

# Ontologies and the Semantic Web

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# Agenda

1. Ontologies
2. Semantic Web
3. Semantic Web Languages
4. Some Applications (Ontoprise)
5. Ontologies & Text

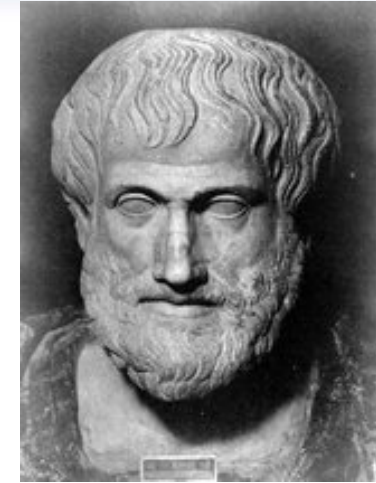
# Part I

## Introduction to Ontologies

# Origin and History

- Ontology in Philosophy
  - a philosophical discipline, branch of philosophy that deals with the nature and the organization of reality
- Science of Being (Aristotle, Metaphysics, IV, 1)
- Tries to answer the questions:
  - *What characterizes being?*
  - *Eventually, what is being?*

# Aristotle - Ontology



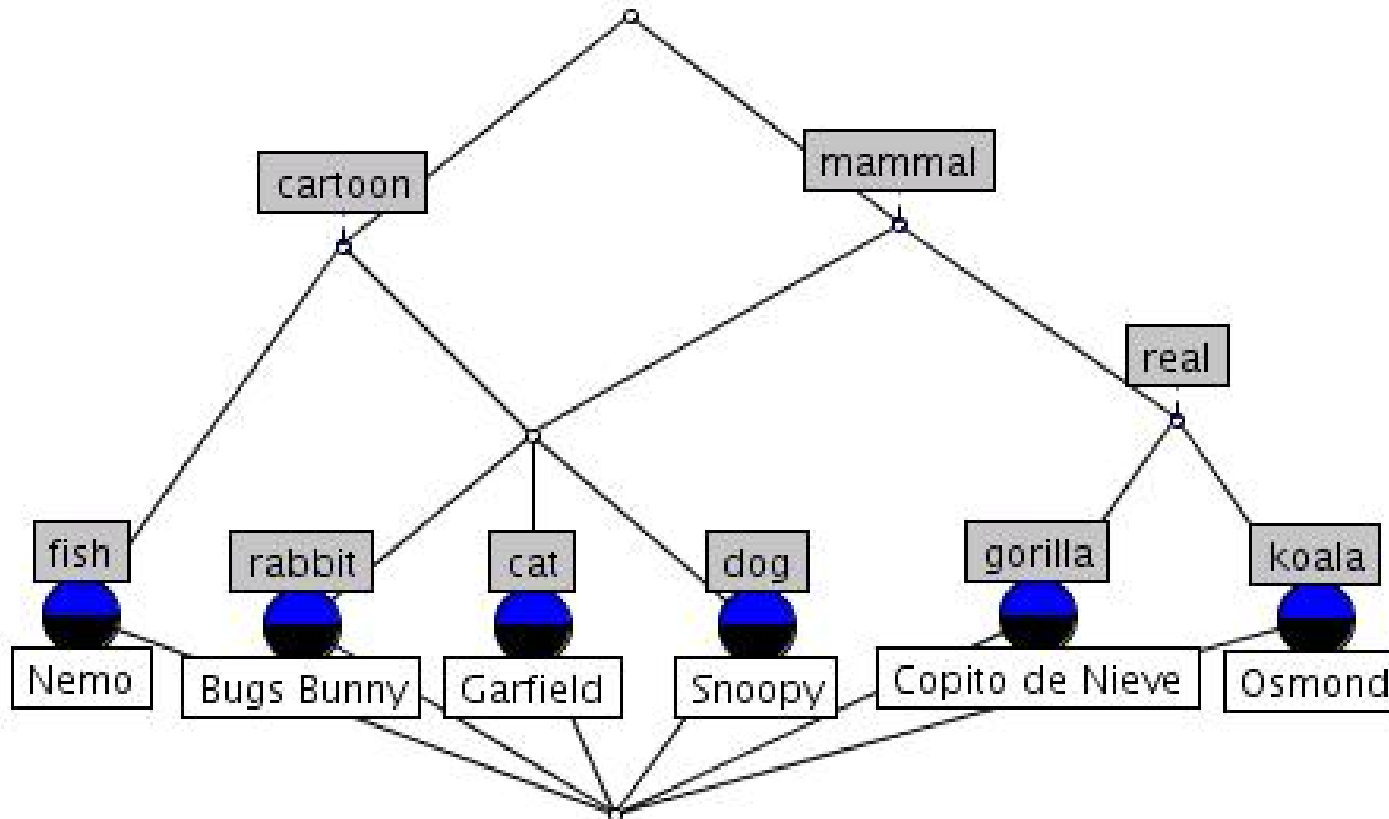
- Before: study of the nature of being
- Since Aristotle: study of knowledge representation and reasoning
- Terminology:
  - **Genus:** (Classes)
  - **Species:** (Subclasses)
  - **Differentiae:** (Characteristics which allow to group or distinguish objects from each other)
- Syllogisms (Inference Rules)

