

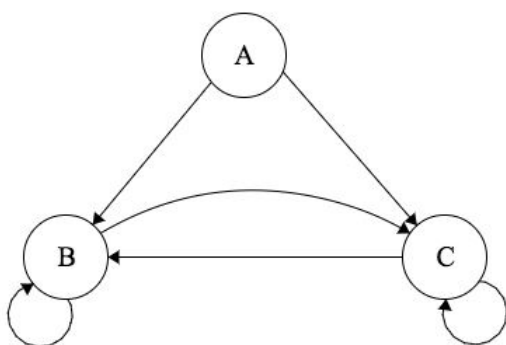
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HOMEWORK 1. FSM

In a Mealy FSM, the output values depend on the input values in addition to the current state. Thus, in the state diagram, the arcs between states show the output values in addition to the input values. This is different from a Moore FSM where the outputs are shown within the bubbles, since they depend only on the current state.

Consider a pattern detector designed as a Mealy machine, with one input and one output. The output is 1 whenever two consecutive ones, or two consecutive zeros, are seen on the input, and the output is 0 otherwise. Overlapping patterns are detected. For example, the input 001011000 produces the output 010001011.

The Mealy FSM is shown below without its input and output values.



The states are the following:

- **A:** Initial state, entered when the FSM is powered on or reset.
- **B:** Used to detect two or more consecutive zeros. This state is entered upon the first occurrence of a 0, and we stay in state B and output a 1 so long as the input remains a 0.
- **C:** Used to detect two or more consecutive ones. This state is entered upon the first occurrence of a 1, and we stay in state C and output a 1 so long as the input remains a 1.

HOMEWORK 1 A. FSM (1/1 point)

What is the minimum number of flips flops required to implement this FSM?

2

2

Answer: 2

EXPLANATION

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HOMework 1 B. FSM (1/1 point)

For the transition from state A to state B, what are the corresponding input and output?

- ☒ Input = 0, Output = 0 
- ☐ Input = 0, Output = 1
- ☐ Input = 1, Output = 0
- ☐ Input = 1, Output = 1

EXPLANATION

When in the initial state A, an input of 0 transitions the FSM to B, since this is the state that detects consecutive zeros. Since we're only making the transition from A to B, only one input value was detected so the output is 0.

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HOMework 1 C. FSM (1/1 point)

For the transition from state A to state C, what are the corresponding input and output?

- ☐ Input = 0, Output = 0
- ☐ Input = 0, Output = 1
- ☒ Input = 1, Output = 0 
- ☐ Input = 1, Output = 1

EXPLANATION

When in the initial state A, an input of 1 transitions the FSM to C, since this is the state that detects consecutive ones. Since we're only making the transition from A to C, only one input value was detected so the output is 0.

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HOMEWORK 1 D. FSM (1/1 point)

For the transition from state B to state B, what are the corresponding input and output?

- ☐ Input = 0, Output = 0
- ☒ Input = 0, Output = 1 
- ☐ Input = 1, Output = 0
- ☐ Input = 1, Output = 1

EXPLANATION

Since we are staying in state B, the input is a 0 and the output is a 1 since we have seen at least two consecutive zeros on the input.

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HOMEWORK 1 E. FSM (1/1 point)

For the transition from state C to state C, what are the corresponding input and output?

- ☐ Input = 0, Output = 0
- ☐ Input = 0, Output = 1
- ☐ Input = 1, Output = 0
- ☒ Input = 1, Output = 1 

EXPLANATION

Since we are staying in state C, the input is a 1 and the output is a 1 since we have seen at least two consecutive ones on the input.

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HOMEWORK 1 F. FSM (1/1 point)

For the transition from state B to state C, what are the corresponding input and output?

- ☐ Input = 0, Output = 0
- ☐ Input = 0, Output = 1
- ☒ Input = 1, Output = 0 
- ☐ Input = 1, Output = 1

EXPLANATION

Since B is the state that detects consecutive zeros, and C the state that detects consecutive ones, we must have received an input of 1. Since we have broken the string of consecutive zeros, the output is 0.

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HOMEWORK 1 G. FSM (1/1 point)

For the transition from state C to state B, what are the corresponding input and output?

- ☒ Input = 0, Output = 0 
- ☐ Input = 0, Output = 1
- ☐ Input = 1, Output = 0
- ☐ Input = 1, Output = 1

EXPLANATION

Since C is the state that detects consecutive ones, and B the state that detects consecutive zeros, we must have received an input of 0. Since we have broken the string of consecutive ones, the output is 0.

