Conceptual Modeling Supported by Semantic Techniques

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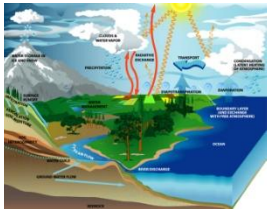
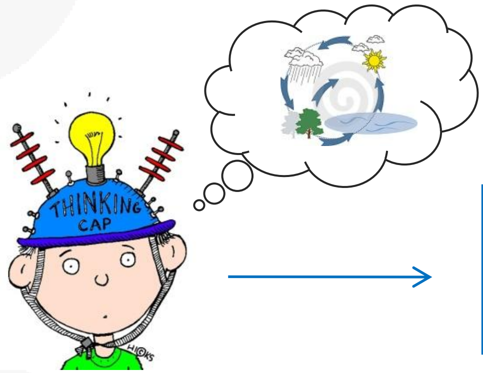
Outline

1. Introduction
2. QR models as application scenario
3. Why INRIA?
4. Our approach
5. Future work

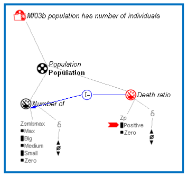
Development levels and scaffolding



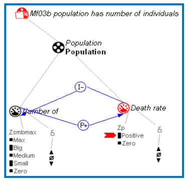
Target model



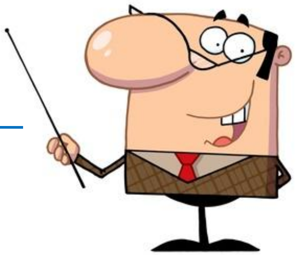
Mental model



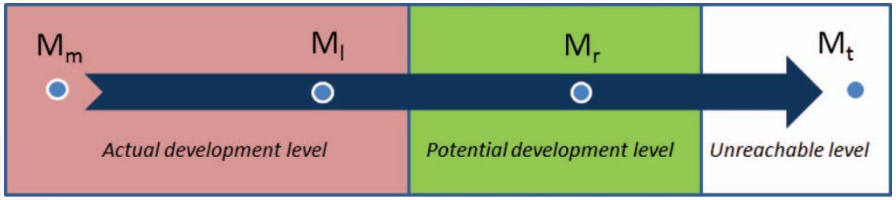
Learner model



Reference model



- Zone of Proximal Development (Vygotsky, 1978)
  - Distance between the actual development level as determined by independent problem solving and the level of potential development [. . .] in collaboration of more capable peers

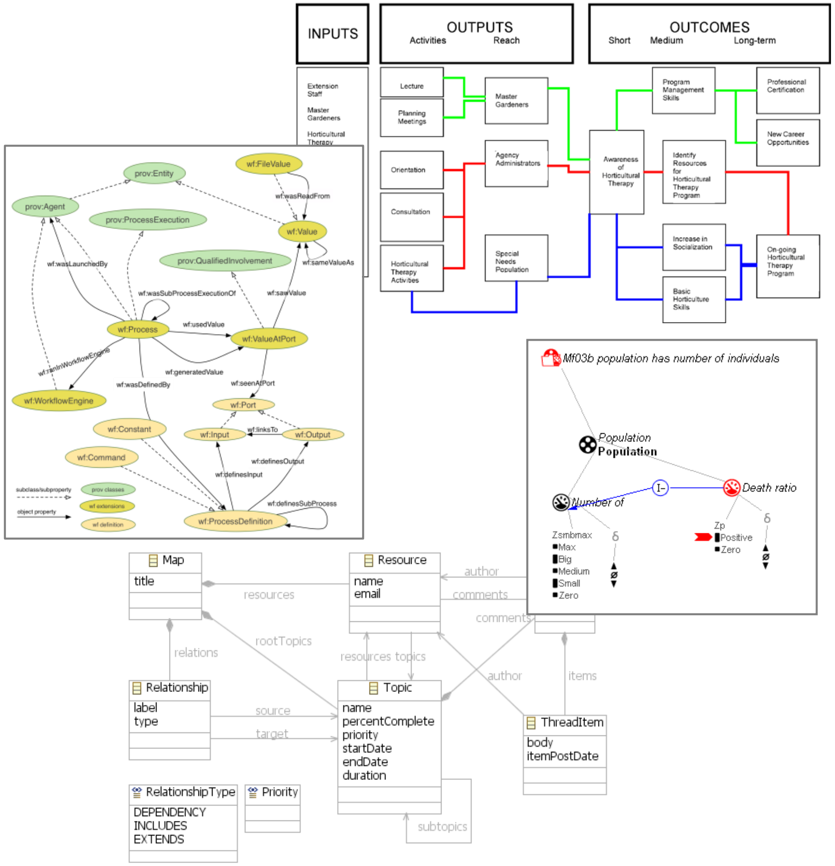


Tran, T., Cimiano, P., Rudolph, S., & Studer, R. (2008). Ontology-based interpretation of keywords for semantic search. In Proceedings of the 6th international semantic web conference and 2nd Asian semantic web conference (ISWC/ASWC–07) (pp. 523–536). Berlin Heidelberg: Springer-Verlag.

