

CNR



**Institute of
Cognitive Sciences
and Technology**

Laboratory for Applied Ontology

Formal ontological methods

(for sharing scientific and cultural information)

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Laboratorio di Ontologia Applicata

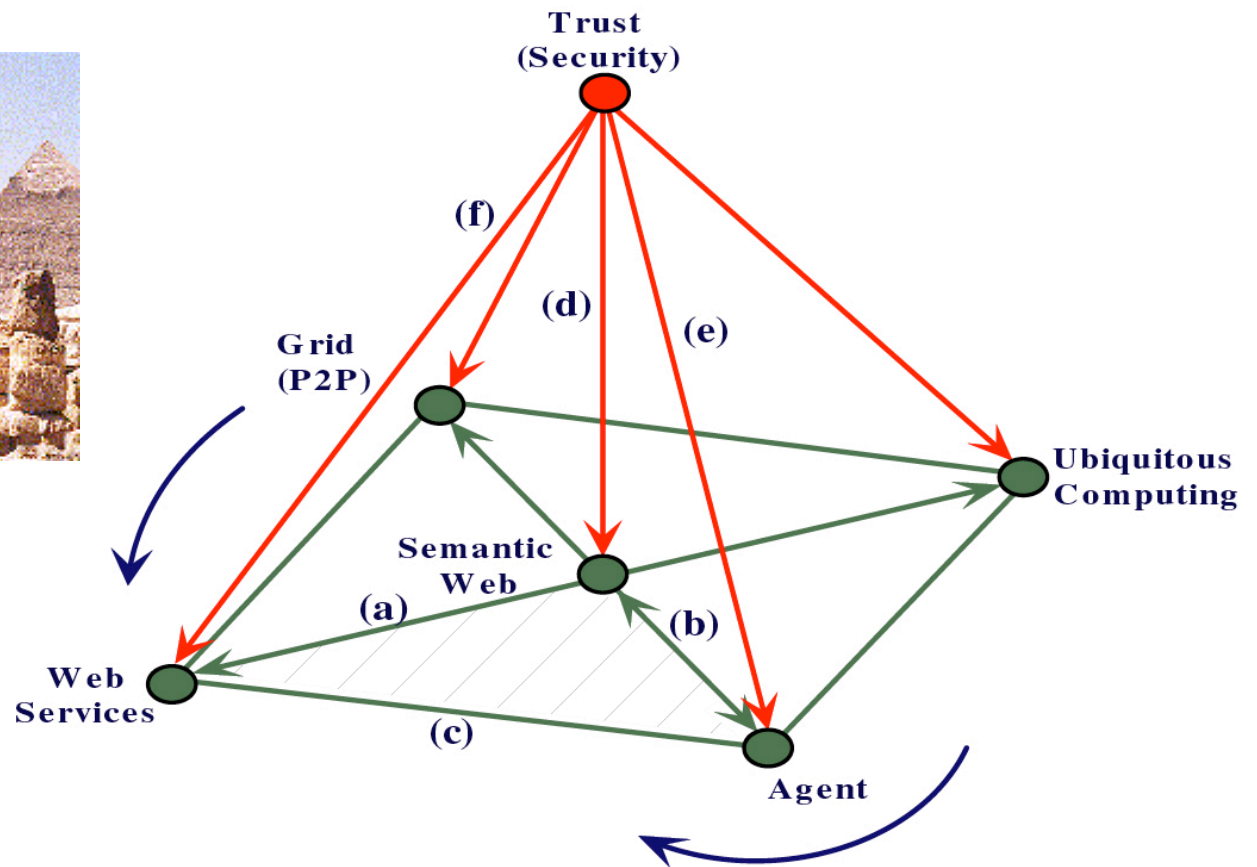
Istituto di Scienze e Tecnologie della Cognizione, C.N.R.

