

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

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And

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LiU

expanding reality

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

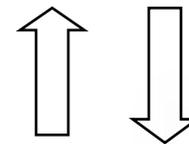
I Diseases Category

I Eye Diseases

I Scleral Diseases

I Scleritis

...



return 1363 articles



Influence of Defects in Structure

- ✓ Incomplete results from ontology-based queries



Medical Subject Headings (MeSH)

All MeSH Categories

I Diseases Category

I Eye Diseases

I Scleral Diseases

~~I Scleritis~~

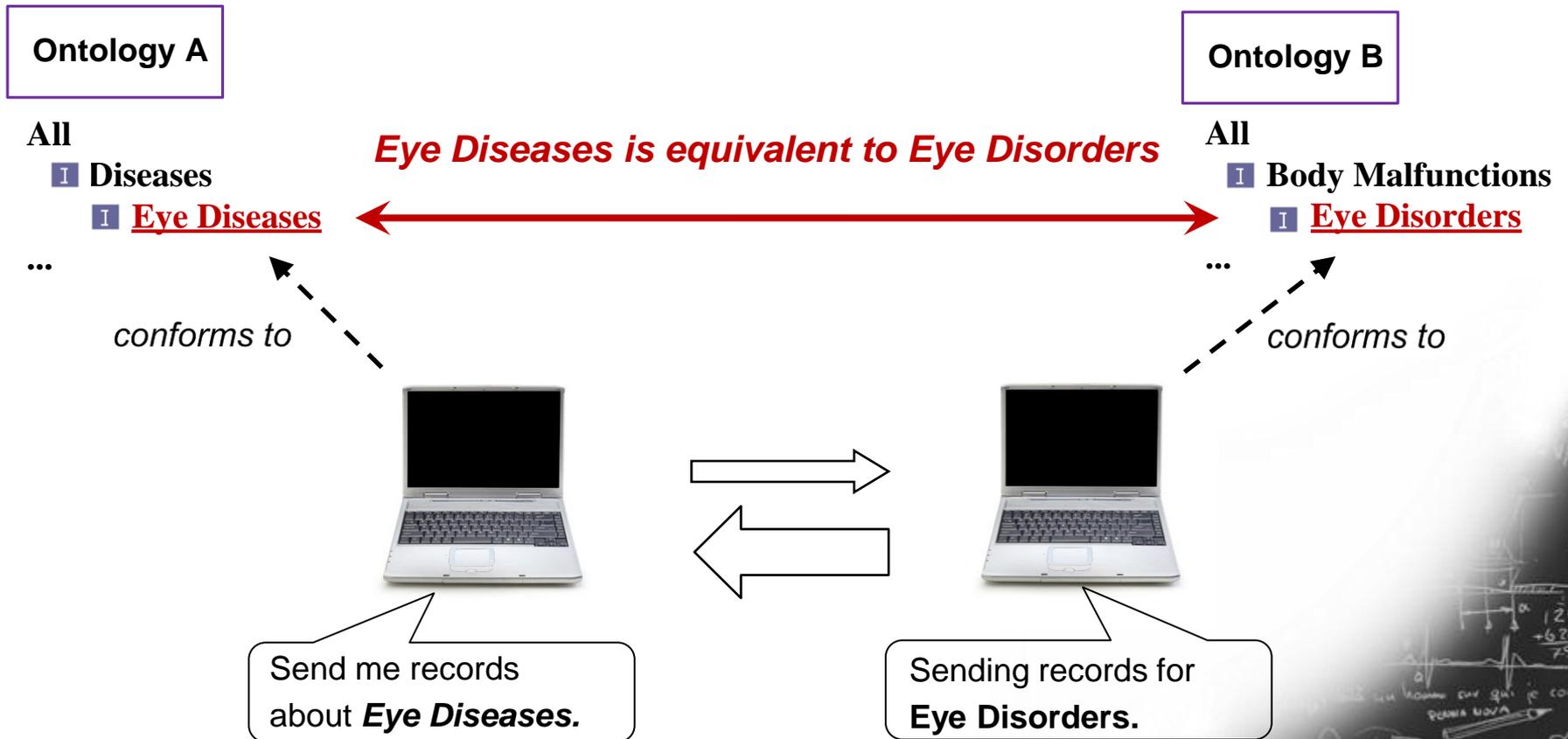
...

↑ ↓
return 1363 articles
return 613 articles
55% results are missed !

