Pattern Comparison of *is-a* Concepts for Ontology Localisation

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Context

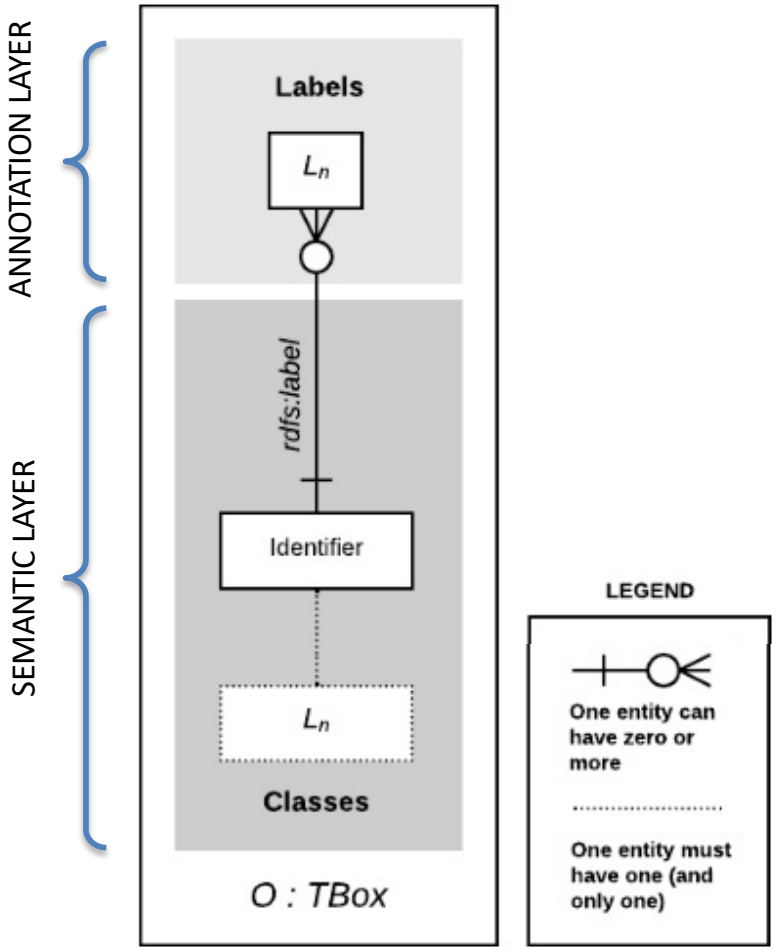
Within an OWL ontology:

- There is a commitment to a conceptualisation by its logical language, using some natural language (L_1) for each concept name, property name, and other axioms
- When making the ontology multilingual for another natural language (L_2), L_2-specific labels are added to each concept and property name
- The underlying axioms remain unchanged, and it is assumed there is a 1-1 mapping from L_1 to L_2
- **L_2 is only a translation**

Ontology localisation

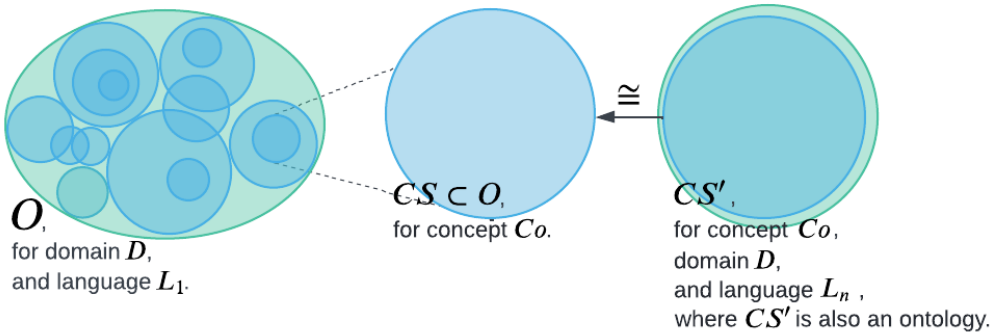
The "*process of* ***adapting a given ontology*** *to the needs of a* ***certain community****, which can be characterized by a* ***common language****, a* ***common culture*** *or a certain* ***geopolitical environment****.*" [1]