Roma/Trento

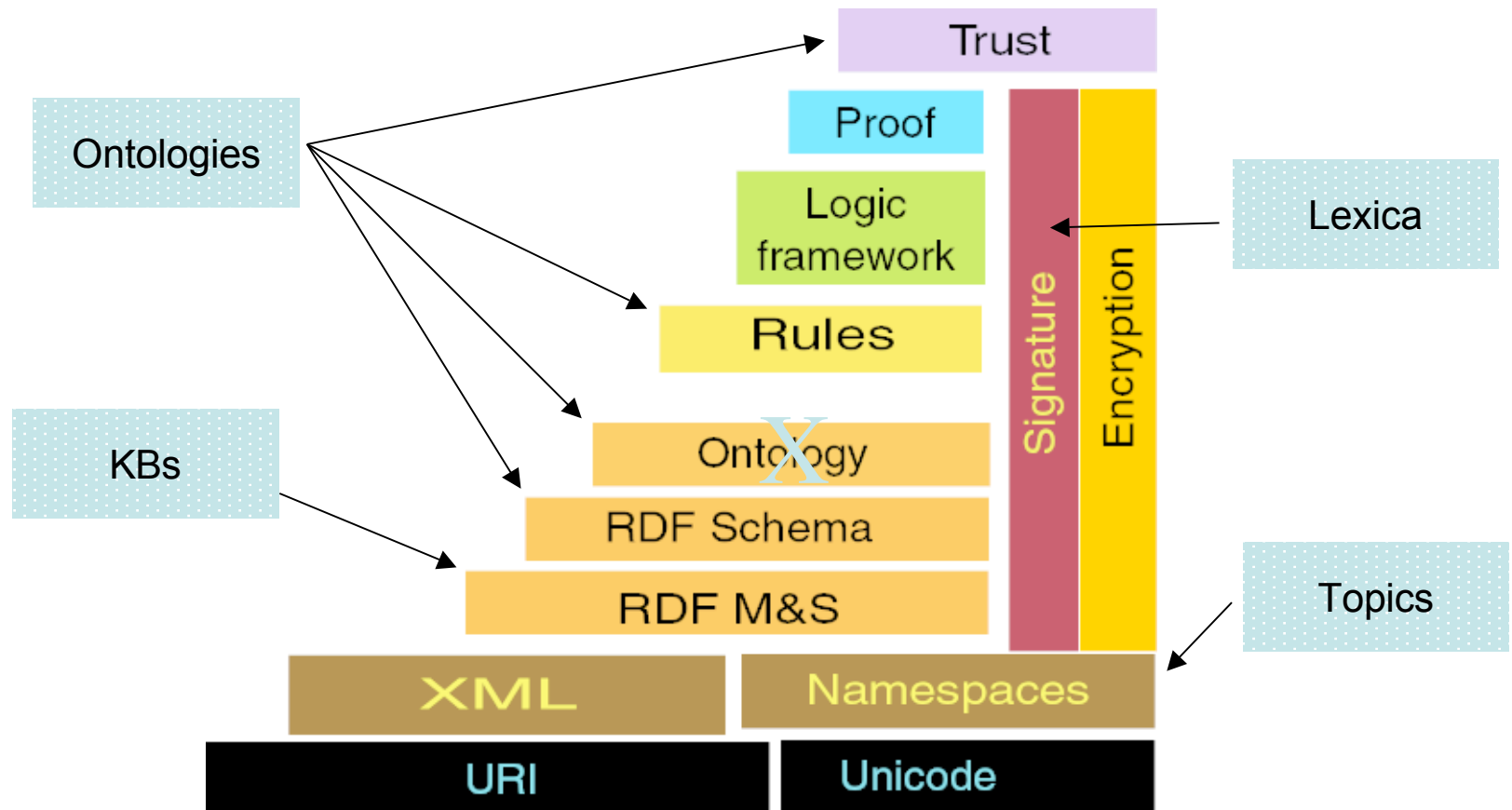
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<http://ontology.ip.rm.cnr.it>

A SemWeb summary (Hu)

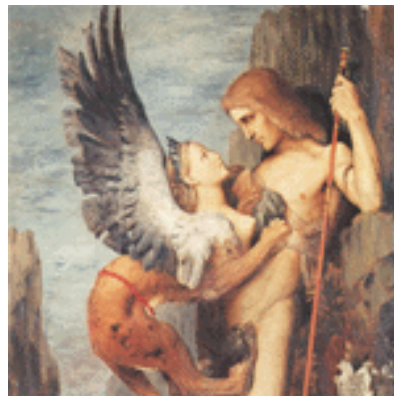


SemWeb architecture (Berners-Lee)



SemWeb and Trust

- *"The real power of the Semantic Web will be realized when people create many programs that collect Web content from diverse sources, process the information and exchange the results with other programs. The effectiveness of such software agents will increase exponentially as more machine-readable Web content and automated services (including other agents) become available..." Tim Berners-Lee, J. Hendler, and Ora Lassila, [The Semantic Web, Scientific American, May \(2001\)](#)*
- *Trust a: assured reliance on the character, ability, strength, or truth of someone or something (Webster)*



Buzzwords or not?

- Semantic Web
- Ontology/ontologies
- Web services
- Information retrieval
- Document indexing
- Meaning negotiation among agents
- Communities of interest

What is semantics?

