A Unified Approach for Aligning Taxonomies and Debugging Taxonomies and Their Alignments

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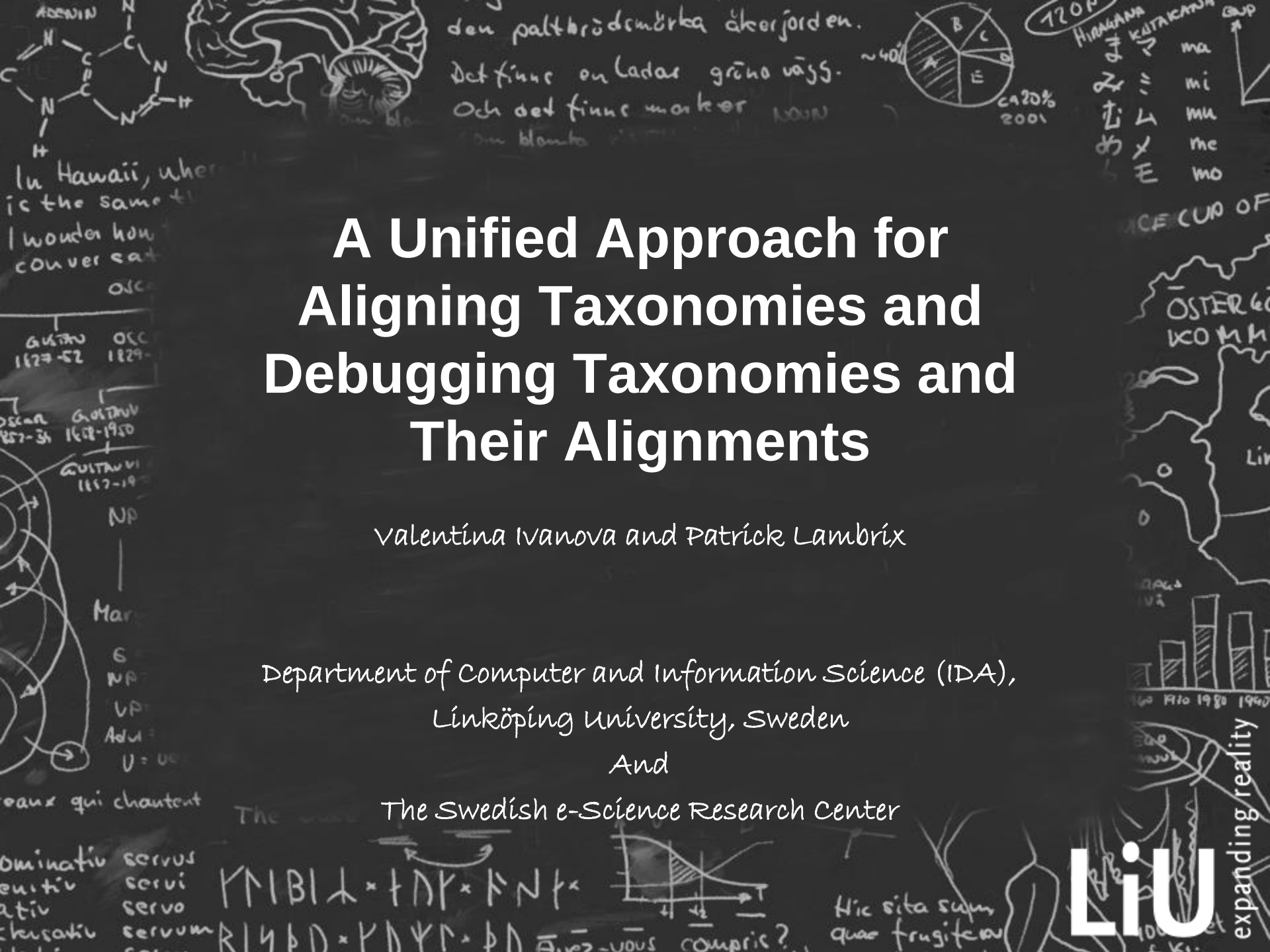

Outline

- ✓ Defects in Ontologies and Alignments
- ✓ Integrated Ontology Alignment and Debugging Framework
- ✓ Experiments
- ✓ Conclusions and Future Work

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Defects in Ontologies and Alignments

- ✓ Neither developing ontologies nor aligning them are easy tasks
  - ✓ ontologies are not correct/complete
  - ✓ mappings between ontologies are not correct/complete
  - ✓ the integrated ontology network is not consistent

- ✓ Modeling defects are the focus of our work
  - ✓ e.g. wrong and missing relations

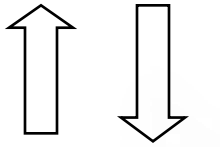
Influence of Defects in Structure

✓Ontology-based querying

Medical Subject Headings (MeSH)

All MeSH Categories
- **Diseases Category**
  - **Eye Diseases**
    - **Scleral Diseases**
      - **Scleritis**

...



return 1363 articles

Influence of Defects in Structure

- ✓ Incomplete results from ontology-based queries

Medical Subject Headings (MeSH)

All MeSH Categories
- **Diseases Category**
  - **Eye Diseases**
    - **Scleral Diseases**
      - ~~**Scleritis**~~

...

