Systems Design Laboratory 2021/2022
Discrete Event Systems Module on Supervisory Control
Rover Battery

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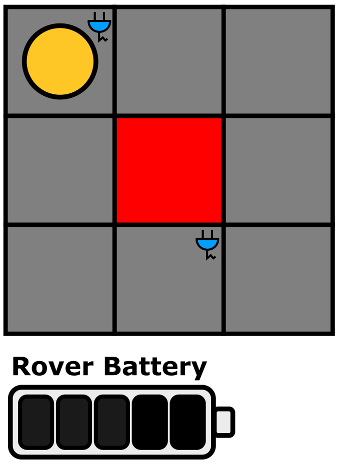
Assignment	Max Grade	Achieved Grade
A1	1	
A2	1	
A3	1	
Final grade	3	

Plant description



The figure above provides a graphical representation of a plant in which a Rover (yellow circle) moves on a 3×3 grid according to the movements that are possible in each specific tile. Initially, the Rover is in position $(1, 1)$, and from that tile the Rover can only go right or down. If the Rover is on a gray tile, then the possible movements are controllable (i.e., the Rover can decide which way to go). Conversely, if the Rover is on a red tile, then the possible movements are uncontrollable (i.e., the Rover cannot decide which way to go). The Rover is also provided with a battery that when fully charged has a capacity of 5 units of energy. Initially, the battery is fully charged. Whenever the Rover makes a movement the battery level decreases by 1 unit of energy. For example, if initially the Rover goes right or down from tile $(1, 1)$, then the battery level goes from 5 to 4. The rover can keep on moving provided it is not out of energy (i.e., no battery underflow). Some of the tiles provide charging stations, depicted as blue power plugs. In our example, we have two charging stations: one in tile $(1, 1)$ and another in tile $(3, 2)$. If the Rover is on any of these tiles, then it can get a full charge provided the battery is not already full (i.e., no battery overflow).

Assignments

A1) Model the plant by using finite state automata.

A2) Model the following two requirements.

- R_1: The Rover never runs out of battery on tiles that do not have a charging station.
- R_2: The Rover must always alternate the use of the charging stations in $(1,1)$ and $(3,2)$ starting from $(3,2)$.

A3) Implement this exercise with ESCET. Specify the plant and the requirements with CIF. Use ToolDef to synthesize the supervisor enforcing R_1 and R_2 and deploy you supervisor. Check that the behavior of the controlled plant is the expected one.

Note for (A1) and (A2). Always discuss and defend your modeling decisions: number of automata, states (marking), events (controllability), and transitions. Avoid computing parallel compositions whenever you see a decomposition for what you are modeling (just say, the result is the parallel composition of the automata...).