Laboratory for Applied Ontology

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Towards a Reference Library of Upper Ontologies
the DOLCE point of view

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Thanks to all LOA people!

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Summary

1. Lightweight ontologies vs. axiomatic ontologies
2. ***Why*** a Reference Library of (axiomatic) Upper Ontologies
3. ***What*** might the library look like
4. ***How*** to build such a library: a common framework
   - A common minimal vocabulary (meta-ontology?)
   - A common strategy to elicit the (hidden) assumptions behind each UO
   - Common guidelines to express ***Ontology Design Rationale***
   - Common metrics to ***compare*** ontologies
5. How to ***evaluate*** the practical utility of the library and of the single modules.
6. (**DOLCE**'s basic choices)

Lightweight ontologies vs. axiomatic ontologies

different roles of ontologies

- **Lightweight ontologies**
  - Intended meaning of terms ***mostly known in advance***
  - ***Taxonomic reasoning*** is the main ontology service
  - ***Limited expressivity***
  - ***On-line reasoning*** (stringent computational requirements)

- **Axiomatic ontologies**
  - ***Negotiate meaning*** across different communities
  - ***Establish consensus*** about meaning of a new term within a community
  - ***Explain meaning*** of a term to somebody new to community
  - ***Higher expressivity*** required to express intended meaning
  - ***Off-line reasoning*** (only needed ***once***, before cooperation process starts)

When are *axiomatic* ontologies useful?

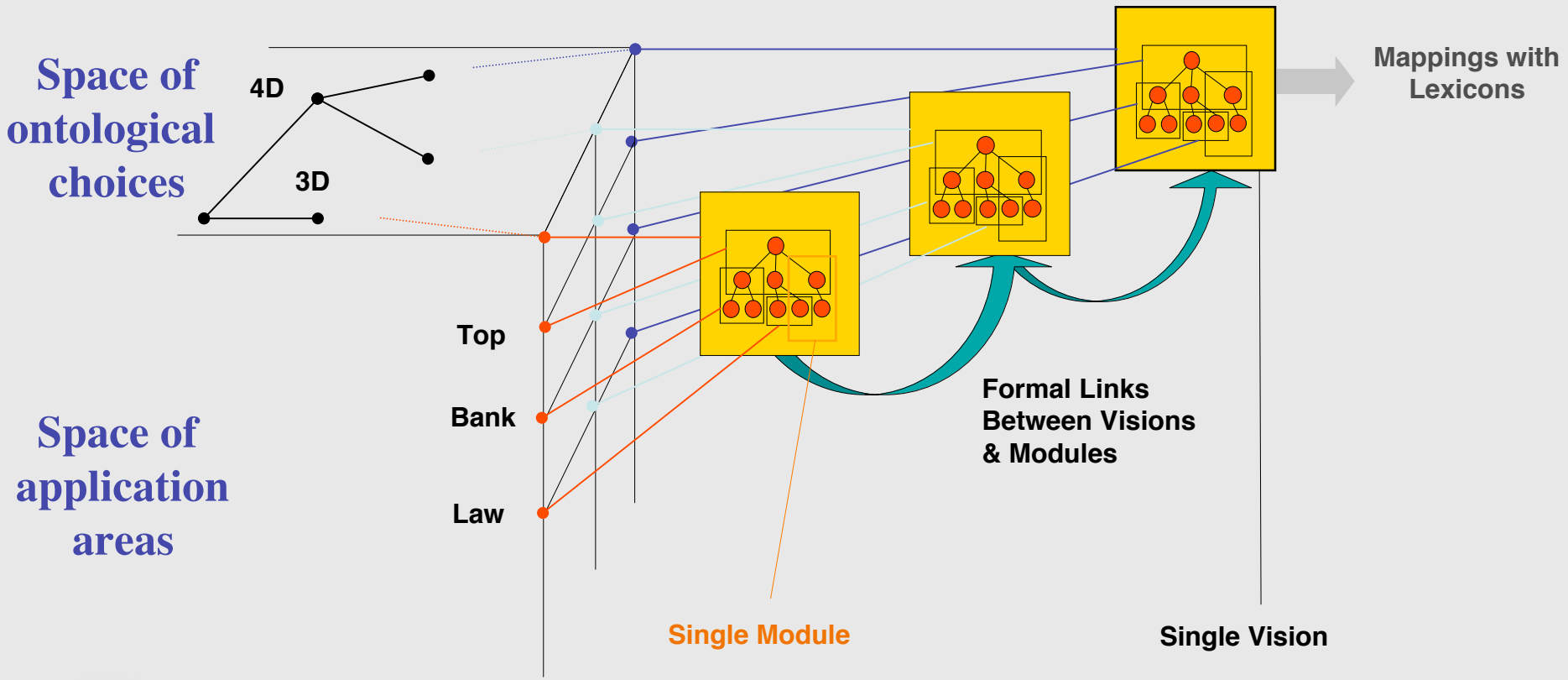
1. When *subtle distinctions* are important
2. When *recognizing disagreement* is important
3. When *rigorous referential semantics* is important
4. When *general abstractions* are important
5. When *careful explanation and justification* of ontological commitment is important
6. When ***mutual understanding*** is important.

