Formale Übersetzungsmodelle

Task 11 (relabeling followed by checking)

Consider the bu-tts $M_{\text{re}} = (\{*\}, \Sigma, \Delta, \{*\}, R_{\text{re}})$ and $M_{\text{ch}} = (\{*, n, f\}, \Delta, \Delta, \{*, f\}, R_{\text{ch}})$ where

$$R_{\text{re}} = \{\ \alpha \to *(\alpha),\ \gamma(*(x_1)) \to *(\gamma_f(x_1)),\ \gamma(*(x_1)) \to *(\gamma(x_1)),\ \sigma(*(x_1), *(x_2)) \to *(\sigma(x_1, x_2))\ \}$$

$$\begin{aligned} R_{\text{ch}} = \{\ \alpha \to *(\alpha),\quad & \gamma(*(x_1)) \to n(\gamma(x_1)), && \gamma(n(x_1)) \to n(\gamma(x_1)), \\ & \gamma_f(*(x_1)) \to f(\gamma_f(x_1)), && \gamma_f(n(x_1)) \to f(\gamma_f(x_1)), \\ & \sigma(*(x_1), *(x_2)) \to *(\sigma(x_1, x_2)), && \sigma(*(x_1), n(x_2)) \to n(\sigma(x_1, x_2)), \\ & \sigma(*(x_1), f(x_2)) \to f(\sigma(x_1, x_2)), && \\ & \sigma(n(x_1), *(x_2)) \to n(\sigma(x_1, x_2)), && \sigma(n(x_1), n(x_2)) \to n(\sigma(x_1, x_2)), \\ & \sigma(f(x_1), *(x_2)) \to f(\sigma(x_1, x_2)), && \sigma(f(x_1), n(x_2)) \to f(\sigma(x_1, x_2))\ \} \end{aligned}$$

(a) Describe the transformations induced by M_{re} and M_{ch}.

(b) Describe the transformation $\tau(M_{\text{re}}) \circ \tau(M_{\text{ch}})$.

(c) Give a bu-tt M such that $\tau(M) = \tau(M_{\text{re}}) \circ \tau(M_{\text{ch}})$.

Task 12 (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

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

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

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