

A Core Ontology of Fishery and its use in the Fishery Ontology Service Project

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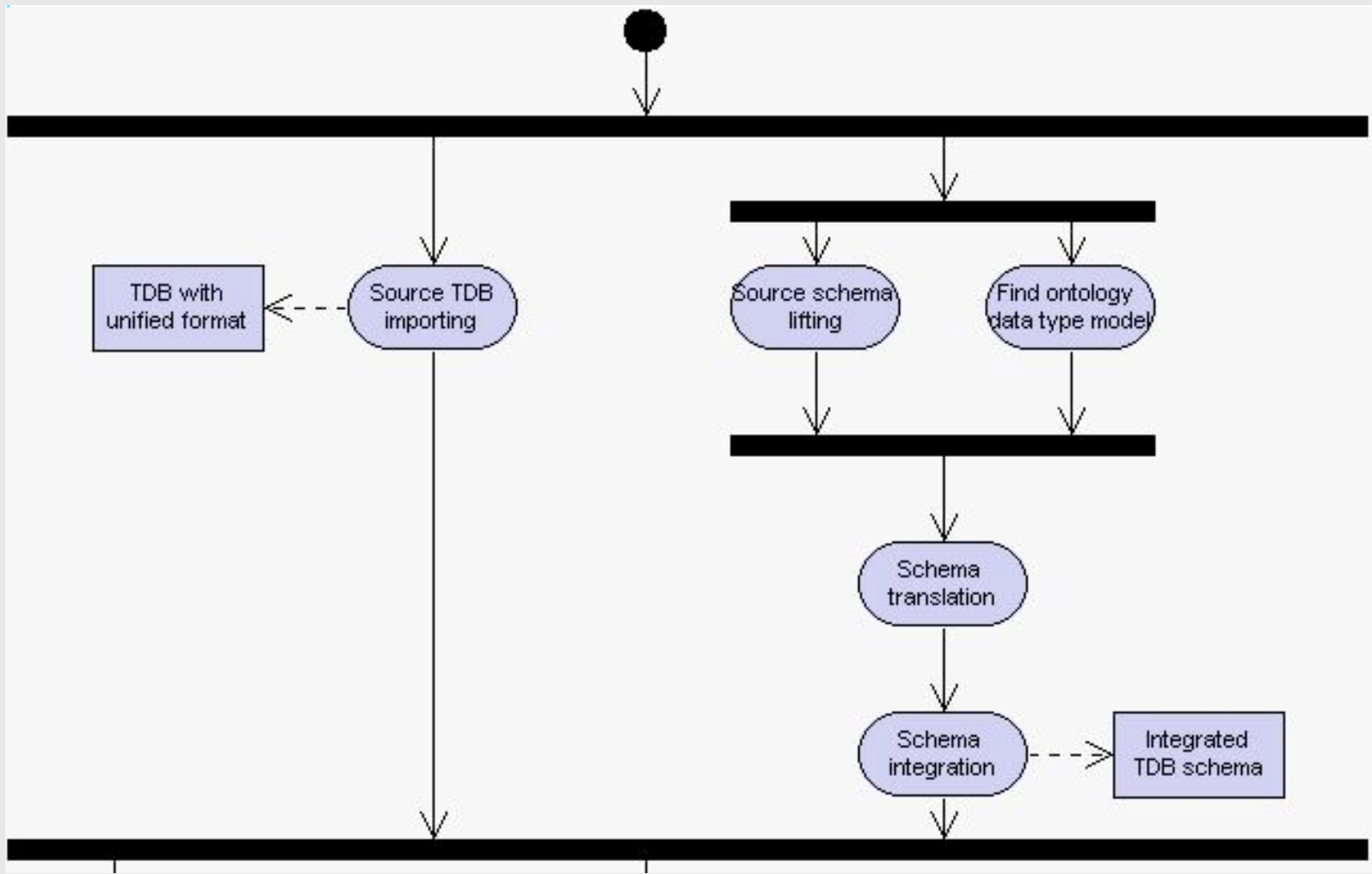
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Liang, Margherita Sini, Frehiwot Fisseha (UN-FAO, Rome)

The original overall proposal

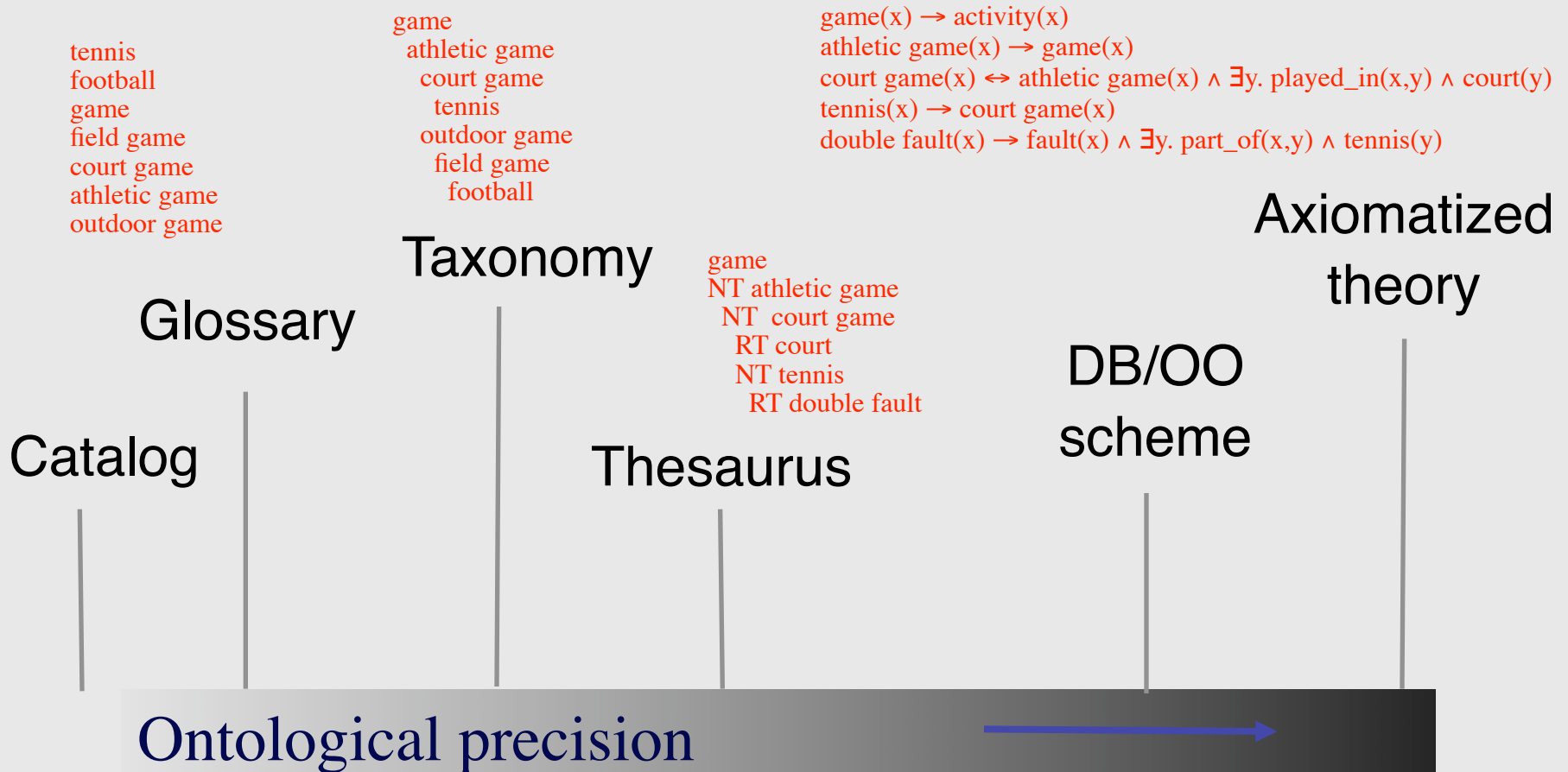
“enhanced online multilingual fishery and aquatic resources terminology tools ... in conjunction with the development of an AGROVOC ontology server ... the oneFish Community Directory, ASFA, FIGIS and WAICENT would gain mutual benefit from the development of such tools” to achieve better indexing and retrieval of information, and increased interaction and knowledge sharing within the fishery community”



