

COE 561, Term 061
Digital System Design and Synthesis
HW# 3

Due date: Tuesday, Dec. 12

Q.1. Consider the logic network defined by the following expressions:

$$X = A B E F + A B G' H' + C D E F + C D G' H' + A' B' C' D';$$
$$Y = A B + C D;$$

- (i) Substitute Y into X by performing the algebraic division X/Y. Show all steps. Determine the number of literals saved.
- (ii) Compare your solution with the result obtained by running the sis command *resub -d* (resubstitute without complement).

Q.2. Consider the following function:

$$X = A C E + A D' E' + B D' E' + B C E + D E + C' E';$$

- (i) Compute all the kernels of X using the recursive kernel computation algorithm. Show all the steps.
- (ii) Compute all the kernels of X based on matrix representation. Compare your answer to the result obtained in (i).
- (iii) Find a quick factor of X by using the first level-0 kernel found. Assume that input variables are sorted in lexicographic order. Determine the number of literals obtained. Compare your solution with the result obtained by running the sis commands *factor -q x; print_factor; print_stats -f*.

Q.3. Consider the logic network defined by the following expressions:

$$X = A B C D + A B C' D' + A B E F' + A B E' F + A B G + A B H + A B K$$
$$+ A B L + C' D G + C D' G + K G' H' + L G' H';$$

- (i) Compute all double-cube divisors of X along with their bases and their weights. Show only double-cube divisors that have non-empty bases.
- (ii) Apply the fast extraction algorithm based on extracting double-cube divisors along with complements or single-cube divisors with two-literals. Show all steps of the algorithm. Determine the number of literals saved. Compare your solution with the result obtained by running the sis commands *fx*.

Q.4. Consider the logic network defined by the following expressions:

$$D = A + B;$$

$$E = A C' + B C;$$

$$F = D E + A' C D';$$

Inputs are {A, B, C} and output is {F}.

- (i) Compute the SDC set for nodes D and E.
- (ii) Compute CDC for the cut including the inputs of functions F.
- (iii) Using the CDC set of node F, simplify the function F.
- (iv) Compute the ODC set for node D based on the simplified network obtained in (iii). Simplify the function of D using its ODC.
- (v) Compute the ODC set for node E based on the simplified network obtained in (iii). Simplify the function of E using its ODC.
- (vi) Apply the sis command *full_simplify* and compare the solution obtained with your obtained solution based on optimizations made in (iii)-(v).