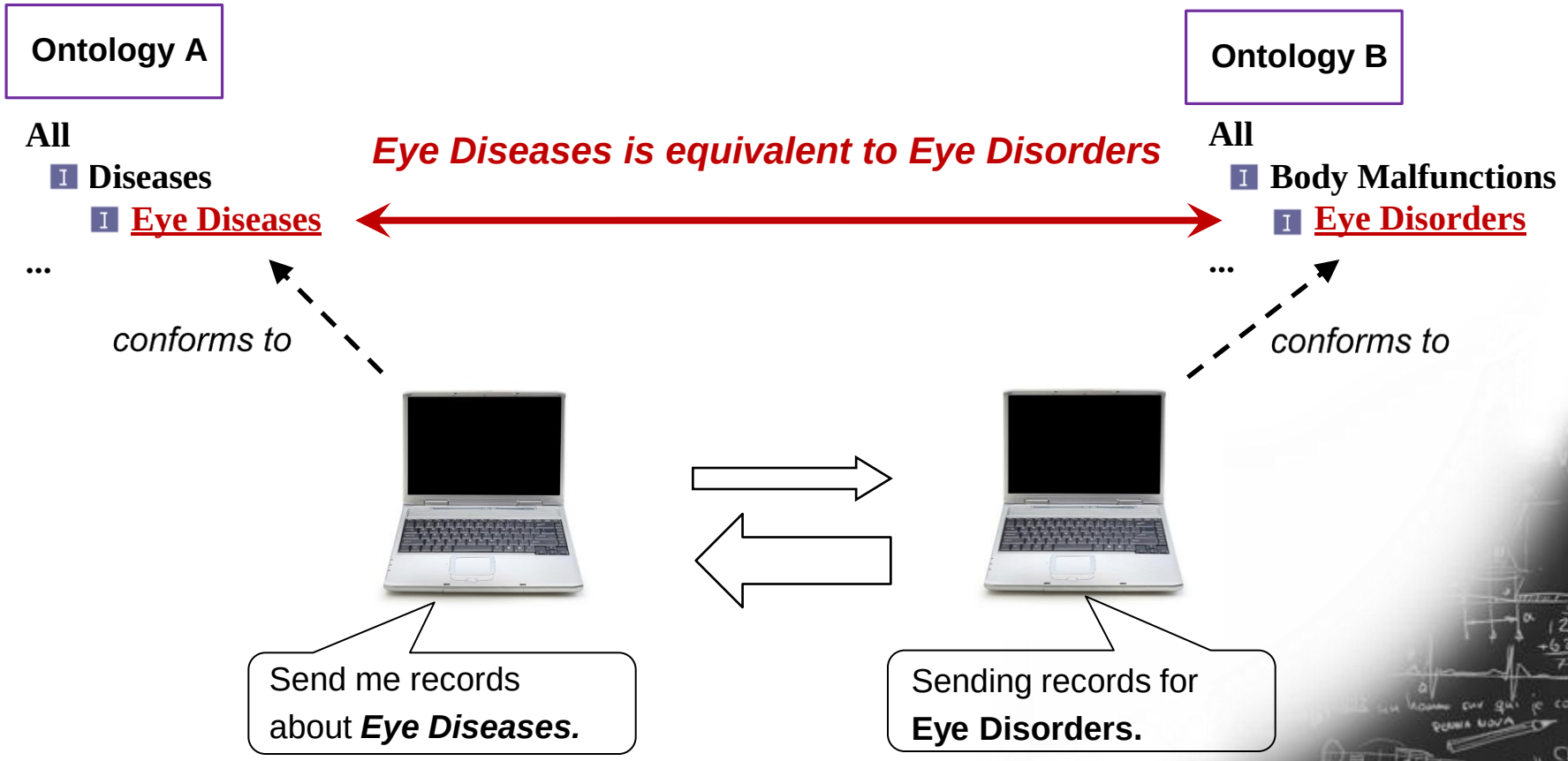
return 1363 articles

return 613 articles

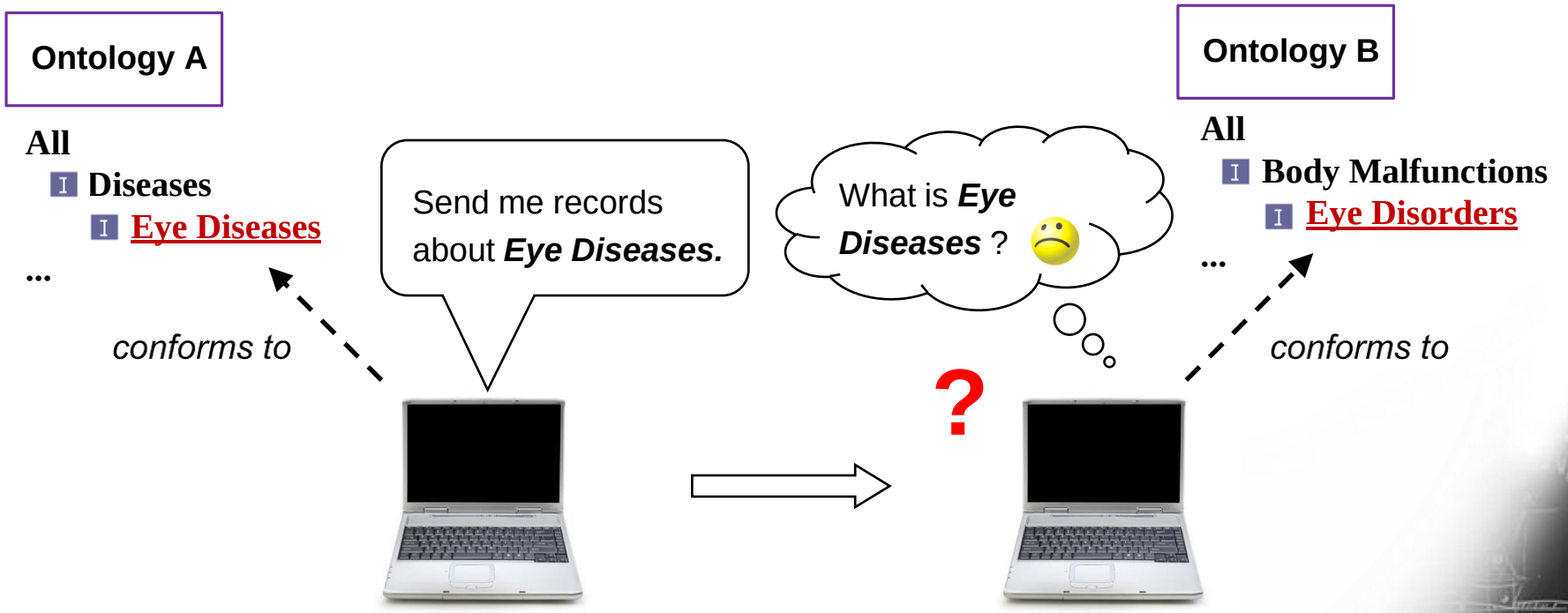
55% results are missed !

Influence of Defects in Mappings

- ✓ Semantically-enabled applications



Influence of Defects in Mappings



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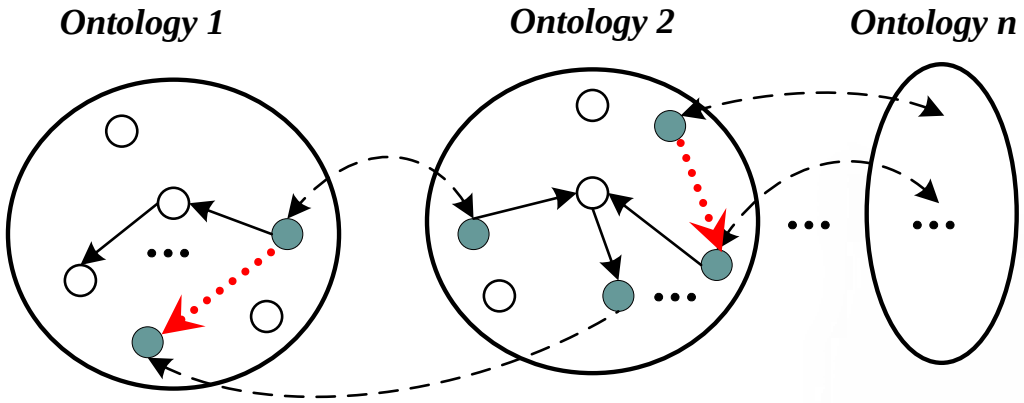
Taxonomy Networks

A **taxonomy network** consists of a set of **taxonomies** and sets of **mappings** between those **taxonomies**

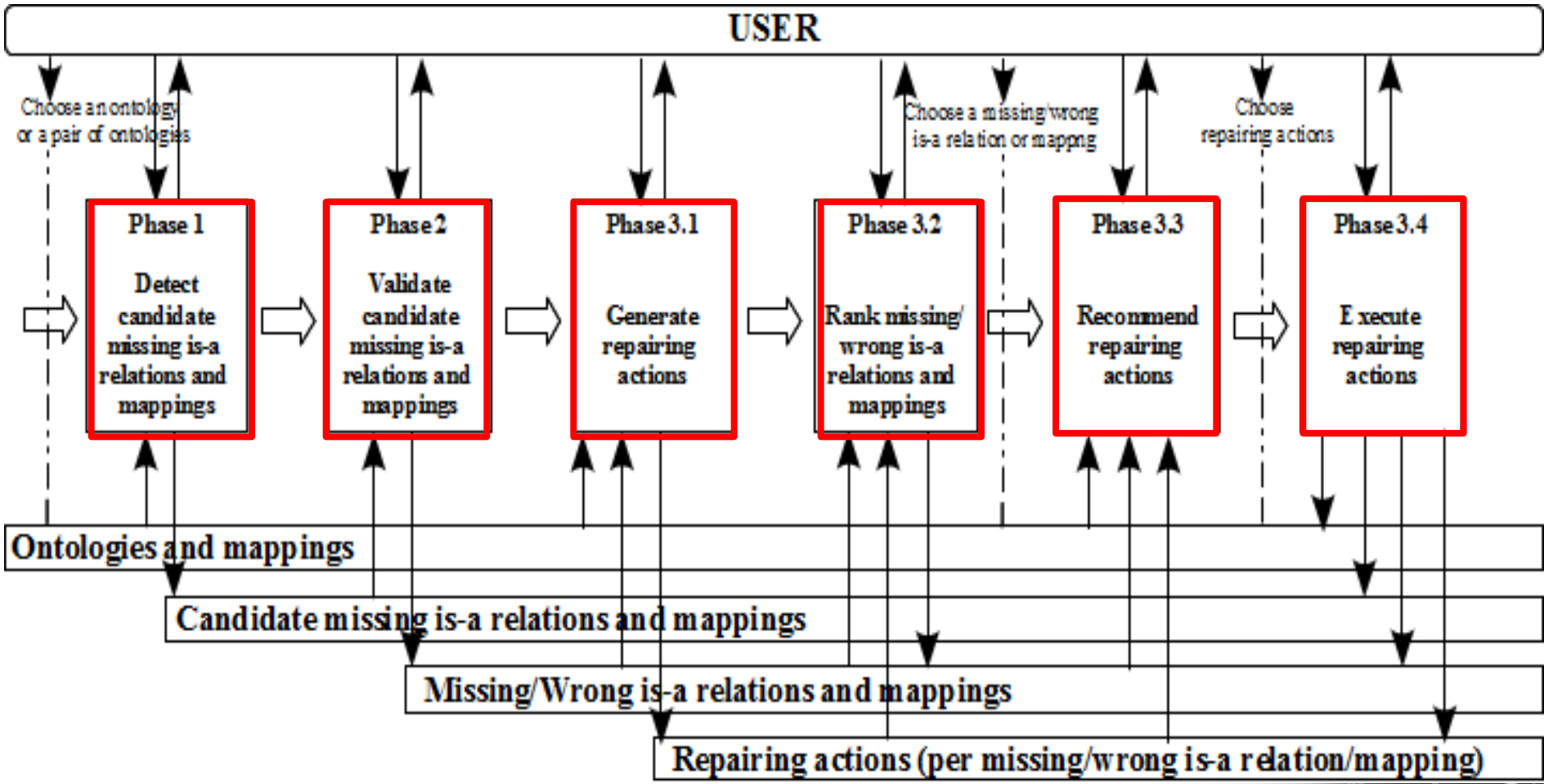


Problem Statement

Given a taxonomy network, how to **DETECT** and **REPAIR**:

- ✓ the missing and wrong is-a relations in each taxonomy **AND**
- ✓ the missing and wrong mappings between each pair of taxonomies?