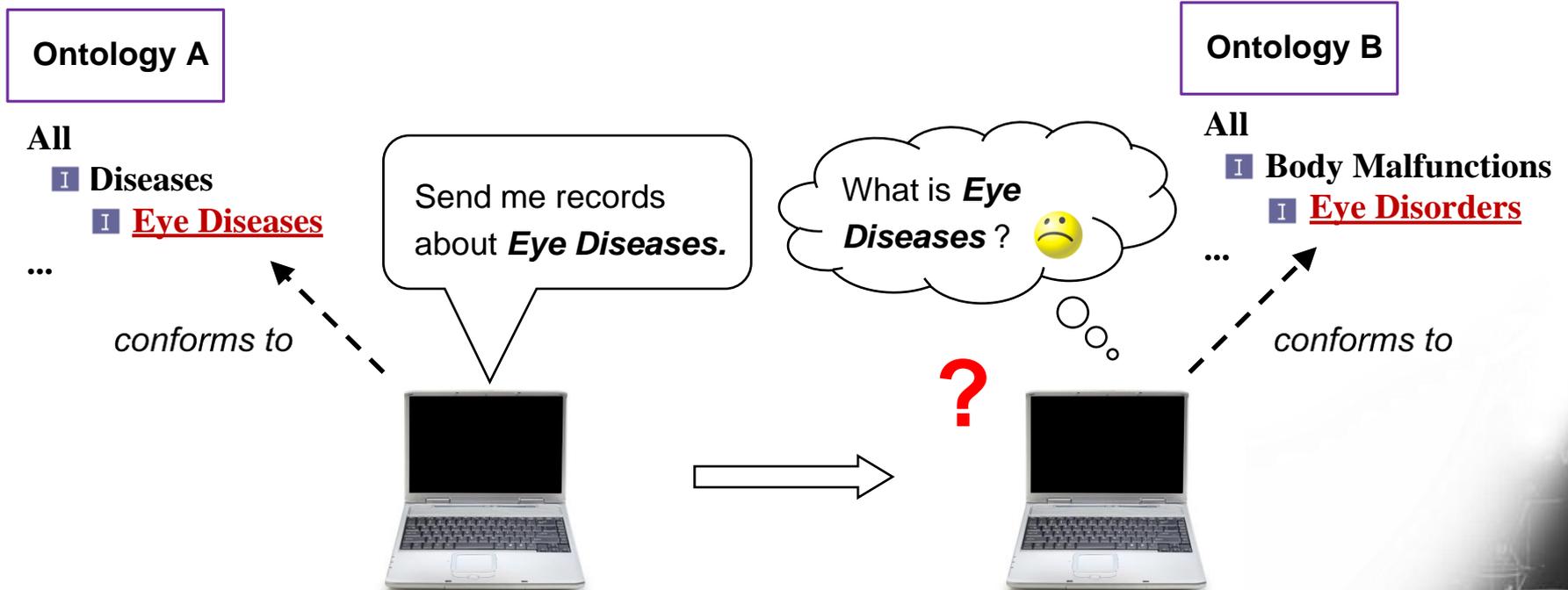


Influence of Defects in Mappings

- ✓ Semantically-enabled applications



Influence of Defects in Mappings

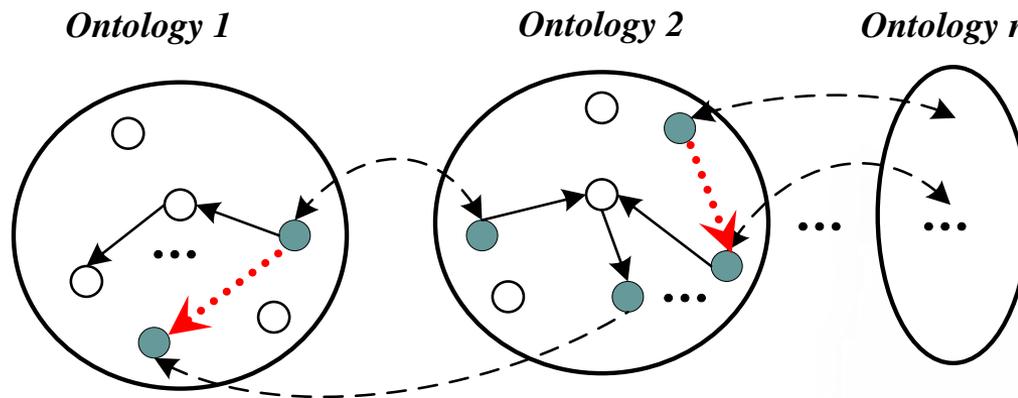


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Taxonomy Networks

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

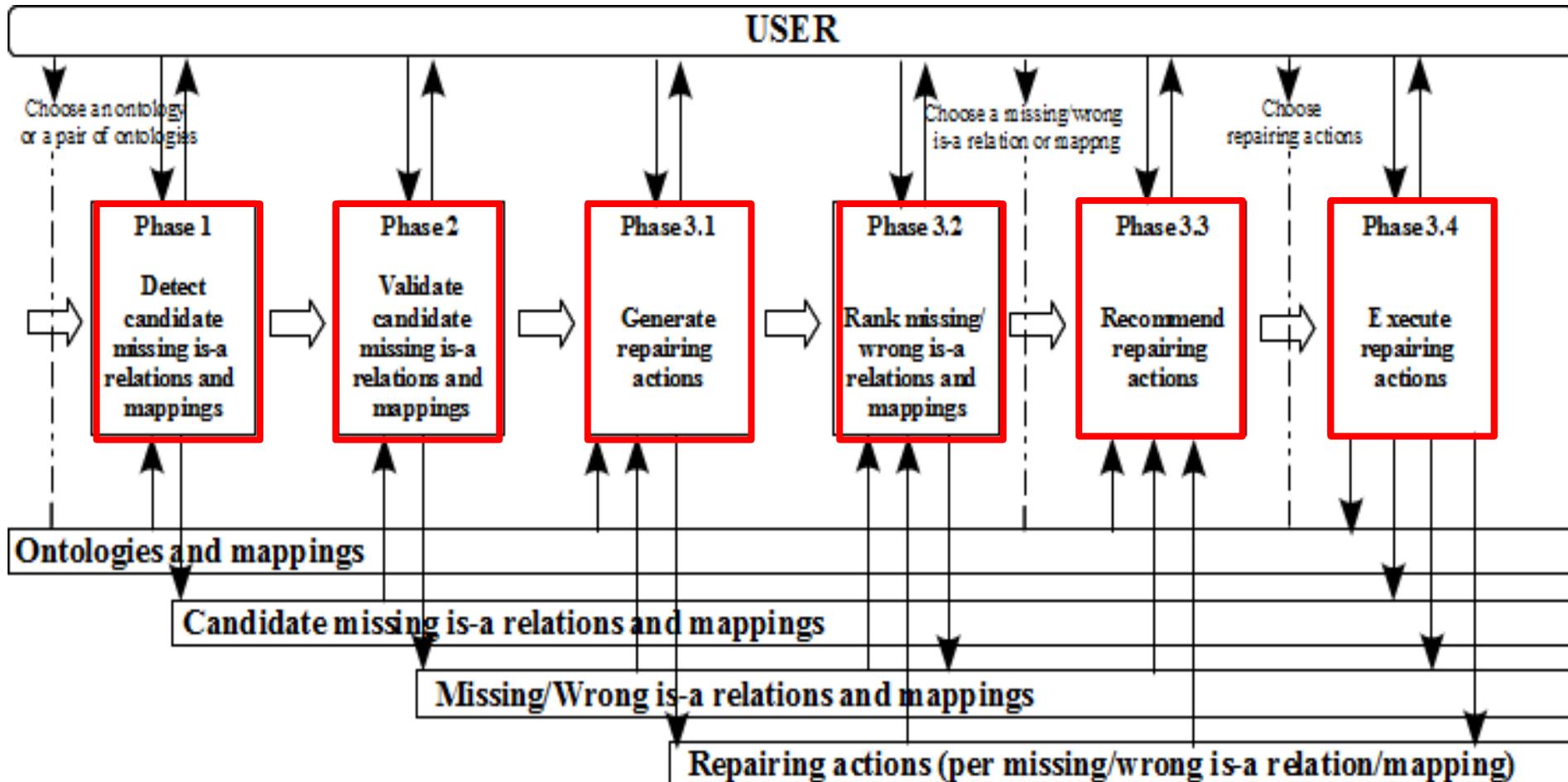


Problem Statement

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?

