RHEINISCH-WESTFÄLISCHE TECHNISCHE HOCHSCHULE AACHEN

LEHRSTUHL FÜR INFORMATIK II
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Exercises to the lecture *"Advanced Model Checking"*, winter term 2006

– Assignment 9 –

The solutions are collected on Jan. 12th at the beginning of the exercise class.
Justify your answers!

Exercise 1 (4 points)

For the given function:

$$F(x_0, \ldots, x_{n-1}, a_0, \ldots, a_{k-1}) = x_{|a|}$$

where $n = 2^k$, $\forall i \in 0 \ldots n-1 \,:\, x_i = 0 \vee x_i = 1$, $\forall j \in 0 \ldots k-1 \,:\, a_j = 0 \vee a_j = 1$ and $|a| = \sum_{j=0}^{k-1} a_j 2^j$, provide two ROBDDs, considering the following two variable orderings:

$$a_0, \ldots, a_{k-1}, x_0, \ldots, x_{n-1}$$

and

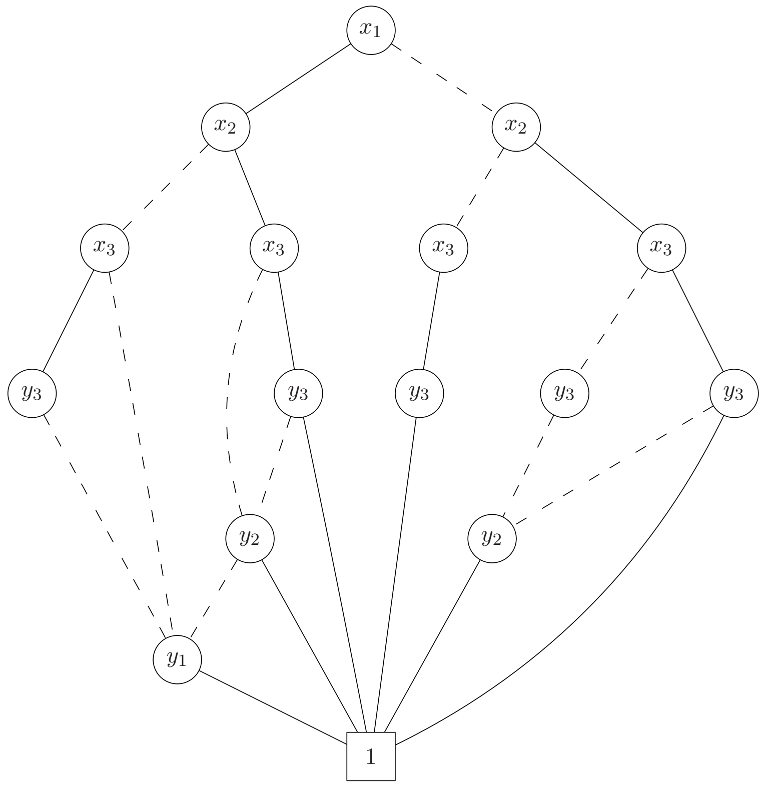
$$a_0, x_0, \ldots, a_{k-1}, x_{k-1}, x_k, \ldots, x_{n-1}$$

with $k = 3$.

Exercise 2 (4 points)

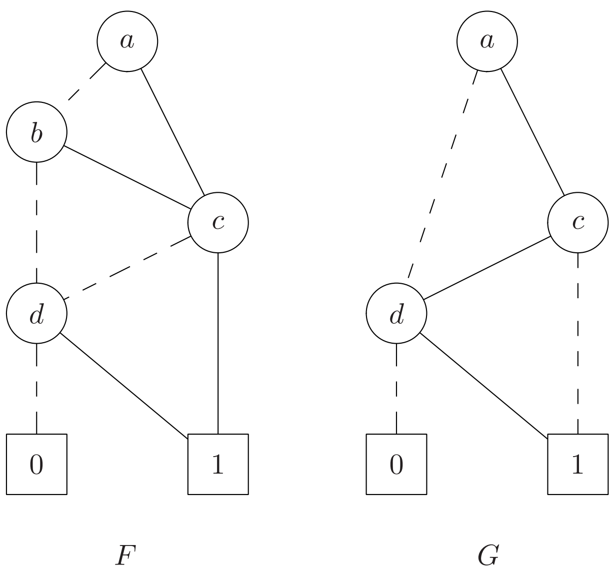
Given an ROBDD as follows, determine the boolean function $f(x_1, x_2, x_3, y_1, y_2, y_3)$ it represents.

(Hint: first to find a better variable ordering)



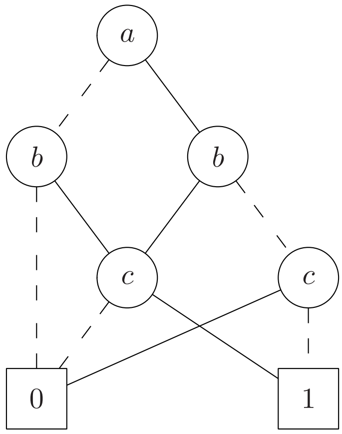
Exercise 3 (4 points)

- Compute $APPLY(\vee, F, G)$ for the following ROBDDs:



Provide intermediate steps of the $APPLY$ algorithm.

