WE6.2

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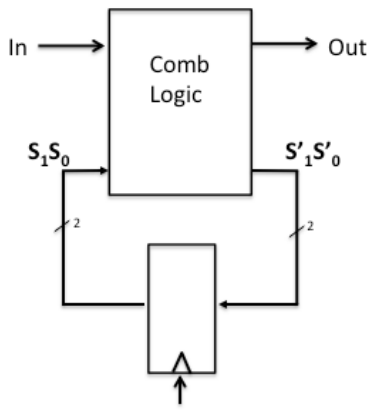
FSM

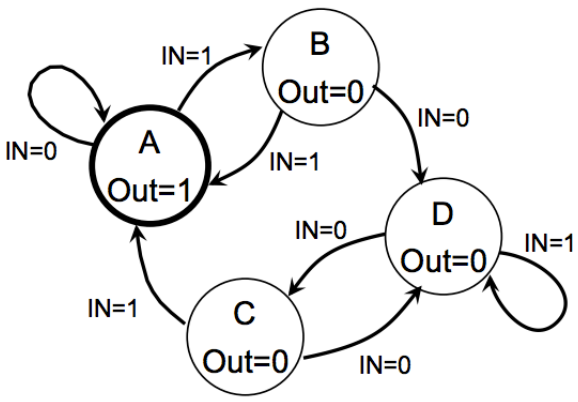
5/6 points (ungraded)

OpenFSM.org, an organization dedicated to public disclosure of the transition diagrams of all commercially interesting FSMs, has hired you as an (unpaid) consultant. They've asked you to help reverse-engineer the BSM, an FSM embedded in the hot-selling consumer product, BlingSox.

You've been given the schematic diagram for the BSM, as shown below, and immediately recognize the S1S0 diagram as an FSM having two state bits held in a single register.



Through a series of tedious experiments, you deduce the state transition diagram for the BSM as shown below.



You have verified that the BSM has four states, that it is a Moore machine (the output is a function only of the current state), and have determined the value of the output for each of the four states. You have also determined that the current state is encoded as two state variables S1S0 stored in the two-bit register shown in the circuit diagram above, and that A is the initial state.

Further reverse engineering on your part yields the partially-completed truth table for the BSM's combinational logic shown below. Unfortunately, you left five blank entries in the table. At the time you made the table, their values seemed too obvious to bother writing down; a week later, however, they didn't seem quite so obvious.

(A) Fill in the missing five entries in the table below.

S1	S0	IN	S1'	S0'	OUT
0	0	0	0	0	1
0	0	1	0	1	0 ✖ Answer: 1
0	1	0	1	0	0
0	1	1	0	0 ✔ Answer: 0	0
1	0	0	1	1	0
1	0	1	1	0 ✔ Answer: 0	0 ✔ Answer: 0
1	1	0	1	0	0
1	1	1	0	0 ✔ Answer: 0	0

Explanation

To fill in the missing entries in the table, you first notice that state A = 00 because it is the only state that outputs a 1. Since this is a more machine, regardless of the value of IN, the output will be a 1, so row 001 has OUT = 1. Next you notice that from state 00, when IN = 1, you move to state 01. Following the arrows in the state diag...

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that means that state B = 01. From state B, when IN = 1 we go back to state A which we now know is state 00, so for row 011, we set S0' to 0.
From state B, when IN = 0, you move to state D. According to the truth table, that means that state D = 10. This leaves us with state C = 11. We see that indeed the truth table shows us that from state D (10) when IN = 0, we move to state C (11). We also know that from state D, when IN = 1, we stay in state D, so in row 101, the first missing entry is S0' = 0. We also know that this this is a Moore machine which means that the output is purely a function of the current state (S1S0). In state D, our output is 0, so the OUT entry of that same row = 0.
Finally, we know that from state C when IN = 1, we go back to state A (00), so the last missing entry which is in row 111, is S0' = 0.

