



The Challenge of Semantic Integration and the Role of Ontologies

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What semantics is about...



Free places



Focusing on content

- The key problems
 - content-based information access (**semantic matching**)
 - content-based information integration (**semantic integration**)
- To approach them, content must be studied, understood, analyzed **as such**, independently of the way it is represented.
- Traditionally, computer technologies are not really good for that (they concentrate on *how*, not on *what*)
- ...and users are often confused by terms with high **evoking power...**
- **Ontology**: the study of *being qua being* (independently of *knowledge*)
- **Applied ontology**: the study of *content qua content* (independently of *representation*)



Subtle distinctions *matter...*

“Trying to engage with too many partners too fast is one of the main reasons that **so many online market makers have foundered.** The transactions they had viewed as simple and routine **actually involved many subtle distinctions in terminology and meaning**”

Harvard Business Review, October 2001

Subtle distinctions in meaning...

- What is an *application* to a public administration?
- What is a *working place*?
- What is an *unemployed person*?
- What is a *customer*?
- What is a *service*?
- What is a *contract*?



Conceptualization

Perception

Reality

relevant invariants across presentations:
 D, \square

Presentation

Phenomena

Ontological commitment K

Language L

Bad Ontology

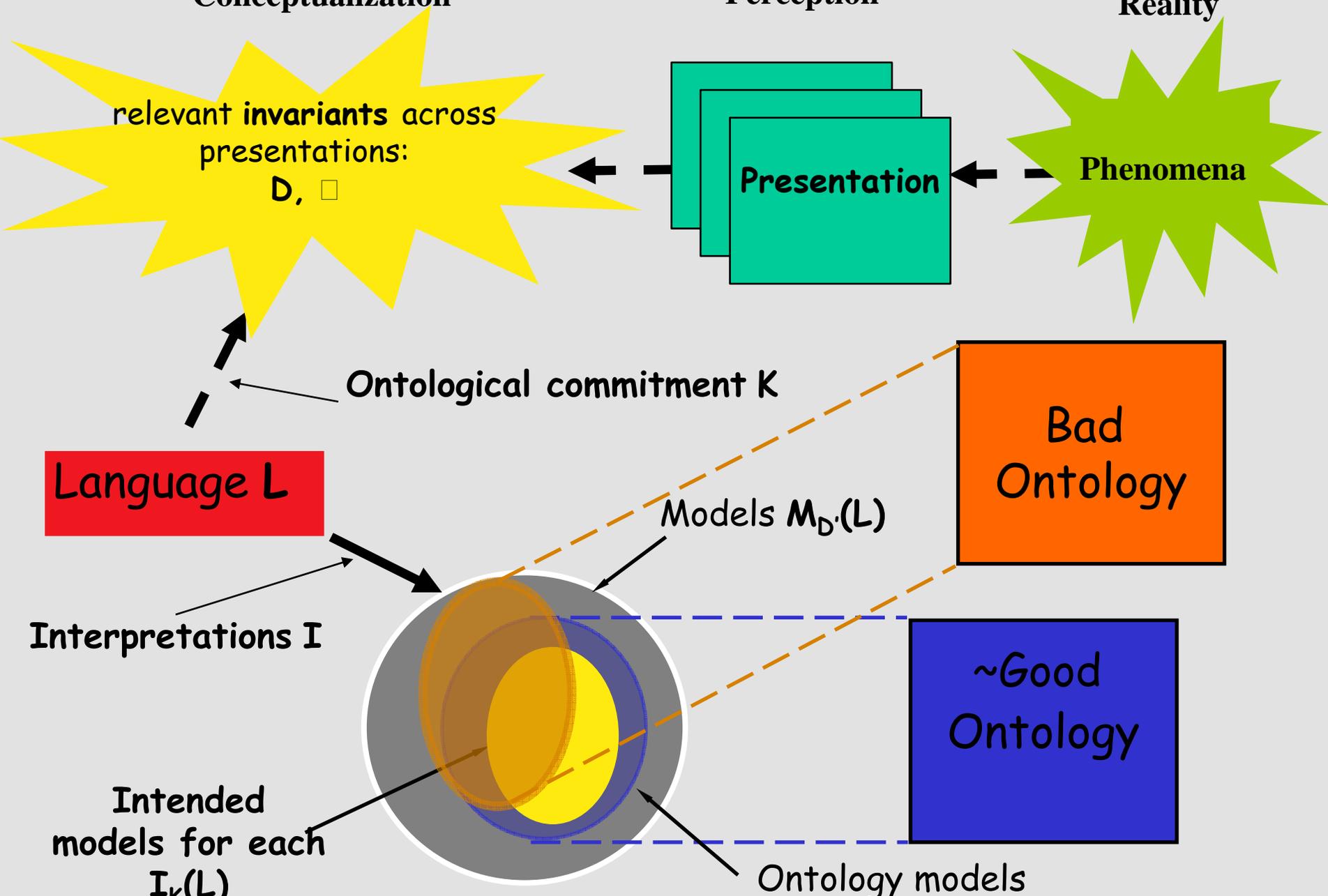
Models $M_D(L)$

Interpretations I

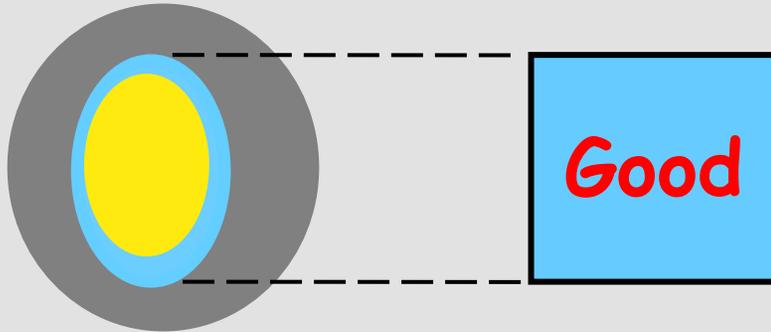
\sim Good Ontology

Intended models for each $I_k(L)$

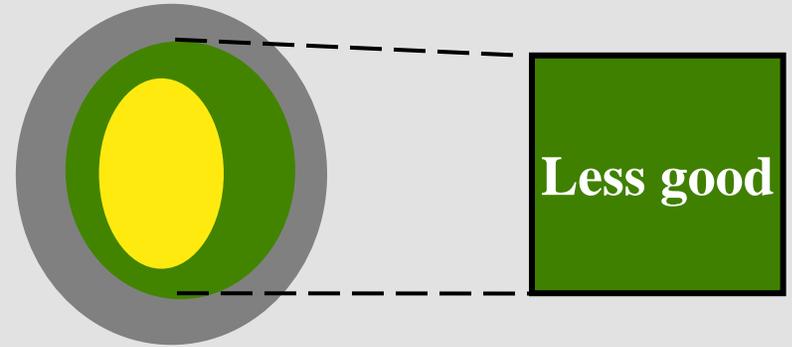
Ontology models



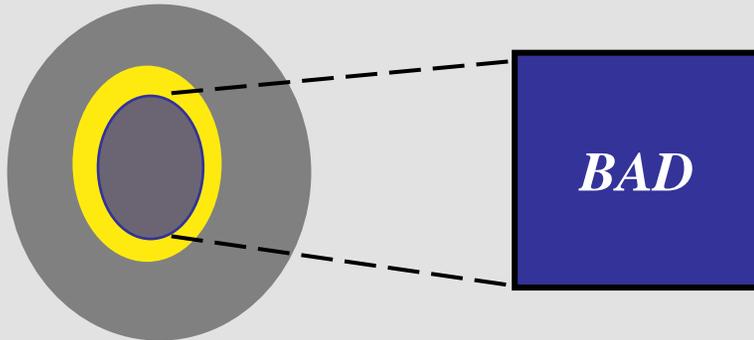
Ontology Quality: Precision and Coverage



