TECHNISCHE UNIVERSITÄT DRESDEN

Computational Logic ∴ Group

Dr. Hannes Strass M.A. Jonas Karge

Knowledge Representation and Reasoning

Winter 2024 Term

Exercises 7

06–10/01/2025

Problem 1.
Consider the Datalog$^\neg$ knowledge base containing a single fact $\mathcal{F} = \{P(a, b)\}$ and a singleton set of rules $\mathcal{R}$ consisting of the following rule:

$$P(x, y) \wedge \neg Q(y) \rightarrow Q(x)$$

Write down a stable model of $\mathcal{K} = \langle \mathcal{R}, \mathcal{F} \rangle$.

Problem 2.
Consider the propositional Datalog$^\neg$ knowledge base containing a single fact $\mathcal{F} = \{\mathsf{Lion}\}$ and the following rules $\mathcal{R}$:

$$\begin{aligned}
\mathsf{Mammal} &\rightarrow \mathsf{Warm_Blooded} \\
\mathsf{Mammal} \wedge \neg\mathsf{Live_Sea} &\rightarrow \mathsf{Live_Land} \\
\mathsf{Mammal} \wedge \neg\mathsf{Male} &\rightarrow \mathsf{Female} \\
\mathsf{Mammal} \wedge \neg\mathsf{Female} &\rightarrow \mathsf{Male} \\
\mathsf{Dolphin} &\rightarrow \mathsf{Mammal} \\
\mathsf{Dolphin} &\rightarrow \mathsf{Live_Sea} \\
\mathsf{Lion} &\rightarrow \mathsf{Mammal}
\end{aligned}$$

Consider the following interpretations, where we indicate explicitly which atoms are true in the interpretation (the remaining ones are false):

$$\begin{aligned}
\mathcal{I}_1 &= \{\mathsf{Lion}, \mathsf{Mammal}, \mathsf{Warm_Blooded}, \mathsf{Live_Land}, \mathsf{Female}\} \\
\mathcal{I}_2 &= \{\mathsf{Lion}, \mathsf{Mammal}, \mathsf{Warm_Blooded}, \mathsf{Live_Land}, \mathsf{Male}\}
\end{aligned}$$

and answer the following questions:

1. Compute the reducts of $\mathcal{K} = \langle \mathcal{R}, \mathcal{F} \rangle$ by $\mathcal{I}_1$ and $\mathcal{I}_2$.
2. Show that $\mathcal{I}_1$ and $\mathcal{I}_2$ are stable models of $\mathcal{K}$.
3. Knowing that $\mathcal{I}_1$ and $\mathcal{I}_2$ are the only stable models of $\mathcal{K}$, show that $\mathsf{Live\_Land}$ is a logical consequence of $\mathcal{K}$. Is Female a logical consequence of $\mathcal{K}$?

Problem 3.
Express the default "I like Chinese food, unless it is spicy" using a propositional Datalog$^\neg$ rule. Use the propositions ChineseFood, Spicy and Like. Given the set of facts $\mathcal{F} = \{\mathsf{ChineseFood}\}$, can I deduce the atom Likes using stable model semantics? What if $\mathcal{F} = \{\mathsf{ChineseFood}, \mathsf{Spicy}\}$? And what if $\mathcal{F} = \emptyset$?

Express the default statement "A friend of a friend is also my friend, unless they are a bully" using a Datalog$^\neg$ rule and the predicates $\mathsf{friendOf}(x, y)$ and $\mathsf{Bully}(x)$. If we know that Peter is a friend of Mary and Mary is my friend, can we infer that Peter is my friend under stable model semantics?