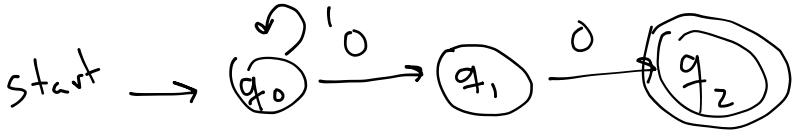
# Autómatas Estado Finito (AEF)




$A = (Q, \Sigma, \delta, q_0, F)$

- $Q$ ~ conjunto finito de estados
- $\Sigma$ ~ conjunto símbolos
- → $\delta$ ~ función de transición
- $q_0$ ~ estado inicial $q \in Q$
- $F$ ~ conjunto est. finales $F \subseteq Q$

Determinístico

Conceptos:

$\Sigma$: Alfabeto

$\Sigma = \{0, 1\}$, $\Sigma = \{a, b, c, \dots, z\}$

strings: $w =$ "101101"

$w = \varepsilon$ Vacío

$|w|$ ~ cuantos símbolos

$|\varepsilon| \sim 0$

Potencia

$\Sigma^k$ ~ strings con k símbolos

$\Sigma = \{0, 1\}$

$\Sigma^2 = \{00, 01, 10, 11\}$

$\Sigma^0$

$\Sigma = \varepsilon$

Conjunto de strings

$\Sigma^* = \Sigma^0 \cup \Sigma^1 \cup \Sigma^2 \cup \dots$

$\Sigma^+ = \Sigma^1 \cup \Sigma^2 \cup \Sigma^3 \cup \dots$

$\Sigma^* = \Sigma^+ \cup \{\varepsilon\}$

Concatenación

si $x = 011$ y $y = 100$

entonces $xy = 011100$

Lenguaje

$L \subseteq \Sigma^*$

Operación de AFD

- Supongamos $q_1 q_2 a_3 \dots a_n$ strings
- estado inicial $q_0$
- $\delta(q_0, q_1) = q_1$ $\quad \delta : Q \times \Sigma \to Q$

  $\delta(q_1, q_2) = q_2$

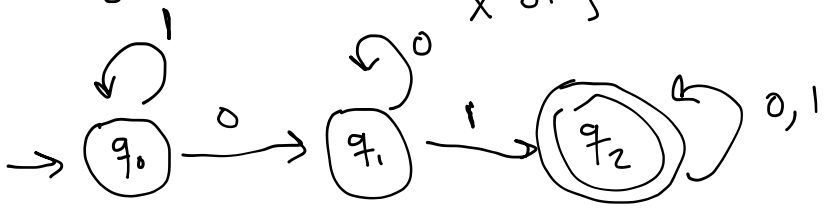
  ⋮

- $q_1, q_2, q_3, q_n$
- $\delta(q_i, a_{i+1}) = q_{i+1}$

Ejemplo:

$1 = \{w \mid w \text{ es } x01y\}$, $\Sigma = \{0, 1\}$

e.g. 01, 11010, 611101000
X 01 y




transiciones

$\delta(q_0, 1) = q_0$

$\delta(q_0, 0) = q_1$

$\delta(q_1, 0) = q_1$

$\delta(q_1, 1) = q_2$

$\delta(q_2, 0) = q_2$

$\delta(q_2, 1) = q_2$

$A = \{\{q_0, q_1, q_2\}, \{0,1\}, \delta, q_0, \{q_2\}\}$

tabla transiciones

| | 0 | 1 |
|---|---|---|
| → $q_0$ | $q_1$ | $q_0$ |
| $q_1$ | $q_1$ | $q_2$ |
| * $q_2$ | $q_2$ | $q_2$ |

$\hat{\delta}$ ~ función extendida

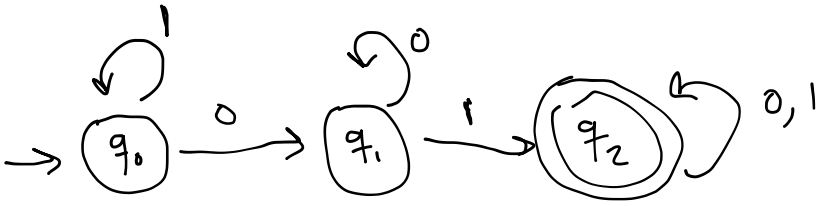
base: $\hat{\delta}(q, \varepsilon) = q$

