Upper ontologies

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Outline

Motivation – Reuse of Ontological Resources

- Types of ontologies:
  - top-level (upper) ontologies
  - domain ontologies and task ontologies
  - application ontologies
- Ways to reuse ontological resources:
  - ontologies as wholes
  - syntactic/semantic ontology modules
  - ontology design patterns
  - ontology statements

Upper Ontologies

Basics

What Are Upper Ontologies ?

- **Upper ontologies** (sometimes also called *top-level* or *foundational* ontologies) describe very general concepts that are independent of particular problem or domain.
- They provide categories of kinds of things and relations that can provide a basic structure for "lower-level" ontologies such as domain ontology.

Why Should We Use Upper Ontologies ?

- Pros:
    - "top-down approach" and modelling guidance for ontology development
    - basic categories and relations that we don't need to reinvent again
    - interoperability among ontologies
- Cons:
    - a lot of effort needed to understand
    - too abstract

Basic Ontological Commitments

- Universals vs. Particulars – Universals can have instances, while Particulars don't
- Descriptive vs. Realist – represent world using natural language and common sense vs. represent it as is
- Multiplicative vs. Reductionist – different objects can be co-located at the same time vs. only one object may be located at the same region at one time
- Endurantism vs. Perdurantism – an object is wholly present at all times vs. an object has temporal parts
- Actualism vs. Possibilism – everything that exists in the ontology is real vs. objects are allowed independent of their actual existence
- Concrete & Abstract entities – entities that exist in space and time & entities that exist neither in space nor time

Overview of Existing Upper Ontologies

Existing Upper Ontologies

- UFO (Unified Foundational Ontology)
- BFO (Basic Formal Ontology)
- DOLCE (Descriptive Ontology for Linguistic and Cognitive Engineering)
- SUMO (Suggested Upper Merged Ontology)
- YOMATO (Yet Another More Advanced Top-level Ontology)
- GFO (General Formal Ontology)
- PROTON (PROTo ONtology)
- Cyc
- ?WordNet

Comparison of Ontological Commitments

Term and meaning	DOLCE	BFO	GFO	SUMO
Ontological Commitments				
Descriptive vs. Realist (Descriptive: represent the entities underlying natural language and human common-sense; Realist: represent the world exactly as is)	Descriptive	Realist	Descriptive and Realist	Descriptive
Universals vs. Particulars (Universals can have instances, particulars do not)	Particulars	Universals	Universals and Particulars	Universals and Particulars
Multiplicative vs. Reductionist (Multiplicative: different objects can be co-located at the same time; Reductionist: only one object may be located at the same region at one time)	Multiplicative	Reductionist	Unclear	Multiplicative
Endurantism vs. Perdurantism (Endurantism: an object is wholly present at all times; Perdurantism: an object has temporal parts)	Endurantism and Perdurantism	Endurantism and Perdurantism	Endurantism and Perdurantism	Endurantism and Perdurantism
Actualism vs. Possibilism (everything that exists in the ontology is real; Objects are allowed independent of their actual existence	Possibilism	Actualism	Unclear	Unclear
Eternalist stance (the past, present and future all exist)	Eternalist	Eternalist	Eternalist	Eternalist
Concrete & Abstract entities (Concrete: entities that exist in space and time; Abstract: entities that exist neither in space nor time)	Concrete and Abstract	Concrete	Concrete and Abstract	Concrete and Abstract
Mereology (theory of parts)	GEM	Own mereology	Own mereology	Own mereology
Temporal aspects	Provided	Not provided	Provided	Provided
Granularity (different levels of detail contained in an ontology)	High level	Sensitive	Unclear	Unclear
Properties and values ('attribute'; e.g., the colour of an apple)	Included	Some support	Included	Included
Model for space and time (Consists of time and space regions and boundaries)	Not included	Included	Not included	Not included
One-layered vs. Three-layered architecture (a basic level only; an abstract top level, abstract core level and basic level)	One-layered	One-layered	Three-layered	One-layered
Situations and situoids (Situation: an aggregate of facts that can be comprehended as a whole and satises certain conditions of unity; Situoid: is a part of the world that is a comprehensible whole and can exist independently)	Not included	Not included	Included	Not included

Comparison of ontological commitments within selected upper ontologies taken from