Vygotsky, L.S. (1978). Mind in society: The development of higher psychological processes. Cambridge, MA: Harvard University Press

Generalizing

- We can apply this to any learner's artifact:
  - Logic theorem
  - Ontology
  - QR model
  - UML model
  - ...
  - Any domain theory

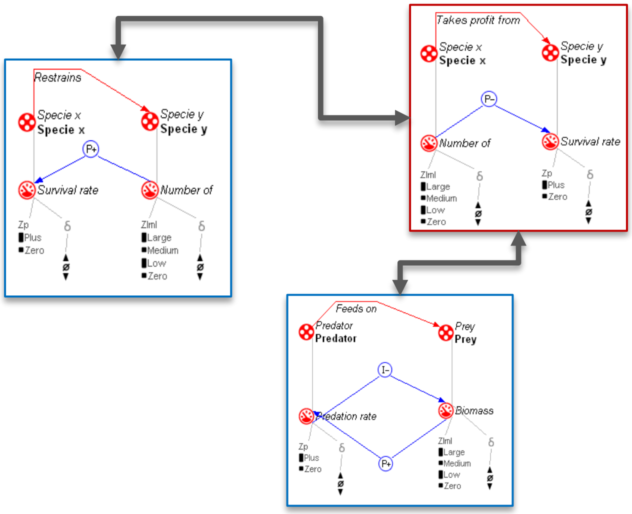


Objectives

1. Link learner's artifact with well-establish vocabularies

2. Compare learner's artifact vs. experts' artifacts

3. Detect discrepancies between artifacts and generate feedback for learners



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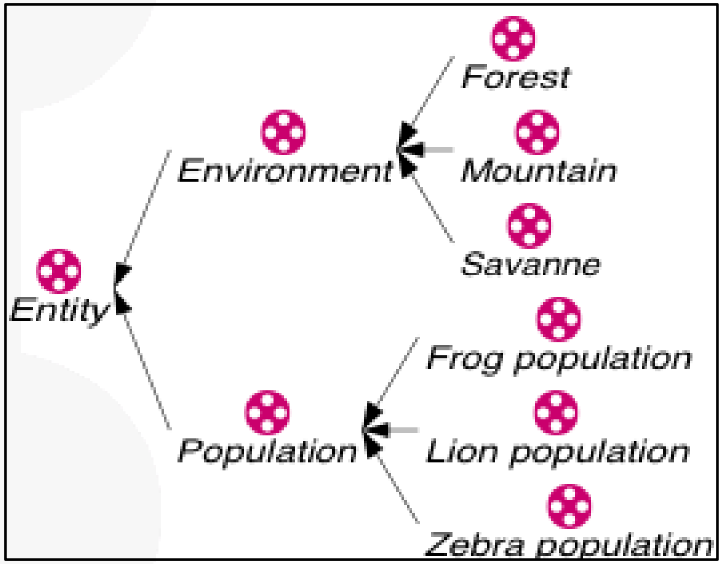
QR models as application scenario

Qualitative Reasoning

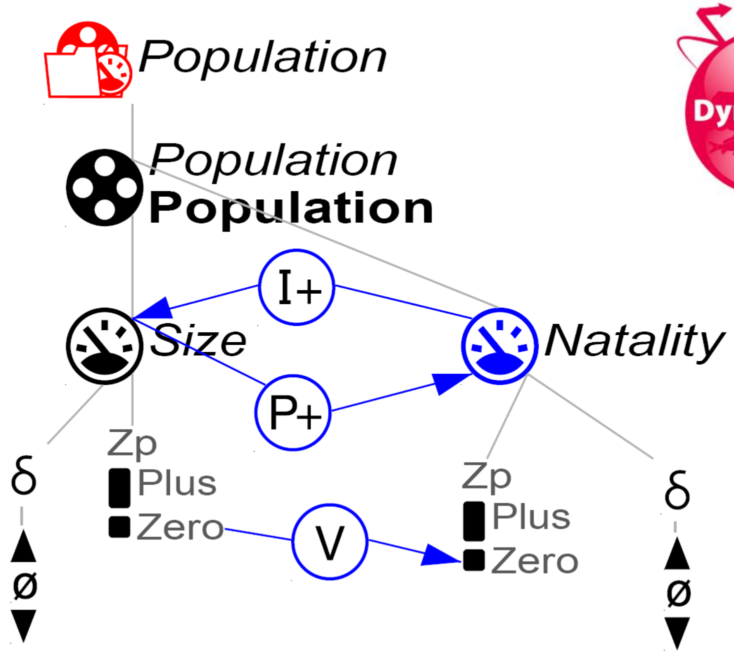
- Conceptual representation of physical systems
- Inherent ontology (particular perspective of the world)
- Prediction of the system behaviour through reasoning
- Simulation
  - Qualitative (important landmarks no numerical details)
  - Separation of structure and behaviour
- Multiple domains of application
  - Environmental science
  - Physics
  - Economy
  - ...

