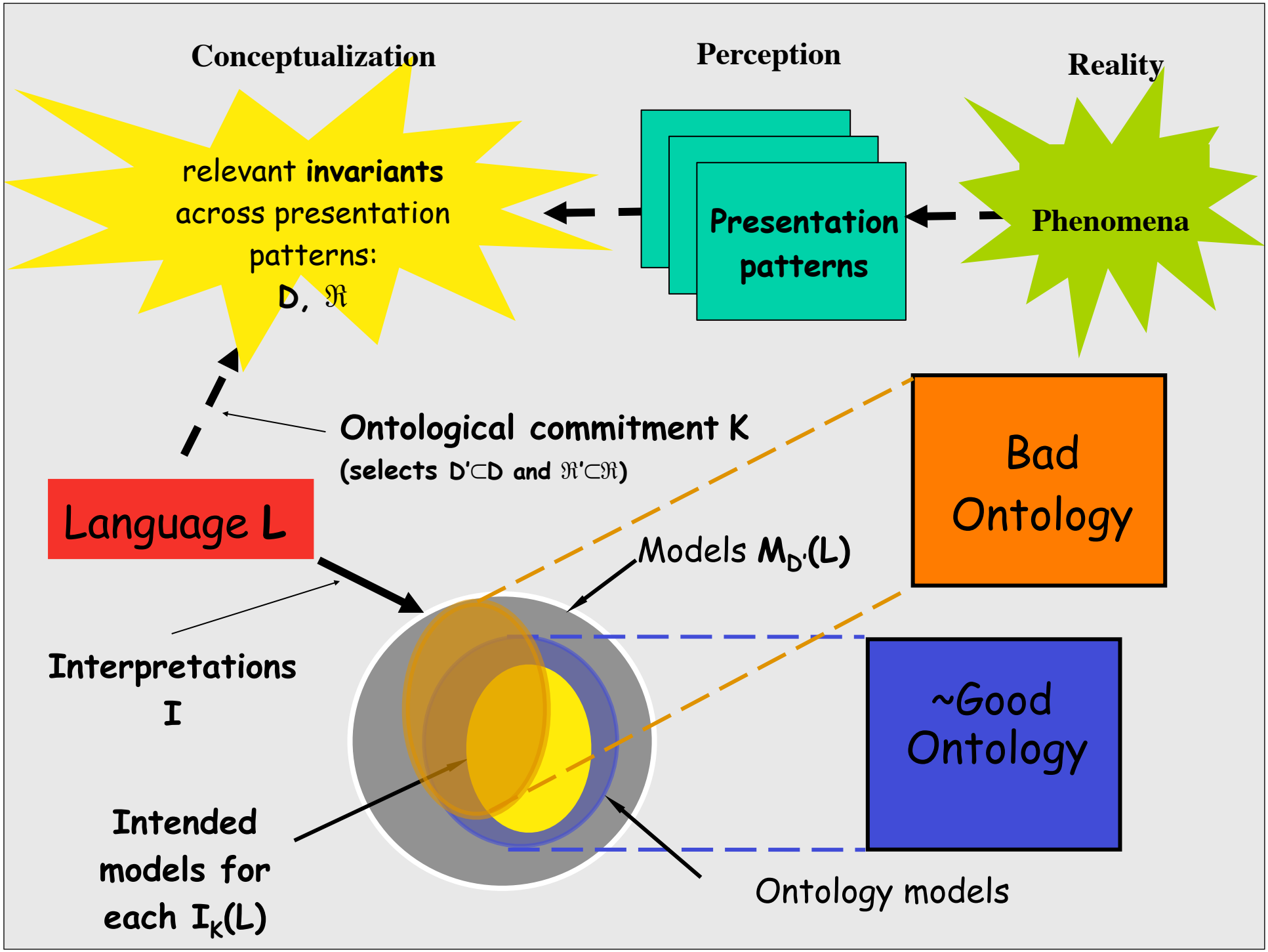
Institute of Cognitive Science and Technology
Italian National Research Council