Lifting and datamodel creation/integration



Ontologies by precision



precision: *the ability to catch/provide all and only the intended meaning (for a logical theory, to be satisfied by intended models)*



Legacy *aquaculture* hierarchies from fishery terminology systems

AQUACULTURE (AGROVOC)

- NT1 fish culture
 - NT2 fish feeding
- NT1 frog culture
- ...
- rt agripisciculture
- rt aquaculture equipment
- ...
- Fr aquaculture
- Es acuicultura

AQUACULTURE (ASFA)

- NT Brackishwater aquaculture
- NT Freshwater aquaculture
- NT Marine aquaculture
- rt Aquaculture development
- rt Aquaculture economics
- rt Aquaculture engineering
- rt Aquaculture facilities

Biological entity (FIGIS)

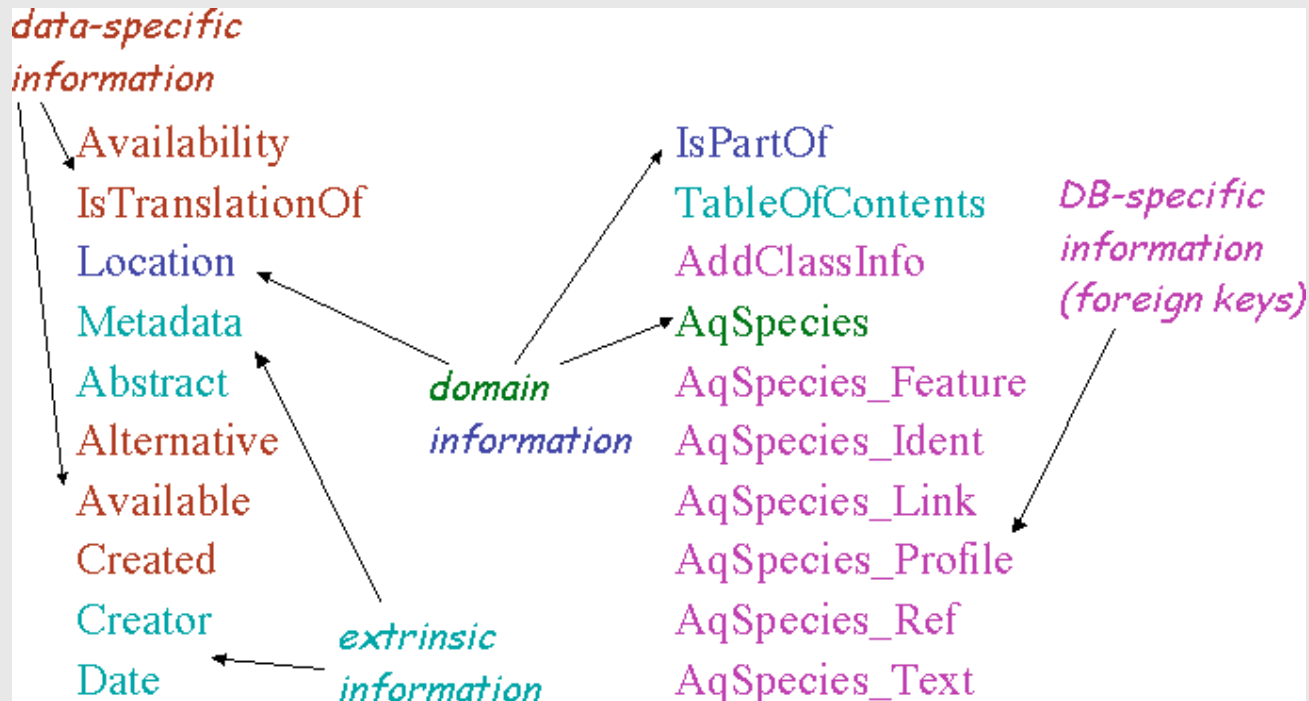
- Taxonomic entity
 - Major group
 - Order
 - Family
 - Genus
 - Species
 - Capture species (filter)
 - Aquaculture species (filter)
 - Production species (filter)
 - Tuna atlas spec

SUBJECT (OneFish)

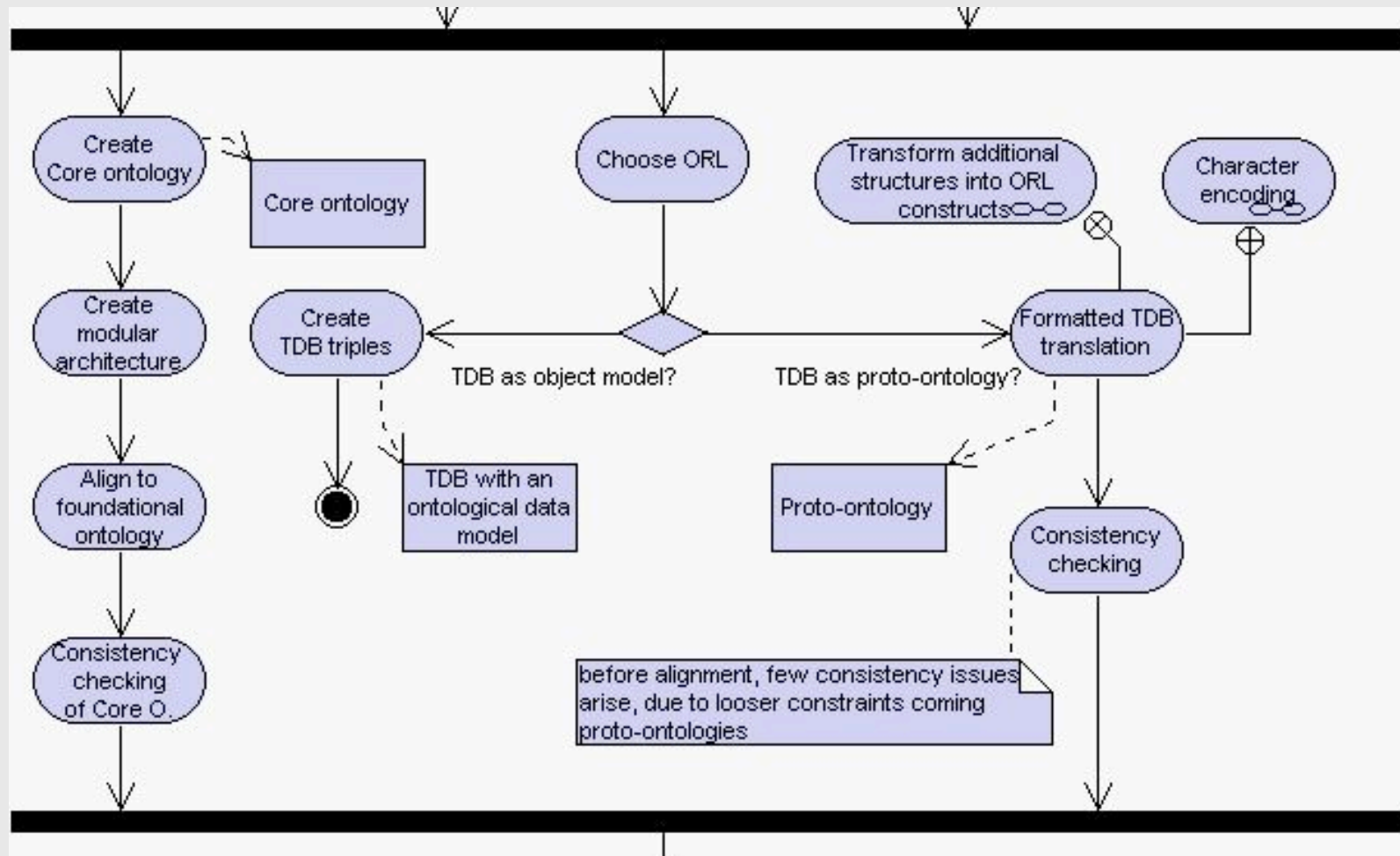
- Aquaculture
 - Aquaculture development
 - Aquaculture economics @
 - Aquaculture planning



