Homework Assignment 10

(Due Apr. 28th at the beginning of the class)

1. [Testing, **30 points**] Find all input vectors that can detect the following stuck-fault errors.

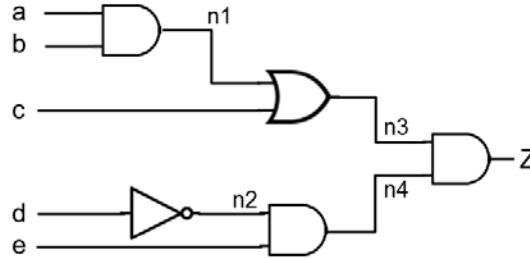
a
b
n1
c
n3
Z
n4
d
n2
e

$$Z = (a\cdot b + c)\cdot(\bar{d}\cdot e)$$

1) a s-a-0: $Z_f = c\cdot\left(\bar{d}\cdot e\right) \Longrightarrow Z \oplus Z_f = \left\{(a\cdot b + c)\cdot\left(\bar{d}\cdot e\right)\right\} \oplus \left\{c\cdot\left(\bar{d}\cdot e\right)\right\} = 1 \Longrightarrow (a\ b\ c\ d\ e) = (1\ 1\ 0\ 0\ 1)$
2) a s-a-1: $Z_f = (b + c)\cdot\left(\bar{d}\cdot e\right) \Longrightarrow Z \oplus Z_f = \left\{(a\cdot b + c)\cdot\left(\bar{d}\cdot e\right)\right\} \oplus \left\{(b + c)\cdot\left(\bar{d}\cdot e\right)\right\} = 1 \Longrightarrow (a\ b\ c\ d\ e) = (0\ 1\ 0\ 0\ 1)$
3) b s-a-0: $(a\ b\ c\ d\ e) = (1\ 1\ 0\ 0\ 1)$
4) b s-a-1: $(a\ b\ c\ d\ e) = (1\ 0\ 0\ 0\ 1)$
5) c s-a-0: $Z_f = (a\cdot b)\cdot\left(\bar{d}\cdot e\right) \Longrightarrow Z \oplus Z_f = \left\{(a\cdot b + c)\cdot\left(\bar{d}\cdot e\right)\right\} \oplus \left\{(a\cdot b)\cdot\left(\bar{d}\cdot e\right)\right\} = 1 \Longrightarrow (a\ b\ c\ d\ e) = (0\ 0\ 1\ 0\ 1), (0\ 1\ 1\ 0\ 1), (1\ 0\ 1\ 0\ 1)$
6) c s-a-1: $Z_f = \left(\bar{d}\cdot e\right) \Longrightarrow Z \oplus Z_f = \left\{(a\cdot b + c)\cdot\left(\bar{d}\cdot e\right)\right\} \oplus \left\{\left(\bar{d}\cdot e\right)\right\} = 1 \Longrightarrow (a\ b\ c\ d\ e) = (0\ 0\ 0\ 0\ 1), (0\ 1\ 0\ 0\ 1), (1\ 0\ 0\ 0\ 1)$
7) d s-a-0: $Z_f = (a\cdot b + c)\cdot(e) \Longrightarrow Z \oplus Z_f = \left\{(a\cdot b + c)\cdot\left(\bar{d}\cdot e\right)\right\} \oplus \left\{(a\cdot b + c)\cdot(e)\right\} = 1 \Longrightarrow (a\ b\ c\ d\ e) = (1\ 1\ 0\ 1\ 1), (1\ 1\ 1\ 1\ 1), (0\ 0\ 1\ 1\ 1), (0\ 1\ 1\ 1\ 1), (1\ 0\ 1\ 1\ 1)$
8) d s-a-1: $Z_f = 0 \Longrightarrow Z \oplus Z_f = \left\{(a\cdot b + c)\cdot\left(\bar{d}\cdot e\right)\right\} \oplus \{0\} = 1 \Longrightarrow (a\ b\ c\ d\ e) = (1\ 1\ 0\ 0\ 1), (1\ 1\ 1\ 0\ 1), (0\ 0\ 1\ 0\ 1), (0\ 1\ 1\ 0\ 1), (1\ 0\ 1\ 0\ 1)$
9) n1 s-a-0: $Z_f = c\cdot\left(\bar{d}\cdot e\right) \Longrightarrow (a\ b\ c\ d\ e) = (1\ 1\ 0\ 0\ 1)$
10) n1 s-a-1: $Z_f = \left(\bar{d}\cdot e\right) \Longrightarrow (a\ b\ c\ d\ e) = (0\ 0\ 0\ 0\ 1), (0\ 1\ 0\ 0\ 1), (1\ 0\ 0\ 0\ 1)$
11) n2 s-a-0: $Z_f = 0 \Longrightarrow (a\ b\ c\ d\ e) = (1\ 1\ 0\ 0\ 1), (1\ 1\ 1\ 0\ 1), (0\ 0\ 1\ 0\ 1), (0\ 1\ 1\ 0\ 1), (1\ 0\ 1\ 0\ 1)$
12) n2 s-a-1: $Z_f = (a\cdot b + c)\cdot(e) \Longrightarrow (a\ b\ c\ d\ e) = (1\ 1\ 0\ 1\ 1), (1\ 1\ 1\ 1\ 1), (0\ 0\ 1\ 1\ 1), (0\ 1\ 1\ 1\ 1), (1\ 0\ 1\ 1\ 1)$
13) n3 s-a-0: $Z_f = 0 \Longrightarrow (a\ b\ c\ d\ e) = (1\ 1\ 0\ 0\ 1), (1\ 1\ 1\ 0\ 1), (0\ 0\ 1\ 0\ 1), (0\ 1\ 1\ 0\ 1), (1\ 0\ 1\ 0\ 1)$
14) n3 s-a-1: $Z_f = \left(\bar{d}\cdot e\right) \Longrightarrow (a\ b\ c\ d\ e) = (0\ 0\ 0\ 0\ 1), (0\ 1\ 0\ 0\ 1), (1\ 0\ 0\ 0\ 1)$

15) n4 s-a-0:

$Z_f = 0 \implies (a\ b\ c\ d\ e) = (1\ 1\ 0\ 0\ 1), (1\ 1\ 1\ 0\ 1), (0\ 0\ 1\ 0\ 1), (0\ 1\ 1\ 0\ 1), (1\ 0\ 1\ 0\ 1)$