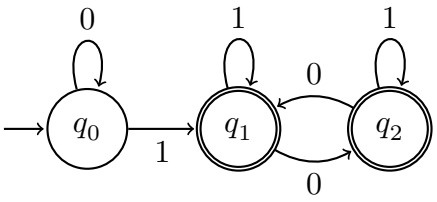
Spring 2018: COT3210–Computability and Automata
Test 01-Answers

1. Draw the state diagram of the DFA M_1 defined by $(\{q_0, q_1, q_2\}, \{0, 1\}, \delta, q_0, \{q_1, q_2\})$, where the transition function δ is given by the following table.

	0	1
$\rightarrow q_0$	q_0	q_1
q_1^*	q_2	q_1
q_2^*	q_1	q_2

State Diagram:



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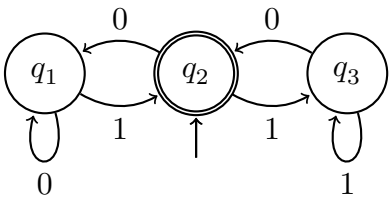
2. Let $L(M_2)$ be the language of the DFA M_2 whose state diagram is as shown below.



Answer the following questions:

a. Yes. $001110 \in L(M_2)$.

b. Sequence of states reached for 001110:

$$q_2 \xrightarrow{0} q_1 \xrightarrow{0} q_1 \xrightarrow{1} q_2 \xrightarrow{1} q_3 \xrightarrow{1} q_3 \xrightarrow{0} q_2$$

c. No. $101 \notin L(M_2)$?.

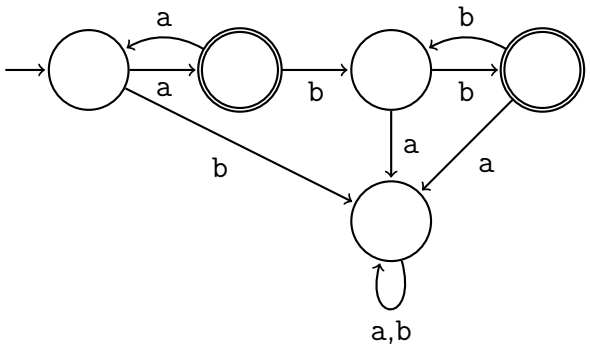
d. Sequence of states reached for 101:

$$q_2 \xrightarrow{1} q_3 \xrightarrow{0} q_2 \xrightarrow{1} q_3$$

3. Let $\Sigma = \{\mathtt{a}, \mathtt{b}\}$. Give the state diagram of the DFA that accepts the language

$$\{w \mid w \text{ is of the form an odd number of a's followed by an even number of b's}\}.$$

State Diagram:



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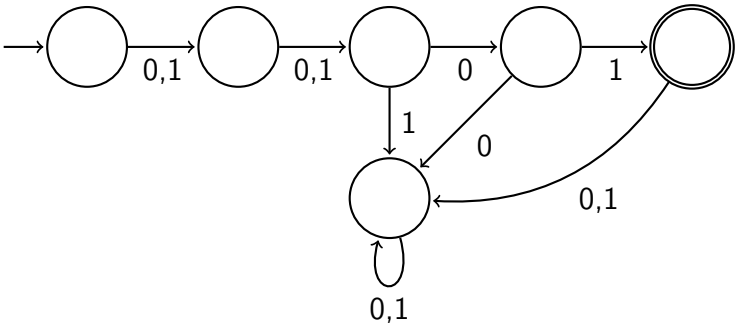
4. Let $\Sigma = \{0, 1\}$. Give the state diagram of the DFA that accepts the language

$$\{w \mid w \text{ is a string of length 4 that ends in 01}\}.$$

State Diagram:



