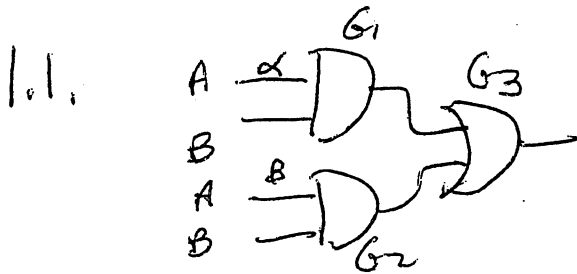


CSE 244A

HW#1 Solution

Prof. A. Friedman



(a)  $G_1$  s-a-0 is undetectable  
as is  $G_2$  s-a-0

(b) Hence these two faults are  
also indistinguishable

$\alpha$  s-a-1 and  $\beta$  s-a-1  
are detectable (Test =  $\overline{A}B$ )  
but are not distinguishable  
since  $f_\alpha = f_\beta = B$

1.2. Impossible

To test for  $S$  s-a-0 the test must have  
a normal value  $S=1$ .

To test for  $S$  s-a-1 the test must have  
a normal value  $S=0$ .

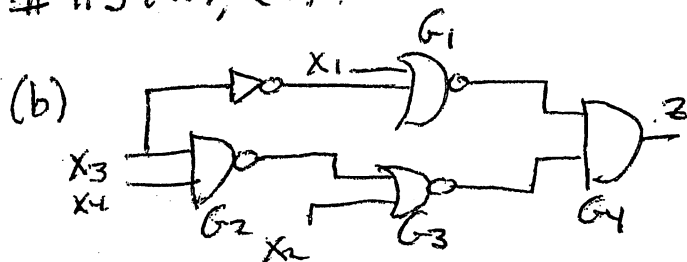
Hence no test  $T$  can detect both  
 $S$  s-a-0 and  $S$  s-a-1.

CS6244A

HW #1 Solution

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# 1.3 (b), (c).



AND Bridge  $G_1$ .

$$\text{Faulty } G_1 \rightarrow \overline{X_1 \cdot X_3} = \overline{X_1} + X_3$$

$$G_3 = \overline{X_2 + G_2} = \overline{X_2} \cdot \overline{G_2}$$

$$\overline{G_2} = \overline{X_3 \cdot X_4} = X_3 + X_4$$

$$G_3 = \overline{X_2} \cdot X_3 \cdot X_4$$

$$Z = G_4 = (\overline{X_1} + X_3) \cdot \overline{X_2} \cdot X_3 \cdot X_4$$

$$= \underline{\overline{X_2} \cdot X_3 \cdot X_4}$$

(c) Multiple Fault

$X_3$  s-a-1  
 $X_2$  s-a-0

Faulty  $G_2 \rightarrow \overline{X_4}$

$$G_1 \rightarrow \overline{X_1}$$

$$G_3 \rightarrow \overline{G_2} = \overline{\overline{X_4}} = X_4$$

$$Z = G_4 = G_1 \cdot G_3 = \overline{X_1} \cdot X_4$$

# 1.4

The normal circuit output is

$$Z = G_1 \cdot G_3$$

$$G_1 = \overline{X_1 + X_3} = \overline{X_1} \cdot \overline{X_3}$$

$$G_3 = \overline{X_2 + G_2} = \overline{X_2} \cdot \overline{G_2}$$

$$\overline{G_2} = \overline{X_3 \cdot X_4}$$

$$G_2 = X_3 \cdot X_4$$

$$G_3 = \overline{X_2} \cdot X_3 \cdot X_4$$

$$Z = \overline{X_1} \cdot \overline{X_3} \cdot \overline{X_2} \cdot X_3 \cdot X_4 = \overline{X_1} \cdot \overline{X_2} \cdot X_3 \cdot X_4$$

With  $X_1$  s-a-0 the output becomes

$$G_1 \rightarrow X_3$$

$$G_3 = \overline{X_2} \cdot X_3 \cdot X_4$$

$$Z' = \overline{X_2} \cdot X_3 \cdot X_4$$

Fault is detected by  $Z \oplus Z'$   
 $= X_1 \cdot \overline{X_2} \cdot X_3 \cdot X_4 = (1, 0, 1, 1)$

None of the tests detect this fault

# 1.5

(a) With  $X_3$  s-a-o  $Z' \rightarrow 0$

(b) With  $x_2$  s-a-o  $z' \rightarrow \bar{x}_1 x_3 x_4$

(C) with  $X_2$  s-a-l  $z' \rightarrow 0$

~~SECRET~~ # 1.6 (b)


$$z'_1 \rightarrow \chi_1 \cdot \overline{\chi_3}$$
$$z_1'' \rightarrow \bar{x}_1 \bar{x}_2 + x_1 x_2$$
$$\begin{aligned} z_1' \oplus z_1'' &= (x_1 \bar{x}_3) \oplus \bar{x}_1 \bar{x}_2 + x_1 x_2 \\ &= x_1 \bar{x}_2 \bar{x}_3 + \bar{x}_1 \bar{x}_2 + x_1 x_2 x_3 \end{aligned}$$

(b)

$$Z_2' \rightarrow \overline{X_3}$$
$$z_2'' \Rightarrow \overline{x_1} \overline{x_2} + x_1 \overline{x_2} + x_2 = 1$$
$$\mathbb{Z}_2^{12} \oplus \mathbb{Z}_2^{11} = \overline{X_3} \oplus 1 = X_3$$