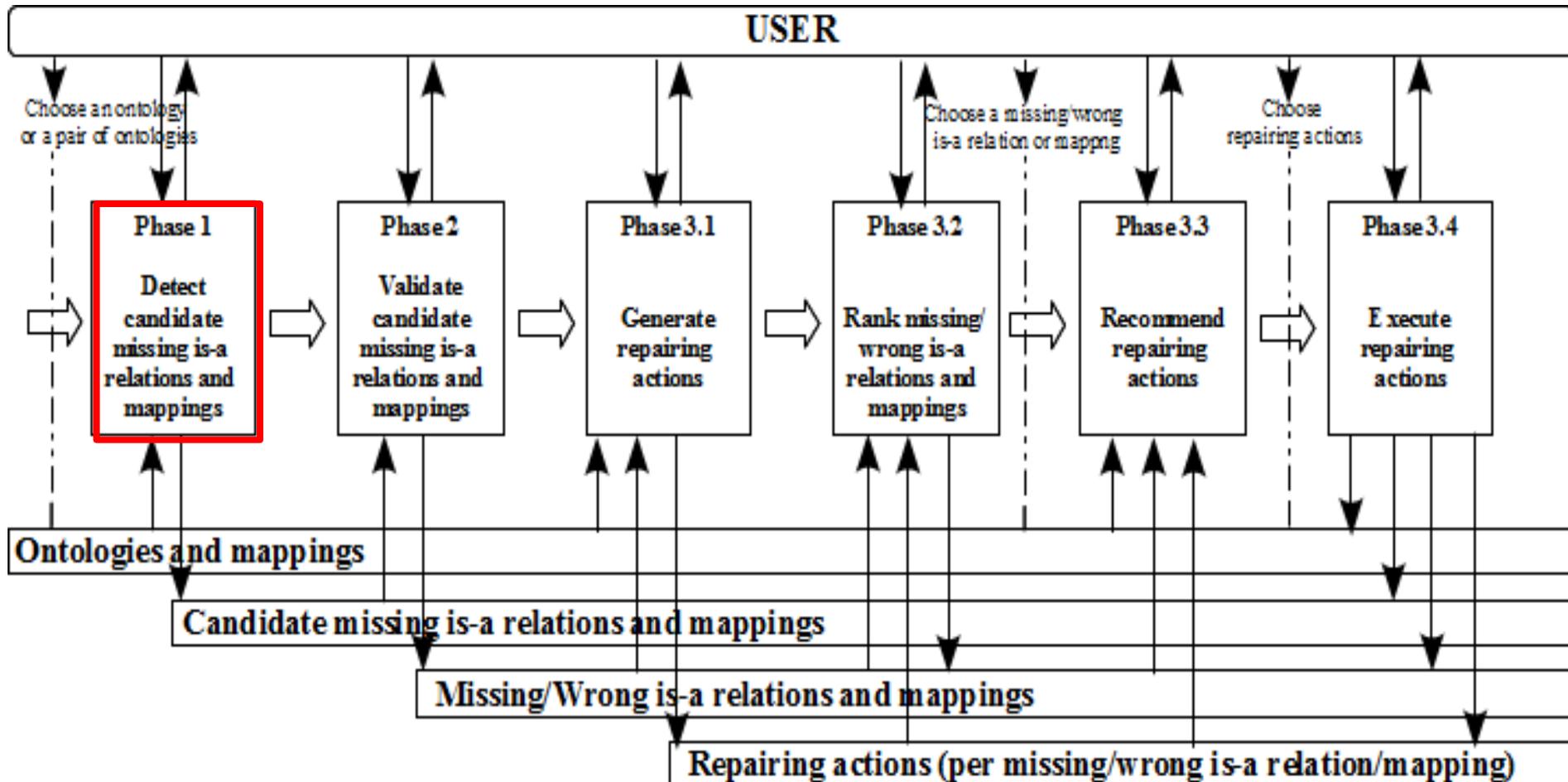
Alignment and Debugging Framework



Outline

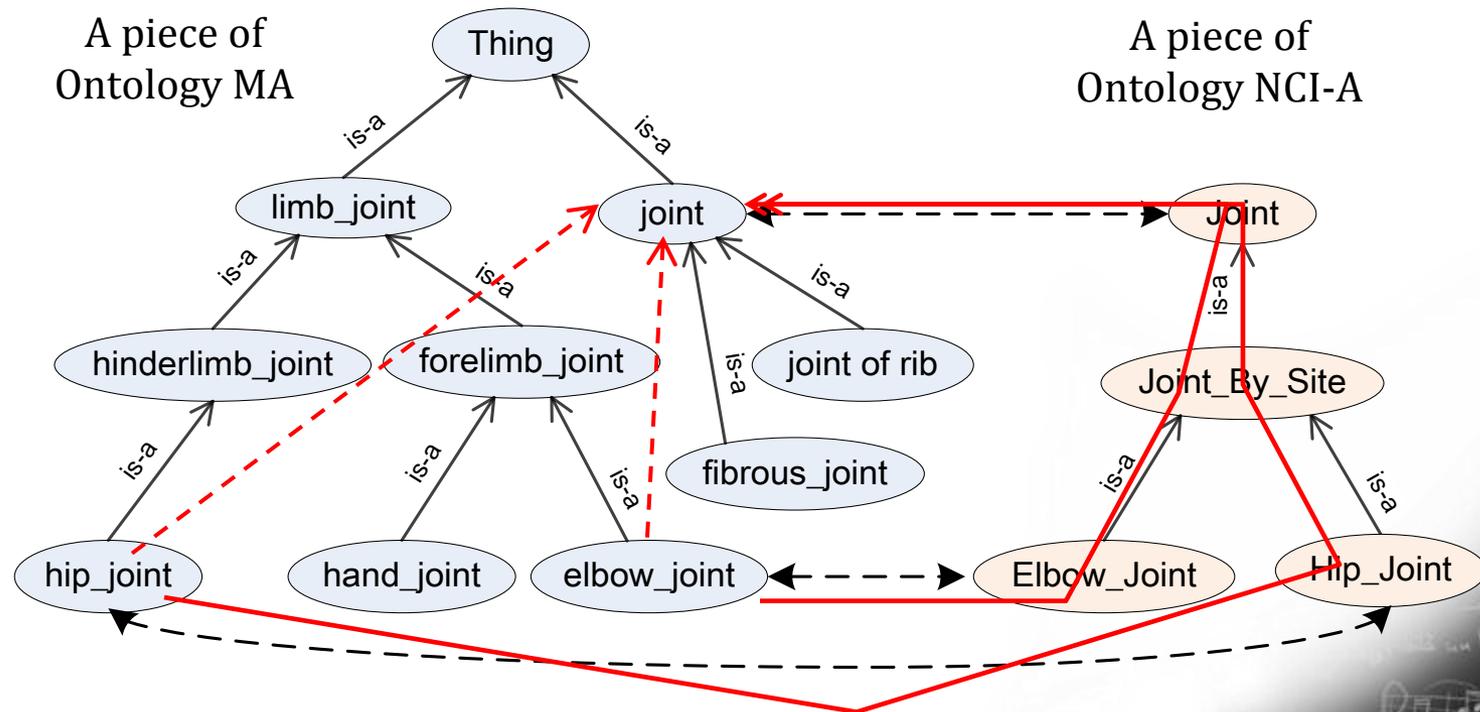
- ✓ Defects in Ontologies and Alignments
- ✓ Integrated Ontology Alignment and Debugging Framework
 - ✓ Detection
 - ✓ Validation
 - ✓ Repairing
- ✓ Experiments
- ✓ Conclusions and Future Work

