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 $E_n(s)$ of all states $s$ determined in 1).

3) Determine the scopes of the edges:
   - $\{H, L\} \rightarrow \{M\}$
   - $\{B\} \rightarrow \{G\}$
   - $\{C\} \rightarrow \{I\}$

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 $A := (Q, q_0, \Sigma, \delta, \omega)$ 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.