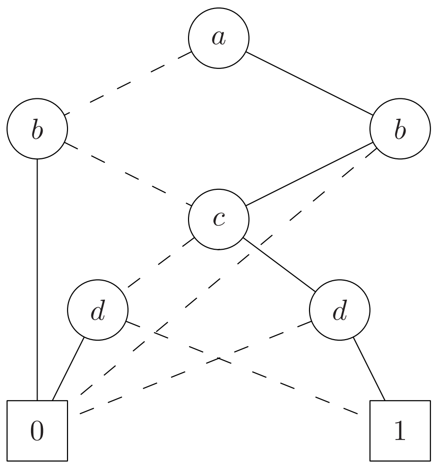
- Compute $RESTRICT(H, b, 1)$, given the ROBDD below:



H

Provide intermediate steps of the *RESTRICT* algorithm (the result should be an ROBDD).

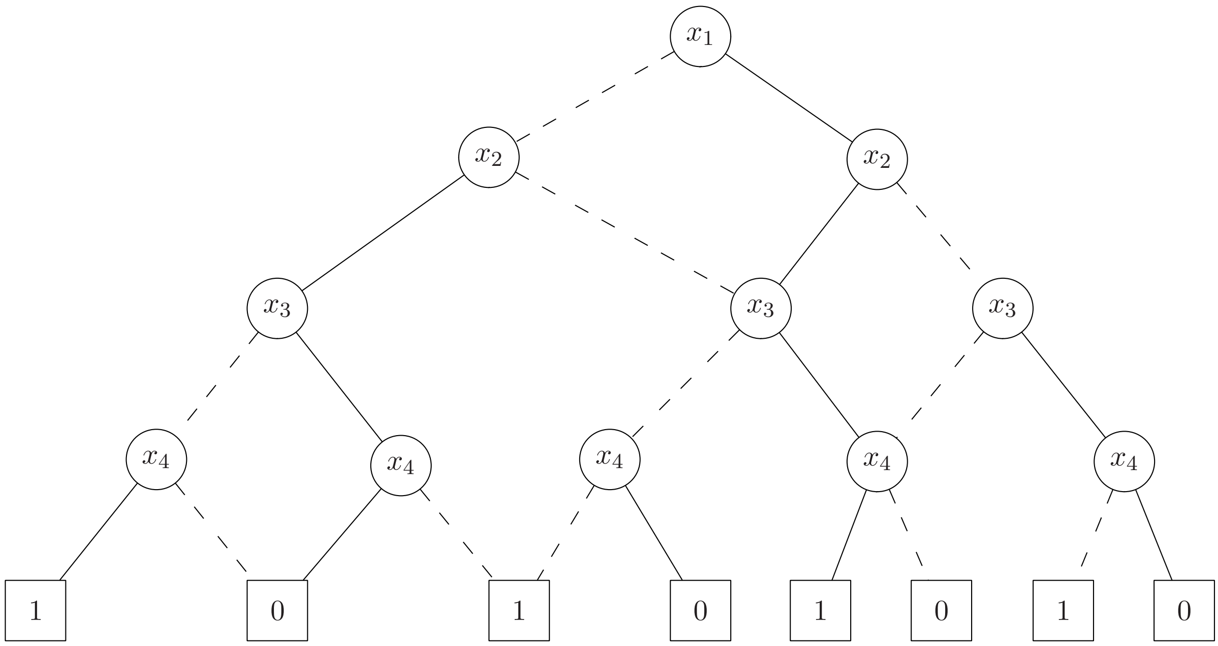
- Compute $\exists a.(\exists d.f(a,b,c,d))$ in the form of ROBDD for the f function defined by the ROBDD below:



Provide intermediate steps.

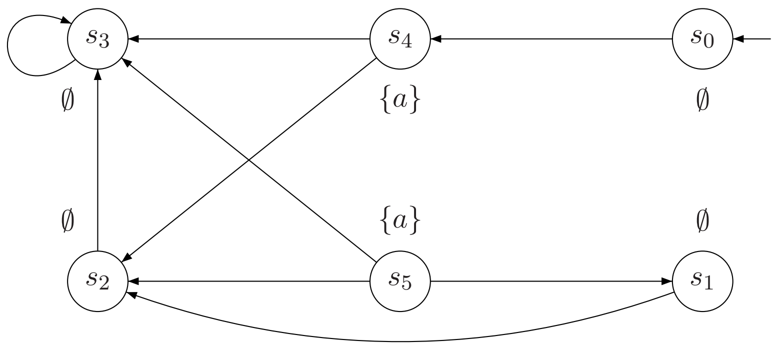
Exercise 4 **(3 points)**

Reduce the following OBDD:



Exercise 5 **(4 points)**

Given a transition system TS as follows:



(a) Encode TS by ROBDD;

(b) Compute its strong bisimulation quotient $TS/\sim$;

(c) Encode $TS/\sim$ by ROBDD using the same variable ordering. (Hint: The representative of an equivalence class is picked as the smallest index of all the state in that equivalence class.)

Merry Christmas and happy new year!!!