Alignment and Debugging Framework



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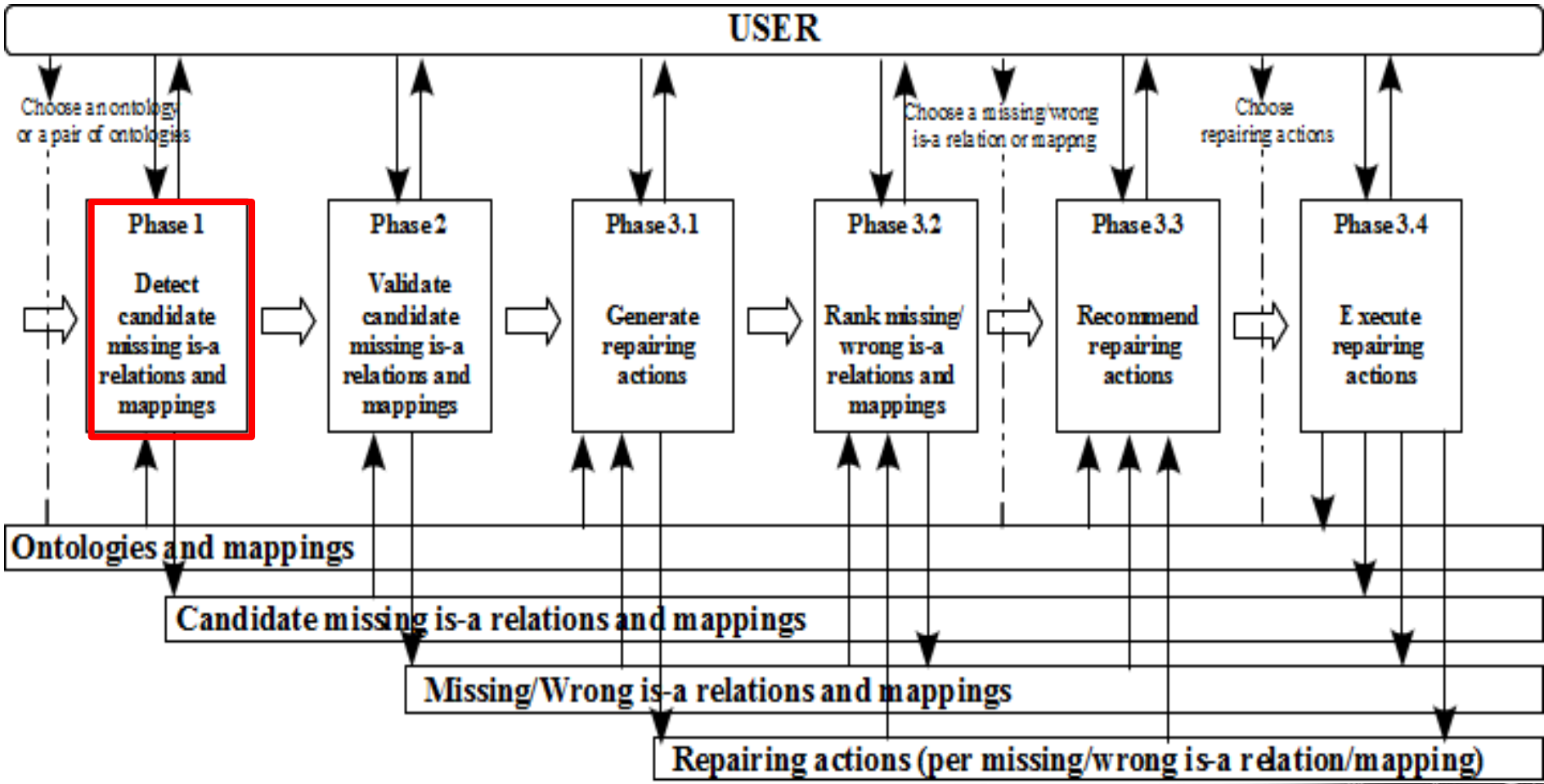
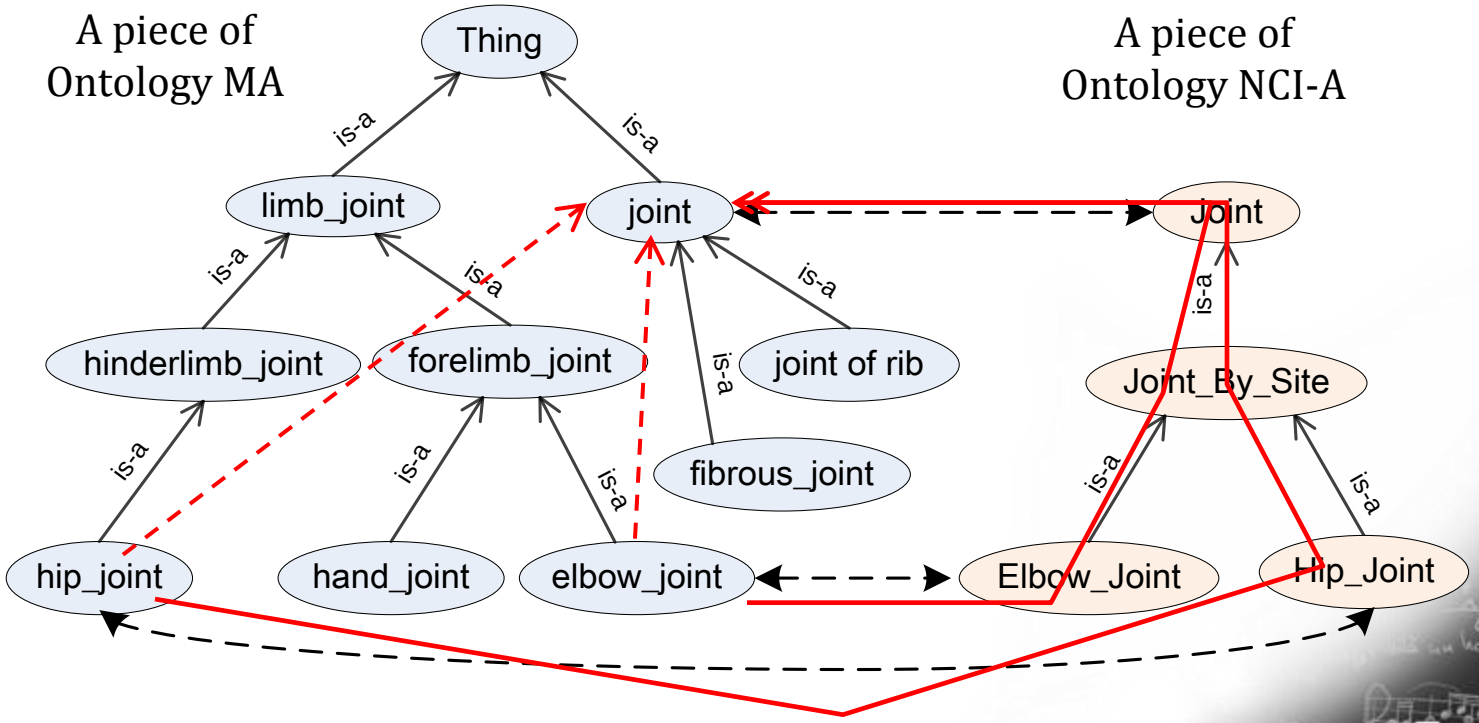
Debugging Workflow: ***Detection*** of Defects

