Formale Übersetzungsmodelle

Task 16 (ln-BOT = ln-TOP)

Let $\Sigma = \{\sigma^{(2)}, \alpha^{(0)}\}$, $\Delta = \{\sigma^{(2)}, \gamma^{(1)}, \alpha^{(0)}\}$ be ranked alphabets, and $\xi = \sigma(\sigma(\alpha, \alpha), \alpha) \in T_\Sigma$. Consider the linear non-deleting bu-tt $B = (\{q_0, q_1\}, \Sigma, \Delta, \{q_0\}, R_B)$ and the linear non-deleting td-tt $T = (\{q_0, q_1\}, \Sigma, \Delta, \{q_0\}, R_T)$ where

$$R_B = \{\ \alpha \to q_0(\alpha),\quad \sigma(q_0(x_1), q_0(x_2)) \to q_1(\sigma(x_1, x_2)),$$
$$\alpha \to q_1(\alpha),\quad \sigma(q_1(x_1), q_1(x_2)) \to q_0(\gamma(\sigma(x_2, x_1)))\ \} \quad \text{and}$$

$$R_T = \{\ q_0(\alpha) \to \alpha,\quad q_0(\sigma(x_1, x_2)) \to \sigma(q_1(x_2), q_1(x_1)),$$
$$q_1(\alpha) \to \alpha,\quad q_1(\sigma(x_1, x_2)) \to \sigma(\gamma(q_0(x_1)), \gamma(q_0(x_2)))\ \}$$

(a) Give a linear non-deleting td-tt T' such that $\tau(B) = \tau(T')$.
Give derivations of B and T' on ξ.

(b) Give a linear non-deleting bu-tt B' such that $\tau(T) = \tau(B')$.
Give derivations of T and B' on ξ.

Task 17 (generalized sequential machines and top-down tree transducers)

GSM is the class of string transformations $\tau \subseteq \Sigma^* \times \Delta^*$ that are be induced by some gsm.

(a) Give formal definitions for the syntax and derivation relation of a gsm, and the string transformation induced by a gsm.

(b) Prove by construction that GSM is closed under composition.
Hint: Use a product construction where the right hand side of a rule of the first gsm is processed by the second gsm (pipelining).

Let $G = (Q, \Sigma, \Delta, q_0, F, R)$ be a gsm.

(c) Give a gsm G^R such that $\tau(G^R) = \{(w_l^R, w_r^R) \mid (w_l, w_r) \in \tau(G)\}$ where w^R denotes the reverse of w.

(d) Give a td-tt that simulates the run of G on the nodes of monadic trees from root to front.

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