# COMP318

## Ontologies and Semantic Web


# Ontology Alignment - Part 2

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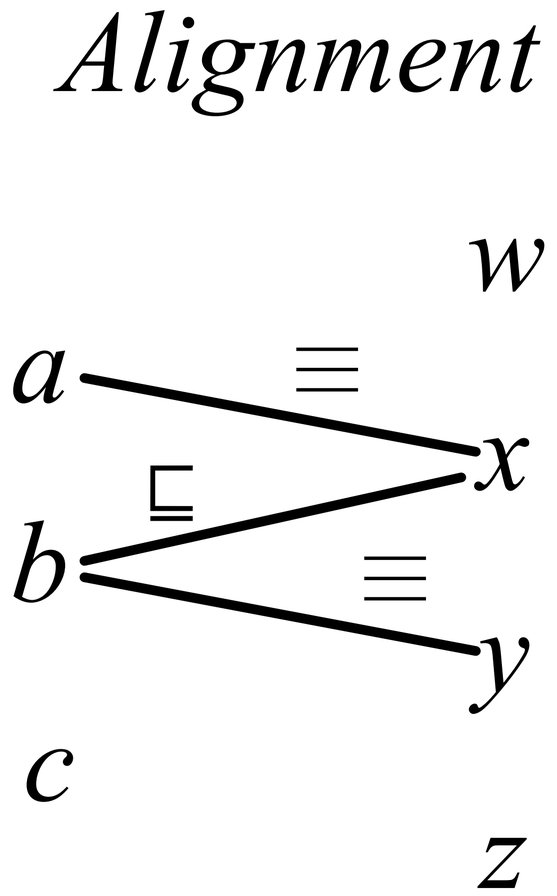
# Aligning ontologies

- Ontology alignment or mapping:
  - The process of determining relationships or correspondences between two or more entities in two or more independent ontologies
  - Use ontologies together by defining a set of “links” (mappings or correspondences)
    - Mappings can be of limited types, i.e. only certain logical relations
- Advantages:
  - Benefit from knowledge encoded in the other ontologies models
  - Enable access from different agents/services and across different collections
  - Partial by nature, does not need to cover the entire ontology

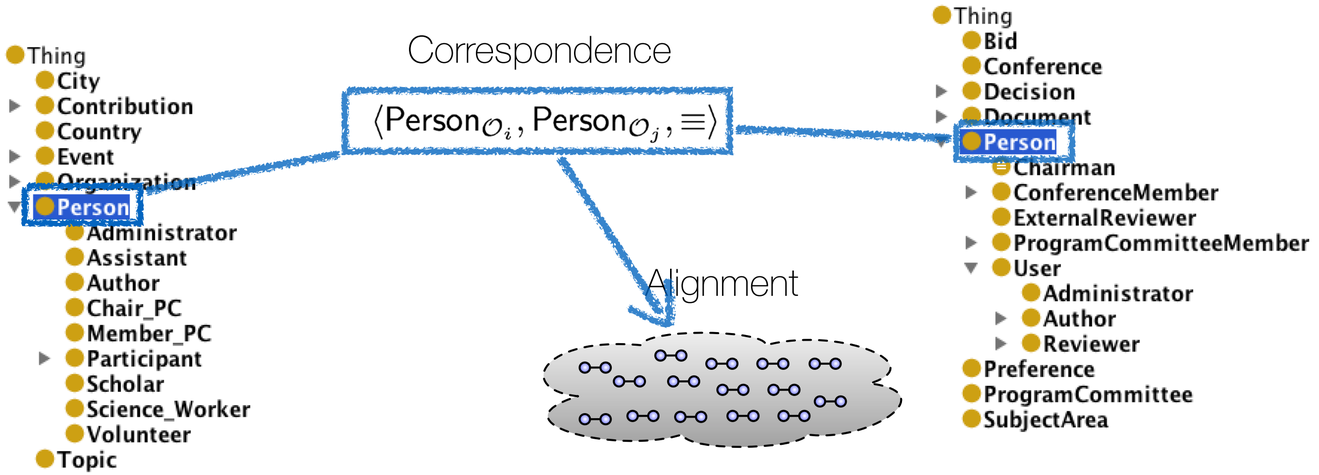


# Ontology alignment: terminology

- Knowledge graph alignment is a type of ontology alignment or ontology matching.
- To match or align or map: the process that produces an alignment or mapping.
- An alignment or mapping set: the final output of matching or aligning.
- A mapping or match: an individual link between related entities (cross reference)