Debugging Workflow: *Detection* of Defects

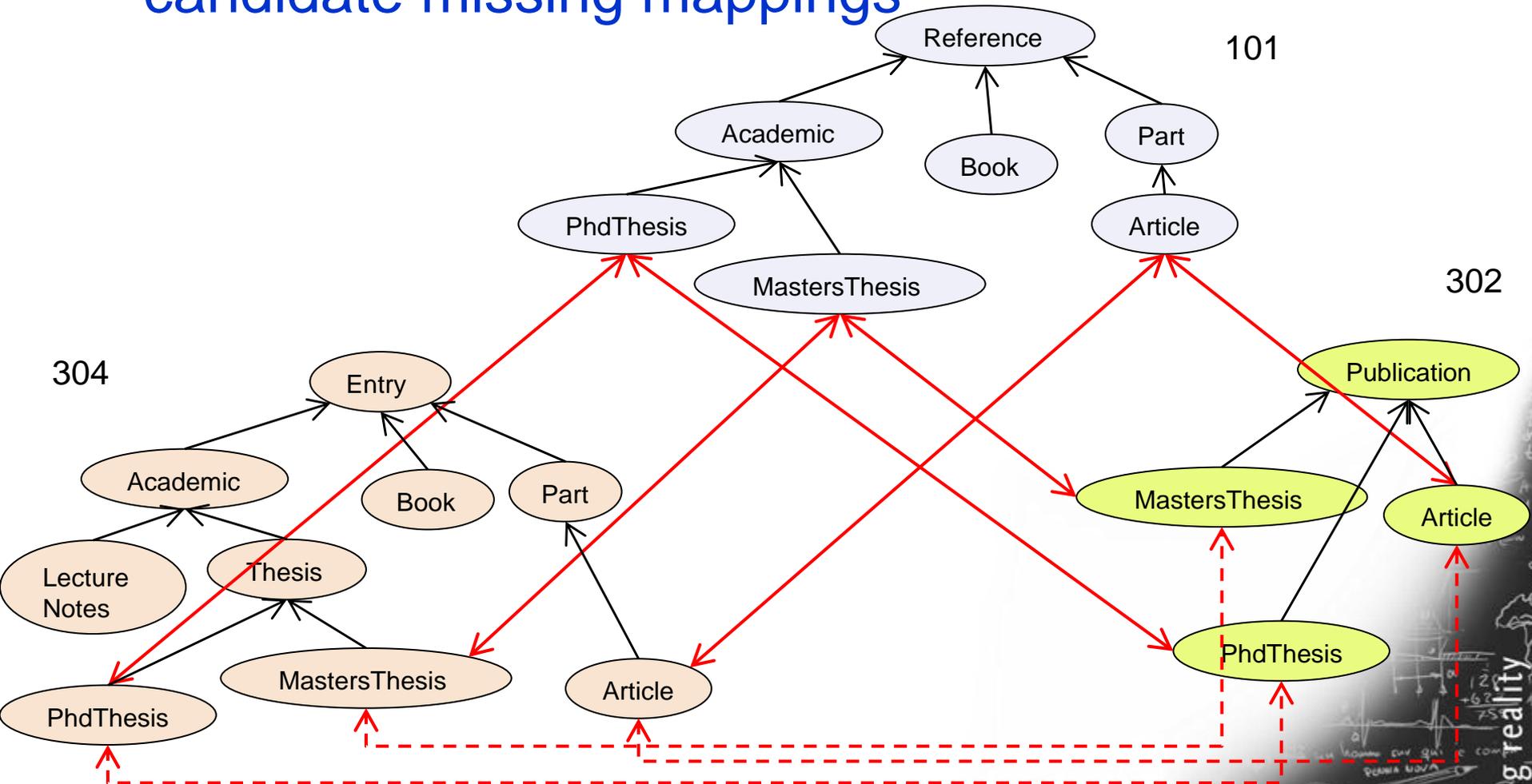


Debugging Workflow: *Detection* of Defects - candidate missing is-a relations

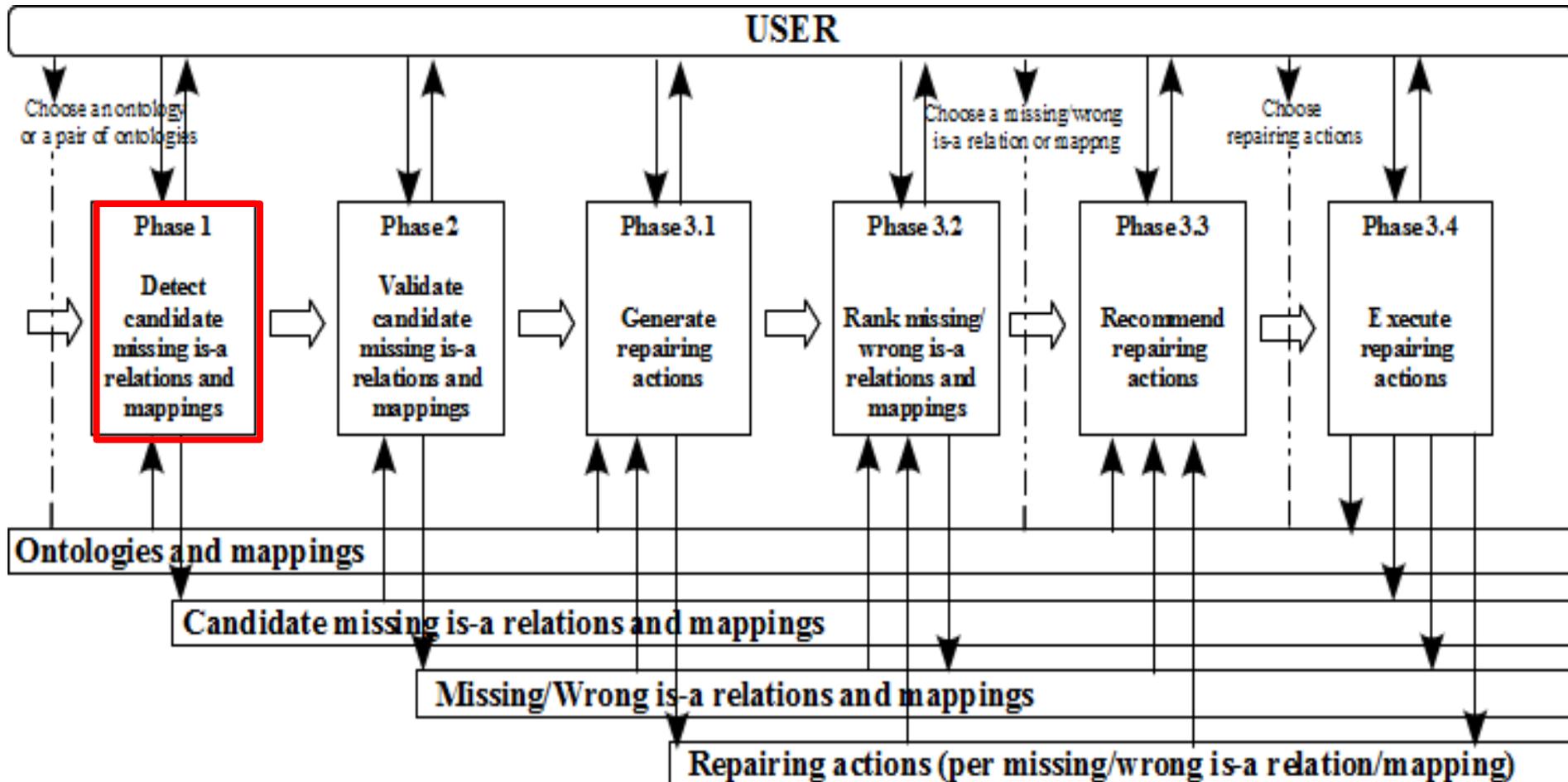
- ✓ Two small pieces of MA and NCI-A, both about concept “joint”, and 3 equivalence mappings



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



Alignment Workflow: *Detection* of Defects



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

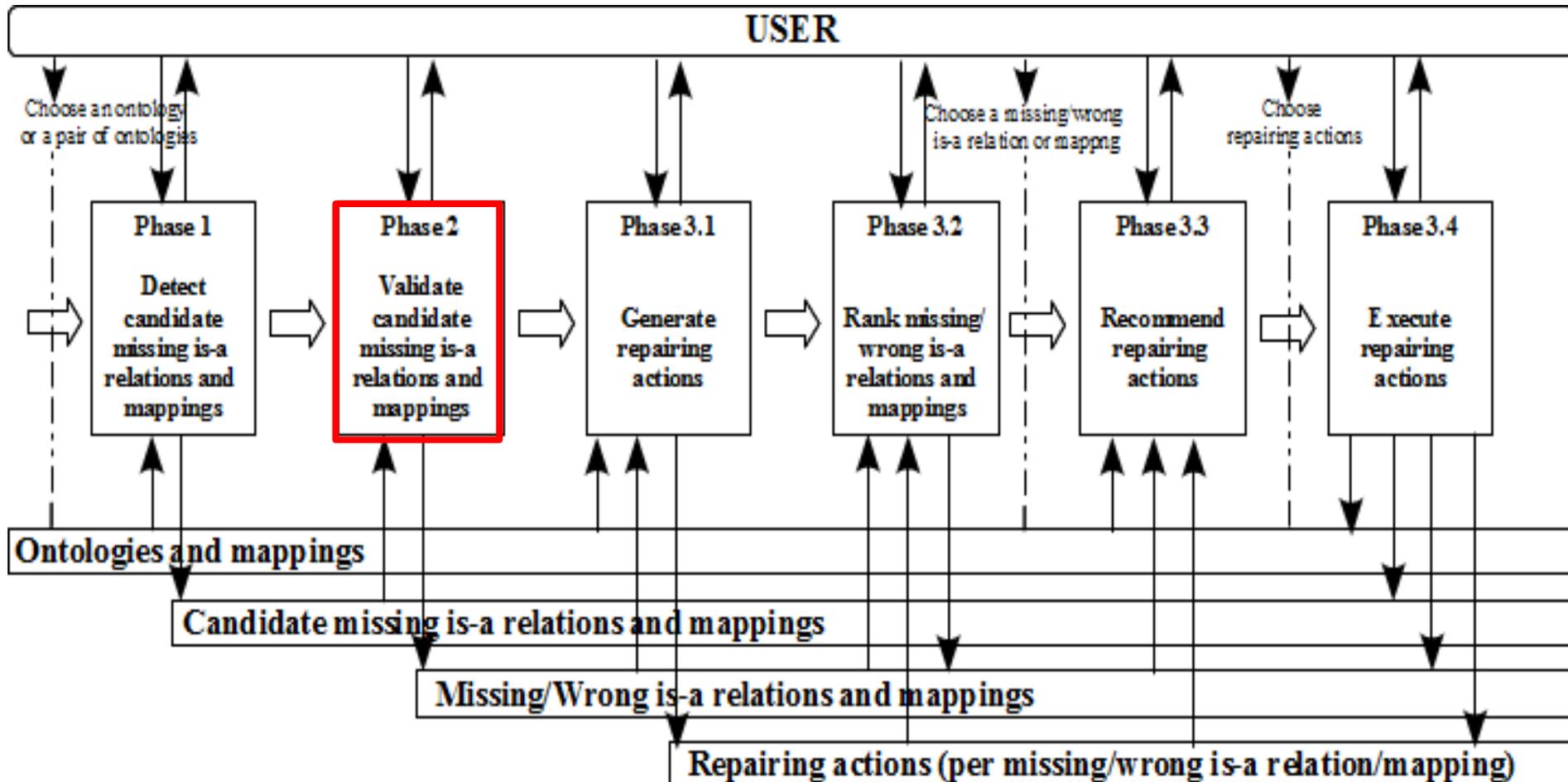
- ✓ Matchers
 - ✓ Linguistic matchers
 - ✓ Matchers employing auxiliary information
- ✓ Combination and filtering of similarity values

