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Theoretical Foundations of the UML WS 17/18
— Exercise Sheet 4 —

Hand in until November 21st before the exercise class.

General Remarks

- The exercises should be solved in groups of *three* students.
- You may hand in your solutions for the exercises just before the exercise class starts at 15:30 or by dropping them into the "TFUML" box at our chair. Do *not* hand in your solutions via L2P.

Exercise 1 (6 Points)

Consider the following sets U and W as input of the Post correspondence problem:

$$U = \{\underbrace{a}_{u_1}, \underbrace{abaaa}_{u_2}, \underbrace{ab}_{u_3}\} \qquad W = \{\underbrace{aaa}_{w_1}, \underbrace{ab}_{w_2}, \underbrace{b}_{w_3}\}$$

a) Apply the reduction to the decision problem whether a safe and accepting path exists in a CMSG, i.e., draw the corresponding CMSG $\mathcal{G}_{U,W}$ as presented in the lecture (cf. Lecture 7 from November 7th).

b) Does $G_{U,W}$ have a safe, accepting path π? If yes, provide the MSC $M(\pi)$; otherwise argue why there is no such path.

Exercise 2 (2 Points)

Proof or disprove whether the following decision problem is decidable:

Problem 4.1:
Given a CMSG G, is there an accepting, unsafe *path of G?*

Exercise 3 (3 Points)

Formally prove or disprove the correctness of the following statements for **CMSGs**:
(here, $M_i \in \mathbb{CM}$, $i \in \{1,2,3\}$; $\mid$ stands for *choice*, $\bullet$ for *(weak) concatenation*, and * for *iteration*)

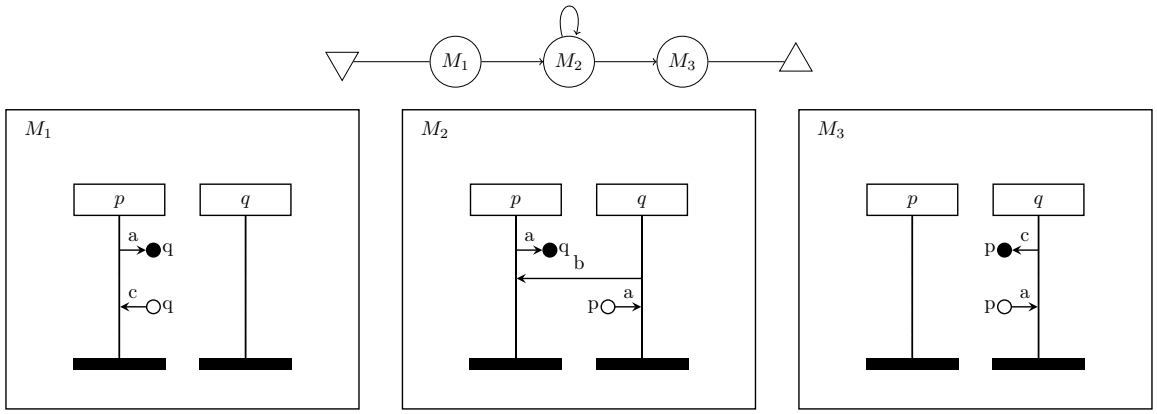
a) $(M_1 \bullet M_2) \mid M_3 = (M_1 \mid M_3) \bullet (M_2 \mid M_3)$

b) $(M_1 \mid M_2) \bullet M_3 = (M_1 \bullet M_3) \mid (M_2 \bullet M_3)$

c) $M_1^* \mid M_2^* = (M_1 \mid M_2)^*$

Exercise 4 (6 Points)

Given a **CMSG** G as follows:



a) Construct the pushdown automaton $K_{p,q}$ for channel p to q in G.

b) Is G safe? Justify your answer.

Exercise 5 (3 Points)

Proof or disprove whether the following decision problem is decidable:

Problem 4.2:
Given a CMSG G, does G have at least two accepting and safe paths?