

2 Finite State Machines [50 points]

The Polybahn from Central to Polyterasse has broken down! To fix it you need to design a finite state machine that controls the Polybahn's two doors *A* and *B*.

The Polybahn should operate as follows:

- Initially the Polybahn is empty and **idle**, and passengers can enter through door *A*.
- The Polybahn is full when it carries 2 passengers.
- When it is full and idle, the Polybahn goes into **transit** to the other station with both doors closed.
- After reaching the station, the Polybahn will **unload** all passengers through door *B*, while door *A* is still closed.
- After the last passenger has exited the Polybahn, door *B* closes and the Polybahn becomes **idle**.
- Should (1) a passenger fall out of the Polybahn during **transit**, or (2) the Polybahn become overfull (≥ 3 passengers) at any point, it stops in **emergency** mode, where it opens all doors and remains (unless reset to the initial **idle** state).

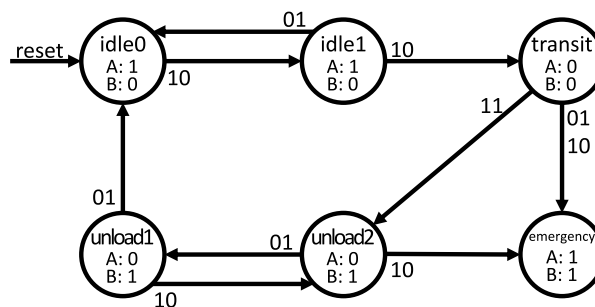
The FSM receives two input bits, with the following meaning:

| Input | Meaning |
|-------|-----------------------------------|
| 00 | no change |
| 01 | exactly one passenger left |
| 10 | exactly one passenger entered |
| 11 | the Polybahn arrived in a station |

The FSM produces two output bits: The first bit, *A*, holds door *A* open when it is 1. The second bit, *B*, holds door *B* open when it is 1.

- (a) [25 points] Complete the Moore-type FSM below by (1) drawing the transition edges between the states (including reset), (2) specifying the edges' respective input bits, and (3) specifying the output bits of each state. Any input for which no outgoing edge is specified is assumed as a self loop. The 6 given states are sufficient, do not draw additional states.

Note: Passengers sometimes slip in or out through incorrect doors, or even through closed doors. Your FSM must correctly handle such cases.



- (b) [25 points] You need to design a second FSM that controls only the bell. The bell should ring (i.e., the output bit is 1) whenever the Moore-type FSM you designed for part (a) opens or closes a door, and is constantly ringing in the case of an **emergency**.

Complete the Mealy-type FSM below by (1) drawing the transition edges between the states (including reset), and (2) specifying the edges' respective input and output bits. Label edges in the following format: [input0][input1]/[bell], e.g., 10/0 = passenger entered, bell off. Any input for which no outgoing edge is specified is assumed as a self loop with output 0.

