UNIL | Université de Lausanne

Frederic Bastian

Homolonto: alignment of anatomical ontologies

| le savoir vivant |

ICBO, 2009 July 24th

More and more anatomical ontologies…

ZFIN

Zebrafish

Xenbase

Xenopus

Drosophila

emap edinburgh mouse atlas project

Human - Mouse

eVOC

Human

… and an ongoing effort to link them

Xref

CARO

Common Anatomy Reference Ontology

Teleost Anatomical Ontology

MIAA

Minimum Information about anatomy

UBERON

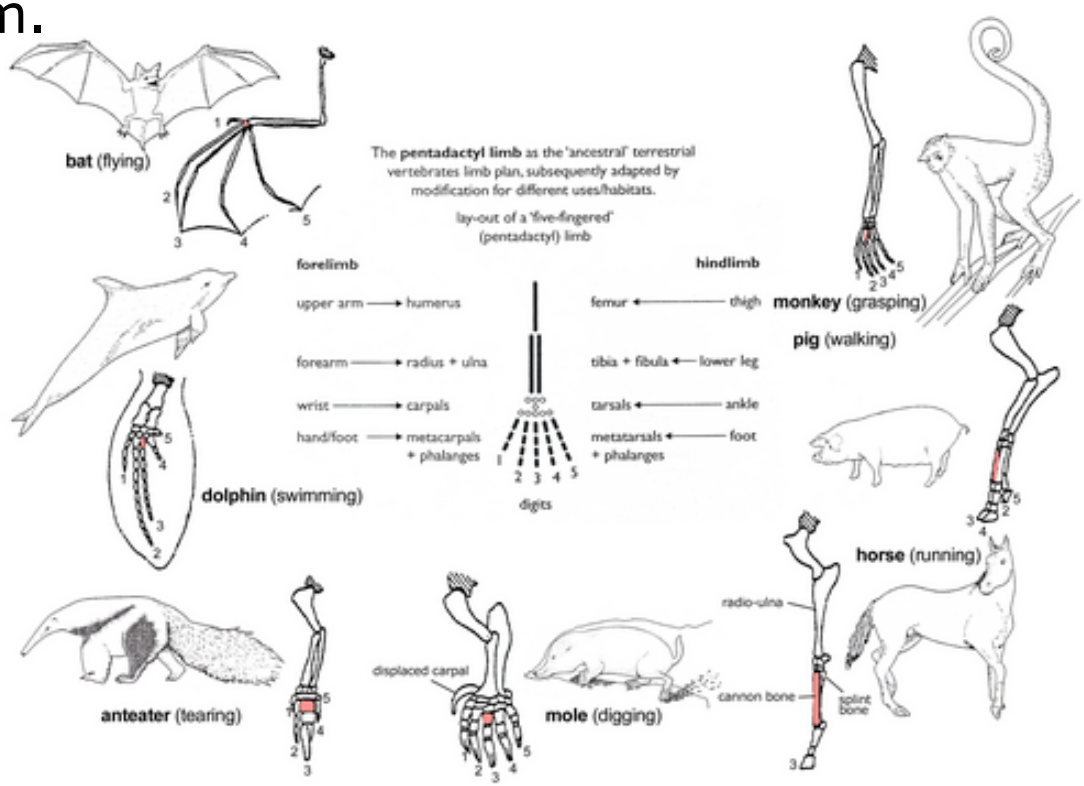
Multi-species Anatomy Ontology

Homology relationships between anatomies

Evolutionary approach => appropriate comparison criterion:

Homology

Strict Homology: two anatomical structures within different organisms which originated from a structure of their common ancestral organism.



Homology relationships between anatomies

Some problems:

- different but similar terms for the same organ

    human ontology: "intersubcardinal venous anastomosis"
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  "ganglion" defined only from its hierarchy

- different relationships between homologous terms

  human ontology: "optic vesicle" part_of "eye"
  zebrafish ontology: "optic vesicle" part_of "immature eye"

Homolonto

-Software to generate homology relationships
-Pairwise alignments of species-specific anatomical ontologies