# Example for differentiae

(adapted from Uta Priss, in preparation)

	real	cartoon	cat	dog	rabbit	fish	gorilla	koala	mammal
Garfield		X	X						X
Snoopy		X		X					X
Bugs Bunny		X			X				X
Nemo		X				X			
Copito	X						X		X
Osmond	X							X	X

# Organizing the Objects as a Lattice



# What is an Ontology?

Gruber 93:

An Ontology is a

formal specification

⇒ Executable, Discussable

of a shared

⇒ Group of persons

conceptualization

⇒ About concepts

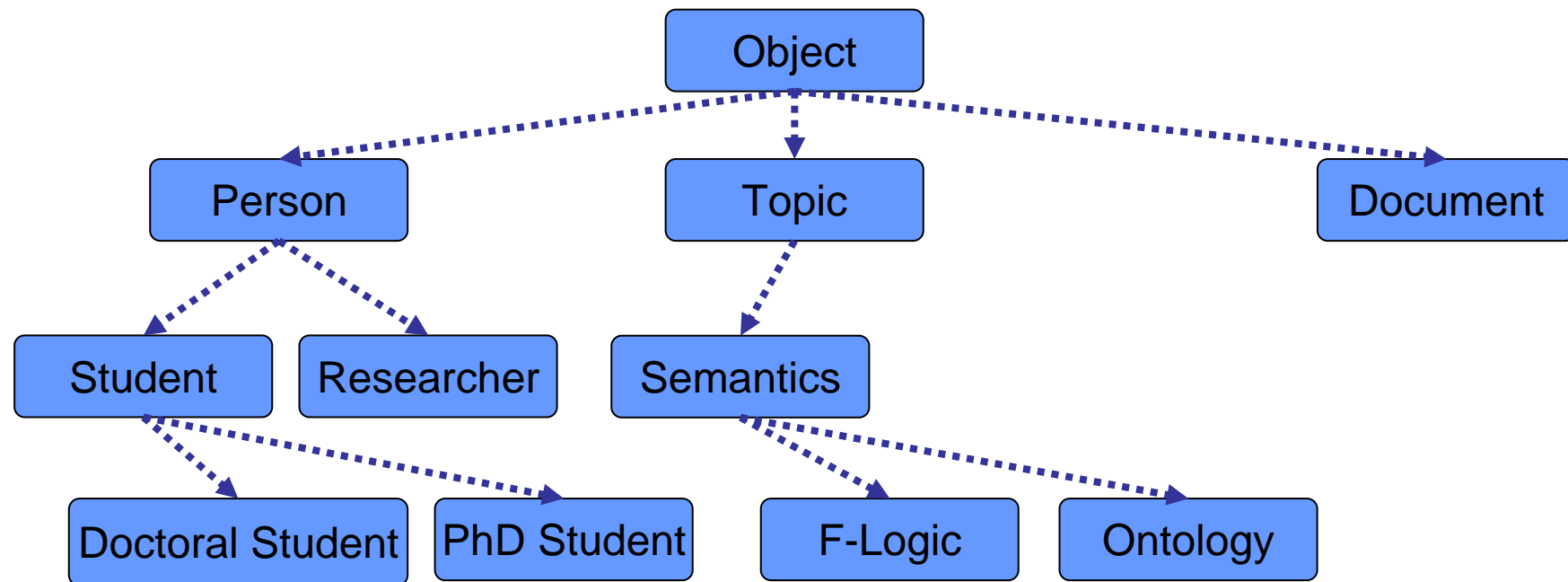