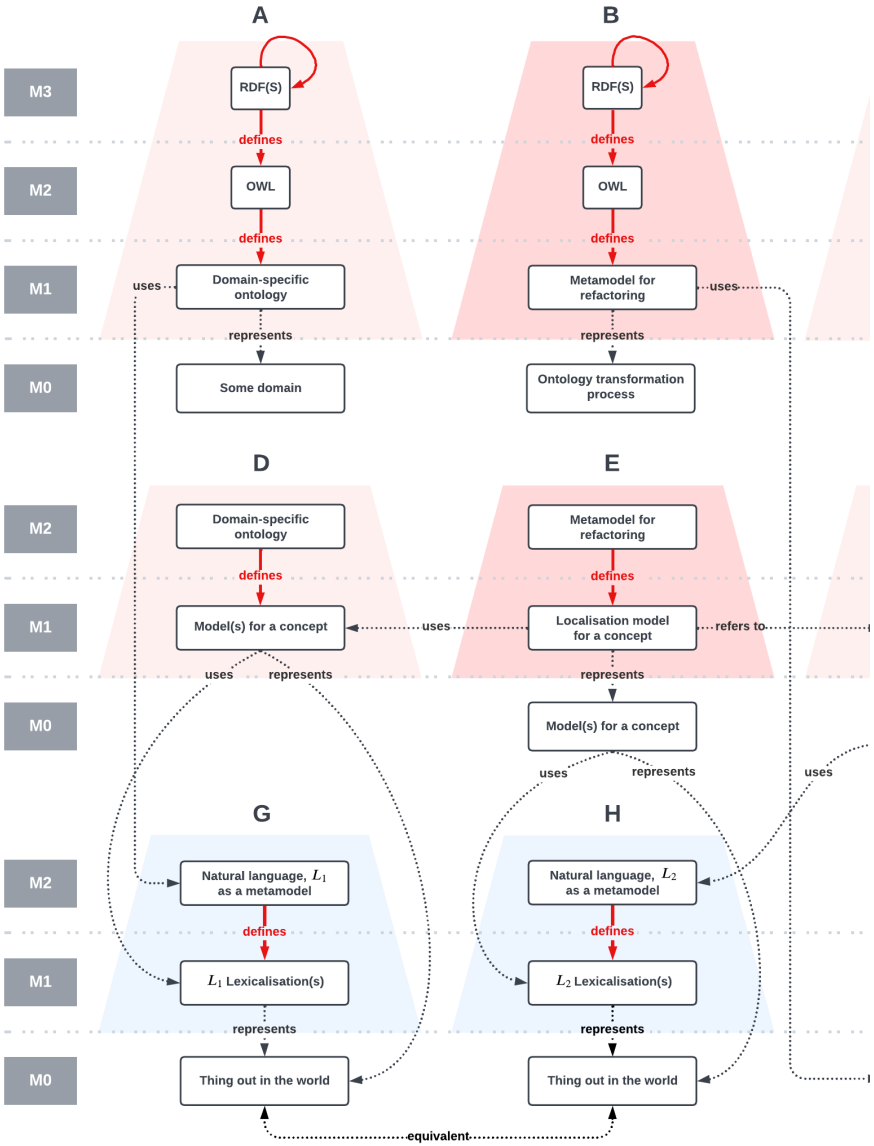
- Adaptation is typically done in the annotation layer
- The underlying axioms remain unchanged



[1] P. Cimiano, E. Montiel-Ponsoda, P. Buitelaar, M. Espinoza Mejía, A. Gomez-Perez, A note on ontology localization, Applied Ontology, 5 (2) (2010) 127—-137. doi:10.3233/AO-2010-0075.

Localisation approach





Types of concepts for a language pair

1. A concept which has a lexical realisation for the natural languages used for both the source and target language.

2. A concept which has a lexical realisation in the source language; in the target language, there is no lexical realisation however the concept is known.

