

CSE 244A

HW #2

Prof Friedman

Problem 2.2

	G_5	G_6	G_7
Normal	1	x	1
	x	1	1
	0	0	0
Faulty	0	0	1
	1	1	1
	0	1	0
	1	0	0

primitive d cubes of f

G_5	G_6	G_7
1	0	D
0	1	D
0	0	$\bar{D}$

Hence the only non-tests
must produce $G_5 = G_6 = 1$

$G_5 = 1$ requires $B = 1$ and $G_2 = 1$

$G_6 = 1$ requires $G_3 = 1$ and $G_4 = 1$

$G_4 = 1$ requires $G_2 = 0$

Contradiction $G_2 = 1$, and $G_2 = 0$.

Hence ~~all~~ there is no input
which does not detect the fault
(i.e. all inputs are tests).

~~Problem 2.2~~

Problem 2.3

First we will try to derive tests which sensitize the fault A s-a-1.

This requires $A=0$. To propagate through G_2

$$\rightarrow G_1 = 0 \rightarrow (C=0 \text{ or } E=0)$$

We can then propagate through G_5 by $B=1$.

If $E=0$ then $G_5=0$ and $G_6=0$ and the fault is propagated to the output.

This leads to the test $\overline{A}B\overline{E} = (0, 1, -, 0)$.

Alternatively if $B=0$ the A s-a-1 fault is propagated through G_6 leading to an error signal D on output of G_5 (D out s-a-0 $\rightarrow D$), and the fault propagates to the output leading to the test $\overline{A}\overline{B}(\overline{C} + \overline{E})$

$$= (0, 0, 0, -), (0, 0, -, 0)$$

We can propagate the A s-a-1 fault through both

G_5 and G_6 (by $B=1, E=1$) but this leads to

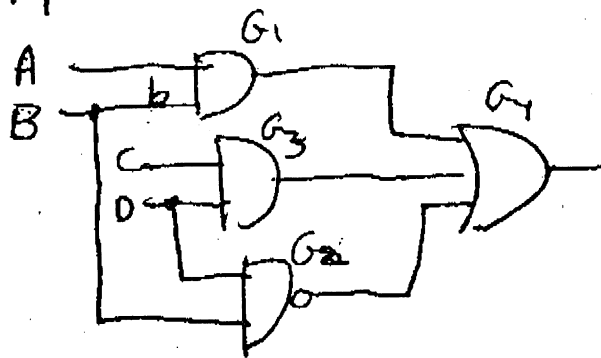
$D + \overline{D} = 1$ at G_1 (errors cancel due to opposite polarity).

By setting $A=1$ we desensitize the fault A s-a-1.

The fault G_6 s-a-0 is sensitized by $G_4 = G_3 = 1$.

However $G_4=1$ implies $G_2=0 \rightarrow A=0$, which is a contradiction. Hence no tests have the value $A=1$.

(3) Problem # 2.4



(a) to detect A s-a-0

$A=1, B=1$ (to propagate through G_1)

$G_2=0, G_3=0$ (to propagate through G_4)

$G_2=0 \rightarrow$ requires $D=1, \underline{B=1}$. $AB\overline{C}D$ is only test

$G_3=0 \rightarrow$ requires $C=0$

(b) Detect b S-a-1

$B=0, A=1$ (to propagate through G_1)

However $B=0$ implies $G_2=1$
which implies $z=1$.

Hence fault is not detectable

(Note G_1 can be removed and replaced by A input to OR gate with no change in output function)

(c) Petrol Gr soil

$G_2 = 0$ requires $B=1, D=1$.

To propagate through G_4 we requires $G_1 = G_3 = 0$.

$G_3 = 0$ implies $C = 0$ (since D has already been set to 1)
 $C = 0$ implies $A = 0$ (since B " " " " ")

$G_1 = 0$ implies $A = 0$ (since $B \neq 0$)

Only test which detects G_2 s-a-1

$$15 \quad \overline{A} \overline{B} \overline{C} D$$

(d) Detect multiple fault b s-a-1, G₂ s-a-1.

