Logic Synthesis & Verification, Fall 2010

National Taiwan University

Problem Set 6

Due on 2010/12/22 before lecture

1 [Technology Mapping]

Process circuit `s444.blif` with the following ABC steps.

```
abc 01> read ./examples/s444.blif
abc 02> cone -O 10
abc 03> strash
abc 04> show
```

Now perform technology mapping on this AIG with the following steps.

(a) Perform exhaustive cut enumeration on the AIG with cut filtering to remove dominated cuts.
(b) Compute the area flows of the 4-feasible cuts of the AIG node closest to the primary output.
(c) What is the best FPGA technology mapping with 4-input LUTs on this example?

2 [SDC and ODC]

Consider the Boolean network of Figure 1.

(a) Write down a Boolean formula for the SDC of the entire network.
(b) Write down a Boolean formula for the satisfiability don't cares SDC_4 of Node 4. Since SDC_4 is imposed by the fanins of Node 4, the formula should depend on variables $x_1, \ldots, x_4, y_1, \ldots, y_3$. How can you make SDC_4 only depend on y_1, y_2, y_3 such that we can minimize Node 4 directly?
(c) Compute the observability don't cares ODC_4 of Node 4.

3 [Don't Cares in Local Variables]

Consider the Boolean network of Figure 1. Suppose the XDC for z_1 is $\neg x_1 \neg x_2 \neg x_3 \neg x_4$ and that for z_2 is $x_1 x_2 x_3 x_4$.

(a) Compute the don't cares D_4 of Node 4 in terms of its local input variables y_1, y_2, and y_3. (Note that in general the computation of ODC may be affected by XDC especially when there exist different XDCs for different primary outputs.)
(b) Based on the computed don't cares, what is the best implementable function for Node 4 (in terms of the literal count and cube count)?

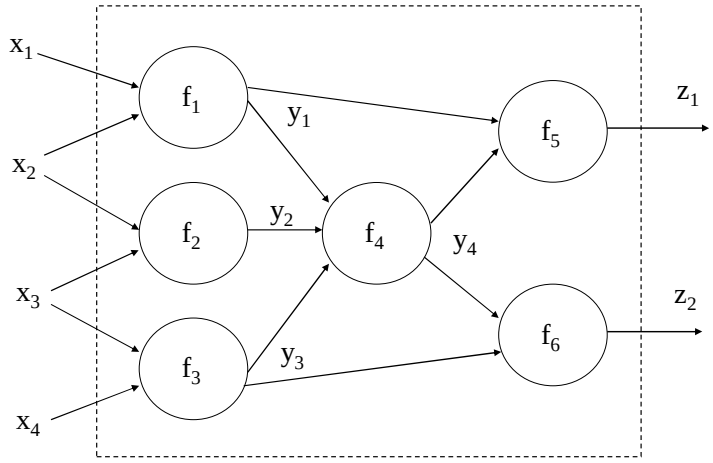

Fig. 1. A Boolean network, where $f_1 = x_1x_2$, $f_2 = x_2 \vee x_3$, $f_3 = \neg(x_3x_4)$, $f_4 = \neg y_1\neg y_2y_3 \vee y_1y_2\neg y_3$, $f_5 = y_1 \vee y_4$, and $f_6 = y_3y_4$.

4 [Complete Flexibility]

Consider the Boolean network of Figure 1. Let $Y = \{y_1, y_2, y_3\}$.

(a) Suppose the XDC for z_1 is $\neg x_1\neg x_2\neg x_3\neg x_4$ and that for z_2 is $x_1x_2x_3x_4$. Write down the specification relation $S(X, Z)$.
(b) What is the influence relation $I(X, y_4, Z)$ of Node 4?
(c) What is the environment relation $E(X, Y)$ of Node 4?
(d) What is the complete flexibility $CF_4(Y, y_4)$ of Node 4?
(e) Is the previously computed don't care set D_4 of Node 4 subsumed by CF_4?