

## Dynamic Epistemic Logic

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### Exercise Sheet 8

**Due: December 22th, 2016, 10:00**

**Exercise 8.1** (Action modalities; 1+1+1+1 points)

Consider the following epistemic state and actions:

$$s_0 = \begin{array}{ccc} \textcircled{\bullet} & \xrightarrow{2} & \bullet \\ w_1 : p & & w_2 : \neg p \end{array}$$

$$a_1 = \begin{array}{cc} \textcircled{\bullet} & \textcircled{\bullet} \\ e_1 : \langle K_1 p, \top \rangle & e_2 : \langle K_1 \neg p, \top \rangle \end{array} \quad a_2 = \begin{array}{c} \textcircled{\bullet} \\ e_1 : \langle p, q \rangle \end{array}$$

Check whether the following formulas hold in  $s_0$ :

- (a)  $K_2[a_2]q$
- (b)  $K_2\langle a_2 \rangle q$
- (c)  $K_1[a_1]K_2[a_2]q$
- (d)  $K_1\langle a_1 \rangle K_2\langle a_2 \rangle q$

**Exercise 8.2** (Partially observable ontic actions; 2+2+2+2 points)

Let  $s_0 = \textcircled{\bullet} w_1 : \neg p$  be a state where it is common knowledge between two agents 1 and 2 that  $\neg p$ . We now want to define two actions  $Maysetp_1$  and  $Maysetp_2$ , where agent 1, respective agent 2, sets the value of  $p$  to  $\top$  and the other agent is unaware whether or not this switch from  $\neg p$  to  $p$  actually occurs (analogously to the *Mayread* actions from last exercise sheet). E.g., one could imagine each agent having a private light switch for a room that both agent cannot observe.

- (a) Define the actions  $Maysetp_1$  for agent 1 and  $Maysetp_2$  for agent 2.
- (b) Calculate the composition  $BothMaysetp = (Maysetp_1 ; Maysetp_2)$ .
- (c) Verify that  $s_0 \models [BothMaysetp](K_1 p \wedge K_2 p \wedge \neg K_1 K_2 p \wedge \neg K_2 K_1 p)$ .
- (d) Let  $Maysetp'_2$  be the action where agent 1 is unaware whether or not agent 2 sets the value of  $p$  to  $\top$ , but the switch actually does not occur. Verify that  $s_0 \models [Maysetp_1][Maysetp'_2](K_1 p \wedge \neg K_2 p \wedge \neg K_1 \neg K_2 p \wedge \neg K_2 K_1 p)$ .