Heterogeneous elements in legacy FIGIS DTDs



Formalization and Core Ontology Creation



Sample data model analysis/conversion in FOS

Term \neq Concept

Term \rightarrow String (or Lexical Item)

Concept = Class

BT \approx subsumption between classes

RT \approx top-level conceptual relation

{Descriptors} = \cup {Classes},{Individuals}

Individual \in Class

Concept \neq Subject/Topic/Domain



Datamodel mapping and its effects on translation

- `agrovoc_schema:Descriptor`
 - `agrovoc:River`
 - `agrovoc:Amazon`



- `owl:Class(agrovoc:River)`
- `owl:Individual(agrovoc:Amazon(rdf:type agrovoc:River))`



Datamodel mapping and required transformations

- agrovoc:RT
- agrovoc_schema:Descriptor
 - agrovoc:Fishing_vessel
 - agrovoc:Fishing_gear
 - agrovoc:Fishing_vessel,RT,Fishing_gear



- Class(agrovoc:Fishing_vessel partial
(restriction(agrovoc:RT
someValuesFrom(agrovoc:Fishing_gear))))

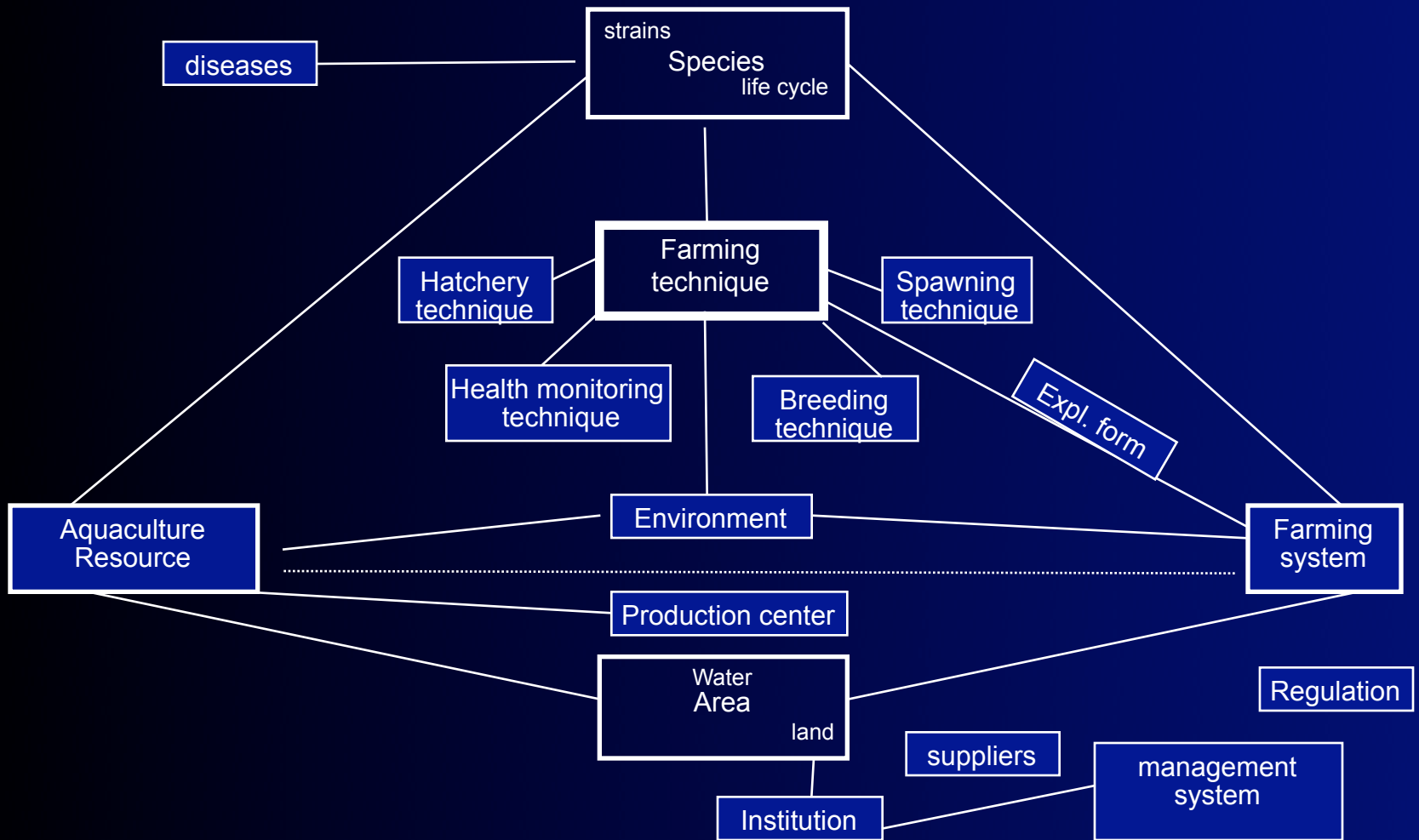


Legacy core notions

- Core building by reusing
-
- terminology tops
- ASFA 1,600, FIGIS 400, Agrovoc 83
- Only 10% into Core Ontology of Fishery
 - Equivalences
 - Non-fishery specific
 - Refinement in lower taxa



