COMP318

Ontologies and Semantic Web

Ontology based information systems - Part 2

Dr Valentina Tamma

V.Tamma@liverpool.ac.uk

Recap

- Data, information & knowledge
- What are ontologies
  - and what do we use them for

So what is an ontology then?

"...An ontology is a (formal), explicit specification of a shared conceptualisation..."

formal: an ontology should be machine-readable

shared: an ontology captures consensual knowledge, that is not private to some individual, but accepted by a group

explicit: the types of concepts used, and the constraints on their use are explicitly defined

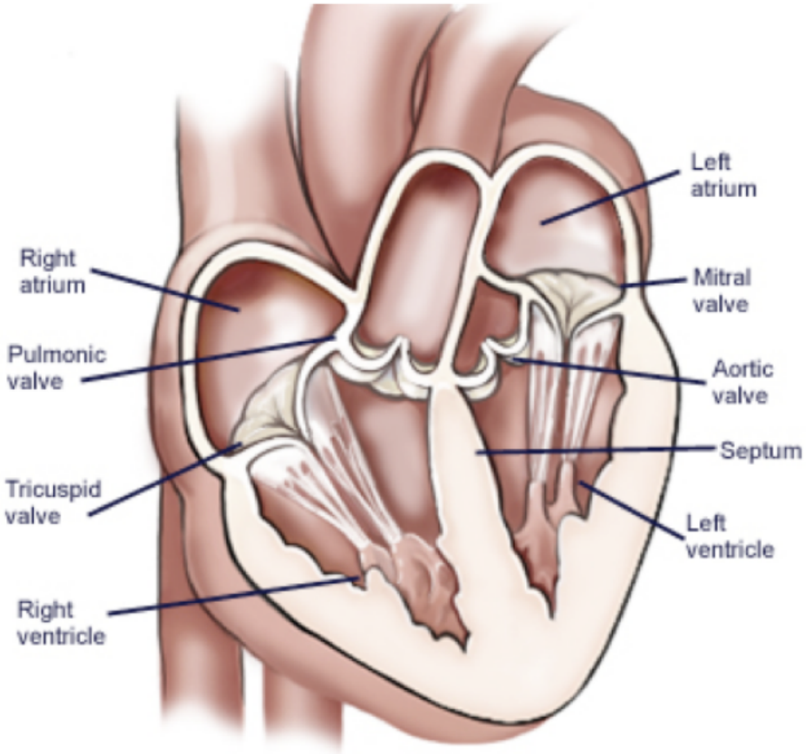
conceptualisation: an abstract model of some phenomenon in the world which identifies the relevant concepts of that phenomenon

Ontologies as domain models

- A model is a simplified (abstract) representation of relevant aspects of a real world situation or phenomenon.
  - Models help people to **communicate**;
  - Models **explain** and **make predictions**;
  - Models **mediate** among different viewpoints.

Ontologies as domain models

- Ontologies as domain models:
  - include vocabulary relevant to a domain (e.g. represented in RDF or OWL)
  - specify the meaning (semantics) of terms in the vocabulary (e.g. with RDFS)
    - Heart is a muscular organ that is part of the circulatory system
  - are formalised using a suitable logic-based language (e.g.OWL)
    - Heart SUBCLASSOF MuscularOrgan AND (isPartOf SOME CirculatorySystem)



What is a conceptualisation

- **Conceptualisation**: the formal structure of reality as perceived and organised by an agent, independently of:
  - the vocabulary used (i.e., the language used)
  - the actual occurrence of a specific situation

- Different situations:
  - involving the same objects,
    - described by different vocabularies,
    - may share the same conceptualisation.

soccer

football

Ontological Commitment

- Agreements to use the vocabulary in a coherent and consistent manne
  - An agent commits (conforms) to an ontology if it “acts” consistently with the definitions
- The assignment of the meaning to the terms in the ontology vocabulary

