



# Ontology-Driven Conceptual Modeling

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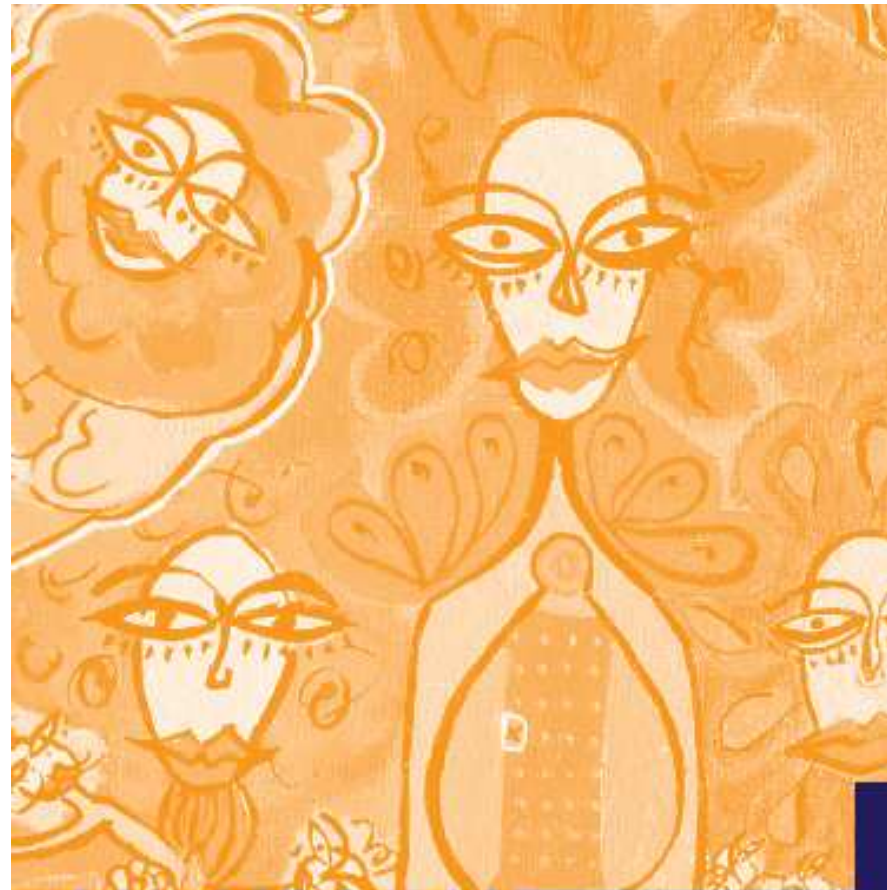


**In association with:**  
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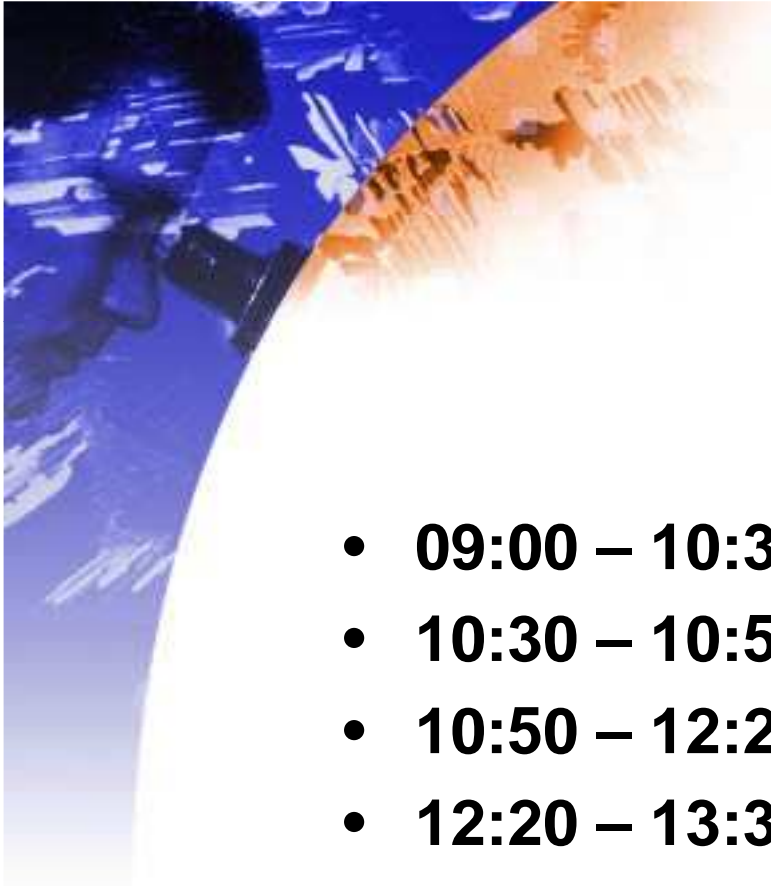
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**ONTOLOGICAL  
FOUNDATIONS  
FOR STRUCTURAL  
CONCEPTUAL  
MODELS**

