

Dynamic Epistemic Logic

B. Nebel, R. Mattmüller, T. Engesser
Summer Semester 2019

University of Freiburg
Department of Computer Science

Exercise Sheet 5

Due: May 29th, 2019, 16:00

Exercise 5.1 (Implementation, 4+2 points)

Your task in this exercise is to implement a model checker that takes an epistemic model and some \mathcal{L}_{KC} formula as input. The output is the set of all worlds in which the formula is satisfied. You can download a template from our website that already parses epistemic formulas and reads out the model from a JSON file (both formula and filename of the JSON file are passed as command line arguments). We illustrate our JSON format for epistemic models with the following example:

```
{"domain": ["w1", "w2", "w3"],  
  "indist": [[1, "w1"], [1, "w2", "w3"], [2, "w1", "w2"]],  
  "val": {"p": ["w1", "w2"], "q": ["w2", "w3"]}}
```

The model consists of three worlds w_1 , w_2 and w_3 , where proposition p is true exactly in w_1 and w_2 , and proposition q is true exactly in w_2 and w_3 . Indistinguishability relations are specified as lists of equivalence classes. E.g., agent 1 has one class of indistinguishable worlds containing w_2 and w_3 and one containing only w_1 . We assume that worlds have their own singleton indistinguishability class if they do not occur in any of the explicitly specified classes (e.g., world w_3 for agent 2).

For formulas, we assume that proposition names start with a lowercase letter and may contain arbitrary lower- and uppercase letters and numbers afterwards. Agent names are represented by positive integers. We use \sim for negation, $\&$ for conjunction, \mid for disjunction, K for knowledge and C for common knowledge between all agents. E.g, the formula $CK_1(p \mid q)$ means that it is common knowledge between all agents that agent 1 knows that p or q .

- Implement the model checking algorithm from the lecture.
- Provide two interesting test cases, each consisting of a model and some formulas to check.

Exercise 5.2 (Hexa, 2+2 points)

In (*Hexa*, 012), Anne says to Bill: “(I hold card 0 and) You don’t know that I hold card 0”.

- Show that this is an unsuccessful update.
- In the resulting epistemic state Bill says to Anne: “But (I hold card 1 and) you don’t know that I hold card 1”. Show that this is also an unsuccessful update.

Exercise 5.3 (Substitution in PA, 2 points)

- Show the *substitution of equals* property of PA:

$$\text{If } \vdash \psi \leftrightarrow \chi, \text{ then } \vdash \varphi(p/\psi) \leftrightarrow \varphi(p/\chi).$$

Use induction on the formula φ .