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Theoretical Foundations of the UML WS 17/18
— Exercise Sheet 10 —

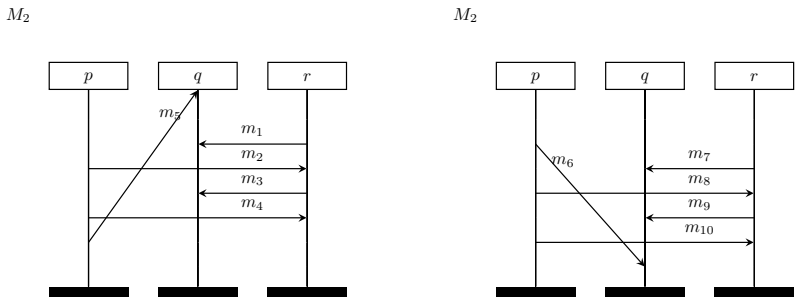
Hand in until January 30th before the exercise class.

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.
- This is the last exercise sheet.

Exercise 1 (8 Points)

Consider the following MSCs. Note that the message for both MSCs is m. The index $i \in \{1, \ldots, 10\}$ is just added to give the send/receive events an unique identifier.



Show, by using the *semantics* of PDL, whether the formulas:

a) $\Phi_1 = \exists\Big(\langle proc\rangle\langle proc\rangle\langle msg\rangle !(p,q,m) \wedge \langle msg\rangle !(p,r,m)\Big)$ and

b) $\Phi_2 = \exists\Big([proc]^{-1} false \wedge \langle msg; proc; proc\rangle^{-1} !(p,r,m)\Big)$

hold for MSC M_1 and whether the formulas

c) $\Phi_3 = \exists\langle\{!(p,q,m)\}\rangle\langle proc\rangle^{-1} ?(q,r,m)$ and

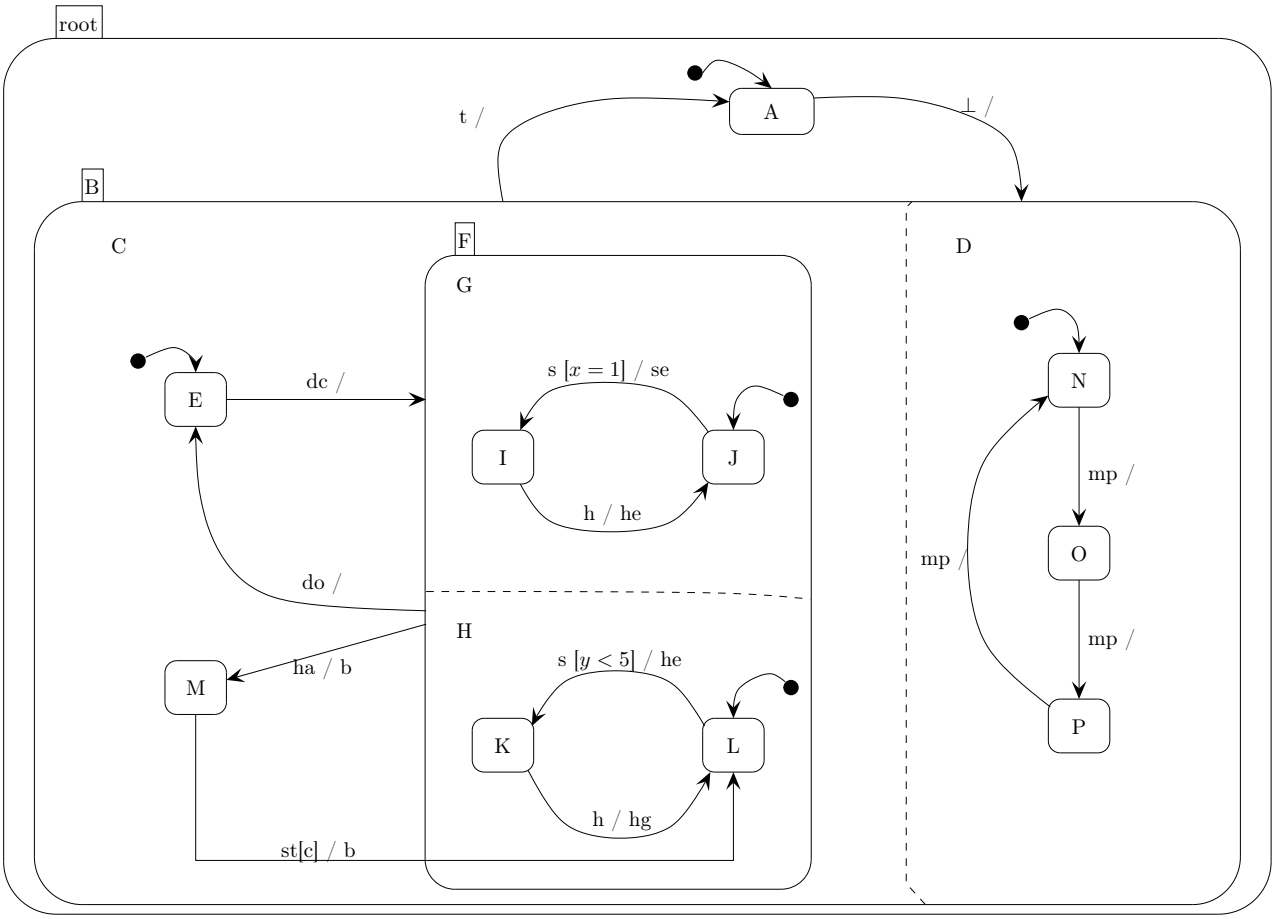
d) $\Phi_4 = \forall\Big(\big([proc + msg]^{-1} false\big) \rightarrow !(p,q,m)\Big)$