of a domain of interest ⇒

Between application  
and „unique truth“

# Why Develop an Ontology?

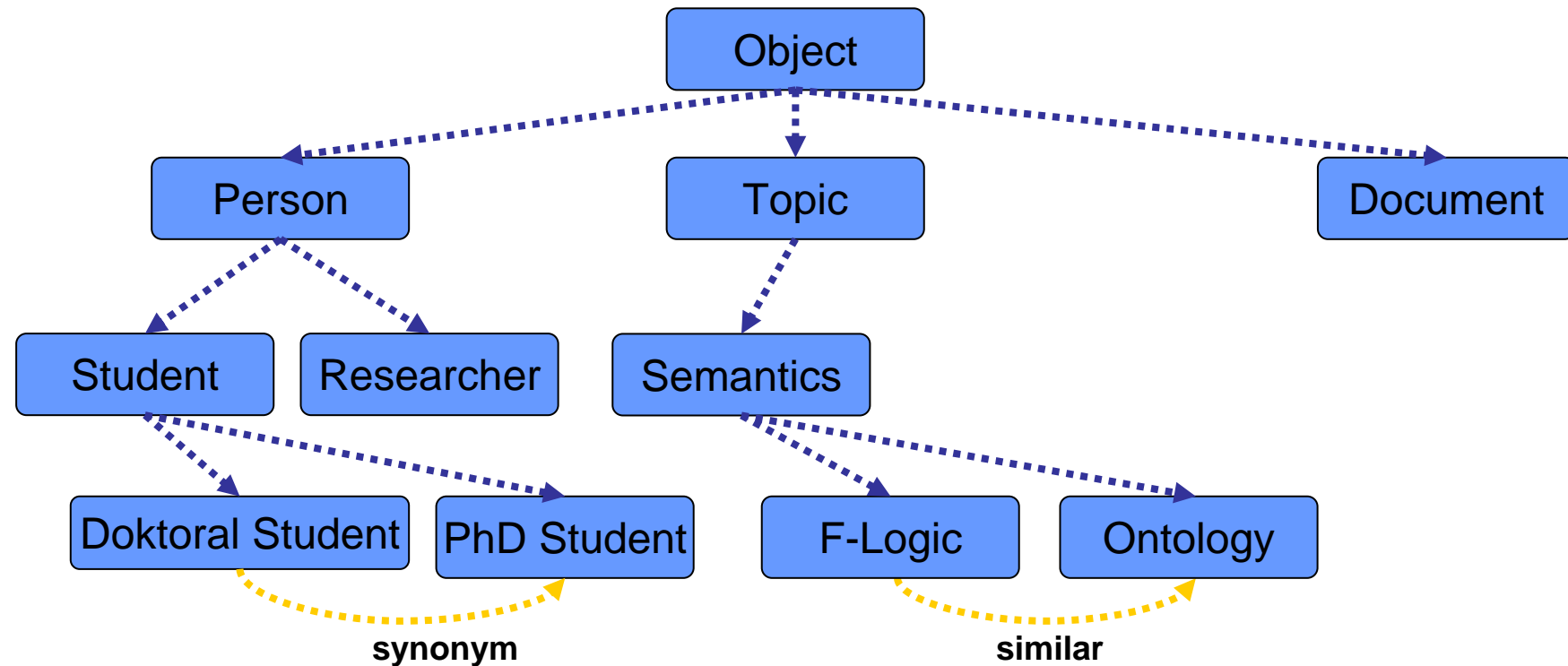
- To make **domain assumptions explicit**
  - Easier to change domain assumptions
  - Easier to understand and update legacy data
- To separate **domain knowledge** from operational knowledge
  - Re-use domain and operational knowledge separately
- A **community reference** for applications
- To **share a consistent understanding** of what information means

