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

Summary

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 $\mathsf{IT}_{\mathcal{N}}(K)$ [Miglioli et al., 1989]

Structured objects that constructively justify the truth of a formula K

Realizability $\mathcal{M} \rhd \langle \alpha \rangle K$

Truth of K in a model $\mathcal{M}$ justified w.r.t. α

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E.g.: Truth of $\exists R.C(a)$ in $\mathcal{M}$ justified by IT (b, α) s.t.

- $\mathcal{M} \models R(a,b)$ and
- α justifies truth of $C(b)$

IT and Answer Set semantics

Task

Compute information terms of input KB Γ 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 Γ of $\mathcal{EL}$ formulas can be obtained by computing the answer sets of input formulas in Γ

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`

Discussion

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 $\mathcal{EL}_\bot$ [Bozzato and Fiorentini, 2020]

- Constructive DL $\mathcal{EL}c_\bot$: IT semantics for $\mathcal{EL}_\bot$
- Formal relation between ASP and IT semantics in $\mathcal{EL}c_\bot$

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