

Diagnosis of Errors from Compacted Test Response

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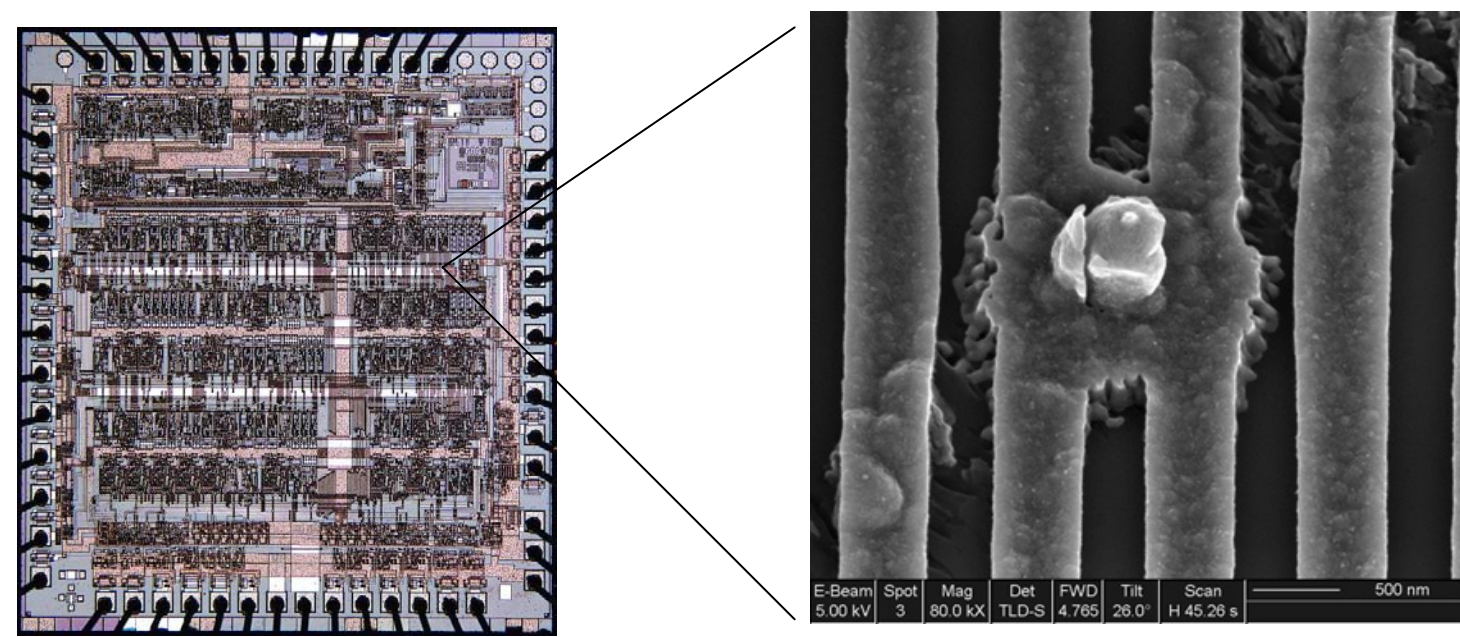
Outline

- Introduction and Motivation.
- Challenge of error diagnosis.
- Diagnosis using dictionaries.
 - Method.
 - Performance evaluation.
- Conclusion and Future work.

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Introduction

- Manufacturing test and debug of IC chips.



