

Diagnosis

- Introduction
- Logic Diagnosis
 - ♦ SSF diagnosis
 - ♦ Delay fault diagnosis
 - ♦ Unmodeled / multiple fault diagnosis *(not in exam)
- Scan Chain Diagnosis
- Failure Analysis
- Conclusions

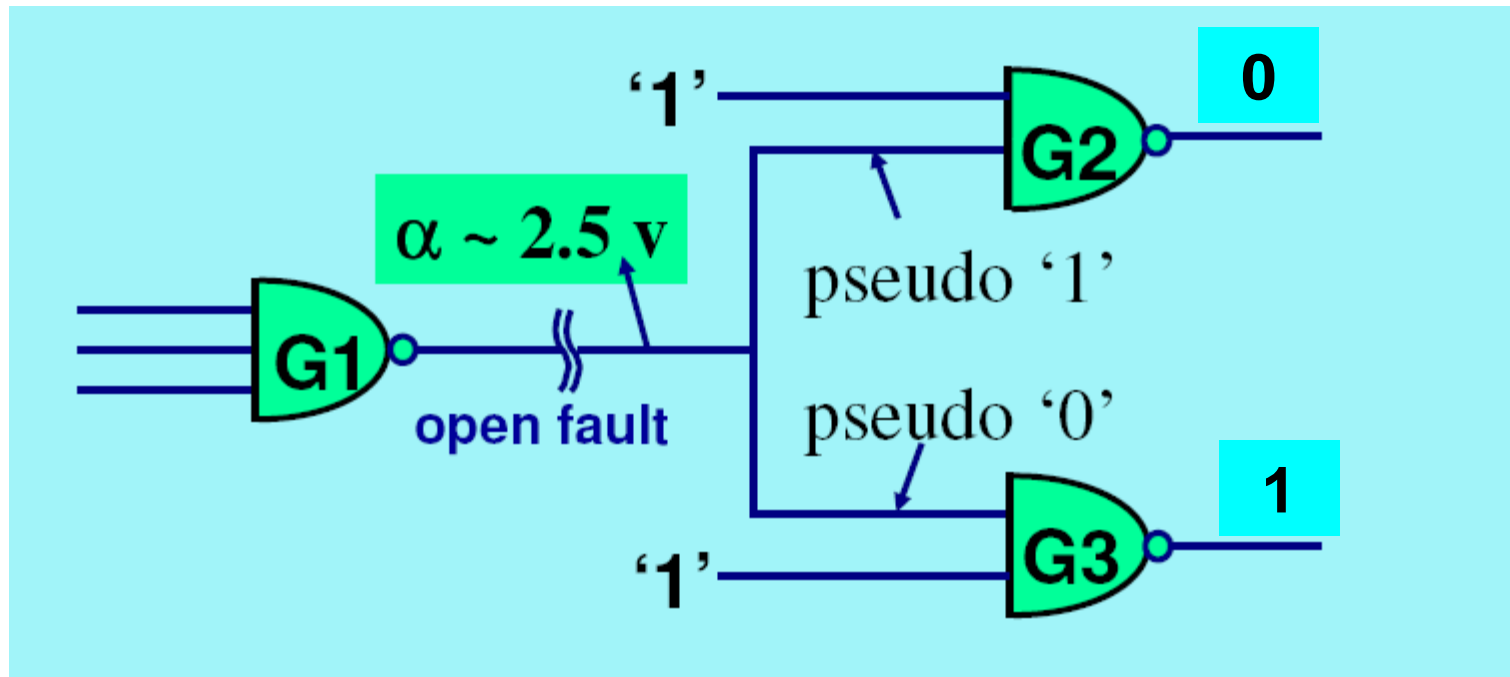


Unmodeled Defects

- Cannot find simulation failures of single fault explain all test failures
- Possible reasons
 - ◆ 1. Defect behavior hard to predict
 - * Example: *Byzantine general's problem*
 - ◆ 2. Multiple faults
 - * Exhaustive search all multiple faults is impossible
 - ◆ 3. Many fault models
 - * Exhaustive trial of all fault models is impossible
- Solution: heuristic methods
 - ◆ Single Location at a Time (SLAT) [Bartenstein 01]
 - ◆ Inject and Cure [Huang 97]

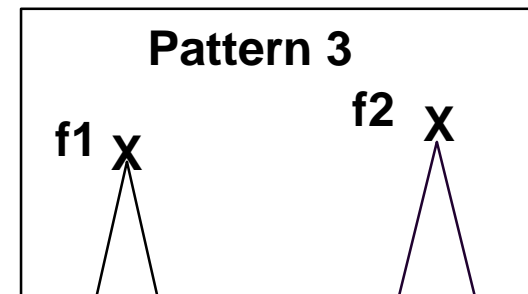
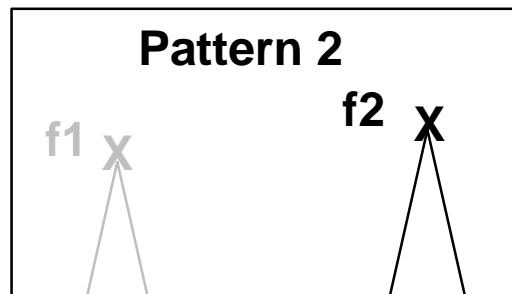
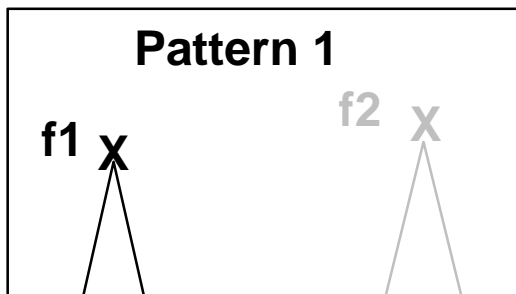
Byzantine Generals Problem

