

# Foundations of Knowledge Representation

## Nonmonotonic Reasoning - Problems 2

**Problem 1.** Consider the Datalog<sup>⊃</sup> 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<sup>⊃</sup> 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  $\text{Live\_Land}$  is a logical consequence of  $\mathcal{K}$ . Is  $\text{Female}$  a logical consequence of  $\mathcal{K}$  ?

**Problem 3.** Express the default “I like Chinese food, unless it is spicy” using a propositional Datalog<sup>¬</sup> 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  $\mathcal{F} = \emptyset$ ?