Formal ontologies vs. triple based KR gap or convergence?

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DL Ontologies (OWL-DL)
- formal axioms
- universal truths
- set semantics
- clear commitment
- Tbox-Abox partition
- instance-level rels
- "in-built" DL reasoning
- "Top down"
- "something goes'

SPO-Triples (RDF)
- informal graphs
- assertions (any)
- shallow semantics
- unclear commitm.
- puns
- unrestricted rels
- Reasoning by hand crafted rules
- "Bottom up" "anything goes"

- RDF(S) syntax (not obligatory)
- restriction to binary relations

… bridging the gap?

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(OWL-DL)**

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Equivalences RDF - OWL?

- English: "Trondheim is part of Norway"
  RDF: <Trondheim; part-of; Norway>
  OWL: **Trondheim part-of Norway**

- English: "The thumb is part of the hand"
  RDF: <Thumb; part-of; Hand>
  OWL: *Thumb* subClassOf **part-of** some *Hand*

- If **has-part** is inverse of **part-of**:
  RDF: < **Norway**; **has-part**; **Trondheim** >
  OWL: **Norway has-part Trondheim**
  RDF: *<Hand; has-part; Thumb>*
  OWL: *Hand* subClassOf **has-part** some *Thumb*

Equivalences RDF - OWL?

- English: "Aspirin treats headache"
  RDF: < *Aspirin*; *treats*; *Headache*>
  OWL: ???

- Ambiguity 1:
  "aspirin molecule" or "portion of aspirin"

- Ambiguity 2:
  "every aspirin treats some headache" ?
  "every headache is treated by some aspirin" ?
  "every aspirin has the potentiality to treat headache"?
  "the relation 'treats' obtains only between the types
   'aspirin' and 'headache' ?

Basic problem

- RDF has a very weak formal semantics. It facilitates the encoding of statements with (hidden) ambiguities.

- OWL has a strict formal semantics. It does not allow to work around ambiguities. Consequence:
  - Risk of creating wrong axioms such as:
    * *Aspirin* subclassOf **treats** some *Headache*
  - Difficulty of represent the intended meaning in case of default or dispositional statements, e.g.
    Aspirin subclassOf **bearerOf** some
        (*Disposition* and **hasRealization** only
            (*TreatingProcess* and **hasParticipant** some *Headache*))
  - Ontology << Knowledge Representation !!

Enriching expressiveness of Triple Stores?

**Description
Logics
(OWL-DL)**

**SPO-
Triples
(RDF)**
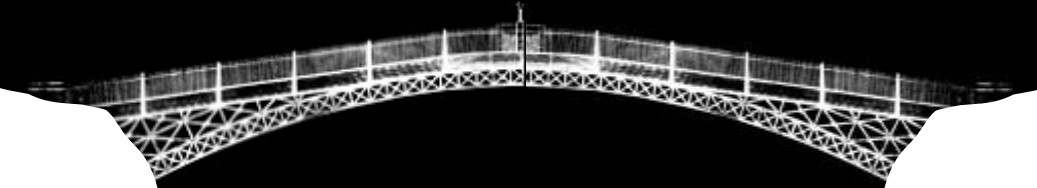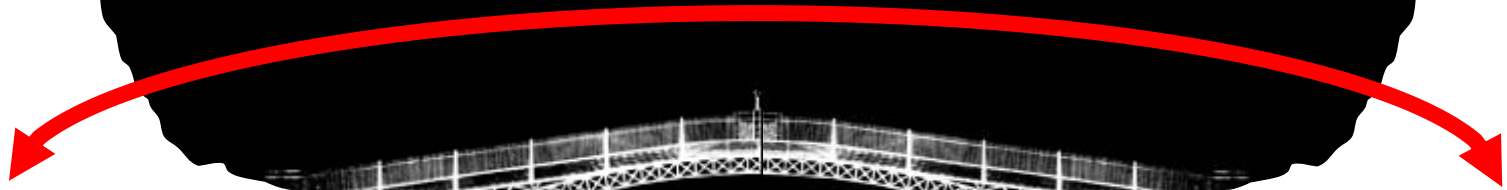
Enriching expressiveness of Triple Stores? Possible strategies

- Test whether an entity is a class or an individual:
  - if *S* or *O* in an rdfs:subclassOf statement -> Class
  - if *O* in a rdf:type statement -> Class
  - if *S* in a rdf:type statement -> Individual
- Make difference between formal relations and material relations:
  - formal relations: typically "all-some" pattern, e.g. part-of
  - material relations: processes, e.g. activates, binds
- Bring quantification inside RDF predicates <*S*; *P*; *O*>
  If *S* and *O* are classes and *P* is a formal relation then:
  <*S* ; P_{AS}; *O*> equivalent to *S* subclassOf *P* some *O*
- Inverse relations only if *S* and *O* are individuals
- If S is and individual then O is an individual (with the exception of P = {an rdfs:subclassOf; rdf:type, …}