3. Similar to (2), except that the concept is not known in the target language.

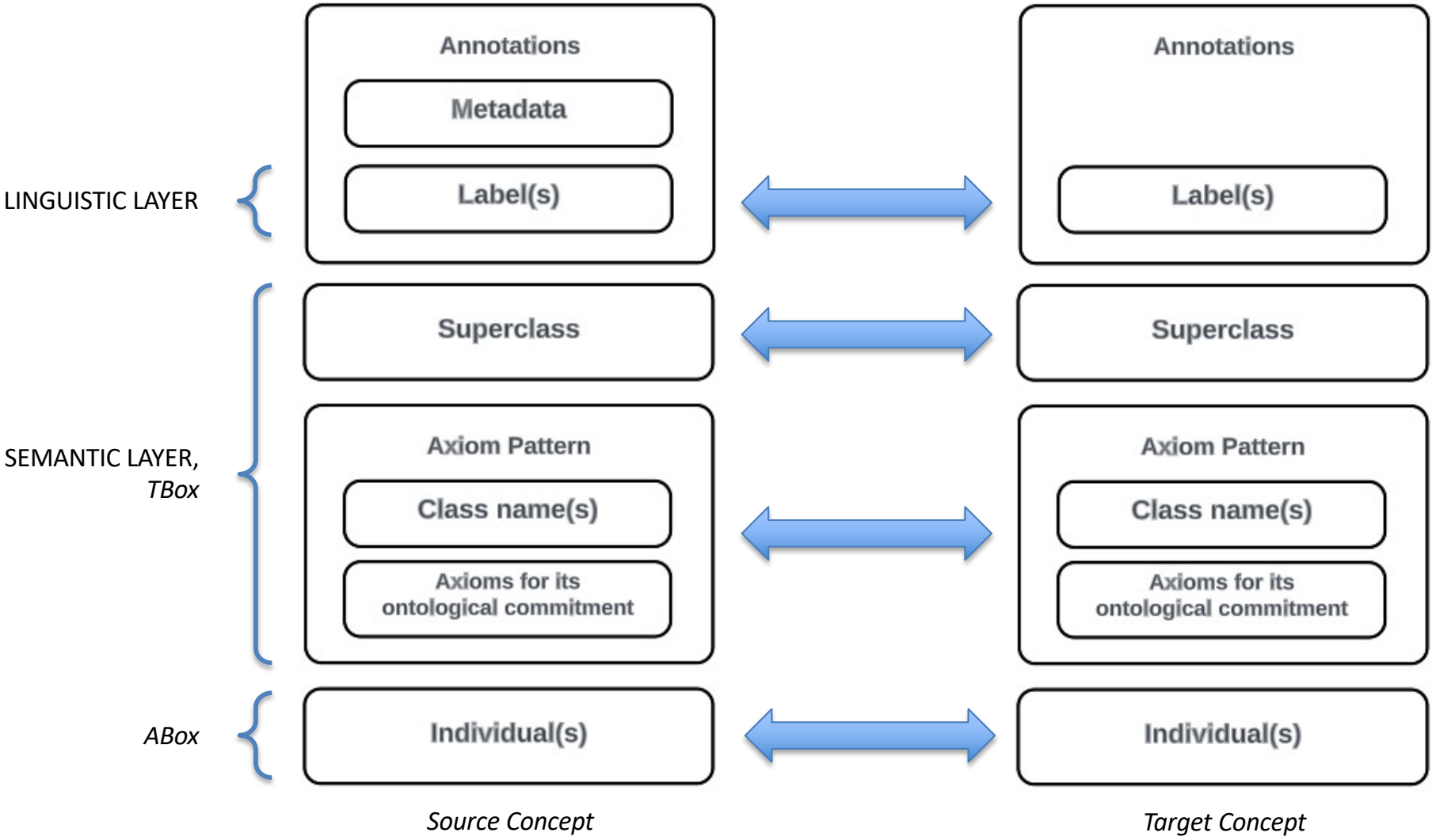
4. For both the source and target language, the concept is known, however neither have a lexical realisation. The concept is known in a third language

For 2-4, this is known as a lexical gap.

