Knowledge Compilation for Description Logics

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Idea of Knowledge Compilation

KB

Queries

Expensive Calculations

Answers
Idea of Knowledge Compilation

Precompiled KB

Expensive Calculations

Queries

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Linkless Formulas in Propositional Logic

A formula $F$ in NNF is called linkless, iff for each conjunction $a \land b$ in $F$ holds:

There is no atom $c$ with $c \in \text{literals}(a)$ and $\neg c \in \text{literals}(b)$. 
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$$(a \lor e) \land c \land (d \lor a)$$ is linkless
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$(a \lor e) \land c \land (d \lor \neg a)$ is not linkless
Transfer the Idea to DL

• Normal form for concept descriptions that allows an efficient consistency check:
  
  -- DL-linkless concept descriptions

  -- Two different kinds of links:
    • concept links
    • role links
Concept Links

• Definition is similar to the definition of a link in propositional logic.

• Example:

\[ B \sqcap (D \sqcup \neg B) \]

contains a concept link
Role Links

- Definition is slightly more complicated (will be given on my poster).
Role Links

• Example: the following concept contains a role link

\[ ((\text{Poor} \sqcap \exists \text{hasCat}.\text{Smelly}) \sqcup \text{Rich}) \sqcap \]
\[ (\forall \text{hasCat}.(\neg \text{Smelly} \sqcap \neg \text{Black}) \sqcup \text{Lonely}) \]
Role Links

• Example: the following concept contains a role link

\[((Poor \square \exists has\text{Cat.} Smelly) \sqcap Rich) \square
(\forall has\text{Cat.}.(\neg Smelly \square \neg Black) \sqcup Lonely)\]
Role Links

• Example: the following concept contains a role link

\[(\forall\text{hasCat}.(\neg\text{Smelly} \sqcap \neg\text{Black}) \sqcup \text{Lonely}) \sqcap ((\text{Poor} \sqcap \exists\text{hasCat}.\text{Smelly}) \sqcup \text{Rich}) \sqcap (\text{Lonely} \sqcap \text{Poor} \sqcap \exists\text{hasCat}.\text{Smelly})\]
My Poster

• Definition of a dl-linkless concept description

• Benefits of dl-linkless concept descriptions

• How to transform a concept description into a dl-linkless concept description