**GIANCARLO GUIZZARDI**



## Schedule

- **09:00 – 10:30 (First Part)**
- **10:30 – 10:50 (Coffee Break)**
- **10:50 – 12:20 (Second Part)**
- **12:20 – 13:30 (Lunch Part)**
- **13:30 – 14:30 (Third Part)**



## Definition (Oxford)

- **Definition (1):** a branch of metaphysics concerned with the nature and relations of being;
- **Definition (2):** a particular theory about the *nature of being* or the *kinds of existents*;
- **Definition (3):** a theory concerning the kinds of entities that are to be admitted to a language system.

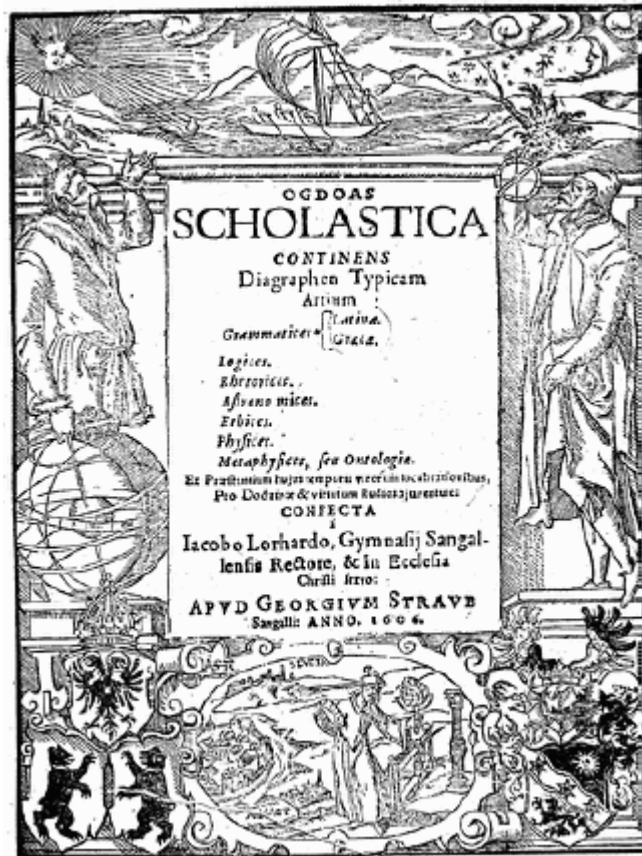


## **Part I – A brief historical overview**



## Historical Overview

- **Aristotles (Categories) – Theory of Substance and Accidents**
- **Locke, Leibniz, Kripke, Lewis, Quine, Armstrong, Bunge, Bacon, Varzi, Poli, Simons, Strawson, Wiggins, Hirsch...**
- **Christian Wolff (term Ontologia - 1730)**
- **Husserl (Formal Ontology)**



PHILOSOPHIA  
PRIMA,  
SIVE  
ONTOLOGIA,  
METHODO SCIENTIFICA  
PERTRACTATA,  
QUA  
OMNIS COGNITIONIS  
HUMANÆ PRINCIPIA  
CONTINENTUR.

