

## Formal Approaches to Structure Ontologies

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Three approaches to understand the structure of an ontology:

1. Separate formal aspects from ontological commitments
2. Organized classifications in a lattice of distinctions
3. Separate ontologies in tiers

A formal ontology is a mathematical theory, with symbols, functions and relations; it should not include debatable, philosophically justified ontological commitments.

A *static (snapshot) ontology* consists of symbols for individuals, properties and property values. Making distinctions between individuals leads to classes and relations between these (*is\_a*, *instance\_of* and *part\_of* are the most important ones). The properties included in an ontology determine the distinctions possible and these in turn produce a taxonomic lattice which includes all possible classes.

Only few restrictions can be included here; most what is usually expressed in temporal or modal logic formulae belongs to a temporal ontology.

For a *temporal ontology* a diachronic identity is required and processes which change the states of the individuals. The classification of individuals can change when the states used for classification changes. In general, relations, which depend on properties of individuals which are affected by a process included in the ontology, can change and, correspondingly, relations are rigid if no process can affect the related properties of individuals.

The link between processes, properties of individuals determines the ontology:

- the properties included, together with the partitions of the property values, define the lattice of all possible classes
- the processes included in an ontology determine which relations are rigid and which can change over time.

Selecting properties of individuals and processes leads therefore to a consistent ontology.

I have advocated separating ontologies in tiers of different forms of 'existence':

Tier 0: the reality

Tier 1: point-wise observations of reality

Tier 2: formation of objects with properties

Tier 3: socially constructed reality

Objects in tier 2 are formed of as regions with uniform attributes in tier 1. Such objects are primarily the physical, solid bodies with which we interact, but also the geographic units like

lakes, woods, streets etc. The formal ontology as a theory is adapted to this tier 2. Tier 3 objects are related to tier 2 objects (or actions) through Searle's formula "X counts as Y in context C", where X is a tier 2 object and Y a socially constructed, tier 3 object, like "ownership right", "One-Way-Street Sign" etc. A formal ontology for socially constructed reality must therefore include a *count\_as* relation.