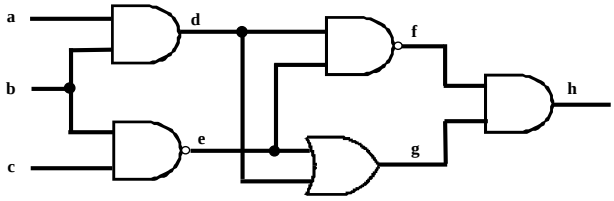
The University of Alabama in Huntsville
ECE Department
CPE 628 01
Fall 2008
Homework #4 Solution

4.13(15), 4.15(10), 4.17(20), 4.20(20), 4.31(25), 4.33(10)

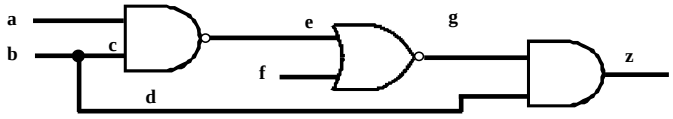
4.13 Given the circuit shown, consider only indirect implications.



a. What are all the implications for g = 0?
b. What are all the implications for f = 0?

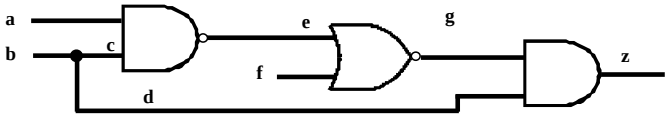
(a) The implications for g=0 include {a=0, b=1, c=1, d=0, e=0, f=1, g=0, h=0}
(b) The implications for f=0 include {a=1, b=1, c=0, d=1, e=1, f=0, g=1, h=0}

4.14 Consider the circuit shown. Suppose justifying e = 1 via a = 0 is not possible due to some prespecified constraints. Perform all dynamic implications for all signals based on the knowledge of this constraints.



Since justifying e=1 via a=0 is not possible, it must be justified via b=0. Thus, e=1 $\rightarrow$ b=0 is a dynamically learned implication.

4.17 Consider the circuit shown.

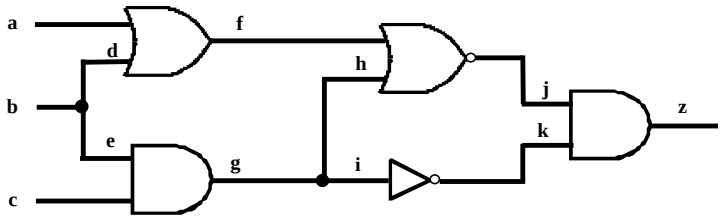


a. Compute the static logic implications of b = 0.
b. Compute the static logic implications of b = 1.
c. Compute the set of faults that are untestable when b = 0.
d. Compute the set of faults that are untestable when b = 1.
e. Compute the set of untestable faults based on the stem analysis of b.

(a) The static logic implications of b=0 include {b=0, c=0, d=0, e=1, g=0, z=0}
(b) The static logic implications of b=1 include {b=1, c=1, d=1}
(c) The set of faults that are untestable when b=0 is {b/0, c/0, d/0, e/1, g/0, z/0, a/0, a/1, f/0, f/1, d/1, g/1, e/0, c/1}
(d) The set of faults that are untestable when b=1 is {b/1, c/1, d/1}
(e) The set of untestable faults based on the stem analysis of b is the intersection of the (c) and (d), which is {c/1, d/1}