Why a Reference Library of Upper Ontologies

- Understand disagreements
- Maximize agreements
- Promote interoperability

- A ***starting point*** for building new ontologies
- A ***reference point*** for easy and rigorous comparison among different ontological approaches
- A ***common framework*** for analyzing, harmonizing and integrating existing ontologies and metadata standards

The WFOL architecture (*WonderWeb FP5 project*)



A common minimal vocabulary (meta-ontology?)

- What is an ontology
- Common terms
  - Property vs. relation
  - Property vs. quality (harder…)
  - Primitive/defined relation
  - Conceptual relation vs. extensional relation
  - …

Common strategy to elicit hidden assumptions

- Systematically explore hidden intra- and inter-categorial relationships
  - How is subprocess related to part?
  - What are the possible relations within processes?

- Use general issues of *formal (philosophical) ontology* to elicit the assumptions made

- Exploit formal meta-properties (OntoClean-like)

Formal Ontological Analysis

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

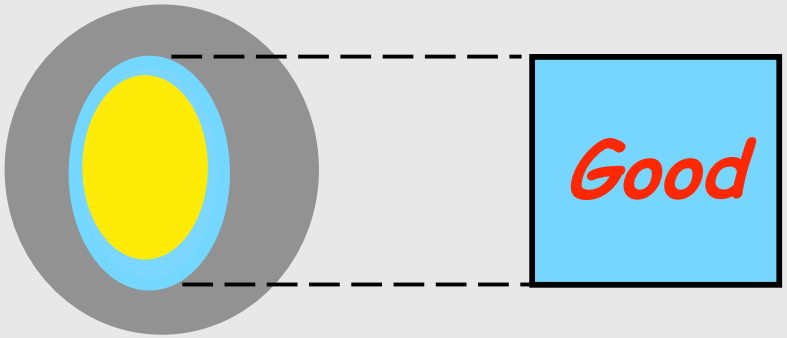
The basis for a common ontology vocabulary

Common guidelines to express ontology design rationale

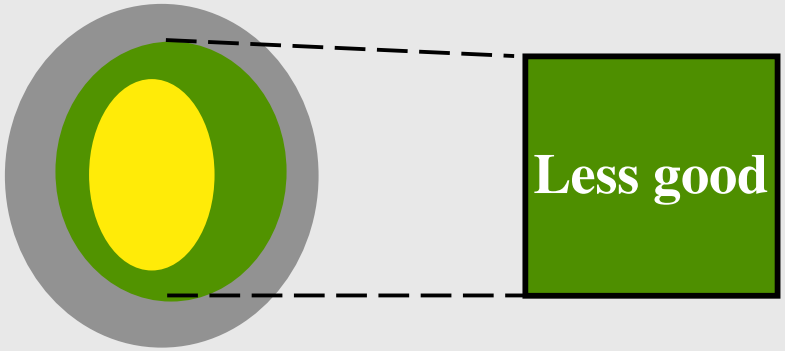
- Identify issues
- List possible alternatives
- Carefully ***justify*** and ***position*** the choices made with respect to possible alternatives
- ***Basic options*** should be clearly documented
- Clear ***branching points*** should allow for easy comparison of ontological options