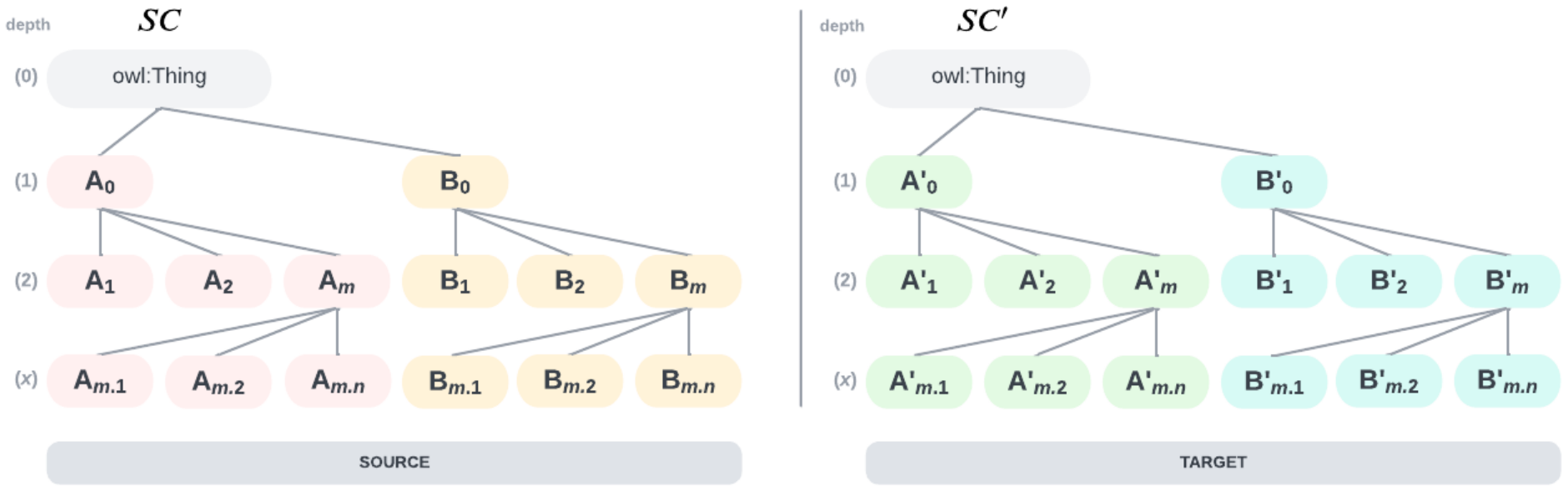
Language examples as use cases

	Source	Target	
UC1	traffic light (en)	robot (en-sa)	Equivalent
UC2	spoon (en)	lepel (af)	Meaning is the same, except that neither share the same hypernym. “Spoon” is a utensil, while “lepel” is a tool.
UC3	river (en)	rivière, fleuve (fr)	Granularity mismatch – French is more specific to that of English.
UC4	city, town, village, hamlet (en)	ville, village, bourg, bourgade, hameau (fr)	Granularity mismatch as well

Concepts in OWL

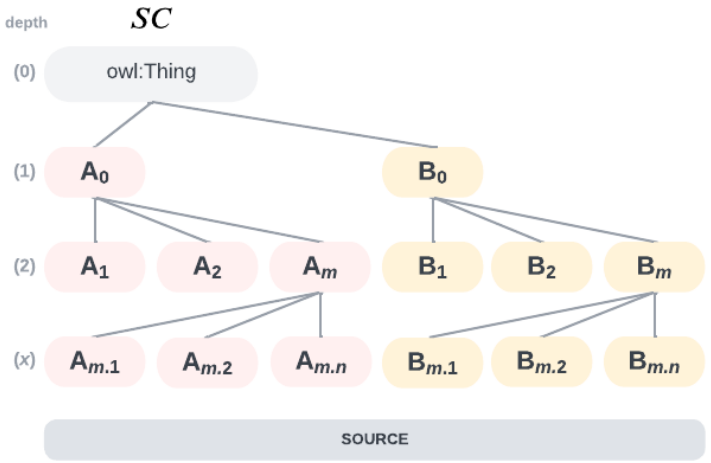


Abstraction of a superclass



	Source		Target		Source		Target
SC1	A_m	→	A'_m	**SC2**	`owl : Thing`	→	`owl : Thing`
SC3	A_1	→	A'_m	**SC4**	A_m	→	A'_0
SC5	A_0	→	B'_0	**SC6**	A_1	→	B'_m
SC7	A_1	→	B'_0	**SC8**	A_0	→	`owl : Thing`