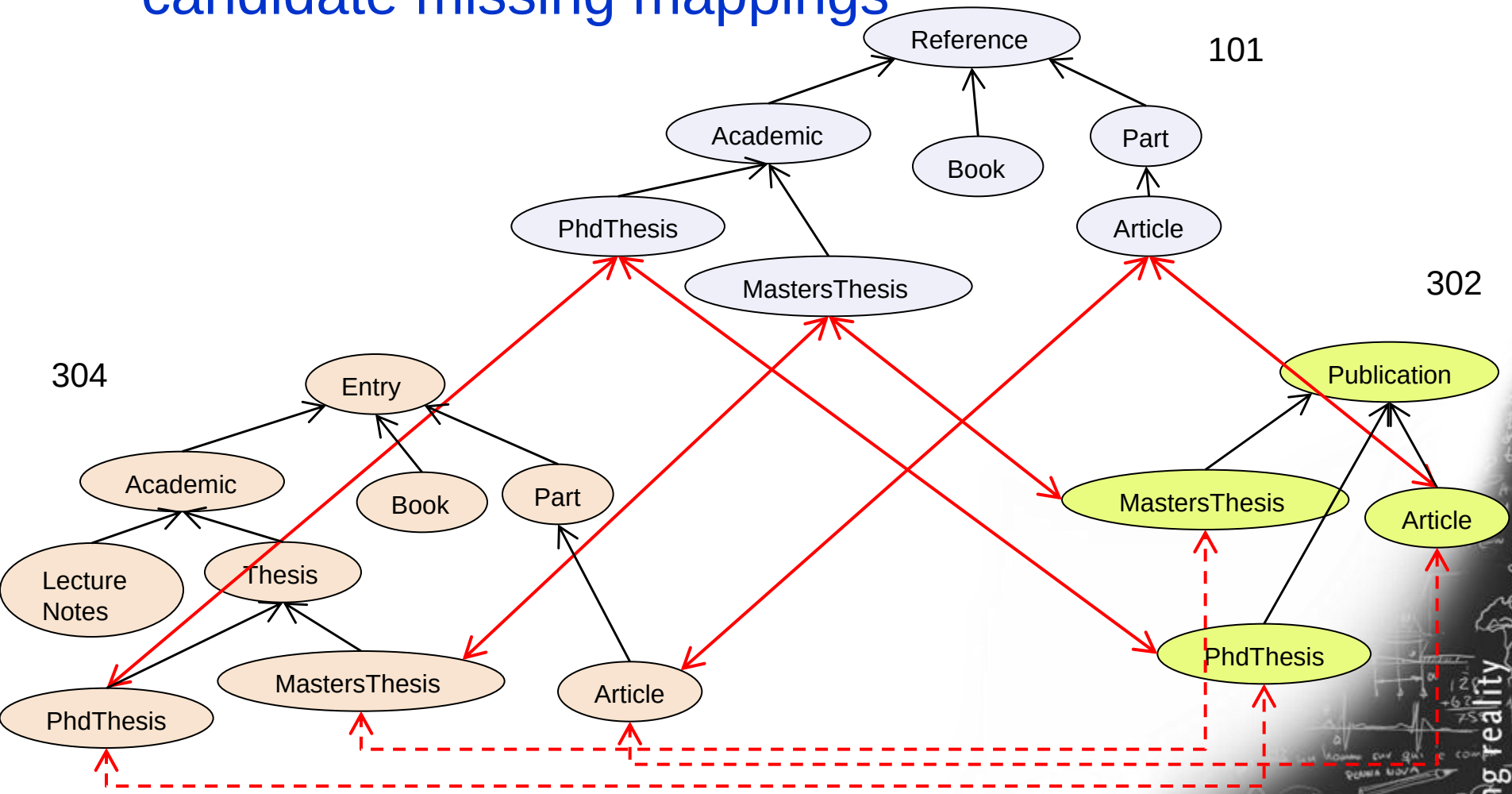


Debugging Workflow: ***Detection*** of Defects - candidate missing is-a relations

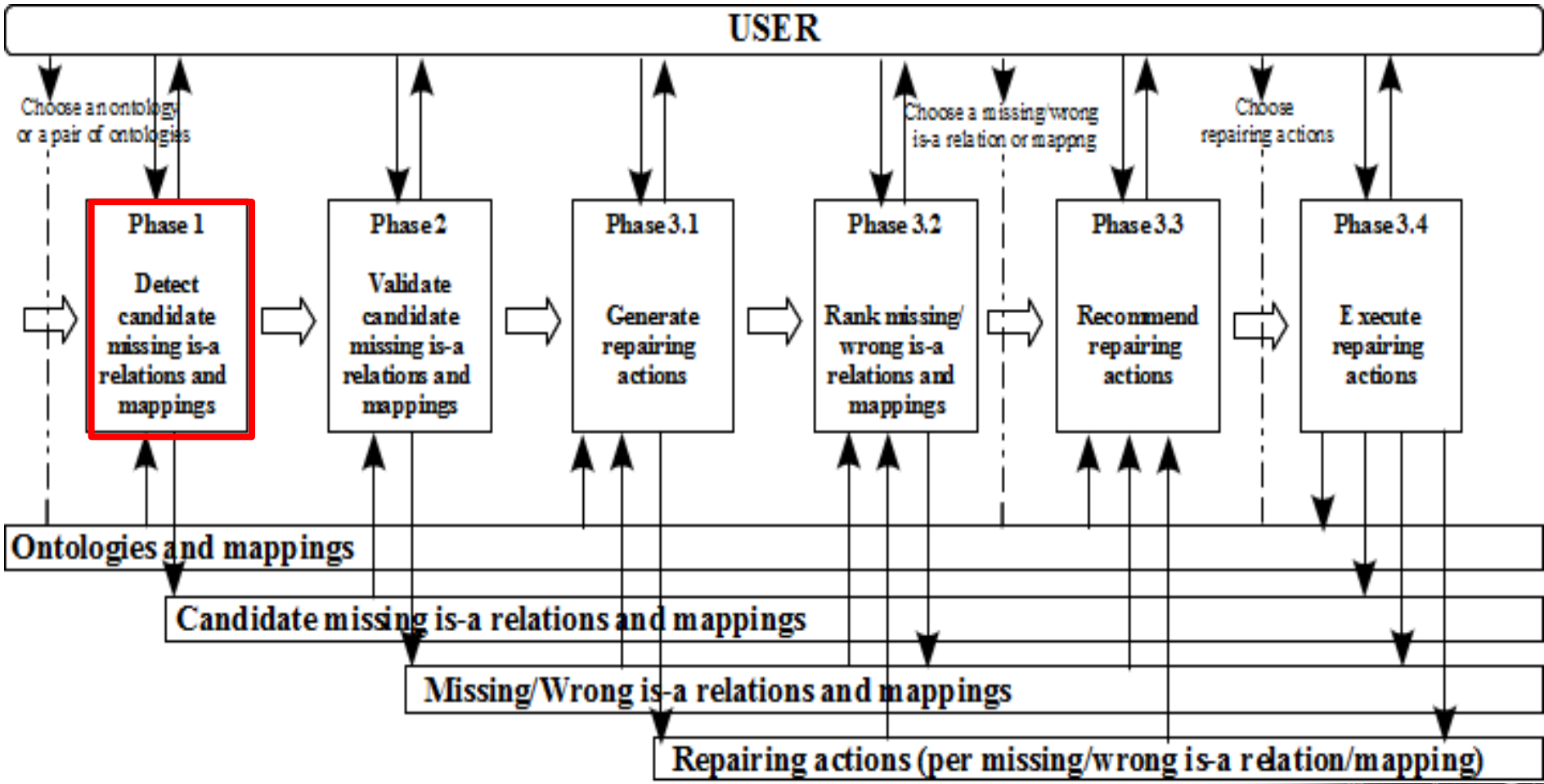
- ✓ Two small pieces of MA and NCI-A, both about concept “joint”, and 3 equivalence mappings



Debugging Workflow: ***Detection*** of Defects - candidate missing mappings



Alignment Workflow: ***Detection*** of Defects



Alignment Workflow: ***Detection*** of Defects - candidate missing mappings

- ✓ Matchers
  - ✓ Linguistic matchers
  - ✓ Matchers employing auxiliary information
- ✓ Combination and filtering of similarity values

- ✓ **Mapping Suggestions are Candidate Missing Mappings**

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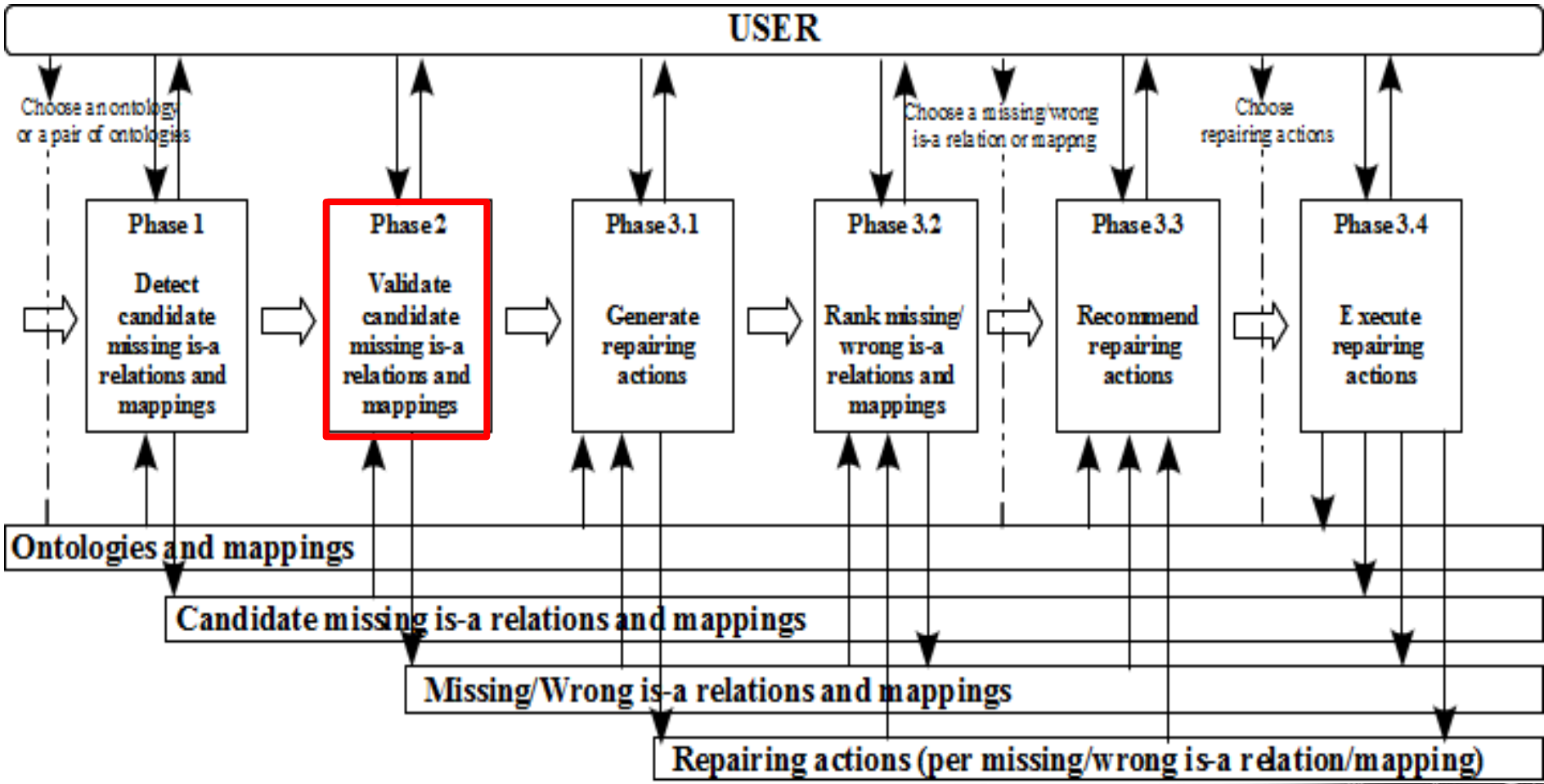
Alignment and Debugging Workflow: ***Validation***