Legacy core notions: informal schemas



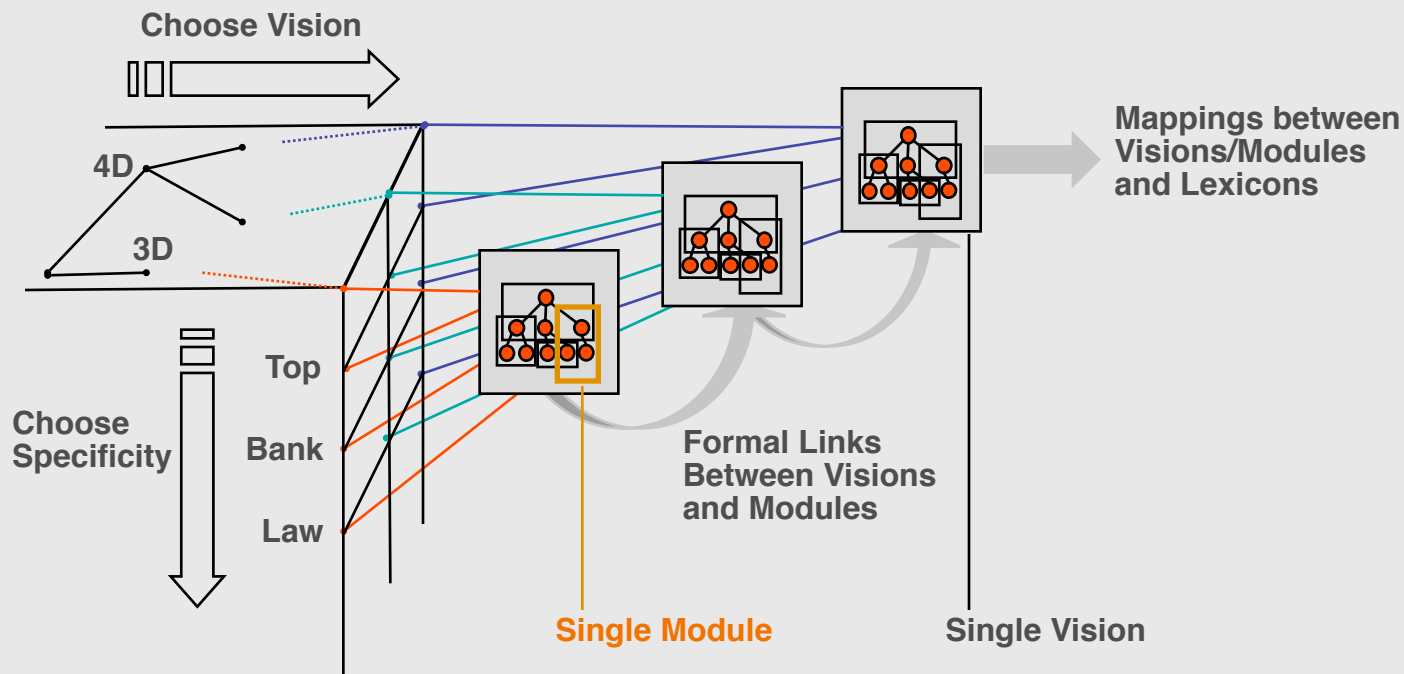
WonderWeb Foundational Ontologies Library (WFOL)

- Reflects different commitments and purposes, rather than a single monolithic view.
- A starting point for building new foundational or domain ontologies.
- A reference point for easy and rigorous comparison among different ontological approaches.
- A common framework for analyzing, harmonizing and integrating existing ontologies and metadata standards.



The structure of the WFOL

- Modules are organized along two dimensions:
 - *visions*, corresponding to basic ontological choices made
 - *specificity*, corresponding to the levels of generality/specific domains

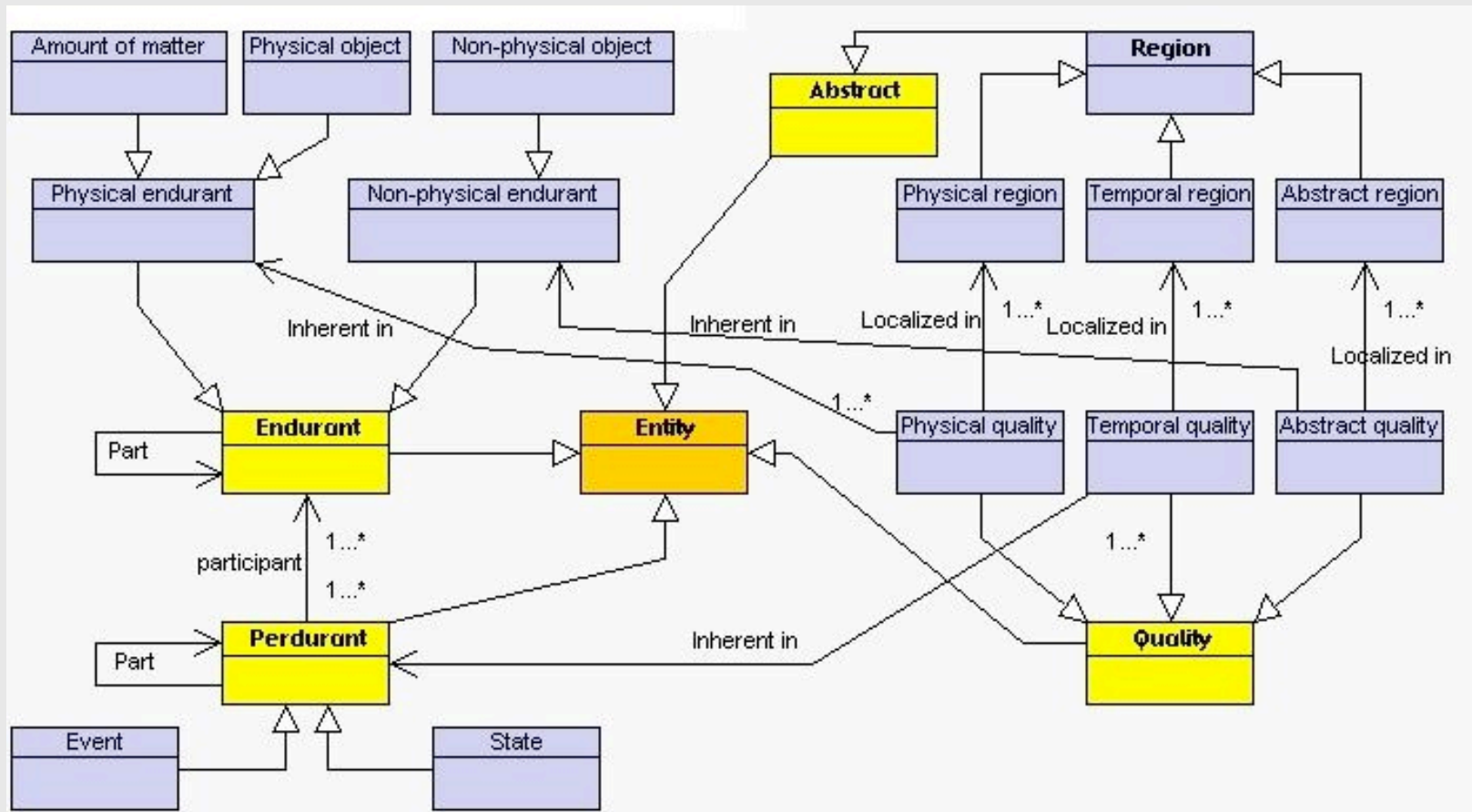


This talk: using UML class diagrams

- Non-standard use of UML to visualize ODPs:
 - generalisation -> subsumption (“subClassOf”)
 - association -> two-way conceptual relation (“property”)
 - assuming reasoning capabilities with classification and role chaining
 - association with no cardinality: 0..*
 - box -> “class”
 - dashed box -> “individual”



