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Theoretical Foundations of the UML WS 17/18

— Exercise Sheet 1 —

Hand in until October 24th 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.
- The solution for this exercise sheet will be presented in the first exercise class on October 24th.
- If you are looking for a group or your group has less than 3 members, please post in the L2P forum.
- You need at least 40% of the exercise points to be admitted to the exam. If you gain at least 70% of the points you get a 0.3 bonus on your grade for the exam.

Exercise 1 (1+1+1 Points)

a) Consider the following formal definition of an MSC: $M = (\mathcal{P}, E, \mathcal{C}, l, m, \preceq)$, with

$\mathcal{P} = \{p_1, p_2, p_3\}$,

$E = E_1 \cup E_2 \cup E_3 = E_? \cup E_!$, with

$E_1 = \{e_1, e_6\}$,

$E_2 = \{e_2, e_3\}$,

$E_3 = \{e_4, e_5\}$,

$E_? = \{e_2, e_4, e_6\}$, and

$E_! = \{e_1, e_3, e_5\}$,

$\mathcal{C} = \{a, b, c\}$,

$l\colon E \to Act$, with

$l(e_1) = !(p_1, p_2, a)$,

$l(e_2) = ?(p_2, p_1, a)$,

$l(e_3) = !(p_2, p_3, b)$,

$l(e_4) = ?(p_3, p_2, b)$,

$l(e_5) = !(p_3, p_1, c)$, and

$l(e_6) = ?(p_1, p_3, c)$,

$m\colon E_! \to E_?$, with

$m(e_1) = e_2$,

$m(e_3) = e_4$, and

$m(e_5) = e_6$, and

$\preceq\ = \{(e_1, e_6), (e_1, e_2), (e_2, e_3), (e_3, e_4), (e_4, e_5), (e_5, e_6)\}^*$.

Draw the visual representation of M.

b) Does the MSC M from part a) satisfy the FIFO property? Justify your answer.

c) Provide $Lin(M)$ of the MSC from part a).

Exercise 2 (5 + 3 Points)

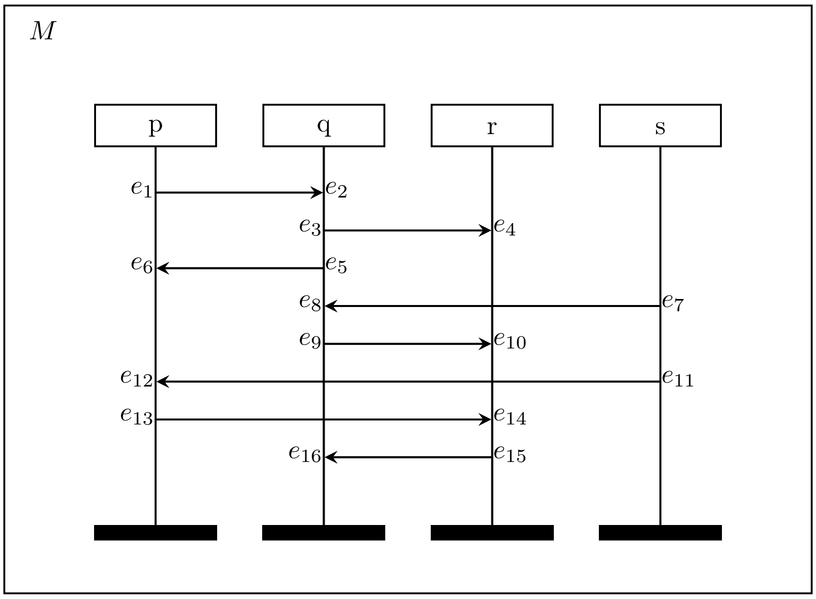
a) Let $\mathcal{P}(E)$ denote the powerset of a set E, i.e. $\mathcal{P}(E) = \{N \mid N \subseteq E\}$, and let $\mathbb{N}$ denote the set of natural numbers, i.e. $\mathbb{N} = \{0, 1, 2, 3, \ldots\}$. Further let $\preceq_1$ and $\preceq_2$ be partial orders over $\mathbb{N}$. Prove or disprove whether the following are partially ordered sets:

1. $\big(\mathcal{P}(\mathbb{N}), \subseteq\big)$
2. $\big(\mathcal{P}(\mathbb{N}), \subsetneq\big)$
3. $(\mathbb{N}, \mathcal{R})$ with $\mathcal{R} = \big\{(x, y) \mid x \text{ and } y \text{ are both even or both odd}\big\}$
4. $(\mathbb{N}, \preceq_1 \cup \preceq_2)$
5. $(\mathbb{N}, \preceq_1 \cap \preceq_2)$

b) Show that every partially ordered set $(E, \preceq)$ has at least one linearization. You can assume that E is finite.

Exercise 3 (2+2 Points)

Consider the MSC M:

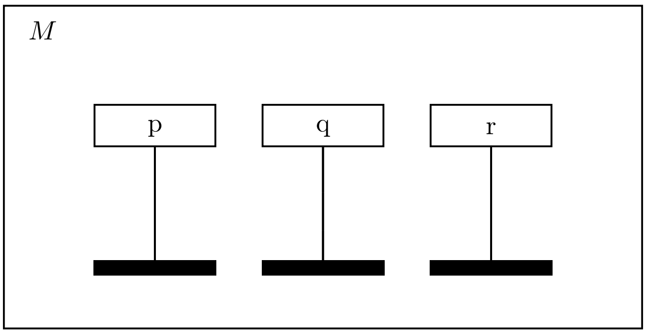


a) Draw the Hasse diagram of M.

b) Determine *all* races in the MSC M and justify your answer (e.g., by means of another Hasse diagram for $\ll$).

Exercise 4 **(1+2+2 Points)**

An incomplete MSC M is shown as follows:



M is supposed to have *exactly* 6 *events*.

a) Complete M, such that it has the minimum number of linearizations.

b) Complete M, such that it has the maximum number of linearizations.

c) Determine all the linearizations in both MSCs.