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– Assignment 2 –

Exercise 1 (2 points)

As presented in the lecture (cf. Lecture slide 4 - p.8), the (weak) concatenation of two MSCs M_1 and M_2 (with $M_i = \langle \mathcal{P}_i, E_i, \mathcal{C}_i, \ell_i, m_i, <_i \rangle$ for $i \in \{1, 2\}$) intuitively is realized by gluing the process lines together such that M_1 is situated on top of MSC M_2 (cf. Figure 1).

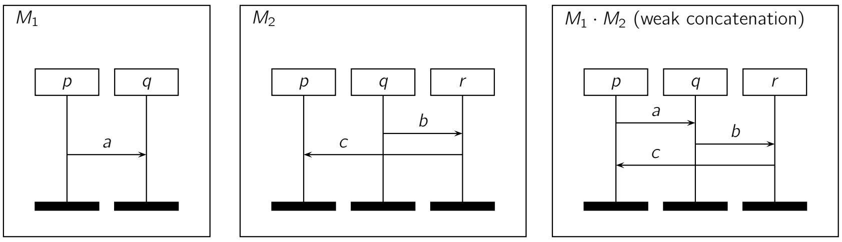

Figure 1: Two MSCs and their weak concatenation

Define the so-called *strong concatenation* $\bullet_s$ of two MSCs M_1 and M_2, i.e., all events of MSC M_1 have to be executed before the first event of M_2. For this purpose determine a structure $M = M_1 \bullet_s M_2 = \langle \mathcal{P}, E, \mathcal{C}, \ell, m, < \rangle$, that (in terms of M_1 and M_2) results from concatenating the two MSCs strongly.

Exercise 2 (4 points)

The *word* language of a (possibly infinite) *set* of MSCs $\mathcal{M} = \{M_1, M_2, \ldots\}$ is defined as

$$\mathcal{L}(\mathcal{M}) := \bigcup_{M \in \mathcal{M}} Lin(M).$$

(Compare with the definition in Lecture slide 4 - p.16).

Show that:

It is decidable whether a *regular* language L is in a word language for some set of MSCs, i.e., there exists $\mathcal{M}$ such that $L \subseteq \mathcal{L}(\mathcal{M})$.
(*Hint*: Find a way to show that every word $w \in L$ is well-formed.)

Exercise 3 (4 points)

Let $w \in Act^*$ be a linearization of an MSC M and $p, q \in \mathcal{P}$ be two processes in M.
The *bound* from p to q in w is defined as:

$$B_w^{pq} := \max_{u \text{ is prefix of } w} \left(\sum_{c \in \mathcal{C}} |u|_{!(p,q,c)} - \sum_{c \in \mathcal{C}} |u|_{?(q,p,c)} \right)$$

where $|u|_a$ denotes the number of occurrences of action a in u. (Compare with the definition in Lecture slide 2 - p.20.) In other words, B_w^{pq} denotes the maximum number of messages in the channel from p to q for the linearization w.
The *bound* B for a set of words $\mathcal{L} \subseteq Act^*$ is then defined as:

$$B := \max_{w \in \mathcal{L},\ p,q \in \mathcal{P}} B_w^{pq}$$

Prove that:

If a word language of a set of MSCs $\mathcal{M}$ is regular (cf. Exercise 2), then the bound B for $\mathcal{L}(\mathcal{M})$ is finite.