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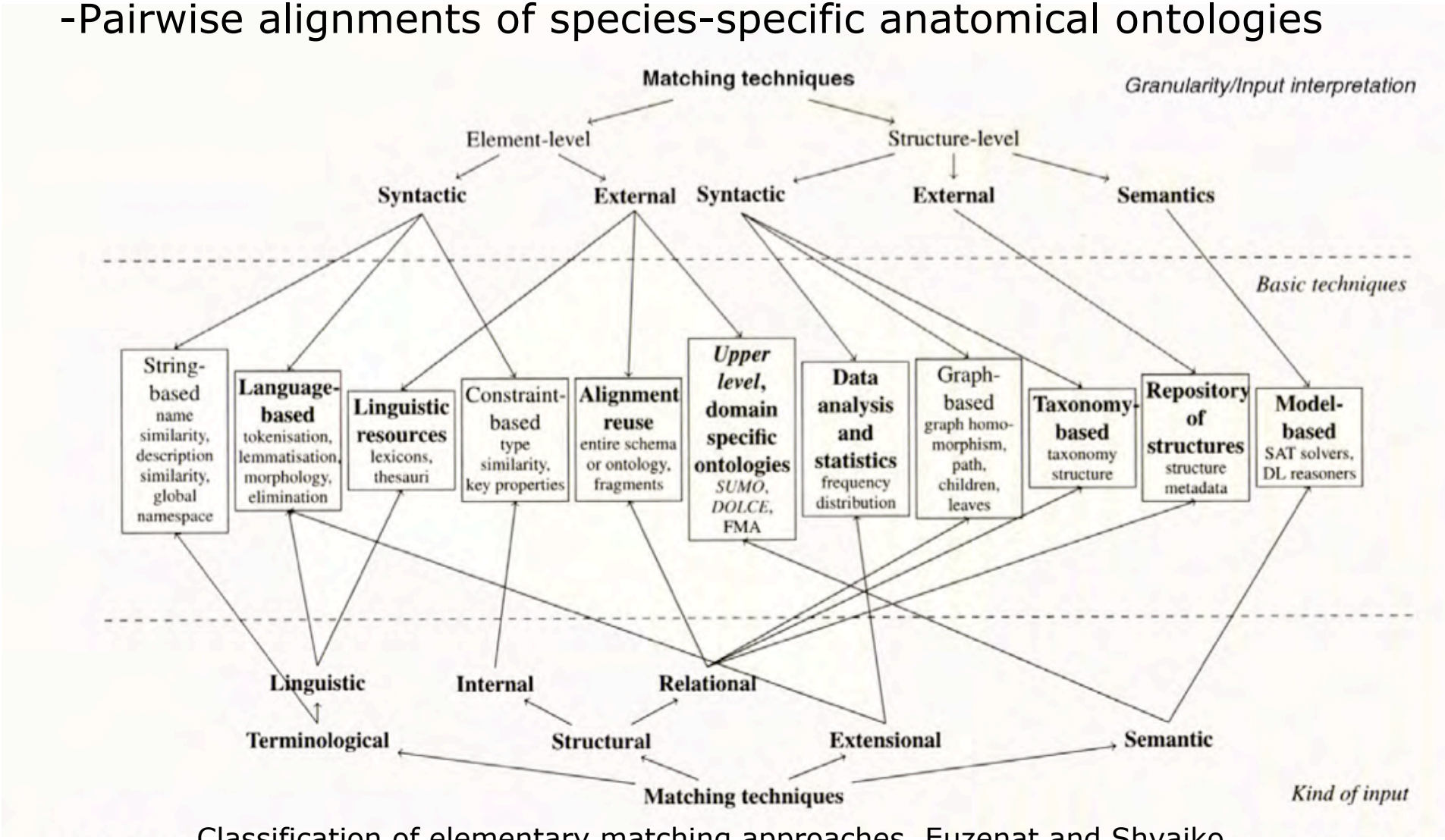

Classification of elementary matching approaches, Euzenat and Shvaiko

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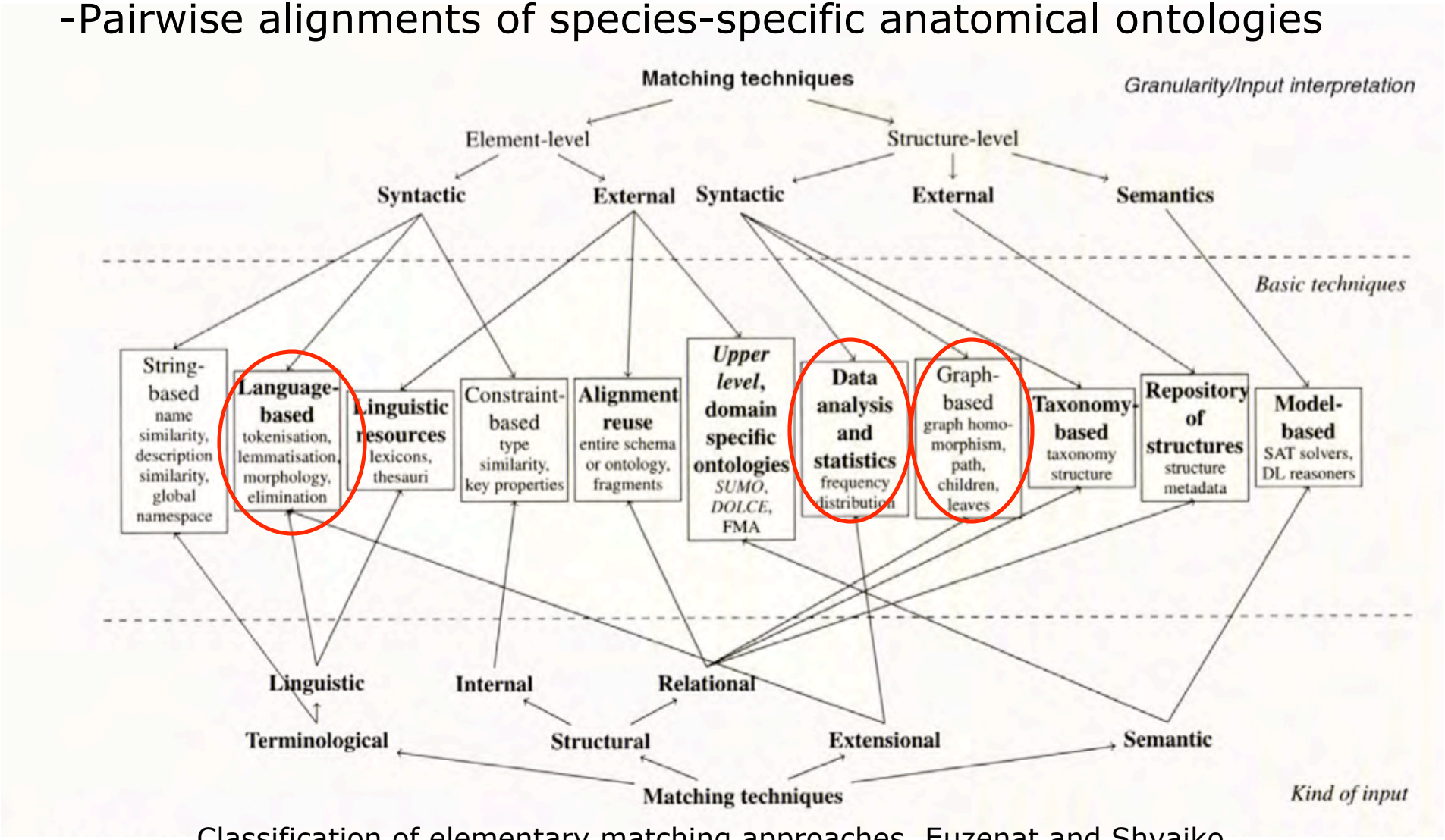

