

## Lecture 6.1 and 6.2: DFA Examples

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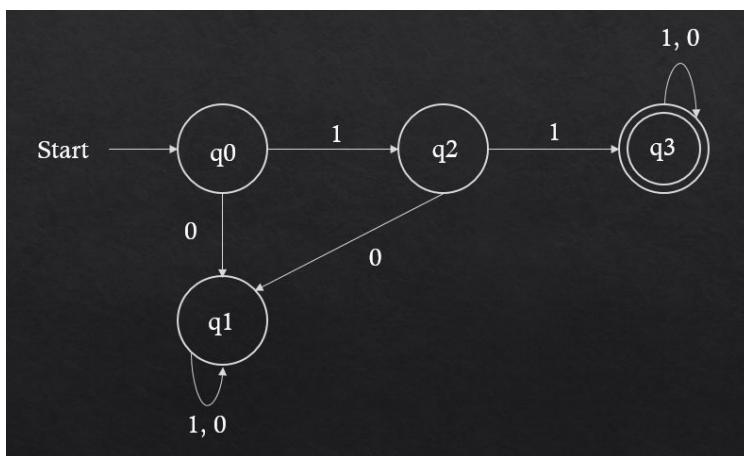
1.  $L(A) = \{w \mid w \in \{0,1\}^* \text{ and } w \text{ starts with } 11\}$  i.e.  $\{11, 110, 111, 1100, 1101, \dots\}$

$q_0$ : Start state. Seen nothing.

$q_1$ : First symbol was 0. It's a **trap** state. Once the DFA is in this state, the string has already violated the condition for the language and therefore is rejected regardless of the next symbols.

$q_2$ : Last symbol seen was 1. It was also the 1st symbol of the string.

$q_3$ : Last symbol was 1 and it was the second symbol of the string. Therefore, the string starts with 11 and  $q_3$  is the final state.

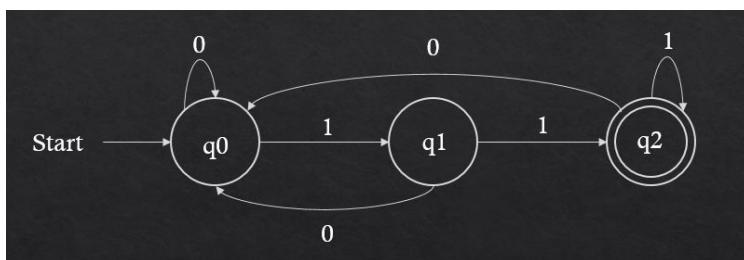


2.  $L(A) = \{w \mid w \in \{0,1\}^* \text{ and } w \text{ ends with } 11\}$  i.e.  $\{11, 011, 111, \dots\}$

$q_0$ : Start state. Seen nothing or the last symbol was 0.

$q_1$ : Last symbol seen was 1. Seen the 1st 1 of the substring 11.

$q_2$ : Last symbol seen was 1 which is the 2nd 1 of the substring 11. If the string ends after seeing 11, it should be accepted. Therefore,  $q_2$  is the final state.

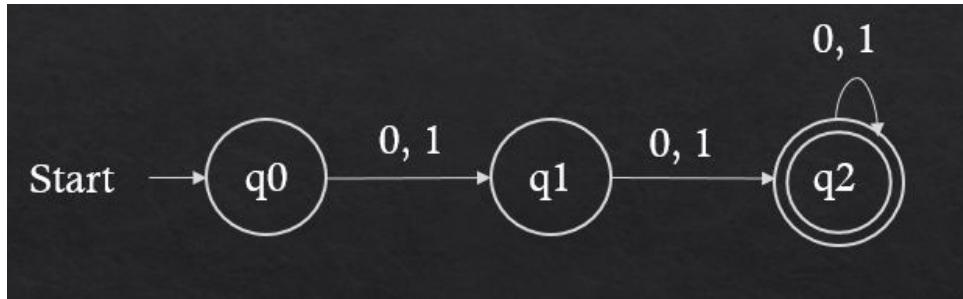


3.  $L(A) = \{w \mid w \in \{0,1\}^* \text{ and } |w| \geq 2\}$  i.e. length of the string is at least 2

$q_0$ : Start state. Seen nothing.

$q_1$ : Seen 1 symbol (0 or 1), length 1.

$q_2$ : Seen 2 symbols (Any combination of 0s and 1s), length 2. This is the final state.



