

INST0072 Logic and Knowledge Representation: Exercise Sheet 4

INST0072 Exercise Sheet 4 - Question 1

Using the domain of discourse

$$\mathbb{D} = \{\heartsuit, \diamond, \spadesuit\}$$

and signature

$$\langle \{bob, wei\}, \{ \}, \{likes/2, works_with/2, is_clever/1\} \rangle$$

for each of the following sentences give an example of an interpretation that satisfies the sentence and one that does not.

- (a) $works_with(bob, wei)$
- (b) $\forall x \forall y. [works_with(x, y) \leftrightarrow works_with(y, x)]$
- (c) $\forall x \exists y. [works_with(x, y) \wedge \neg likes(x, y)]$.
- (d) $\forall x. [is_clever(x) \rightarrow \exists y. (works_with(y, x) \wedge likes(y, x))]$

[[Example Answer](#)]

INST0072 Exercise Sheet 4 - Question 2

Write a predicate logic sentence that ensures that in all models the domain of discourse contains either exactly one or exactly two objects.

[[Example Answer](#)]

INST0072 Exercise Sheet 4 - Question 3

For each of the following sentences write down (i) a semantically equivalent sentence that contains no “ \forall ” quantifiers and no “ \rightarrow ” or “ \leftarrow ” connectives, and (ii) a semantically equivalent sentence that contains no “ \exists ” quantifiers and no “ \wedge ” connectives.

- (a) $\exists x. [baker(x) \wedge \forall y. (customer(y) \rightarrow likes(x, y))]$
- (b) $\forall x. [boss(x) \rightarrow \exists y. (worker(y) \wedge obeys(y, x))]$

[[Example Answer](#)]

Convert the following sentences to prenex normal form.

(a) $\forall y.[(\forall x.\neg bigger_than(x, y)) \rightarrow (\exists x.smaller_than(x, y))]$

(b) $[\exists x \forall y.boss_of(x, y)] \vee \neg \exists y.[office(y) \rightarrow \forall z.works_in(z, y)]$

[[Example Answer](#)]