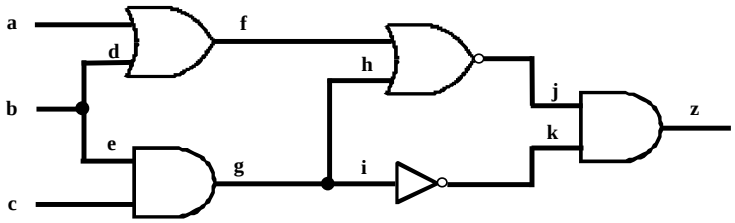
The University of Alabama in Huntsville
ECE Department
CPE 628 01
Fall 2008
Homework #5a Solution

Consider the following circuit.



a. Generate all paths in the circuit. How many paths are there in this circuit? The paths are ↑afjz, ↓afjz, ↑bdfjz, ↓bdfjz, ↑beghjz, ↓beghjz, ↑begikz, ↓begikz, ↑cghjz, ↓cghjz, ↑cgikz, ↓cgikz, 12 paths
b. Which paths are functionally unsensitizable? ↑cghjz, ↓cghjz, ↑cgikz, ↓cgikz
c. For those sensitizable paths, which ones are robustly testable, and which ones are nonrobustly testable

↑afjz a nc-c d = S0
f nc-c h = S0
j nc-c k = S1
robustly testable

↓afjz a c-nc d = X0
f c-nc h = X0
j c-nc k = X1
robustly testable

↑bdfjz b,d nc-c a = S0
f nc-c h = S0
j nc-c k = S1
robustly testable

↓bdfjz b, d c-nc a = X0
f c-nc h = X0
j c-nc k = X1
robustly testable

↑beghjz b,e c-nc c = X1 b,e c-nc c = X1
g, h nc-c f = S0 g, h nc-c f = S0
j nc-c k = S1 j nc-c k = S1
neither robustly testable nor non-robustly testable

↓beghjz b,e nc-c c = S1
g, h c-nc f = X0
j c-nc k = X1
robustly testable

↑begikz b, e c-nc c = X1
k nc-c j = S1
neither robustly testable nor non-robustly testable

↓begikz b, e nc-c c = S1
k c-nc j = X1
robustly testable

4.35 Consider the dictionary of excited and detected stuck-at faults of a test set shown in Table 4.18. Construct the smallest set of vectors that can detect as many transition faults as possible using only these seven stuck-at vectors.

Vectors	Excited Faults	Detected Faults
V_1	a/0, b/0, c/0, d/0	e/1, f/1
V_2	c/0, f/0, g/0, h/0	e/1, f/1
V_3	d/0, e/0, h/0, i/0	a/1, b/1, c/1, f/1, g/1
V_4	a/0, b/0, g/0, i/0	d/1, e/1, f/1
V_5	c/0, d/0, g/0	a/1, d/1, h/1, i/1
V_6	d/0, e/0, i/0	a/1, b/1, c/1, f/1, g/1
V_7	b/0, g/0	e/1, i/1

Pattern Pair	Delay Faults Detected	Pattern Pair	Delay Faults Detected
V_1-V_2	**None**	**V_4-V_5**	**a slow-to-fall**
V_2-V_3	**c slow-to-fall**		**i slow-to-fall**
	f slow-to-fall	**V_5-V_6**	**c slow-to-fall**
	g slow-to-fall		**g slow-to-fall**
V_3-V_4	**d slow-to-fall**	**V_6-V_7**	**e slow-to-fall**
	e slow-to-fall		**i slow-to-fall**

The faults that remain undetected after applying the seven pattern sequence include:
b stf, h stf, a str, b str, c str, d str, e str, f str, g str, h str, i str , where stf is slow-to-fall and str is slow-to-rise

For these undetected faults, consider other vector pairs

Pattern Pair	Delay Faults Detected	Pattern Pair	Delay Faults Detected
V_1-V_3	**b slow-to-fall**	**V_4-V_6**	**b slow-to-fall**
V_1-V_4	**None**	**V_4-V_7**	**None**
V_1-V_5	**None**		
V_1-V_6	**b slow-to-fall**	**V_5-V_1**	**None**
V_1-V_7	**None**	**V_5-V_2**	**None**
		V_5-V_3	**None**
V_2-V_1	**None**	**V_5-V_4**	**None**
V_2-V_4	**None**	**V_5-V_7**	**None**
V_2-V_5	**h slow-to-fall**		
V_2-V_6	**None**	**V_6-V_1**	**None**
V_2-V_7	**None**	**V_6-V_2**	**None**
		V_6-V_3	**None**
V_3-V_1	**None**	**V_6-V_4**	**None**
V_3-V_2	**None**	**V_6-V_5**	**None**
V_3-V_5	**h slow-to-fall**		
V_3-V_6	**None**	**V_7-V_1**	**None**
V_3-V_7	**None**	**V_7-V_2**	**None**
		V_7-V_3	**b slow-to-fall**
V_4-V_1	**None**	**V_7-V_4**	**None**
V_4-V_2	**None**	**V_7-V_5**	**None**
V_4-V_3	**b slow-to-fall**	**V_7-V_6**	**b slow-to-fall**

Two pattern pairs are needed to detect the additional two delay faults.
So, use {V_1, V_2, V_3, V_4, V_5, V_6, V_7, V_1, V_3, V_5,}