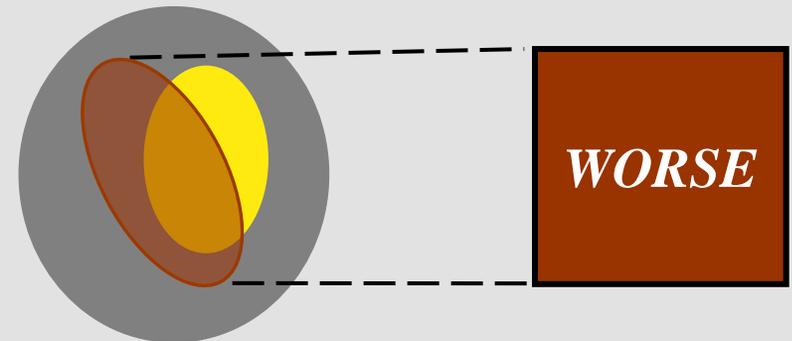
High precision, max coverage



Low precision, max coverage



Max precision, limited coverage



Low precision, limited coverage

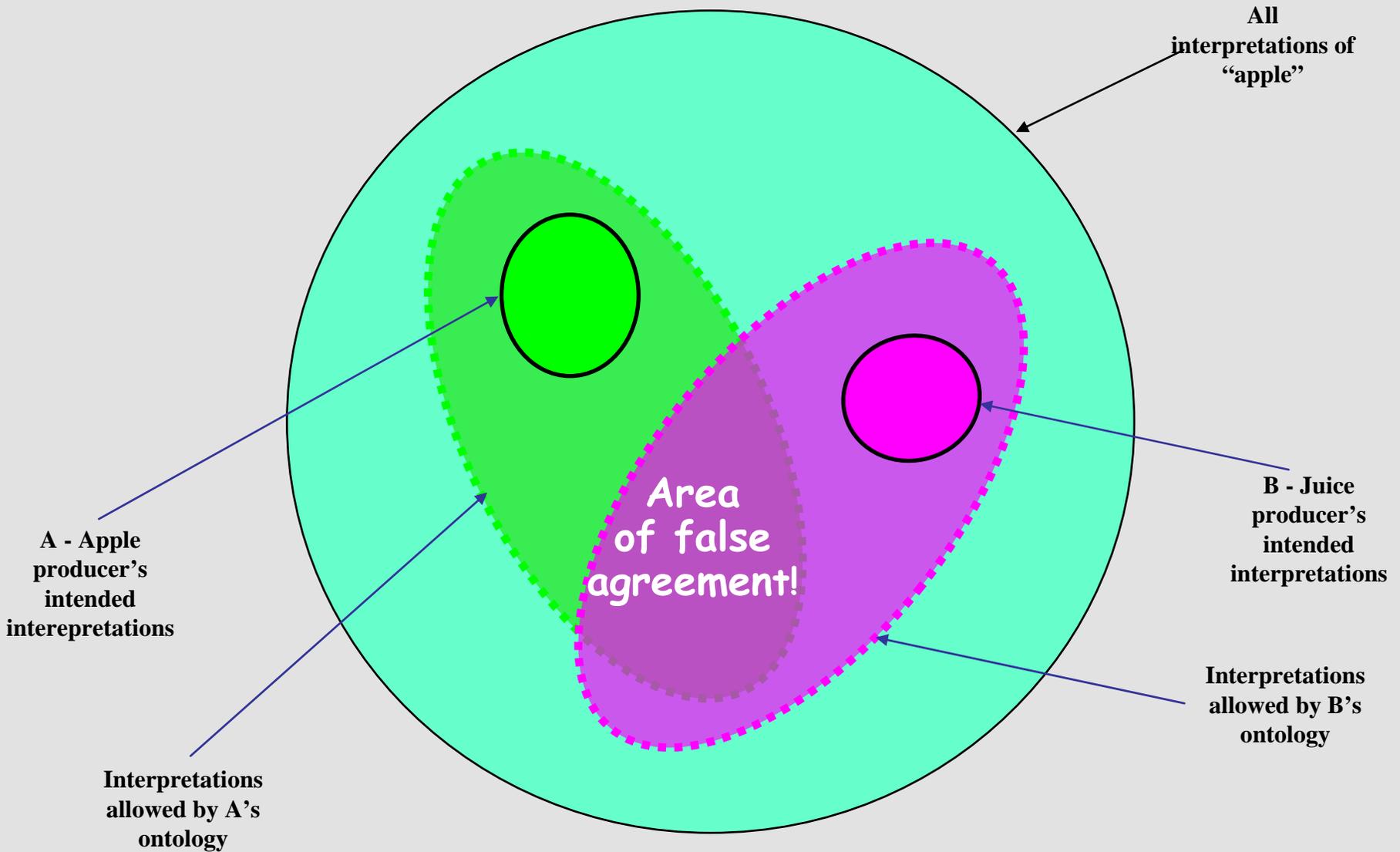
Database A: keeping track of fruit stock