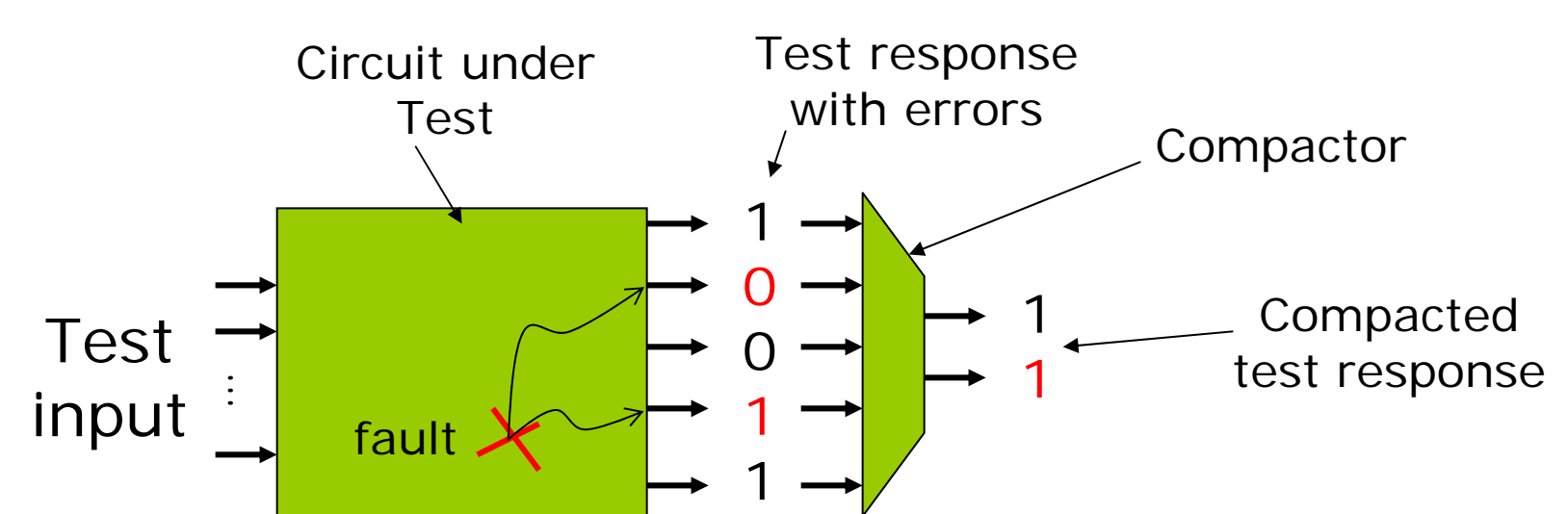
Circuit layout

Defect

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Motivation

- Goal: identify fault location from test response.



- Problem: identify errors from compacted test response.

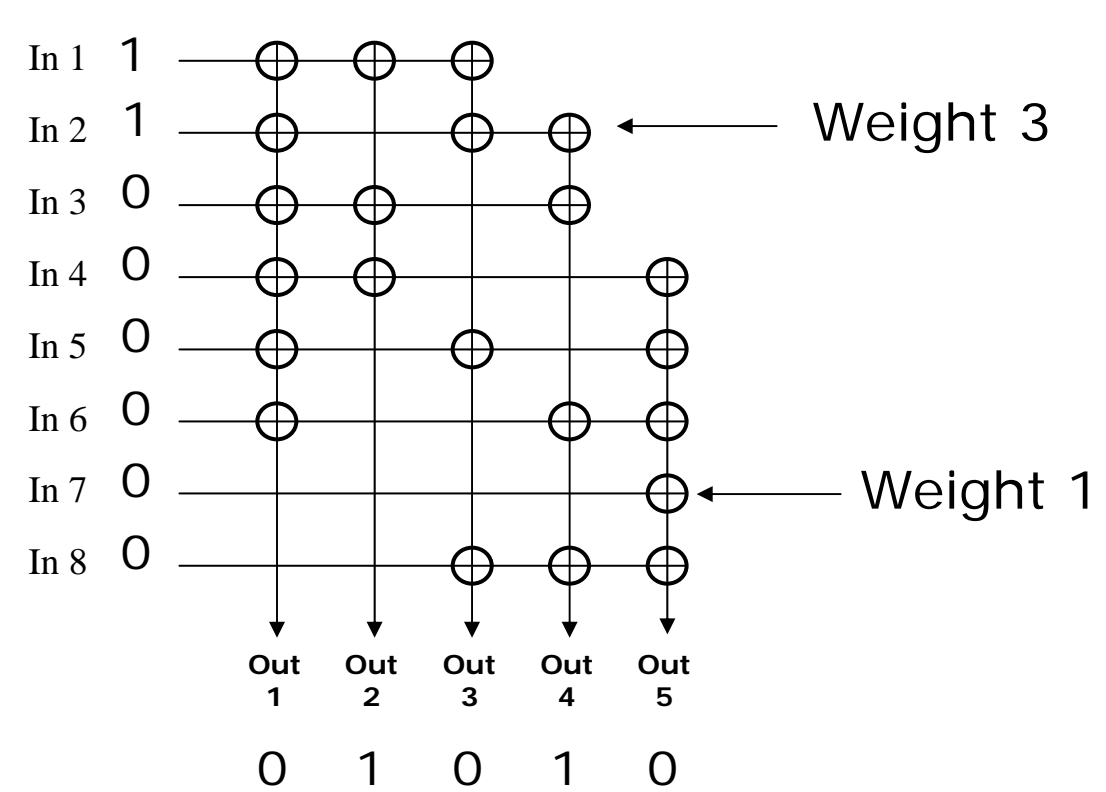
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Linear compactors

