Extending ASP Based Reasoning to Expressive Constructive Description Logics

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Research interests (KRR)

- Context representation and reasoning
- Defeasibility in description logics
- Constructive semantics for description logics
Constructive description logics
Constructive interpretations of description logics

- **Goal**: develop reasoning tools for Constructive DLs
- **Approach**: use connections to Answer Set Programming (ASP)

→ we want to highlight this line of research and the challenges in its extension to more expressive DLs
Constructive Description Logic $\mathcal{EL}c$

Constructive DL $\mathcal{EL}c$ [Bozzato, 2018]

- Information term (IT) semantics for $\mathcal{EL}$
- Restriction of $\mathcal{BCDL}$ [Ferrari et al., 2010]
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**Information terms $\text{IT}_{\mathcal{N}}(K)$ [Miglioli et al., 1989]**
Structured objects that **constructively justify the truth** of a formula $K$

**Realizability $\mathcal{M} \triangleright \langle \alpha \rangle K$**
Truth of $K$ in a model $\mathcal{M}$ **justified** w.r.t. $\alpha$
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Truth of $K$ in a model $\mathcal{M}$ justified w.r.t. $\alpha$

E.g.: Truth of $\exists R.C(a)$ in $\mathcal{M}$ justified by IT $(b, \alpha)$ s.t.
- $\mathcal{M} \models R(a, b)$ and
- $\alpha$ justifies truth of $C(b)$
Task

Compute information terms of input KB $\Gamma$ in $\mathcal{EL}$

Idea

Use relations across IT and Answer Sets semantics

[Fiorentini and Ornaghi, 2007] on propositional nested expressions

→ We extend these results to $\mathcal{EL}_c$ formulas

Result (sketch) [Bozzato, 2018]

The (minimal) information terms for a set $\Gamma$ of $\mathcal{EL}$ formulas can be obtained by computing the answer sets of input formulas in $\Gamma$
ASP translations

**ASP based generation of IT** [Bozzato, 2018]

- **Model generating rewriting** ($P_1$)
  Generates interpretations for input $\mathcal{EL}$ formulas (fixed roles assertions)

- **Model generating rewriting** ($P_{1}^f$)
  Generates interpretations for input $\mathcal{EL}$ formulas (with existential fillers)

- **IT generating rewriting** ($P_2$)
  Retrieves IT as complex terms, using definition of ITs

**Asp-it prototype**

ASP based IT generator for OWL EL ontologies

https://github.com/dkmfbk/asp-it
Current challenges:

- Semantic extension to expressive DL operators
- ASP translation extension to expressive DLs
- Further reasoning tasks: manipulation of ITs
- Implementation and application to real use cases

Extension to $\mathcal{EL}_\perp$ [Bozzato and Fiorentini, 2020]

- Constructive DL $\mathcal{ELc}_\perp$: IT semantics for $\mathcal{EL}_\perp$
- Formal relation between ASP and IT semantics in $\mathcal{ELc}_\perp$
ASP based generation of information terms for constructive $\mathcal{EL}$.

Reasoning on information term semantics with ASP for constructive $\mathcal{EL}_\bot$.

BTC$\mathcal{DL}$: basic constructive description logic.

Answer set semantics vs. information term semantics.

A constructivism based on classical truth.