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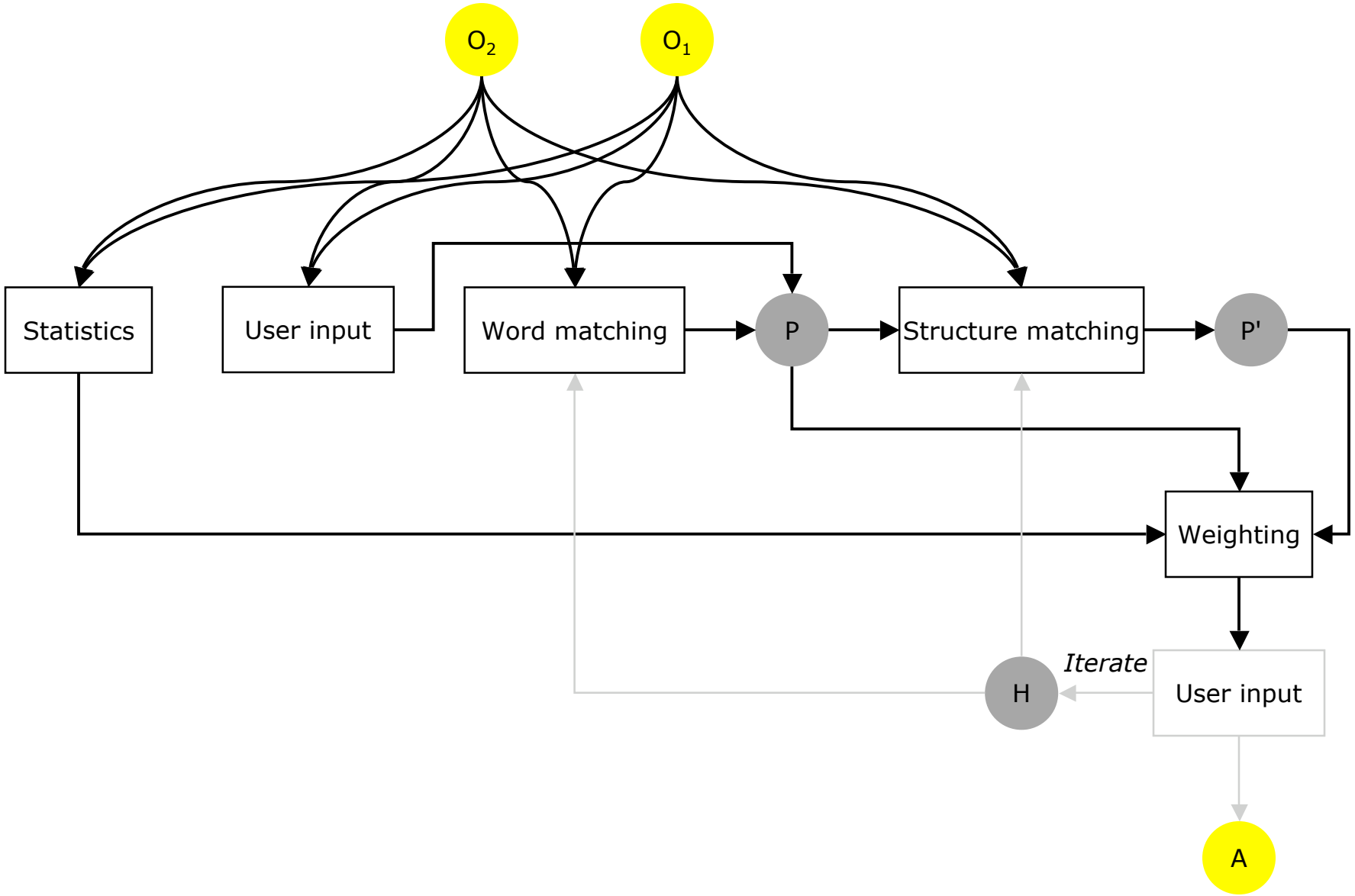
O_2
O_1
Statistics
User input
Word matching
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Structure