Advanced Topics on Weighted Tree Automata

Exercise 7 (Composition and decomposition)

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 $\mathrm{pos}(s) = \mathrm{pos}(t)$.

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

(c) There exists a $c \in \mathbb{N}$ such that for every $(s, t) \in \tau(M)$ holds $\mathrm{height}(t) \leq c \cdot \mathrm{height}(s)$.

Exercise 8 (Subclasses of BOT)

Describe the relations of the classes of relations BOT, d-BOT, t-BOT, HOM, QREL, REL, l-BOT, n-BOT, and FTA by means of a set diagram (also known as VENN diagram).

Exercise 9 (Nondeterminism and determinism)

Let $\Sigma = \{\top^{(0)}, \bot^{(0)}, \neg^{(1)}, \wedge^{(2)}\}$ be a ranked alphabet. Note that the trees over Σ represent a subset of the formulae of propositional logic.

(a) Give a bu-tt M that eliminates double negations, i.e., for every $\xi \in T_\Sigma$, M reduces every subtree of the form $\neg(\neg(\xi))$ to ξ.

(b) Give a deterministic bu-tt M_{det}, such that $\tau(M_{\mathrm{det}}) = \tau(M)$.

(c) For any given bu-tt M', is there a deterministic bu-tt M'_{det} such that $\tau(M'_{\mathrm{det}}) = \tau(M')$?

(d) What restriction is required from M' in order for M'_{det} to exist?

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