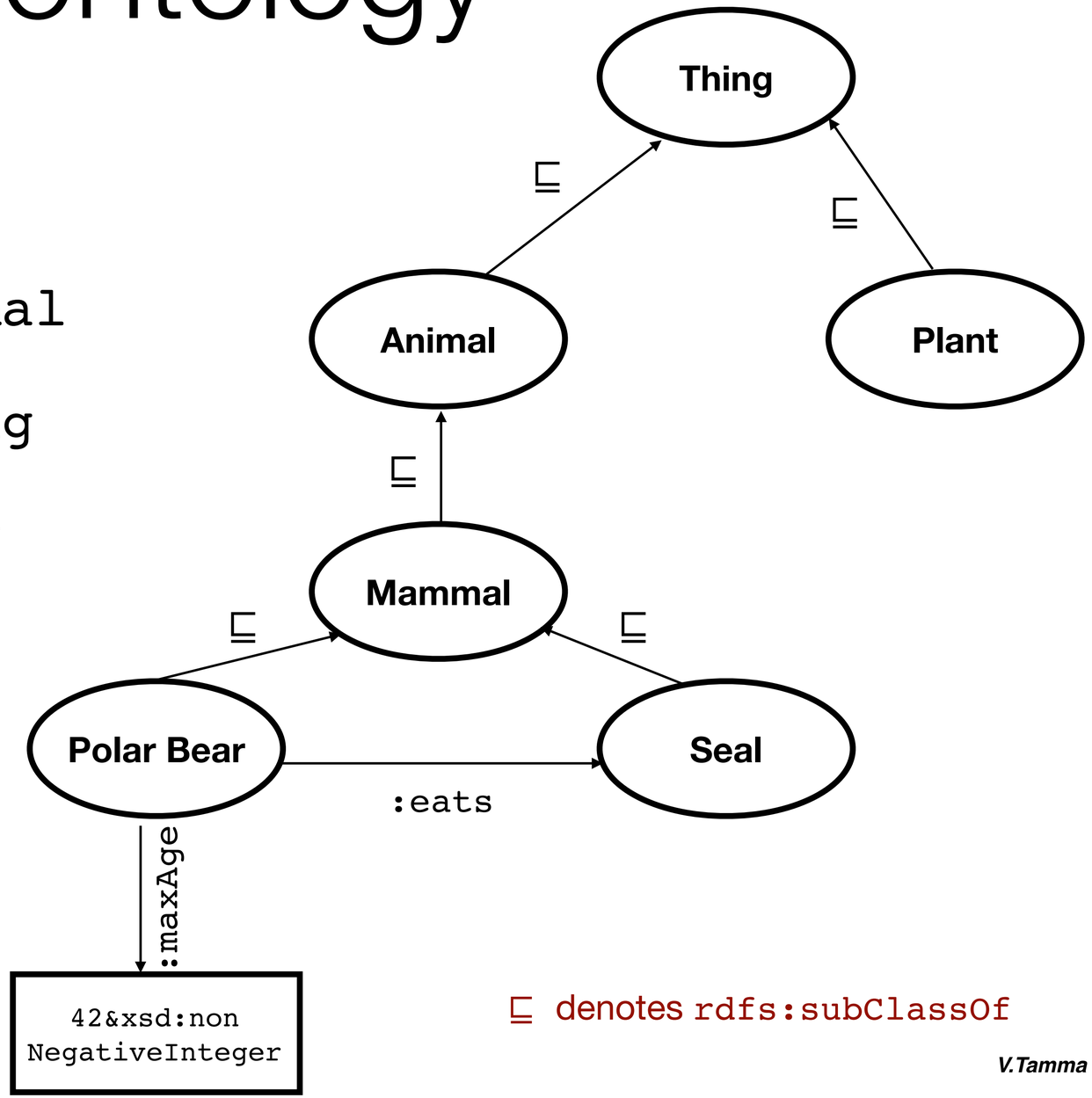
Who is using ontologies

"Who's doing this? ***75% of the Fortune 500*** *companies have some kind of* ***smart data or semantics program underway****, most under the banner of 360° initiatives, comprehensive enterprise data systems, or machine learning/ data science projects.* ***Amazon has recently added linked data capabilities*** *to their AWS infrastructure with the Neptune project, and* ***social media giants have built their entire data infrastructure around smart ontological data****. Moreover, China, Japan, England, the OECD, and the United States have all* ***moved critical data resources into semantic form****, and* ***semantics has become one of the hottest areas for investment banks such as Wells Fargo, Morgan Stanley, Citigroup, Goldman Sachs and others****. It even ties into such cutting-edge technologies as Blockchain and the Internet of Things."*

