TECHNISCHE UNIVERSITÄT DRESDEN

Faculty of Computer Science Institute of Theoretical Computer Science, Chair of Automata Theory

Description Logics

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Exercise Sheet 12

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Exercise 12.39 Consider the concrete domain $\mathcal{N} := (\Delta^{\mathcal{N}}, \Phi^{\mathcal{N}})$ defined in Section 7.2 of the lecture. Show that $\mathcal{N}$ is admissible.

$$\Delta^{\mathcal{N}} := \mathbb{N}$$
$$\Phi^{\mathcal{N}} := \{=, =_0, +1, \top_{\mathcal{N}}\} \cup \{\text{negations of } =, =_0, +1, \top_{\mathcal{N}}\}$$

Exercise 12.40 Let $\mathcal{D}$ be a concrete domain and $\mathcal{ALC}(\mathcal{D})$ denote the extension of $\mathcal{ALC}$ with the concrete domain $\mathcal{D}$. Show the following statements:

(a) If f is an abstract feature, then $\exists f.C$ is equivalent to $\exists f.\top \sqcap \forall f.C$.

(b) If $\mathcal{D}$ contains only unary predicates, every $\mathcal{ALC}(\mathcal{D})$-concept can be 'emulated' by a corresponding $\mathcal{ALCN}$-concept.

Exercise 12.41 Consider the concrete domain $\mathcal{B}$ where $\Delta^{\mathcal{B}} := \{0,1\}$, and the predicate set is given as

(i) $\Phi^{\mathcal{B}} := \{\bot_{\mathcal{B}}, \top_{\mathcal{B}}, =_0, =_1\}$,

(ii) $\Phi^{\mathcal{B}} := \{\phi(x_1, \ldots, x_n) \mid n \in \mathbb{N} \text{ and } \phi \text{ is a propositional formula over the variables } x_1, \ldots, x_n\}$ such that

$$(\phi(x_1, \ldots, x_n))^{\mathcal{B}} := \{(v_1, \ldots, v_n) \mid v_1, \ldots, v_n \in \{0,1\} \text{ and } \phi[x_1 \mapsto v_1, \ldots, x_n \mapsto v_n] \equiv 1\}.$$

Prove the following claims:

(a) $\mathcal{B}$ is admissible.

(b) Satisfiability of $\mathcal{ALC}(\mathcal{B})$-concepts w.r.t. general TBoxes is EXPTIME-complete.