QR models as application scenario

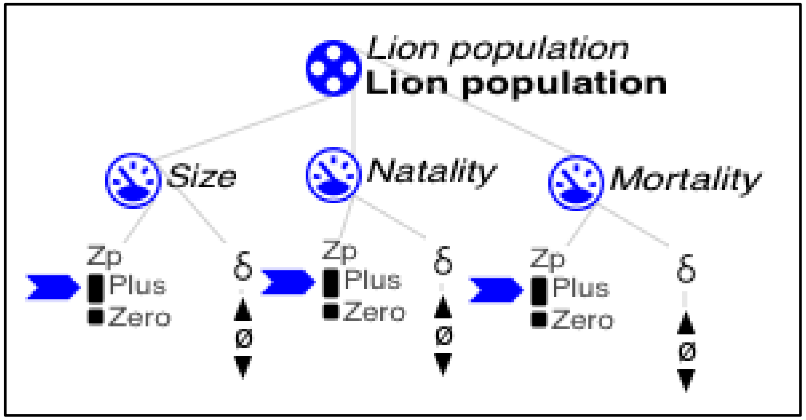
Knowledge Representation



Entity hierarchy

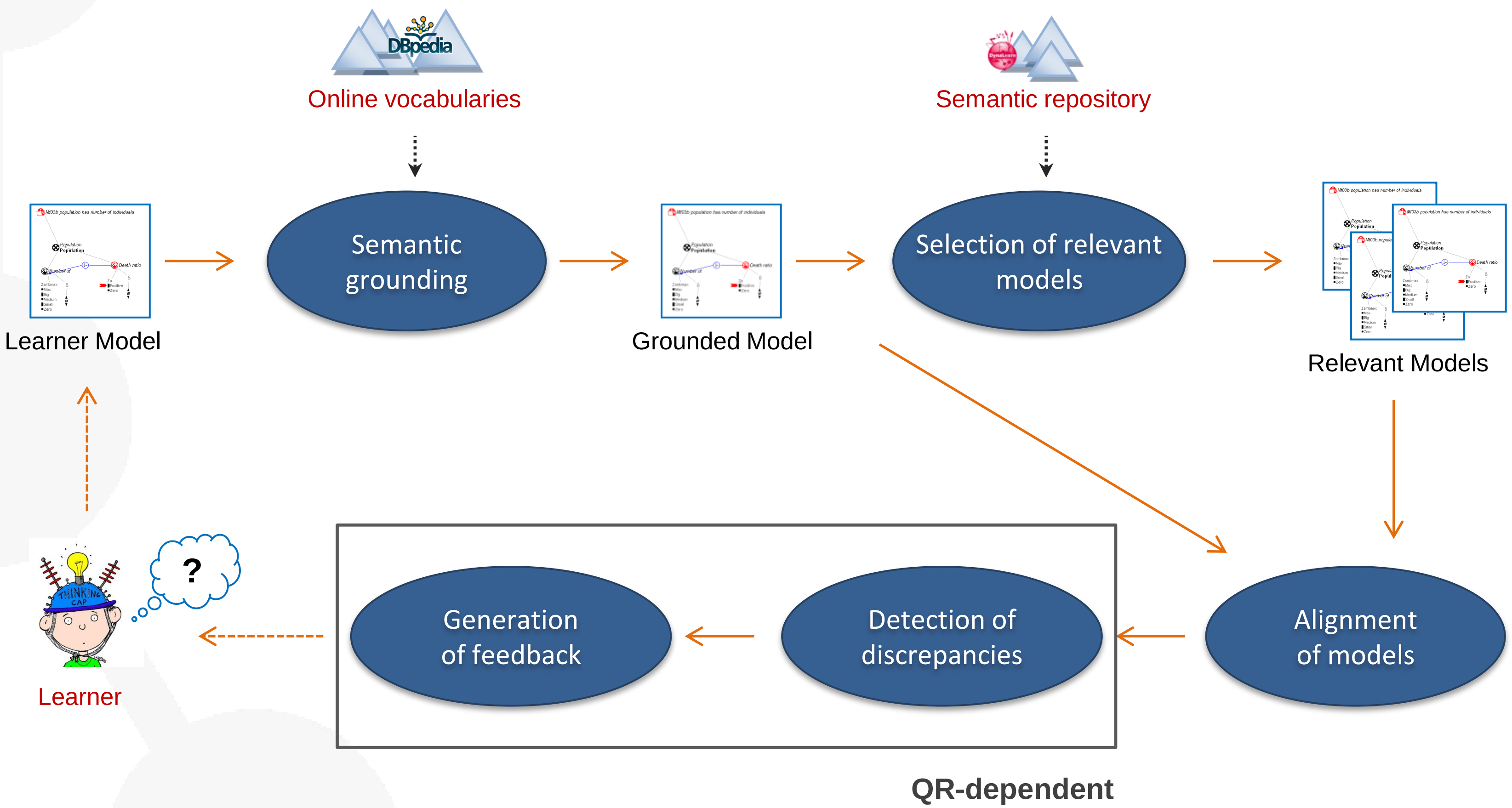


Scenario



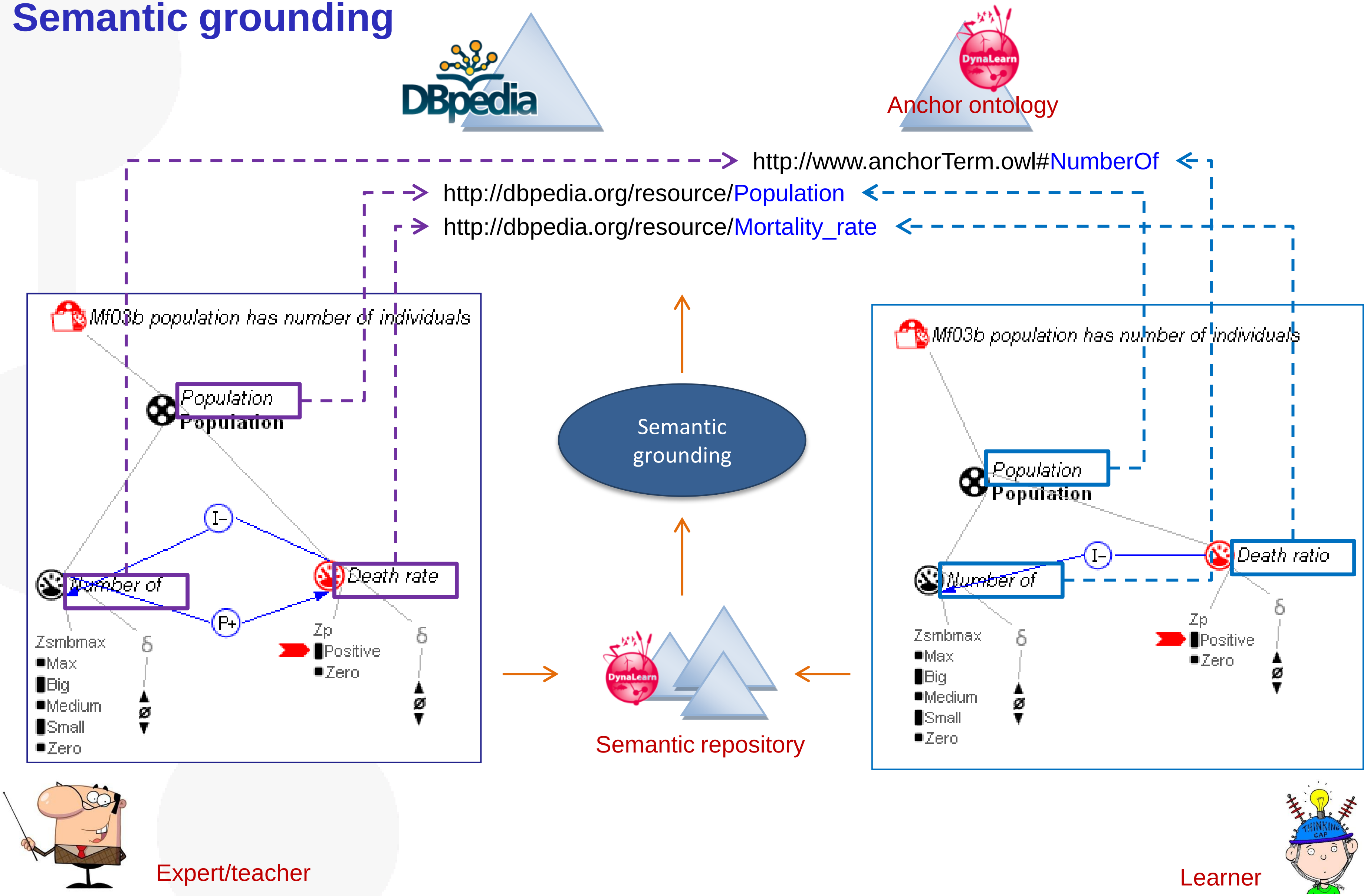
QR models as application scenario

Required techniques

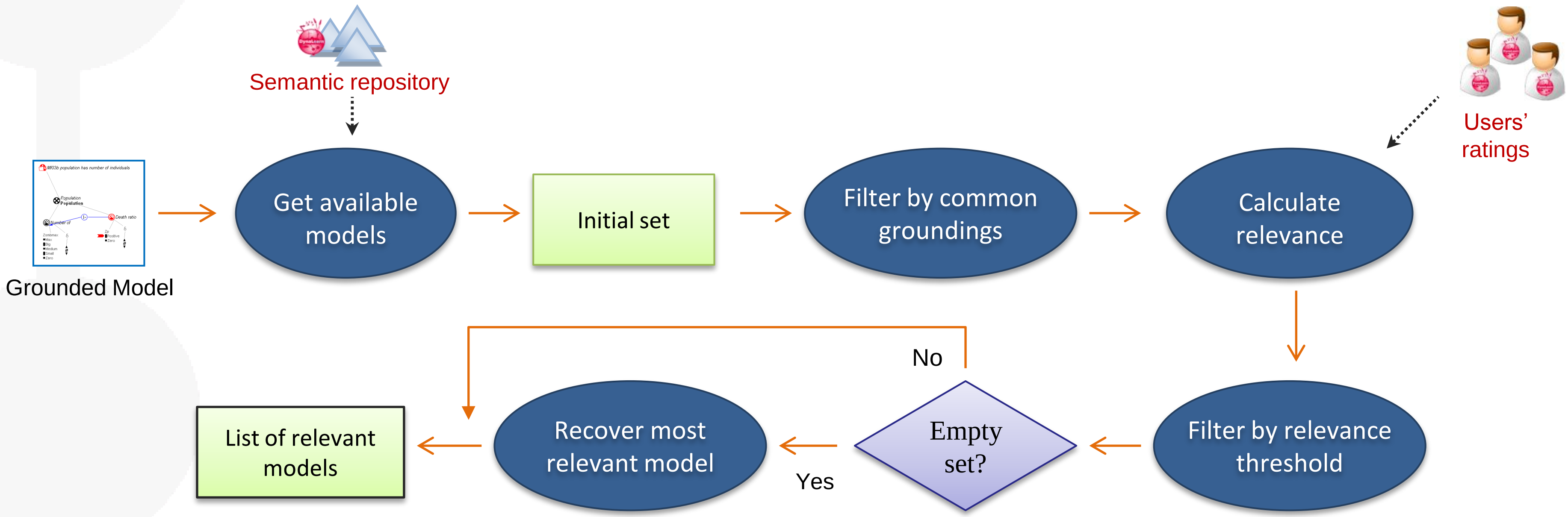


QR models as application scenario

Semantic grounding



Selection of relevant models

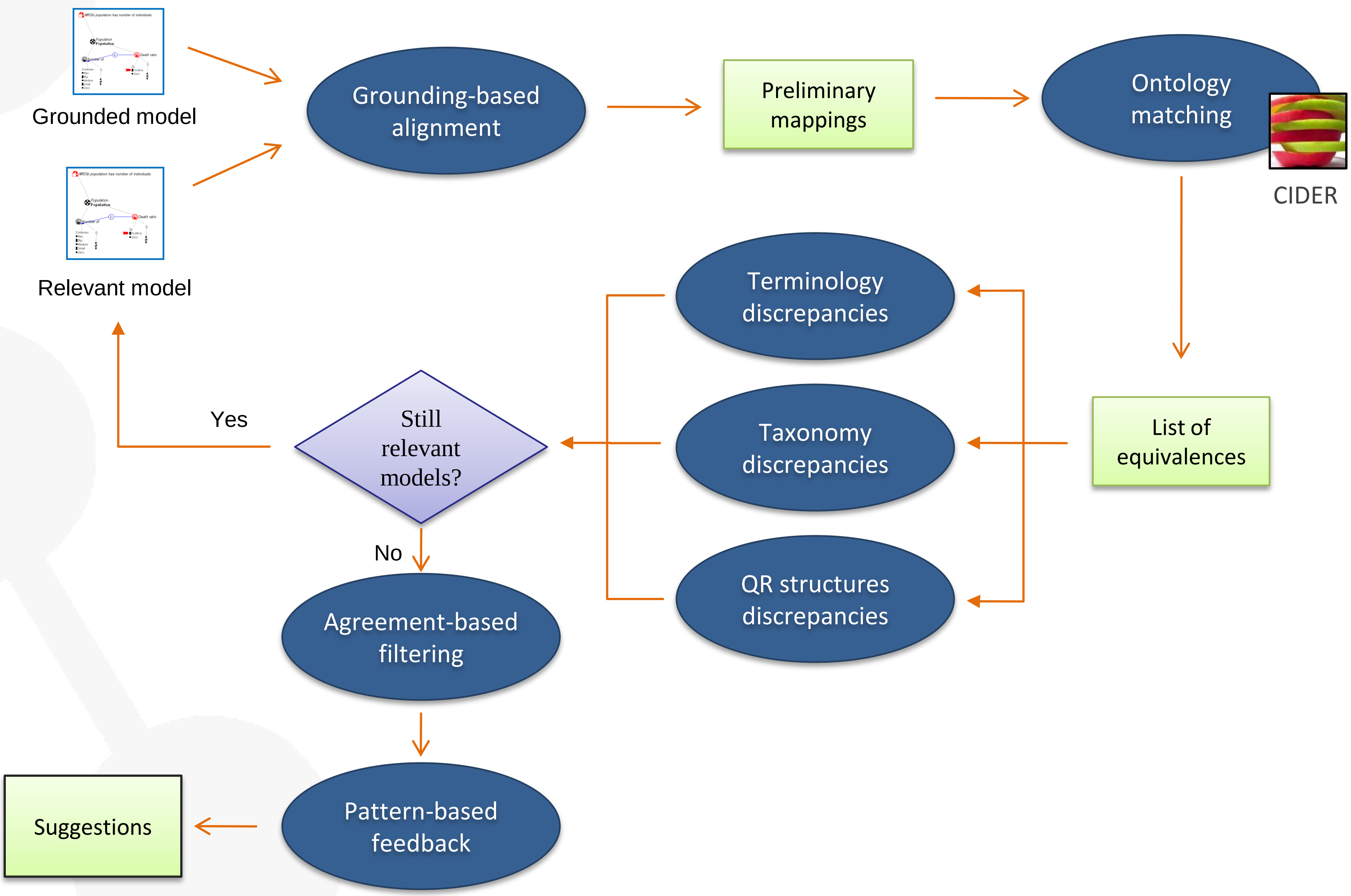


Multi-criteria utility-based recommendation system :

- Common groundings for candidate model
- Number of terms in candidate model
- Distance between learning spaces
- Rating of candidate model

QR models as application scenario

