Problem Set 2: Introduction to Deterministic Finite Automaton

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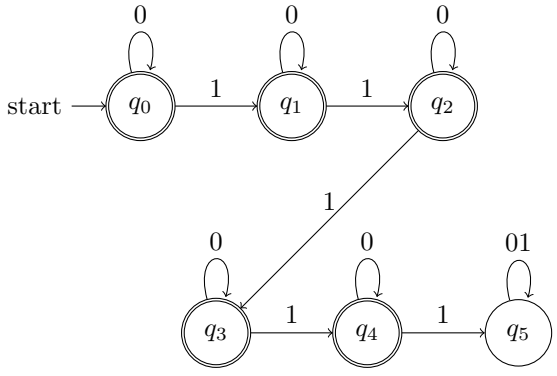
Critical Thinking

1. (a) ($Q = \{q_0, q_1, q_2, q_3, q_4, q_5\}$, $\Sigma = \{1, 0\}$, δ, q_0, $F = \{q_0, q_1, q_2, q_3, q_4\}$)

$\delta =$

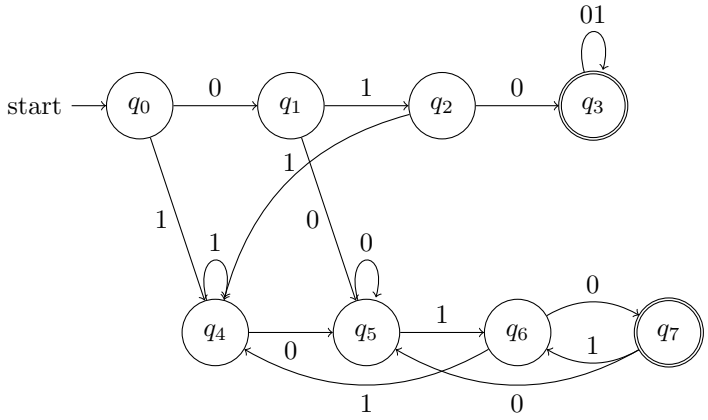
	1	0
q_0	q_1	q_0
q_1	q_2	q_1
q_2	q_3	q_2
q_3	q_4	q_3
q_4	q_5	q_4
q_5	q_5	q_5



(b) ($Q = \{q_0, q_1, q_2, q_3, q_4, q_5, q_6, q_7\}$, $\Sigma = \{1, 0\}$, δ, q_0, $F = \{q_3, q_7\}$)

$\delta =$

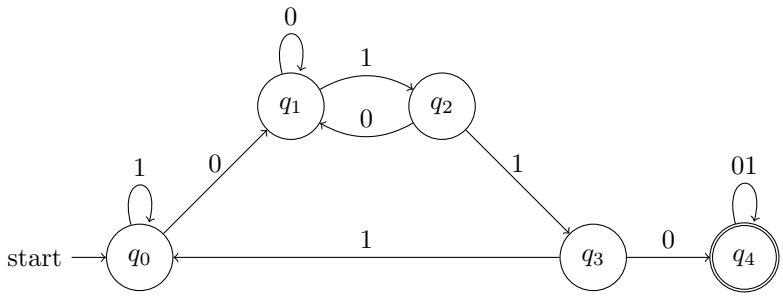
	1	0
q_0	q_4	q_1
q_1	q_2	q_5
q_2	q_4	q_3
q_3	q_3	q_3
q_4	q_4	q_5
q_5	q_6	q_5
q_6	q_4	q_7
q_7	q_6	q_5



(c) $(Q = \{q_0, q_1, q_2, q_3, q_4\}, \Sigma = \{1, 0\}, \delta, q_0, F = \{q_4\})$

$\delta =$

	1	0
q_0	q_0	q_1
q_1	q_2	q_1
q_2	q_3	q_1
q_3	q_0	q_4
q_4	q_4	q_4



2. A language is considered regular if there is a finite automaton that recognizes/accepts it.

3. A collection of objects is closed under some operation if the result of that operation on two of the objects from the collection is also in the collection. For example $\mathbb{N}$ is closed under multiplication, let $x, y \in \mathbb{N}$, $x * y = z$, $z \in \mathbb{N}$.

4. Even and odd numbers conform to the following forms, $2n$ and $2n + 1$, $n \in \mathbb{Z}$; From this we can conclude that two consecutive integers will contain both an odd and even integer as integers must fill one of the two forms provided and the form alternates from each consecutive number. The prior statement also applies to natural numbers as $\mathbb{N} \subseteq \mathbb{Z}$. Now given x and y we can view these as $2n$ and $2n+1$ because they are consecutive.

$$x + y = \big(2n\big) + \big(2n + 1\big)$$

$$x + y = 4n + 1$$

As we know from before the definition of an odd number is $2n + 1$, $2n$ just denoting an integer or natural number in this case multiplied by 2 meaning it is also divisible by 2 and therefore even. 4 is also divisible by 2 denoting it is even, meaning the result of $x + y = 4n + 1$ follows the form of an odd number; therefore we can definitively conclude that $x + y =$ odd, given that x and y are consecutive and $x, y \in \mathbb{N}$.