DOLCE top-level

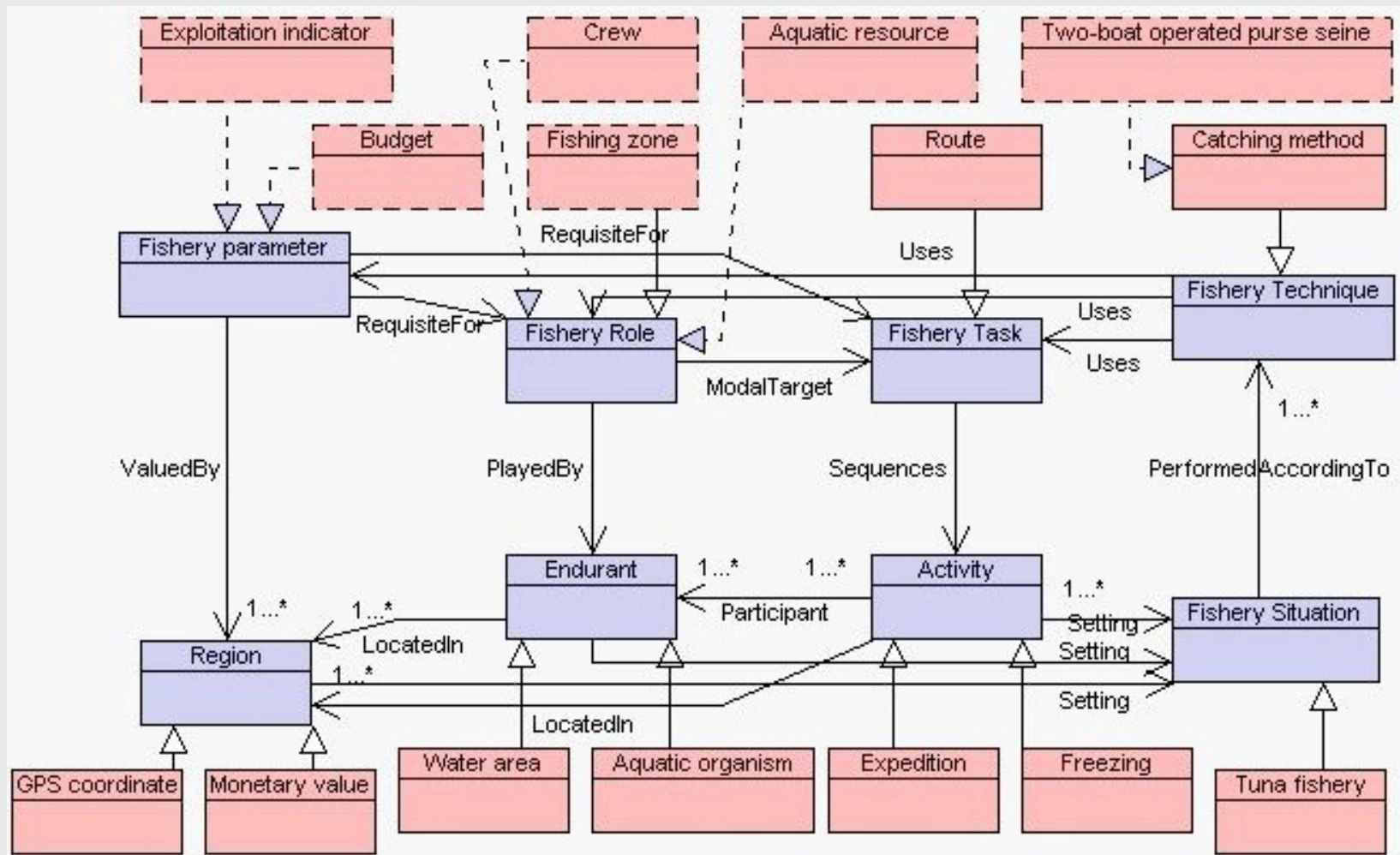


Why extended reification?

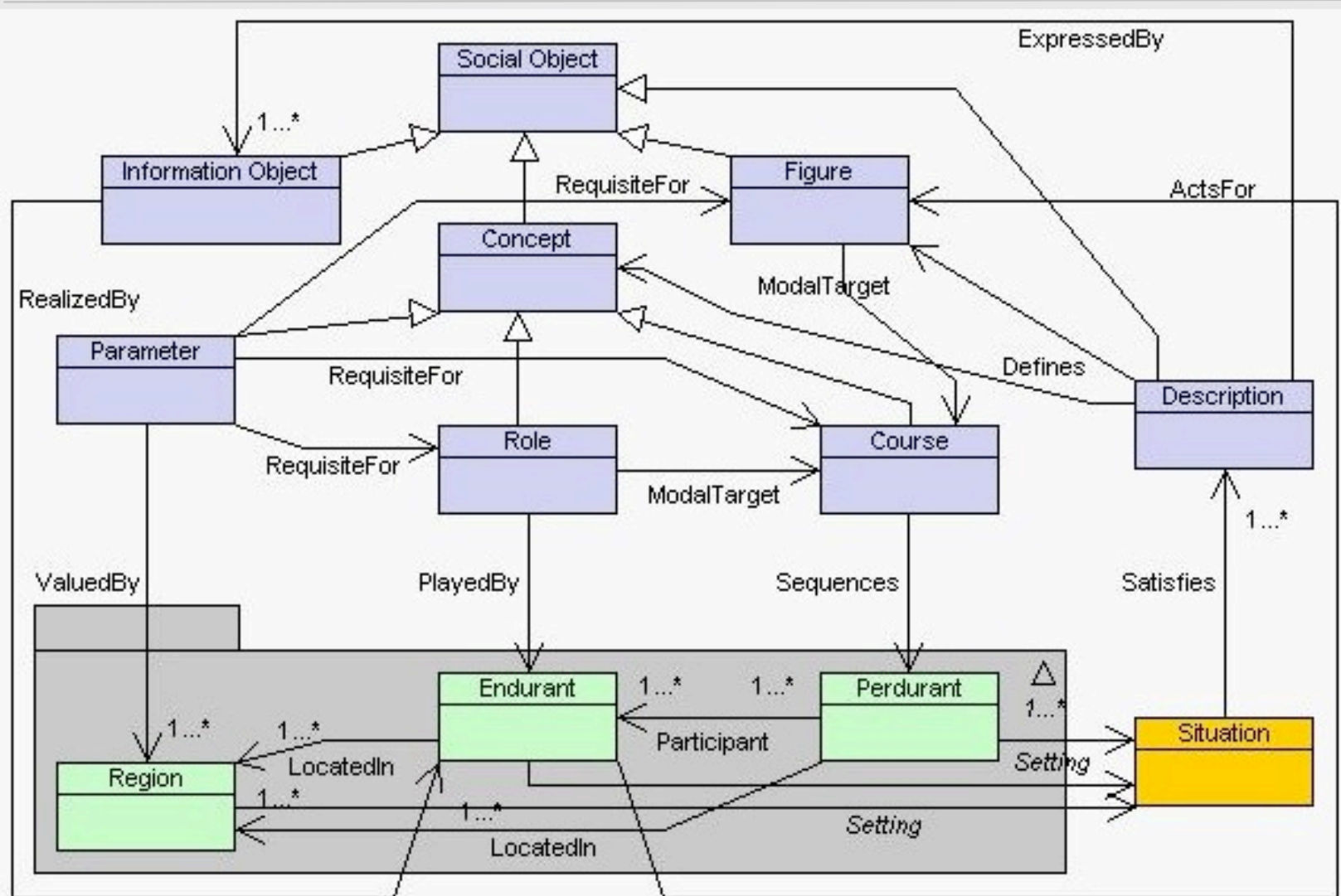
- *The European Union has created rights for air passengers, and is working to enforce them*
- *Two-boat operated purse seine is a catching technique involving the use of a purse seiner, etc.*
- *Italian maximum urban speed limit is 50kmph*
- *FIAT workers have decided a strike*