Design patterns, competency questions, and ontology quality

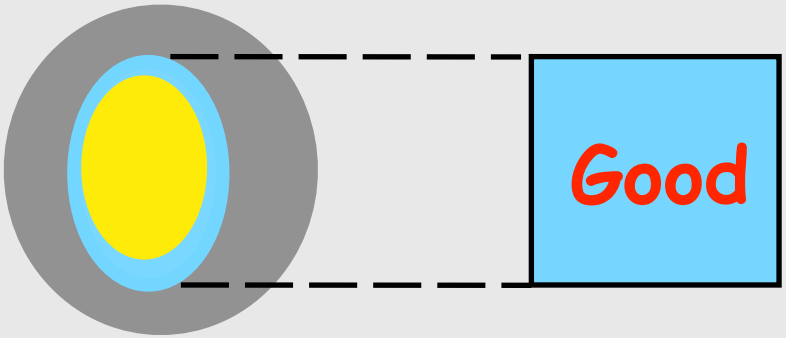
Nicola Guarino

Italian National Research Council
Institute of Cognitive Sciences and Technology (ISTC-CNR)
Laboratory for Applied Ontology, Trento

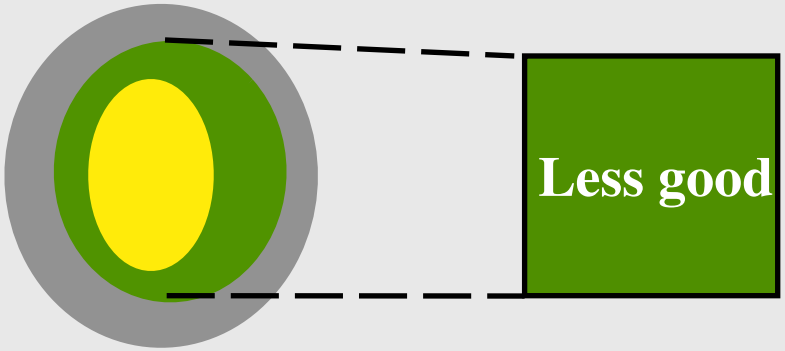
Good ontologies and bad ontologies


Conceptualization
Perception
Reality
relevant invariants across presentation patterns: D, ℜ
Presentation patterns
Phenomena
Ontological commitment K
(selects D'⊂D and ℜ'⊂ℜ)
Language L
Models $M_{D'}(L)$
Bad Ontology
Interpretations I
~Good Ontology
Intended models for each $I_K(L)$
Ontology models

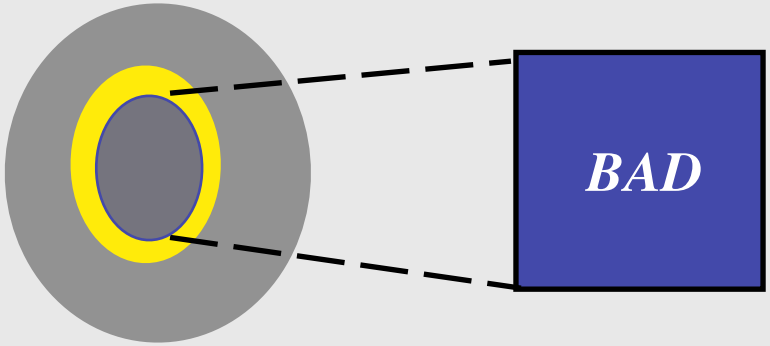
Ontology Quality: Precision and Correctness



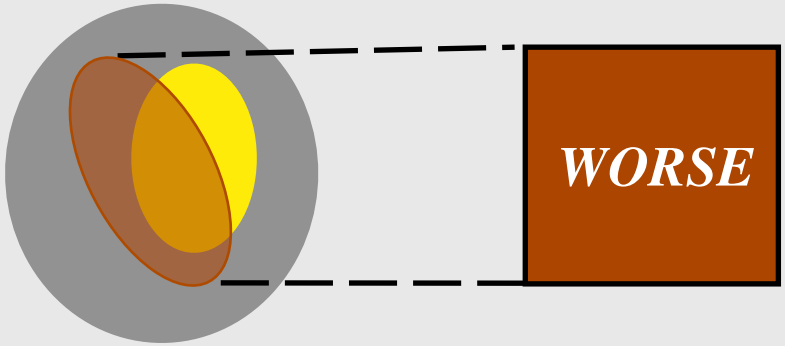
High precision, max correctness



Low precision, max correctness



Max precision, low correctness



Low precision, low correctness

When precision is not enough

Only one binary predicate in the language: on

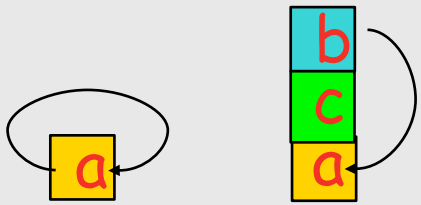
Only three blocks in the domain: a, b, c.