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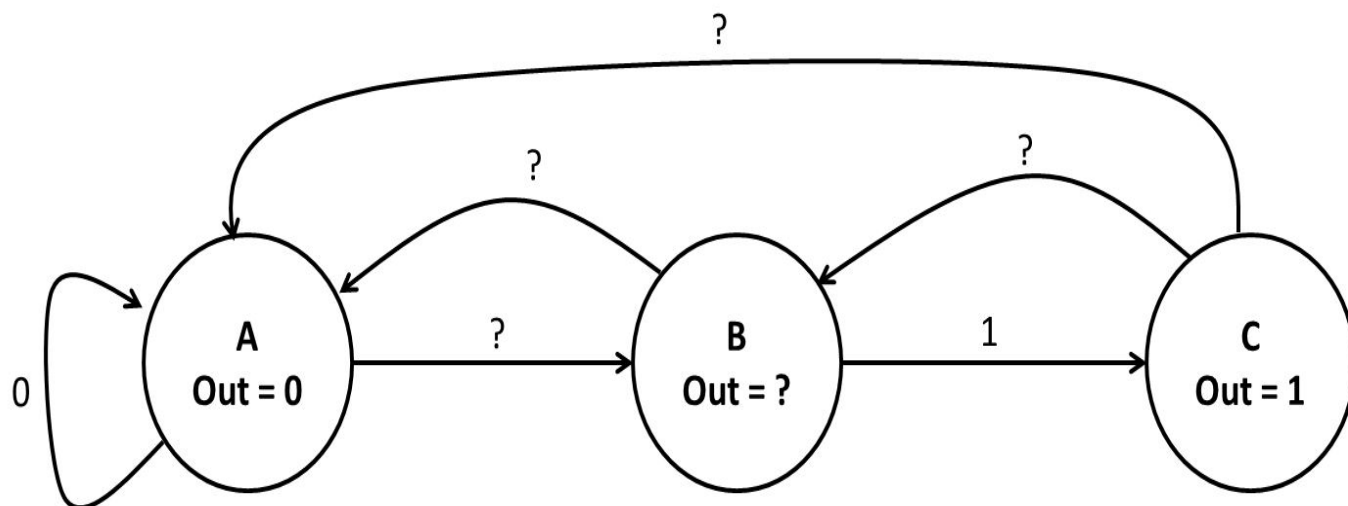
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HOMEWORK 2. FSM

Consider a pattern detector designed as a Moore machine that detects two consecutive ones on the input without overlap. For example, the input 01011110 produces the output 00001010. Shown below is a partial depiction of the FSM where A is the initial state that is entered when the FSM is powered up or reset.



HOMEWORK 2 A. FSM (1/1 point)

Which state detects two consecutive ones on the input?

- ☐ A
- ☐ B
- ☒ C ✓
- ☐ That pattern is not detected by the FSM

EXPLANATION

Since state C has Out = 1, it detects the input pattern.

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HOMEWORK 2 B. FSM (1/1 point)

For the transition from state A to state B, what is the value of the input? What is the value of Out when in state B?

Help

- ☐ Input = 0, Out = 0
- ☐ Input = 0, Out = 1
- ☒ Input = 1, Out = 0 ✓
- ☐ Input = 1, Out = 1

EXPLANATION

State A is the initial state where we are waiting for the first occurrence of a 1. When that occurs, we move to B, but the output remains 0 since we have only encountered a single 1.

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HOMEWORK 2 C. FSM (1/1 point)

For the transition from state C to state B, what is the value of the input? What is the value of Out when in state B?

- ☐ Input = 0, Out = 0
- ☐ Input = 0, Out = 1
- ☒ Input = 1, Out = 0 ✓
- ☐ Input = 1, Out = 1

EXPLANATION

In state C, we have seen exactly two consecutive ones on the input. When we receive a third consecutive one, we must move back to state B since this is the first occurrence of a new sequence of back-to-back ones. The output is 0 since we have only encountered a single 1 in the new sequence.

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Which of the following input pattern would cause a transition from C to A?

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☐ 001

☐ 011

☒ 110

☐ 111



EXPLANATION

The first pattern causes a transition from A to B since we encountered our first 1. The second causes a transition from B to C since two consecutive ones were detected. The third causes a transition from C to A since we detected two consecutive ones and then a 0, and thus we need to return to A to look for the first 1 of a new pattern. The fourth causes a transition from C to B since we detected two consecutive ones, followed by the first 1 in a new sequence.

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