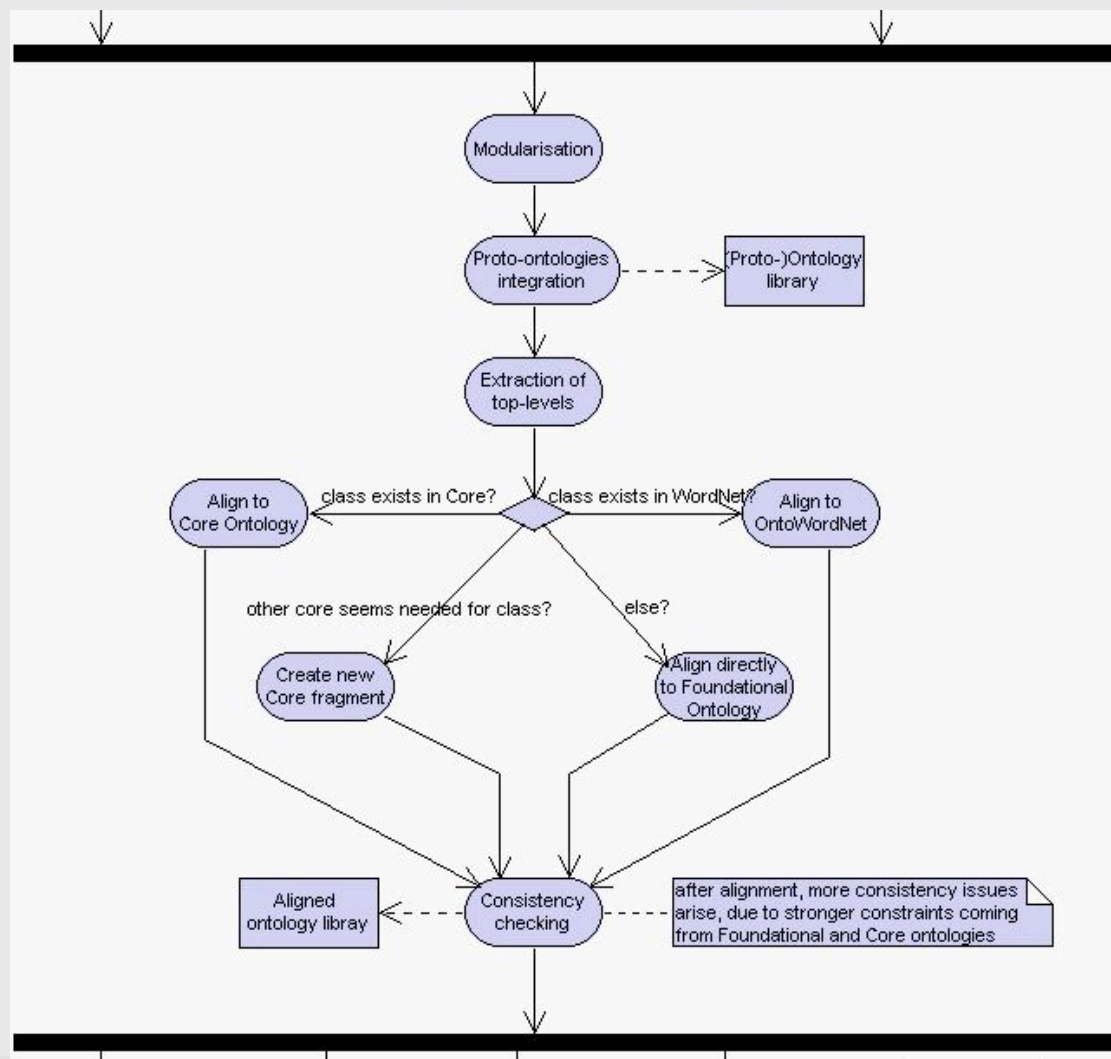
A fishery core ontology for *techniques*



