

# Multi-Agent Systems

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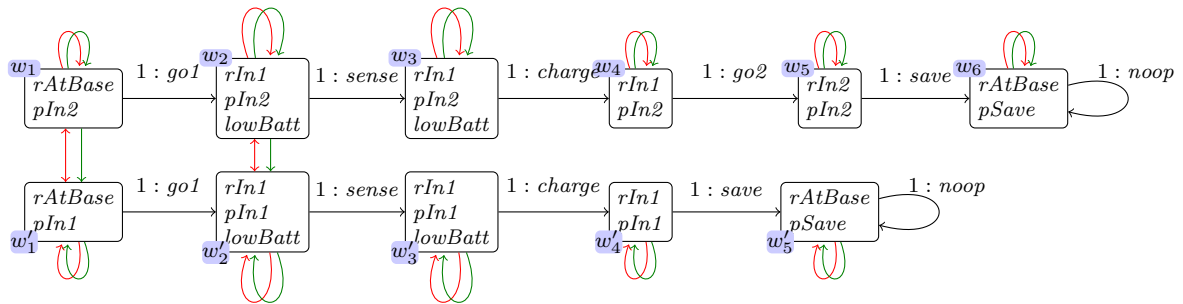
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## Exercise Sheet 6

Due: November 28, 2018, 16:00

### Exercise 6.1 (BDI Logics, 2+2)

Consider the following run-based model  $M$  of the execution of a search-and-rescue robot (the robot has to save a patient that might be in one of two rooms). In our depiction of the model, the doxastic accessibility relation is given by the red arrows, while the preference for the agent is denoted by the green arrows.



- (a) Show that the run conforms to the following specification  $\phi$ , i.e., check that  $M, w_1 \models \phi$ .

$$\phi = G(\neg pSave \rightarrow Intend(pSave)) \wedge G(lowBatt \rightarrow Intend(\neg lowBatt))$$

- (b) In the BDI logic of Cohen & Levesque,  $\phi = AGOAL(\psi \wedge \chi) \rightarrow AGOAL(\psi) \wedge AGOAL(\chi)$  is not valid. Prove that  $\phi$  is not valid by providing a pointed model  $M, w$  as a counterexample.

### Exercise 6.2 (Abandoning Persistent Goals, 2+2)

Consider the following scenario:

Alice comes back home late in the night just to find out that she has forgotten the key to the entrance door. Her overall goal is to enter her apartment building so she forms the plan to climb up the wall and then jump through an open window on the second floor. Just before she starts climbing, a flatmate sees her and decides to help her out by opening the entrance door instead.

- (a) Justify formally why in the BDI-formalism (using the definitions from the lecture) Alice is not allowed to drop her plan in favor of simply going through the entrance door.
- (b) How could we change the definition of  $PGoal_i\phi$  to allow agent  $i$  to abandon the persistent goal  $\phi$  given a condition  $\psi$  is met? Can you think of any problems of using this approach?

### Exercise 6.3 (Introspection of Intention, 2+2)

Cohen and Levesque do not assume introspection of preference by the agents. A natural way of axiomatizing e.g. positive introspection of preference is to add the axiom  $Pref_i\phi \rightarrow Bel_i Pref_i\phi$ .

- (a) Formalize a constraint on the accessibility relations for preference and belief that appropriately characterizes the described positive introspection of preferences.
- (b) Prove that the axiom  $Pref_i\phi \rightarrow Bel_i Pref_i\phi$  defines exactly the class of frames that satisfy your constraint. *Hint:* You can do this analogously to the proofs in Exercise 2.2.