`http://www.thezfiles.co.za/ROMULUS/ontologicalCommitments.html`

DOLCE overview

- **D**escriptive **O**ntology for **L**inguistic and **C**ognitive **E**ngineering[1]
- developed by researchers from the Laboratory of Applied Ontology, headed by N. Guarino
- first module of the WonderWeb Foundational Ontologies Library
- ontology of particulars, multiplicative, possibilism
- strong cognitive/linguistic bias – descriptive attitude with categories mirroring cognition, common sense, and the lexical structure of natural language

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[1]Home page – http://www.loa.istc.cnr.it/old/DOLCE.html,
online term search –
https://www.w3.org/2001/sw/BestPractices/WNET/DLP3941_daml.html

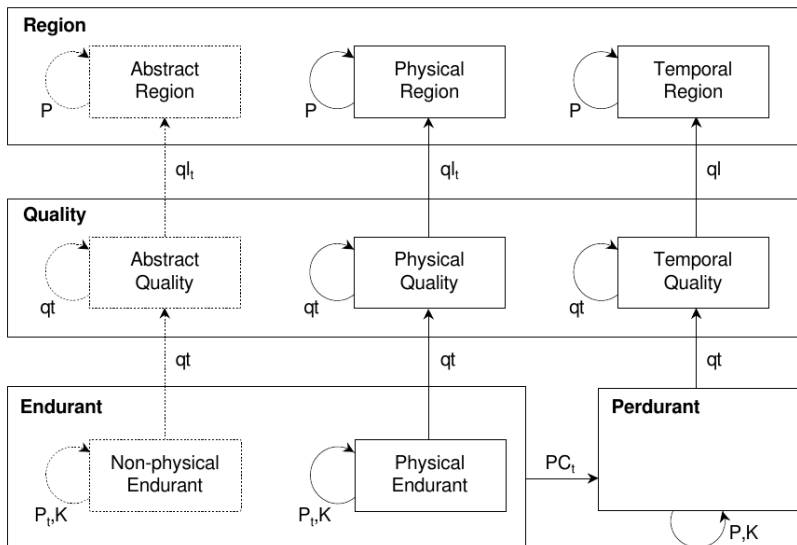# DOLCE's Taxonomy of Basic Categories
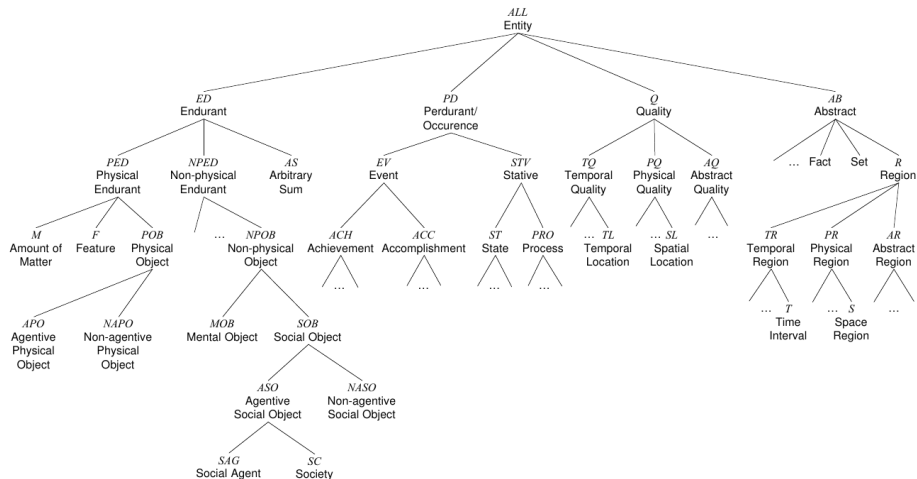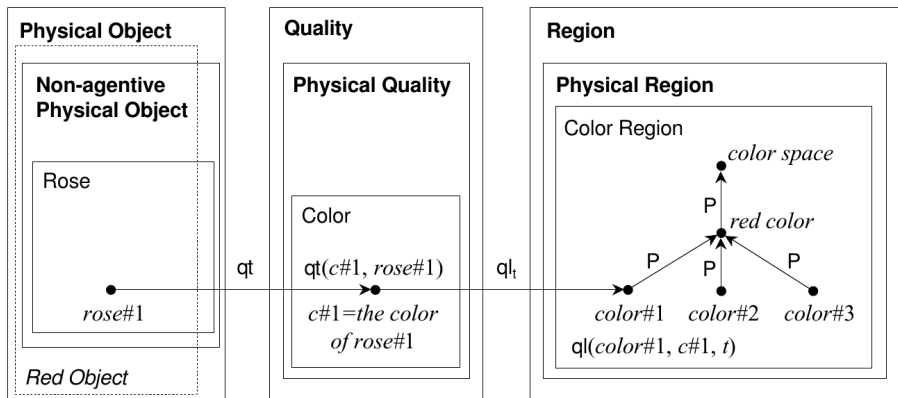
DOLCE Basic Relations

