Formale Übersetzungsmodelle

*Task 21 (*BOT^2 *and* TOP^2*)*

Let $\Sigma = \{\sigma^{(2)}, \gamma^{(1)}, \alpha^{(0)}, \beta^{(0)}\}$ be a ranked alphabet. Consider the bu-tt $B = (Q_B, \Sigma, \Sigma, F, R_B)$ and the td-tt $T = (Q_T, \Sigma, \Sigma, I, R_T)$ where $Q_B = \{*, q, q_f\}$, $F = \{q_f\}$, $Q_T = \{*, q\}$, $I = \{*\}$, and

$$
\begin{aligned}
R_B = \{\ & \sigma(*(x_1), *(x_2)) \to *(\sigma(x_1, x_2)), \\
& \sigma(*(x_1), q(x_2)) \to q_f(x_1), \\
& \gamma(*(x_1)) \to *(\gamma(x_1)), \\
& \gamma(q(x_1)) \to q(\gamma(x_1)), \\
& \gamma(q_f(x_1)) \to q_f(\gamma(x_1)), \\
& \alpha \to *(\alpha),\ \ \alpha \to q(\alpha),\ \ \beta \to q(\beta)\ \}
\end{aligned}
\qquad
\begin{aligned}
R_T = \{\ & q(\sigma(x_1, x_2)) \to \sigma(q(x_1), q(x_2)), \\
& *(\sigma(x_1, x_2)) \to \sigma(q(x_1), *(x_1)), \\
& *(\sigma(x_1, x_2)) \to \sigma(*(x_1), q(x_1)), \\
& *(\gamma(x_1)) \to \gamma(*(x_1)), \\
& q(\gamma(x_1)) \to \gamma(q(x_1)), \\
& *(\alpha) \to \alpha,\ \ q(\alpha) \to \alpha,\ \ *(\beta) \to \beta\ \}
\end{aligned}
$$

(a) Identify the bottom-up and top-down specific properties of the tree transformations induced by B and T respectively.

(b) Give td-tt T_1 and T_2 and bu-tt B_1 and B_2 such that $\tau(B) = \tau(T_1) \circ \tau(T_2)$ and $\tau(T) = \tau(B_1) \circ \tau(B_2)$.

Task 22 (Regular tree grammars)

Consider the ranked alphabet $\Sigma = \{\alpha^{(0)}, \sigma^{(2)}\}$, the tree $\xi = \sigma(\sigma(\alpha, \alpha), \sigma(\alpha, \alpha)) \in T_\Sigma$, and the regular tree grammar $G = (\{S, A\}, \Sigma, S, \{S \to A, S \to \sigma(S, S), A \to \alpha, A \to \sigma(\alpha, S)\})$.

(a) Give a derivation and the corresponding derivation tree of ξ in G.
How many derivation trees of ξ do exist in G?

(b) Give an RTG H and a tree ζ such that ζ has infinitely many derivations in H.

(c) Give an RTG G' such that G' is in normal form and $L(G') = L(G)$.
Give a derivation tree of ξ in G'.

(d) Prove by construction that for every RTG G there exists an RTG G' in normal form such that $L(G') = L(G)$.

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