Faults Detection and Location Methods

Classification:

- Single faults:
  - Fault table method (Fixed schedule)
  - Adaptive schedule (using Diagnosing tree)
  - Path sensitizing method

Adaptive Schedule Method:

- Choice of test schedules is dependent on the outcomes of the experiment (length of test schedule may vary depending upon the fault)
- Example: If test set = {2,3,4,5}
- Then length = 4 (fixed) for fixed-schedule or fault table method
- But for adaptive, length may be 1 or 2 or 3 or 4 depending upon which fault needs to be identified.
- Uses Diagnosing tree (directed graph whose nodes are tests)
- 3 var= 8 tests possible = 8 nodes
- Levels 1 2 3 4 5 6 7 8 length=8
- Adaptive Fault table, length=4 (detection) and <=5(location)

Diagnosing Tree:

- Directed graph whose nodes are tests
- Outgoing branches from a node represent the different outcomes of the particular test.

Diagnosing Tree Preparation:

- Test set = {2,3,5,6} for fault detection
  = {2,3,6 + 1,4 or 1,5 or 4,5} for fault location

Test	x_1 x_2 x_3	f_0	f_1	f_2	f_3	f_4	f_5	f_6
0	000	0	0	0	0	0	0	1
1	001	0	0	0	0	0	1	1
2	010	0	0	1	0	0	0	1
3	011	1	1	1	1	0	1	1
4	100	0	0	0	1	0	0	1
5	101	0	0	0	1	0	1	1
6	110	1	0	1	1	1	1	1
7	111	1	1	1	1	1	1	1

Fault Detection & Location Diagnosing Tree:

- **Test set = {2,3,5,6} for fault detection**
- Length of test set= 4 (whether for fixed-schedule or adaptive-schedule method)
- Fault-free output (f0) needs to be separated using diagnosing tree.

- **Test set = {2,3,6 + 1,4 or 1,5 or 4,5} for fault location**
- Lets assume Test set = {2,3,6,4,5} , so length = 5 (fault location)
- **Minimum Length of test set = 5 {tests in any order} for fixed-schedule**
- **Length of test set = 4 {5, 3, 6, 2} or 5 {5,4,6,3,2} depending upon order of tests for adaptive-schedule method.**

Adaptive-Schedule Using Matrix Form Method:

- **Test set = {2,3,5,6} for fault detection**
- Length of test set= 4 (whether for fixed-schedule or adaptive-schedule method)
- Fault-free output (f0) needs to be separated using diagnosing tree.

- **Test set = {2,3,6 + 1,4 or 1,5 or 4,5} for fault location**
- Lets assume Test set = {2,3,6,4,5} , so length = 5 (fault location)
- **Minimum Length of test set = 5 {tests in any order} for fixed-schedule**
- **Length of test set = 4 {5, 3, 6, 2} or 5 {5,4,6,3,2} depending upon order of tests for adaptive-schedule method.**

Path Sensitizing Method:

- Fault table method requires construction of big tables if there are many lines within the circuit.
- Need to have an alternative method.
- **Principle**:

  Examine the path of transmission from the location of an assumed fault to one of its primary outputs.

Definitions:

- **Primary input:** A line that is not fed by any other line in the circuit.

- **Primary output:** A line whose signal output is accessible to the exterior of the circuit.

- **Transmission path:** Path of a combinational circuit is a connected directed graph containing no loops from a primary input or internal line to one of its primary outputs.

Steps for Path Sensitizing Method:

1. Choose a path from the faulty line to one of its primary outputs.
2. Assign a faulty line a value of ‘0’ or ‘1’ if the fault is a s-a-1 or s-a-0.
3. Along the chosen path, except the lines of path,

   Assign a value ‘0’ to the OR and NOR gates in the path.

   Assign a value ‘1’ to the AND and NAND gates in the path.
4. Trace back along the sensitized path towards the circuit inputs.

Tree-line Circuits:

- Tree-line circuit is defined as a circuit in which
  - each input is an independent input line to the circuit
  - Fan-out of every gate is 1.

  Fan-out: defines number of devices/gates which can be connected at output of that particular gate/device.

  The complete test set for tree-like circuits by using path sensitizing method.

  Here, every path of the circuit is sensitizable.

  But if the fan-out of a gate is >1, then some paths may not be sensitizable.