inductivo: $w = xq$ ← símbolo
↳ string

estado
string

$$\hat{\delta}(q, w) = \delta(\delta(q, x), a)$$

Q — símbolo




10010

$$\hat{\delta}(q_0, 10010) = \delta(\hat{\delta}(q_0, 1001), 0) = q_2$$

$$\hat{\delta}(q_0, 1001) = \delta(\hat{\delta}(q_0, 100), 1) = q_2$$

$$\hat{\delta}(q_0, 100) = \delta(\hat{\delta}(q_0, 10), 0) = q_1$$

$$\hat{\delta}(q_0, 10) = \delta(\hat{\delta}(q_0, 1), 0) = q_1$$

$$\hat{\delta}(q_0, 1) = \delta(\hat{\delta}(q_0, \varepsilon), 1) = q_0$$

$q_0$

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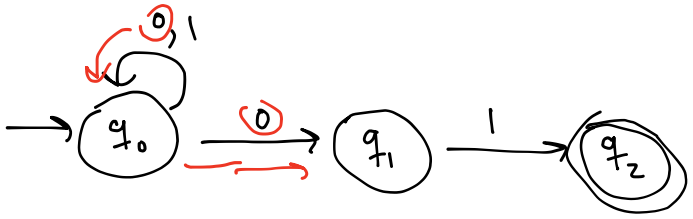
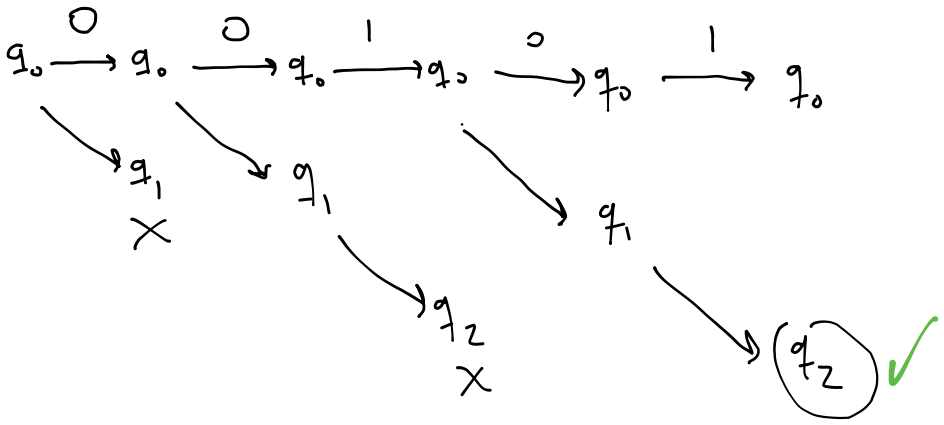
$$L(A) = \{ w \mid \hat{\delta}(q_0, w) \in F \}$$

$L(A)$ ~ Lenguaje aceptado por el AFD A

Autómata Finitos No-Determinísticos




Procesar 00101




Definición Formal

$$A = (Q, \Sigma, \delta, q_0, F)$$

$$\delta : Q \times \Sigma \longrightarrow Q \times Q \times Q \times \dots$$

$$\delta(q_0, 0) = \{q_0, q_1\}$$ conjunto

$\hat{\delta}$ ~ función extendida

base: $\hat{\delta}(q, \varepsilon) = \{q\}$

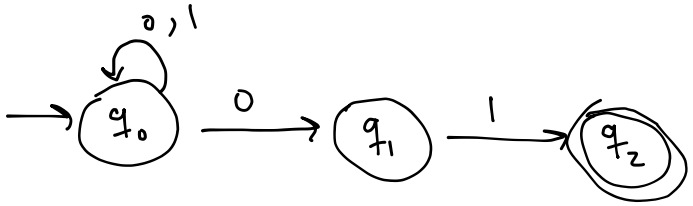
Inductivo: $w = xa$ (x: strings, a: símbolo final) y $\delta(q, x) = \{p_1, p_2, \ldots, p_k\}$

Sea $\bigcup_{i=1}^{k} \delta(p_i, a) = \{r_1, r_2, \ldots, r_m\}$

$$\hat{\delta}(q, w) = \{r_1, r_2, \ldots, r_m\}$$

$$\hat{\delta}(q, w) = \bigcup_{i=1}^{k} \delta(p_i, a) = \{r_1, r_2, \ldots, r_m\}$$

$$L(A) = \{ w \mid \hat{\delta}(q_0, w) \cap F \neq \emptyset \}$$




$w = 0\,0\,1\,0\,1$

1. $\hat{\delta}(q_0, \varepsilon) = \{q_0\}$
2. $\hat{\delta}(q_0, 0) = \delta(q_0, 0) = \{q_0, q_1\}$
3. $\hat{\delta}(q_0, 00) = \delta(q_0, 0) \cup \delta(q_1, 0) = \{q_0, q_1\} \cup \emptyset = \{q_0, q_1\}$
4. $\hat{\delta}(q_0, 001) = \delta(q_0, 1) \cup \delta(q_1, 1) = \{q_0\} \cup \{q_2\} = \{q_0, q_2\}$

5. $\hat{\delta}(q_0, 0010) = \delta(q_0, 0) \cup \delta(q_2, 0) = \{q_0, q_1\} \cup \emptyset = \{q_0, q_1\}$

6. $\hat{\delta}(q_0, 00101) = \delta(q_0, 1) \cup \delta(q_1, 1) = \{q_0\} \cup \{q_2\} = \{q_0, q_2\}$

$\hat{\delta}(q_0, 00101) = \{q_0, q_2\} \cap F = \{q_2\}$ ✓