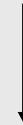


## What is an ontology

## Ontology and (natural language) semantics

- Strictly intertwined: ontology is about *what there is*, semantics is about *referring* to what there is...
- Structural semantics vs. *referential semantics*
- Different aspects of language, different roles of ontology
  - Language connectives (conjunctions, conditionals...)
  - Primitive sentences (predication)
  - Quantifiers and modifiers
  - Prepositions
  - Nouns and verbs
  - Discourse structure

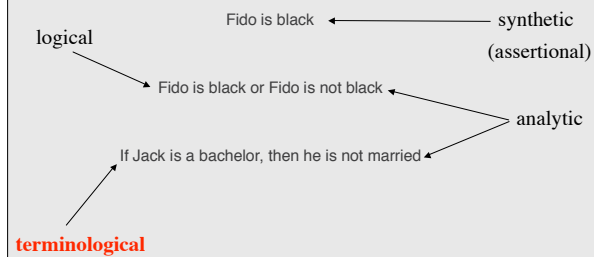
Increasing  
ontological  
commitment



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## Kinds of meaning



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## Ontological commitment

- Every natural language (or maybe every contextualized sentence) *commits* to some ontology (i.e., makes assumptions on *what there is*), in two ways:
  - Through a *closed* system of grammatical features
  - Through an *open* system of lexemes
- "Ontological semantics" [Nirenburg & Raskin 2004]: the semantics is driven by an ontology.
  - Practical role of ontologies for NLP systems
- Every organization, every computer system
  - Adopts a certain lexicon, to which an *intended semantics* is ascribed.
  - Makes (implicit) ontologic assumptions



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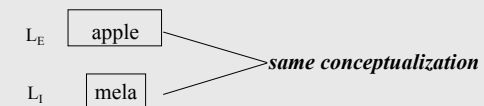
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## What kinds of commitment?

- Commitment to **existence**:
  - Quine: every (logical) theory commits to the class of entities it **quantifies on**.
  - Problems:
    - Should every common noun correspond to an ontological category?
      - Questionable entities**: Events, features, qualities, fictional characters...
    - Should different linguistic behaviors mark/reflect different ontological categories?
- Commitment to **meaning**:
  - Problem: capturing **meaning postulates**
- Ontologies are a way to specify *both* commitments.

## What is a conceptualization

- Formal structure of (a piece of) reality *as perceived and organized by an agent, independently of*:
  - the **vocabulary** used
  - the actual occurrence of a specific **situation**
- Different situations involving same objects, described by different vocabularies, may share the same conceptualization.



## Ontology and Ontologies

- Ontology**: the philosophical discipline
  - Study of *what there is* (being qua being...)
    - ...a liberal reinterpretation for computer science:
      - content qua content**, independently of the way it is represented
  - Study of the **nature** and **structure** of "reality"

### ontologies:

Specific (theoretical or computational) artifacts expressing the **intended meaning** of a **vocabulary** in terms of **primitive** categories and relations describing the **nature** and **structure** of a **domain of discourse**

...in order to account for the competent use of vocabulary in real situations!

Gruber: "Explicit and formal specifications of a **conceptualization**"

## Representing Intensional Relations

ordinary (extensional) relations are defined on a **domain**  $D$ :

$$r_1 \subseteq D \quad r_2 \subseteq D \times D \quad r_n \subseteq D^n \quad r_n \in 2^{D^n}$$

intensional relations are defined on a **domain space**  $\langle D, W \rangle$

$$\rho_n : W \rightarrow 2^{D^n} \quad (\text{Carnap, Montague})$$

But what are possible worlds?  
What are the elements of a domain of discourse?

