CSE435 Introduction to EDA & Testing - Spring 2022

Homework Assignment #3

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1. (20%) For a D F/F of the following truth table, try to derive a set of function pattern to test this F/F. What functional fault can be detected by your derived pattern.

D	Q_{n+1}
0	0
1	1

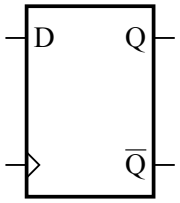


Figure 1: D F/F

Solution: The test pattern can be given as the table below. Each row is a clock tick, and at the initial tick, Q_n is in the don't-care condition. For all the following ticks, Q_n is the Q_{n+1} from the previous tick.

D	Q_{n+1}	Functions
0	0	set 0 (with $Q_n = \times$)
0	0	set 0 (with $Q_n = 0$)
1	1	set 1 (with $Q_n = 0$)
1	1	set 1 (with $Q_n = 1$)
0	0	set 0 (with $Q_n = 1$)

If output does not meet the expectation, a functional fault is detected in the F/F. One of the set-to-0 or set-to-1 functions could not behave properly.

2. (20%) For a T F/F of the following truth table, try to derive a set of function pattern to test this F/F. What functional fault can be detected by your derived pattern.

T	Q_{n+1}
0	Q_n
1	$\overline{Q_n}$

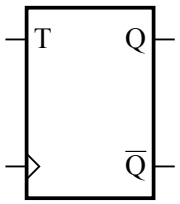


Figure 2: T F/F

Solution: The test pattern can be given as the table below. Each row is a clock tick. Assume $Q_n = 0$ at the initial tick. (Todo: How to make such assumption?) For all the following ticks, Q_n is the Q_{n+1} from the previous tick.

T	Q_{n+1}	Functions
0	0	hold 0
1	1	toggle to 1
0	1	hold 1
1	0	toggle to 0

If output does not meet the expectation, a functional fault is detected in the F/F. One of the hold or toggle to 0/1 functions could not behave properly.

3. (20%) For a J-K F/F of the following truth table, try to derive a set of function pattern to test this F/F. What functional fault can be detected by your derived pattern.

J	K	Q_{n+1}
0	0	Q_n
0	1	0
1	0	1
1	1	$\overline{Q_n}$

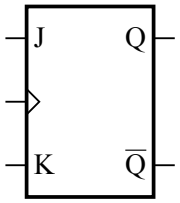


Figure 3: J-K F/F

Solution: The test pattern can be given as the table below. Each row is a clock tick, and at the initial tick, Q_n is in the don't-care condition. For all the following ticks, Q_n is the Q_{n+1} from the previous tick.

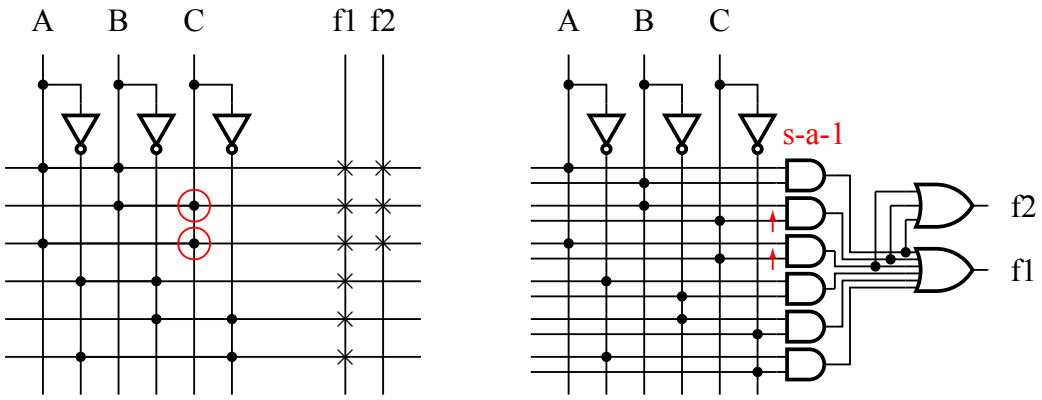
J	K	Q_{n+1}	Functions
0	1	0	set 0
0	0	0	hold 0
1	0	1	set 1
0	0	1	hold 1
1	1	0	toggle to 0
1	1	1	toggle to 1

If output does not meet the expectation, a functional fault is detected in the F/F. One of the set, hold or toggle to 0/1 functions could not behave properly.