# Taxonomy



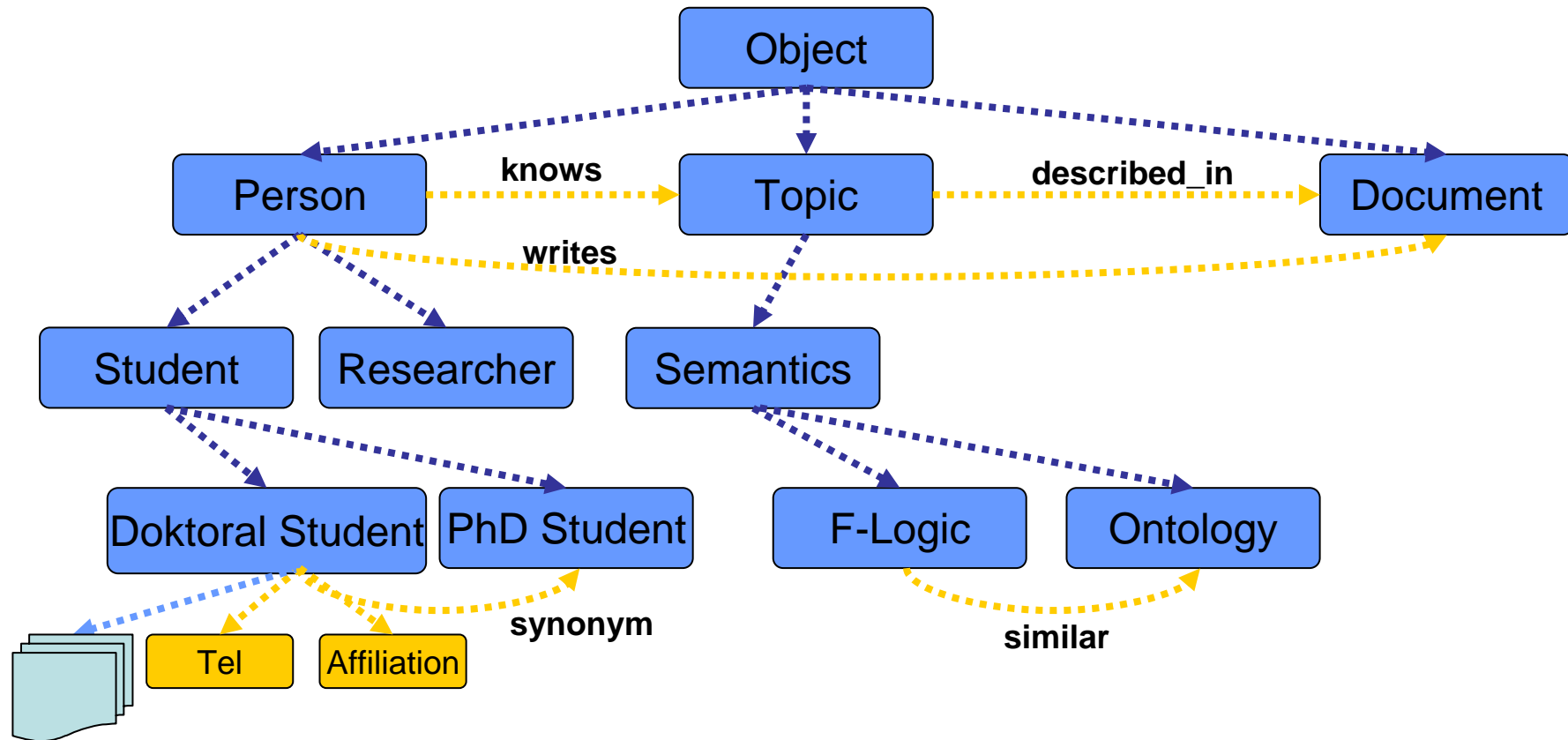
**Taxonomy := Segmentation, classification and ordering of elements into a classification system according to their relationships between each other**

# Thesaurus



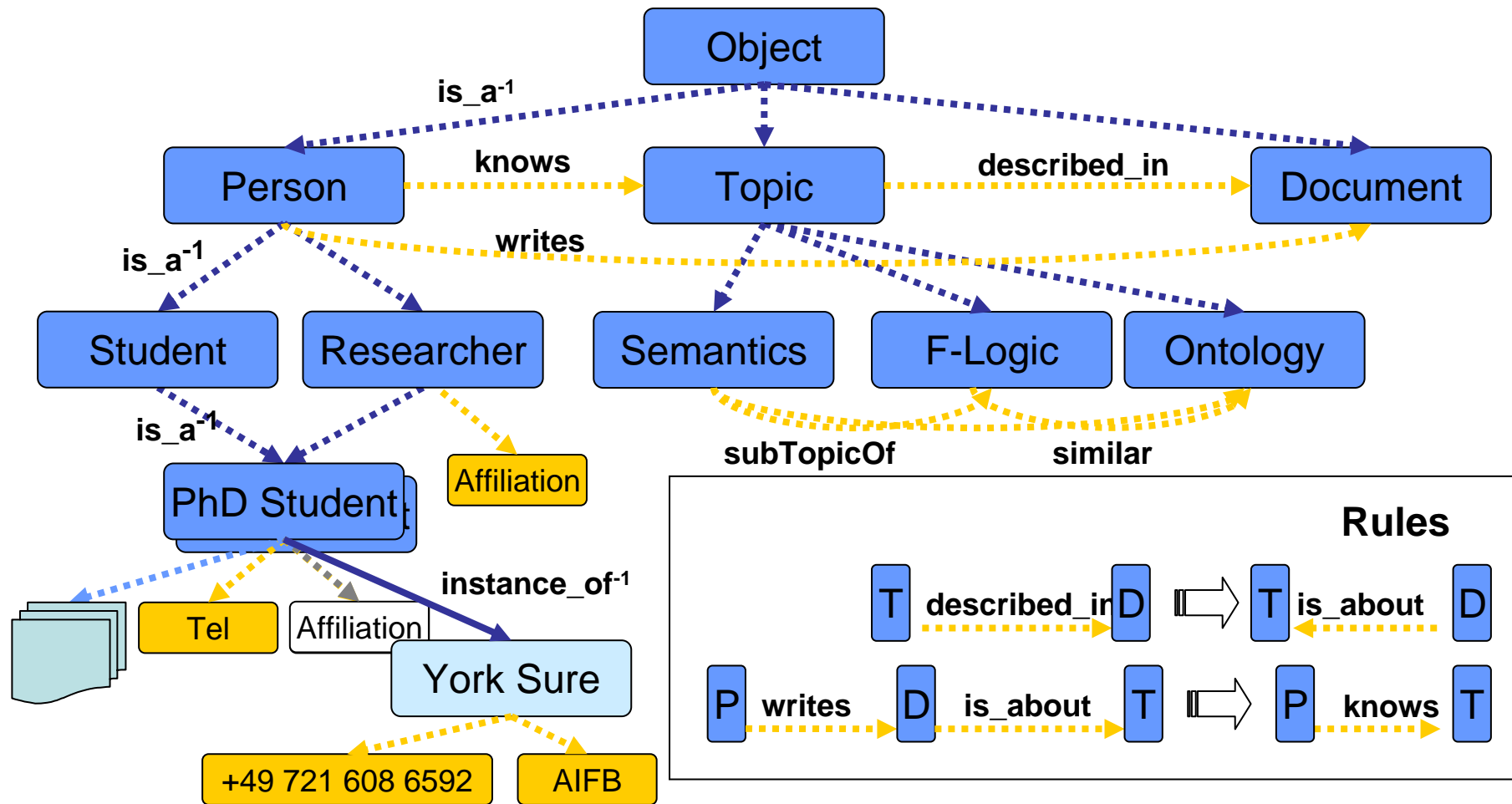
- Terminology for specific domain
- Taxonomy plus fixed relationships (similar, synonym, related to)
- originate from bibliography

# Topic Map



- Topics (nodes), relationships and *occurences* (to documents)
- ISO-Standard
- typically for navigation- and visualisation

# Ontology (in our sense)



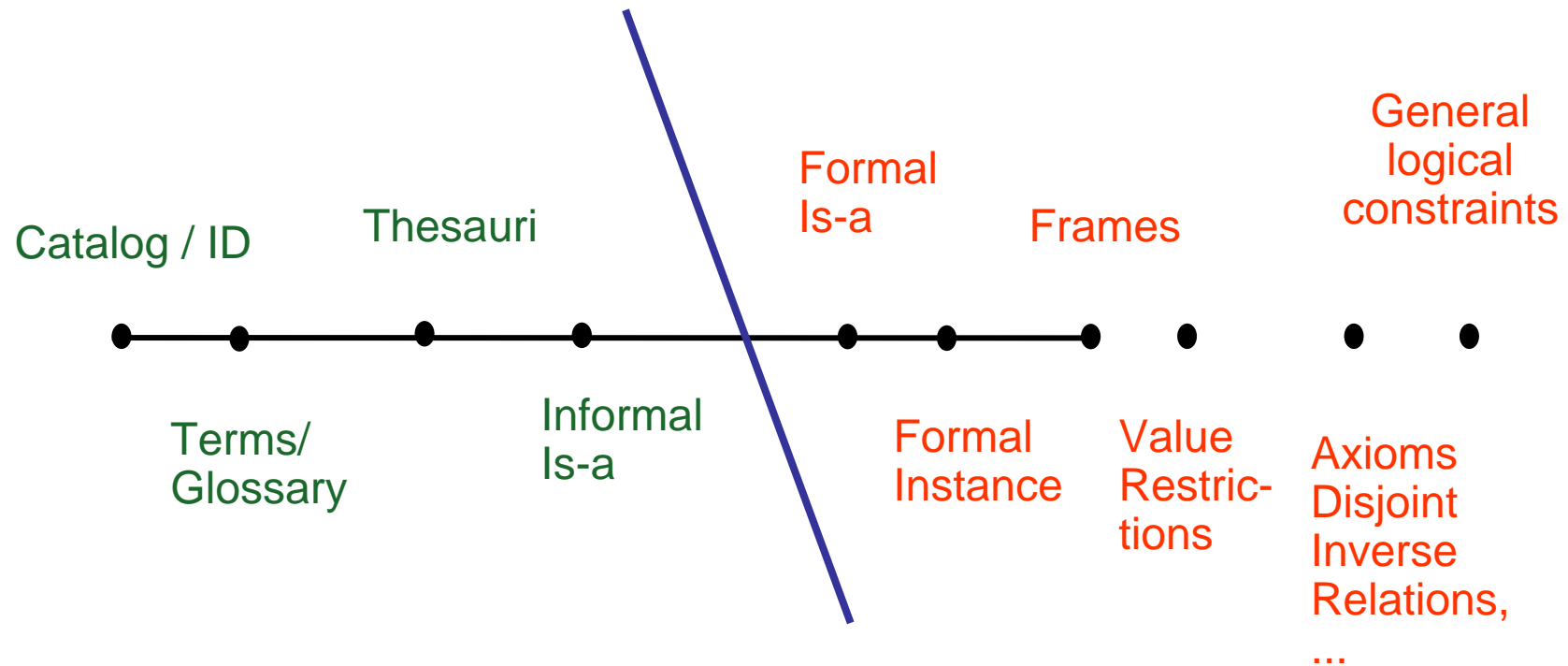
- Representation Language: Predicate Logic (F-Logic)
- Standards: RDF(S); OWL