- parthood (immediate and temporary)
- constitution
- participation
- representation
- specific/generic constant dependence
- inherence (between a quality and its host)
- quale (immediate and temporary)

DOLCE's Primitive Relations Between Basic Categories

# DOLCE's Relations About Qualities

BFO Overview

- **B**asic **F**ormal **O**ntology[2]
- developed in Saarland University mainly by B.Smith, P.Grenon
- designed for use in supporting information retrieval, analysis and integration in scientific and other domains
- realistic and reductionist view of the word, actualism
- limited granularity
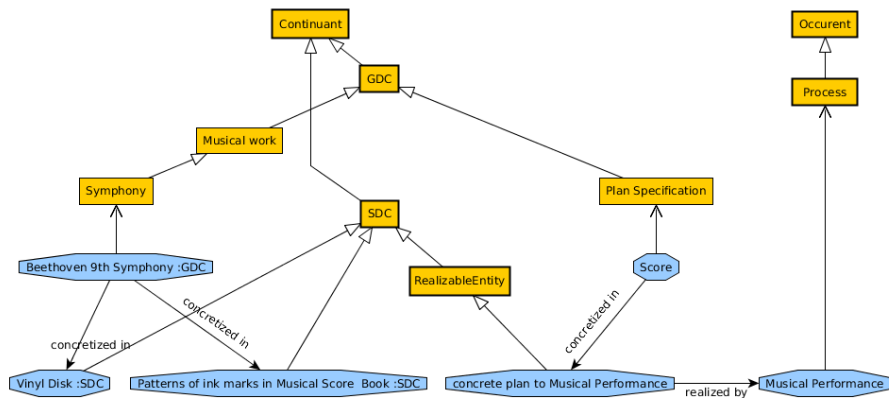- contains both SNAP (endurants) and SPAN (perdurants) sub-ontologies

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[2]http://ifomis.uni-saarland.de/bfo/

BFO's Taxonomy of Basic Categories
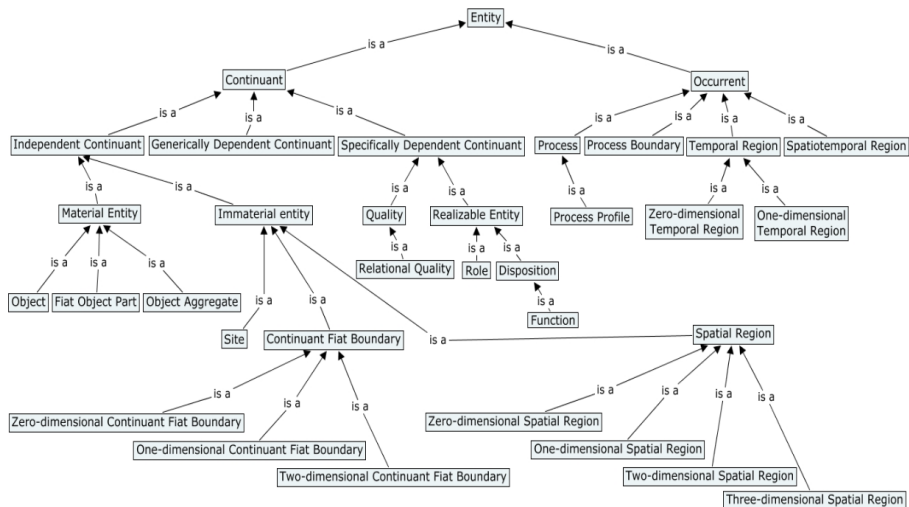
BFO's realizable entity example

Other interesting upper ontology resources

- ONSET: the foundational ONtology Selection and Explanation Tool –
  http://www.meteck.org/files/onset
- Ontology browser integrated mainly through BFO –
  http://www.ontobee.org
- SUMO Concept hierarchy and search –
  http://virtual.cvut.cz/kifb/en/toc/root.html
- YOMATO ontology description – http:
  //download.hozo.jp/onto_library/YAMATO101216.pdf
- UFO related community portal – https://ontouml.org