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

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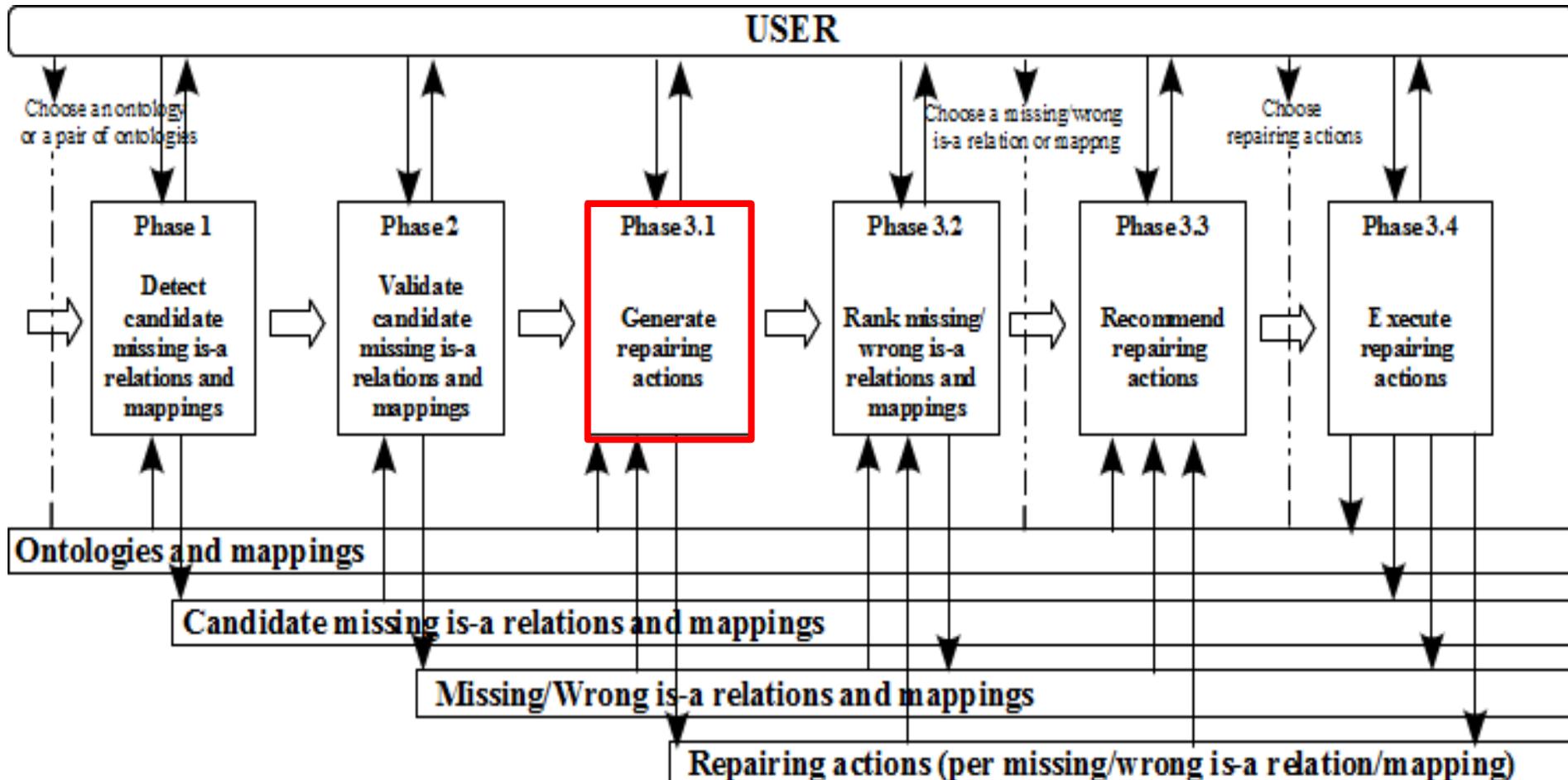
Alignment and Debugging Workflow: *Validation*



Outline

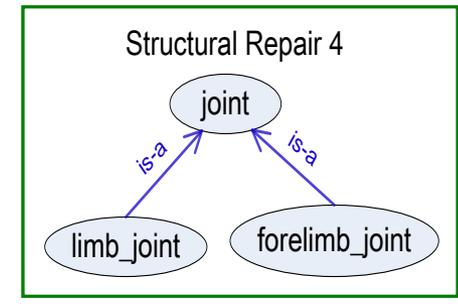
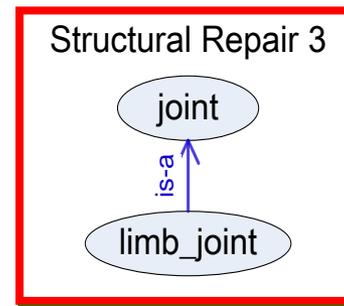
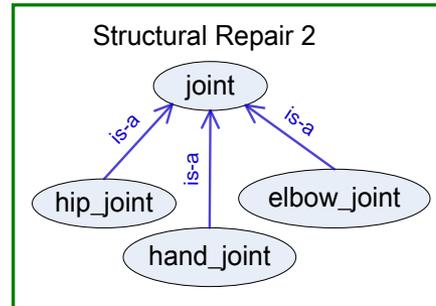
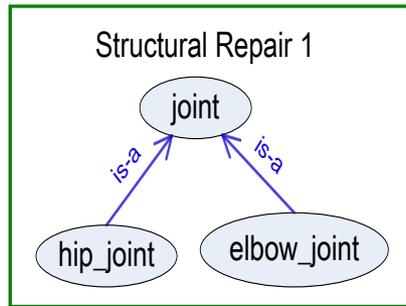
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Alignment and Debugging Workflow: *Repairing*