Variety	Quantity
Granny Smith	12
Golden delicious	10
Stark delicious	15

Database B: keeping track of juice stock

Variety	Quantity
Granny Smith	12
Golden delicious	10
Stark delicious	15

Why ontological precision is important



When is a precise and accurate ontology useful?

1. When *subtle distinctions* are important
2. When *recognizing disagreement* is important
3. When *careful explanation and justification* of ontological commitment is important
4. When *mutual understanding* is more important than interoperability.



The two fundamental scenarios for semantic integration

1. *Same domain, same terminology, same conceptualization:* e.g., different processes within a very small, family-managed enterprise (everybody does everything)
2. *Same domain, shared terminology, different conceptualization:* e.g., different branches of a big company with a strong organization structure..

Current ontologies have been born for 2, but, they are actually used for 1: *just shared data schemes*. The result is the so-called “**data sylos**” effect.

The effects of *data sylos*

- C. Petrie, C. Bussler, *The Myth of Open Web Services*, *IEEE Internet Computing* 2008:

“run-time interoperability is **technically feasible only within service parks**, where [...] services are very constrained, and [...] the semantics will be common because the objects are common”

“some interoperability among service parks might emerge, but could take a long time”

- K. Sykara, *Unthethering Semantic Web Services*, *IEEE Intelligent Systems* 2007:

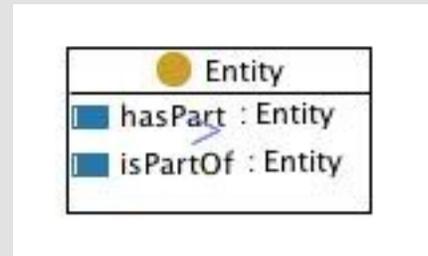
“current Web services proposals **don’t enable the semantic representation of business relations, contracts, or business rules** in a machine-understandable way”, while “current business-process languages [...] are at a low abstraction level and don’t provide formal business semantics”.

The ontologies paradox

- Ontologies are supposed to solve interoperability issues
- So there is a increasing demand for ontologies
- Including people who have only a vague idea of what ontologies are, and almost no education on ontological analysis
- These people want to keep their ontology simple, and tend to refuse existing ontologies unless they are really minimal
- But minimalist ontologies are inevitably used and adapted in incompatible, idiosyncratic ways
- As a result, new interoperability problems are introduced

A critical tradeoff: reusability vs. interoperability

- So-called *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**?

Competency questions

- 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?



Some competency questions for the SUPER project

- **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?



The formal tools of ontological analysis

- Theory of Essence and Identity
- Theory of Parts (Mereology)
- Theory of Unity and Plurality
- Theory of Dependence
- Theory of Composition and Constitution
- Theory of Properties and Qualities

The basis for a common ontology vocabulary



Idea of Chris Welty, IBM Watson Research Centre, in sabbatical at our lab in 2000

Going beyond (linked) data:

- What data are about: events, people, locations, organizations, goods, services...
- The social and institutional entities who create and use the data
- the social interactions where data play an essential role
- the sorts of things which we can *do* with data

No semantic interoperability without this rich ontology!

The Pan-European Person Model

- Core personal data
 - Born date
 - Born place
 - Name
 - Gender
 - Biological data
 - ...
- Do these attributes have the same ontological status?
- NO! the name is the result of a *naming event*....



Ontologies should be SIMPLE...

WHY?!

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

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

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



I A O A

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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.
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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.