Logic Synthesis & Verification, Fall 2014

National Taiwan University

Problem Set 4

Due on 2014/12/17 before lecture.)

1 [Smallest Cube Containing]

(20%) Prove or disprove the following statements.

(a) $\mathrm{SCC}(c_1 + c_2) = \mathrm{SCC}(c_1) + \mathrm{SCC}(c_2)$, for any cubes c_1 and c_2.
(b) $\mathrm{SCC}(c_1 \cdot c_2) = c_1 \cdot c_2$, for any cubes c_1 and c_2.
(c) $\mathrm{SCC}(c \cdot f) = \mathrm{SCC}(c \cdot f_c) = c \cdot \mathrm{SCC}(f)$, for any cube c and function f.

2 [ESPRESSO - REDUCE]

(20%) Given an incompletely specified function as follows.

$$F = ad'e' + b'c'd' + bce + acde + abd'e' + abcd' + acd'e',$$
$$D = bc'e + ac'de + a'cd'e' + a'bd'e',$$
$$R = de' + b'cd'e + a'b'de,$$

Apply REDUCE based on the unate recursive paradigm as in the lecture notes on the cubes of F in order (from left to right). Show intermediate steps.

3 [ESPRESSO - EXPAND]

(20%) Apply EXPAND (using the procedure in the lecture notes) on the reduced cover derived above by REDUCE. Show intermediate steps.

4 [ESPRESSO - IRREDUNDANT]

(20%) Apply IRREDUNDANT (using the procedure in the lecture notes) on the cover derived above by EXPAND. Show intermediate steps.

5 [ESPRESSO Application]

(20%) Consider the following table with 6 columns a, b, c, d, e, f.

a	b	c	d	e	f
0	1	0	-	0	1
1	1	-	1	0	-
-	0	1	-	-	-
-	-	1	0	-	0
0	-	-	0	-	0

Two columns are called *compatible* if and only if in these two columns every two entries in the same row do not have different polarities (assuming 0 and 1 are of different polarity.) The *minimum compatibility problem* asks to group the columns into a minimum number of compatible sets such that every two columns in the same set are mutually compatible. Formulate the minimum compatibility problem as a two-level minimization problem and use ESPRESSO (downloadable, e.g., from
`http://embedded.eecs.berkeley.edu/pubs/downloads/espresso/index.htm`)
to solve it.

(a) Get the solution with ESPRESSO default option.
(b) Get the exact minimum solution with ESPRESSO "`-Dexact`" option.

How many compatible sets are there? Explain your formulation and attach the PLA files for the input and output of ESPRESSO.

(Hint: Specify the onset and offset constraints related to conditions (1) every column is in some set and (2) incompatible columns must be in different sets, respectively, using the PLA format such that after SOP minimizing the number of cubes corresponds to the number of compatible sets. For PLA file format, see, e.g.,
`http://www.engineering.uiowa.edu/~switchin/OldSwitching/espresso.5.html`
In particular, you may need "`.type fr`" to specify the onset and offset. A detailed description of ESPRESSO usage can be found in
`http://www.engineering.uiowa.edu/~switchin/OldSwitching/espresso.1.html`.)
(Note that, when copy and paste the above URLs to a web browser, the symbol "∼" needs to be retyped.)