Alignment and Debugging Workflow: Example

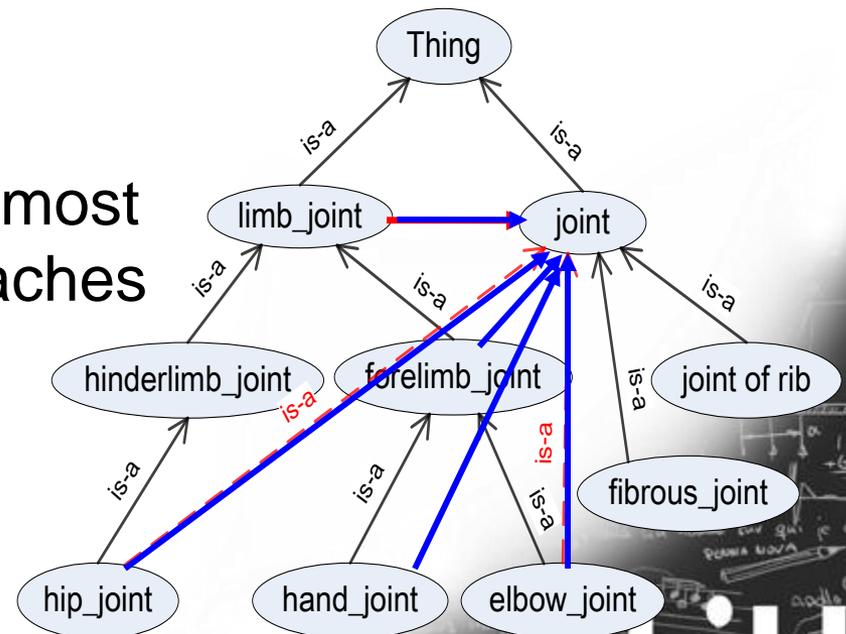
– repairing missing is-a relations



Question:

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

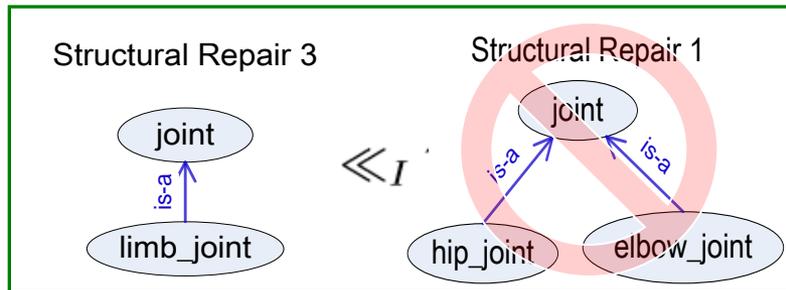
→ preferences.



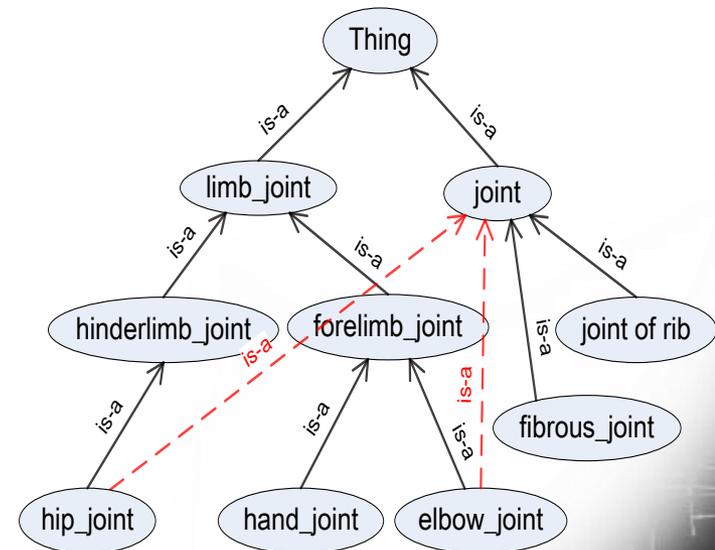
Alignment and Debugging Workflow: *Repairing*

– Information-based preference

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

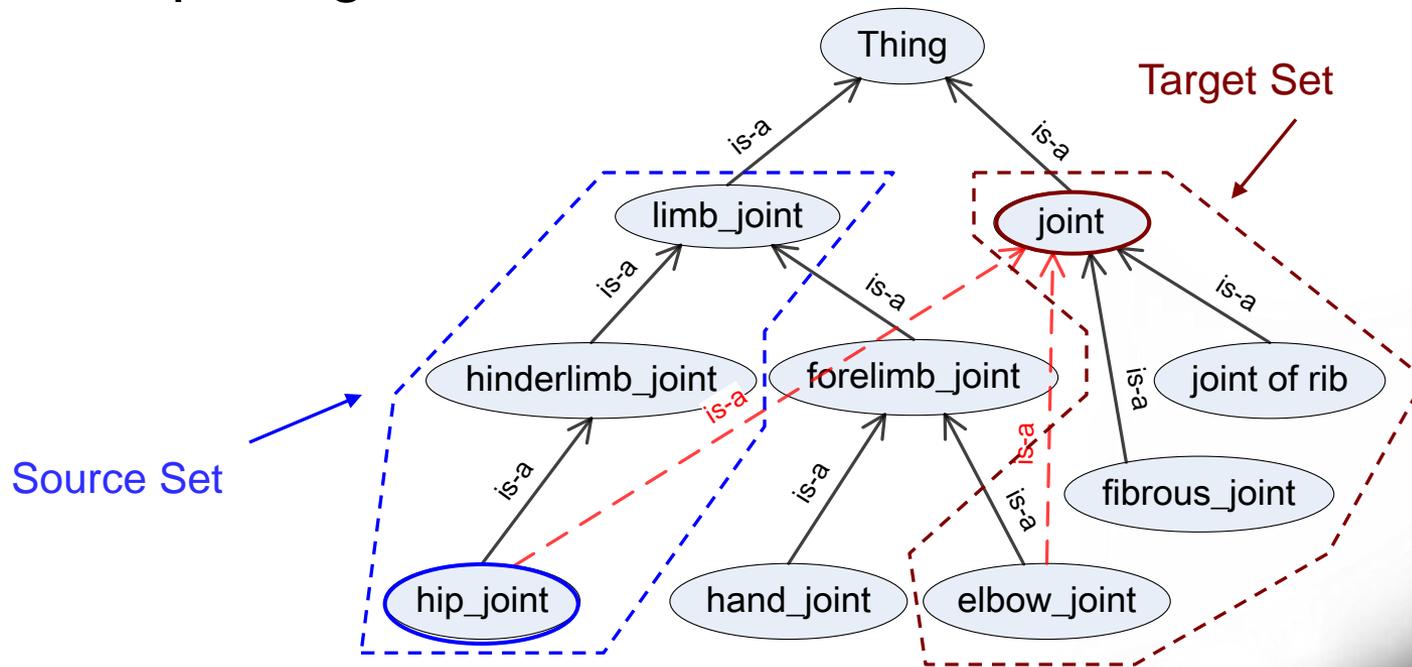


(limb_joint, joint) is more informative than **(hip_joint, joint)** and **(elbow_joint, joint)**