Semantic-based feedback



Grounding-based alignment

- In the learner model:

```
<owl:Class rdf:about = “&qrm;owl_ae_Death”>
  …
  <owl:sameAs rdf:resource = “http://dbpedia.org/resource/Mortality_rate”/>
</owl:Class>
```

- In the reference model:

```
<owl:Class rdf:about = “&qrm;owl_ae_Mortality”>
  …
  <owl:sameAs rdf:resource = “http://dbpedia.org/resource/Mortality_rate”/>
</owl:Class>
```

- Resulting preliminary mapping (added to the learner model):

```
<owl:Class rdf:about = “&qrm;owl_ae_Death”>
  …
  <owl:equivalentClass rdf:resource = “&qrm2;owl_ae_Mortality”/>
</owl:Class>
```

QR models as application scenario

- Ontology matching tool: CIDER
- Input of the ontology matching tool
  - Learner model with preliminary mappings
  - Reference model
- Output: set of mappings (Alignment API format)


```xml
<map>
  <Cell>
    <entity1 rdf:resource='http://www.dynalearn.eu/models/Model23.owl#owl_ae_Death'/>
    <entity2 rdf:resource='http://www.dynalearn.eu/models/Expert6.owl#owl_ae_Mortality'/>
    <relation>=</relation>
    <measure rdf:datatype='http://www.w3.org/2001/XMLSchema#float'>0.4526</measure>
  </Cell>
</map>
```


J. Gracia and E. Mena. Ontology matching with CIDER: Evaluation report for the OAEI 2008. In *Proc. of 3rd Ontology Matching Workshop (OM'08), at ISWC'08, Karlsruhe, Germany*, volume 431, pages 140-146. CEUR-WS, October 2008