- Open or bridging faults on fanout stem
 - ♦ Faulty values on fanout branches may not be the same
- (WWW CH7), assume $V_{DD}=5V$
 - ♦ G2 and G3 have different threshold voltage



Single Location at a time, *SLAT* [Bartenstein 01]

- Diagnosis procedure
 - ◆ 1. For every failing pattern
 - * find a fault whose $SF = TF$
 - If succeed → *SLAT pattern*, insert fault to set U
 - Else → not SLAT pattern
 - ◆ 2. For all failing patterns
 - * Find a minimum subset of U that covers all failing patterns
- Example:
 - ◆ pattern 1 and pattern 2 are SLAT pattern
 - ◆ Pattern 3 is not SLAT pattern



Example

- pattern 1: 1sa1, 4o sa0 → SLAT pattern
- pattern 3: 2 sa0 , 4o sa1 → SLAT pattern
- pattern 4: no SSF → not SLAT pattern
- $U = \{1sa1, 4o sa0, 2 sa0, 4o sa1\}$
- Diagnosed fault list = {1 sa1, 2 sa0}

	faults	pattern1		pattern2		pattern3		pattern4	
		7	8	7	8	7	8	7	8
1	1 sa1	X	X					X	
2	2 sa0					X	X		X
3	2 sa1			X	X				
4	3 sa1		X						
5	4o sa0	X	X	X	X			X	
6	4o sa1; 4i2 sa0; 1sa0					X	X		
7	4i2 sa1			X	X				
8	5o sa1; 3 sa0; 5i1 sa0								X
...	...								
	Test Failures	X	X			X	X	X	X

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Diagnosis Pattern Generation

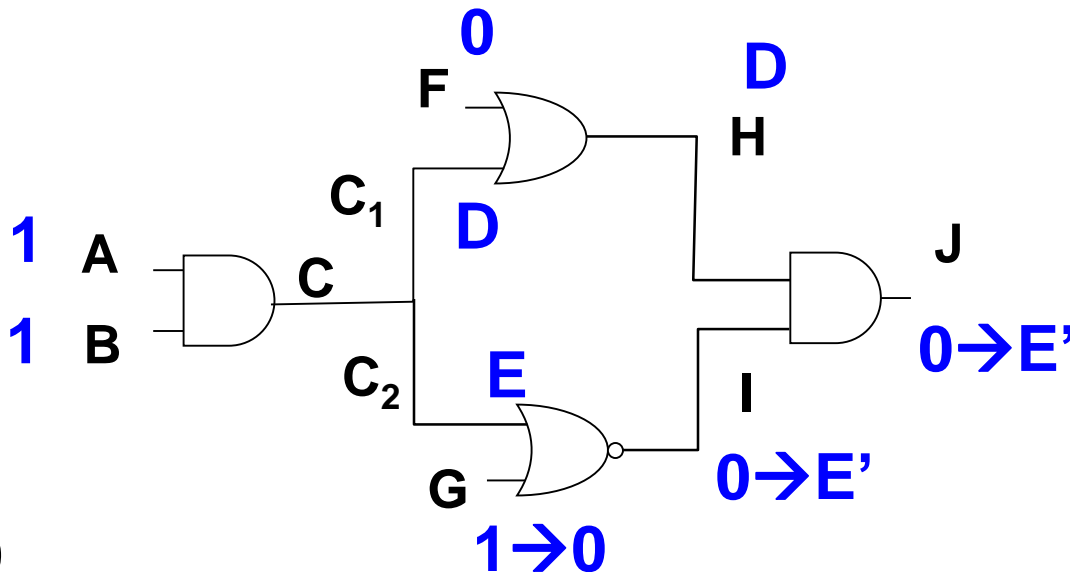
- Diagnosis patterns are specific purpose patterns
 - ◆ To improve *diagnosis resolution*
- *Iterative (aka. adaptive) diagnosis* is some times required
 - ◆ Collect data, DPG, collect more data, DPG again ...
- DPG becomes popular only recently
 - ◆ Enabled by on-line pattern generation on ATE

Diagnosis Resolution

- Degree of accuracy to which faults can be distinguished
- Two faults α and β can be *distinguished* if
 - ♦ outputs with fault $\alpha \neq$ outputs with fault β
- Two measures (ABF Ch 12)
 - ♦ Maximal fault resolution of a circuit
 - * Partitions of equivalent fault classes
 - * Limited by circuit structure
 - ♦ Fault resolution of a test set
 - * Partition of distinguishable faults
 - * Can be improved by generating test patterns for diagnosis purpose → diagnosis pattern generation

Diagnosis Pattern Gen. Example

- $C_1/0$ and $C_2/0$ are not equivalent
- DE-algorithm (ABF Example 12.3)
 - ♦ Assign $A=1, B=1 \rightarrow C_1 = D, C_2 = E$
 - ♦ Propagate $D \rightarrow$ assign $F=0$
 - ♦ Prevent $E \rightarrow$ assign $G=1 \rightarrow I = 0, J=0 \rightarrow D$ disappear
 - ♦ Backtrack, assign $G=0 \rightarrow I = E' \rightarrow J = E'$
 - ♦ Test generated ABFG = {1100}



OR

	E	E'
D	1	D
D'	E	D', E'

AND

	E	E'
D	D, E	E'
D'	D'	0