hold for MSC M_2.

Note: In this assignment an edge label of the form e/e' of Statechart SC_1 means that SC_1 is consuming event e and executing an action that is sending the event e' to SC_1 (i.e., to itself).

Exercise 2 (3 Points)

Let the following Statechart $SC_1 = (N, E, Edges)$ be given:



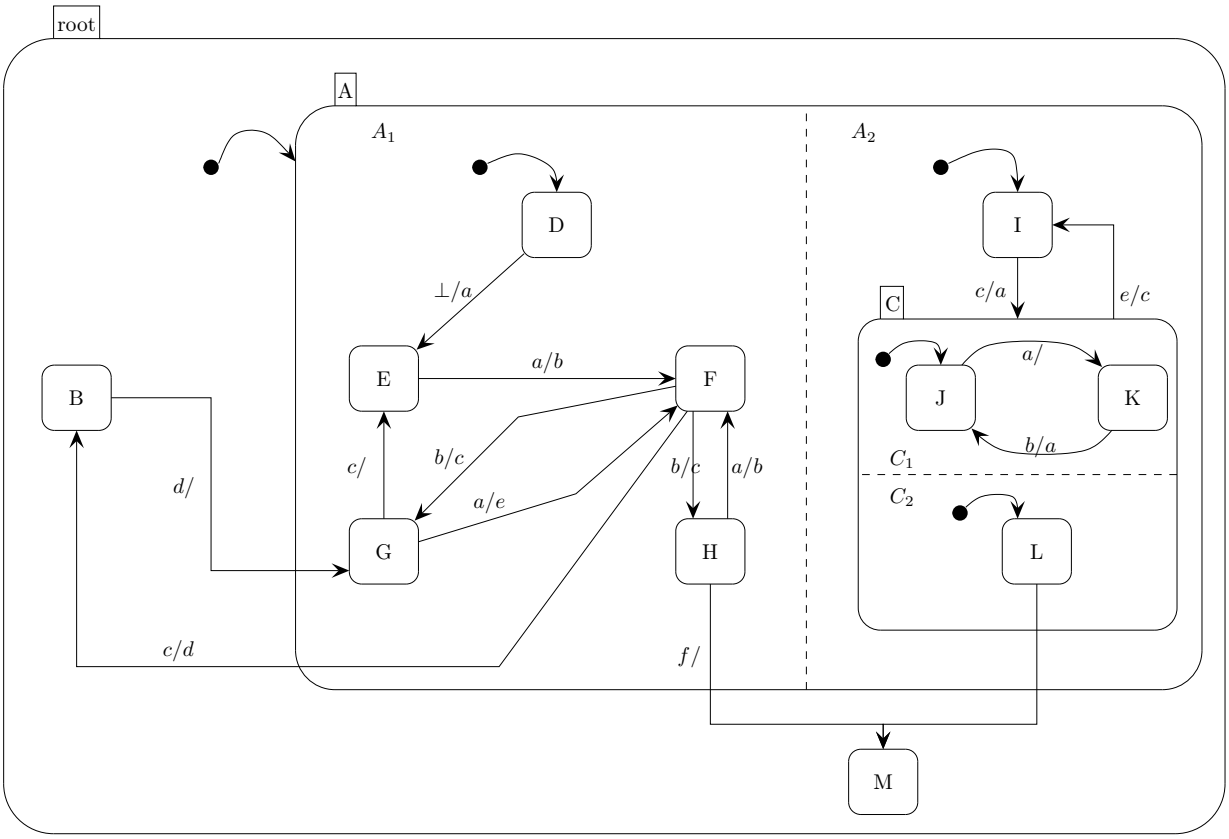
a) Describe Statechart SC_1 formally, i.e., give the components $(N, E, Edges)$.