- Linear compactors implemented with xor trees.

- Example:

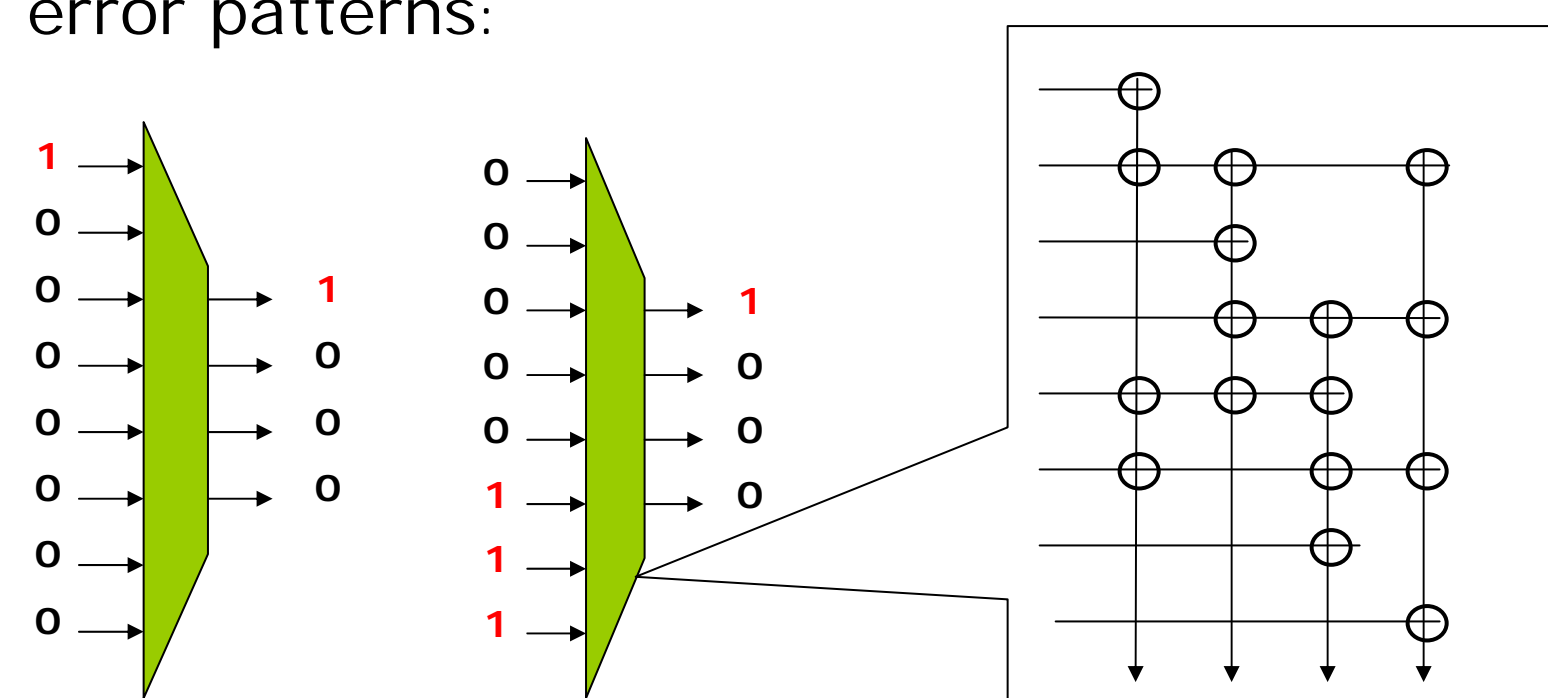
- 8 inputs
- 5 outputs



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Challenge of diagnostic

- One erroneous signature corresponds to several error patterns:

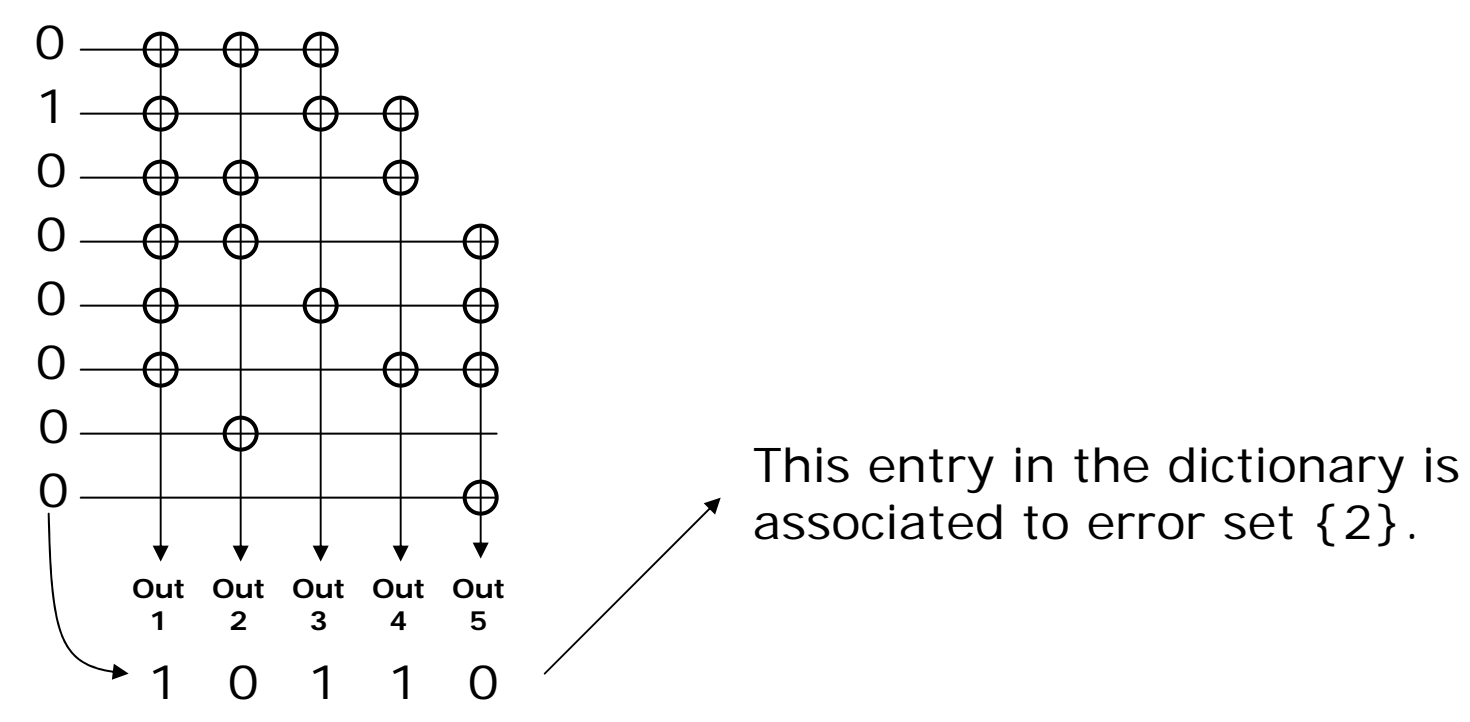


- In general, only part of the error patterns can be correctly identified.

