

Lecture 6.1 and 6.2: DFA Examples

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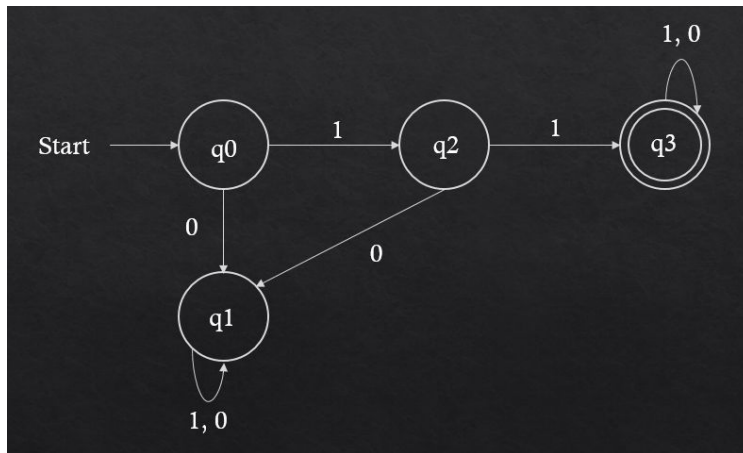
1. $L(A) = \{w \mid w \in (0,1)^* \text{ and } w \text{ starts with } 11\}$ i.e. $\{11, 110, 111, 1100, 1101, \dots\}$

q0: Start state. Seen nothing.

q1: 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.

q2: Last symbol seen was 1. It was also the 1st symbol of the string.

q3: Last symbol was 1 and it was the second symbol of the string. Therefore, the string starts with 11 and q3 is the final state.

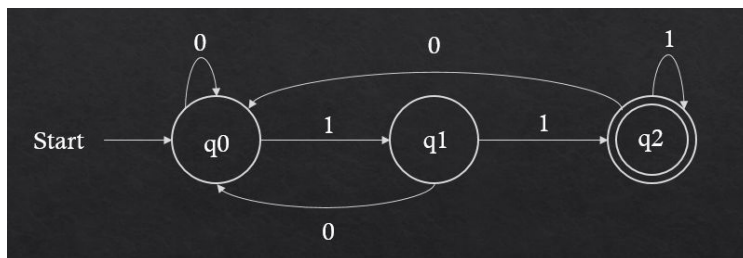


2. $L(A) = \{w \mid w \in (0,1)^* \text{ and } w \text{ ends with } 11\}$ i.e. $\{11, 011, 111, \dots\}$

q0: Start state. Seen nothing or the last symbol was 0.

q1: Last symbol seen was 1. Seen the 1st 1 of the substring 11.

q2: 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, q2 is the final state.

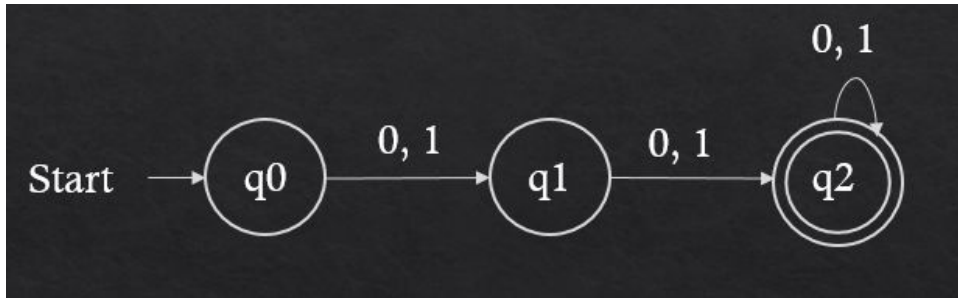


3. $L(A) = \{w \mid w \in (0,1)^* \text{ and } |w| \geq 2\}$ i.e. length of the string is at least 2

q0: Start state. Seen nothing.

q1: Seen 1 symbol (0 or 1), length 1.

q2: Seen 2 symbols (Any combination of 0s and 1s), length 2. This is the final state.



