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Knowledge Representation and Reasoning

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Exercises 7

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Problem 1.

Consider the Datalog[¬] 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[¬] knowledge base containing a single fact $\mathcal{F} = \{\text{Lion}\}$ and the following rules \mathcal{R} :

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

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

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

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 `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[¬] rule. Use the propositions ChineseFood, Spicy and Like. Given the set of facts $\mathcal{F} = \{\text{ChineseFood}\}$, can I deduce the atom Likes using stable model semantics? What if $\mathcal{F} = \{\text{ChineseFood}, \text{Spicy}\}$? 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[¬] rule and the predicates friendOf(x, y) and 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?