- Linguistic meaning characterization
 - Interlinguistic (lexicography, semiotics)
 - Formal semantics of natural languages
- Logical theory for interpretation of logical (and programming) languages
- Intersection: formal ontology
- *Semantic Web???*
 - mostly annotations
 - often no formal semantics
 - usually no formal ontology

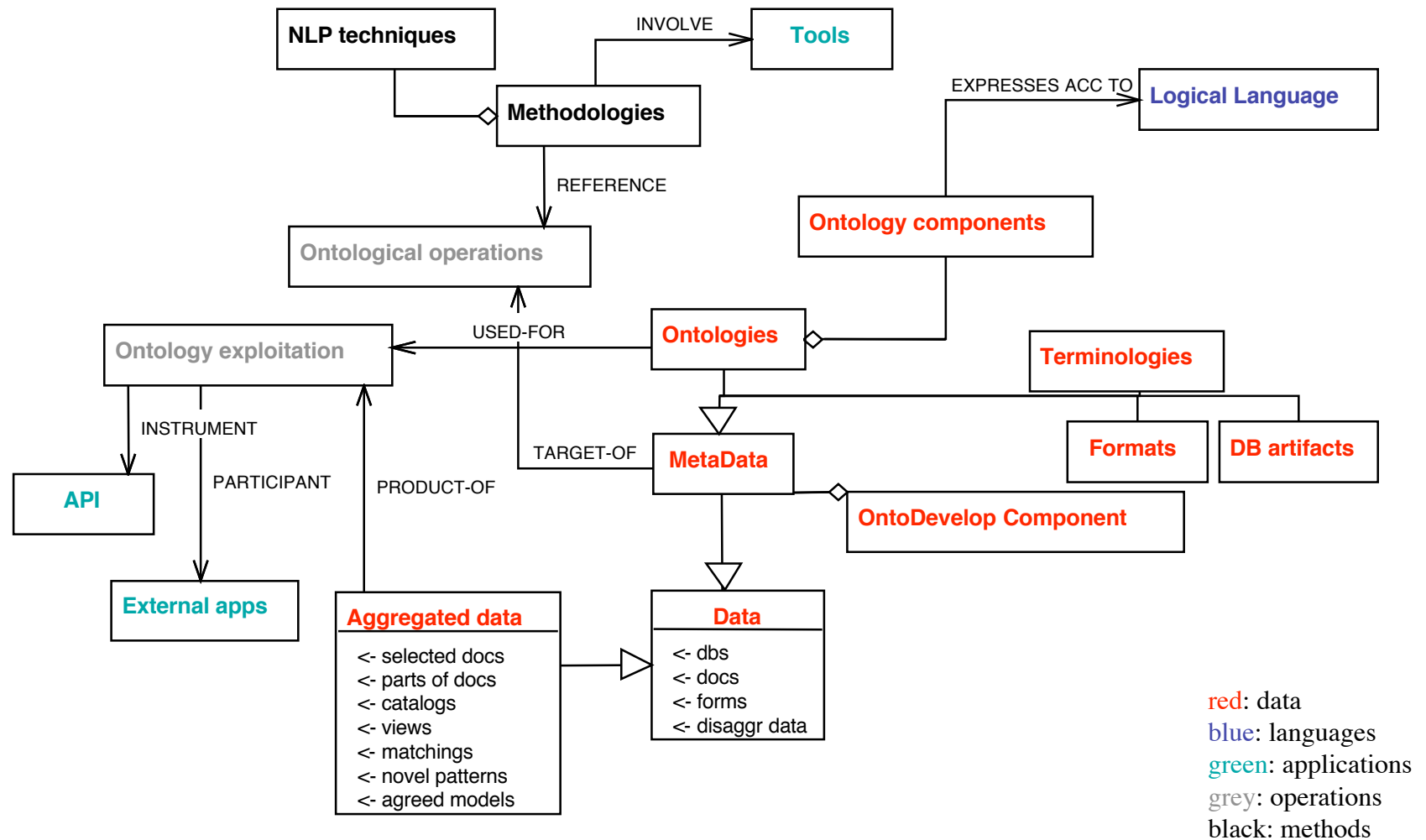
What is ontology?

- Philosophical commitment to what exists
- Axiomatic theory
- Informal model (topic maps, xmls, etc.)
- Terminology (thesauri, classifications, etc.)
- ...
- *Formal ontology* is about building axiomatic theories that are based on formal principles
 - *ex-sistere* \approx "come into being"
 - formal \rightarrow grounded, (cognitively) schematic

Existing "ontologies"

- Controlled terminologies or axiomatic theories?
- Terminologies need re-engineering
 - Low detail (e.g. DAML DB, ...)
 - Low formalization (e.g. thesauri, ...)
 - Inexplicable or non-explicit distinctions (e.g. bottom-up domain specifications)
- Heterogeneity
 - How to negotiate, integrate, merge?