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Diagnostic method

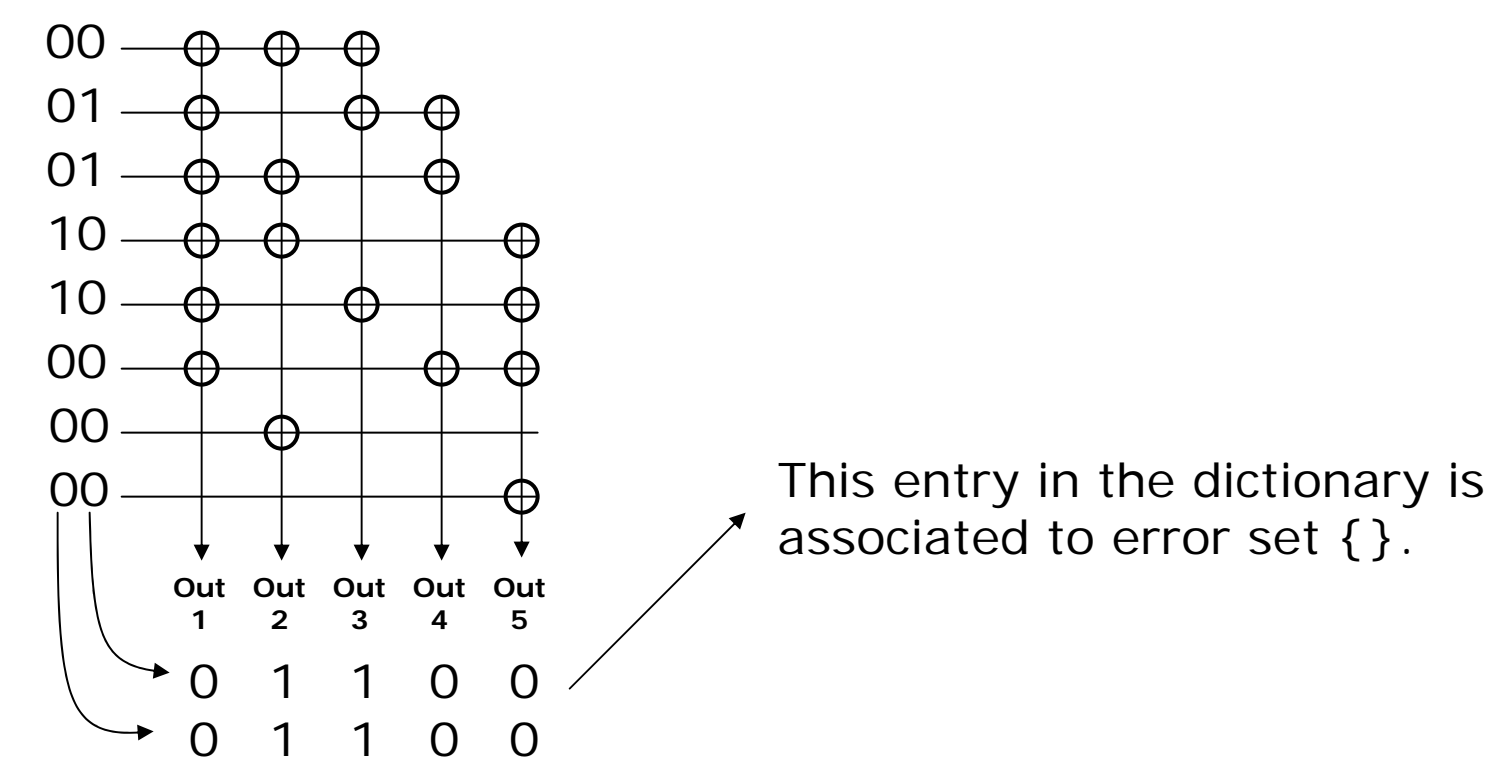
- Diagnostic using dictionary:
 - Build dictionary for combinations of one, two, three... errors.