DynaLearn results

- Management of QR models in a central semantic repository
- Grounding of QR models using DBpedia as background knowledge
- Selection of QR relevant models to the user from the repository, based on QR modeling similarity and users' ratings
- Alignment of QR models using ontology matching techniques
- Detection of discrepancies in the learner's model based on mappings
- Generation of feedback suggesting actions to avoid the discrepancies
- System for rating the obtained feedback

Next steps after DynaLearn

- ✓ Isolate our semantic techniques and repository from DynaLearn
  - ✓ New project with no QR references nor particular DynaLearn features
  - ✓ New internal web interface to call our techniques and visualize the results
- ≈ Improve ranking of grounding results
  - ✓ Add more context to the candidates
  - ≈ Tune the relevance formula
- ○ Inference of new relations during the grounding-based alignment
  - ○ Direct common grounding
  - ○ Indirect related grounding (1 source)
  - ○ Indirect related grounding (n sources)

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Why INRIA?

SCARLET

SemantiC relAtion discoveRy by harvesting onLinE onTologies

Marta Sabou

KNOWLEDGE MEDIA KMi INSTITUTE

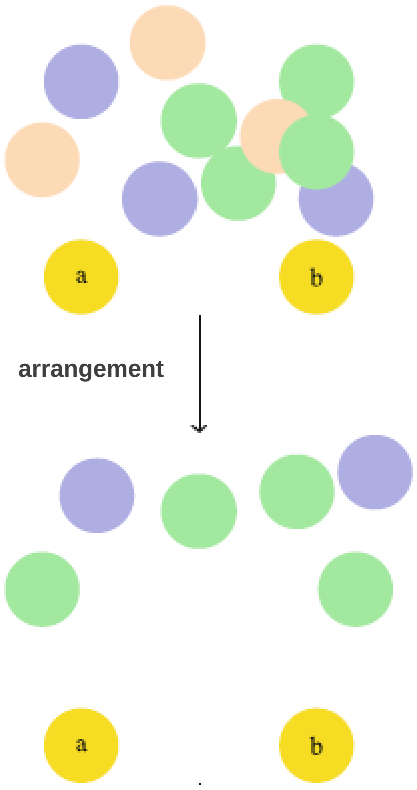
Inria INVENTEURS DU MONDE NUMÉRIQUE

Jérôme Euzenat

Sabou, M., d'Aquin, M., Motta, E. (2008). Scarlet: Semantic relation discovery by harvesting online ontologies. In: ESWC. Pp. 854-858.

How Scarlet works

- Ontology arrangement
- Contextualisation
- Ontology selection
- Local inference
- Global inference
- Composition
- Aggregation



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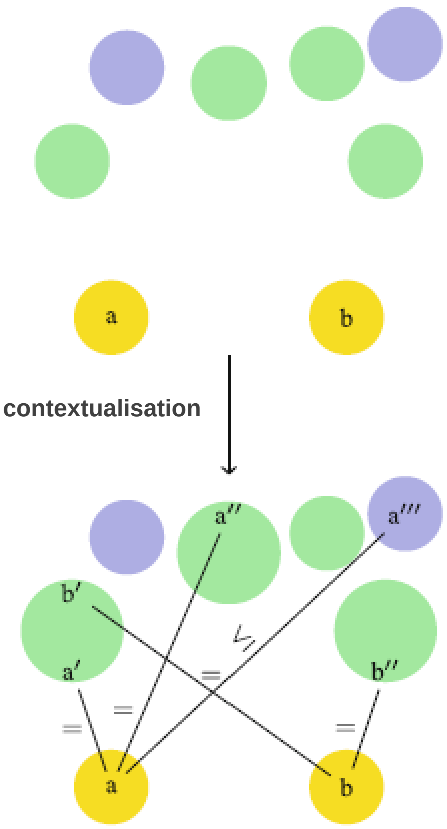

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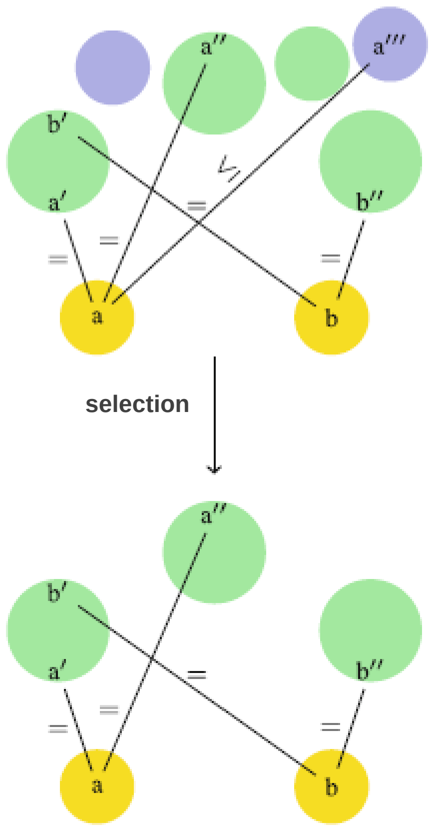

