Base Revision in Description Logics Preliminary Results

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Outline of Topics

Ontology Dynamics

Knowledge in the web is not static.
Ontologies should be dynamic too.
In this work:

- Description Logics (to represent ontologies)

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- Belief Revision (for ontology dynamics)

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- well defined semantics
- decidable subset of first order logic
- expressive enough for a huge amount of applications
- the formal framework behind OWL-lite and OWL-DL (SHIF and SHOIN)

Belief Revision

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- **Expansion** - adding knowledge (possibly inconsistent)

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Revision usually defined in terms of contraction:
$K * \alpha = (K - \neg\alpha) + \alpha$

AGM Theory

Most influential work in belief revision area.
For contraction and revision:

- **Rationality Postulates**

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Not good for ontologies in practice:

- Deals with logically closed sets (too big)
- Can not be applied to every logic. In particular it can not be applied to SHIF and SHOIN. [Flouris 2006]

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Definition

Kernel set ($B \perp\!\!\!\perp \alpha$): Minimal subsets of B that imply α.
Incision function (σ): Picks at least one element of each kernel.

$$B -_{\sigma} a = B \setminus \sigma(B \perp\!\!\!\perp a)$$

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Can be used for most DLs!

Kernel Belief Base Revision

Revision can be defined as:

- $K * a = K \cup \{a\} - \neg a$ (external revision)
- $K * a = K - \neg a \cup \{a\}$ (internal revision)

Both depend on negation, but many DLs do not allow negation of any sentence.

Kernel Belief Base Revision

Desired properties:

- **(success)** $\alpha \in B * \alpha$
- **(consistency)** $\bot \notin Cn(B * \alpha)$

Not possible to satisfy both!

Belief revision without negation

We have proposed two kinds of revision without negation (with postulates, construction and representation result):

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- Revision with weak consistency (success always satisfied)

The first one seems more intuitive, the second is more AGM-like.

Kernel External Revision without Negation with Weak-Success

Postulates

- **weak-success** If $\perp \notin Cn(\{\alpha\})$, then $\alpha \in B * \alpha$
- **consistency** $\perp \notin Cn(B * \alpha)$
- **inclusion** $B * \alpha \subseteq B \cup \{\alpha\}$
- **core-retainment** If $\beta \in B$ and $\beta \notin B * \alpha$ then there is $B' \subseteq B \cup \{\alpha\}$ and $\perp \notin Cn(B')$, but $\perp \in Cn(B' \cup \{\beta\})$
- **pre-expansion** $(B \cup \{\alpha\}) * \alpha = B * \alpha$

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Construction

If α is consistent then $\alpha \notin \sigma(B \cup \{\alpha\} \perp\!\!\!\perp \alpha)$.

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Construction

α is never in $\sigma(B \cup \{\alpha\} \perp\!\!\!\perp \alpha)$.

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- Proposed two operations that do not depend on negation.
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What we plan to do

- Implement operations.
- Try approaches based on [Schlobach and Cornet, 2003], [Kalyanpur, 2006].
- Use Reiter's algorithm as in [Wassermann 2000].