Formale Baumsprachen

Task 4 (deterministic bu-ta)

Let $\Sigma = \{\sigma^{(2)}, \alpha^{(0)}, \beta^{(0)}\}$. Give deterministic bu-ta $\mathcal{A}_1$ and $\mathcal{A}_2$ such that $L_1 = L(\mathcal{A}_1)$ and $L_2 = L(\mathcal{A}_2)$ where

(a) $L_1 = \{\xi \in T_\Sigma \mid \xi$ contains at least one α and one $\beta\}$ and

(b) $L_2 = \{\xi \in T_\Sigma \mid \xi$ contains an even number of α symbols$\}$.

Task 5 (finite state automata)

Recall the concept of string automata. Let Σ be an alphabet and $\# \notin \Sigma$. We define the ranked alphabet $\Sigma_\# = \Sigma_\#^{(0)} \cup \Sigma_\#^{(1)}$ where $\Sigma_\#^{(0)} = \{\#\}$ and $\Sigma_\#^{(1)} = \Sigma$. Moreover, we define the $\Sigma_\#$-algebra (Σ^*, θ) where $\theta(\#) = \varepsilon$ and $\theta(a)(w) = wa$ for every $a \in \Sigma$ and $w \in \Sigma^*$.

(a) Show that Σ^* is initial in the class of $\Sigma_\#$-algebras.

(b) We consider $\Sigma = \{a, b\}$ and the language $L = \{a^n b^m \mid n, m \in N\}$. Sketch the diagram of a total deterministic finite-state automaton accepting L and model the transition table using a finite $\Sigma_\#$-algebra Q. How can we interpret the uniquely determined homomorphism $h\colon \Sigma^* \to Q$?

(c) Convince yourself that any total deterministic finite-state automaton can be modeled as a quadruple $\mathcal{A} = (Q, \Sigma, \theta, F)$ where (Q, θ) is a finite $\Sigma_\#$-algebra and $F \subseteq Q$. Define the language accepted by $\mathcal{A}$ using the homomorphism $h\colon \Sigma^* \to Q$.

*Task 6 (*bud-Rec$(\Sigma) \subseteq$ Rec(Σ)*)*

Let Σ be a ranked alphabet. In the lecture we have shown that Rec(Σ) is a subset of bud-Rec(Σ) using the powerset construction. Show that bud-Rec(Σ) is a subset of Rec(Σ).

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