Forbes, July 2018

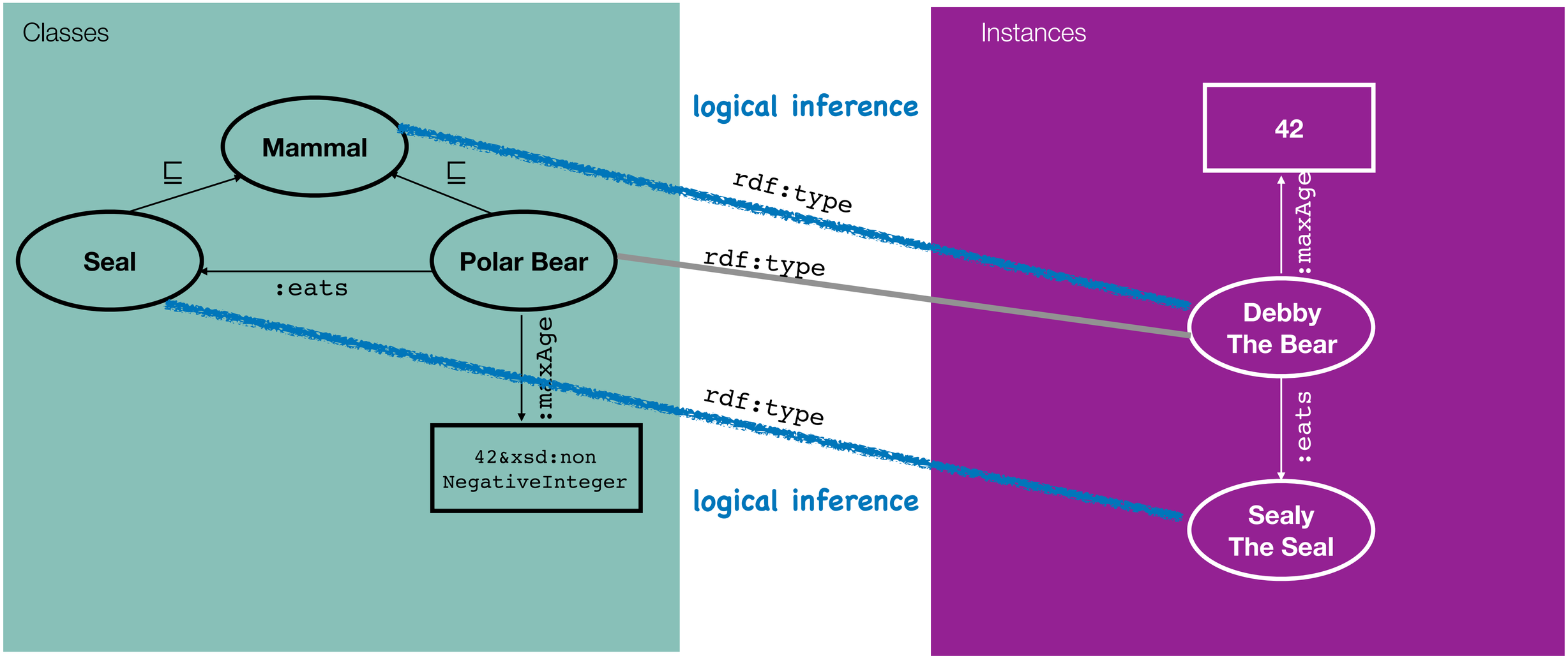
A simple ontology

- `Class: PolarBear SubClassOf: Mammal and maxAge only 42`
- `Class: Mammal SubClassOf: Animal`
- `Class: Animal SubClassOf: Thing`
- `Class: Plant SubClassOf: Thing`
- `Class: Seal SubClassOf: Mammal`
- `ObjectProperty: eats`
- `Domain: PolarBear`
- `Range: Seal`

