Model-Checking Exercises
Sommersemester 2009 / Sheet 4

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We are going to discuss the examples together at 2.7. For questions about the exercises or examples, please send me an email `campetel@in.tum.de`.

Example 4.1: CTL

Find out for the following pairs of **CTL**-formulas, if either one side implies the other, or whether they are equivalent. If an implication does not hold, you will find an appropriate Kripke structure, which proves this fact.

1. $\mathbf{AF}(p \vee q)$ and $\mathbf{AF}\, p \vee \mathbf{AF}\, q$
2. $\mathbf{AG}(p \wedge q)$ and $\mathbf{AG}\, p \wedge \mathbf{AG}\, q$
3. $\mathbf{EG}(p \wedge q)$ and $\mathbf{EG}\, p \wedge \mathbf{EG}\, q$
4. $\mathbf{EF}\,\mathbf{AG}\, p$ and $\mathbf{AG}\,\mathbf{EF}\, p$
5. $\mathbf{EF}\,\mathbf{AG}\, p$ and $\mathbf{EF}\, p$

Example 4.2: BDD

Given the boolean expressions $F := (a \wedge b) \rightarrow (c \vee d)$ and $G := (a \vee b) \rightarrow d$.

1. Calculate a BDD for F.
2. Calculate a BDD for G with the same variable order as for F.
3. Calculate a BDD for the boolean function $F \wedge G$.

Example 4.3: Add to BDDs

Let $f(x_0, \ldots, x_3, y_0, \ldots, y_3)$ the boolean function, which evaluates to **true**, if holds $(x_3x_2x_1x_0)_{\mathsf{bin}}{+}1 = (y_3y_2y_1y_0)_{\mathsf{bin}}$, in which we use $(x_3x_2x_1x_0)_{\mathsf{bin}} = \Sigma_{i=0}^{3} x_i 2^i$.

1. Describe f in propositional logic.
2. Indicate for f a BDD with a good order of variables.
3. Generalize your solution for 4 Bits to a solution for n Bits.