ELE523E Computational Nanoelectronics
# Homework 4
Deadline: 20/12/2021 (before 13:30)

1. **GATES WITH TRANSITION FAULTS**
    Consider the circuit shown below. Suppose that each gate produces the incorrect result (i.e., the complement of the correct Boolean value) with an independent transition error probability of ϵ. For each input assignment of x, y and z, derive an expression stating the probability of obtaining an incorrect result at the outputs c and s. Expressions should be in terms of ϵ and/or the inputs x, y, and z. In your expressions, use arithmetic operators (not Boolean). Calculate the expressions by choosing $\epsilon = 0.05$ and determine the worst case input assignments, resulting in the highest error probabilities, for c and s.
    *   Hint: since each of the inputs x, y, and z takes 2 values (0 or 1), there should be total of **8** assignments. Since there are two outputs c and s, you should derive **2** expressions for each assignment corresponding to a row of the truth table.
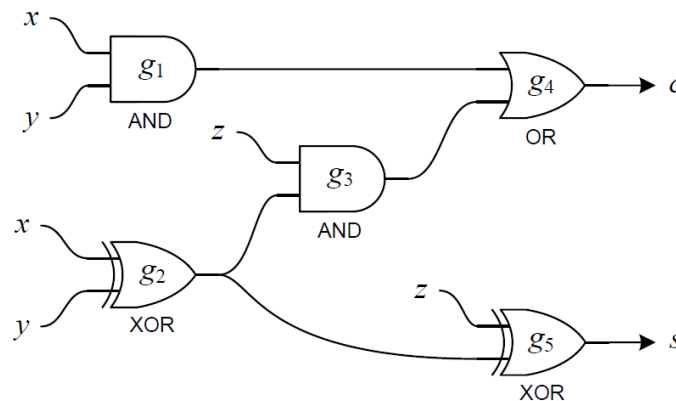
2. **NANO ARRAYS WITH PERMANENT DEFECTS**
    Consider an $n \times n$ reconfigurable nano-crossbar array such that each crosspoint can be selected as a diode or an open circuit. Suppose that in the fabrication process, each crosspoint independently has a permanent stuck at deactivated faults with **defect probability** of $\epsilon = 0.20$. In other words, each crosspoint is stuck at open circuit that cannot behave as a diode anymore with a probability of 20%. You are asked to implement f with a minimum array size (minimum value of n) such that the array has at least 99% accuracy or success rate. It means that in average only 1 out of 100 arrays has an error. Also try to minimize the runtime value; it should under 1 minute.

$$f = x_1 x_2 x_3 + x_1 x_5 + x_2 x_3 x_4 + x_2 x_5 + x_3 x_5 + x_4 x_5$$

    *   Hint: using a Monte Carlo analysis you can assign random defects and evaluate the error at the output for different n values.

Grading: 1)50%, 2)50%
Note: *Submit hard copies before the lecture.*