Logic Synthesis & Verification, Fall 2010

National Taiwan University

Problem Set 5

Due on 2010/12/15 before lecture

1 [Node Value and Elimination]

(a) Show that the value of node j can be calculated as

$$value(j) = \left(\sum_{i \in FO(j)} n_i \right) (l_j - 1) - l_j,$$

where n_i is the number of times that literals y_j and y'_j occur in the factored form of node i, and l_j is the number of literals in the factored form of node j.

(b) Given the Boolean network of Figure 1 (assuming the node functions are expressed in the sum-of-products form), compute the values of nodes 1, 2, 3, and 4. After eliminating node 1 (by collapsing it into its fanout nodes), compute the new values of nodes 2, 3, 4.

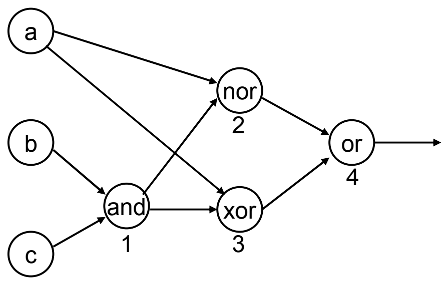

Fig. 1. Boolean network for node elimination.

2 Weak Division

Given an expression F and a divisor G, suppose $F = G \cdot H + R$ by weak division. Prove that H and R are unique.

3 [Kernelling and Factoring]

Let $F = aefh + aegh + aei + befh + begh + bei + cdefh + cdegh + cdei$.

(a) Compute $\texttt{KERNEL}(0, F)$ with literals ordered alphabetically. Draw the kernelling tree (as in the slides) and list the kernels and their corresponding co-kernels.

(b) Compute all 2-cube divisors and 2-literal cube divisors (including those after complementation). For each 2-cube divisor, indicate whether or not it is a kernel.

(c) Apply `GFACTOR` on F by using the largest level-0 kernels as the divisors and using weak division. (In case that there are several choices of divisors, using one of them is sufficient.)

(d) Apply `GFACTOR` on F by using the 2-cube divisors with literals appearing most frequently in F and using weak division. (In case that there are several choices of divisors, using one of them is sufficient.)

4 [Extraction by Rectangle Covering]

Given two algebraic expressions

$$F = ac + ad + af + be + bc + bd + bf, \text{ and}$$
$$G = acd + ae + bcd + be,$$

use rectangle covering to extract a common sub-expression with the largest value.