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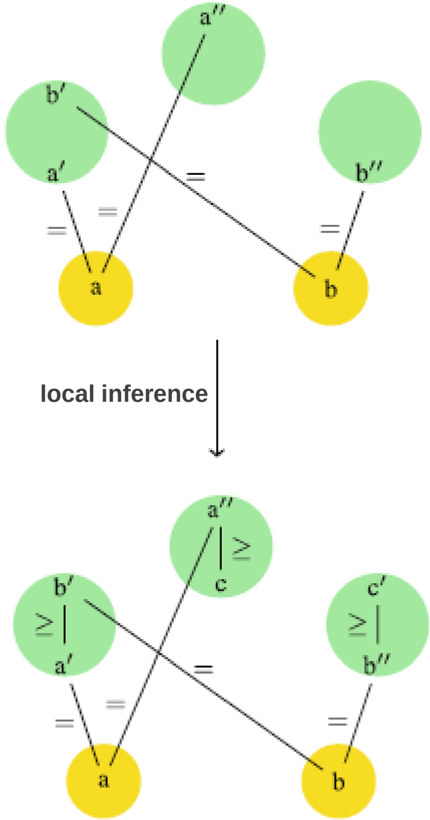

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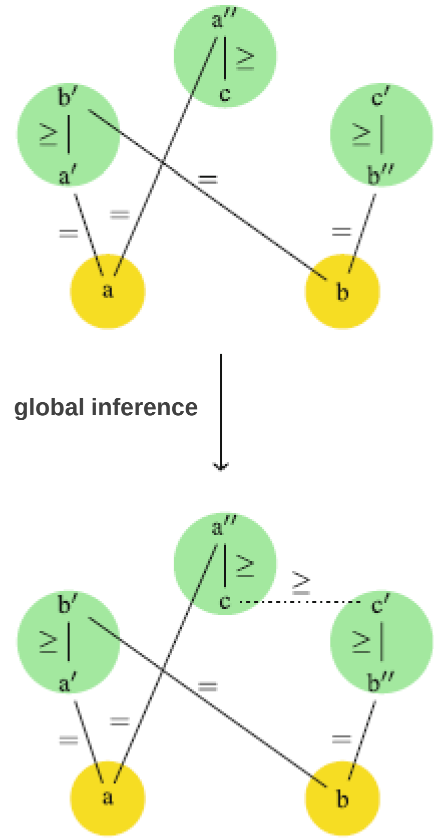

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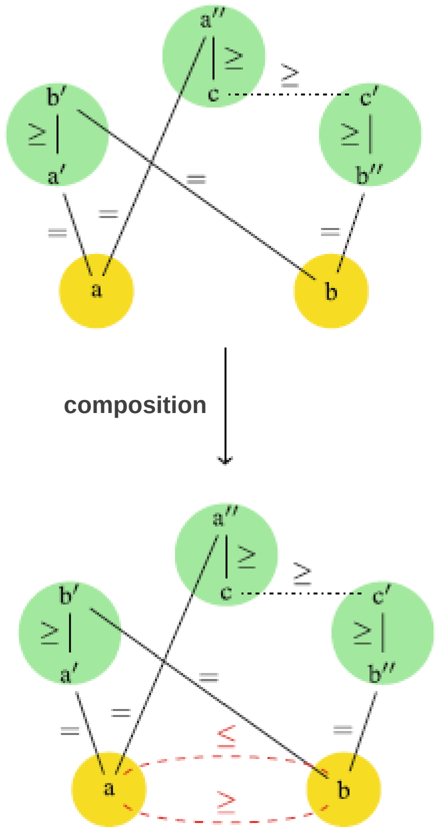

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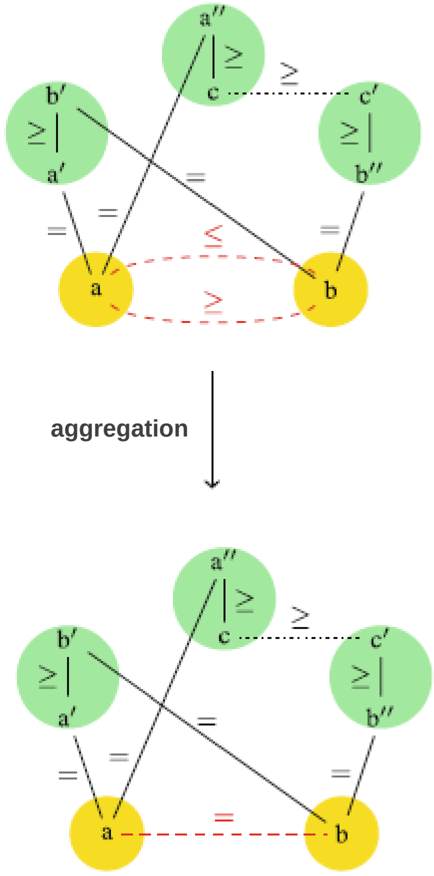

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2. A QR implementation
3. Why INRIA?
4. **Our approach**
    1. **Local inference**
    2. **Global inference**
    3. **Composition**
5. Future work

Objective

- Mining the LOD to find relations between models

Hypothesis

- Scarlet techniques for ontologies can be applied to Linked Open Data
- Scarlet techniques on Linked Open Data can improve our alignment

Restriction

- No classes, no instances... just concepts
- DBpedia as starting point
- Not always subclass links between DBpedia resources
- owl:sameAs links in DBpedia usually to other DBpedias (not too helpful...)