Superclass patterns



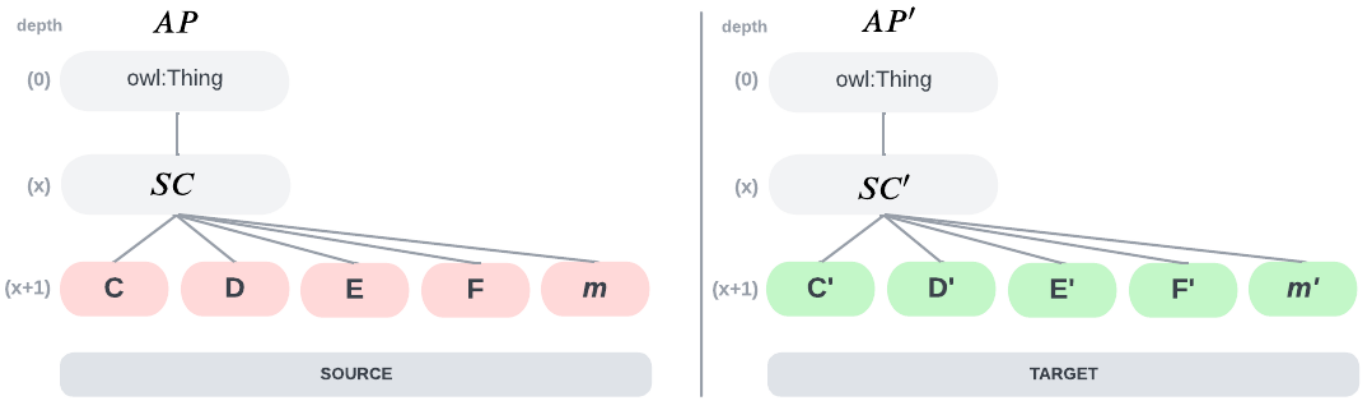
- **P-SC1:** Equal source and target superclass
- **P-SC2:** Unequal source and target superclass at same depth, and shared parent
- **P-SC3:** Unequal source and target superclass at different depth, and shared parent
- **P-SC4:** Unequal source and target superclass, and no shared parent
- **P-SC5:** No source and target superclass

Example superclass pattern

P-SC3: Unequal source and target superclass at different depth, and shared parent

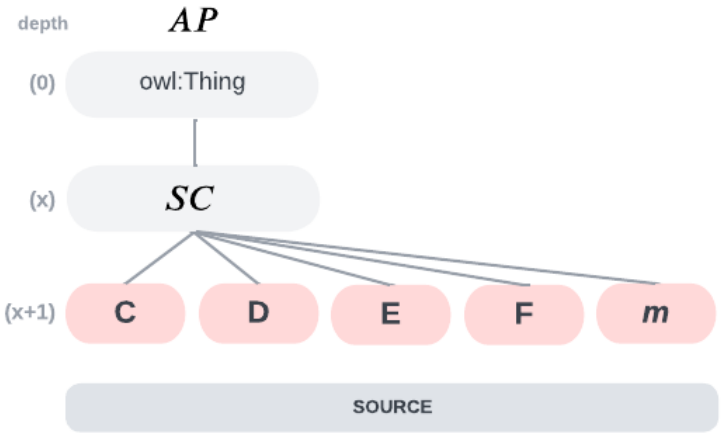
- *alignment pattern name:* sc-unequal-differentDepth-sharedParent
- *pattern element variations:*
  1. $Src = \{A_m\}$, $Trg = \{A'_0\}$, where $m \neq 0$
  2. $Src = \{A_{m.n}\}$, $Trg = \{A'_m\}$, where $m \neq 0$ and $n \geq 1$
  3. $Src = \{A_{m.n}\}$, $Trg = \{A'_0\}$, where $m \neq 0$ and $n \geq 1$
  4. $Src = \{A_{m.n}\}$, $Trg = \{\texttt{owl : Thing}\}$, where $m, n \geq 0$
  5. Same as (1)–(4), but mirrored
- *equality of PE:* $Src \not\equiv Trg$
- *refactoring required:* for the *Src* or Trg with the least depth, this is possibly a lexical gap. Options include:
  1. Add a pseudo-class as a translation of the opposite superclass.
  2. Remove the extra classes, taking care to refactor any subclasses and individuals.