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Diagnostic method

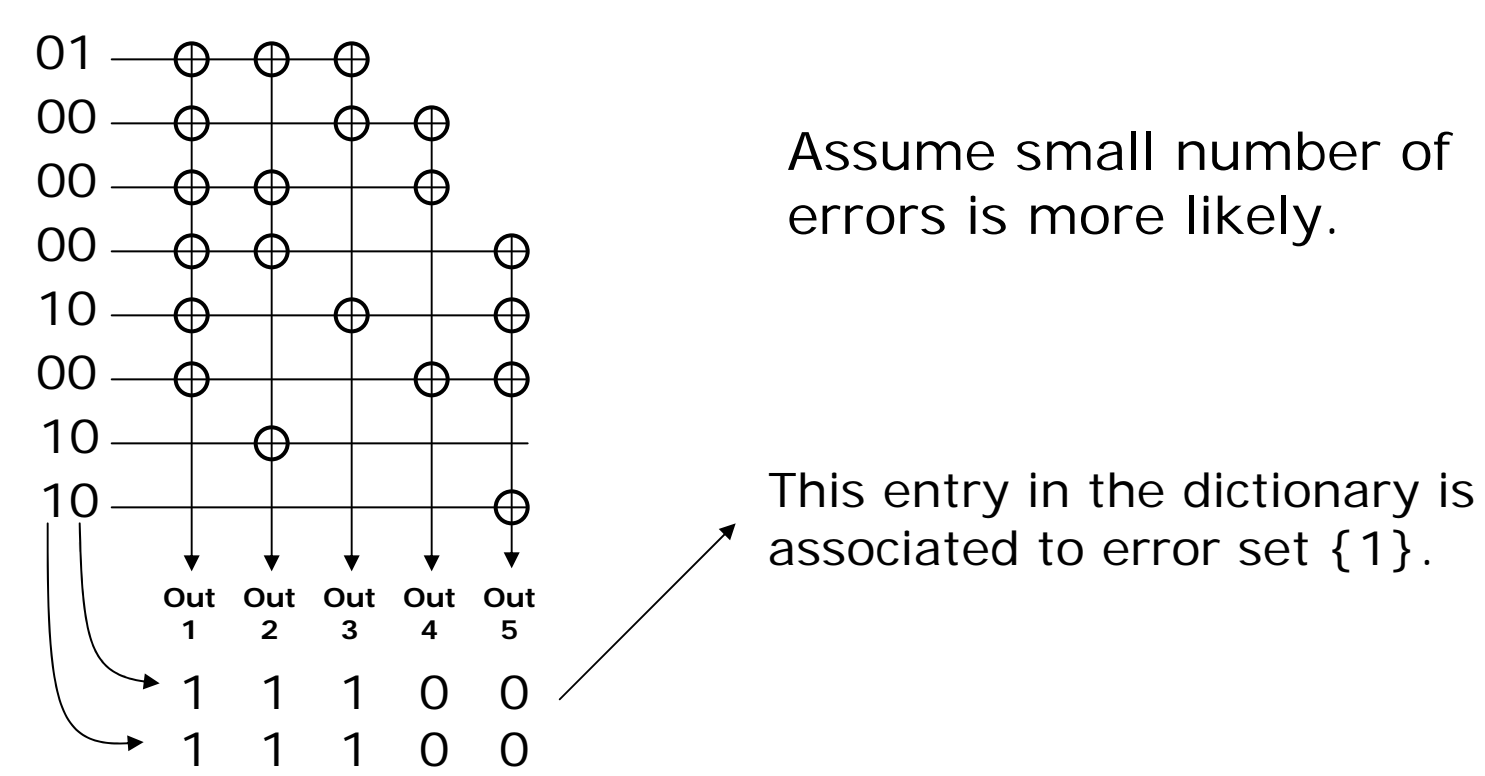
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Diagnostic method

- Diagnostic using dictionary:
 - Build dictionary for combinations of one, two, three... errors.



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Assume small number of errors is more likely.

Diagnostic method

- For each compacted response:
 - Lookup response in the dictionary.

- Possible events:
 - Not in dictionary.
 - In dictionary but error set is {}.
 - In dictionary with non empty error set.

Result: Correct Missed Undiagnosed

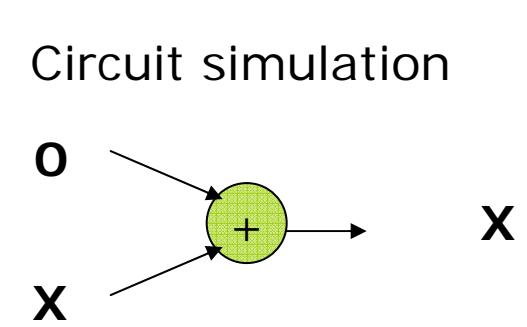
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Unknown values

- Unknown values (X) are circuit responses that cannot be determined during simulation.