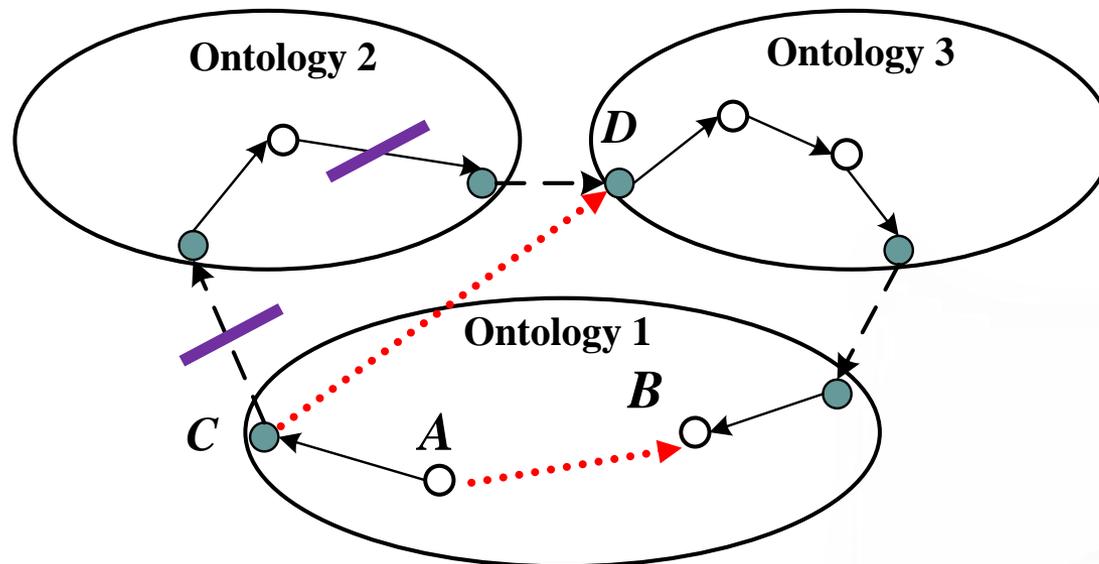
Alignment and Debugging Workflow: *Repair* missing is-a relations and mappings

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



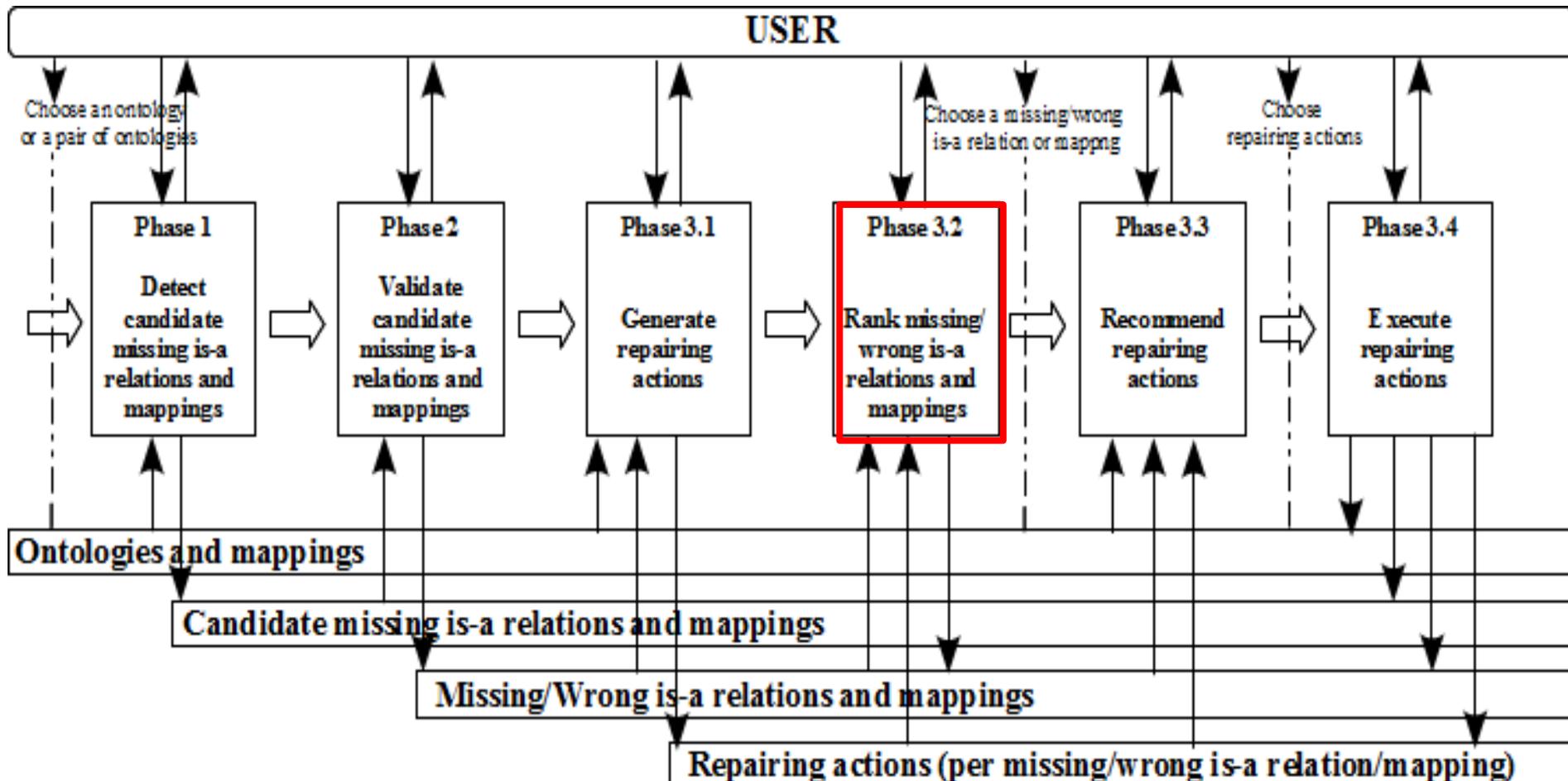
Alignment and Debugging Workflow: *Repair* wrong is-a relations and mappings

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



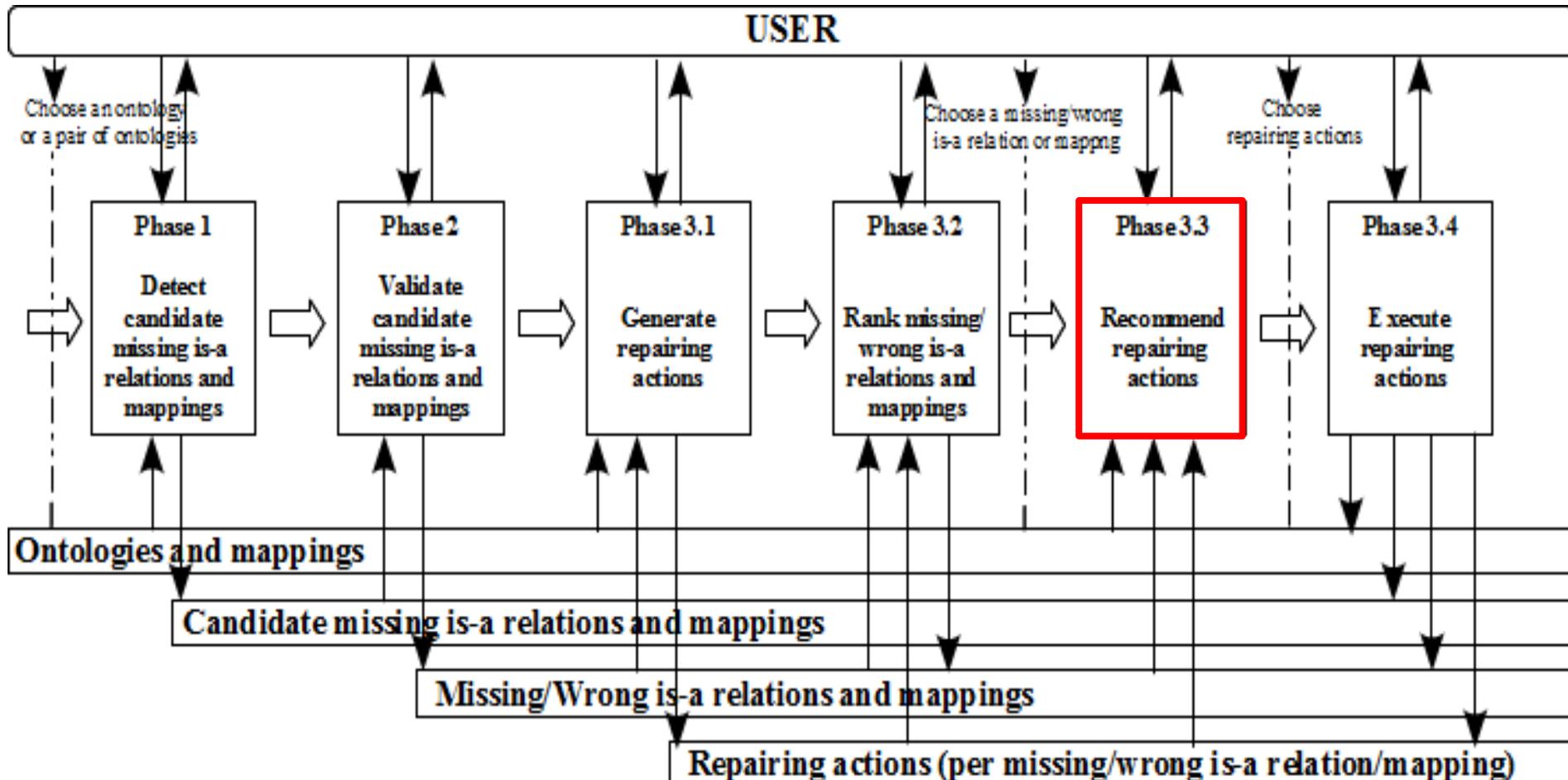
Alignment and Debugging Workflow: *Repairing*

