Theoretical Foundations of the UML - SS 2020
— Exercise Sheet 10 —

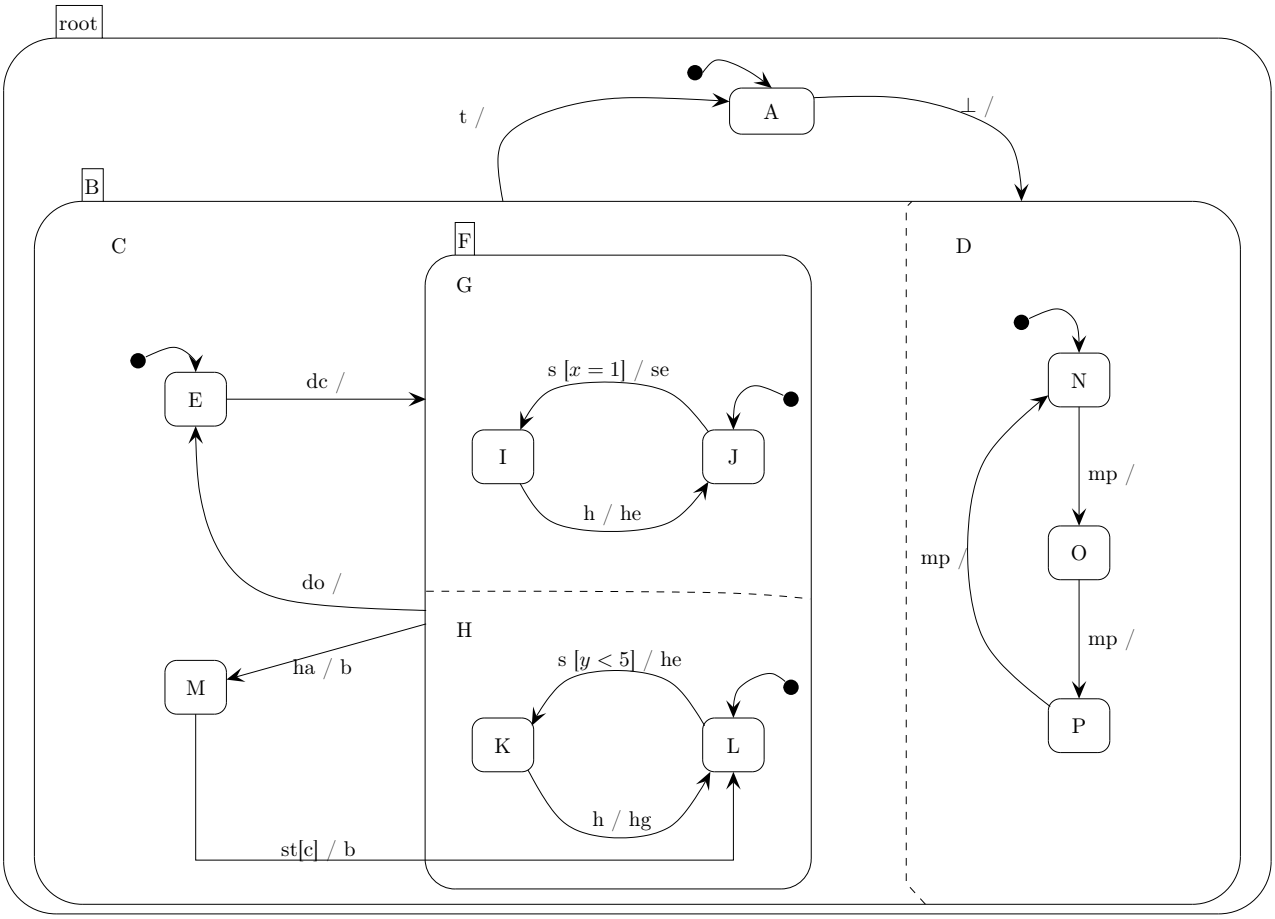
Hand in until Monday July 6, 09:00 am via RWTHmoodle

General Remarks

- Questions regarding the lectures and exercises, if any, are expected in the Q&A session via Zoom, with the next on Thursday July 2, at 16:00. Zoom ID: 369 366 110, Password: FUML-QA.
- In this assignment an edge label of the form e/e' in a statechart SC indicates that SC is consuming the event e and executing an action that sends the event e' to SC (i.e., to itself).