- Sources: bus contention, unmodeled memory...

- Impact on compactor:



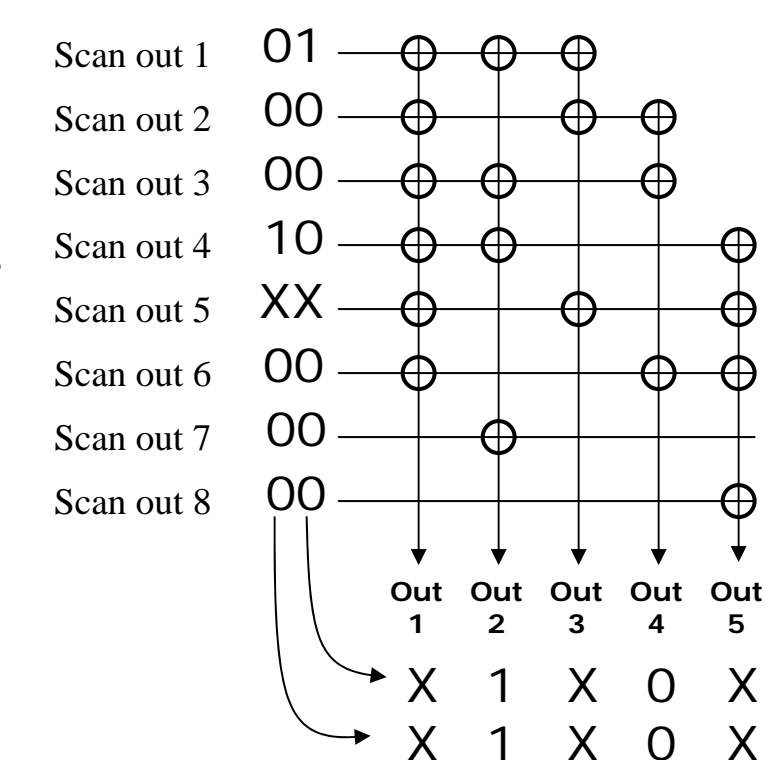
- Masking of values from other cells.
- In practice, 1% of scan cells with Xs can mask remaining 99% of scan cells for compaction ratio of 100.

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Diagnostic performance

- Impact of X values on diagnostic:

If X is given high weight:
Two single error patterns become indistinguishable.



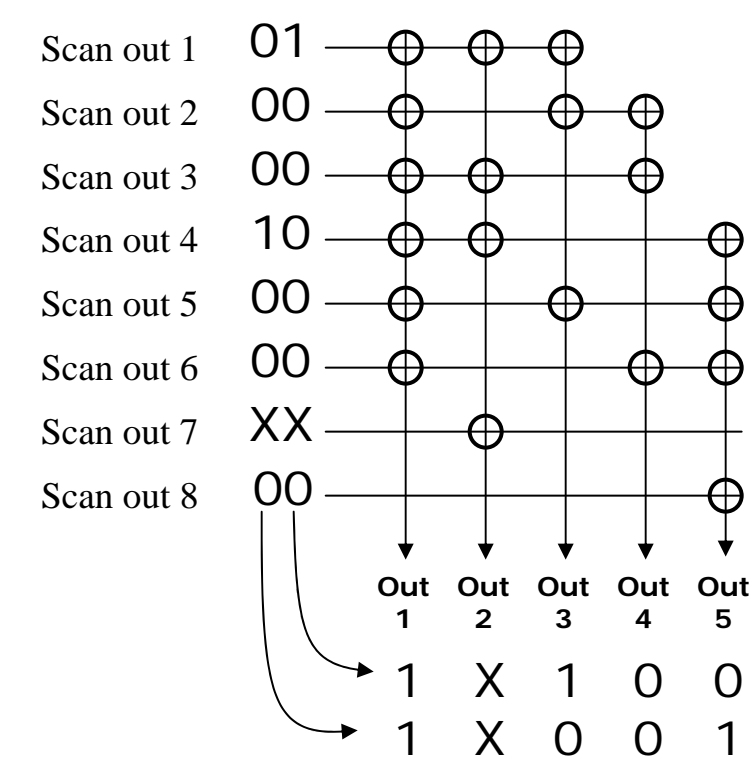
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Diagnostic performance

Impact of X values on diagnostic:

If X is given high weight:
Two single error patterns
become indistinguishable.

