CSE435 Introduction to EDA & Testing - Spring 2022

Homework Assignment #6

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About Path-Oriented Decision Making (PODEM), please answer the following questions according to Figure 1.

1-4 PODEM (See Figure 1)

1. (15%) Derive the effective test set for G5 SA0 by PODEM

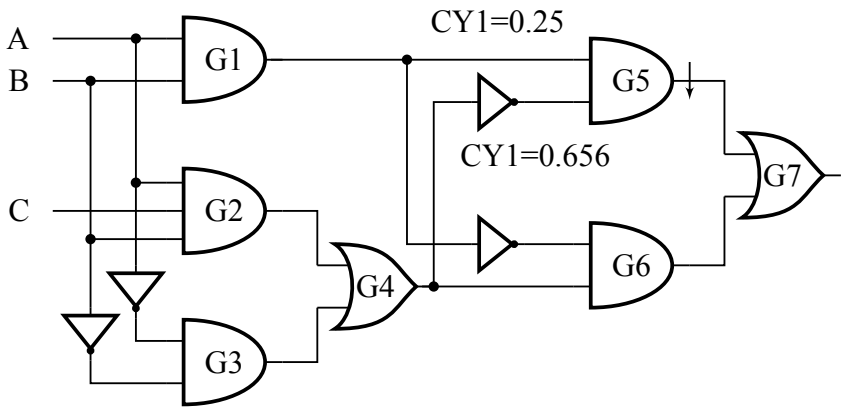

Figure 1

Solution:

1. Activate G5 SA0. Initial objective: (G5, D).
2. Backtrace to A. With an even inversion parity, A = 1. Simulation, objective not achieved.
3. Backtrace to B. With an even inversion parity, B = 1. Simulation, objective not achieved.
4. Backtrace to C. With an odd inversion parity, C = 0. Simulation, objective achieved. The fault has reached the primary output.
5. Test generated, (A, B, C) = (1, 1, 0).

Answer: (A, B, C) = (1, 1, 0).

2. (15%) Derive the effective test set for G5 SA0 by PODEM with More Intelligent Backtracing

Solution:

1. Activate G5 SA0. Initial objective: (G5, D).
2. (a) Since G5 is an imply gate, backtrace to the hardest unknown input, G1, with CY1(G1) = 0.25. With an even inversion parity, intermediate objective: (G1, 1).
   (b) Since G1 is an imply gate, keep backtrace to the hardest unknown input, A, (CY1(A) = CY1(B) = 0.5, so we may choose either one). With an even inversion parity, intermediate objective: (A, 1).
   (c) Since A is not a gate, stop backtracing. Assign 1 to A. Simulation, objective not achieved. Implication: G3 = 0.
3. (a) Since G5 is an imply gate, backtrace to the hardest unknown input, G1, with CY1(G1) = 0.25. With an even inversion parity, intermediate objective: (G1, 1).
   (b) Since G1 is an imply gate, keep backtrace to the hardest unknown input, B. With an even inversion parity, intermediate objective: (B, 1).
   (c) Since B is not a gate, stop backtracing. Assign 1 to B. Simulation, objective not achieved. Implication: G1 = 1, G6 = 0.
4. (a) Since G5 is an imply gate, backtrace to the hardest unknown input, G4. With an odd inversion parity, intermediate objective: (G4, 0).
   (b) Since G4 is an imply gate, keep backtrace to the hardest unknown input, G2. With an even inversion parity, intermediate objective: (G2, 0).
   (c) Since G2 is an imply gate, keep backtrace to the hardest unknown input, C. With an even inversion parity, intermediate objective: (C, 0).
   (d) Since C is not a gate, stop backtracing. Assign 0 to C. Simulation, objective achieved. Implication: G2 = 0, G4 = 0, G5 = D, G7 = D. The fault has reached the primary output.
5. Test generated, (A, B, C) = (1, 1, 0).

Answer: (A, B, C) = (1, 1, 0).

3. (15%) Derive the effective test set for G5 SA0 by PODEM with Unguided Backtracing

Solution: We intentionally don't follow the controllability guidance in this example.

1. Activate G5 SA0. Initial objective: (G5, D).

2. (a) Since G5 is an imply gate, instead of backtrace to the hardest unknown input, G1, with CY1(G1) = 0.25, we backtrace to G4, with CY1(G4) = 0.656. With an odd inversion parity, intermediate objective: (G4, 0).