Axioms (for all x,y,z):

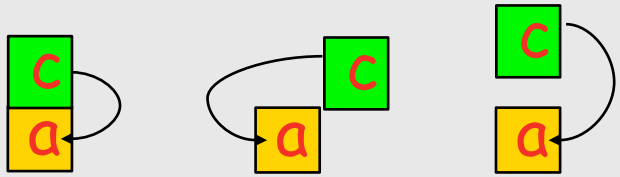
$on(x,y) \rightarrow \neg on(y,x)$

$on(x,y) \rightarrow \neg \exists z\ (on(x,z) \wedge on(z,y))$

Non-intended models are excluded, but the rules for the competent usage of on across different examples (presentations) are not captured.



Excluded conceptualizations



Indistinguishable conceptualizations

The reasons for ontology inaccuracy

- In general, a single intended ***model*** may not discriminate between positive and negative ***examples*** because of a ***mismatch*** between*:*
  - Cognitive domain and domain of discourse: lack of ***entities***
  - Conceptual relations and ontology relations: lack of ***primitives***

- Capturing all intended models is not sufficient for a “perfect” ontology

  Precision: non-intended *models* are excluded

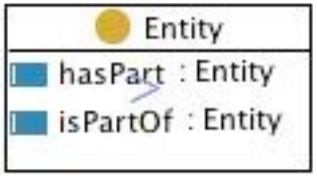
  Accuracy: negative *examples* are excluded

Ontology design patterns and ontology quality

"ontology design patterns play an important role in obtaining higher quality ontologies"
(from the Ontology Quality Workshop CFP)

A critical tradeoff: reusability vs. interoperabilty

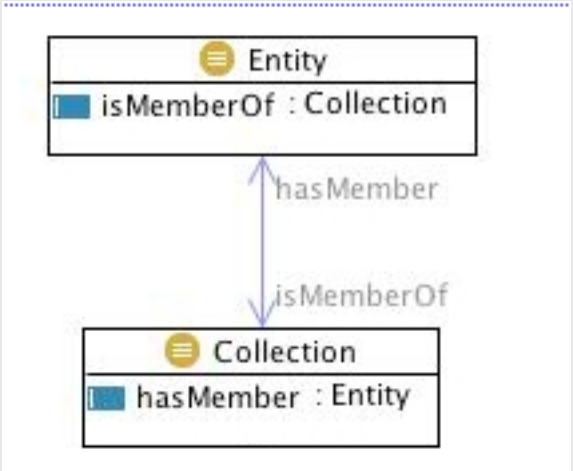
- *ontology patterns* are supposed to be highly ***reusable***...



- Name: part of
- Intent: To represent entities and their parts
- Competency questions: what is this entity part of? What are the parts of this entity?

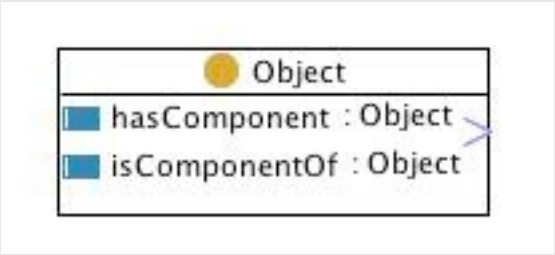
- Are they ***interoperable***?
- Differently from generic software, interoperability is the *reason d'être* of ontologies...