# Atomic ontology alignment

- *Given two ontologies $O$ and $O'$, an alignment $\mathcal{A}$ is the set of correspondences c between the entities $e \in O$ and $e' \in O'$*
  - *A correspondence c is the tuple* c = <e, e', r, w>
    - $e \in O$ and $e' \in O'$, where e and e' can be classes, properties, individuals
    - r = {≡, ⊑, ⊥} and w ∈ [0,…, 1] is the weight



# Types of correspondence relation between classes/ properties

| | OWL | Example |
|---|---|---|
| ≡<br>Equivalence | `owl:EquivalentClass` | O:Person ≡ O':Person |
| ⊑<br>Subclass | `rdfs:subClassOf`<br>`rdfs:subPropertyOf` | O:Assistant ⊑ O':User |
| ⊥<br>Disjointness | `owl:disjointWith`,<br>`owl:allDisjointClasses` | O:Topic ⊥ O':Person |

# Types of correspondence relation between classes/ properties

| | OWL | Example |
|---|---|---|
| = Equivalence | `owl:sameAs` | O:Florence = O':Firenze |
| ≠ Difference | `owl:differentFrom` | O:John ≠ O':Ringo |
| ∈ Instance | `rdf:type` | O:Beatles ∈ O':MusicGroup |

# Ontology alignment motivation

- An application domain can be modelled with different points of view and purposes
- Ontologies with different naming and modelling conventions exist for the same domain
- Aligning these ontologies will enable interoperability between ontology-based information systems and data migration
- Reusing vocabulary from domain ontologies is a good practice in ontology engineering

**The Architect**

*When modelling a bridge, important characteristics include:*

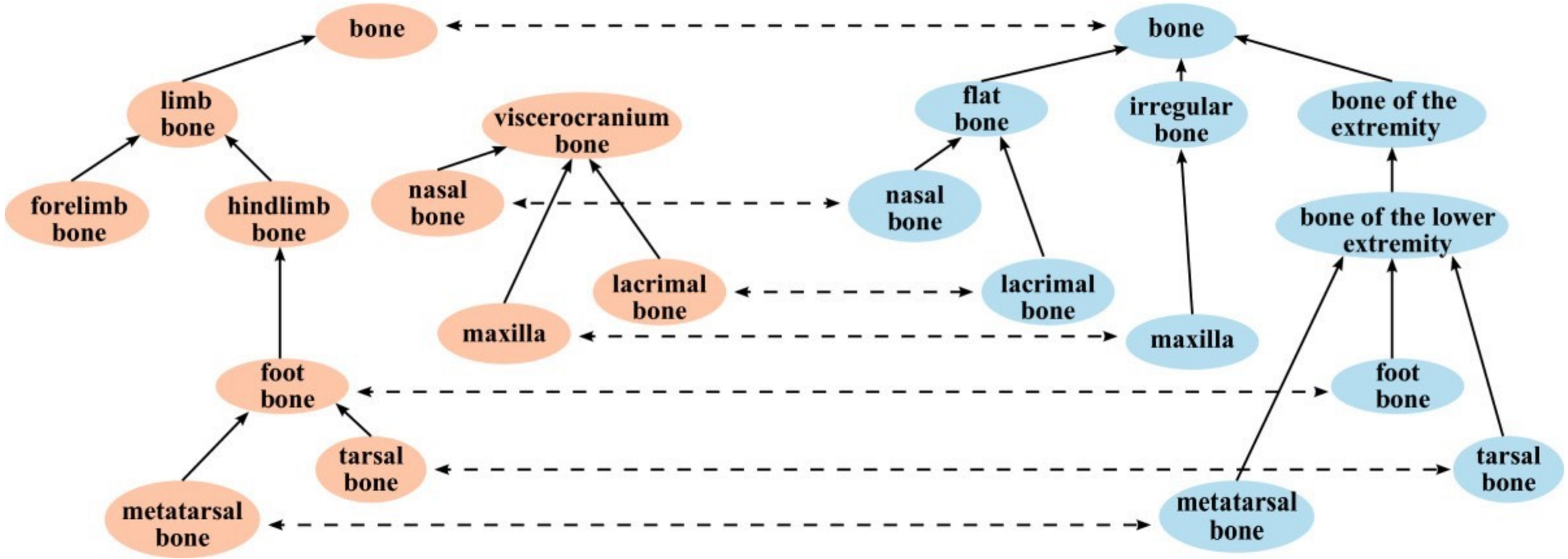
*tensile strength*
*weight*
*load*
*etc*

