Formale Übersetzungsmodelle

Task 13 (decompositions of BOT*)*

Let $\Sigma = \{\sigma^{(2)}, \gamma^{(1)}, \alpha^{(0)}\}$. Consider the bu-tt $M = (\{q_0, q_1, p\}, \Sigma, \Sigma, \{q_0\}, R)$, where

$$R: \quad \alpha \to q_0(\alpha), \qquad \gamma(p(x_1)) \to p(\gamma(x_1)), \qquad \sigma(q_0(x_1), p(x_2)) \to q_1(\sigma(x_2, x_1)),$$
$$\alpha \to p(\alpha), \qquad \sigma(q_1(x_1), p(x_2)) \to q_0(\sigma(x_1, x_1)).$$

(a) Describe $\tau(M)$.

(b) Construct, according to the decomposition result from the lecture, a relabeling bu-tt M_1, an fta M_2, and a homomorphism bu-tt M_3 such that $\tau(M) = \tau(M_1)\,;\tau(M_2)\,;\tau(M_3)$.

(c) Illustrate the transformation $\tau(M_1)\,;\tau(M_2)\,;\tau(M_3)$ with the input tree $\sigma(\alpha, \gamma\alpha) \in T_\Sigma$.

(d) Elaborate on the construction of the qrel bu-tt in the proof of $\mathsf{BOT} \subseteq \mathsf{QREL}\,;\mathsf{HOM}$.

(e) Give a qrel bu-tt M_1' and a homomorphism bu-tt M_2' such that $\tau(M) = \tau(M_1')\,;\tau(M_2')$.

Task 14 (bimorphism characterization of BOT*)*

Recall the decomposition result $\mathsf{BOT} \subseteq \mathsf{REL}\,;\mathsf{FTA}\,;\mathsf{HOM}$. For every bottom-up tree transducer B we can construct a bottom-up tree relabeling B_1, a bottom-up finite state tree automaton B_2, and a bottom-up tree homomorphism B_3 such that $\tau(B) = \tau(B_1)\,;\tau(B_2)\,;\tau(B_3)$.

(a) Show that $\big(\tau(B_1)\big)^{-1} \in \mathsf{HOM}$.

(b) Give a bimorphism characterization of BOT, i.e., give a formal definition of (the syntax of) bimorphisms, and its induced tree transformation. Show that the class of tree transformations induced by bimorphisms subsumes BOT.

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

$$R: \quad \alpha \to q(\alpha) \quad \beta \to *(\beta) \quad \gamma(*(x_1)) \to *(\gamma(x_1)) \quad \sigma(*(x_1), q(x_2)) \to q_f(x_1)$$
$$\alpha \to *(\alpha) \quad \gamma(q(x_1)) \to q(\gamma(x_1)) \quad \sigma(*(x_1), *(x_2)) \to *(\sigma(x_1, x_2))$$

Give a bimorphism $\mathcal{B} = (A, \varphi, \psi)$ such that $\tau(B) = \tau(\mathcal{B})$.
Give a derivation of $\xi = \sigma\big(\gamma(\beta), \gamma(\alpha)\big)$ in B.
Give a tree $\zeta \in T_\Omega$ such that $\zeta \in L(A)$ and $\varphi(\zeta) = \xi$.

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