Member-collection



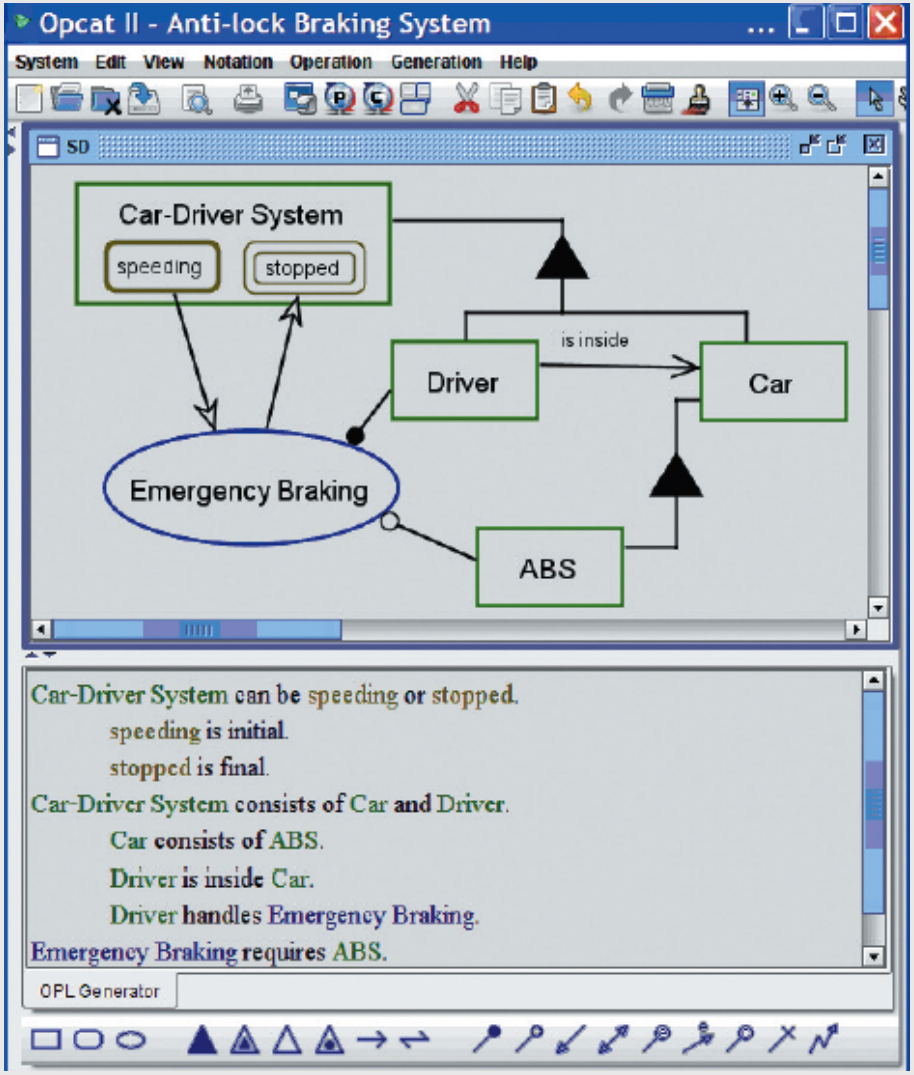
- What things are contained in this collection?
- What collections this thing is member of?

Componency



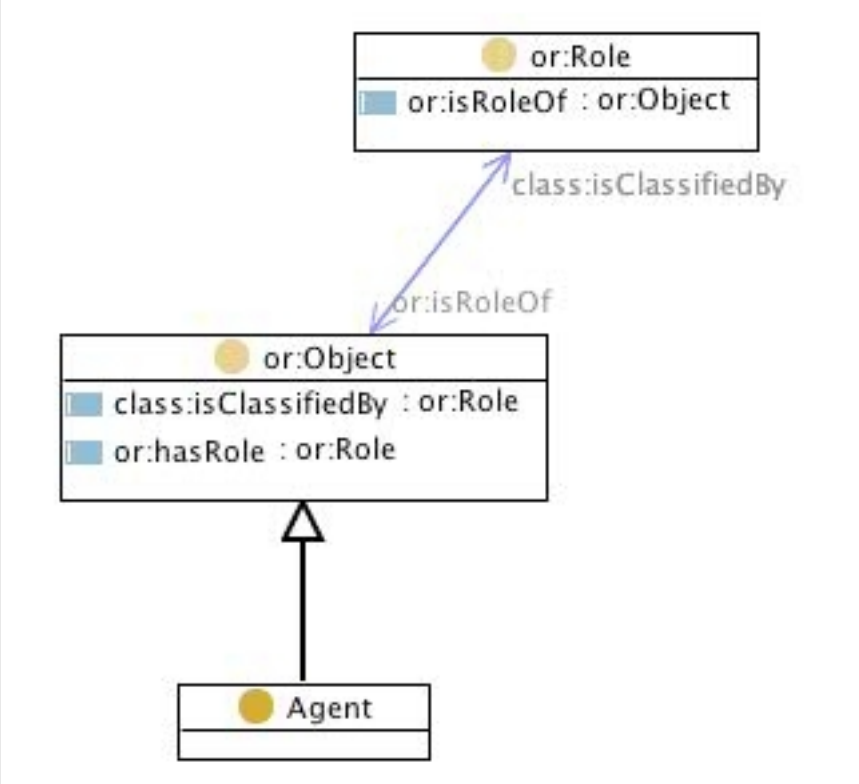
What is this object component of? What are the components of this object?