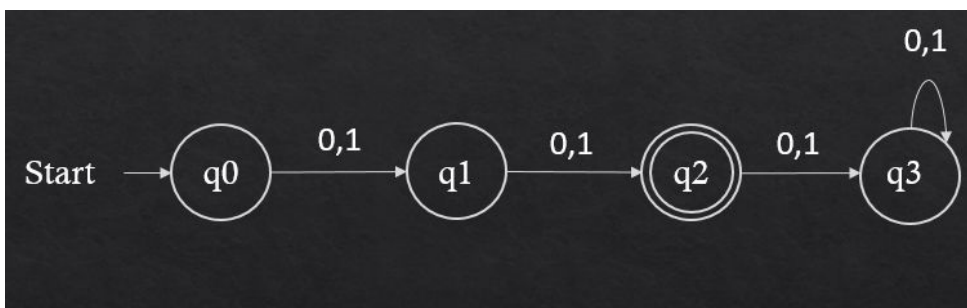
4. $L(A) = \{w \mid w \in (0,1)^* \text{ and } |w| = 2\}$ length of the string is 2

q0: Start state. Seen nothing.

q1: Seen 1 symbol (0 or 1), length 1.

q2: Seen 2 symbols (Any combination of 0s and 1s), length 2. This is the final state.

q3: Seen 3 symbols (Any combination of 0s and 1s), length 3. This is the **trap state** since the condition is violated.



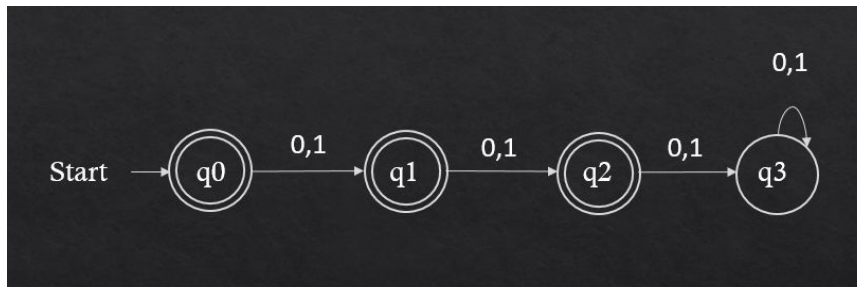
5. $L(A) = \{w \mid w \in (0,1)^* \text{ and } |w| \leq 2\}$ i.e. length of the string is at most 2

q0: Start state. Seen nothing and it is one of the final states.

q1: Seen 1 symbol (0 or 1), length 1 and it is one of the final states.

q2: Seen 2 symbols (Any combination of 0s and 1s), length 2 and it is one of the final states.

q3: Seen 3 symbols (Any combination of 0s and 1s), length 3. This is the **trap state** since the condition is violated.

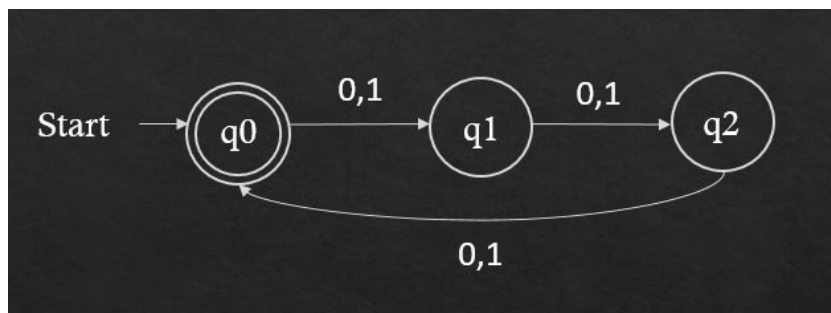


6. $L(A) = \{w \mid w \in (0,1)^* \text{ and the length of } w \text{ is divisible by } 3\}$ i.e. w of length 0, 3, 6, 9, 12, 15

q0: 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

q1: The remainder is 1 when the length is divided by 3.

q2: 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.

