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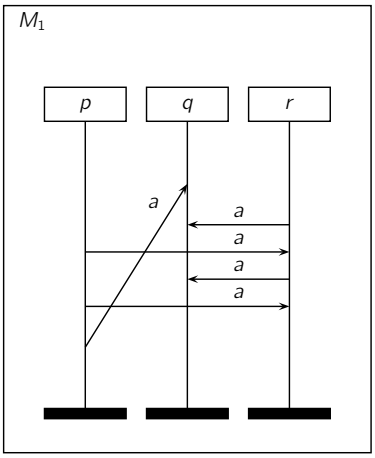
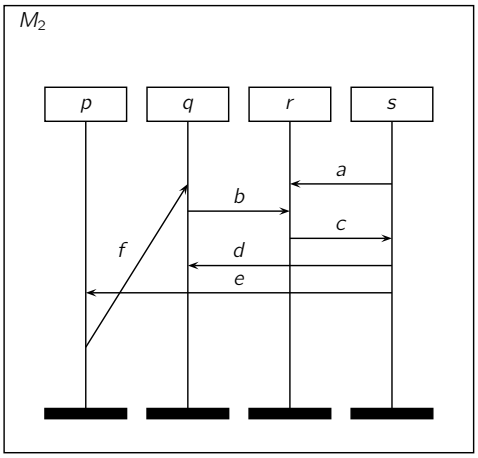
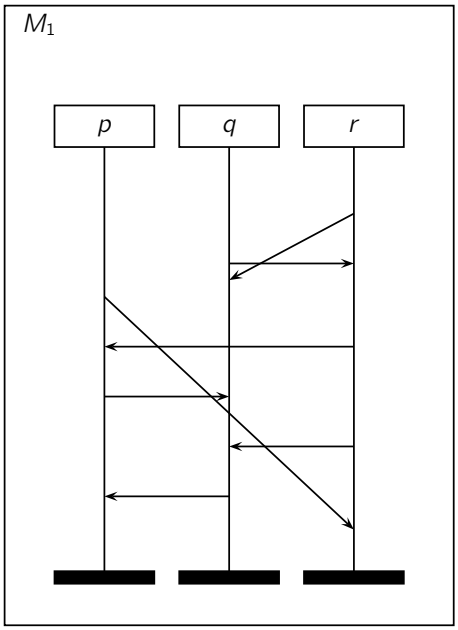
Exercise 1 (Message Sequence Charts): (4+2 Points)

a) Let the following pictures M_1, M_2, be given: Prove or disprove that M_1 and M_2 are MSCs.





b) Does the following MSC have a race? Justify your answer.



Exercise 2 (Concatenation): (5 Points)

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).
Define the so-called *strong concatenation* $\cdot_s$ 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 is executed. For this purpose determine a MSC $M = M_1 \cdot_s M_2 = \langle \mathcal{P}, E, \mathcal{C}, \ell, m, < \rangle$, that (in terms of M_1 and M_2) results from concatenating the two MSCs strongly.

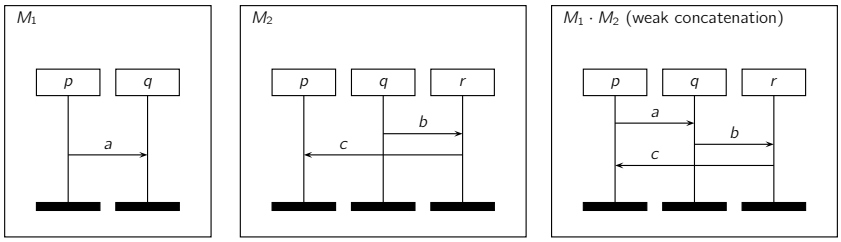


Abbildung 1: Two MSCs and their weak concatenation

Exercise 3 (Prove or disprove): (10 Points)

Formally prove or disprove the correctness of the following statements for MSGs (i.e., $M_i \in \mathbb{M}$, $i \in \{1, 2, 3\}$): (remember: $|$ $\widehat{=}$ choice, $\times$ $\widehat{=}$ (weak) sequence, * $\widehat{=}$ iteration)

1. $M_1|M_2 = M_2|M_1$
2. $M_1 \times M_2 = M_2 \times M_1$
3. $(M_1 \times M_2) \times M_3 = M_1 \times (M_2 \times M_3)$
4. $(M_1 \times M_2)|M_3 = (M_1|M_3) \times (M_2|M_3)$
5. $M_1^*|M_2^* = (M_1|M_2)^*$