An interpretation of “part-of”



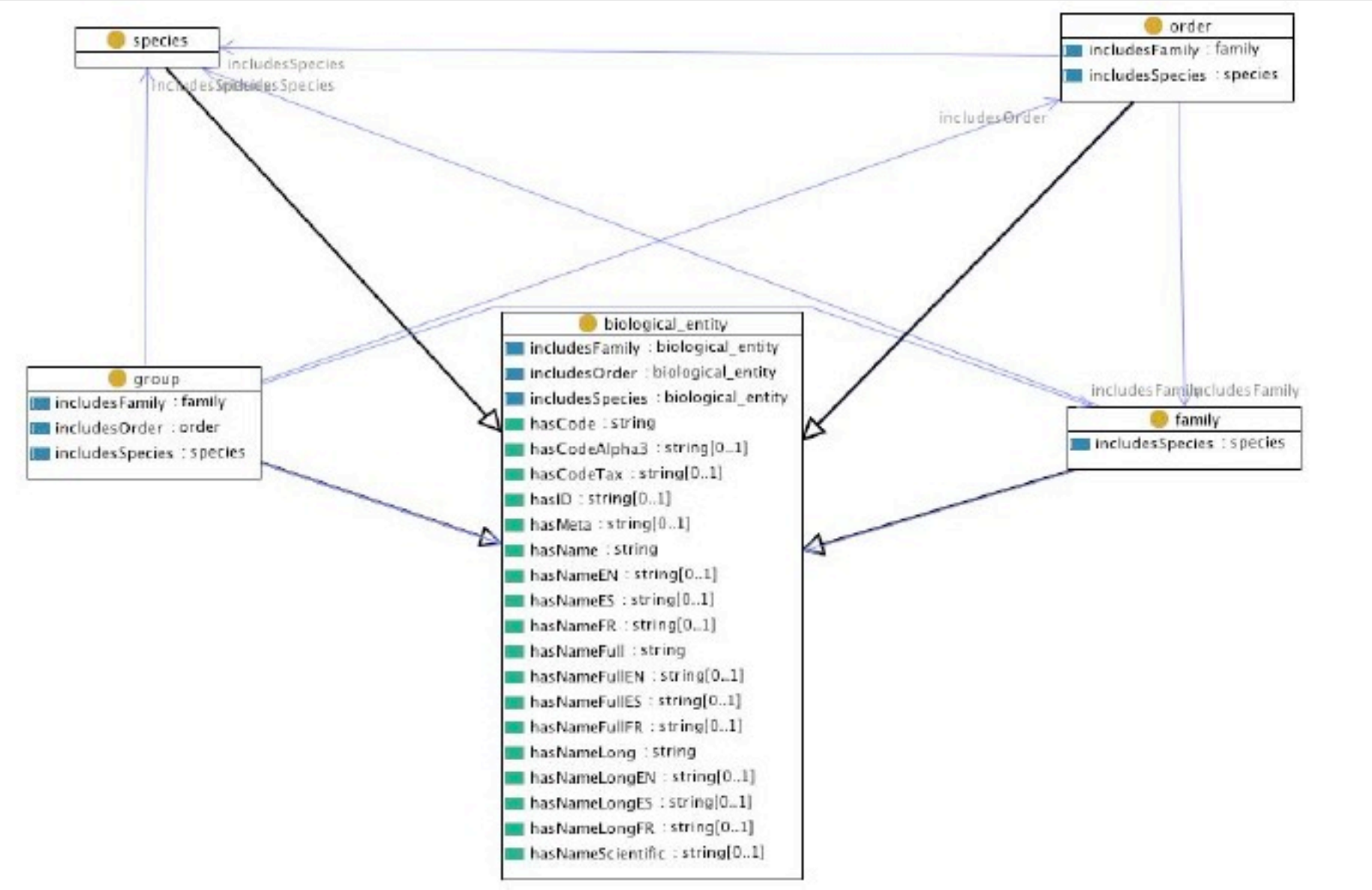
Dov Dory, Words from pictures for dual-channel processing, *Communications of the ACM* 51, 2008