matching
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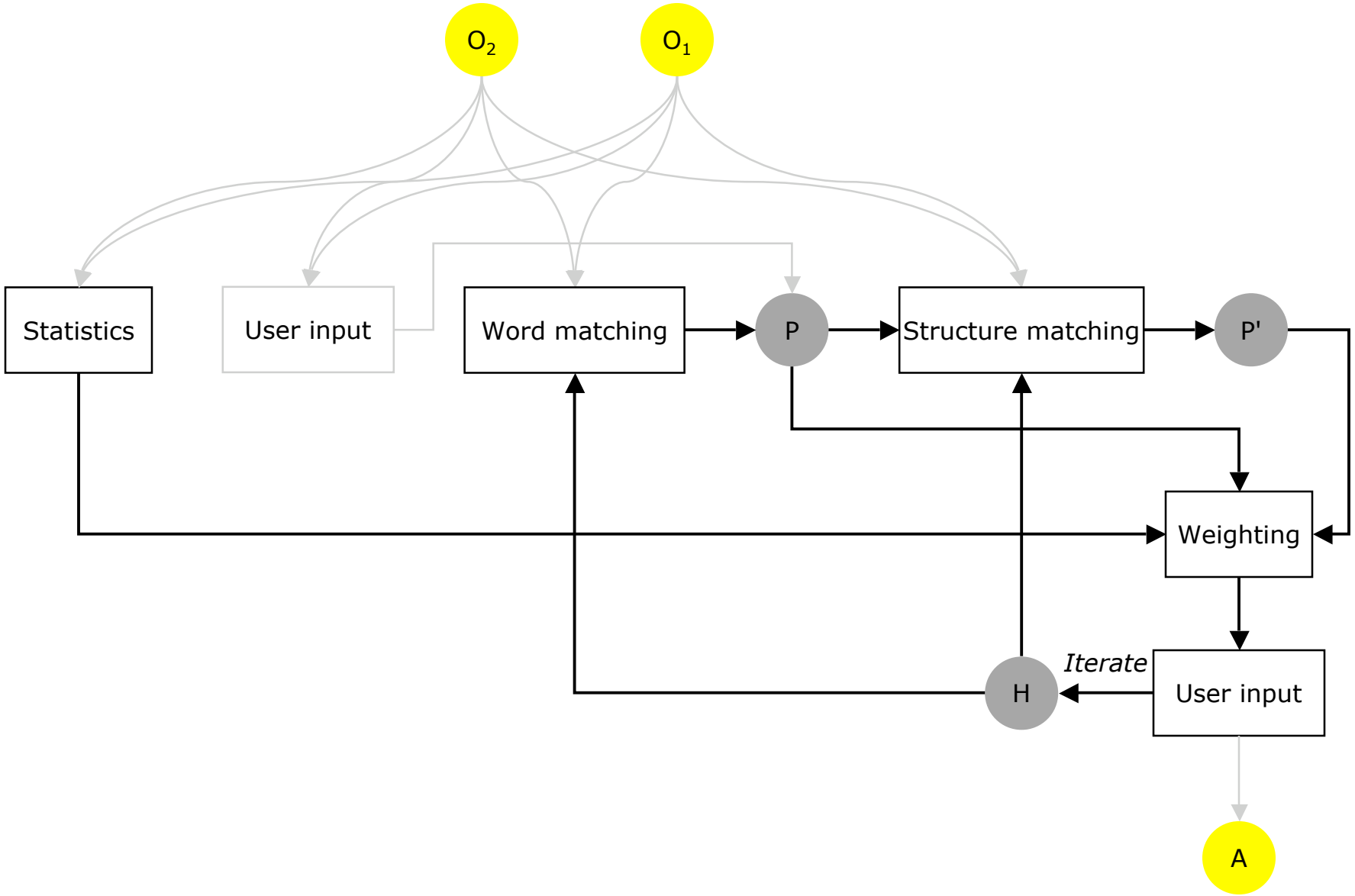
Homolonto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