

CS4600 - Introduction to Intelligent Systems

Homework 3 - Sample Solution

Write the following sentences in first-order logic using these literals: Has(Joe,x), Dog(x), Cat(x), Cute(x), Scary(x).

a) Joe has a cute dog.

$$\exists x (\text{Has}(\text{Joe},x) \wedge \text{Dog}(x) \wedge \text{Cute}(x))$$

b) All of Joe's dogs are cute.

$$\forall x ((\text{Has}(\text{Joe},x) \wedge \text{Dog}(x)) \Rightarrow \text{Cute}(x))$$

c) Unless Joe has a dog, he is scary.

$$(\sim \exists x (\text{Has}(\text{Joe},x) \wedge \text{Dog}(x))) \Rightarrow \text{Scary}(\text{Joe})$$

d) Either Joe has at least one cat and at least one dog or he is scary (but not both at the same time).

$$\exists x,y (\text{Has}(\text{Joe},x) \wedge \text{Has}(\text{Joe},y) \wedge \text{Dog}(x) \wedge \text{Cat}(y)) \Leftrightarrow \sim \text{Scary}(\text{Joe})$$

e) Not all dogs are both scary and cute.

$$\sim \forall x (\text{Dog}(x) \Rightarrow (\text{Scary}(x) \wedge \text{Cute}(x)))$$