Agent-Role

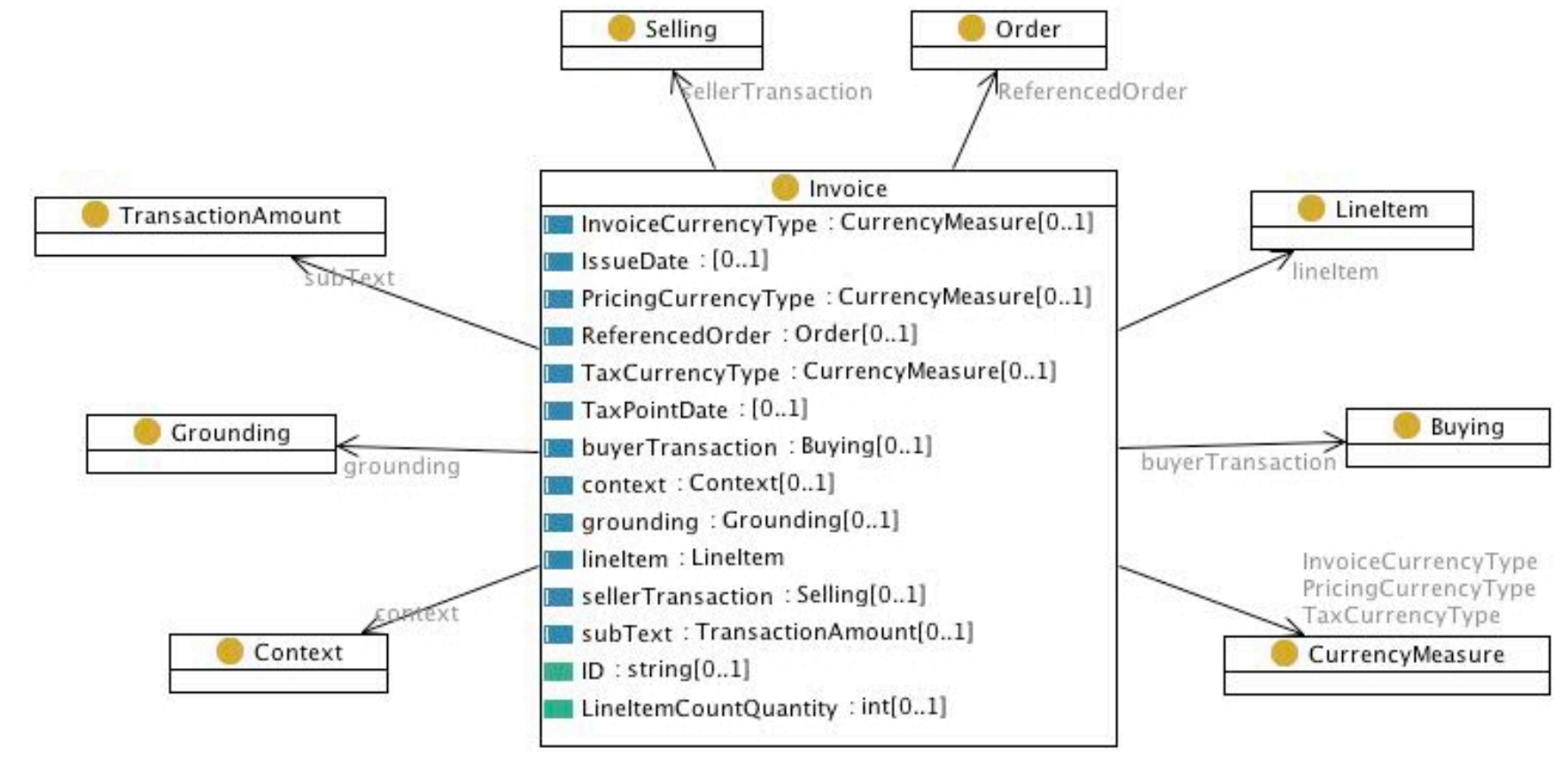


- which agent does play this role?
- what is the role that played by that agent?

Biological species



Invoice



- What are the transactions involved in this invoice?
- What is the order this invoice is referring to?
- What is the line item for this invoice?
- What is the amount of the transactions involved in this invoice?
- What currency is applied to this invoice?

Some competency questions for the GoodRelations ontology

- CQ1: Which retrievable Web Resources describe an offer?
- CQ2: For which time frame is the offer valid?
- CQ3: Which types of customers are eligible?
- CQ4: Which are the eligible customer regions?
- CQ5: Which shipping / delivery methods are available?
- CQ6: Which methods of payment are accepted?
- CQ10: What is the mail address and which are the contact details of the offering business entity?

Competency questions, according to their inventors (1)

It is not a well-designed ontology if all competency questions have the form of simple lookup queries

Uschold & Gruninger 96

Competency questions, according to their inventors (2)