# Ontologies - Some Examples

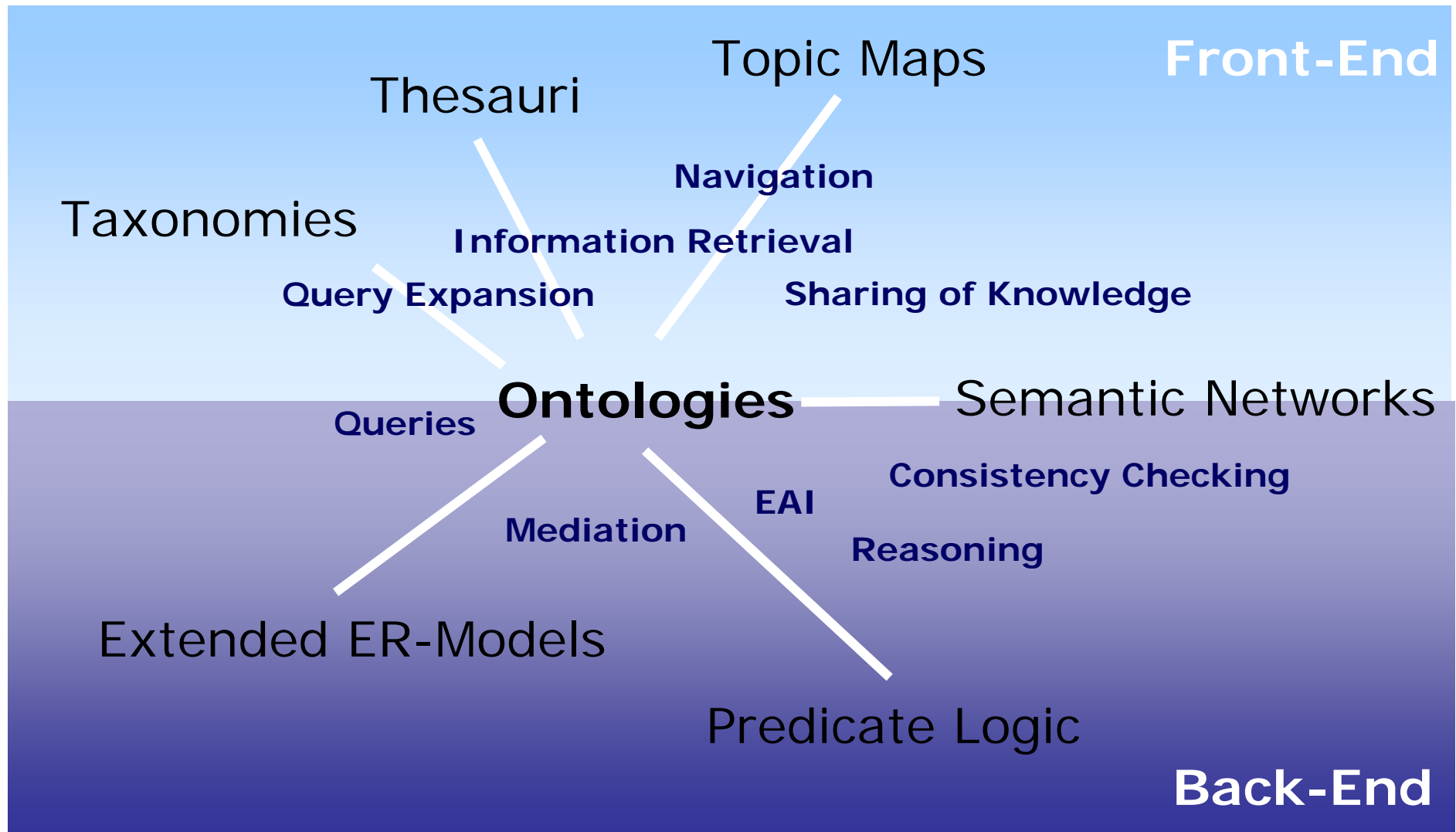
- General purpose ontologies:
  - DOLCE, <http://www.loa-cnr.it/DOLCE.html>
  - The Upper Cyc Ontology, <http://www.cyc.com/cyc-2-1/index.html>
  - IEEE Standard Upper Ontology, <http://suo.ieee.org/>
- Domain and application-specific ontologies:
  - GALEN, [http://www.openclinical.org/prj\\_galen.html](http://www.openclinical.org/prj_galen.html)
  - Foundational Model of Anatomy, <http://sig.biostr.washington.edu/projects/fm/AboutFM.html>
  - RETSINA Calendaring Agent, <http://ilrt.org/discovery/2001/06/schemas/ical-full/hybrid.rdf>
  - Dublin Core, <http://dublincore.org/>
- Semantic Desktop Ontologies
  - Semantics-Aware instant Messaging: SAM Ontology, <http://www.uni-koblenz.de/FB4/Institutes/IFI/AGStaab/Research/sam>
  - Haystack, <http://haystack.lcs.mit.edu/>
  - Gnowsis, <http://www.gnowsis.org/>
  - Piggybank, <http://simile.mit.edu/piggy-bank/>
- Web Services Ontologies
  - Core ontology of services <http://cos.ontoware.org>
  - Web Service Modeling ontology <http://www.wsmo.org>
  - OWL-S, <http://www.daml.org/services/owl-s/1.0/>
- Ontologies in a wider sense
  - GO - Gene Ontology, <http://www.geneontology.org/>
  - UMLS, <http://www.nlm.nih.gov/research/umls/>
  - Agrovoc, <http://www.fao.org/agrovoc/>
  - Art and Architecture, <http://www.getty.edu/research/tools/vocabulary/aat/>
  - DTD standardizations, e.g. HR-XML, <http://www.hr-xml.org/>
  - WordNet / EuroWordNet, <http://www.cogsci.princeton.edu/~wn>