AVCTORE  
CHRISTIANO WOLFIO,  
SOPHTENIMENSI SUBICORUM RECTOR, PRAESIDE SANDORAVIO,  
SCHOLARUM SAGILLIENSIS, MATHEMATICAE AC PHILOSOPHIAE  
IN ACADEMIA HANNOVERENSIS PROFESSORE PRIMARIO,  
PROFESSORE PRAECEPTORUM HANNOVERENSIS, ACADEMIAE SAGILLIENSIS  
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## Formal Ontology

- **Objective:** To develop a generic theory (formal) and a system of categories to qualify the *modes of existence*
- **End Result:** Foundational Ontologies (Top-Level Ontologies, Upper-Level Ontologies)



## Foundational and Material Ontologies

- **Material Ontologies**: Set of categories whose existence is to be admitted in specific domain (e.g. Molecular Biology)
- A **foundational ontology** supply a set of (meta-) categories which can be used in the development of **material ontologies**



## **Part II – Ontologies in Computer and Information Sciences**



## Formal Ontologies

- Prescriptive (Revisionary): Philosophy of Science (Simons, Bunge, BFO, **GOL/GFO**)
- Descriptive: Language and Cognition (Strawson, Wiggins, Hirsch, van Leeuwen, **DOLCE**)



## Ontologies in Information Sciences

- **Foundations of data modeling by S. H. Mealy (1967):** three distinct realms in the field of data processing, namely: (i) *“the real world itself”*; (ii) *“ideas about it existing in the minds of men”*; (iii) *“symbols on paper or some other storage medium”*.
- ***Kent’s Data and Reality (1987)***
- ***BWW approach (1987)***
- ***OntoUML: First ontologically well-founded conceptual modeling language based on a descriptive ontology (developed between 2000-2005)***



## Ontologies in Artificial Intelligence

- Here ontologies acquire the meaning that they have today in computer science, which is the same as in domain engineering.
- First AI-Ontology is Pat Hayes' Naive Physics Manifesto (1978) – Ontology of Liquids (1985)
- Popularized due to the shift of perspective proposed by Clancy's work (1993), i.e., the so-called Modeling view of knowledge acquisition: *“the primary concern of knowledge engineering is modeling systems in the world, not replicating how people think”*.

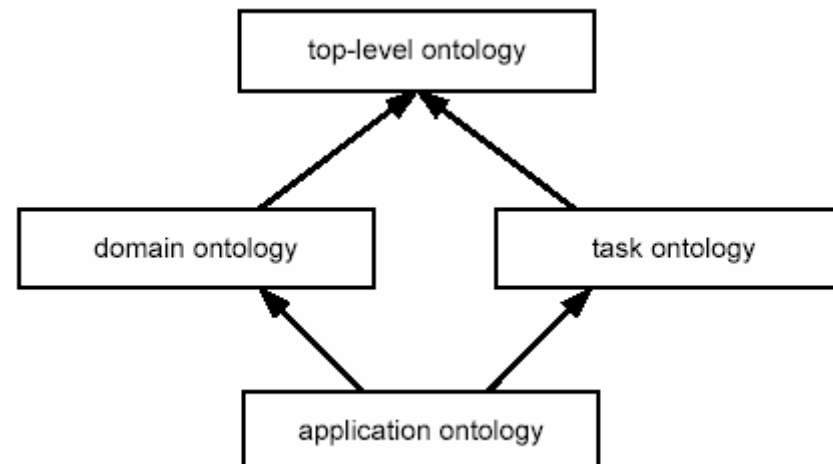


## Ontologies in Artificial Intelligence

- **Contrary to the way the term is used in information sciences, an ontology becomes an engineering artifact representing a specific domain in a specific language**
- **Beginning of a concern about the representation language**

# Ontologies in Artificial Intelligence

- Separation of Domain (universe of discourse) and the *behavior* of the intelligent system (problem-solving expertise)





