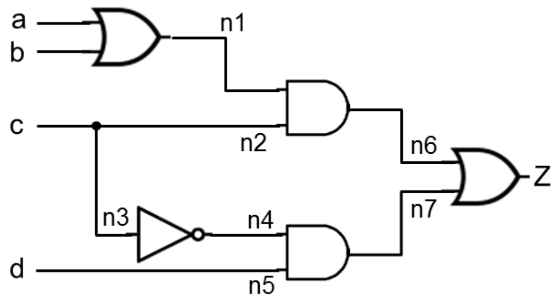
Homework Assignment 9

(Due Apr. 25th at the beginning of the class)

1. [Testing, **20 points**] Find all input vectors that can detect the following stuck-fault errors.



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

- a s-a-0: $Z \oplus Z_f = \{(a + b)c + \bar{c}d\} \oplus \{bc + \bar{c}d\} = 1 \;\Longrightarrow\; abcd = 101*$
- a s-a-1: $Z \oplus Z_f = \{(a + b)c + \bar{c}d\} \oplus \{c + \bar{c}d\} = 1 \;\Longrightarrow\; abcd = 001*$
- b s-a-0: $Z \oplus Z_f = \{(a + b)c + \bar{c}d\} \oplus \{ac + \bar{c}d\} = 1 \;\Longrightarrow\; abcd = 011*$
- b s-a-1: $Z \oplus Z_f = \{(a + b)c + \bar{c}d\} \oplus \{c + \bar{c}d\} = 1 \;\Longrightarrow\; abcd = 001*$
- c s-a-0: $Z \oplus Z_f = \{(a + b)c + \bar{c}d\} \oplus \{d\} = 1 \;\Longrightarrow\; abcd = 1010, 0110, 1110, 0011$
- c s-a-1: $Z \oplus Z_f = \{(a + b)c + \bar{c}d\} \oplus \{a + b\} = 1 \;\Longrightarrow\; abcd = 0001, 0100, 1000, 1100$
- d s-a-0: $Z \oplus Z_f = \{(a + b)c + \bar{c}d\} \oplus \{(a + b)c\} = 1 \;\Longrightarrow\; abcd =** 01$
- d s-a-1: $Z \oplus Z_f = \{(a + b)c + \bar{c}d\} \oplus \{(a + b)c + \bar{c}\} = 1 \;\Longrightarrow\; abcd =** 00$
- n1 s-a-0: $Z \oplus Z_f = \{(a + b)c + \bar{c}d\} \oplus \{\bar{c}d\} = 1 \;\Longrightarrow\; abcd = 101*, 011*, 111*$
- n1 s-a-1: $Z \oplus Z_f = \{(a + b)c + \bar{c}d\} \oplus \{c + \bar{c}d\} = 1 \;\Longrightarrow\; abcd = 001*$
- n2 s-a-0: $Z \oplus Z_f = \{(a + b)c + \bar{c}d\} \oplus \{\bar{c}d\} = 1 \;\Longrightarrow\; abcd = 101*, 011,* \; 111*$
- n2 s-a-1: $Z \oplus Z_f = \{(a + b)c + \bar{c}d\} \oplus \{(a + b) + \bar{c}d\} = 1 \;\Longrightarrow\; abcd = 100*, 010*$ $, 110*$
- n3 s-a-0: $Z \oplus Z_f = \{(a + b)c + \bar{c}d\} \oplus \{(a + b)c + d\} = 1 \;\Longrightarrow\; abcd = 0011$
- n3 s-a-1: $Z \oplus Z_f = \{(a + b)c + \bar{c}d\} \oplus \{(a + b)c\} = 1 \;\Longrightarrow\; abcd =** 01$
- n4 s-a-0: $Z \oplus Z_f = \{(a + b)c + \bar{c}d\} \oplus \{(a + b)c\} = 1 \;\Longrightarrow\; abcd =** 01$
- n4 s-a-1: $Z \oplus Z_f = \{(a + b)c + \bar{c}d\} \oplus \{(a + b)c + d\} = 1 \;\Longrightarrow\; abcd = 0011$
- n5 s-a-0: $Z \oplus Z_f = \{(a + b)c + \bar{c}d\} \oplus \{(a + b)c\} = 1 \;\Longrightarrow\; abcd =** 01$
- n5 s-a-1: $Z \oplus Z_f = \{(a + b)c + \bar{c}d\} \oplus \{(a + b)c + \bar{c}\} = 1 \;\Longrightarrow\; abcd =** 00$
- n6 s-a-0: $Z \oplus Z_f = \{(a + b)c + \bar{c}d\} \oplus \{\bar{c}d\} = 1 \;\Longrightarrow\; abcd = 101*, 011*, 111*$
- n6 s-a-1: $Z \oplus Z_f = \{(a + b)c + \bar{c}d\} \oplus \{1\} = 1 \;\Longrightarrow\; abcd =** 00, 001*$
- n7 s-a-0: $Z \oplus Z_f = \{(a + b)c + \bar{c}d\} \oplus \{(a + b)c\} = 1 \;\Longrightarrow\; abcd =** 01$
- n7 s-a-1: $Z \oplus Z_f = \{(a + b)c + \bar{c}d\} \oplus \{1\} = 1 \;\Longrightarrow\; abcd =** 00, 001*$

- Z s-a-0: $Z \oplus Z_f = \{(a+b)c + \bar{c}d\} \oplus \{0\} = 1 \quad \Longrightarrow \quad abcd = {*}{*}\,01, 101{*}, 011{*}, 111{*}$
- Z s-a-1: $Z \oplus Z_f = \{(a+b)c + \bar{c}d\} \oplus \{1\} = 1 \quad \Longrightarrow \quad abcd = {*}{*}\,00, 001{*}$