Formale Übersetzungsmodelle

Exercise 37 (Top-down tree transducer with regular look-ahead)

Let $T = \big(Q, \Sigma, \Delta, I, R\big)$ be a top-down tree transducer with regular look-ahead.

(a) Give a formal definition of the derivation relation of T.

(b) Give a formal definition of the tree transformation induced by T.

Exercise 38 ($TOP^R \subseteq$ d-QREL $\circ$ TOP)

Let $L_1, \ldots, L_n \in \mathrm{REC}(\Sigma)$ be recognizable tree languages, $U = \{0, 1\}^n$, and Σ and Ω be ranked alphabets where

$$\Omega = \big\{ \langle \sigma, (u_1, \ldots, u_k) \rangle^{(k)} \mid \sigma \in \Sigma,\ \mathrm{rk}(\sigma) = k,\ u_1, \ldots, u_k \in U \big\}.$$

If $k = 0$, we write σ rather than $\langle \sigma, () \rangle$.

Consider the function $B\colon T_\Sigma \to T_\Omega$, defined as follows. For every $k \in \mathbb{N}$, $\sigma \in \Sigma^{(k)}$, and $t_1, \ldots, t_k \in T_\Sigma$, we let

$$B(\sigma(t_1, \ldots, t_k)) = \tau(B(t_1), \ldots, B(t_k)),$$

where $\tau = \langle \sigma, (u_1, \ldots, u_k) \rangle$ and $u_i(j) = 1$ iff $t_i \in L_j$ for every $1 \le i \le k$ and $1 \le j \le n$.

(a) Give a deterministic state-relabeling bu-tt that computes B.

(b) Let $\Sigma = \big\{\sigma^{(2)}, \gamma^{(1)}, \alpha^{(0)}, \beta^{(0)}\big\}$ be a ranked alphabet, $n = 2$, and $L_1 = \{\gamma^k(\beta) \mid k \in \mathbb{N}\}$ and $L_2 = \{\gamma^k(\alpha) \mid k \in \mathbb{N}\}$ be recognizable tree languages. Construct a deterministic state-relabeling bu-tt for L_1 and L_2.

Exercise 39 (l-BOT = l-TOP^R)

Consider the linear bu-tt $B = \big(Q, \Sigma, \Delta, F, R\big)$ where $\Sigma = \Delta = \big\{\sigma^{(2)}, \gamma^{(1)}, \alpha^{(0)}, \beta^{(0)}\big\}$, $Q = \{*, q, q_f\}$, $F = \{q_f\}$, and R contains

$$\begin{array}{ccc} \alpha \to q(\alpha), & \alpha \to *(\alpha), & \beta \to *(\beta), \\ \gamma(q(x_1)) \to q(\gamma(x_1)), & \gamma(*(x_1)) \to *(\gamma(x_1)), & \sigma(*(x_1), q(x_2)) \to q_f(x_1), \\ \sigma(*(x_1), *(x_2)) \to *(\sigma(x_1, x_2)). & & \end{array}$$

(a) Give a linear td-tt with regular look-ahead T such that $\tau(T) = \tau(B)$.

(b) Construct a deterministic state-relabeling bu-tt B' and a linear td-tt T' such that $\tau(T) = \tau(B') \circ \tau(T')$.

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