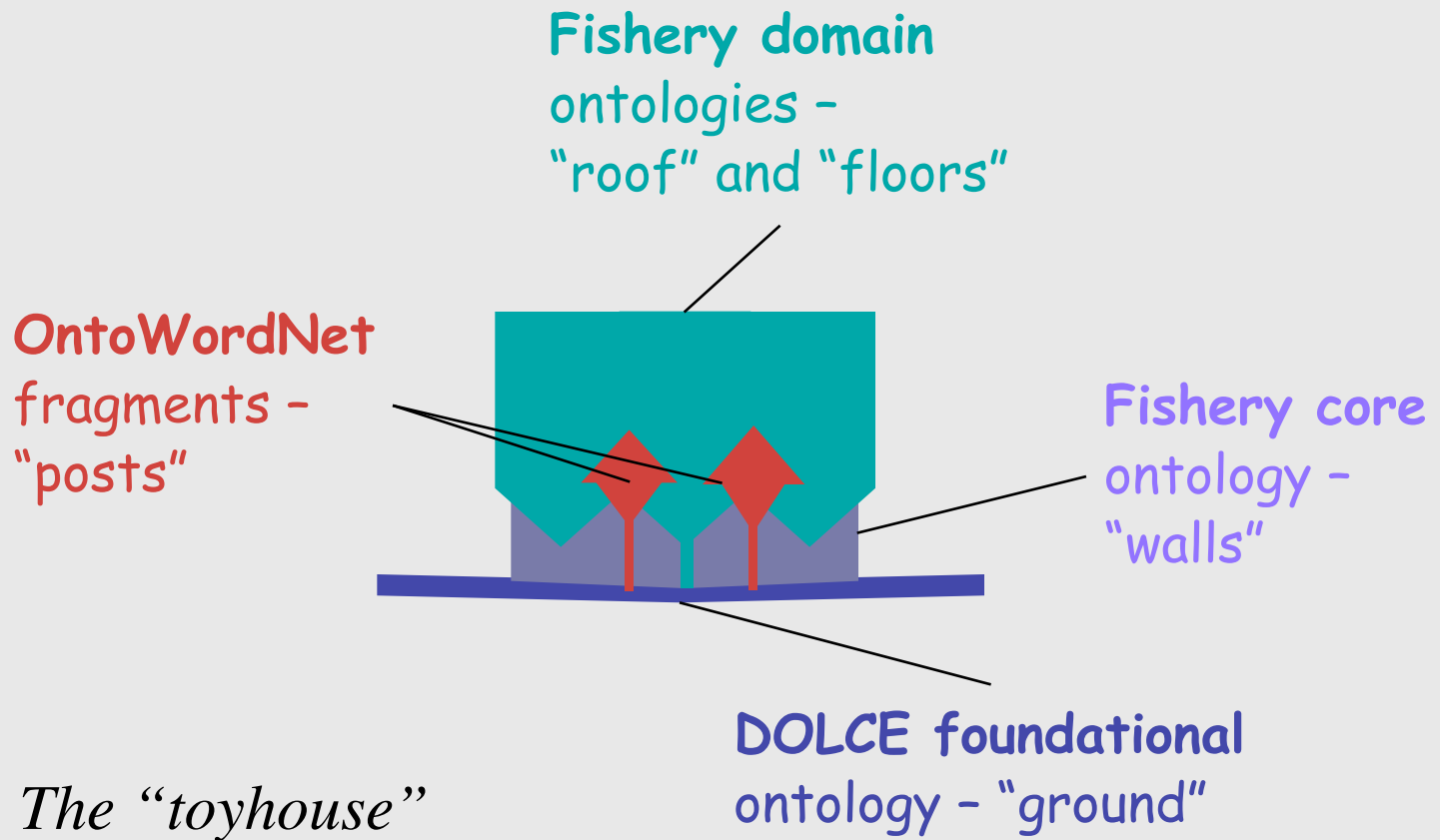
D&S Ontology Design Pattern



Modularization and alignment



FOS library



Alignment method

- Does the class to be aligned (or a proximal one) exist in COF? if so, align it, e.g.:
 - Class(figis:Marine_fishes partial cof:Aquatic_organism)
 - Otherwise:
- Does the class exist in WordNet? if so, include the OntoWordNet fragment related to that class into the library, e.g.:
 - Class(figis:Aquatic_resource partial own:Asset)
 - Otherwise:
- Do the experts think the class is very relevant for fishery, or the class has a rich taxonomy under it? if so, create a small taxonomy that sketches a new core ontology for that domain, e.g. by adapting them from OntoWordNet (e.g. *vehicles, equipments*) or from existing ones (*biomedicine*)
 - Otherwise:
- Align the class directly under a generic class in the foundational layer, e.g.:
 - Class(figis:Country partial dlp:Political_Geographic_Object).



Minimal case of alignment

foundational

dlp:physical_object

core

cof:Fishing_vessel

domain

asfa:Trawlers

| = rdfs:subClassOf



Sample taxonomy within library

Class(ns10:Moonfish partial (Agrovoc)

Class(ns10:Saltwater_Fishes partial (Agrovoc)

Class(ns10:Fishes partial (Agrovoc)

Class(ns3: Aquatic-Organism partial (COF)

Class(ns4:Life_form\$Organism\$Being\$Living_thing partial
(OntoWordNet)

Class(ns1:agentive-physical-object partial (DOLCE)

...



Modules within fishery

- Biological entities
- Continental and water areas
- Ecosystems
- Techniques (capture, culture)
- Vessels and gears
- Resources, stocks, and management
- Commodities and commercialization
- Institutions



Consistency issues

- From ASFA formalization, we get that:
 - `Class(asfa:Trap_fishing partial asfa:Catching_methods)`
 - `Class(asfa:Trap_fishing partial asfa:Fishing)`
- From the alignment, we know that (transitively):
 - `Class(asfa:Catching_methods partial dlp:Object)`, while `Class(asfa:Fishing partial dlp:Activity)`
- And from DOLCE+ we know that:
 - `(disjointClasses dlp:Object dlp:Activity)`
- Hence the intersection:
 - `Class(asfa:Trap_fishing partial`
`(intersection asfa:Catching_methods asfa:Fishing))`
- is *inconsistent*

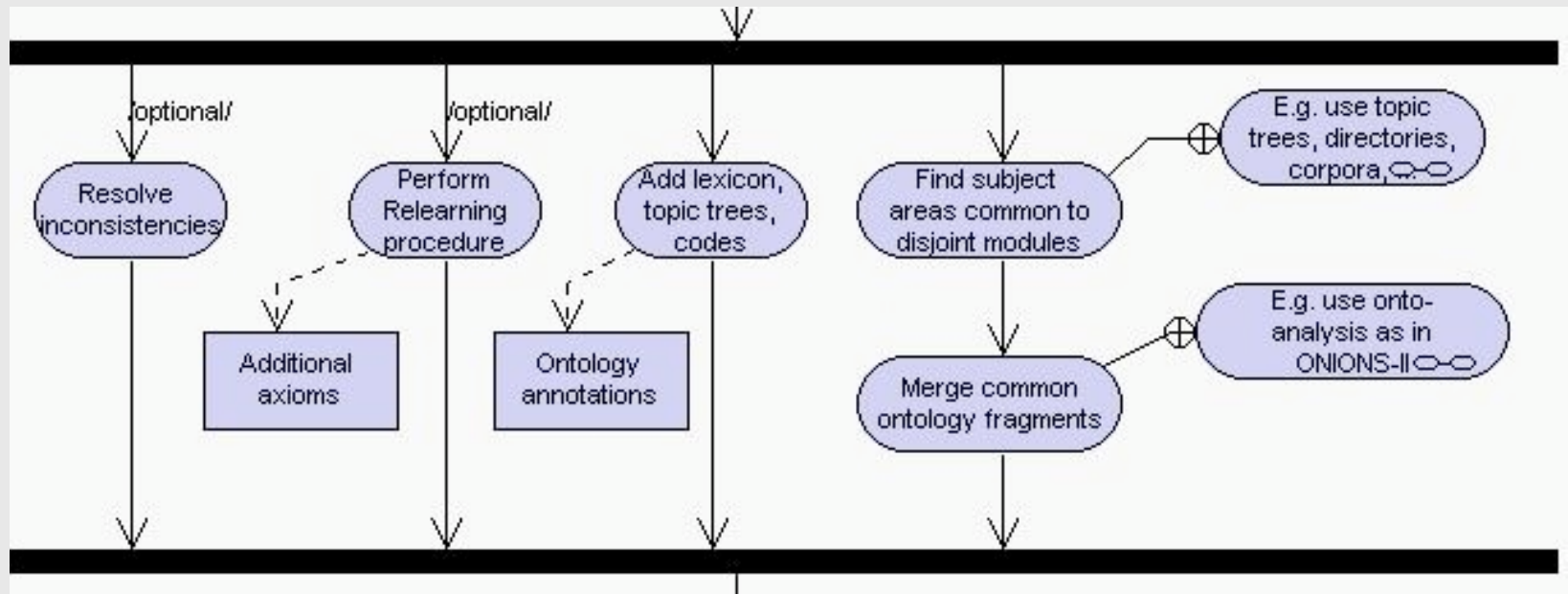


BT polysemy issues

- From AGROVOC we know:
 - `Class(agrovoc:Blood_Cells partial agrovoc:Blood)`
- From a biomedical ontology(ON9.3) we know:
 - `Class(agrovoc:Blood_Cells partial on9:Cell)`
 - `Class(agrovoc:Blood partial on9:Tissue)`
 - `(DisjointClasses on9:Tissue on9:Cell)`
 - `Class(on9:Cell partial`
 - `(restriction(dlp:finer_grain_component_of someValuesFrom(on9:Tissue))))`
- Therefore, on the basis of ON9, we can suggest that
 - * `Class(agrovoc:Blood_Cells partial agrovoc:Blood)`
- is a polysemous use of the BT relations (a cell cannot be a tissue, because the two classes are disjoint), while it is possibly the case that:
 - `Class(agrovoc:Blood_Cells partial (restriction(dlp:finer_grain_component_of someValuesFrom(agrovoc:Blood))))`



Refinement, annotation, and merging



ReLearning procedure

- Given RT relations and axioms from reference ontologies:
 - Class(asfa:Trawlers partial
 (restriction(asfa:RT someValuesFrom(asfa:Pelagic_fisheries))))
 - Class(own:Instrumentality partial
 (restriction(dlp:instrument_for
 someValuesFrom(dlp:Activity))))
- and we know transitively that:
 - Class(asfa:Trawlers partial own:Instrumentality)
 - Class(asfa:Pelagic_fisheries partial cof:Fishing_activity)
- then we can infer that:
 - Class(asfa:Trawlers partial
 (restriction(dlp:instrument_for
 someValuesFrom(asfa:Pelagic_fisheries))))

