

**Exercise 2.23** This exercise goes with the article “Collective intentions” by Dunin-Kępicz en Verbrugge. Consider the following potential definitions for “collective intention within a group to achieve  $\varphi$  together”. Keep in mind that for a collective intention to exist there should be true teamwork, full cooperation.

1.  $E\text{-INT}_G(\varphi)$
2.  $E\text{-INT}_G(\varphi) \wedge C\text{-BEL}_G(E\text{-INT}_G(\varphi))$
3.  $E\text{-INT}_G(E\text{-INT}_G(\varphi))$
4.  $M\text{-INT}_G(\varphi)$
5.  $C\text{-INT}_G(\varphi)$  (d.w.z.  $M\text{-INT}_G(\varphi) \wedge C\text{-BEL}_G(M\text{-INT}_G(\varphi))$ )

Compare these definitions by answering the following questions:

- a** Devise a concrete situation with a group of people and a goal formula  $\varphi$ , where 1 holds, but 2 does not. Why is 1 not sufficient for a collective intention?
- b** Devise a concrete situation with a group of people and a goal formula  $\varphi$ , where 2 holds, but 3 does not. Why is 2 not sufficient for a collective intention?
- c** Devise a concrete situation with a group of people and a goal formula  $\varphi$ , where 3 holds, but 4 does not. Why is 3 not sufficient for a collective intention?
- d** Devise a concrete situation with a group of people and a goal formula  $\varphi$ , where 4 holds, but 5 does not. Why is 4 not sufficient for a collective intention?

**Exercise 2.24** Make the task “agentlogica: Rao en Georgeff” from the domain “Multi agent systemen en cognitieve robotica” at the LOKweb. There is a direct link from the MAS website. Use the article by Rao and Georgeff, and possibly also the other sources downloadable from the task website.

Here follow translations for the non-formula parts of the exercise:

- 2** Translate the three formulas under 2 a, b, c into natural language (English without variables); then for each formula, construct a model in which it is satisfied and explain why the model does so.
- 3** Prove or refute the three general properties 3 a, b, c. This may be done semantically. Note that it may make a difference whether you assume that all trees are finite or infinite.