Logic Synthesis & Verification, Fall 2013

National Taiwan University

Problem Set 4

Due on 2013/12/13 17:30
(Please put your solution in the instructor's mailbox at EE2 Building.)

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) $\mathrm{SCC}(\neg c) = \neg\mathrm{SCC}(c)$, for any cube c.
(c) $\mathrm{SCC}(c \cdot f) = c \cdot \mathrm{SCC}(f)$, for any function f and cube c.
(d) $\mathrm{SCC}(c \cdot f_c) = c \cdot \mathrm{SCC}(f_c)$, for any function f and cube c.

2 [ESPRESSO - REDUCE]

(20%) Let

$$F = a'b'de + a'b'c'e + a'bce + abc'e + abde + ab'ce,$$
$$D = a'bc'd'e + abcd'e + bce',$$
$$R = a'b'cd'e + a'bc'de + ab'c'e + b'e' + c'e',$$

be the covers of the incompletely specified function (f, d, r), don't care function d, and offset function r, respectively. 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%) Given a map, the *map coloring problem* asks to use a minimum number of colors to color the map such that (1) every country gets one color and (2) adjacent two countries receive different colors. Given the map of Figure 1, formulate the coloring problem as a two-level minimization problem and use ESPRESSO (downloadable, e.g., from
`http://diamond.gem.valpo.edu/~dhart/ece110/espresso/tutorial.html`)
to solve it.

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

How many colors are needed? 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) and (2), respectively, using the PLA format such that after SOP minimizing the number of cubes corresponds to the number of colors. 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.)

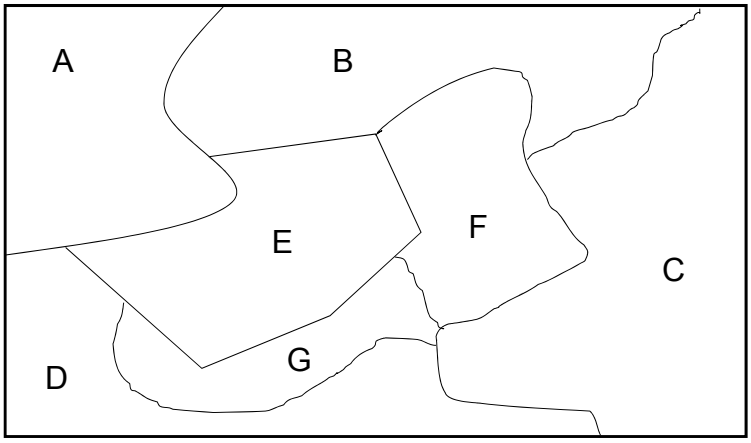

Fig. 1. A map to be colored.