   (b) Since G4 is an imply gate, instead of keep backtrace to the hardest unknown input, G3, with CY0(G3) = 0.75, we backtrace to G2, with CY0(G2) = 0.875. With an even inversion parity, intermediate objective: (G2, 0).

   (c) Since G2 is a decision gate, we back trace to A, (CY0(A) = CY0(B) = CY0(C) = 0.5, so we may choose either one). With an even inversion parity, intermediate objective: (A, 0).

   (d) Since A is not a gate, stop backtracing. Assign 0 to A. Simulation, objective not achieved. Implication: G1 = 0, ... , G5 = 0, conflict with the objective.

   (e) Backtrack and flip A to 1. Simulation, objective not achieved. Implication: G3 = 0;

3. (a) Since G5 is an imply gate, instead of backtrace to the hardest unknown input, G1, with CY1(G1) = 0.25, we backtrace to G4, with CY1(G4) = 0.656. With an odd inversion parity, intermediate objective: (G4, 0).

   (b) Since G4 is an imply gate, keep backtrace to the hardest unknown input, G2. With an even inversion parity, intermediate objective: (G2, 0).

   (c) Since G2 is a decision gate, we back trace to B. With an even inversion parity, intermediate objective: (B, 0).

   (d) Since B is not a gate, stop backtracing. Assign 0 to B. Simulation, objective not achieved. Implication: G1 = 1, ... , G5 = 0, conflict with the objective.

   (e) Backtrack and flip B to 1. Simulation, objective not achieved. Implication: G1 = 1, G6 = 0.

4. (a) Since G5 is an imply gate, backtrace to the hardest unknown input, G4. With an odd inversion parity, intermediate objective: (G4, 0).

   (b) Since G4 is an imply gate, keep backtrace to the hardest unknown input, G2. With an even inversion parity, intermediate objective: (G2, 0).

   (c) Since G2 is a decision gate, we back trace to C. With an even inversion parity, intermediate objective: (C, 0).

   (d) Since C is not a gate, stop backtracing. Assign 0 to C. Simulation, objective achieved. Implication: G2 = 0, G4 = 0, G5 = D, G7 = D. The fault has reached the primary output.

5. Test generated, (A, B, C) = (1, 1, 0).

Answer: (A, B, C) = (1, 1, 0).

4. (15%) Please compare the above (1), (2), (3). [Chapter 10, slides 7-23]

   (a) (7%) What are the differences between (1) and (2)/(3)?

> **Solution:**
> (1) do not check the controllability of each line, so it don't make intermediate objectives. It just sets the primary input based on the inversion parity of the entire backtracing path.
> (2)/(3) utilize the controllability of each line to choose the backtracing path. They thus set the intermediate objectives in order to apply the heuristics. These heuristics reduce the possibility of encountering a conflict in comparison to (1).

   (b) (8%) What are the differences between (2) and (3)?

> **Solution:**
> (2) follows the guidance of the controllability measures. It encounters zero conflict and thus performs no backtracking.
> (3) intentionally disobeys the guidance of the controllability measures. It encounters two conflict and thus performs two backtracking. The empirical result shows the heuristic does reduce the possibility of encountering a conflict.

5. (15%) What are the difference between Backtracking and Backtracing? Please show by example.

> **Solution:**
> A backtracing procedure maps the objective into a PI assignment that is likely to contribute to achieve the objective, while a backtracking procedure goes back to the last decision when encountering a conflict.

6. (25%) FAN (See Figure 2)

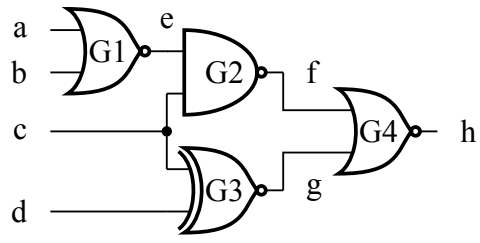

Figure 2

   (a) (15%) Generate a test for the fault f-sa1 by using FAN algorithm.

Solution:

1. Identify headlines: c, d, e.
2. Activate f-sa1. Assign D' to f.
3. Backward implication: c = e = 1, a = b = 0.
4. Since G4 is an unique D-frontier, perform unique sensitization. Assign 0 to g.
5. Backward implication: d = 0.
6. Forward implication: h = D. The fault has reached the primary output.
7. No justification needed. Test generated, (a, b, c, d) = (0, 0, 1, 0).

Answer: (a, b, c, d) = (0, 0, 1, 0).

(b) (10%) What are the differences between PODEM and FAN?

Solution: