Advanced Logics
Winter term 2015

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Exercise sheet 7

Exercise 1: Show that $\{\mathrm{EX}, \mathrm{EG}, \mathrm{EU}\}$ together with BF can express every other CTL-operator.

Exercise 2: Show CTL-MC $\in \mathsf{P}$.

Exercise 3: Consider the dining philosophers problem you probably know from a lecture about computer architecture: Assume we may use the atomic propositions e_i

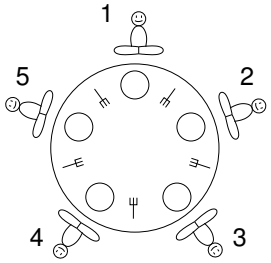

Figure 1: Dining philosophers problem. Source: Propositional Methods 2005 Lecture, Michael Fourman, University of Edinburgh.

which state that philosopher i is currently eating and f_i stating that philosopher i has just finished eating. Now express the following properties with CTL-formulas:

1. Philosophers 1 and 4 will never eat at the same time.
2. Whenever philosopher 4 has finished eating, he cannot eat again until philosopher 3 has eaten.
3. Philosopher 2 will be the first to eat.

Exercise 4: Construct a model for ϕ which is not a model for ψ, where

1. $\phi = \mathrm{AG}p_1 \to \mathrm{EG}p_2$ and $\psi = \mathrm{AG}(p_1 \to \mathrm{EG}p_2)$,
2. $\phi = \mathrm{EG}p_1 \wedge \mathrm{EX}p_2$ and $\psi = \mathrm{EG}(p_1 \wedge \mathrm{EX}p_2)$.

Exercise 5: Construct formulas for the following properties:

1. Mutal exclusion, i.e., no two processes can be in their critical section at the same time.

2. Starvation freeness, i.e., there is always a call to process p.

3. Progress, i.e., some property r which implies a future call of process p.

Exercise 6: Show that AFAXp is not expressible in LTL by FXp, i.e., state a Kripke structure K for which $K, w \not\models \text{AFAX}p$, but $K, w \models \text{EFX}p$.

Exercise 7: Show that FGp is not expressible in CTL by AFAGp.