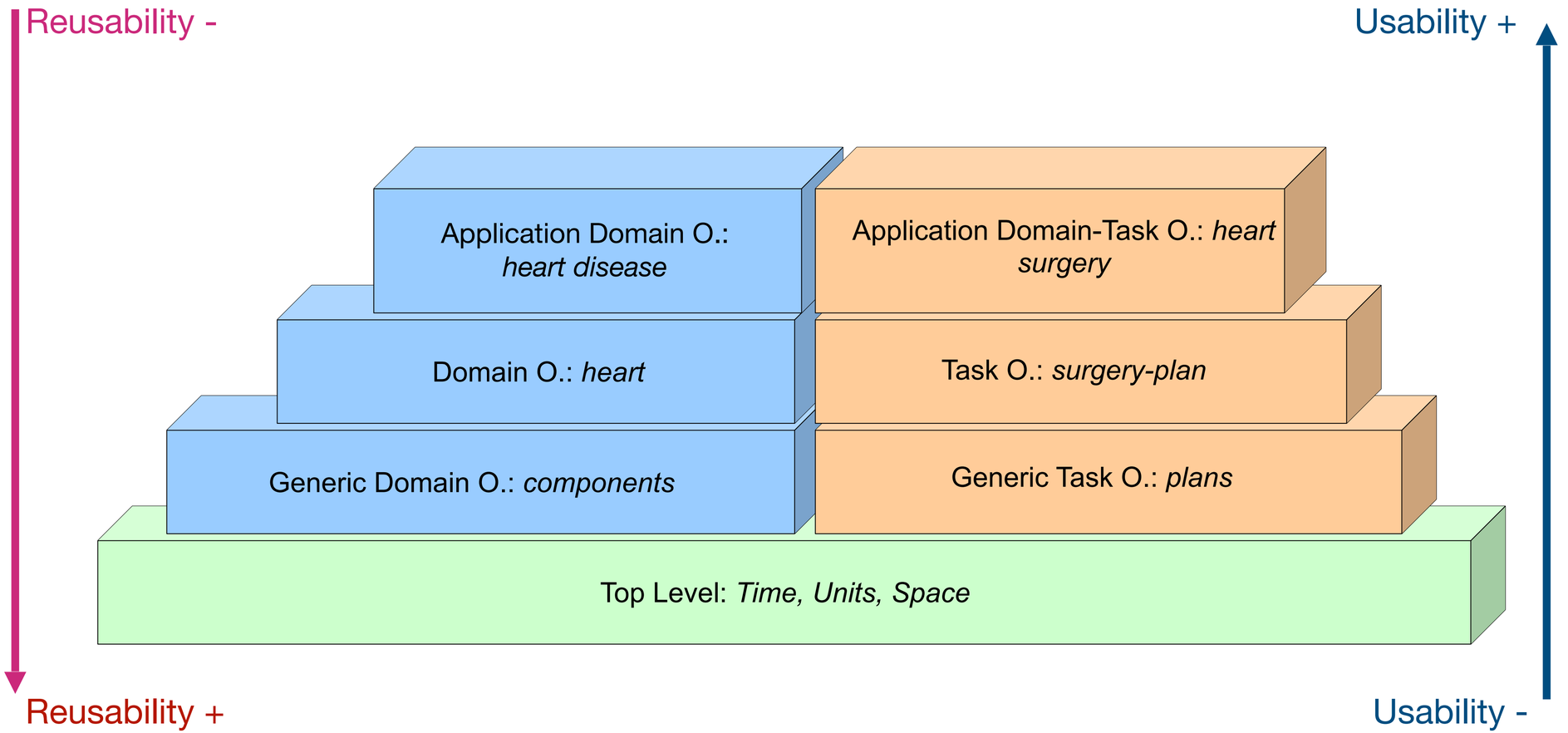


⊑ denotes `rdfs:subClassOf`

A simple ontology: inferences



Types of Ontologies



Types of ontologies

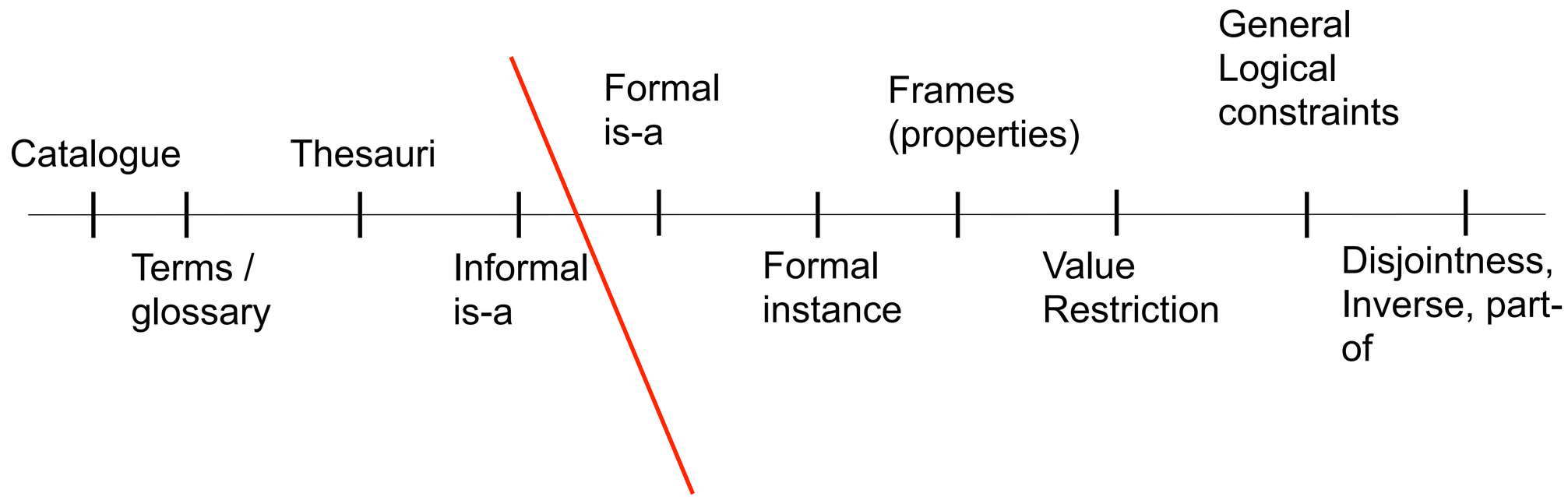
- **Top level ontology:** general, cross domain ontologies;
  represent very general concepts as e.g., Time, Space, Event; independent of a specific domain or problem
  - also called Upper Ontology or Foundational Ontology

- **Domain ontology:** fundamental concepts according to a generic domain;
  - specialises terms introduced in top-level ontology

- **Task ontology:** fundamental concepts according to a general activity or task; specializes terms introduced in top-level ontolog

- **Application ontology:** specialized ontology focussed on a specific task and domain;
  - often a specialization of both task and domain ontology; often specify roles played by domain entities for specific activity