How to proceed

1. Modify Scarlet using Linked Open Data sources instead of ontologies
    - New version of Scarlet
    - New version of our system

2. Modify our system to implement the “LOD version” of Scarlet techniques
    - New version of our system

Local inference

- dbpedia:category + skos:broader **Only DBpedia**
- rdf:type + rdfs:subclassOf
- Domain properties (First Level Relation + Second Level Relation)
- wikilink **Only DBpedia**

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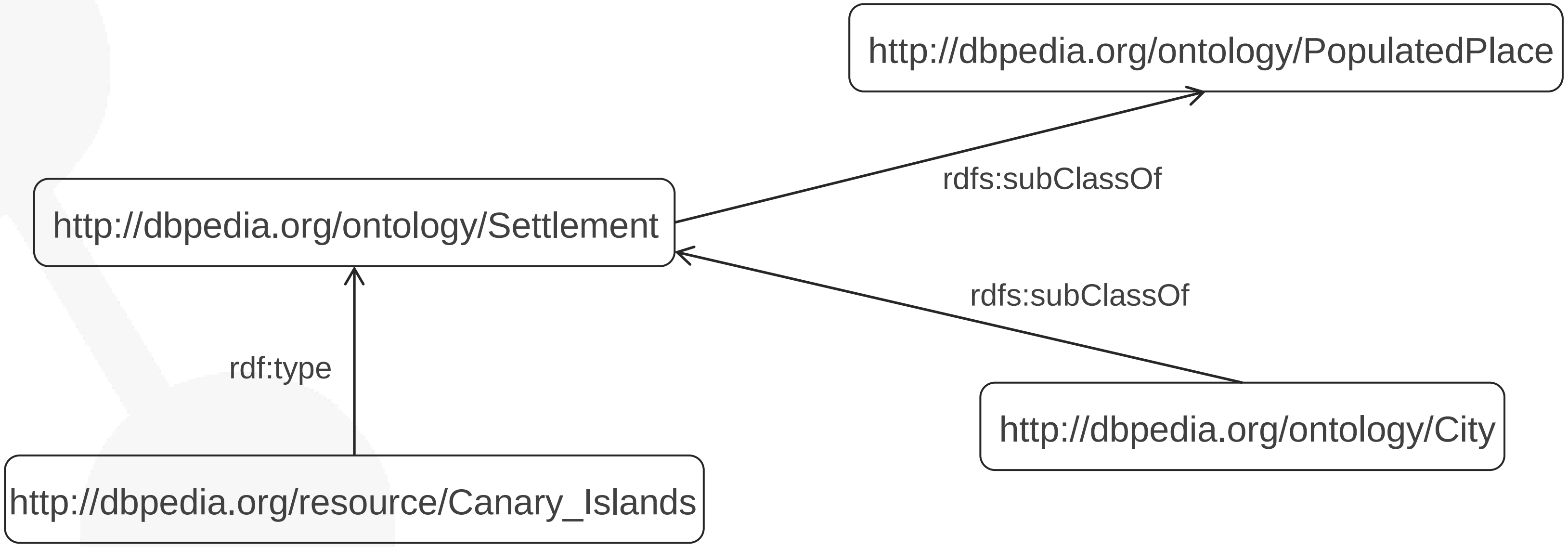

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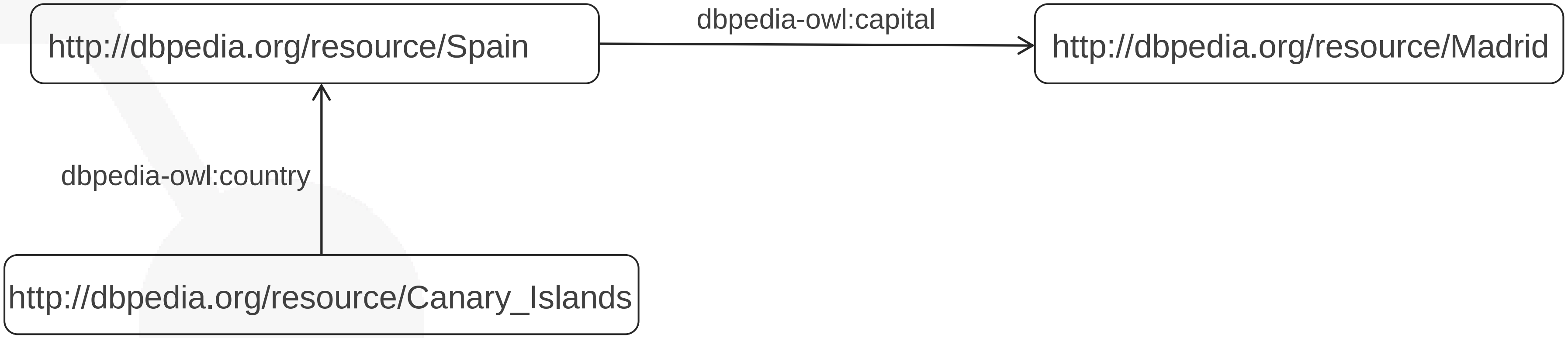

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Global inference

1. sameAs.org to find links to other sources
2. Follow the links and apply local inference on each new source
3. The process could then start again...

Our approach

Composition

- SKOS is an ontology for concepts
  - Subjects in descriptions
  - Clusters for different labels with similar meaning
  - Semantic relationships with other concepts
- Represented in OWL (as our models are)
- Minimal semantic commitment
- Web-oriented representation

We lose inference power (only hierarchical), but gain flexibility

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Future work

- Composition and aggregation of relations into skos:X
  - Small evaluation to induce the right relation
  - Larger evaluation to validate our choice
- Add more sources using the sameAs.org bridge
  - Freebase dumps in process to be stored in Virtuoso
- Apply this approach back to DynaLearn and check improvement (hopefully)
- Find a new use case with poorly structured models, taxonomies...
- Write the thesis and finish!

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