Ontological engineering (static view)



Methodology types

- Linguistic ontology development
 - lexicographic treatment of domain terminologies
- Community ontology development
 - negotiating an intersubjective agreement among the members of a community of interest
- Cognitive ontology development
 - axiomatic theories and cognitive invariants to be used in performing domain analysis

Different uses of ontologies

- Reference ontologies (*development time*)
 - **establish consensus** about meaning of terms (in general)
 - higher expressivity (non-stringent computational reqs.): task to be undertaken only once for cooperation process types
- Application ontologies (*run time*)
 - offer **terminological services** for semantic access, checking constraints between terms
 - limited expressivity (stringent computational reqs.)
 - can be derived from reference ontologies
- **Mutual understanding** more important than mass interoperability
 - understanding disagreements in the context of common criteria
 - establish trustable mappings among application ontologies

Dimensions of ontology quality

- Logical consistency
- Extensional coverage (every entity I want)
- Intensional coverage (every property I construct)
- Precision (just the models I intend)
- **Groundedness of primitives**
 - for concepts and for relations
- **Multilayered contextualization**

Formal criteria (concepts)

- individuals vs. concepts
- 3D vs 4D
- unity vs. amount
- regions vs. entities
- situations and descriptions

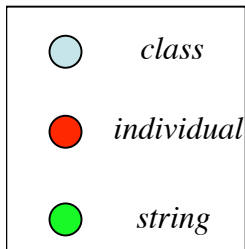
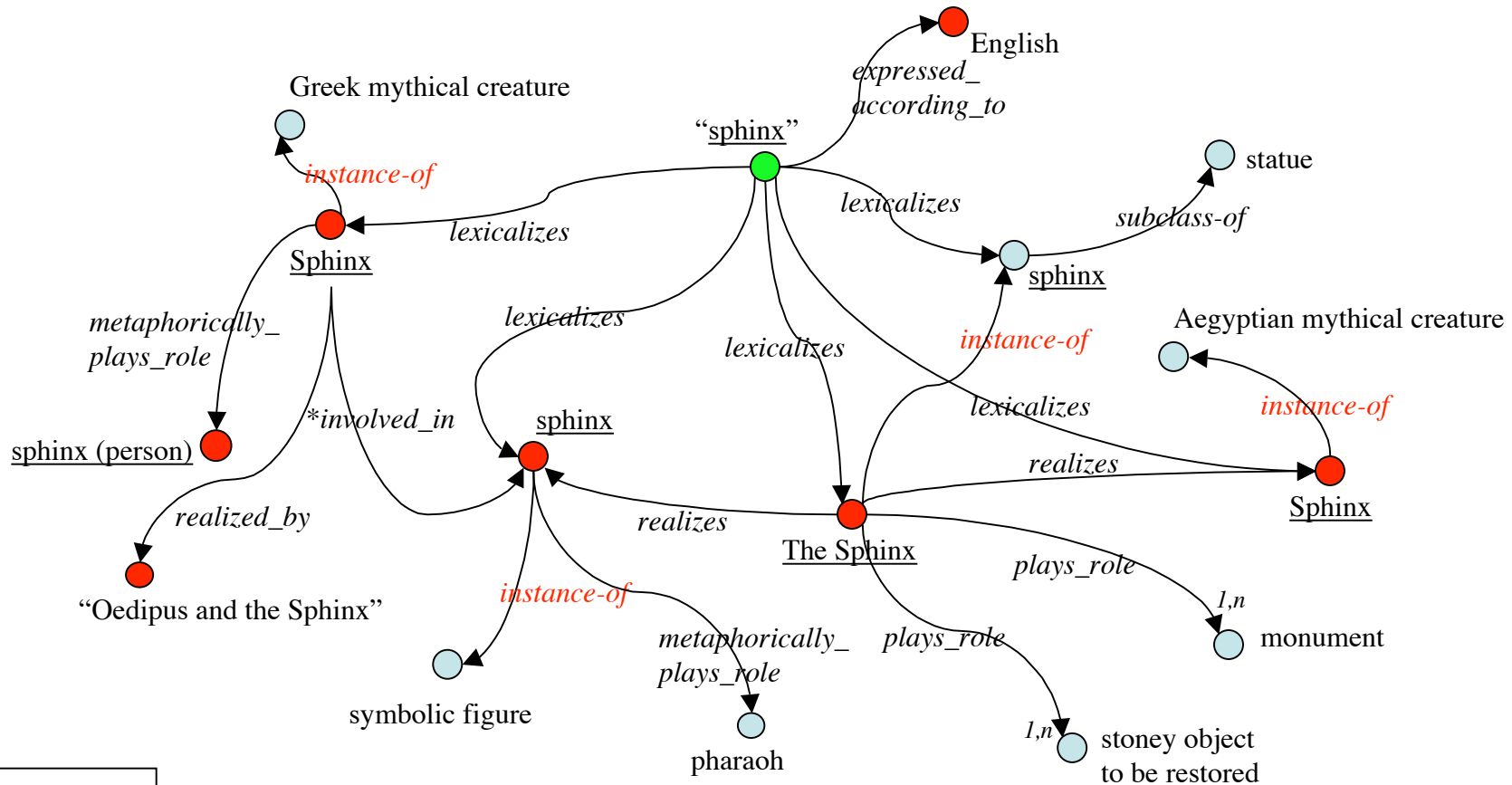
Formal criteria (relations)

- symmetry (e.g. "connection" vs. "part")
- transitivity (e.g. "ancestor" vs. "father")
- immediacy vs. compositionality (e.g. "part" vs. "systemic component")
- *intra-categoriality* vs. *inter-categoriality* (e.g. "part" vs. "participation")
- schematic primitives
 - *part, function, structure, participation, inheritance, localization, succession, satisfaction*
 - ...