Abstraction of an axiom pattern



	Source		Target		Source		Target
AP1	C	$\rightarrow$	C'	**AP2**	C	$\rightarrow$	D'
AP3	C	$\rightarrow$	$C' \sqcup D'$	**AP4**	C	$\rightarrow$	$D' \sqcup E'$
AP5	$C \sqcup D$	$\rightarrow$	$D' \sqcup E'$	**AP6**	$C \sqcup D$	$\rightarrow$	$E' \sqcup F'$

Axiom patterns



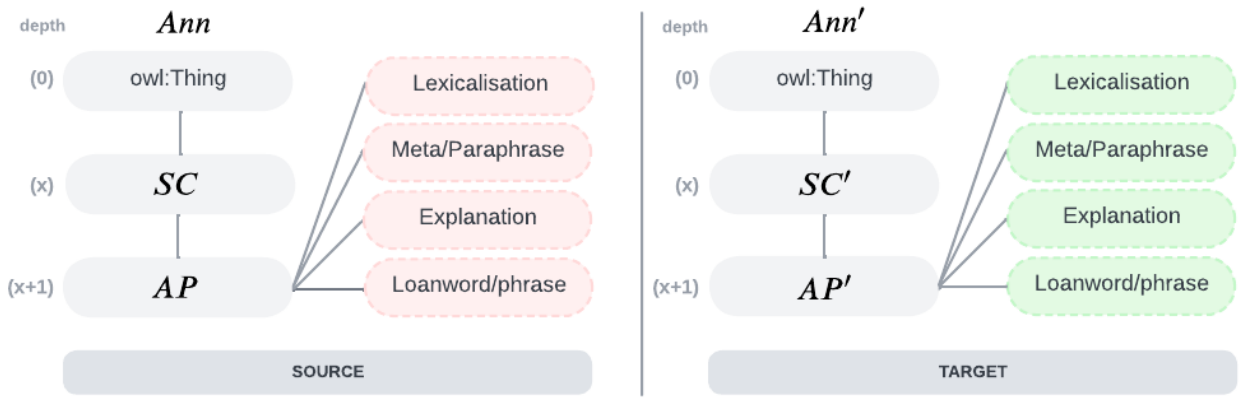
- **P-AP1:** Equal source and target axiom pattern, same superclass
- **P-AP2:** Equal source and target axiom pattern, different superclass
- **P-AP3:** Unequal source and target axiom pattern, some shared classes
- **P-AP4:** Unequal source and target axiom pattern, no shared classes

Example axiom pattern

P-AP1: Equal source and target axiom pattern, same superclass

- *alignment pattern name:* ap-equal-sameSuperclass
- *pattern element variations:*
  1. $Src = \{\circ C\}$, $Trg = \{\circ C'\}$, where $\circ$ is the same for *Src* and *Trg*
  2. $Src = \{\triangledown R_x.C\}$, $Trg = \{\triangledown R_x.C'\}$, where $\triangledown$ and x are each the same for *Src* and *Trg*
  3. $Src = \{C \square D\}$, $Trg = \{C' \square D'\}$, where $\square$ is the same for *Src* and *Trg*
- *superclass pattern variations:* P-SC1, P-SC3
- *equality of PE:* $Src \equiv Trg$
- *refactoring required:* none

Abstraction of an annotation



- **P-Ann1:** Both source and target have a label of similar content
- **P-Ann2:** Both source and target do not have a label
- **P-Ann3:** Both source and target do not have a label of similar content
- **P-Ann4:** Target uses the source label
- **P-Ann5:** Both source and target use a lexicalisation from another language

Example annotation pattern

P-Ann3: Both source and target do not have a label of similar content

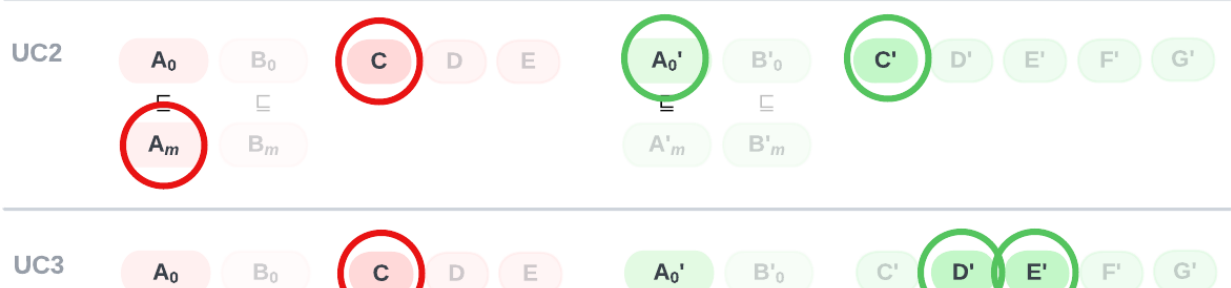
- *alignment pattern name:* ann-unequal-annotation
- *pattern element variations:*
  1. *Src* = lexicalisation, *Trg* = meta/paraphrase
  2. *Src* = lexicalisation, *Trg* = explanation