## Ontologies in Artificial Intelligence

- **Examples of applications include:**
- **Domain Ontology**
  - Engineering (YMIR, PHYSSYS, DORPA)
  - Enterprise Modeling (TOVE, PSL)
  - Natural Sciences (CHEMICALS, Plinius, Gene Ontology, Fishery Core Ontology)
  - Medicine (UMLS, ONIONS, GALEN)
  - Law (Core Legal Ontology)

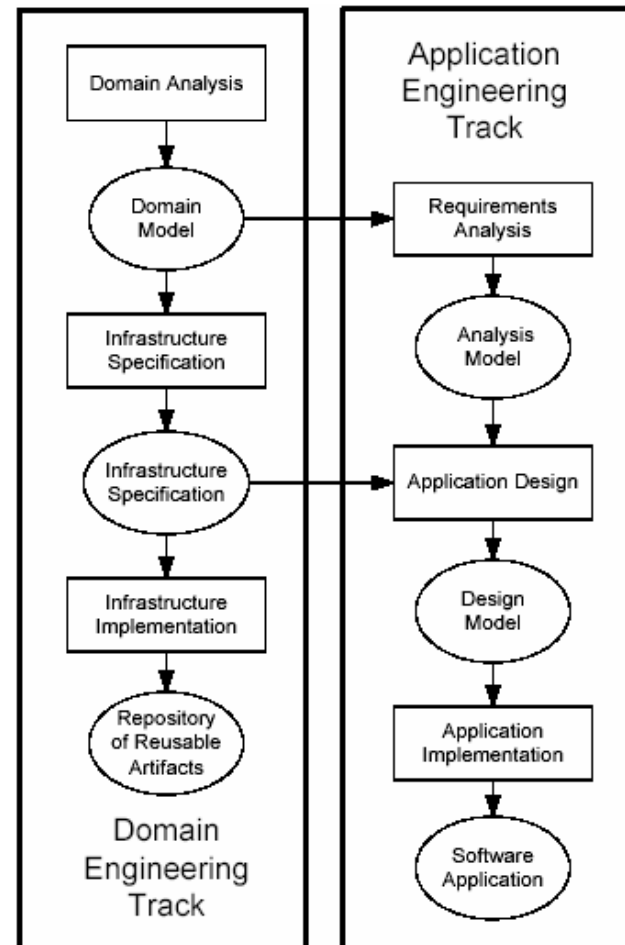


## Ontologies in Artificial Intelligence

- **Upper-Level Ontology**
  - SUMO
  - CyC
  - WordNet
  - John Sowa's work
- **Task Ontology**
  - Some important advances but not in AI ! (Workflow patterns, BPR Patterns, Behavior General Models)

# Ontologies in Domain Engineering

- **Use of domain ontology for domain engineering (Falbo & Guizzardi): An ontology based approach for domain engineering (domain analysis and systematic generation of specification)**



