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

Exercise 43:

Prove that the following K_n-formulas are theorems:

(a) $[n]([m](p \vee q) \vee \neg[m](p \vee q))$

(b) $[m](p \wedge q) \to [m]q$ and $[m](p \wedge q) \to [m]p$

(c) $[m](p \wedge q) \to ([m]p \wedge [m]q)$

Exercise 44:

Let Δ and Γ be sets of K_n-formulas. Prove or refute the following claims:

(a) if Γ is consistent and $\Delta \subseteq \Gamma$, then Δ is consistent

(b) if Γ is inconsistent and $\Gamma \subseteq \Delta$, then Δ is inconsistent.

(c) Let $\Gamma = \bigcup_{i \geq 0} \Gamma_i$. Then Γ is consistent iff all Γ_i are consistent.

(d) Let $\Gamma = \bigcup_{i \geq 0} \Gamma_i$ and $\Gamma_0 \subseteq \Gamma_1 \subseteq \Gamma_2 \cdots$. Then Γ is consistent iff all Γ_i are consistent.

Exercise 45:

Prove Lemma 7.16 from the lecture:

Lemma 7.16 Let R_m be a reachability relation.

(a) If R_m is symmetric and transitiv, then R_m is euklidian.

(b) The following three conditions are equivalent:

  (i) R_m is symmetric, transitiv, and seriell.

  (ii) R_m is reflexiv and euklidian.

  (iii) R_m is an equivalence relation, i.e., reflexiv, transitiv, and symmetric.

Exercise 46:

Show that the sets of theorems of K_n, $\mathsf{S4}_n$, and $\mathsf{S5}_n$ are recursively enumerable (in other words, partially decidable).