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7. Exercises for the Course „Logic-based Knowledge Representation“

Exercise 24:

Let $\phi := \forall a_1 \exists a_2\ a_1 \rightarrow a_2$ be a quantified Boolean formula.

(a) Show that ϕ is valid.

(b) Define an $\mathcal{ALC}$-concept C_ϕ such that ϕ is valid if and only if C_ϕ is satisfiable. Apply tableux algorithm to C_ϕ and describe a canonical model for this concept.

Exercise 25:

Consider the following extension of the Description Logic $\mathcal{ALCN}$:

Addition of a new concept constructor $(r \sqsubseteq s)$, where r and s are role names, with the following semantics:

$$(r \sqsubseteq s)^\mathcal{I} = \{a \in \Delta^\mathcal{I} \mid \text{for all } b \in \Delta^\mathcal{I}, (a,b) \in r^\mathcal{I} \text{ implies } (a,b) \in s^\mathcal{I}\}$$

Then do the following:

(a) Devise a new tableau rule for dealing with the above extension of $\mathcal{ALCN}$.

(b) Sketch the modifications that need to be made to the $\mathcal{ALCN}$-ABox consistency algorithm and its soundness, completeness, and termination proofs when adding a new rule for this extension.