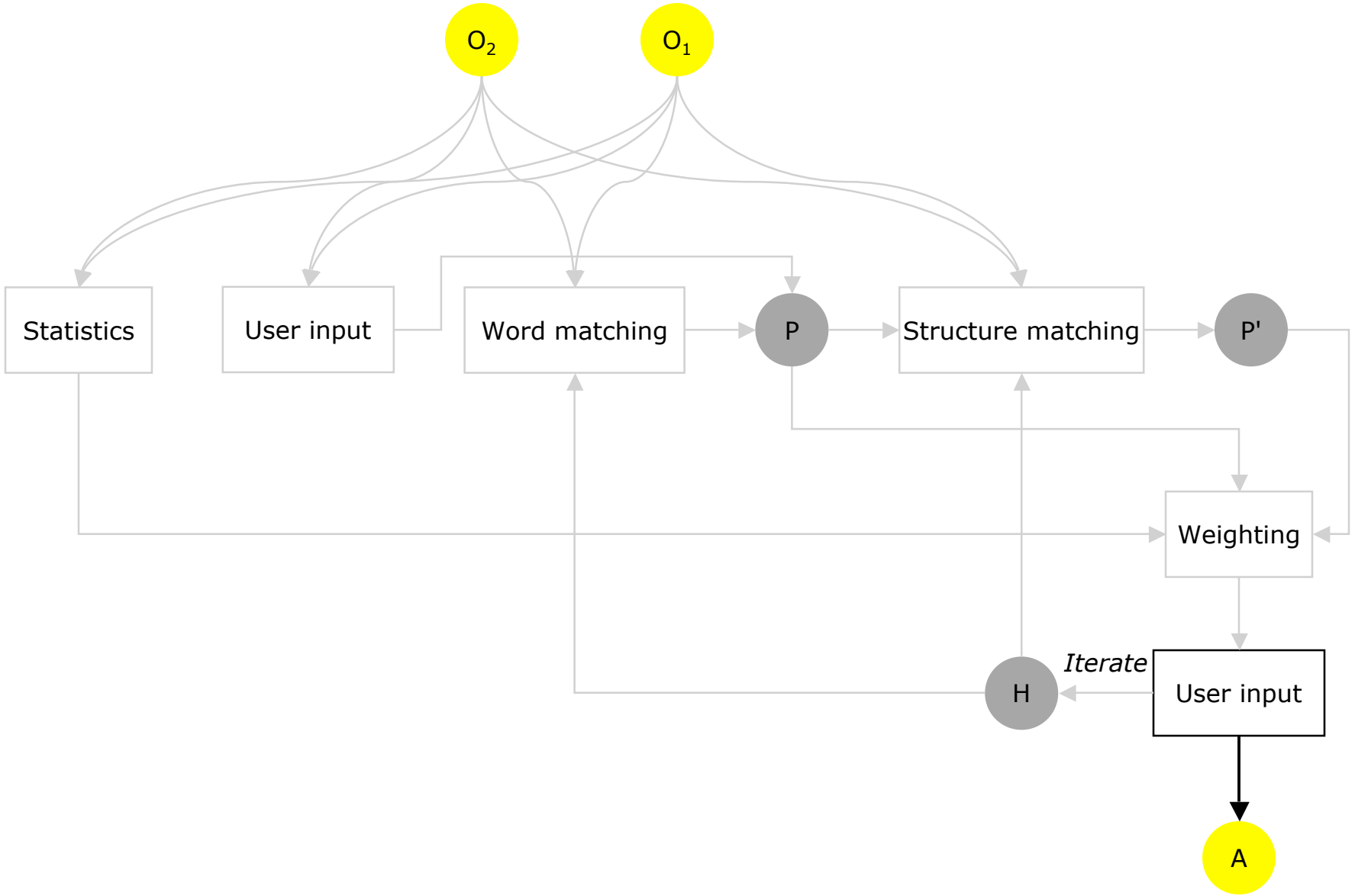
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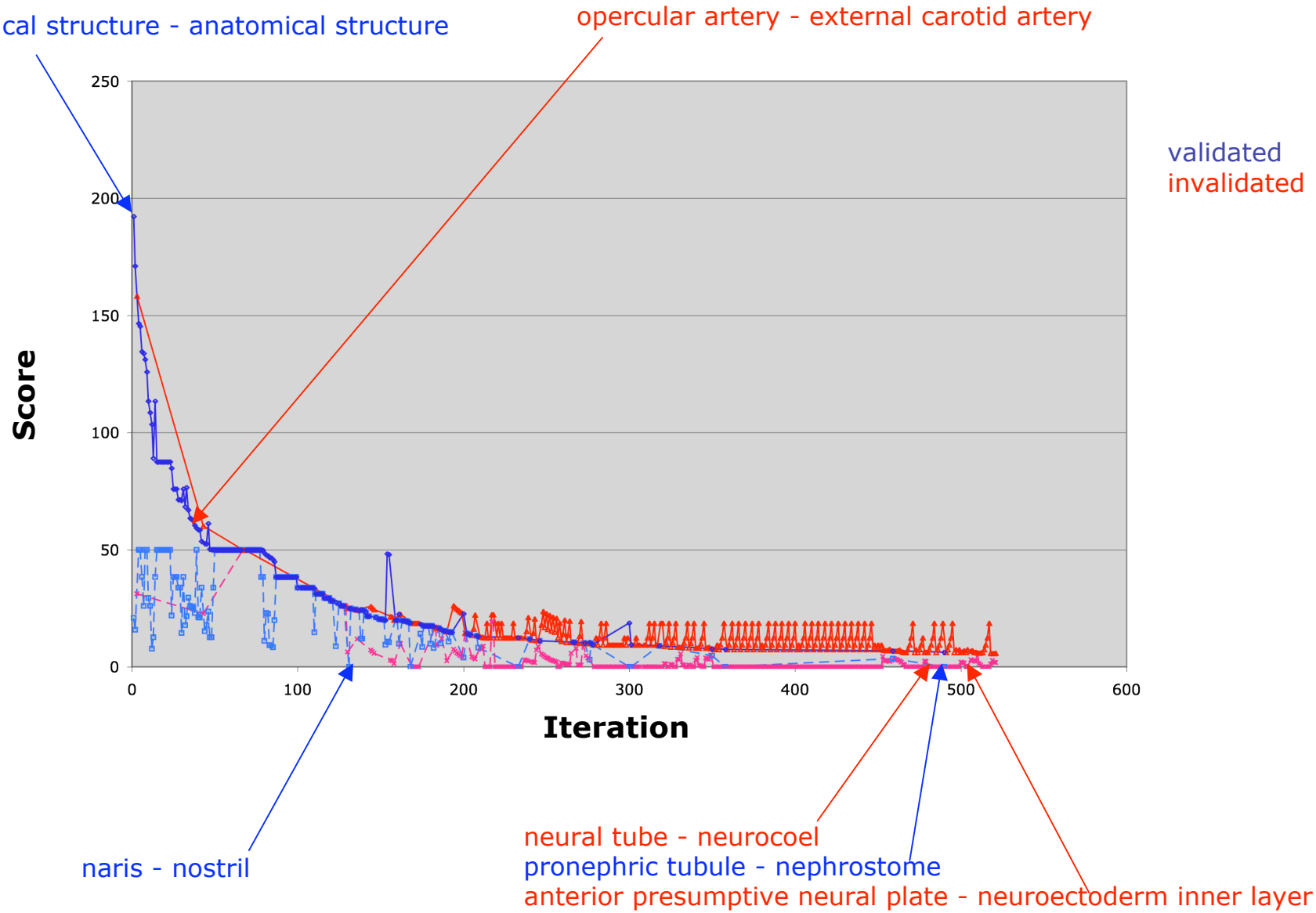
Test case: Xenopus-zebrafish ontologies