- Tradeoffs with respect to:
  - Choice of domain
  - Choice of relevant conceptual relations
  - Choice of primitives
  - Choice of axioms

Comparing ontolgoies: precision and coverage



High precision, max coverage



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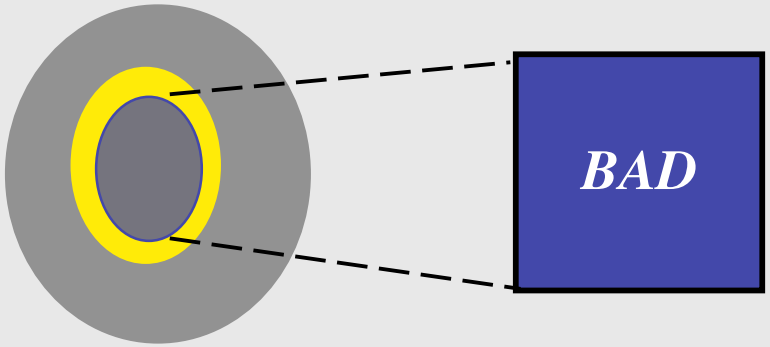
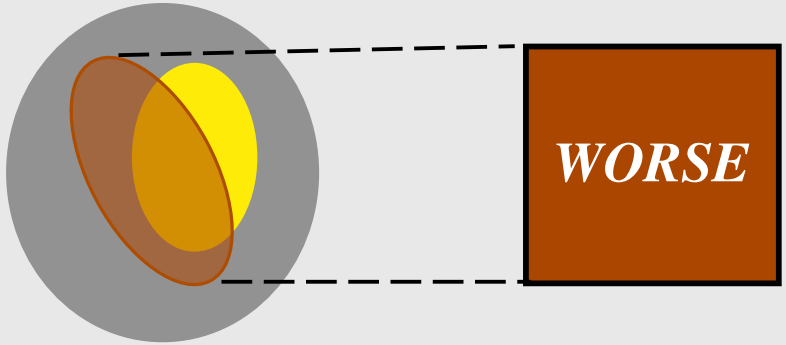