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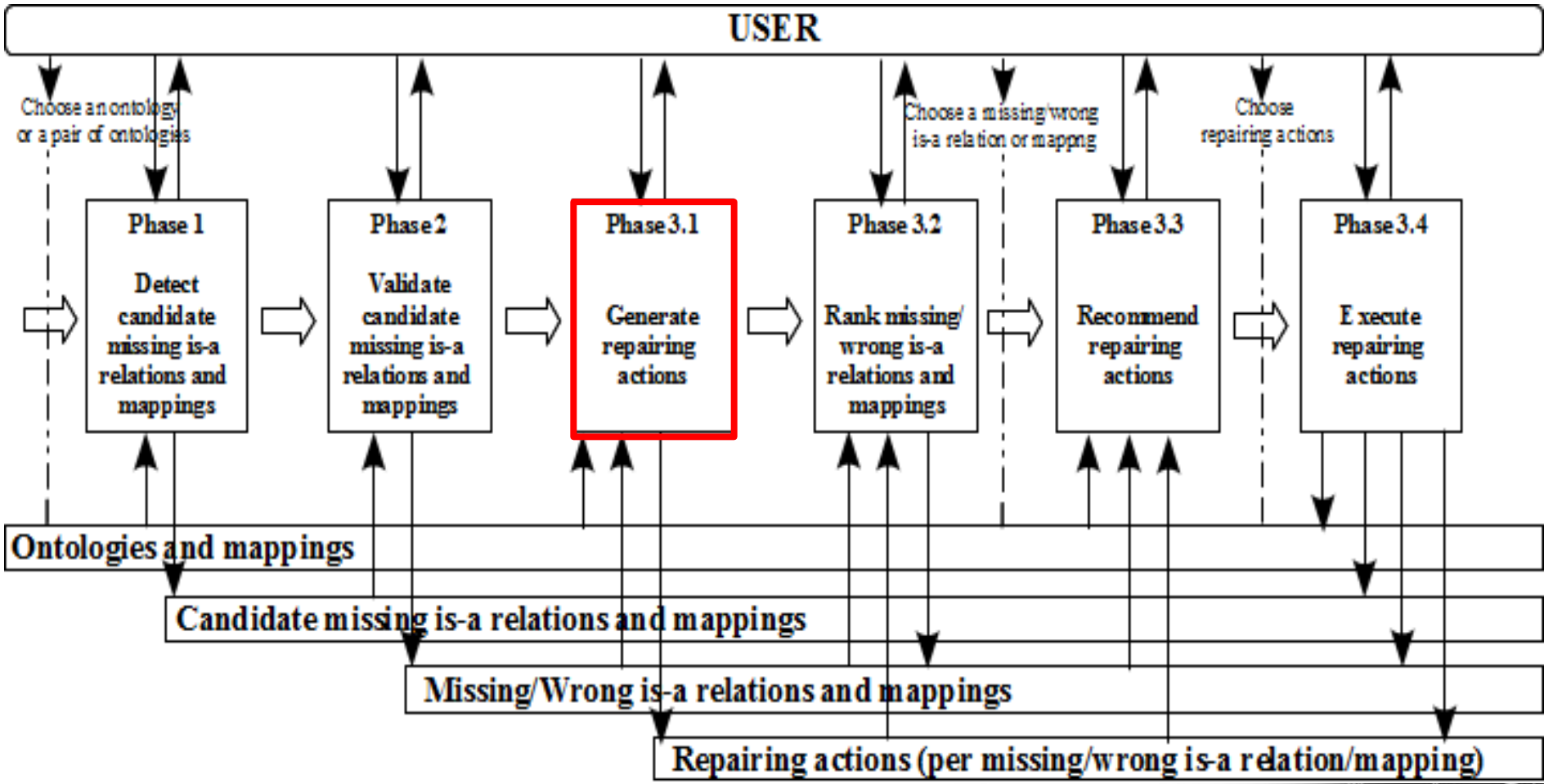
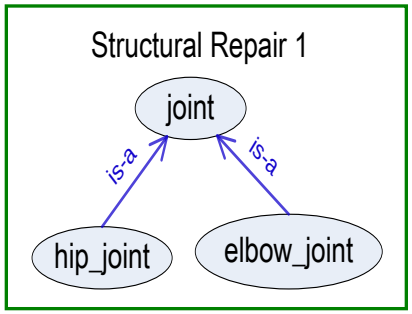
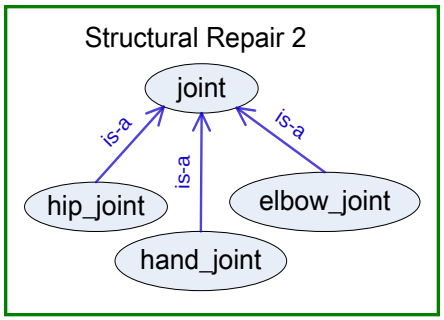
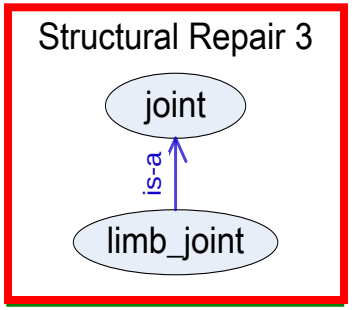
Alignment and Debugging Workflow: ***Repairing***

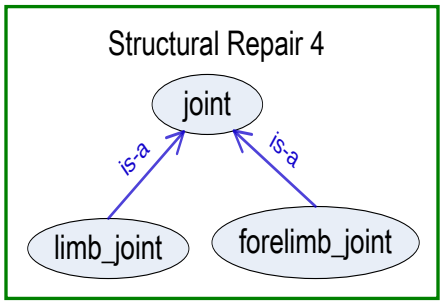


Alignment and Debugging Workflow: Example – repairing missing is-a relations





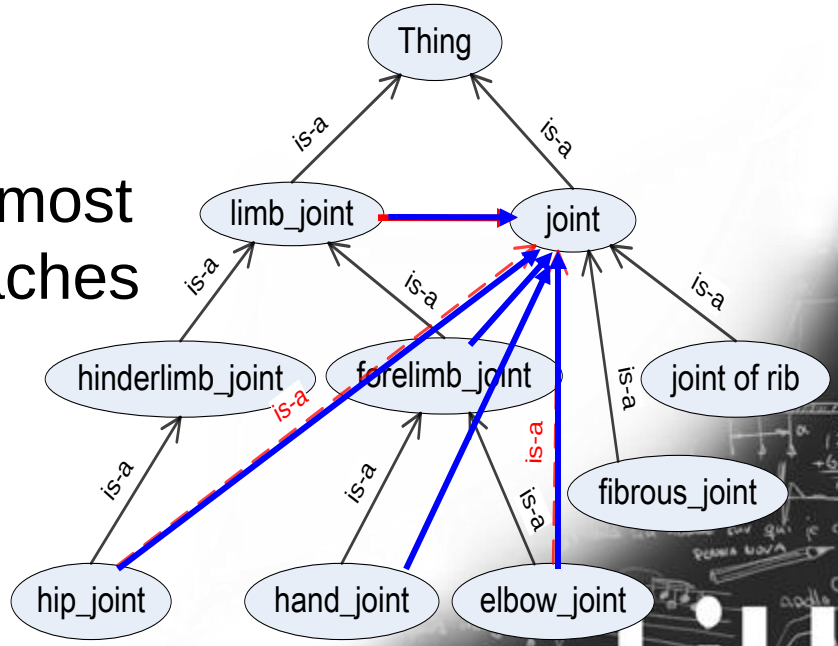




Question:

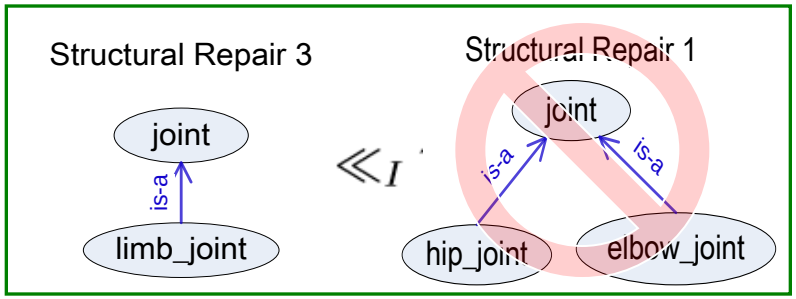
How can we recognize the most interesting repairing approaches for a domain expert?