If X is given low weight:
Two single error patterns
remain distinguishable.

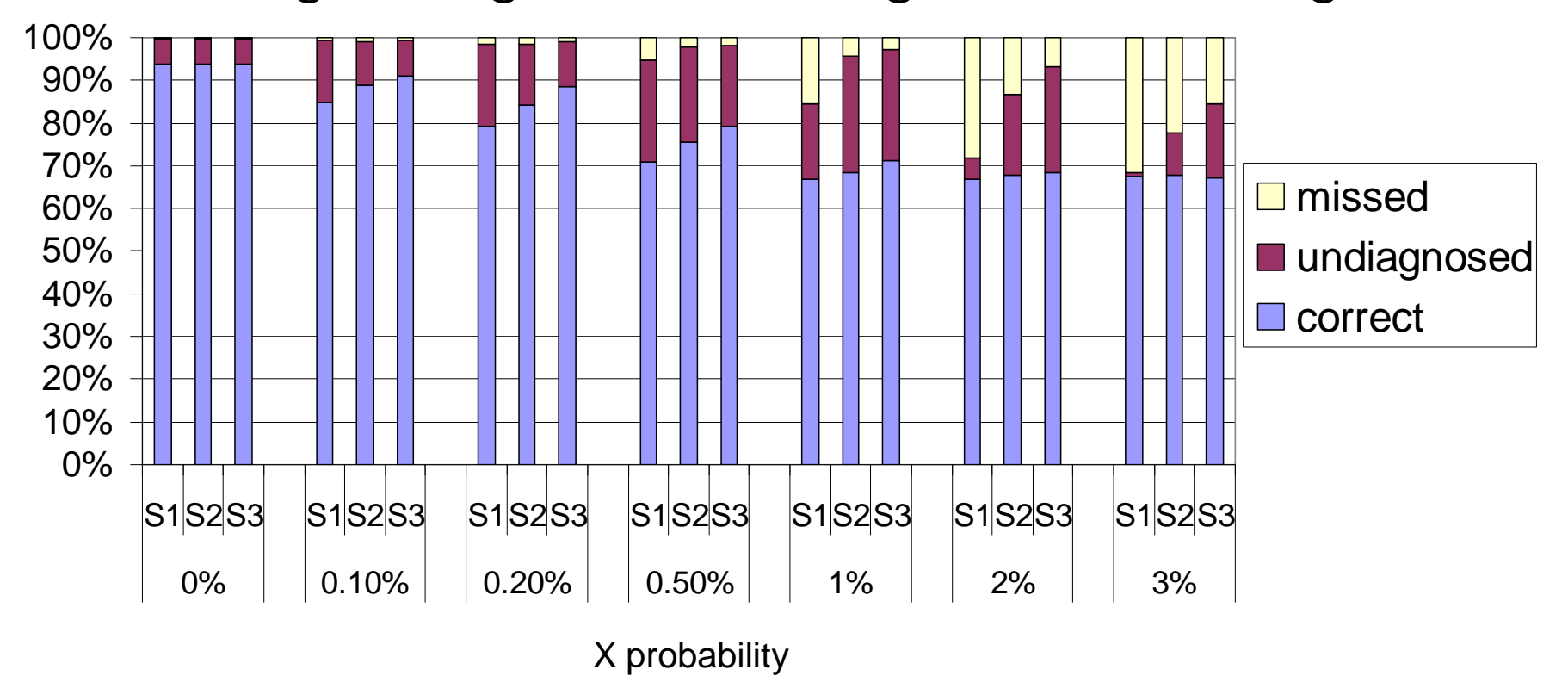


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Diagnostic performance

400 scan chains, 12 outputs.

S1: single weight, S2: 2 weights, S3: 3 weights.



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Conclusion and Future work

- Multiple weight matrices can improve diagnostic resolution.
- Performance remains poor in presence of many unknowns.
- Future work:
 - Develop a method to optimally assign weights.
 - Evaluate diagnostic performance for faults.
 - Develop search algorithm to overcome limitation of dictionaries.

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