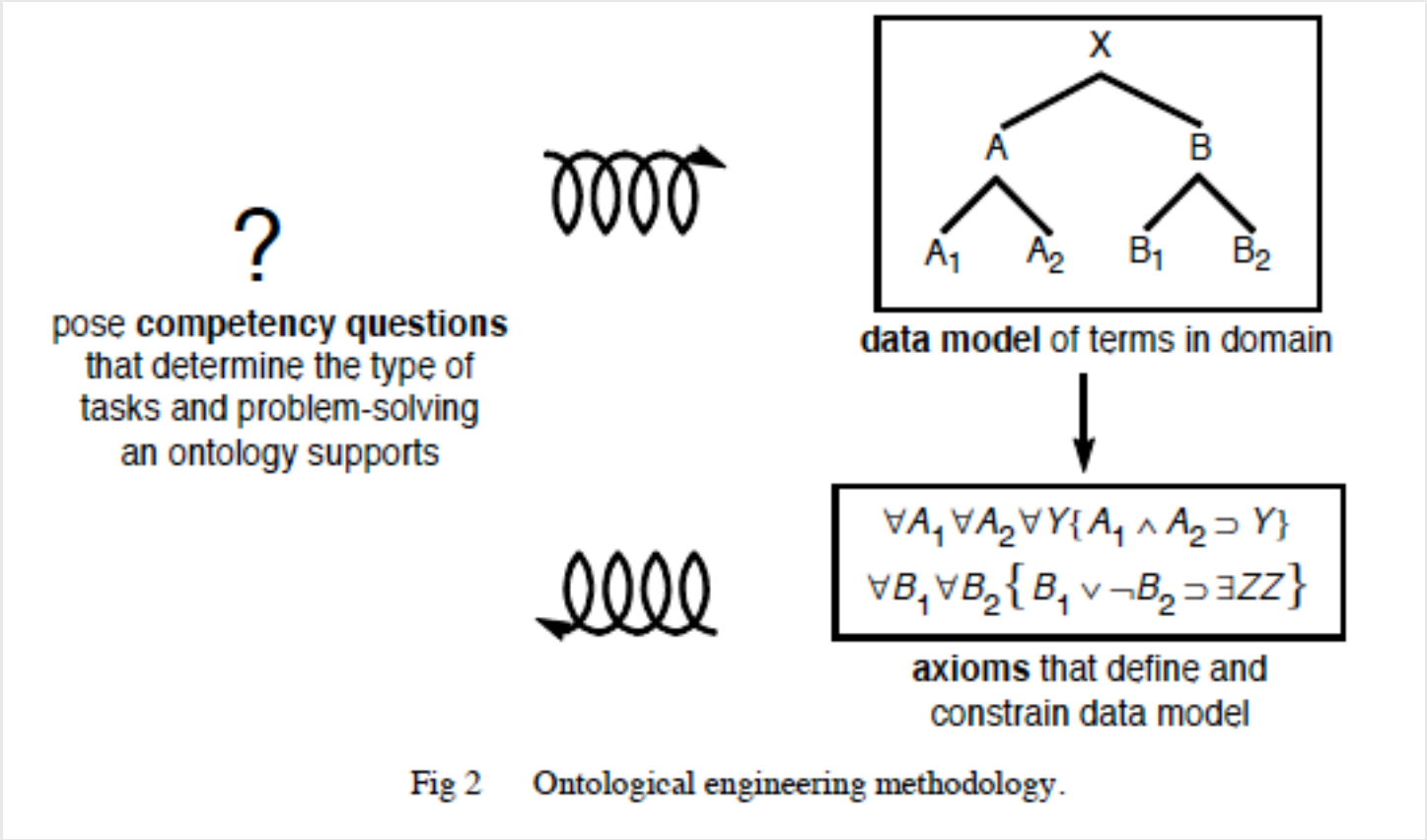


Fig 2 Ontological engineering methodology.

Kim, Fox & Gruninger 99

Original Gruninger's competency questions

- Planning and scheduling -- what sequence of activities must be completed to achieve some goal? At what times must these activities be initiated and terminated?
- Temporal projection -- Given a set of actions that occur at different points in the future, what are the properties of resources and activities at arbitrary points in time?
- Execution monitoring and external events -- What are the effects on the enterprise model of the occurrence of external and unexpected events (such as machine breakdown or the unavailability of resources)?
- Hypothetical reasoning -- what will happen if we move one task ahead of schedule and another task behind schedule? What are the effects on orders if we buy another machine?

Competency questions revisited

- Epistemological:
  - what is this entity part of?
  - what are the parts of this entity?

- Ontological:
  - what does it mean to be a part of something?
  - can something be part of itself?
  - can something have only one (proper) part?
  - are two entities the same if they have the same parts?
  - does parthood imply contact?
  - what's the difference between parthood and spatial inclusion?
  - what's the difference between parts and components?
  - how are they related?

A simple methodology towards ontology quality

- List possible ambiguities (collecting examples and using “stress tests”)
- Account for the differences
- Account for the relationships
- Stop when all the terms used are unambiguous (at least for your target community)

The risks of (current) ODPs

- ***Underspecification***: simplicity encourages reusability but risks to decrease interoperability
- ***Isolation***: focusing on an isolated pattern risks to overlook important ***structural connections***

Ontologies should be SIMPLE...

WHY?!