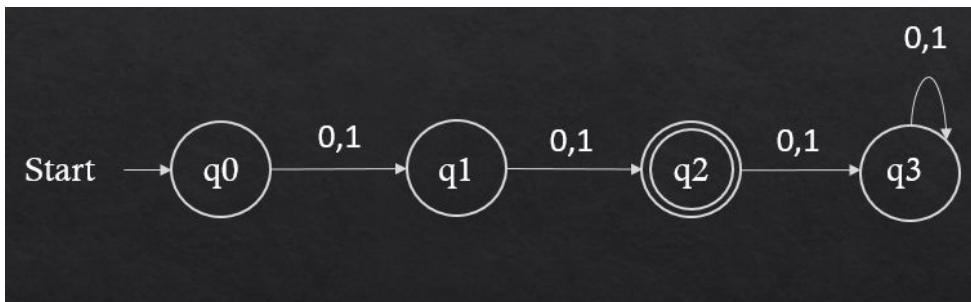
4.  $L(A) = \{w \mid w \in \{0,1\}^* \text{ and } |w| = 2\}$  length of the string is 2

$q_0$ : Start state. Seen nothing.

$q_1$ : Seen 1 symbol (0 or 1), length 1.

$q_2$ : Seen 2 symbols (Any combination of 0s and 1s), length 2. This is the final state.

$q_3$ : Seen 3 symbols (Any combination of 0s and 1s), length 3. This is the **trap state** since the condition is violated.



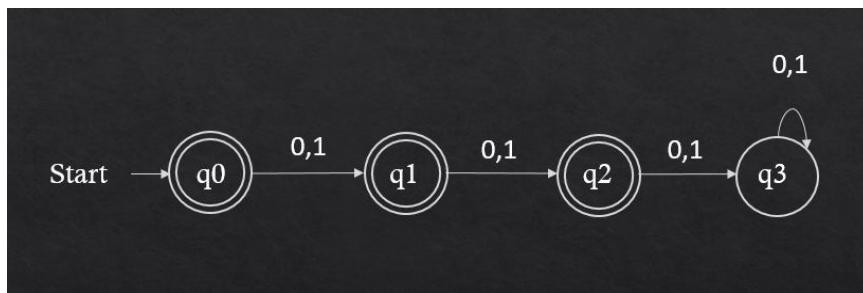
5.  $L(A) = \{w \mid w \in (0,1)^* \text{ and } |w| \leq 2\}$  i.e. length of the string is at most 2

$q_0$ : Start state. Seen nothing and it is one of the final states.

$q_1$ : Seen 1 symbol (0 or 1), length 1 and it is one of the final states.

$q_2$ : Seen 2 symbols (Any combination of 0s and 1s), length 2 and it is one of the final states.

$q_3$ : Seen 3 symbols (Any combination of 0s and 1s), length 3. This is the **trap state** since the condition is violated.

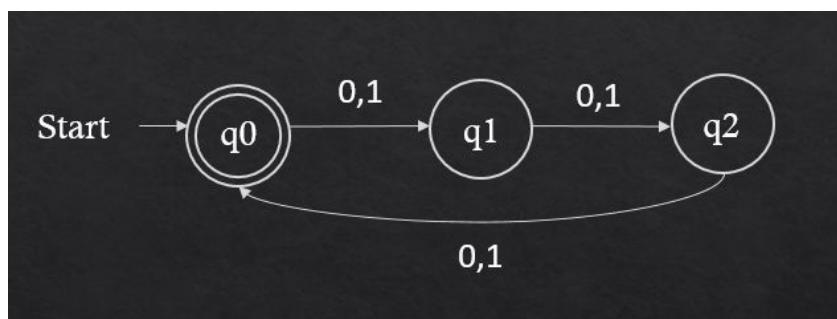


6.  $L(A) = \{w \mid w \in (0,1)^* \text{ and the length of } w \text{ is divisible by 3}\}$  i.e. w of length 0, 3, 6, 9, 12, 15

$q_0$ : Start state and the remainder is 0 when the length is divided by 3 i.e. the length is divisible by 3. Therefore, it is also the final state

$q_1$ : The remainder is 1 when the length is divided by 3.

$q_2$ : The remainder is 2 when the length is divided by 3.



7.  $L(A) = \{w \mid w \in (0,1)^* \text{ and } w \text{ as a binary integer is divisible by 5}\}$

q0: The string processed so far represents an integer of the form  $5m$  where  $m$  is any integer. Since numbers of this form are divisible by 5, it is the final state.

q1: The string processed so far represents an integer of the form  $5m+1$  where  $m$  is any integer i.e. the remainder is 1 when the number is divided by 5.

q2: The string processed so far represents an integer of the form  $5m+2$  where  $m$  is any integer i.e. the remainder is 2 when the number is divided by 5.

q3: The string processed so far represents an integer of the form  $5m+3$  where  $m$  is any integer i.e. the remainder is 3 when the number is divided by 5.

q4: The string processed so far represents an integer of the form  $5m+4$  where  $m$  is any integer i.e. the remainder is 4 when the number is divided by 5.