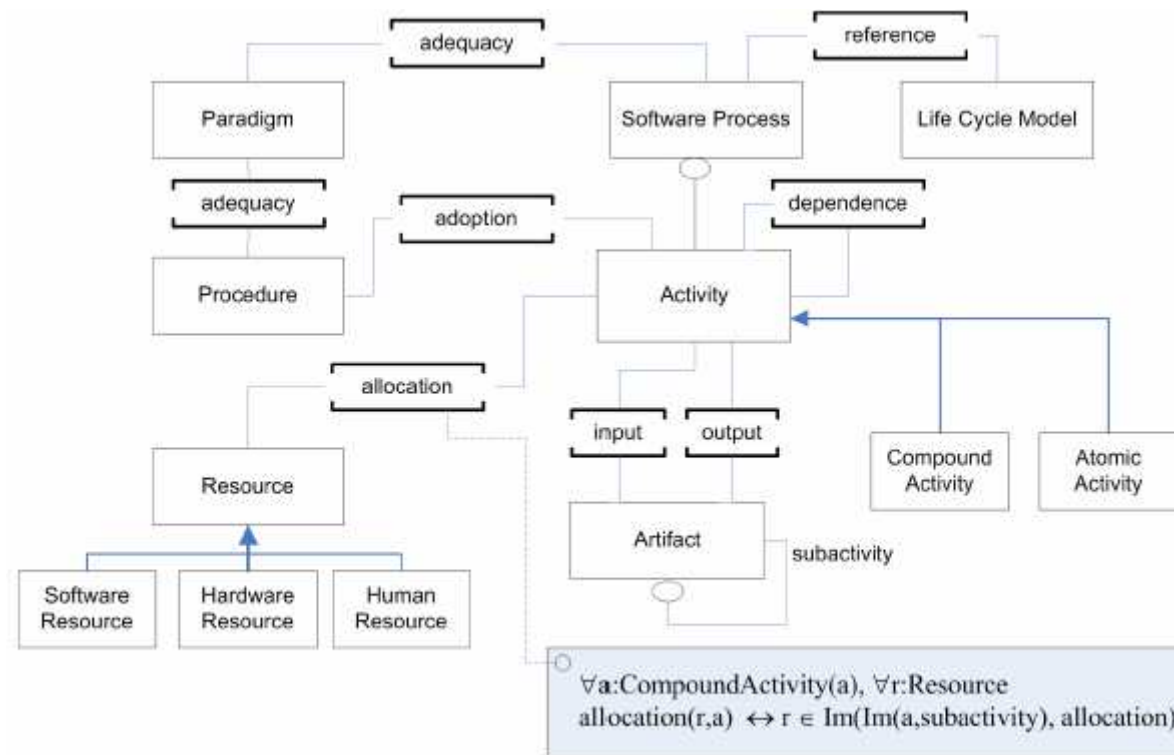


## **Ontology-Based Domain Analysis**

- **A Development Process for Ontology-Based Domain Analysis**
- **A Formal Ontology Representation Language suitable for Domain Modeling**
- **A systematic Approach to Generate Java Frameworks from Domain Models**
- **Tool Support for Modeling, Validation and Framework Generation**