After you show your progress to your OpenFSM buddies, they ask if you can tell from that diagram whether it might be possible to find a 3-state machine that is equivalent to the 4-state BSM.

(B) Is an equivalent state reduction is possible from the state transition diagram given above? If so, mark two equivalent states that may be merged to yield the simpler FSM; otherwise, mark NO.

- [ ] NO
- [ ] A
- [x] B
- [x] C
- [ ] D

✔

Explanation
Equivalent states are states that have the same transitions and outputs. States B and C are equivalent as they both output 0, they both go to state D on input 0, and they both go to state A on input 1.

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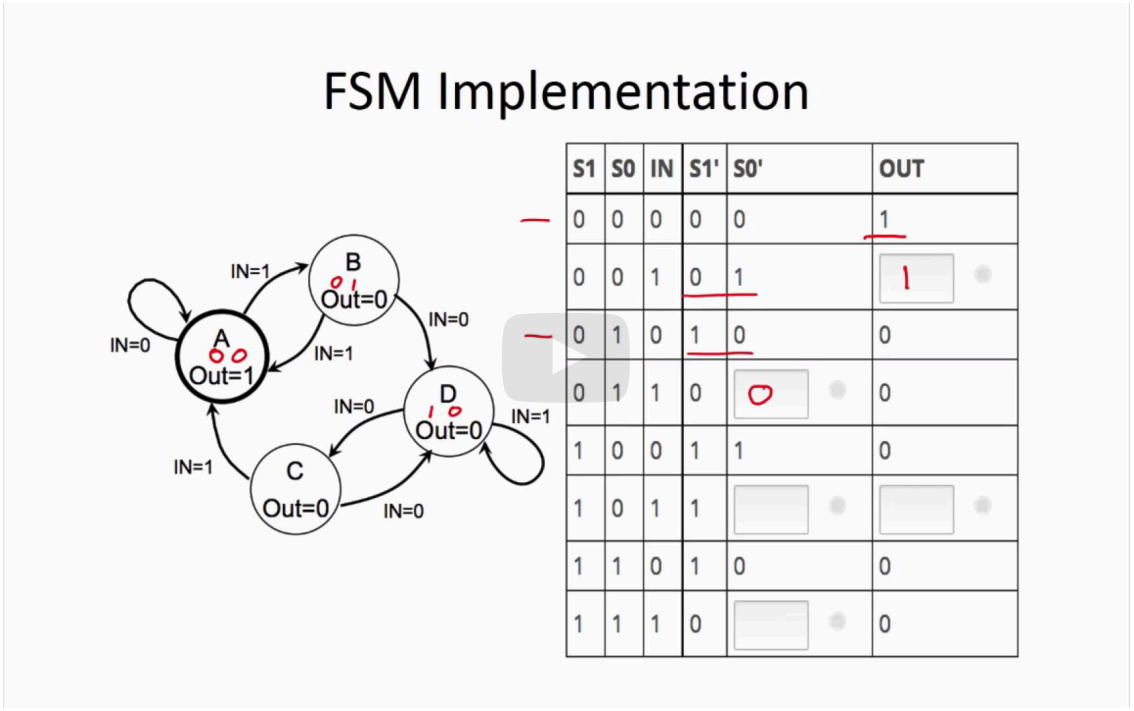
Answers are displayed within the problem

FSM Implementation



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In this problem, we are given a 4 state transition diagram.

We know that it represents a Moore machine because the output is a function of only the current state.

We are also given a partially filled out truth table and our first job is to fill in the missing entries in the truth table.

In order to do this, we need to find the correlation between states A - and their S1S0 encoding

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and their 3130 encoding.

We begin by looking at the output column.

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- Benefit of merging states ? — 2
  Hello , We see from the lecture that we get two states merged as one leaving behind a total of 3 states instead of 4 But for both 3,...
- Shouldn't the answer to the second column be 0? — 3
  On an input of 1, A transitions to B, which has an output of 0.

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