

# CSE435 Introduction to EDA & Testing - Spring 2022

## Homework Assignment #5

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1. (20%) A circuit has the truth table of Table 1. When there is a fault (faults) on the circuit, the faulty truth table becomes Table 2. Try to derive tests to detect the fault (faults).

| CD \ AB | AB |    |    |    |
|---------|----|----|----|----|
|         | 00 | 01 | 11 | 10 |
| 00      | 1  |    |    |    |
| 01      |    | 1  | 1  |    |
| 11      |    |    |    | 1  |
| 10      |    |    | 1  | 1  |

Table 1

| CD \ AB | AB |    |    |    |
|---------|----|----|----|----|
|         | 00 | 01 | 11 | 10 |
| 00      |    |    |    |    |
| 01      |    | 1  | 1  |    |
| 11      |    |    |    |    |
| 10      | 1  |    | 1  | 1  |

Table 2

**Solution:** Compare two truth tables, we can tell the circuit has stuck-at-0 fault at output when input  $\{A, B, C, D\}$  equals  $\{0, 0, 0, 0\}$  or  $\{1, 0, 1, 1\}$ . The circuit also has stuck-at-1 fault at output when the input equals  $\{0, 0, 1, 0\}$ .

**Answers:**  $\{\{0, 0, 0, 0\}, \{1, 0, 1, 1\}, \{0, 0, 1, 0\}\}$

2. (80%) Generate a test for the fault f-sa1 in Figure 1 by the following FOUR methods. Be sure to give the **key steps to show the features of every algorithm**, and also **draw the decision trees** for each case.

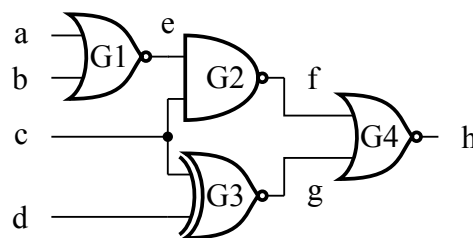


Figure 1

- (a) (20%) Use the **Boolean difference method** to derive all the test patterns to detect the fault f-sa1.

**Solution:** To test the stuck-at-1 fault at  $f$ ,  $f$  must equal 0 to activate the fault. In addition, the fault has to be observable at the output, meaning that the boolean difference of the logic function  $F$  w.r.t.  $f$  should be 1, i.e.,  $F_f(0) \oplus F_f(1) = 1$ .

$$\begin{aligned}
f &= 0 \\
f' &= 1 \\
F_f(0) \oplus F_f(1) &= 1 \\
(f')(F_f(0) \oplus F_f(1)) &= 1 \\
(f')(0 + (c \oplus d)') \oplus (1 + (c \oplus d)') &= 1 \\
(f')(c \oplus d \oplus 0) &= 1 \\
(f')(c \oplus d) &= 1 \\
((a + b)'c)''(c \oplus d) &= 1 \\
((a + b)'c)(c \oplus d) &= 1 \\
a'b'c(c \oplus d) &= 1 \\
a'b'c(cd' + c'd) &= 1 \\
a'b'ccd' + a'b'cc'd &= 1 \\
a'b'cd' &= 1
\end{aligned}$$

**Answer:** The test input for  $\{a, b, c, d\}$  is thus  $\{0, 0, 1, 0\}$ .

- (b) (20%) Generate a test for the fault f-sa1 by using **D-algorithm**.

**Solution:**

- (c) (20%) Generate a test for the fault f-sa1 by using **9-V Algorithm**.

**Solution:**

- (d) (20%) Generate a test for the fault f-sa1 by using **PODEM algorithm**.

**Solution:**