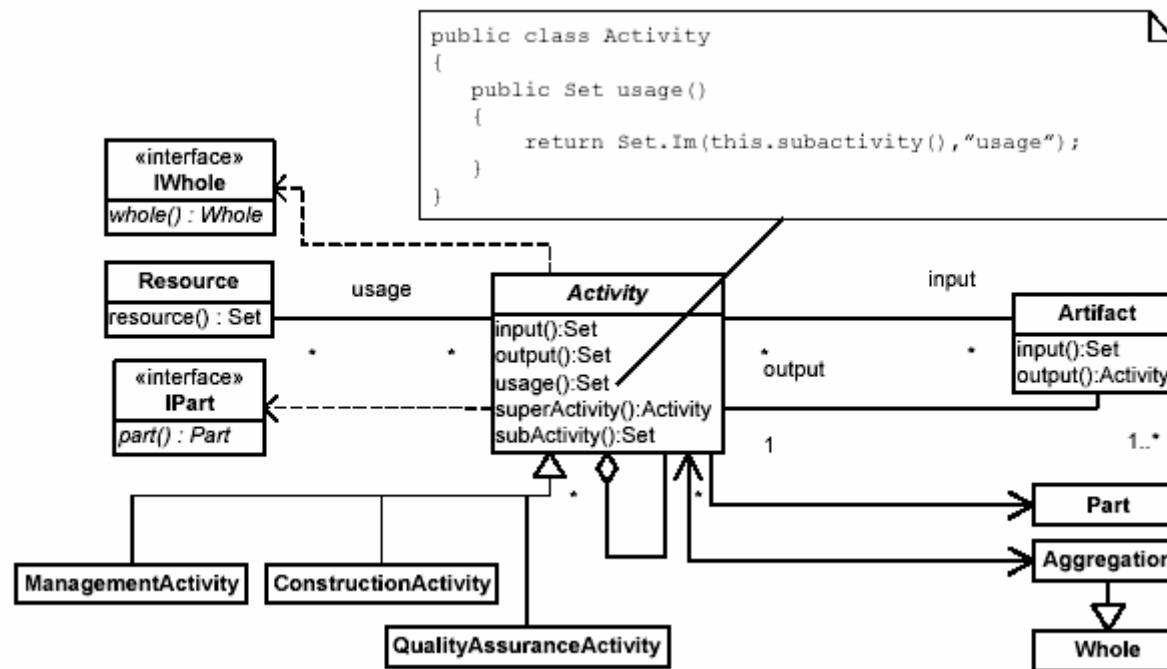
# Ontologies in Domain Engineering

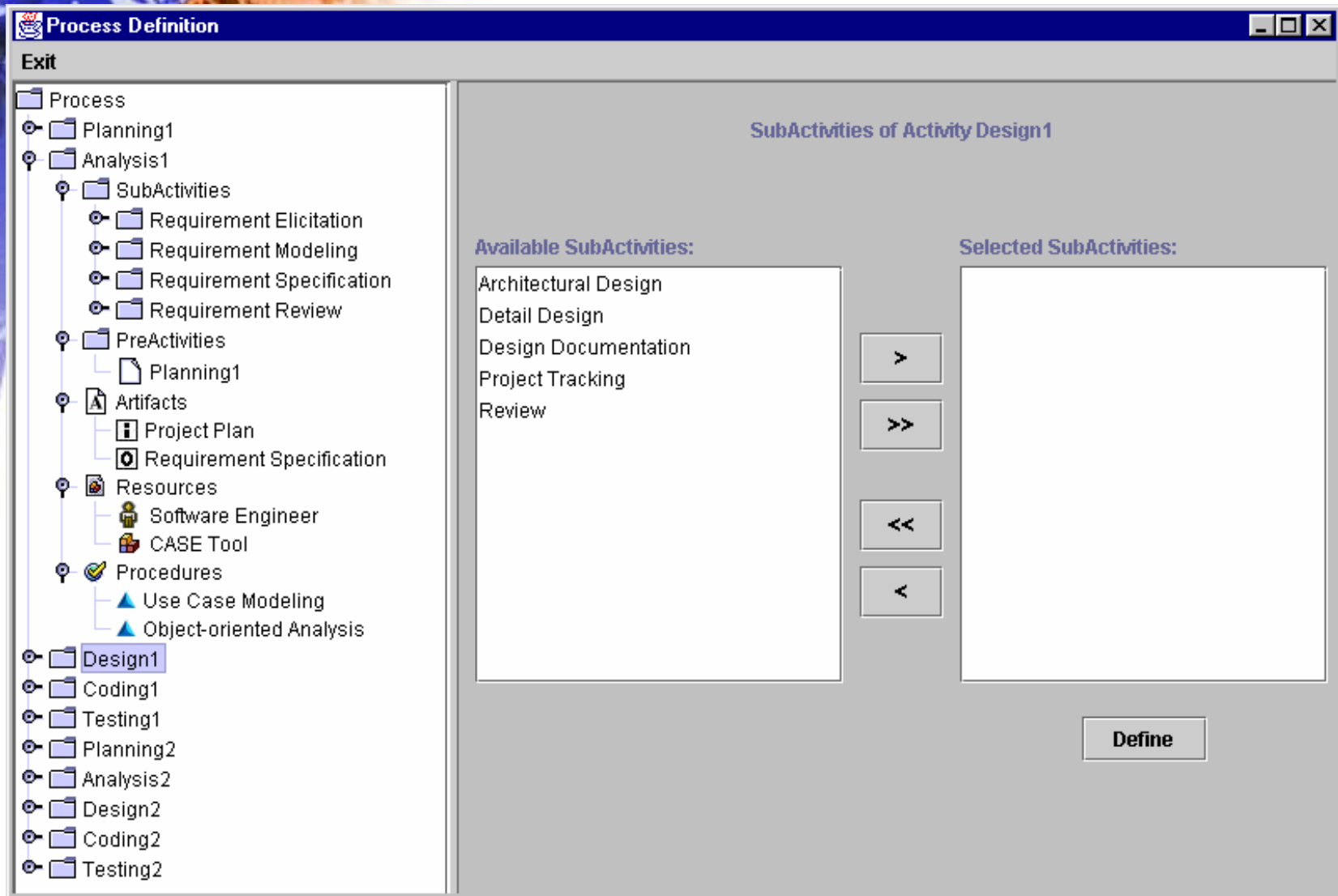
- Frameworks with methods that explicitly answer the competence questions of the ontology.

