Ontology Links in the Distributed Ontology Language (DOL)

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2012-04-24
DOL is the **Distributed Ontology Language** being standardized in the course of the OntolOp (**Ontology Integration and Interoperability**) activity (ISO Working Draft 17347).

A distributed ontology consists of

- **basic ontologies**
  - in a single ontology language and a single logic
  - multiple basic ontologies possibly in different languages/logics

- **links** between basic ontologies:
  - **logical links**: so far interpretations (a.k.a. views), module relations, and imports; have a formal semantics
  - **alignments**: informal semantics
Logical Links (I): Interpretations

**interpretation i**: 

\[
\text{logic } \log:\text{OWLtoCommonLogic}, \\
\text{foaf:Person } \mapsto \text{people:HumanBeing}
\]

- Interprets the FOAF OWL ontology in terms of a Common Logic ontology about people
- ... after a logic translation and renaming entities
- Not shown here: Entities with same local name implicitly mapped to each other (where they exist), e.g. `foaf:Agent` to `people:Agent`; entity map needs to cover all entities of the source ontology
- Note: `prefix:name` syntax abbreviates IRIs, e.g. 
  `http://xmlns.com/foaf/0.1/Agent`. 
Interpretation Example: V-Alignment

\[\{\text{Woman, River\_Bank, Financial\_Bank, Human\_Being}\} \vdash \{\text{Woman, Bank, Person}\} \vdash \{\text{Woman, Bank, Human}\}\]

**interpretation** \(\sigma_1 : \Sigma \text{ to } O_1\)

**interpretation** \(\sigma_2 : \Sigma \text{ to } O_2\) with Person \(\mapsto\) Human

**ontology** A = combine \(O_1 \cup O_2\)

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DOL supports **extraction of modules** from an ontology (given a **restriction signature**), ...  

... but also the **declaration** that one ontology is a module of another one (creates a proof obligation).

Suppose *foafPeople* is an ontology that declares *foaf:Person*, *foaf:knows* and all axioms known about them in the original FOAF ontology; then we can write:

```
module m : foafPeople of foaf: for foaf:Person, foaf:knows
```
(Informal) Alignments

- An (informal) alignment is a set of **correspondences** between entities of a source ontology and a target ontology.
- Each correspondence has a relation and a confidence measure $0 \leq c \leq 1$
  - default relation: (non-logical) equivalence
  - further relations from the Alignment API (some are OWL-specific): subsumption, instance of, incompatibility
  - arbitrary other relations possible (in DOL: any IRI; in the Alignment API: any Java class name)
DOL Syntax for Alignments (I)

- DOL largely reuses the syntax of the Alignment API
  (http://alignapi.gforge.inria.fr/format.html)
- Some examples in DOL Text syntax follow; DOL RDF and DOL
  XML (under development) will be similar.

Empty alignment:

alignment a : 01 to 02

First pair of entities equivalent, second and third one “similar” (with
custom relation, third one with custom confidence instead of default
1); assuming $O_1$ with signature \{a, b, c\} and $O_2$ with signature
\{x, y, z\}

\[\text{alignment } a \, 11 \, : \, 01 \, \text{to} \, 02 \, \%\% \, 11 = \text{Align. API syntax for bijective}\]
\[a = x, \quad \%\% = \text{is a relation defined by the Alignment API}\]
\[b \, \text{my:similarTo} \, y, \, \%\%(\text{correspond-b-to-y})\%\,, \quad \%\% \, \text{naming it ...}\]
\[c \, \text{my:similarTo} \, 0.75 \, z \quad \%\% \, \text{for later reference or annotation}\]
DOL Syntax for Alignments (II)

- DOL uses an extensible registry of logics, ontology languages, logic and ontology language translations, etc.
- All of these are identified by IRIs and accessible as linked open data (try e.g. http://purl.net/dol/logics/SROIQ)
- Correspondence relations also part of the registry: “=” expands into http://purl.net/dol/relations/Equivalent, which we declare equivalent to (via owl:sameAs) java: fr.inrialpes.exmo.align.impl.rel.EquivRelation from the Alignment API.
- No need to expand the fixed number ($4 \times 4$) of alignment types into registry IRIs – except when using DOL RDF syntax.
Shorthands when multiple correspondences share the same relation and confidence; different way of writing previous example:

```
alignment a 11 : 01 to 02 =
  relation foo:similarTo 0.75 {
    %
    unless stated otherwise, this holds for all correspond’s.
    a = x,
    b  ⇝ 1 y, % using default relation
    c  ⇝ z % using default relation and confidence
  }
```
Suppose we had larger signatures (e.g. 
\( \exists \text{http://O1} - \text{namespace/Concept} \in \Sigma(O_1), \text{http://O2} - \text{namespace/Concept} \)): shorthand for applying default correspondence to all entities with the same local names:

```
alignment a 11 : O1 to O2 =
  relation foo:similarTo 0.75 {
    a \mapsto x,
    b \mapsto y,
    c \mapsto z,
    * \%\% maps Concept \mapsto Concept
  }
```