Multilayered contexts

- **Textual** (in what text or kind of texts ...)
 - sphinx as in a web site
 - The sphinx appears to have started in Egypt in the form of a sun god
- **Lexical** (in what language or kind of language ...)
 - sphinx (English)
- **Theoretical** (in what theory, domain, subject, system of rules ...)
 - sphinx as in the Thutmose's legend
 - King Thutmose IV (1425 - 1417 BC) placed a stela between the front paws of the figure. It describes when Thutmose, while still a prince, had gone hunting and fell asleep in the shade of the sphinx ...
- **Situational** (in what situation or kind of situation or social community ...)
 - sphinx within a restoration plan execution
 - In the 1980's, a carefully planned restoration of the Sphinx was in progress
- **Personal** (for what person or kind of person ...)
 - sphinx for a professional restorer or for Mario Rossi's needs

How many sphinges?

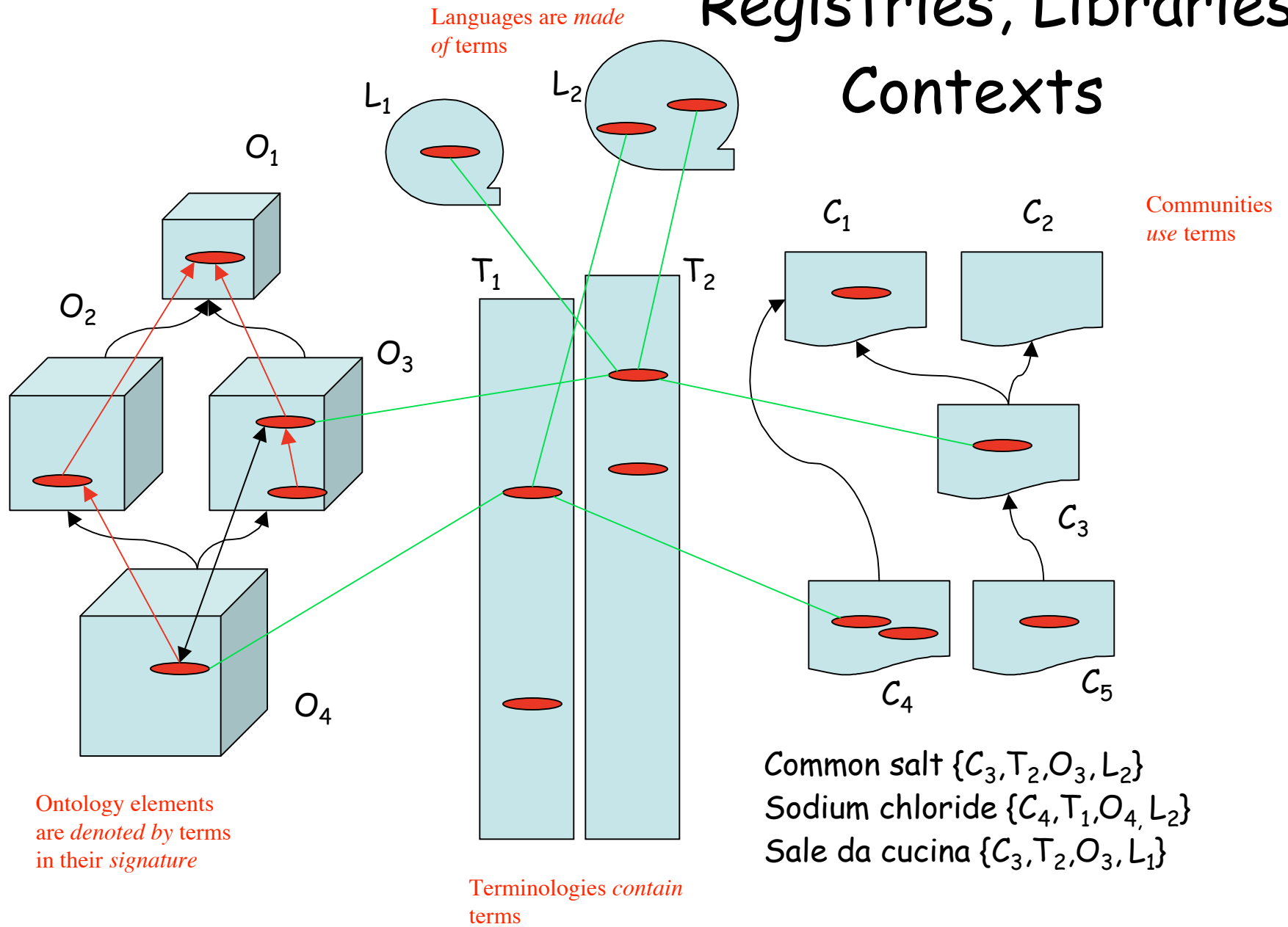


* in naïve iconography

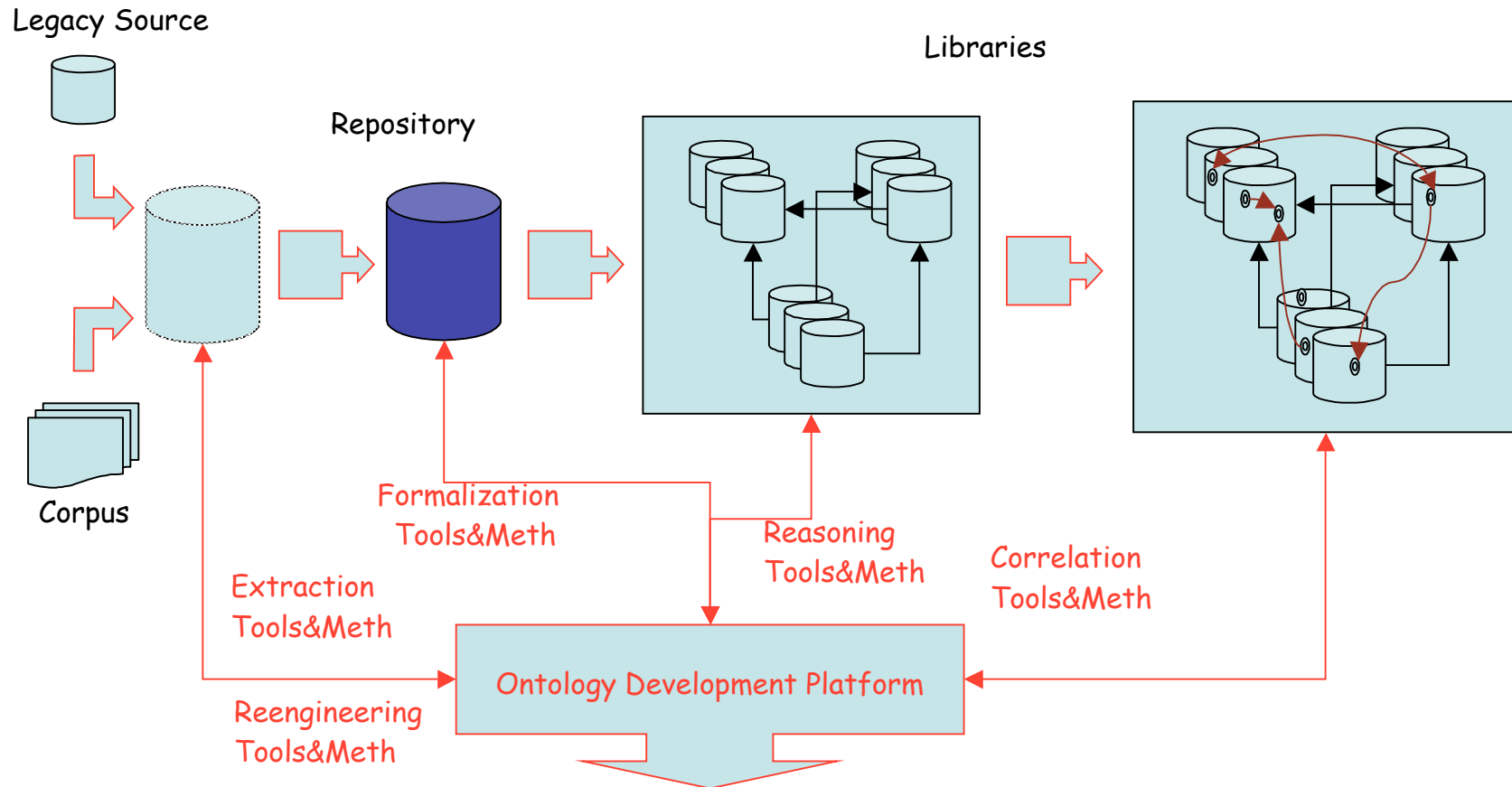
The Modularity Manifesto: “representational” contexts

- Registries (in what registry is an ontological element included?)
- Topics (what catalogue label is used for an ontological element?)
- Conceptual modules (what conceptual module represents a domain, topic, or subject?)
- Semiotic domains (for any domain, task, community, what lexical item is used for a conceptual element?)
- Reified contexts (within what description or situation are we referring to something?)
- Personal profiles (what contextual profile can be built out of someone's interestes?)