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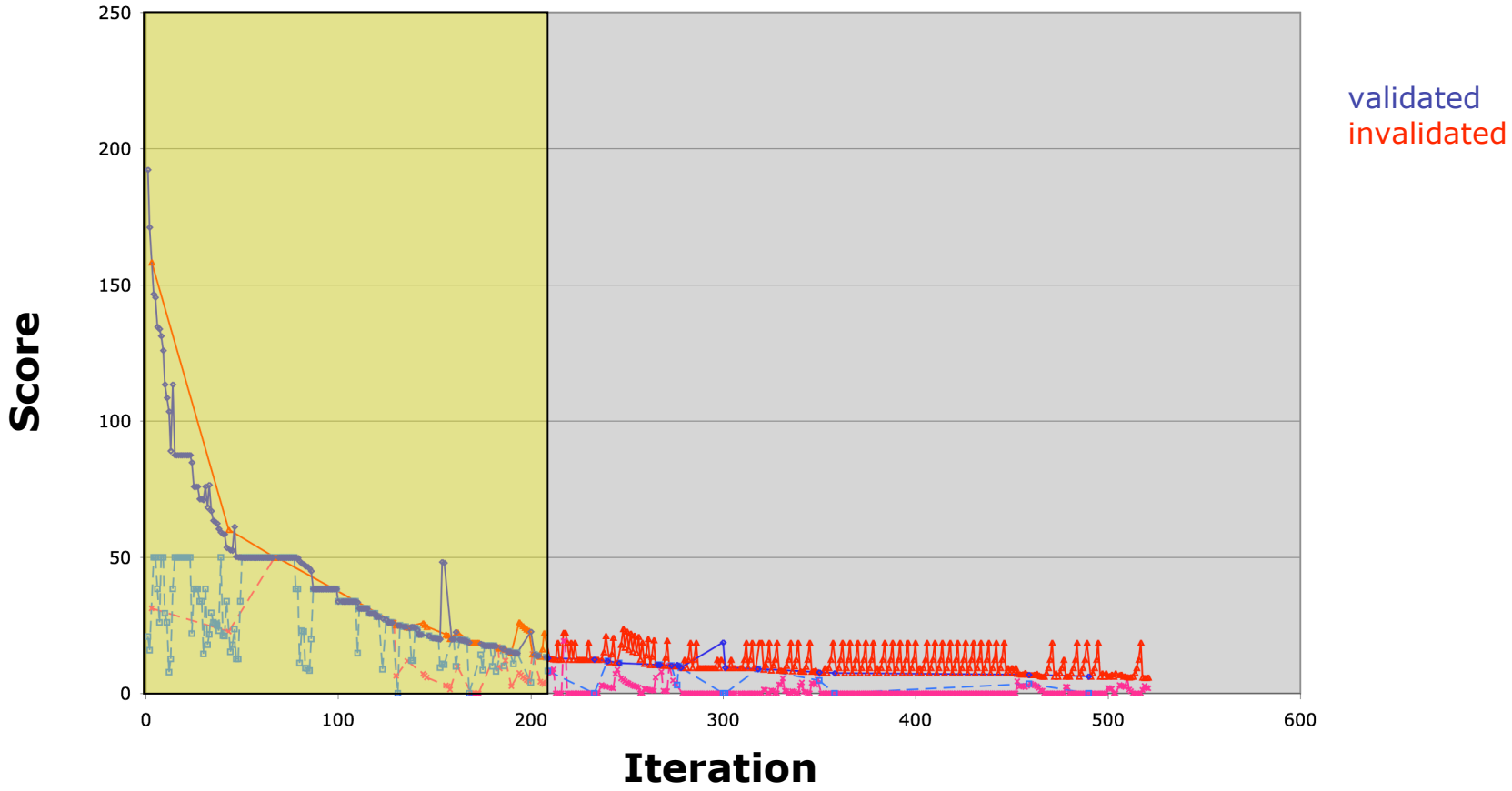
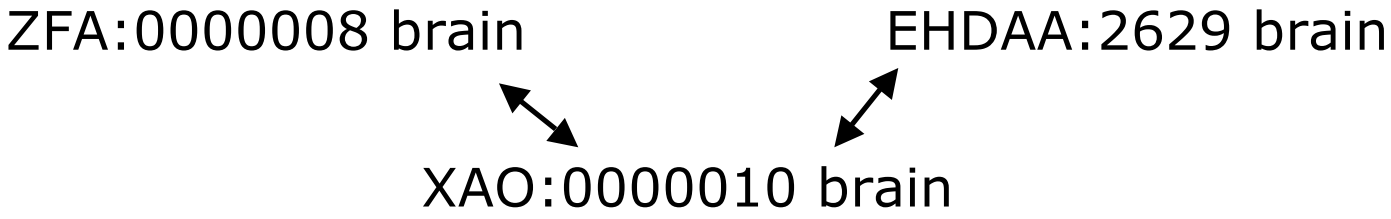
213 first pairs: 80% validated - contains 91% of homologs validated