b) Construct the tree that represents the node hierarchy of Statechart SC_1.

c) Determine the types of the nodes of Statechart SC_1.

Exercise 3 (2 Points)

Let the following stand-alone Statechart (i.e., there are no Statecharts running in parallel to SC) $SC = (N, E, Edges)$ be given:



a) Determine 2 example configurations (c_1, c_2) of SC. The configurations shall contain at least three nodes. Moreover, give two distinct example states s_i, s_i' for the configuration c_i, $i \in \{1, \ldots, 2\}$ (i.e., provide four example states in total). As there are no variables considered in SC, you may omit the variable valuation from each state.

b) Calculate the sets of enabled edges $En(s)$ of all states s determined in b).

c) Determine the scopes of the edges:

(i) {H,L} $\longrightarrow$ {M}

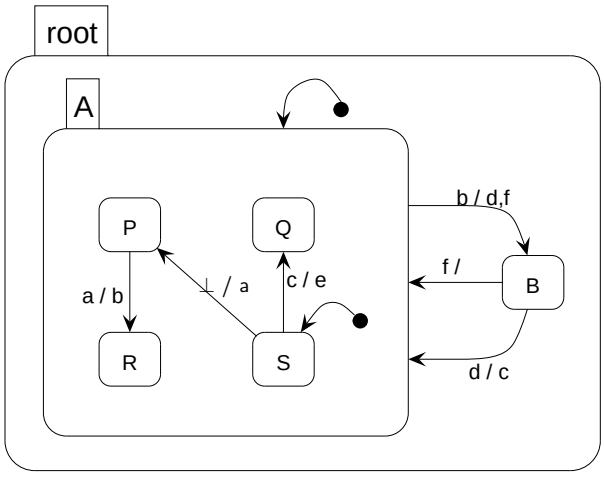
(ii) {B} $\longrightarrow$ {G}

(iii) {C} $\longrightarrow$ {I}

d) List at least 2 examples of pairs of inconsistent edges and 2 examples of pairs of consistent (and distinct) edges.

Exercise 4 (7 Points)

Let the following Statechart SC_1 be given:
SC_1:



Determine the formal semantics for the Statechart SC_1 (i.e., construct the related Mealy machine $\mathcal{A} = (Q, q_0, \Sigma, \delta, \omega)$ for the Statechart) as follows:

(1) determine the initial state q_0

(2) determine the enabled edges $En(q_0)$

(3) determine every possible $nextStep(q_0)$

(4) determine the successor state $\delta(q_0, E')$ for each set of event $E' \subseteq E$ for which a corresponding macro step exists.

(5) repeat these steps for each successor state

Write down the corresponding results for step (1) to step (5) above. When all states and their successors are determined, draw the resulting automaton.
We assume that $\delta(q, E')$ is only defined if there is a macro step $T \subseteq En(q)$ for which E' is the set of trigger events of the edges in T. As there are no variables considered in SC_1, you may omit the variable valuation from each state.