Formale Baumsprachen

Task 25 (closure of recognizable step functions)

Show that recognizable step functions are closed under pointwise addition and multiplication for any semiring.

Task 26 (height in multioperator monoid weighted tree automata and M-expressions)

Let Σ be a ranked alphabet. Recall the function $\mathsf{height}\colon \mathrm{T}_\Sigma \to \mathbb{N} \setminus \{0\}$ that is defined for every tree $\sigma(\xi_1, ..., \xi_k) \in \mathrm{T}_\Sigma$ by

$$\mathsf{height}(\sigma(\xi_1, ..., \xi_k)) = 1 + \max\{\mathsf{height}(\xi_1), ..., \mathsf{height}(\xi_k)\}.$$

(a) Give a multioperator monoid $\mathcal{A}$ and a wta $\mathcal{M}$ over Σ and $\mathcal{A}$ such that $[\![\mathcal{M}]\!] = \mathsf{height}$.

(b) Give the multioperator monoid $\mathcal{A}_{\mathsf{Arct}}$ constructed from the arctic semiring and a wta $\mathcal{M}_{\mathsf{Arct}}$ over Σ and $\mathcal{A}_{\mathsf{Arct}}$ such that $[\![M_{\mathsf{Arct}}]\!] = \mathsf{height}$.

(c) Give an M-expression φ over Σ and $\mathcal{A}$ such that $[\![\varphi]\!] = \mathsf{height}$.

(d) Let Σ contain a binary symbol σ and a nullary symbol α, and let $\xi = \sigma(\sigma(\alpha, \alpha), \alpha) \in \mathrm{T}_\Sigma$. Illustrate the calculations of $[\![\mathcal{M}]\!](\xi)$, $[\![\mathcal{M}_{\mathsf{Arct}}]\!](\xi)$, and $[\![\varphi]\!](\xi)$.

Note: The remainder of the tutorial's time is dedicated to answer the questions you may have concerning the already discussed portion of the paper (Fülöp, Stüber, and Vogler: A Büchi-Like Theorem for Weighted Tree Automata over Multioperator Monoids). Please bring your own copy of the paper.

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