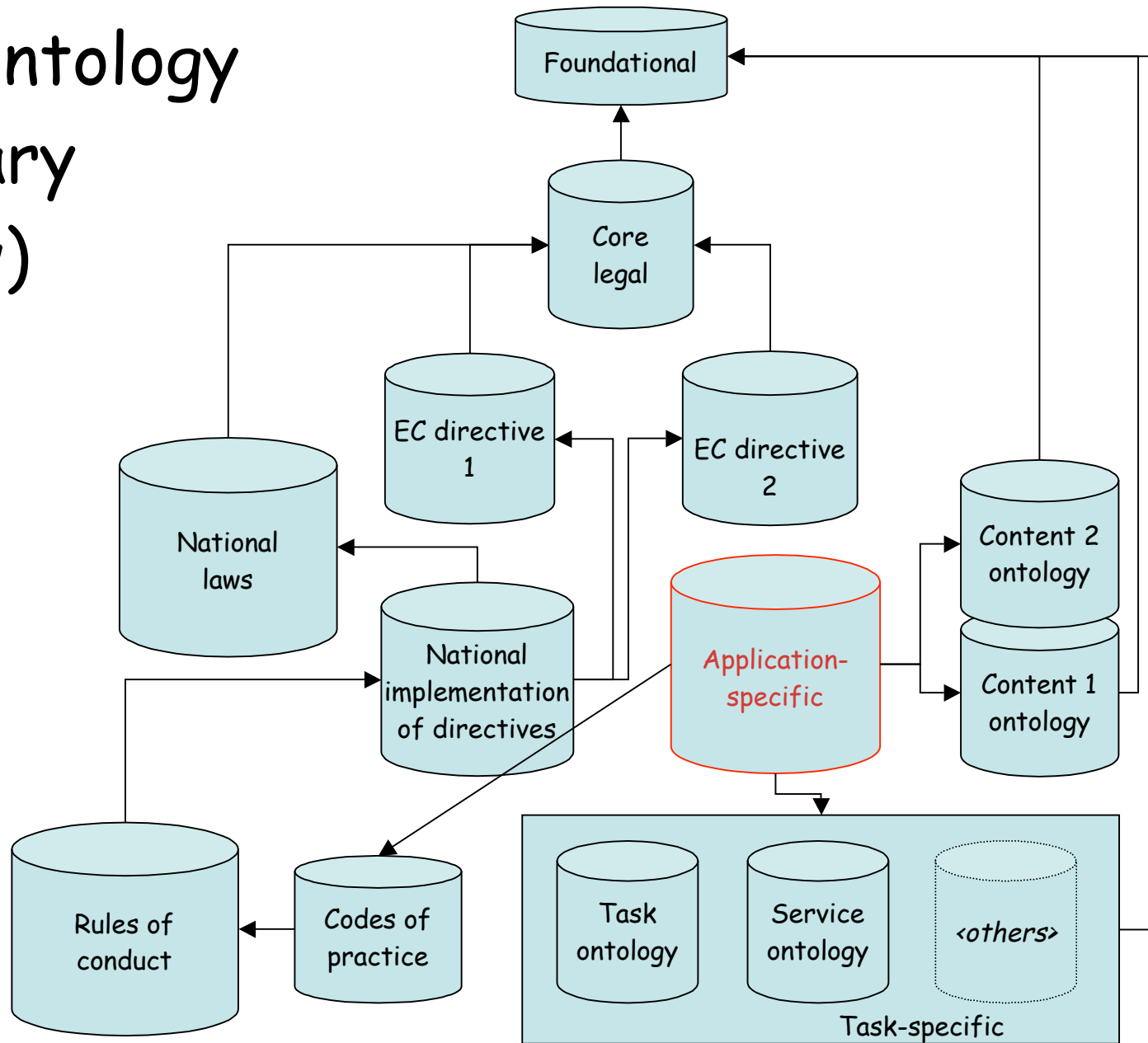
Registries, Libraries, Contexts



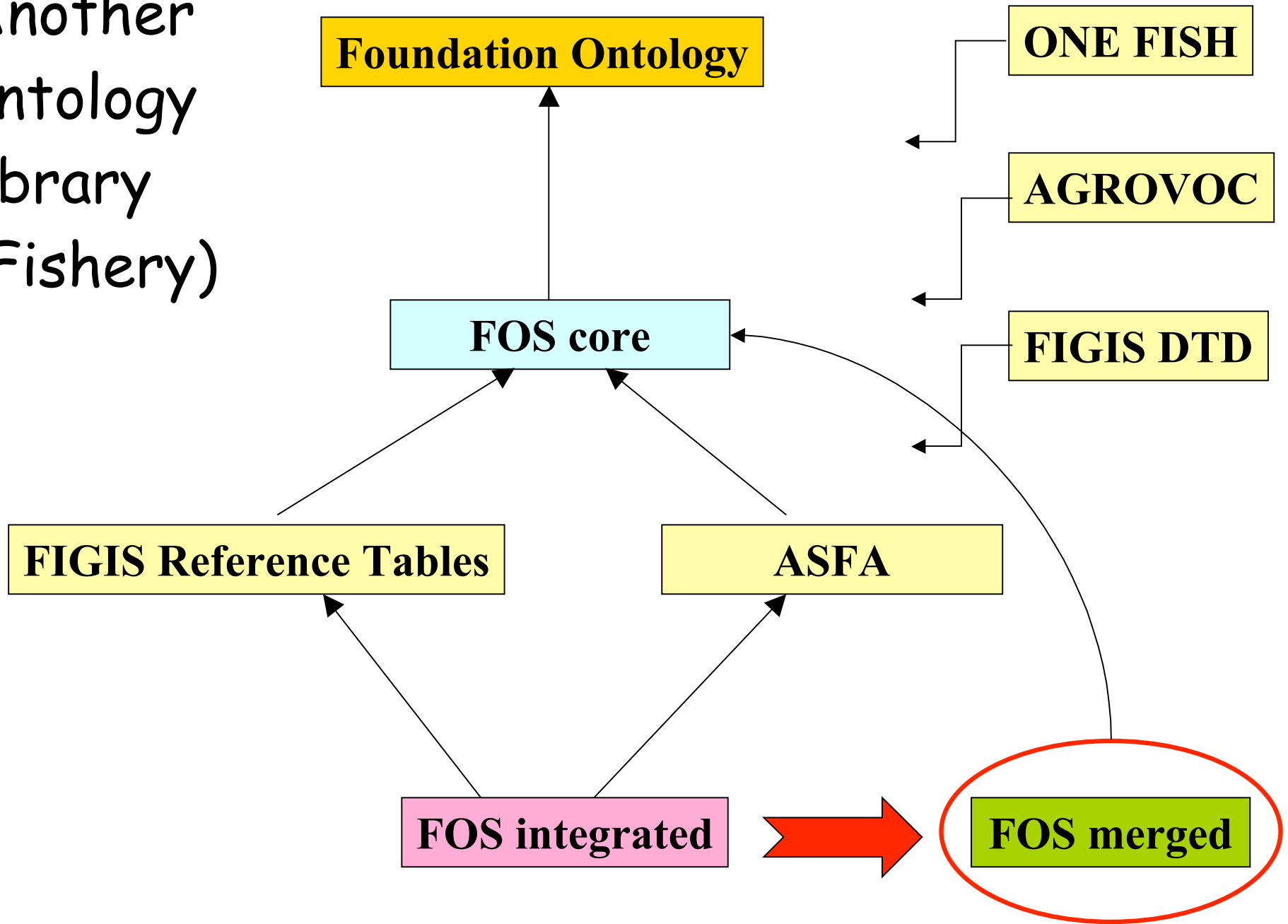
An ontology development platform



An ontology library (Law)



Another
ontology
library
(Fishery)



Cultural riddles that FO helps describing (Sphinx too simple ...)

- Objectual vs. eventual artifacts: e.g. plastic art vs. music
- Artistic periods: time, events, descriptions?
- Authorship: contingency vs. functionality
- Authenticity: neither monotonic nor homogeneous evolution
- Interpretation: symbolic figures, depicted objects, explicit and implicit meaning, etc.
- Metaphoric role playing
- Scientific repositories
 - Natural taxonomies and holotypes
 - Pathway discovering

Some LOA projects

- *WonderWeb*, Ontologies for the semantic web (EU Fifth Framework Program project)
- *FOS*, Fishery Ontology Service (International project with UN-FAO)
- *IKF-IFLEX*, Intelligent Knowledge Fusion (Eureka Project E!2235, academic/industrial project for information integration in the business domain), and some linked industrial projects (banking, SLM, insurance)
- *OntoWeb*: Ontology-based information exchange for knowledge management and electronic commerce (EU Thematic Network), SIG on Content Standards, WGs on Foundational and on Legal Ontologies
- *TICCA* (Italian Project, Cognitive technologies for artificial agents)

