Formale Übersetzungsmodelle

Task 6 (non-determinism and determinism)

Let $\Sigma = \{\gamma^{(1)}, \alpha^{(0)}\}$ and $\Delta = \Sigma \cup \{\delta^{(1)}\}$ be ranked alphabets and $M = (\{q\}, \Sigma, \Delta, \{q\}, R)$ be a bu-tt with $R = \{\alpha \to q(\alpha),\ \gamma(q(x_1)) \to q(\gamma(x_1)),\ \gamma(q(x_1)) \to q(\delta(x_1))\}$.

(a) What is the tree transformation of M?

(b) Show that there is no deterministic bu-tt M' with $\tau(M') = \tau(M)$.

Task 7 (shape-preserving tree transformations)

Let $M = (Q, \Sigma, \Delta, F, R)$ be a bu-tt. Prove the following statements:

(a) If M is a bottom-up state relabeling and $(s, t) \in \tau(M)$, then $\mathsf{pos}(s) = \mathsf{pos}(t)$.

(b) If M is a bottom-up finite state tree automaton and $(s, t) \in \tau(M)$, then $s = t$.

Hint: Use Lemma 1.1 from Engelfriet [Eng75, p. 205].

Task 8 (finite non-determinism)

Let $B = (Q, \Sigma, \Delta, F, R)$ be a bu-tt. Prove that the set $\tau(B)(s) = \{t \in \mathrm{T}_\Delta \mid (s, t) \in \tau(B)\}$ is finite for each $s \in \mathrm{T}_\Sigma$.

Task 9 (syntactic subclasses of BOT)

Describe the relations between the following (syntactic) classes of bottom-up tree transducers using set diagrams:

- bu-tt,
- deterministic bu-tt,
- total bu-tt,
- homomorphism bu-tt,
- state-relabeling bu-tt,
- relabeling bu-tt,
- linear bu-tt,
- non-deleting bu-tt, and
- bottom-up finite state tree automata.

References

[Eng75] J. Engelfriet. "Bottom-up and top-down tree transformations—a comparison". In: *Mathematical systems theory* 9.2 (1975), pp. 198–231. issn: 0025-5661. doi: `10.1007/BF01704020`.

Note. The tutorial's time might not suffice to present all solutions. Please prepare to ask for the solutions you are most interested in.

`http://www.orchid.inf.tu-dresden.de` `Tobias.Denkinger@tu-dresden.de`