# Multi-Agent Systems 

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## Exercise Sheet 6 <br> Due: June 26th, 2017, 10:00

Exercise 6.1 (BDI Logics, $3+3+3$ )
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 $M, w_{1} \models \phi$.

$$
\phi=G(\neg p \text { Save } \rightarrow \text { Intend }(p S a v e)) \wedge G(\text { lowBatt } \rightarrow \text { Intend }(\neg \text { lowBatt }))
$$

(b) In the BDI logic of Cohen \& Levesque, $\phi=A G O A L(\psi \wedge \chi) \rightarrow A G O A L(\psi) \wedge A G O A L(\chi)$ is not valid. Prove that $\phi$ is not valid by providing a pointed model $M, w$ as a counterexample.
(c) Compare the achievement goal as defined by Cohen \& Levesque with the achievement goal as defined in the GOAL programming language. Check subsection 3.2.2 in the GOAL programming guide (especially the keywords goal and a-goal), and discuss commonalities and differences between these two definitions by Cohen \& Levesque and the GOAL language.

## Exercise 6.2 (Tableaux II, $2+2+2$ )

Your task in this exercise is to use the tableau method from the lecture to construct some models and show some validities. For parts (b) and (c), also briefly discuss the intuitive appropriateness of the respective results taking into account that $K \phi$ reads "The agent knows that $\phi$ " and $O \phi$ reads "The agent ought to bring about that $\phi$ ".
(a) Construct a $\mathbf{S 5} 5_{n}$-model for $\phi_{2}=\left(K_{a} p \vee K_{a} \neg p\right) \wedge \neg K_{b}\left(K_{a} p \vee K_{a} \neg p\right)$.
(b) Prove the validity of $\phi_{3}=O K p \rightarrow O p$ where $O$ is a KD modality and $K$ is a $\mathbf{S} 5$ modality.
(c) Prove the validity of $\phi_{4}=O(O p \rightarrow p) \rightarrow(O O p \rightarrow O p)$ in KD.