4.20 Consider the circuit shown and use PODEM to generate a vector for each of the following faults:

a. k/1
b. k/0
c. g/1
d. g/0



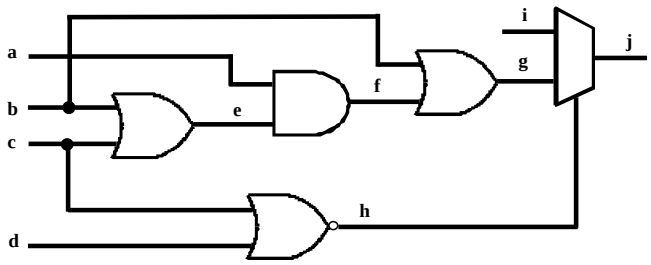
Objective	Backtrace	Assignment	Implications	Decision Tree
(k, 0)	(i, 1), (g, 1), (e, 1), (c, 1), (b, 1)	c = 1		c = 1
(k, 0)	(i, 1), (g, 1), (e, 1), (b, 1)	b = 1	d = 1, e = 1, f = 1, g = 1, h = 1, j = 0, i = 1, k = D', z = 0	c = 1, b = 1
		b = 0	d = 0, e = 0, g = 0, i = 0, k = 1, no excitation	c = 1, b = 0
		c = 0	g = 0, i = 0, k = 1, no excitation	c = 0
No further options available, fault redundant				

Objective	Backtrace	Assignment	Implications	Decision Tree
(k, 1)	(i, 0), (g, 0), (c, 0)	c = 0	e = 0, h = 0, i = 0, k = D	c = 0
(j, 1)	(f, 0), (a, 0), (d, 0), (b, 0)	b = 0	d = 0, e = 0	c = 0, b = 0
(j, 1)	(f, 0), (a, 0)	a = 0	f = 0, j = 1, z = D	c = 0, b = 0, a = 0
Test vector is (a, b, c) = (0, 0, 0)				

Objective	Backtrace	Assignment	Implications	Decision Tree
(g, 0)	(c, 0)	c = 0	g = D', h = D', i = D', k = D	c = 0
(j, 0)	(f, 0), (h, 0)		Conflict, pick another gate from D frontier	c = 0
(f, 0)	(a, 0), (d, 0), (b, 0)	a = 0		c = 0, a = 0
(f, 0)	(d, 0), (b, 0)	b = 0	f = 0, j = D, z = D	c = 0, a = 0, b = 0
Test vector is (a, b, c) = (0, 0, 0)				

Objective	Backtrace	Assignment	Implications	Decision Tree
(g, 1)	(e, 1), (c, 1), (b, 1)	c = 1		c = 1
(g, 1)	(e, 1), (b, 1)	b = 1	d = 1, e = 1, f = 1, g = D, h = D, I = D, k = D', j = 0, z = 0, no path	c = 1, b = 1
		b = 0	d = 0, e = 0, g = 0, no excitation	c = 1, b = 0
		c = 0	g = 0, no excitation	c = 0
No further options available, fault redundant				

4.31 Consider the circuit fragment shown.



a. Generate all paths in the circuit. How many paths are there in this circuit?
b. Which paths are functionally unsensitizable?
c. For those sensitizable paths, which ones are robustly testable, and which ones are nonrobustly testable?

(a) There are 14 paths in the circuit: ↑ afgj, ↓ afgj, ↑ bgj, ↓ bgj, ↑ befgj, ↓ befgj, ↑ cefgj, ↓ cefgj, ↑ chj, ↓ chj, ↑ dhj, ↓ dhj, ↑ ij, ↓ ij.

(b) Both ↑ afgj and ↓ afgj are unsensitizable. In both cases, a 1 is needed on e to propagate from a to f. A 1 on e can be accomplished be either setting b to 1 or setting C to 1. A 1 on b would block propagation from f to g and a 1 on c would block propagation from g to j by selecting the 0

(c) input of the multiplexer.

(d) ↑ bgj, ↓ bgj, ↓ befgj, ↑ chj, ↓ chj, ↑ dhj, ↓ dhj, ↑ ij, ↓ ij are all robustly testable

↑ befgj, ↓ cefgj are non-robustly testable

↑ cefgj is not testable

4.31 Construct the table for the XNOR operation for the 5-valued system similar to Tables 4.12, 4.13, and 4.14.

XNOR	S0	U0	S1	U1	XX
S0	S1	U1	S0	U0	XX
U0	U1	U1	U0	U0	XX
S1	S0	U0	S1	U1	XX
U1	U0	U0	U1	U1	XX
XX	XX	XX	XX	XX	XX