... and tools

- **DOLCE** (Descriptive Ontology for Linguistic and Cognitive Engineering). A foundational ontology containing a special recipe of formal principles that generates a so-called 3D view of a domain.
- The **OntoClean** methodology and meta-properties, currently implemented in many toolkits for ontology development, provides means to remodel existing ontologies by separating their backbone, stable taxonomy, from accessory hierarchies.
- The **ONIONS** methodology provides guidelines to analyze and merge existing ontologies, and addresses the reengineering of domain terminologies.
- The **DOLCE-Lite+** library is a library containing plug-ins (so-called *conceptual templates*) to the DOLCE foundational ontology that have been customized by starting e.g. from *systematic polysemy* evidence. Currently, it includes plug-ins for *plans*, *semiotic relations*, *spatial location relations*, *functional participation relations*. Now a **DOLCE+WordNet** is available.
- Domain applications: fishery, Law, banking, SLA, biomedicine, guidelines, insurance CRM, multimedia cultural repositories, ...

Sites

- *LOA*: <http://ontology.ip.rm.cnr.it>
- *WonderWeb*:
<http://wonderweb.semanticweb.org>
- *DOLCE-Lite+*:
<http://150.146.7.151:8080/loom/shuttle.html>
- user: cakewalk, pass: sweetooth