4. PLA Faults, Given f1=AB+BC+CA+$\overline{A}\,\overline{B}$+$\overline{B}\,\overline{C}$+$\overline{C}\,\overline{A}$, f2=AB+BC+CA.
(20%) Please draw AND-Array and OR-Array of Missing Crosspoint Faults in AND-OR Plane, and show the equivalent stuck fault representation.

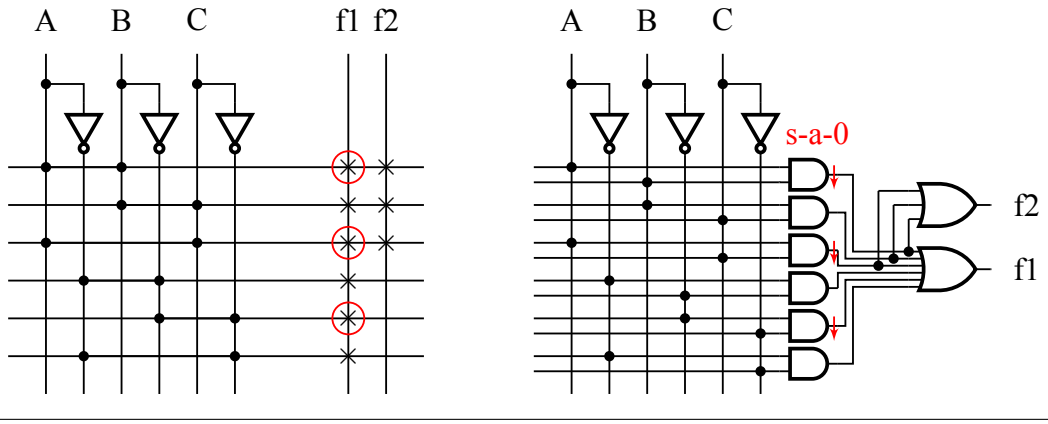
(a) Missing Crosspoint Faults: Missing C in AND Plane.

Solution:



(b) Missing Crosspoint Faults: Missing P1, P3, P5 in f1 in OR Plane.

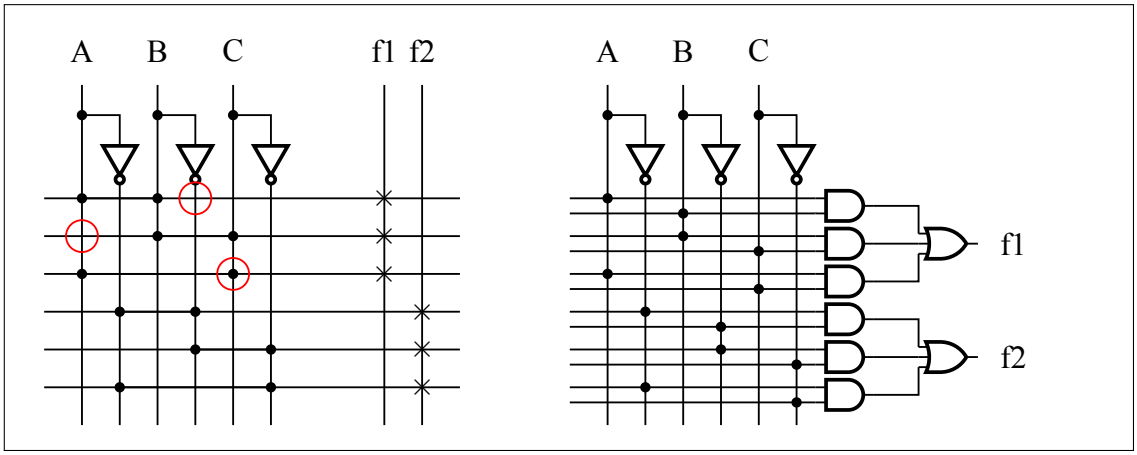
Solution:



5. PLA Faults, Given f1=AB+BC+CA, f2=$\overline{A}\,\overline{B}$+$\overline{B}\,\overline{C}$+$\overline{C}\,\overline{A}$.
(20%) Please draw AND-Array and OR-Array of Extra Crosspoint Faults in AND-OR Plane, and show the equivalent stuck fault representation.

(a) Extra Crosspoint Faults: Extra $\overline{B}$ in P1, A in P2, C in P3 in AND Plane.

Solution:



(b) Extra Crosspoint Faults: Extra P4, P5, P6 in f2 in OR Plane.

Solution: