# Logic Synthesis & Verification, Fall 2014

**National Taiwan University**

## Programming Assignment 2

Due on 2014/12/10 before lecture

## 1 [Programming ABC]

Please write in the ABC environment an ALLSAT procedure to convert a given circuit to a disjunctive normal form (DNF) formula. (Note that an ALLSAT procedure aims to generate all satisfying solutions to a given CNF formula.)

Reference: Y. Yu *et al.* All-SAT using minimal blocking clauses. In *Proc. Int'l Conf. on VLSI Design*, 2014.

**Programming task**:

1. Input: A single-output circuit specified by a BLIF file.
2. Output: A DNF expression of the input circuit in the PLA format.
3. Name the command `ckt2dnf`.
4. Write your program in `abc.c` starting with a new function named `Abc_CommandCkt2Dnf`.
5. Use MiniSAT to obtain all satisfying solutions to the given circuit. Please first convert the circuit to an AIG, and then convert the AIG to a CNF formula for SAT solving.
6. Name your output PLA file as `ckt-dnf.pla` for the input file `ckt.blif`.
7. Run Espresso on your generated PLA file to see how much reduction can be achieved.

**Programming help**:

One simple implementation may proceed in the following steps: 1) `strash` the current network into an AIG, 2) convert the AIG into CNF[1], and 3) enumerate all solutions by iteratively adding blocking clauses to the solver. Note that incremental SAT solving[2] using **unit assumptions**[3] may be helpful.

**Items to turn in**:

(1) Your new file `abc.c`
(2) Your output PLA files.

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[1] Procedure `Cnf_DeriveSimple` is recommended for circuit to CNF conversion (easier to understand).

[2] Procedure `Abc_NtkDSat` in `src/base/abci/abcDar.c` shows an example of SAT solver usage.

[3] Unit assumptions can be added in the second and third arguments of `sat_solver_solve` for incremental SAT solving.

(3) A brief description about your implementation, where any effort to enhance computation efficiency should be highlighted. (A 10% bonus credit will be given to implementations with compact PLA outputs.)
(4) A table summarizing your DNF expressions and the ESPRESSO minimized DNF expressions.