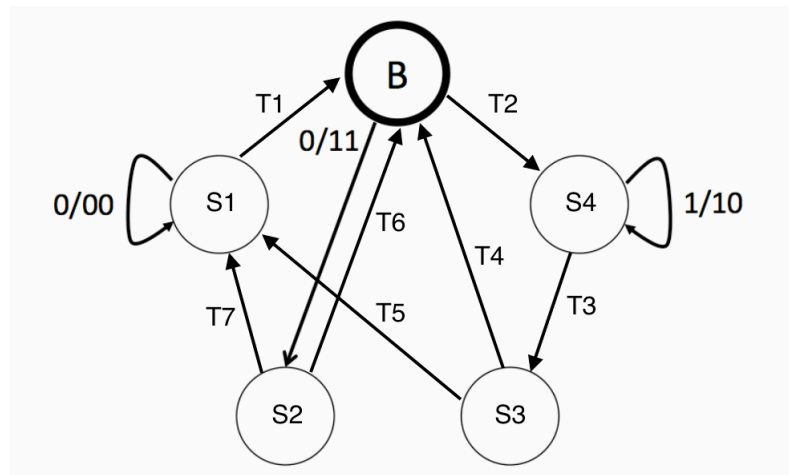


## FSM

15/15 points (ungraded)

The truth table below represents a 5-state FSM with a 1-bit input (IN) and a 2-bit output (OUT). This FSM is a Mealy machine, i.e., its outputs are a function of both the current state and the current input. When the FSM is initialized its starting state is B.

S	IN	Next S	OUT
A	0	A	00
A	1	B	11
B	0	C	11
B	1	D	00
C	0	A	10
C	1	B	01
D	0	E	01
D	1	D	10
E	0	A	10
E	1	B	01



(A) Using the state transition table as a guide, match the numbered states (S1-S4) in the diagram with their corresponding labels (A-E) and label each transition (T1-T7) with IN/OUT (ex: 0/00) to represent which input causes the given transition and what the output is.

S1:  ✓ Answer: A S2:  ✓ Answer: C S3:

✓ Answer: E S4:  ✓ Answer: D

T1:  ✓ Answer: 1/11 T2:  ✓ Answer: 1/00

T3:  ✓ Answer: 0/01 T4:  ✓ Answer: 1/01

T5:  ✓ Answer: 0/10 T6:  ✓ Answer: 1/01

T7:  ✓ Answer: 0/10

### Explanation

In order to do this we begin by looking at the truth table beginning with the starting state B. The truth table shows us that when  $IN = 0$ , our next state is state C. Since the 0 input transition out of state B is already labeled for us, we know that  $S_2 = C$ . This also tells us that  $T_2$  corresponds to  $IN = 1$  so  $S_4 = D$ , and  $T_2 = 1/00$ . From state D, we have the 1 input transition already labeled, so  $T_3$  corresponds to  $IN = 0$ . Looking at the truth table that means that  $S_3 = E$ , and  $T_3 = 0/01$ . The truth table then shows us that from state E, a 1 input takes you back to state B. So  $T_4 = 1/01$ , which in turn means that  $T_5 = 0/10$ , and state  $S_1 = A$ . From state A, the 0 input transition is already filled in, so  $T_1 = 1/11$ . From state C, a 1 input goes to state B so  $T_6 = 1/01$ , which in turn means that  $T_7 = 0/10$ .

(B) Suppose the machine is initialized to its starting state B and then processes three input values 1,0,0. What sequence of outputs does it produce and what is its final state? (Put one space in between each pair of outputs in your answer, ex: xx xx xx.)

Sequence of outputs:

✓ Answer: 00 01 10

Final state:

✓ Answer: A

### Explanation

Starting at B, a 1 moves the FSM to state D and produces 00 on the output. From D a 0 moves to E and outputs 01 and from E a 0 moves to A and produces 10 on the output. The output sequence is then 00 01 10 and the final state is A.

(C) What sequence of inputs is guaranteed to leave the FSM in state E regardless of the state it's in before the sequence is processed? Give the shortest such sequence or write NONE if none exists. (Don't put spaces between inputs in your answer, ex: xxxx)

✓ Answer: 110

### Explanation

The binary sequence 1 1 0 will always bring you to state E, regardless of which state you start in.

(D) Is there an equivalent FSM that has only 4 states? Either check NONE if no such FSM exists or check the names of the two states in the original 5-state FSM that can be

merged to form an equivalent 4-state machine.

☐ NONE

☐ A

☐ B

☒ C

☐ D

☒ E


### Explanation

Equivalent states are states that have the same transitions and outputs, so C and E are equivalent because for input 0 they both transition to state A and output 10, and for input 1 they both transition to state B and output 01.

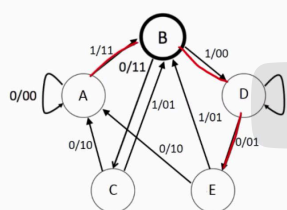
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**i** Answers are displayed within the problem

## FSM States and Transitions

[Start of transcript. Skip to the end.](#)

### FSM Transitions and Equivalent FSMs



- What outputs are produced and what is the final state if you begin in state B and receive 1,0,0 inputs?
- Sequence of inputs that leave FSM in state E regardless of initial state. **110**

This truth table represents a 5-state finite state machine, or FSM, with a 1-bit input IN and a 2-bit output OUT.




This FSM is a Mealy machine.


That means that its outputs are a function of both the current state and the current input.

When this FSM is initialized,

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