(1) sensitize G_2 fault by $B=0=1 \rightarrow G_2 = \overline{D}$

This desensitizes to fault.

hence $\bar{A}\bar{B}\bar{C}D$ detects multiple fault

(2) Sensitize b s-a-1 fault by $B=0$

This desensitizes G_2 fault by produced $G_2 = 1$ but results in $Z = 1$ and does not detect multiple fault.

Hence only $A\bar{B}C0$ detects multiple fault b-s-a-1,
G₂ s-a-1.

Problem 2.5

(a) Tests which detect A s-a-0

$A=1$, $B=1$ (to propagate through G_1)

$G_2=0$ (to propagate through G_4) $\rightarrow B=1$ and $D=1$

$G_3=0$ (to propagate through G_4) $\rightarrow C=0$ or $D=0$

$\therefore$ Test is $AB\bar{C}D = T_\alpha$

Tests which detect G_2 s-a-1

$G_2=0 \rightarrow B=1, D=1$

$G_1=0$ (to propagate through G_4) $\rightarrow A=0$ or $B=0$

$G_3=0$ (to propagate through G_4) $\rightarrow C=0$ or $D=0$

$\therefore$ Test is $\bar{A}B\bar{C}D = T_\beta$

Tests which distinguish A s-a-0 from G_2 s-a-1

$$= T_\alpha \oplus T_\beta = AB\bar{C}D + \bar{A}B\bar{C}D$$

$$= (-1, 0, 1)$$

(b) The test $AB\bar{C}D$ sensitizes both faults but the two errors cancel each other $((D+\bar{D})=1)$ and does not detect the multiple fault

$$f_{\text{normal}} = AB + CD + \bar{B}\bar{D} = AB + CD + \bar{B} + \bar{D}$$

$$= A + C + \bar{B} + \bar{D}$$

$$f'_{\alpha,1} = (0 \cdot B) + CD + 1 = 1 \text{ (multiple fault)}$$

$f \oplus f'_{\alpha,0} = \bar{A}B\bar{C}D$ is only test which detects multiple fault but it does not sensitize A s-a-0 fault.

Problem 2.6

(a) for fault A s-a-1
 $A=0$ ($B=1, C=0$ or $B=0, C=1$)
 to propagate thru G₂ G₃ to propagate thru G₂ G₃

$$T_A = \bar{A}B\bar{C} + \bar{A}\bar{B}C$$

(0,1,0) or (0,0,1)

(b) for fault b s-a-0

$$b=1 \rightarrow C=0, \bar{A}=1 \rightarrow A=0$$

$$T_A = \bar{A}C \rightarrow (0, -, 1)$$

(c) If A=1 both A s-a-1 and b s-a-0 are sensitized, Therefore test for multiple fault requires A=0. If C=0, b s-a-0 fault is desensitized and if B=1 A s-a-1 fault is propagated to the output. Therefore test $\bar{A}B\bar{C} = (0, 1, 0)$ detects the multiple fault. If C=1 the fault A s-a-1 propagates onto b s-a-0 line resulting in error signal D on b. If B=1 A s-a-1 fault also propagates to OR gate resulting in $D+\bar{D}=1$ at output (errors cancel). If B=0 fault on s propagates to output. Therefore test $\bar{A}\bar{B}C = (0, 0, 1)$ also detects multiple fault

$$\text{Check formula} = AB + AC$$

$$f_{A,B}(\text{mult. fault}) = 1 \cdot B + 0 = B + 0 = B$$

$$f \oplus f_{A,B} = \bar{A}B\bar{C} + \bar{A}B\bar{C} \text{ detect multiple fault } A \text{ s-a-1, } b \text{ s-a-0.}$$

$$(d) T_A \oplus T_B = (\bar{A}B\bar{C} + \bar{A}\bar{B}C) \oplus \bar{A}C$$

$$= \bar{A}B\bar{C} + \bar{A}B\bar{C}$$

$$= (0, 1, 0) \quad (0, 1, 1)$$

(0, 1, -) distinguishes 2 faults

$$f_A = B$$

$$f_B = AB$$

$$f_A \oplus f_B = \bar{A}C$$