→ preferences.

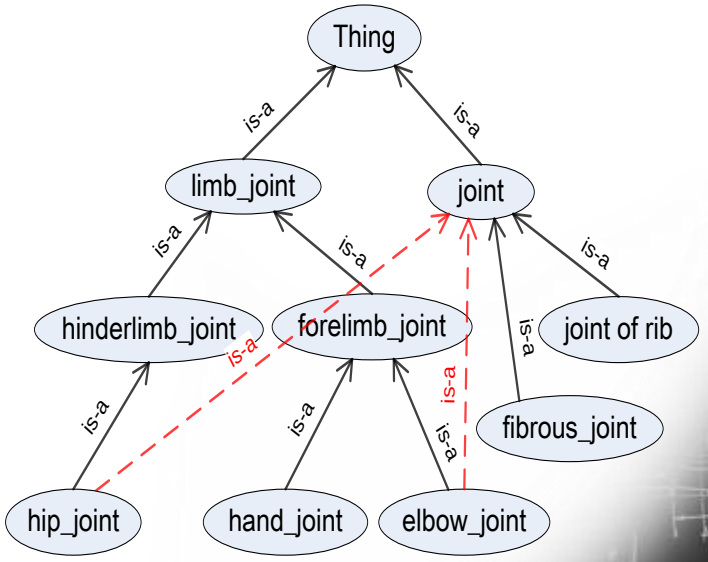


Alignment and Debugging Workflow: ***Repairing*** – Information-based preference

✓ Prefer to add **more informative** is-a relations

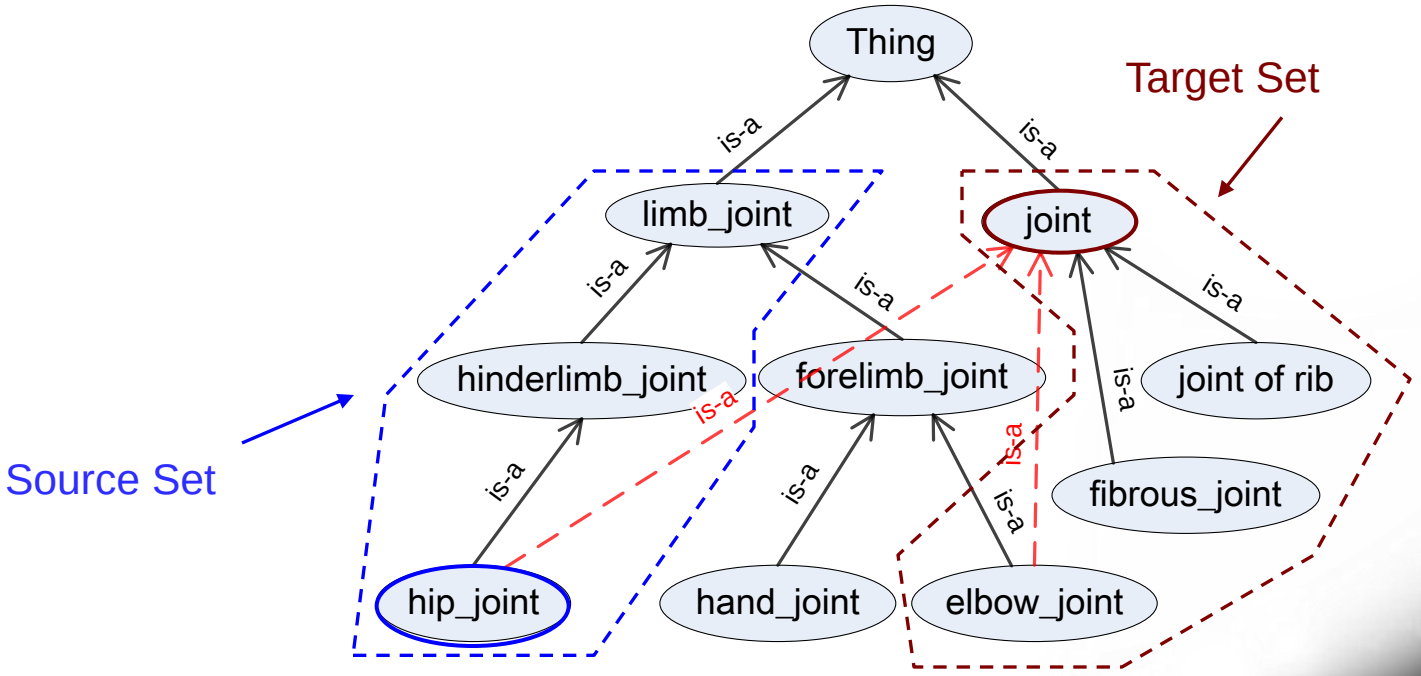


(limb_joint, joint) is more informative than **(hip_joint, joint)** and **(elbow_joint, joint)**



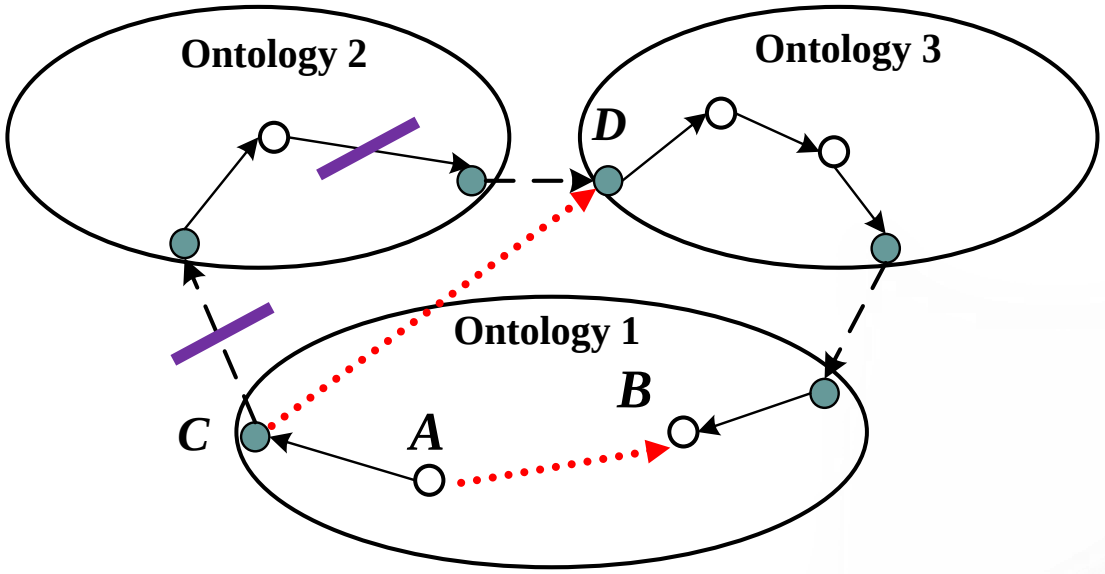
Alignment and Debugging Workflow: ***Repair*** missing is-a relations and mappings

- ✓ For missing is-a relation **(hip_joint, joint)**, we generate two sets of concepts representing 3×4 repairing actions

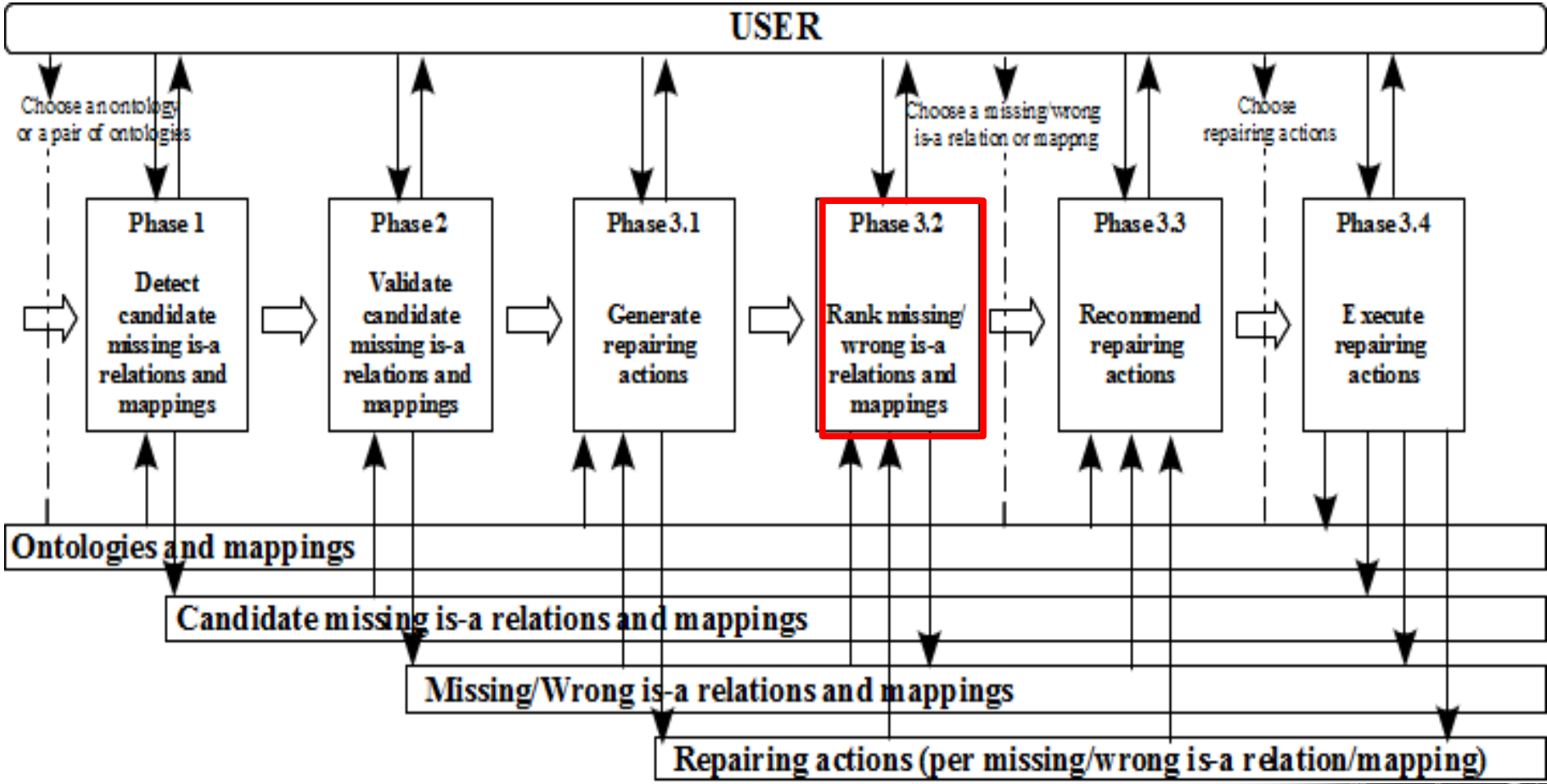


Alignment and Debugging Workflow: ***Repair*** wrong is-a relations and mappings

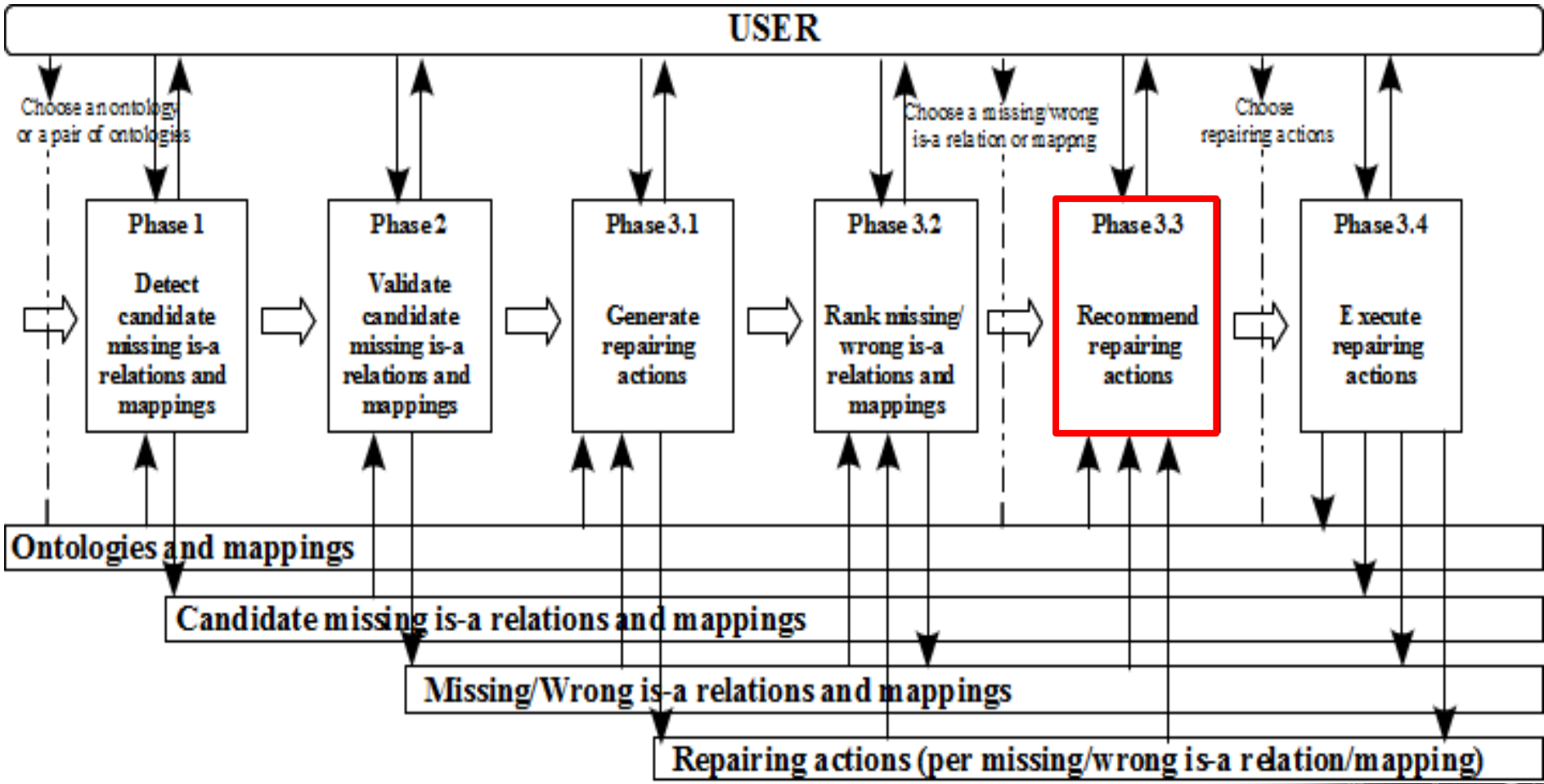
- ✓ Find explanations (justifications)
- ✓ Remove part of the explanation



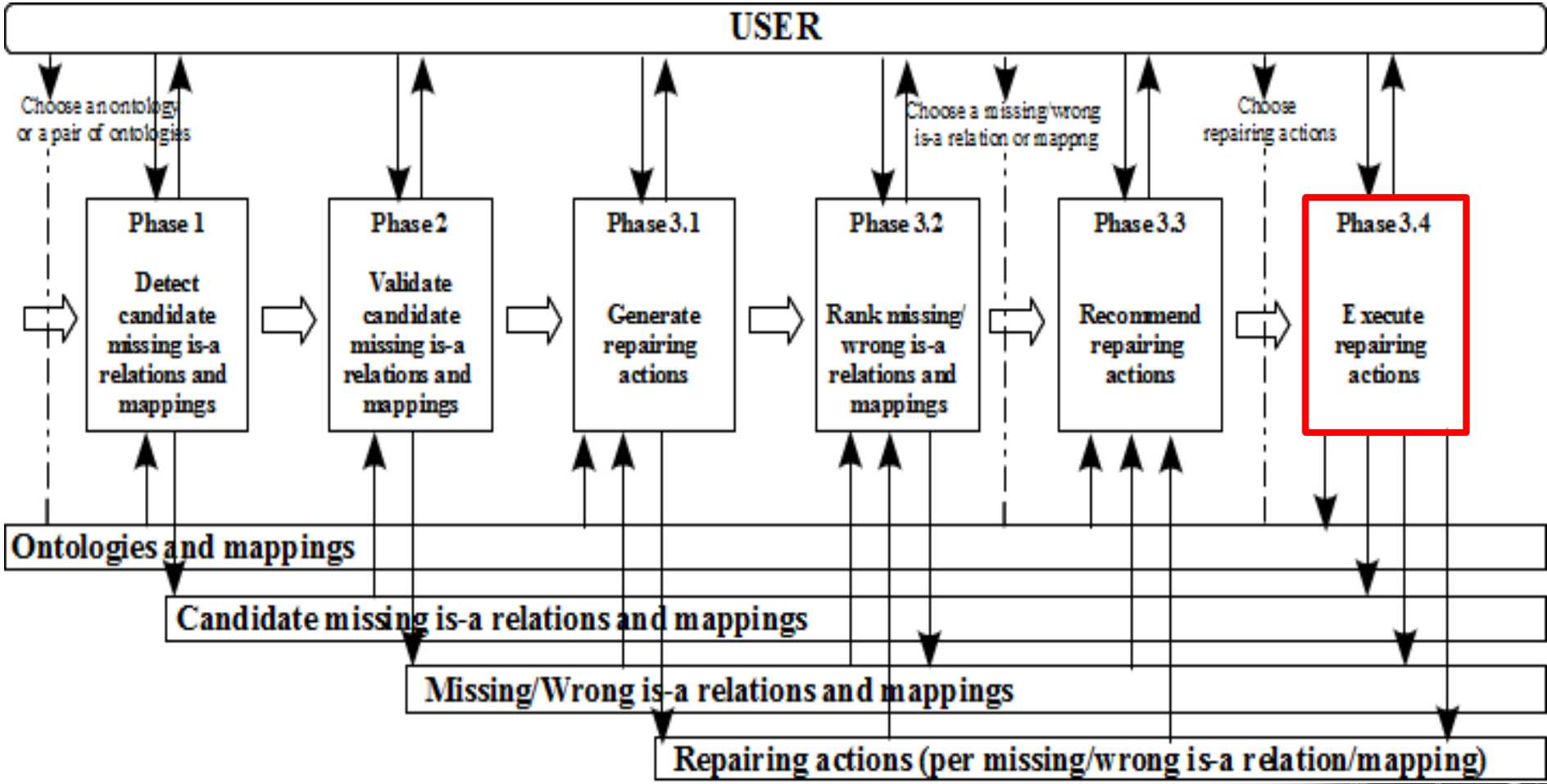
Alignment and Debugging Workflow: ***Repairing*** – Ranking



Alignment and Debugging Workflow: ***Repairing*** – Recommendation



Alignment and Debugging Workflow: ***Repairing*** – Executing repairing actions



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Experiments Setup

- ✓ Ontologies and alignment from OAEI 2011 – Anatomy track

Ontology	#Concepts	#Relations
MA	2737	1807
NCI-A	3298	3761

Alignment	#Equivalence mappings
MA - NCI-A	1516

Experiment 1

✓ Complete debugging and alignment session

Part A	candidate missing mappings	missing ≡ / ← or →	wrong ≡ / ← or →	repair missing ≡ / ← / → / derivable / more informative	repair missing is-a relations
Alignment	1384	**1286/39**	**59/39**	1286/20/8/6/5	-
AMA	-	-	-	-	3
NCI-A	-	-	-	-	2

Part B	candidate missing is-a relations all/non-redundant	missing	wrong	repair missing self / more informative / other	repair wrong removed
Alignment	-	-	-	-	8 ≡ and 1 →
AMA	410/263	**224**	**39**	144/57/23	30
NCI-A	355/183	**166**	**17**	127/13/26	17

Experiment 2

✓ Debugging leads to alignments with higher quality

	I run **≡ / ← or →**	**II run** **≡ / ← or → (more informative) / derivable / is-a relations**
Alignment	1286/39	**1286/28(5)/6/5**

Experiment 3

- ✓ Extending the alignment leads to discovering more possible defects

Ontology	I run candidate missing is-a relations all/non-redundant	II run candidate missing is-a relations all/non-redundant
MA	496/280	**638/357**
NCI-A	365/193	**460/234**

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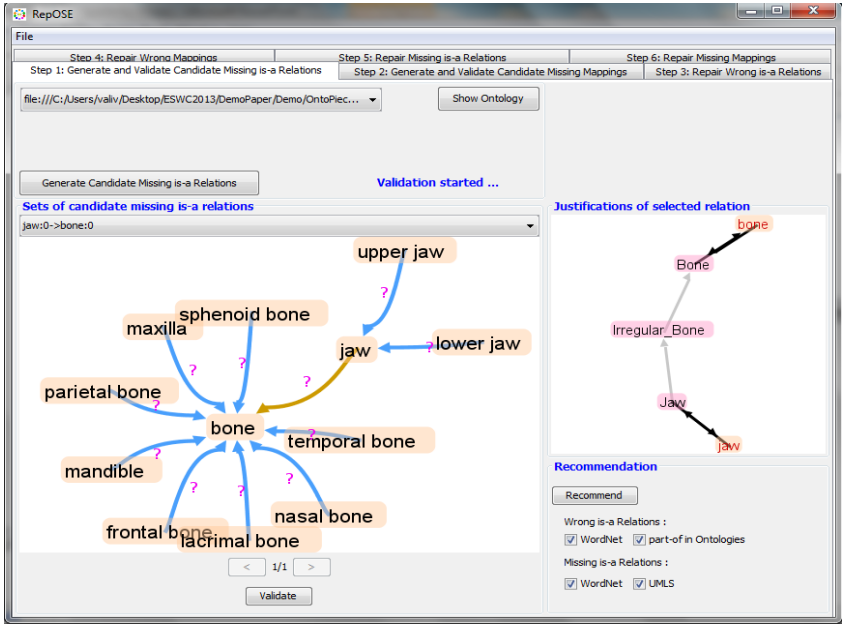
Conclusions

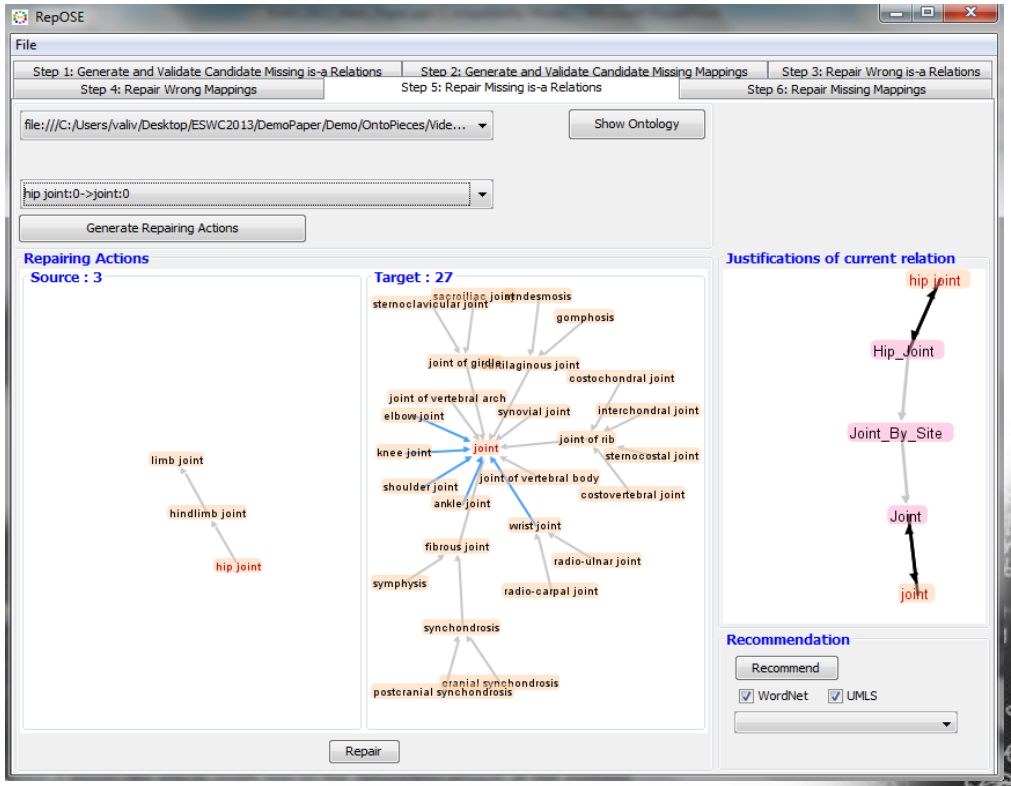
- ✓ The first integrated Ontology Alignment and Debugging Framework
- ✓ Alignment Contributions to Debugging
  - ✓ Calculates possible mappings
  - ✓ Provides/extends alignments
- ✓ Debugging Contributions to Alignment
  - ✓ Provides repairing algorithms not available in the alignment systems
  - ✓ Repairs the is-a structure and the mappings

Future Work

- ✓ Explore further the interactions between ontology alignment and debugging
- ✓ Include structure-based matchers
- ✓ Include partial-alignment-based filtering and preprocessing strategies
- ✓ Extend the approach to ontologies represented in more expressive languages

Demonstration – OAEI 2011 Anatomy track





Thank you!

Questions?