Generating a multi-species ontology

-Homolonto: generates pairwise relationships between ontologies



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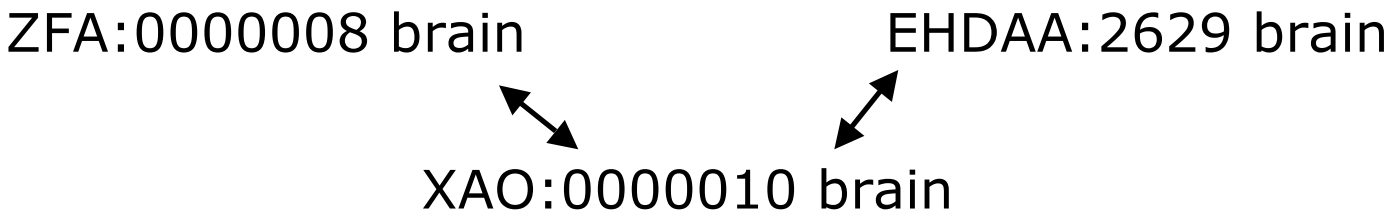

-Merging pairwise alignments: generates groups of homologs

HOG:0000157 brain

ZFA:0000008

XAO:0000010

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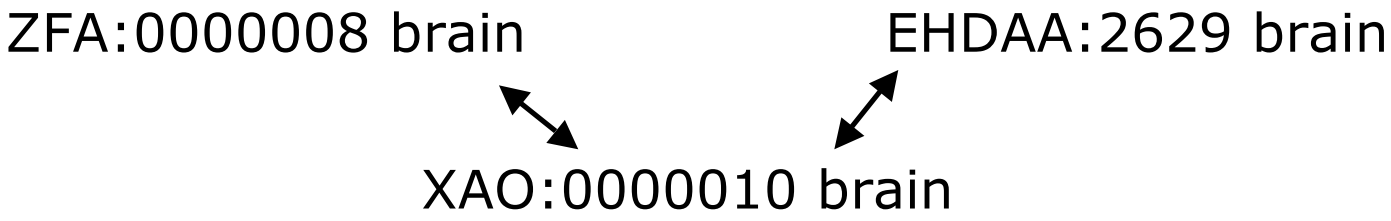

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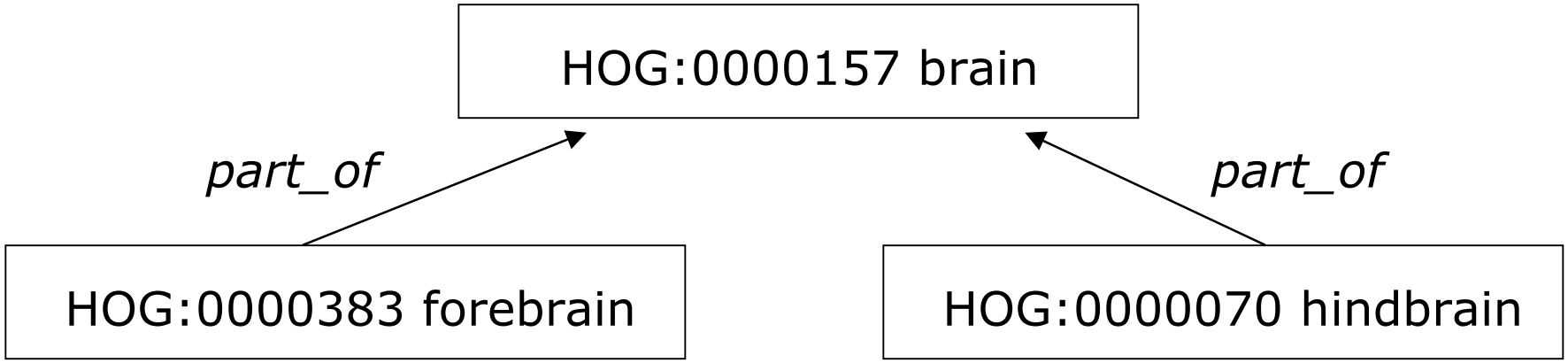
=>List of Homologous Organs Groups (HOGs)