**The Military**

*When modelling a bridge, important characteristics include:*

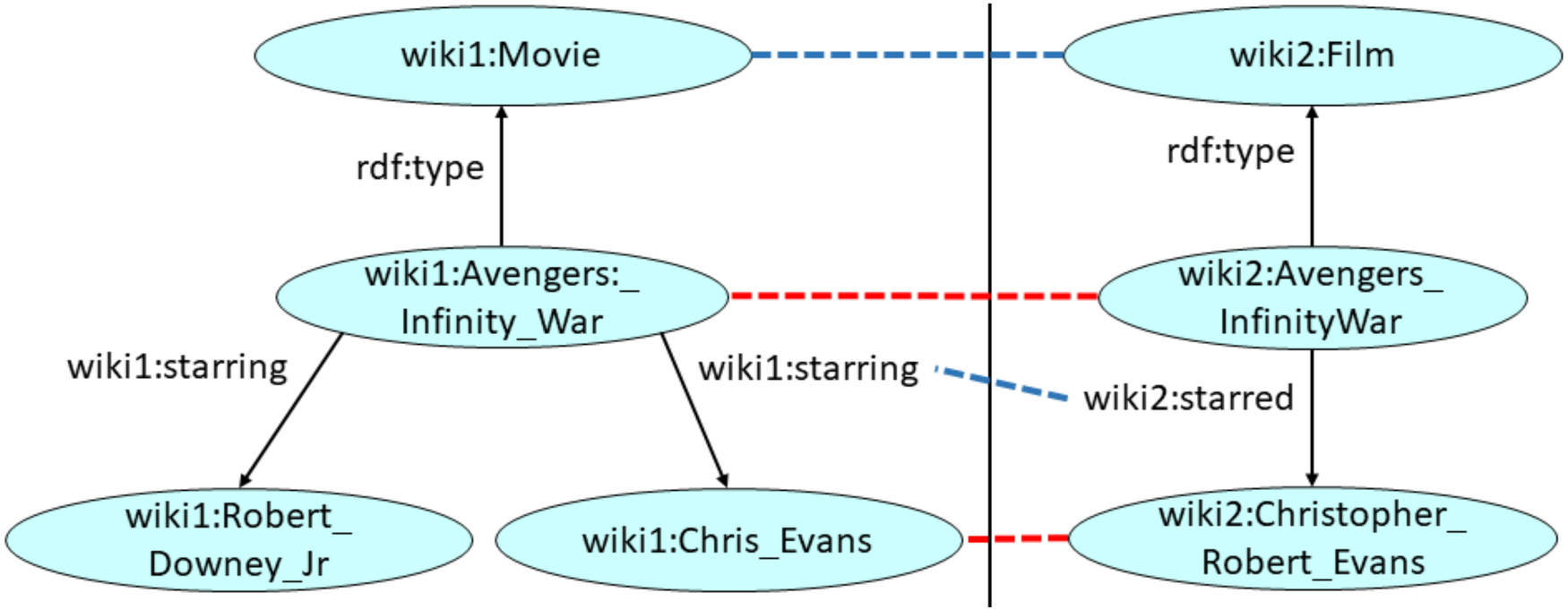
*what munitions are required to destroy it!*