Exercise 1 (Ingredients of Statecharts) (1+1+1 Points)

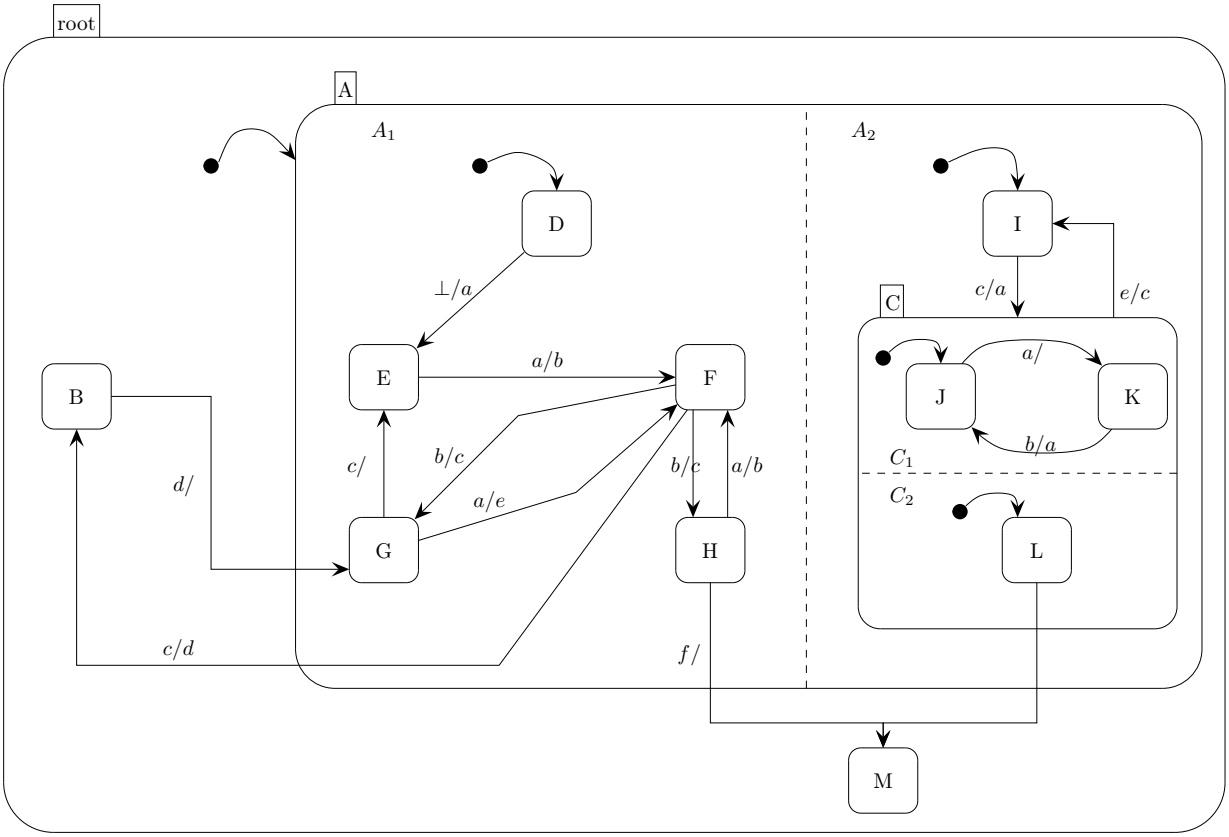
Consider the following statechart $SC_1 := (N, E, Edges)$.



1) Give the formal description of SC_1 by specifying its components $(N, E, Edges)$.
2) Construct the tree that represents the node hierarchy of SC_1.
3) Determine the types of the nodes in SC_1.

Exercise 2 (Macro-Step Semantics) (1+1+1+1 Points)

Consider the following stand-alone statechart SC (i.e., there are no statecharts running in parallel to SC).



1) Determine two example configurations c_1 and c_2 of SC. The configurations shall contain at least three nodes. Moreover, give two distinct example states s_i and s_i' for the configuration $c_i, i \in \{1, 2\}$ (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.

2) Calculate the sets of enabled edges $En(s)$ of all states s determined in 1).

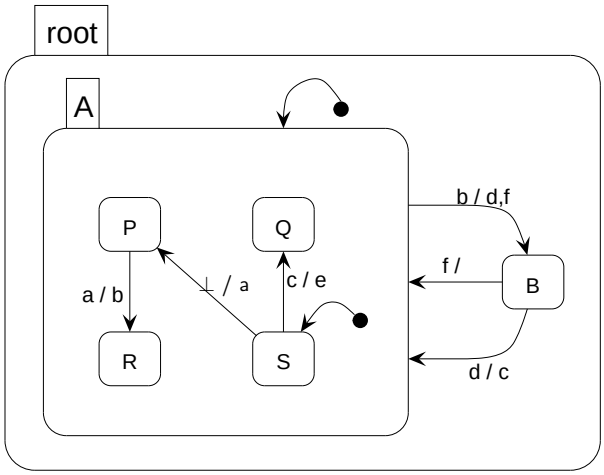
3) Determine the scopes of the edges:

   - $\{H, L\} \to \{M\}$
   - $\{B\} \to \{G\}$
   - $\{C\} \to \{I\}$

4) List at least two examples of pairs of inconsistent edges and two examples of pairs of consistent (and distinct) edges.

Exercise 3 (Statecharts to a Mealy Machine) (7 Points)

Consider the following statechart SC_1.



Determine the formal semantics of SC_1 by constructing the underlying Mealy machine $\mathcal{A} := (Q, q_0, \Sigma, \delta, \omega)$ through the following steps.

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.

When all states and their successors are determined, draw the resulting Mealy machine.

We assume that $\delta(q, E')$ is defined only 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.