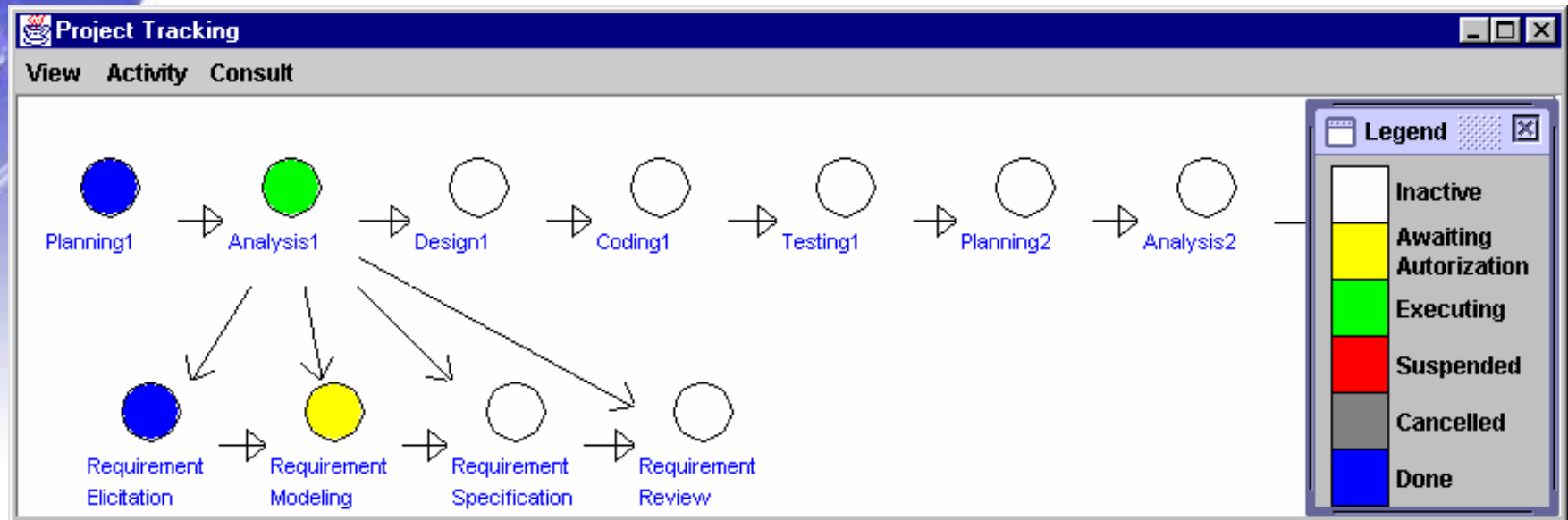


# Ontologies in Domain Engineering

- Frameworks with methods that explicitly answer the competence questions of the ontology.









## Why a Set-Theoretical Language in that case?

- **Allows modeling in High-Level of abstraction without including unnecessary ontological commitments**
- **Facilitates the transition to Object Frameworks**
- **Solid and Simple Mathematical Theory**
- **Familiar to the Target Audience**
- **Easily Translatable to F-Logic**



## Ontologies and The Semantic Web

- **The real popularization of ontologies in computer science started in 2000 when Tim Bernes-Lee start publicizing his view of the “Semantic Web” and the role ontologies played in it**
- **HOWEVER, THIS DESERVES A SEPARATE TALK!**



## References

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