Language examples revisited

traffic light (en)
robot (en-sa)

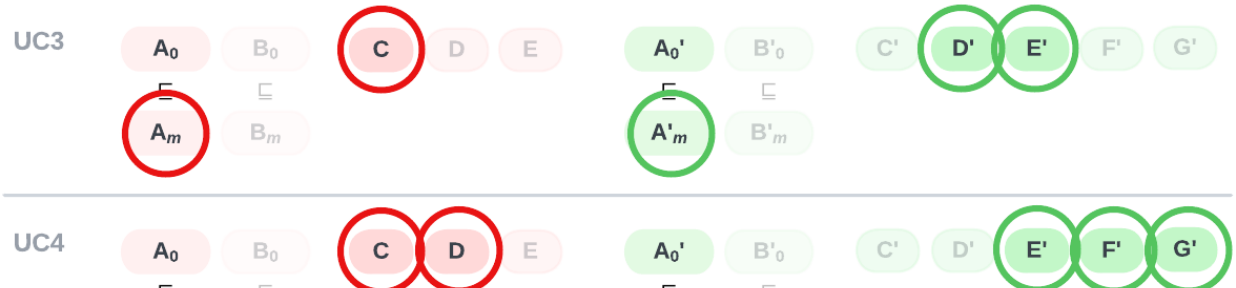
P-AP1 and P-SC1, P-Ann1

spoon (en)
lepel (af)



P-AP2 and P-SC3, P-Ann1

river (en)
rivière, fleuve (fr)



P-AP-4 and P-SC1, P-Ann1

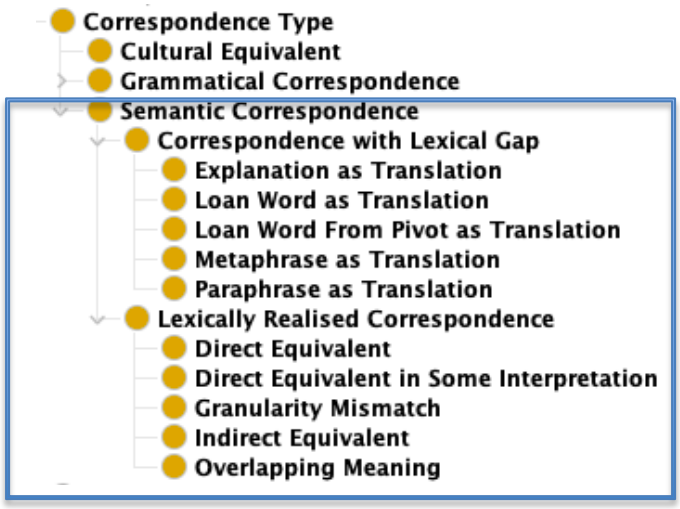
city, town, village, hamlet (en)
ville, village, bourg, bourgade, hameau (fr)

AP-3 and P-SC1, P-Ann1

Ontology Localisation

```
1  pcs:cs_uc2   a :PairedConceptSpace ;
2               :targetViewpoint vp:AFViewpoint ;
3               :sourceConcept ont:Spoon ;
4               :targetConcept micro:UC2 ;
5               :semanticCategory :IndirectEquivalent ;
6               :hasPattern :P-AP2 , :P-SC3 , :P-Ann1 ;
7               :hasProcess pcs:cs_uc2_action1 .
8
9  pcs:cs_uc2_action1 a :RefactorAction , :ChangeSuperclassOfTarget ;
10              :targetNode micro/UC2:Spoon ;
11              :targetSuperclass ont:Utensil .
```

RDF to localise a concept from a source to a target language, region or other viewpoint



F. Gillis-Webber, Refinement of the Classification of Translations: Extension of the vartrans Module in OntoLex-Lemon, in: Proceedings of the 4th Conference on Language, Data and Knowledge (LDK 2023), 12–15 September, Vienna, Austria, 2023.

Thank You!