## What is a *conceptualization*? A cognitive approach

- Humans isolate **relevant invariances** from physical reality (quality distributions) on the basis of:
  - Perception (as resulting from evolution)
  - Cognition and cultural experience (driven by actual needs)
  - (Language)
- presentation**: atomic event corresponding to the perception of an external phenomenon occurring in a certain region of space (the *presentation space*).
- Presentation pattern** (or *input pattern*): a pattern of **atomic stimuli** each associated to an atomic region of the presentation space. (Each presentation tessellates its presentation space in a sum of atomic regions, depending on the granularity of the sensory system).
- Each atomic stimulus consists of a bundle of **sensory quality values** (qualia) related to an atomic region of timespace (e.g., *there is red, here; it is soft and white, here*).
- Domain elements corresponds to invariants **within and across** presentation patterns

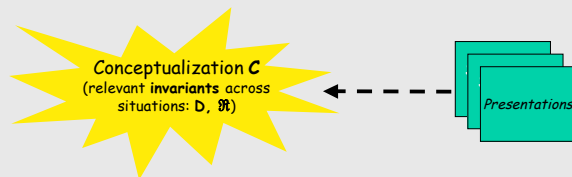


## The basic ingredients of a conceptualization (simplified view)

- cognitive objects (and events)**: mappings from (sequences of) presentation patterns into their **parts**
  - for every presentation, such parts constitute the **perceptual reification** of the object.
  - multiple objects in a single presentation: equivalence relationship among parts based on **unity criteria**
- concepts and conceptual relations**: functions from (sequences of) presentation patterns into **sets of (tuples of) cognitive objects**
  - if the value of such function (the concept's **extension**) is not an empty set, the corresponding perceptual state is a (positive) **example** of the given concept
  - Rigid concepts**: same extension for all presentation patterns (possible worlds)



## From experience to *conceptualization*



**D** : cognitive domain

**R** : set of *conceptual relations* on elements of D



## Possible worlds as presentation patterns (or sensory states)

**Presentation pattern**: unique (maximal) pattern of **qualia** ascribed to a spatiotemporal region tessellated at a certain granularity

...This corresponds to the notion of *state* for a sensory system (maximal combination of values for sensory variables)

Possible worlds are (for our purposes)  
**sensory states**  
(or if you prefer, [maximal] sensory *situations*)



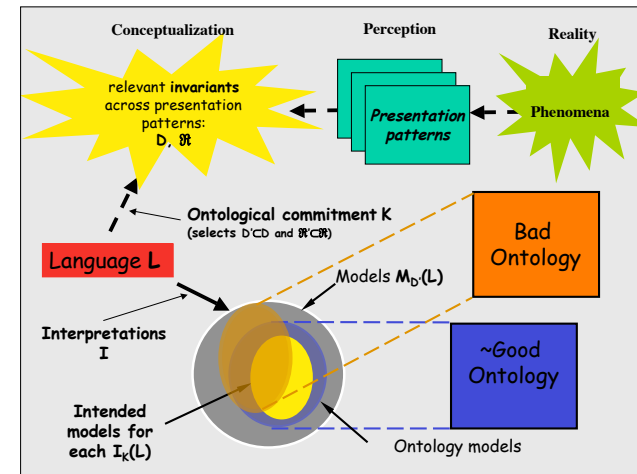
## Possible worlds vs. models

- Models are combinations of *meaning assignments*
- Worlds are - so to speak - combinations of *things!*
- Consider the *model* where there is a bachelor which is married.
- Is there a *world* where bachelors are not married?
  - ...in this world *bachelor* and *married* would have a different *meaning!!*



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A **conceptualization** for  $D$  is a tuple  $C = \langle D, W, \mathfrak{R} \rangle$ , where  $\mathfrak{R}$  is a set of conceptual relations on  $\langle D, W \rangle$

A **model** for a language  $L$  with vocabulary  $V$  is a structure

$\langle S, I \rangle$ , where  $S = \langle D, R \rangle$  is a **world structure** and  $I: V \rightarrow D \cup R$  is the **usual** interpretation function.

A model fixes a particular extensional interpretation of the language. Analogously, we can fix an **intensional** interpretation by means of a structure

$\langle C, \mathfrak{S} \rangle$  where  $C = \langle D, W, \mathfrak{R} \rangle$  is a conceptualization and  $\mathfrak{S}: V \rightarrow D \cup \mathfrak{R}$  is an **intensional interpretation** function.

We call such a structure  $K = \langle C, \mathfrak{S} \rangle$  an **ontological commitment** for  $L$ .

$L$  **commits** to  $C$  by means of  $K$ .

$C$  is the **underlying conceptualization** of  $K$ .