- Are mobile phones simple?
- Are computers simple?
- Are nuclear plants simple?
- Are *bank contracts* simple?

- Bulding an ontology is not simple...
- Using an ontology should be simple, and should help to simplify communication

- EKAW 2010: Ontology engineering ***by the masses****???*

IAOA

The International Association for Ontology and its Applications

News and Info

Join the IAOA **mailing list here**.
Download the **Association info flyer**.
Download the **Association statute**.
Please help us find a **logo**.

FOIS 2010
Sixth International Conference on Formal Ontology in Information Systems (CFP)

Welcome to the homepage of the IAOA. We will be extending this page over the coming weeks and month and welcome your input; meanwhile you will find all the necessary information to see what the association is for, what it might do for you, and how you can join.

Mission Statement:

The International Association for Ontology and its Applications is a non-profit organization the purpose of which is to promote interdisciplinary research and international collaboration at the intersection of philosophical ontology, linguistics, logic, cognitive science, and computer science, as well as in the applications of ontological analysis to conceptual modeling, knowledge engineering, knowledge management, information-systems development, library and information science, scientific research, and semantic technologies in general.
IAOA is open to all individuals and institutions who share its goals.

The Association is addressed to:

- Philosophers who have an interest in applying their analytical tools to technology advancement;
- cognitive scientists, linguists and terminologists aware of the subtle interplays among ontology, language, and cognition;
- computer scientists and IT professionals aware of the desperate need of a sound interdisciplinary approach for building future generation socio-technical systems.