Lehrstuhl für Automatentheorie
Institut für Theoretische Informatik, TU Dresden
Prof. Dr. F. Baader

Nöthnitzer Str. 46
01187 Dresden
Tel.: 0351/463–38237
Tel.: 0351/463–39171

7. Exercises for the Course „Description Logics“

Exercise 31:

Prove that, in $\mathcal{ALCO}$, knowlegde base consistency can be polynomially reduced to satisfiability of concepts w.r.t. TBoxes.

Exercise 32:

Extend the mappings π_x and π_y of $\mathcal{ALC}$-concept descriptions to first-order formulas given in the lecture to $\mathcal{ALCI}$, $\mathcal{ALCQ}$, and $\mathcal{ALCO}$.

Exercise 33:

Reconsider the algorithm for converting an $\mathcal{ALC}$-concept description into negation normal form, which works by exhaustively applying the following rules:

$$
\begin{array}{rclcrcl}
\neg\top & \to & \bot & \qquad & \neg(C \sqcap D) & \to & \neg C \sqcup \neg D \\
\neg\bot & \to & \top & & \neg(C \sqcup D) & \to & \neg C \sqcap \neg D \\
\neg\neg C & \to & C & & \neg\forall r.C & \to & \exists r.\neg C \\
 & & & & \neg\exists r.C & \to & \forall r.\neg C
\end{array}
$$

Prove that the algorithm generates an equivalent concept description, and that it needs only polynomial time.

Exercise 34:

Use the tableau algorithm from the lecture to decide whether the following subsumption holds:

$$\neg\forall r.A \sqcap \forall r.((\forall r.B) \sqcup A) \sqsubseteq \forall r.\neg(\exists r.A) \sqcap \exists r.\exists r.B$$

Exercise 35:

Extend the proof of Lemma 3.4 (local correctness) to the $\sqcap$-rule and the $\forall$-rule.

Exercise 36:

Reconsider the proof of Point 1 of Lemma 3.5 (soundness). Fill in the remaining cases in the inductive proof that $\mathcal{I}_\mathcal{A}$ satisfies every assertion $C(x) \in \mathcal{A}$.