# Ontology alignment



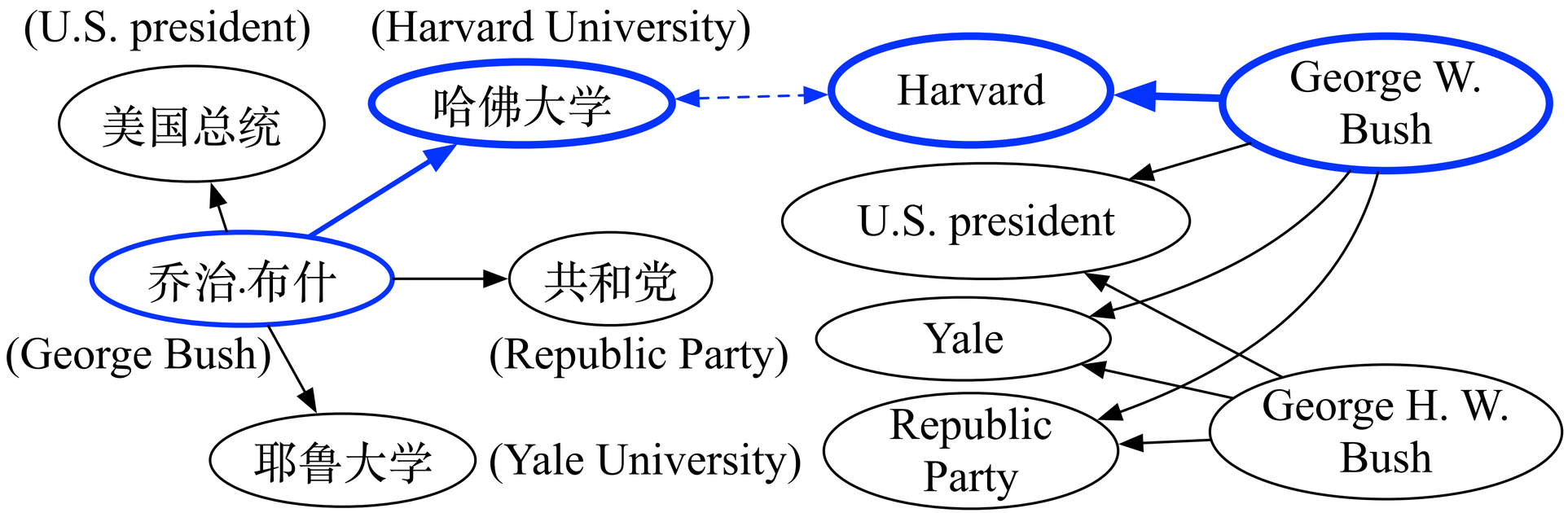

P. Lambrix and V. Ivanova. A unified approach for debugging is-a structure and mappings in networked taxonomies. Journal of Biomedical Semantics 2013

# Knowledge Graph Alignment




S. Hertling and H Paulheim. The Knowledge Graph Track at OAEI: Gold Standards, Baselines, and the Golden Hammer Bias. ESWC 2020.

# Knowledge Graph Cross Lingual Alignment




K. Xu, L. Song, Y. Feng, Y. Song, D. Yu. Coordinated Reasoning for Cross-Lingual Knowledge Graph Alignment. AAAI 2020

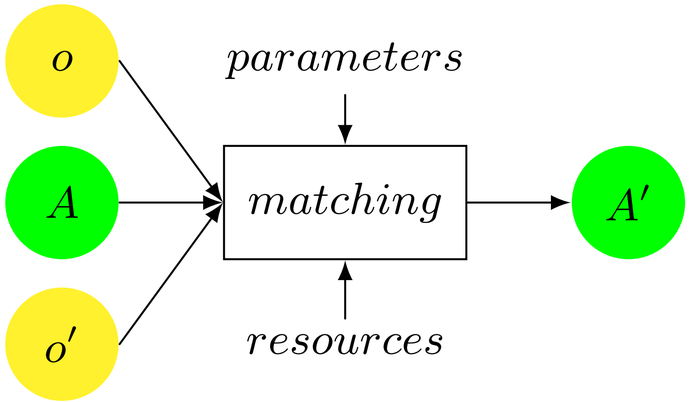
# Alignment approaches

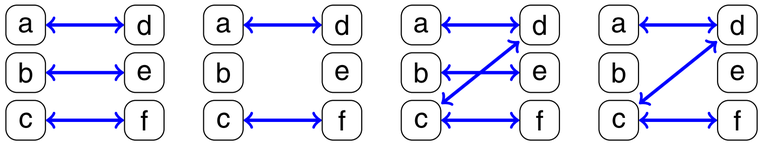
- Different alignment approach are available depending on
  - the expressivity of the two ontologies O and O’
  - The availability of additional inputs to the matching process:
    - Oracles, input alignment and external resources, i.e. Wordnet or BabelNet
  - The entities to match:
    - Only the T-box or schema, i.e. classes and possibly properties
    - Instances

- The majority of current ontology alignment systems align classes, and restrict the relationships to equivalence

# Ontology alignment and the matching process

- Alignments are generated through *a matching process*, a function *f*
  - Input: two ontologies *O and O', and an optional input alignment* $A_{input}$ , *set of parameters par, oracles and resources res*
  - Output: an alignment *A' between O and O'*
    - *A' = f(O, O', $A_{input}$, par, res)*
    - Set of possible correspondences, with the relationships between entities of O and O'
      - Different multiplicities possible



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# End Ontology Alignment - Part 2

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