# Ontologies and Their Relatives



# Ontologies and Their Relatives (cont'd)



# Applications of Ontologies

- **Natural Language Processing and Machine Translation**, e.g. Nirenburg et al. 2004, Maedche et al. 2001, Agirre et al. 1996, Beale et al. 1995
- **Semantic Web**, see <http://www.w3.org/2001/sw/> and <http://www.w3.org/2001/sw/WebOnt/>
- **Knowledge Engineering & Management**, e.g. Fensel 2001, Mullholland et al. 2000; Staab & Schnurr, 2000; Sure et al., 2000, Abecker et al. 1997
- **Electronic Commerce**, e.g. RosettaNet3 and Ontology.org4
- **Information Retrieval and Information Integration**, e.g. Kashyap, 1999; Mena et al., 1998; Wiederhold, 1992
- **Intelligent Search Engines**, e.g. WebKB (Martin et al. 2000), SHOE (Heflin & Hendler, 2000), OntoSeek (Guarino et al., 1999), Ontobroker (Decker et al., 1999)
- **Digital Libraries**, e.g. Amann & Fundulaki, 1999
- **Enhanced User Interfaces**, e.g. (Kesseler, 1996), Inxight5
- **Software Agents**, e.g. OnTo-agents, FIPA, (Gluschko et al., 1999; Smith & Poulter, 1999)
- **Business Process Modeling**, e.g. Decker et al., 1997; TOVE, 1995; Uschold et al., 1998

# Overview Literature

S. Staab, R. Studer. Handbook on Ontologies. Springer, 2004.