Generating a multi-species ontology

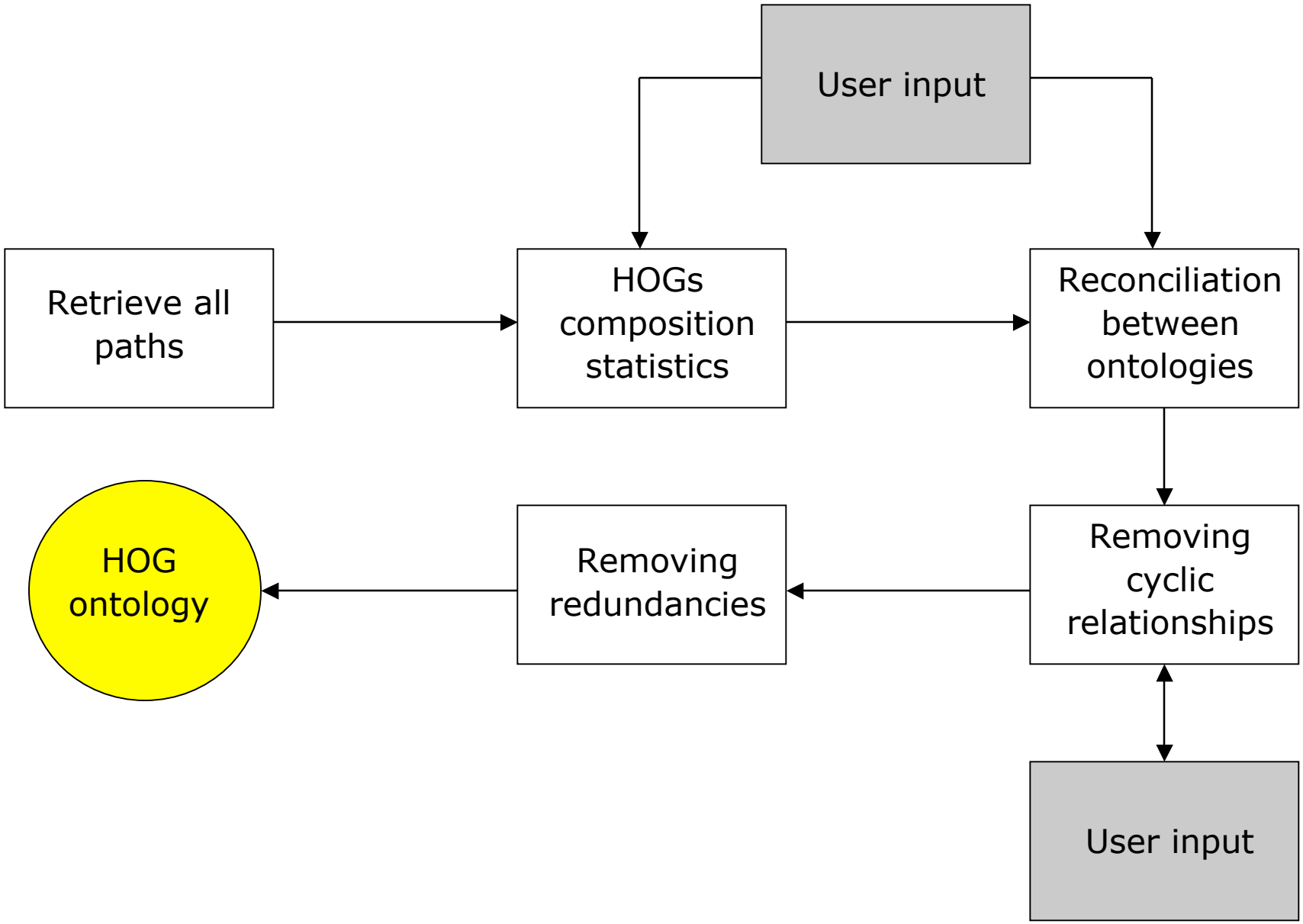
-HOGs need to be structured as an ontology to allow reasoning

-At a minimum, relationships amongst them have to be designed



=>Algorithm to infer relationships between HOGs

Inferring relationships amongst HOGs



Results

Use of Homolonto, followed by a curation process:

-4 species: human, mouse, zebrafish, Xenopus

-6 ontologies: ZFA, EHDAA, EV, EMAPA, MA, XAO

HOG ontology in OBO:

-1241 HOGs, 311 with description, 400 with synonyms

-1595 relations, 367 *part_of,* 12 *is_a*

External Mapping file:

-involving 5314 anatomical structures

-all manually reviewed, providing evidence codes and references

Conclusion

The HOG ontology has been successfully implemented into Bgee

http://bgee.unil.ch

Application examples:

- Decrypthon: searching for genes involved in muscle dysfunctions
- CRESCENDO: nuclear receptors function throughout development

- Developmental Constraints on Vertebrate Genome Evolution (J. Roux, 2008, PLoS Genet)
- Tissue expression complementarity after duplication

Perspective

Cross-species mapping: need for a representation formalism:

-Mapping of species-specific structures to a common ontology?

-What about mappings not based on homology (e.g. analogy)?

Acknowledgements

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SIB

CRESCENDO