– Ranking



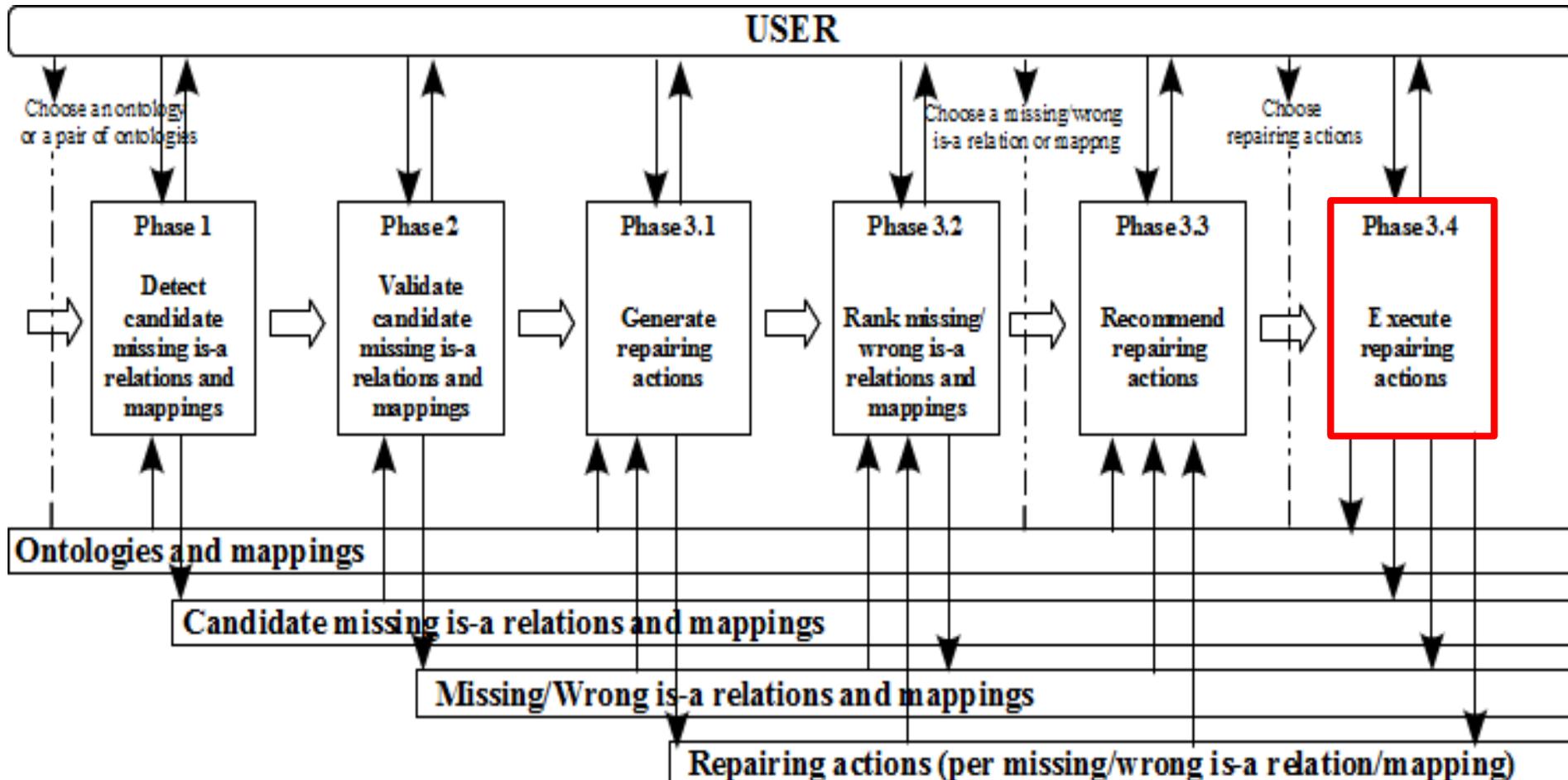
Alignment and Debugging Workflow: *Repairing*

– 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 \equiv / \leftarrow or \rightarrow	wrong \equiv / \leftarrow or \rightarrow	repair missing $\equiv / \leftarrow / \rightarrow /$ 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 \equiv and 1 \rightarrow
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	II run
	≡ / ← or →	≡ / ← 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

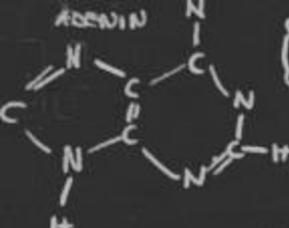
Demonstration – OAEI 2011 Anatomy track

RepOSE interface showing a network diagram of bones and joints. The central node is 'bone', with arrows pointing to 'upper jaw', 'lower jaw', 'temporal bone', 'nasal bone', 'lacrimal bone', 'frontal bone', 'mandible', 'parietal bone', and 'maxilla'. A 'Validation started ...' message is visible. The interface includes a menu bar with steps 4, 5, and 6, and a 'Validate' button at the bottom.

RepOSE interface showing a detailed network diagram of joints. The central node is 'joint', with arrows pointing to 'sternoclavicular joint', 'sacroiliac joint', 'desmosis', 'gomphosis', 'joint of vertebral arch', 'synovial joint', 'interchondral joint', 'elbow joint', 'joint of rib', 'sternocostal joint', 'shoulder joint', 'joint of vertebral body', 'costovertebral joint', 'ankle joint', 'wrist joint', 'radio-ulnar joint', 'fibrous joint', 'radio-carpal joint', 'synchondrosis', 'cranial synchondrosis', and 'postcranial synchondrosis'. The interface includes a menu bar with steps 1 through 6, a 'Generate Repairing Actions' button, and a 'Repair' button at the bottom.

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den paltbrödsrörka åkerjorden.
 Det finns en lada grön vägg.
 Och det finns marker



7200

HIRAGANA	KATAKANA	ma
ま	マ	mi
み	ミ	me
め	メ	mo

In Hawaii, where
 is the same thing
 I wonder how
 conversation



Thank you!

Questions?



eaux qui chantent

ominativ	servus
genitiv	servi
dativ	servo
accusativ	servum

ΚΤΙΒΙΛ * ΤΑΥ * ΤΝΤ *
 ΡΙΥΠΟ * ΥΝΥΥ * ΠΝ



Hic sita sum
 quas frugitea