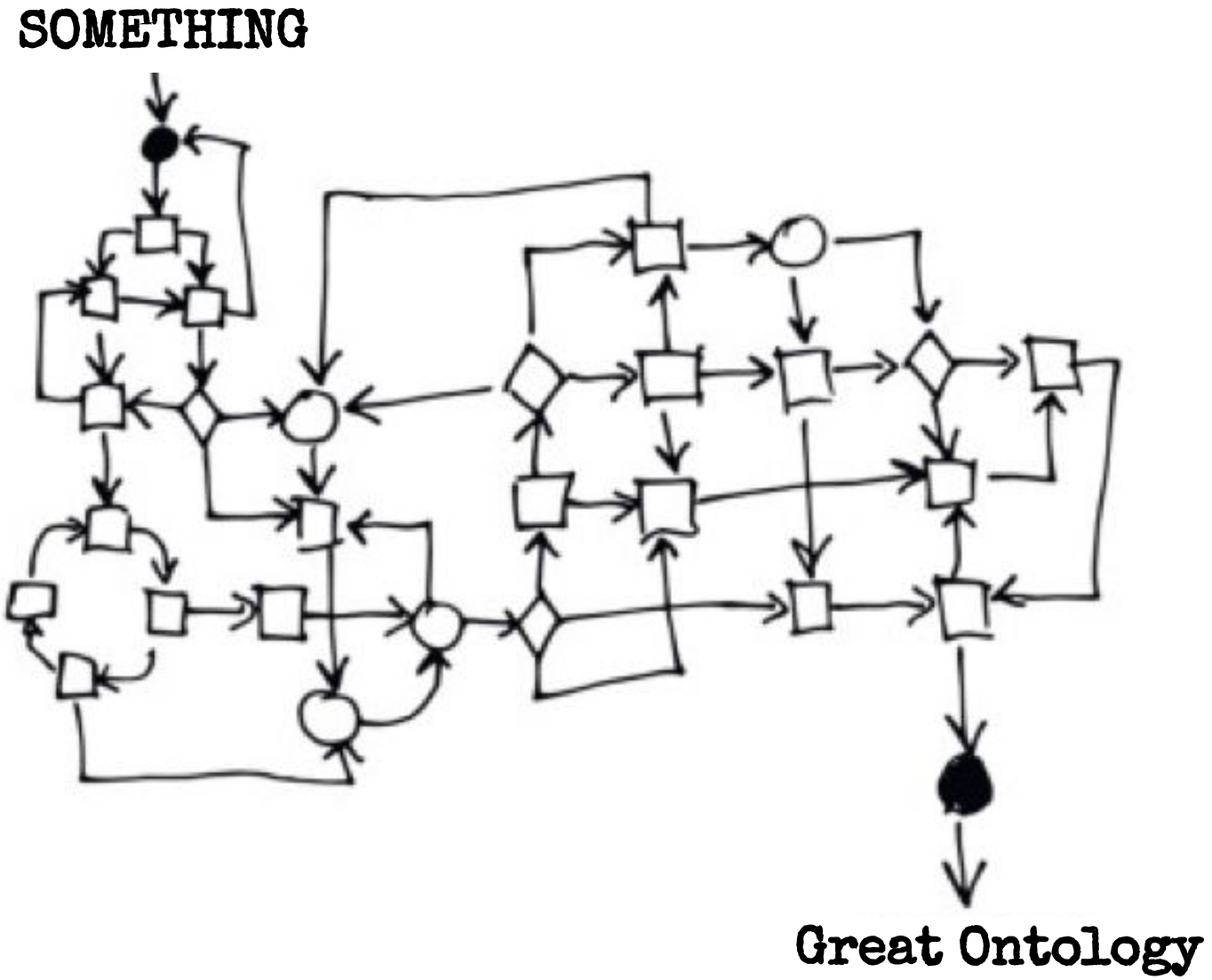
Level of Granularity



Level of Granularity

- An ontology specifies a rich description of the:
  - Terminology, concepts, vocabulary
  - Properties explicitly describing concepts
  - Relations among concepts
  - Rules distinguishing concepts,
    - refining definitions and relations (constraints, restrictions, regular expressions) relevant to a particular domain or area of interest.

Ontology development process



Summary

- What are ontologies
  - and what do we use them for
- Types of ontology

COMP318

Ontologies and Semantic Web

End of ontology based information systems - Part 2

Dr Valentina Tamma

V.Tamma@liverpool.ac.uk