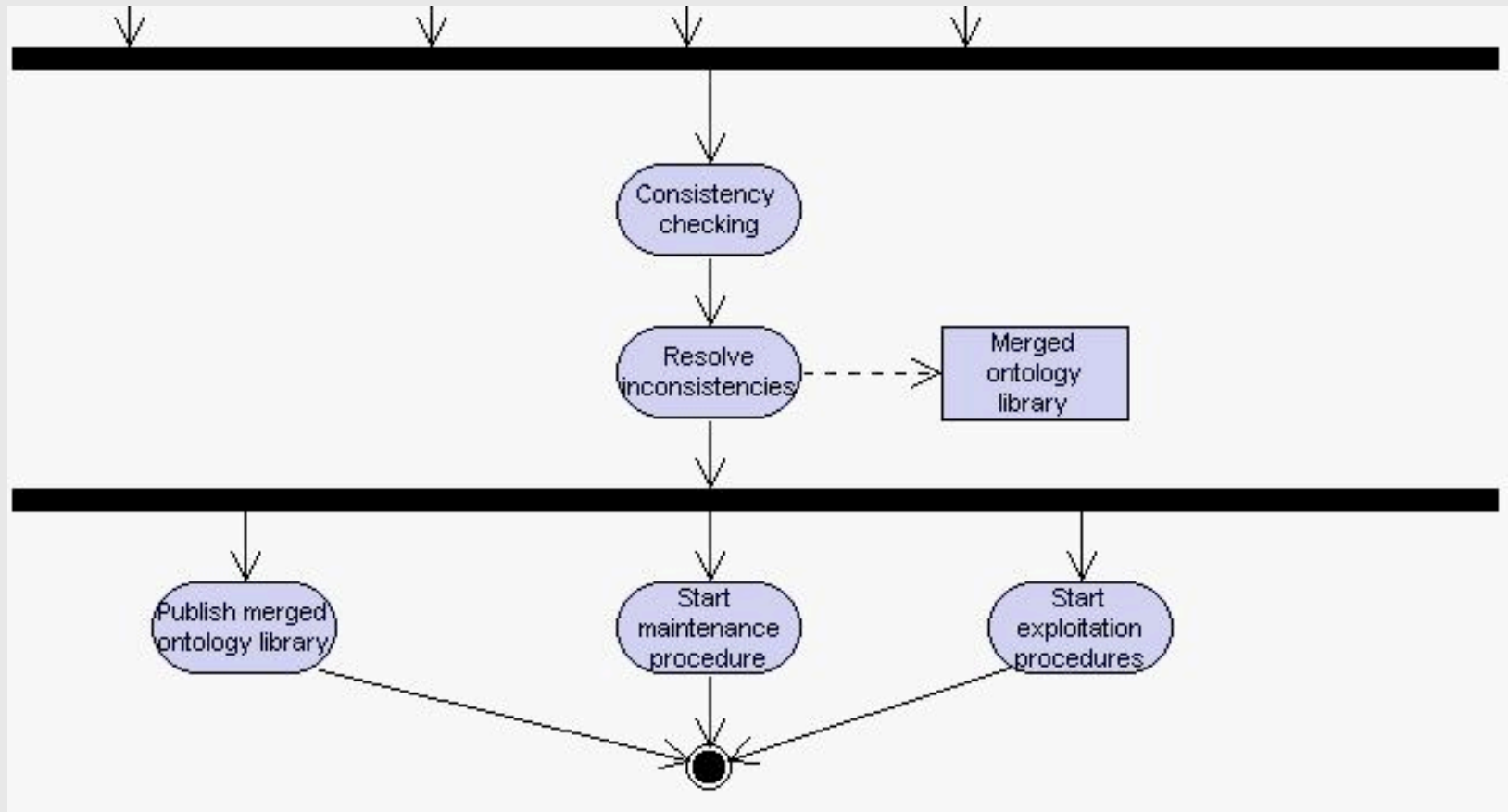


Merging

- Homonymic merging:
 - agrovoc:Trawlers
 - figis:Trawlers
 - asfa:Trawlers
 - → fos_vessel:Trawler
- Heterogeneous taxonomic position (*emergent polysemy*):
 - Class(agrovoc:Dredgers partial agrovoc:Ships)
 - Class(asfa:Dredgers partial asfa:Work_platforms)
- Expert's merging (*emergent synonymy*):
 - asfa:Ships
 - figis:Non-fishing_vessels



Post-processing lifecycle



Query expansion and brokering to distributed document management systems

Query expansion	
Search	
Search for: fishing vessel OR fishing vessels not specified OR fishing vessels OR other fishing vessels AND (capture fishery OR drilling vessels OR fishing vessels OR work platforms)	
Google	
Search keywords field	
Search in:	Search for:
EIMS	fishing vessel OR fishing vessels not specified OR fishing vessels OR other fishing vessels AND (capture fishery OR drilling vessels OR fishing vessels OR work platforms)
Figis	fishing vessels not specified OR other fishing vessels
OneFish	fishing vessel OR fishing vessels not specified OR fishing vessels OR other fishing vessels AND (capture fishery OR drilling vessels OR fishing vessels OR work platforms)
FAOBIB	fishing vessels
Asfa	fishing vessels AND (drilling vessels OR fishing vessels OR work platforms)



Fishery KBase through the Ontosaurus ontology server



Mock-up for querying distributed dynamic data

"tell me what vessels from a nearby country are currently in the marine area 50N060W within Atlantic Ocean, provided that also some Thunnus alalunga stock can be fished by those vessels, through allowed techniques"

```
(retrieve ?ves
  (exists (?type ?tech ?spec ?cou ?stock)
    (and
      (instance-of ?ves ?type)
      (superrelations ?type Fishing-Vessel)
      (superrelations ?tech Fishing-Technique)
      (has-depend-ons ?type ?tech)
      (has-depend-ons ?tech ?spec)
      (subrelations ?spec |Thunnus alalunga|)
      (instance-of ?cou Country)
      (instance-of ?stock Aquatic-Stock)
      (FLAG-STATE ?ves ?cou)
      (WEAK-CONNECTION ?cou |Atlantic Ocean@fig|)
      (OCEANIC-POSITION ?stock |50N060W@fig|)
      (OCEANIC-POSITION ?ves |50N060W@fig|)
      (fail (has-depend-ons ?tech |Drifting longlines@fig|))
      (RESOURCE-SPECIES ?stock |Thunnus alalunga|))))))
```

-> (|Atlantic Enterprise III|)

Blue: core concept types
Pale blue: domain
concept types
Red: individuals
Dark red: individual(s)
found



Figures

- 35828 domain classes have been integrated in the library
- 272 classes and 164 properties populate the DOLCE-Lite-Plus foundational ontology with about 1200 axioms
- 809 classes populate the top part of OntoWordNet resulting from the alignment of WordNet to DOLCE+
- 170 classes and 48 properties populate the COF, with about 650 axioms
- 1154 classes have been reused from OntoWordNet in order to align ASFA and AGROVOC to DOLCE+ (for the parts not covered by COF)
- 22274 domain classes have been aligned (13554 classes not yet aligned come from the non-fishery part of AGROVOC, which have been included in the integration because they have some RT relations with the fishery part)
- 12700 domain classes have been merged
- 9944 domain individuals have been aligned
- 4700 domain individuals have been merged