Max precision, limited coverage



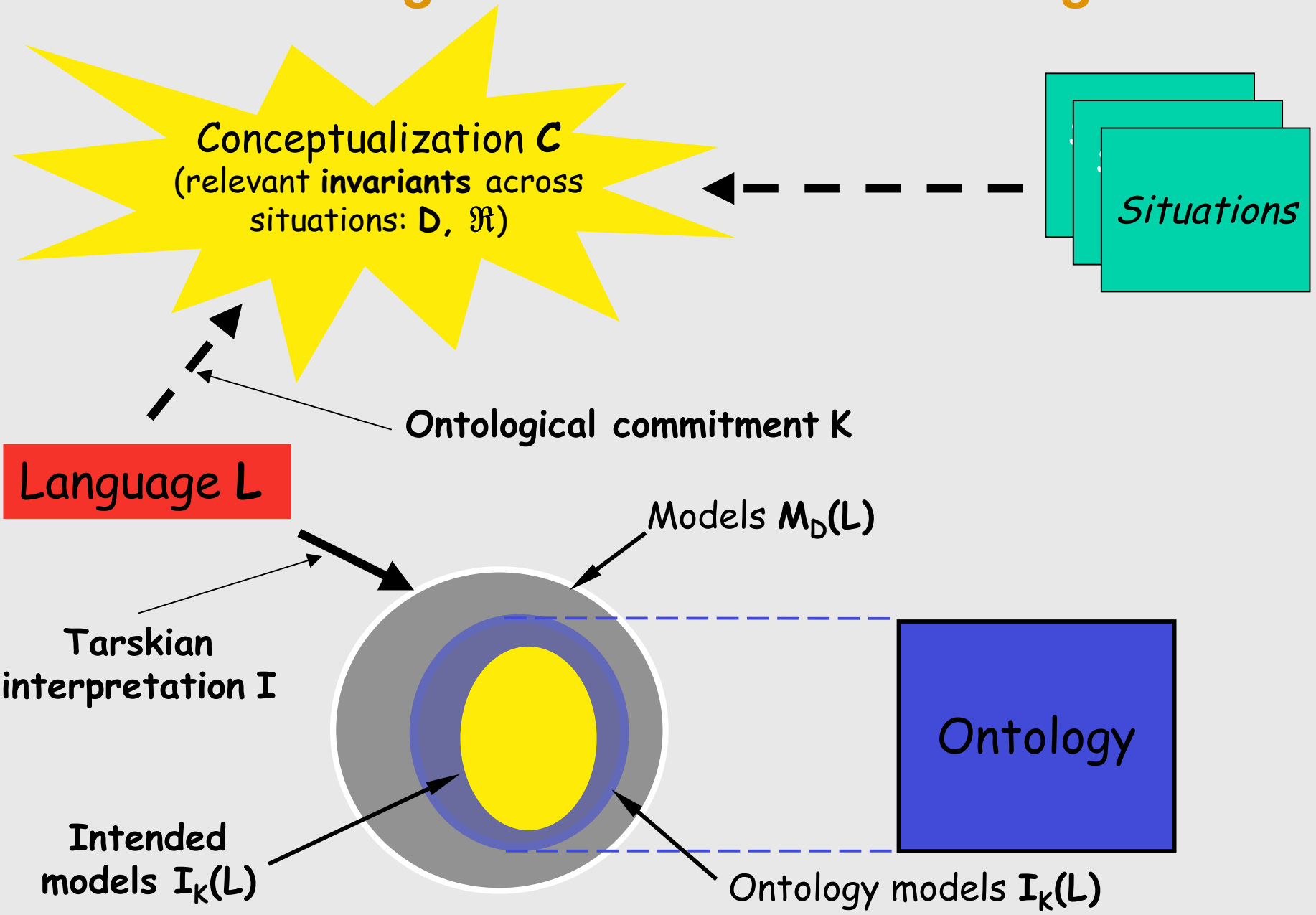
Low precision, limited coverage

Evaluating Upper Ontologies

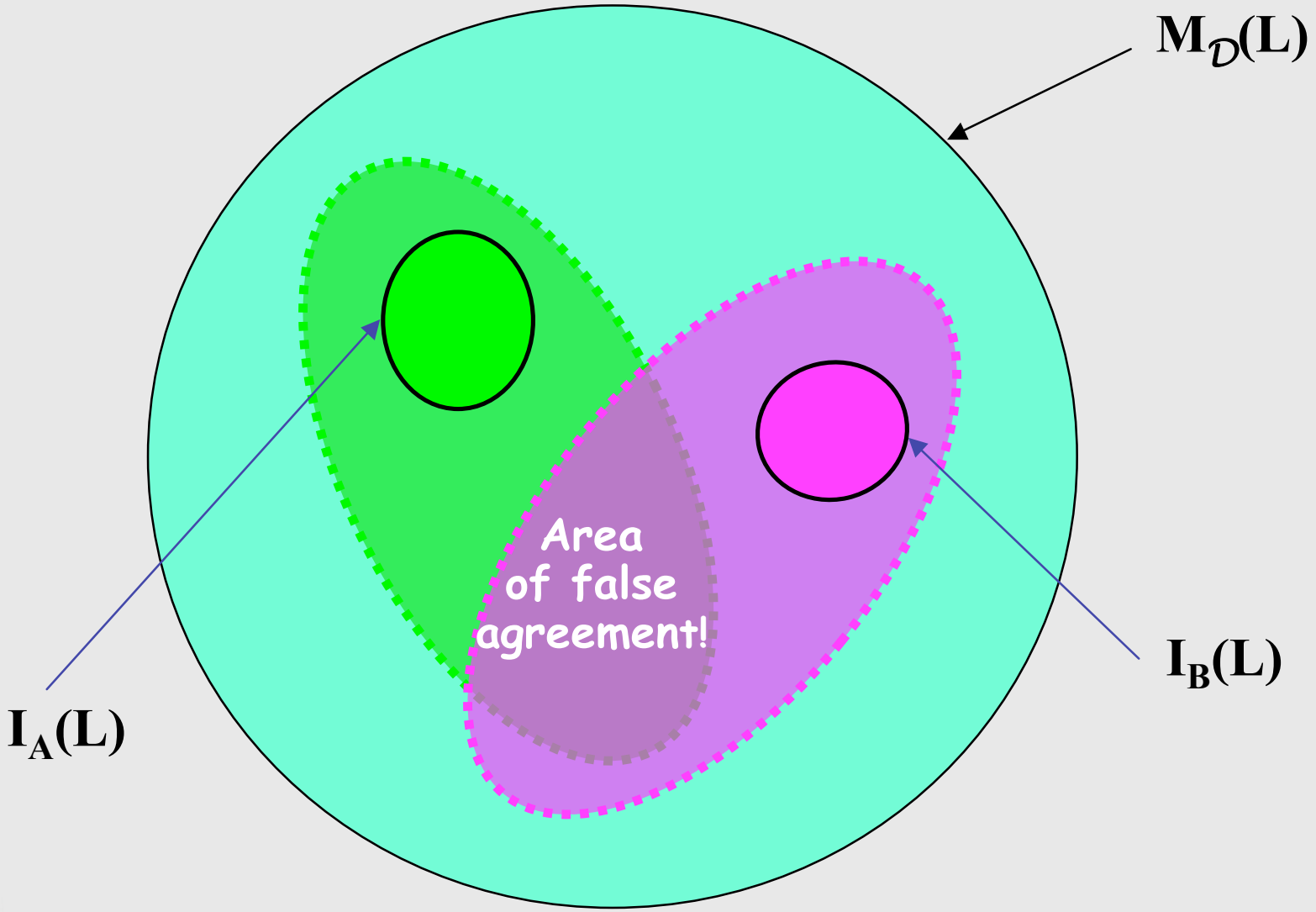
- [to be completed]

Extra slides

Ontologies and intended meaning



Why precision is important



DOLCE
a Descriptive Ontology for Linguistic and Cognitive Engineering

- Strong cognitive/linguistic bias:
  - ***descriptive*** (as opposite to *prescriptive*) attitude
  - Categories mirror cognition, common sense, and the lexical structure of natural language.
- Emphasis on ***cognitive invariants***
- Categories as ***conceptual containers***: no "deep" metaphysical implications
- Focus on ***design rationale*** to allow easy comparison with different ontological options
- Rigorous, systematic, interdisciplinary approach
- ***Rich axiomatization***
  - *37 basic categories*
  - *7 basic relations*
  - *80 axioms, 100 definitions, 20 theorems*
- Rigorous quality criteria
- Documentation

DOLCE's basic taxonomy

- Endurant
  - Physical
    - Amount of matter
    - Physical object
    - Feature
  - Non-Physical
    - Mental object
    - Social object
  - …
- Perdurant
  - Static
    - State
    - Process
  - Dynamic
    - Achievement
    - Accomplishment
- Quality
  - Physical
    - Spatial location
    - …
  - Temporal
    - Temporal location
    - …
  - Abstract
- Abstract
  - Quality region
    - Time region
    - Space region
    - Color region
    - …
  - …

DOLCE's Basic Ontological Choices

- **Endurants** (aka *continuants* or *objects*) and **Perdurants** (aka *occurrences* or *events*)
  - distinct categories connected by the relation of *participation*.

- **Qualities**
  - Individual entities *inhering in* Endurants or Perdurants
  - can live/change with the objects they inhere in
  - Instance of *quality kinds,* each associated to a **Quality Space** representing the *"values" (qualia)* that qualities (of that kind) can assume. Quality Spaces are neither in time nor in space.

- **Multiplicative approach**
  - Different Objects/Events can be spatio-temporally co-localized: the relation of *constitution* is considered.