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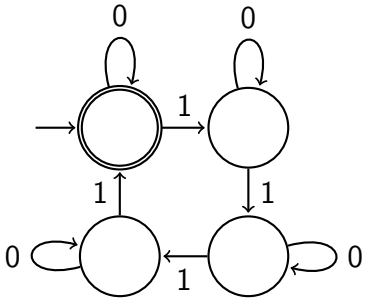
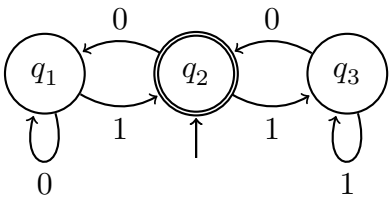
5. Let $\Sigma = \{0, 1\}$. Draw the state diagram of a DFA M_3 with

$$L(M_3) = \{w \mid \text{The number of 1s in } w \text{ is a multiple of 4}\}.$$

State Diagram:



6. Let $\Sigma = \{0, 1\}$. Let M_4 be the DFA for which the state transition diagram is given below. Show its transition table.



	0	1
q_1	q_1	q_2
$\rightarrow q_2^*$	q_1	q_3
q_3	q_2	q_2

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7. Indicate whether each of the following statemens is TRUE or FALSE.

   i. A finite automaton can have no states. False

   ii. A finite automaton can have zero accepting states. True

   iii. Every state in a finite automaton can be an accepting state. True

   iv. ε concatenated to any string produces the same string. True

   v. The empty set concatenated to any language produces the same language. False

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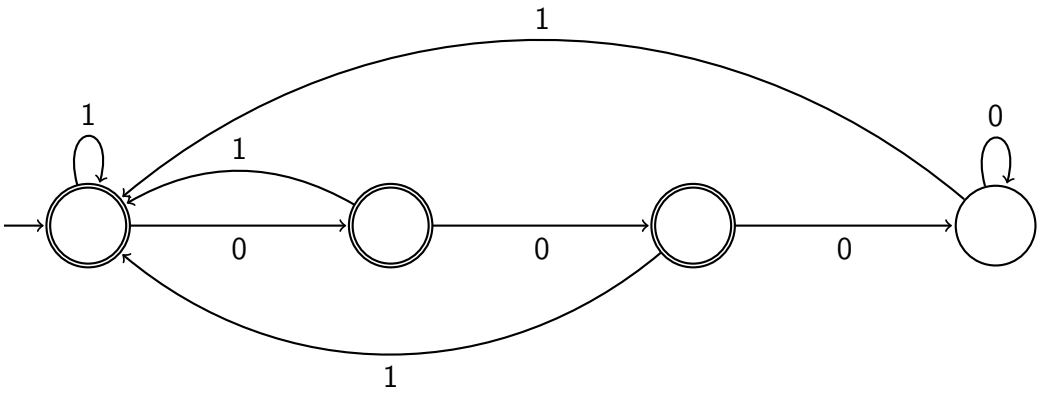
8. Let $\Sigma = \{0, 1\}$. Draw the state diagram of a DFA M_5 with

$$L(M_5) = \{w \mid w \text{ does not end in } 000\}.$$

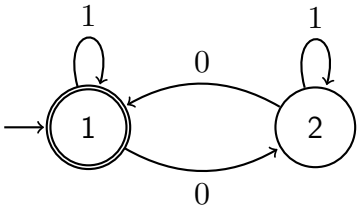


9. Let $\Sigma = \{0, 1\}$. Draw the state diagram for the DFA M_6 with

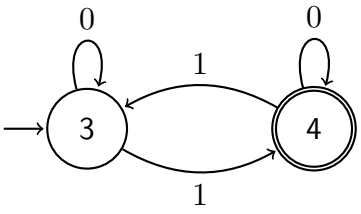
$$L(M_6) = \{w \mid w \text{ contains an even number of 0s OR an odd number of 1s}\}.$$

Use the Cartesian product construction (discussed in class) in which you will first construct two separate machines (call them M_a and M_b), and then combine them to get M_6. Place the state diagrams for the DFAs in separate boxes provided below. For each DFA, the start state and the final state(s) must be shown clearly.

M_a: The DFA that accepts strings containing an even number of 0s.



M_b: The DFA that accepts strings containing an odd number of 1s.



M_6: The DFA that accepts strings containing an even number of 0s OR an odd number of 1s.