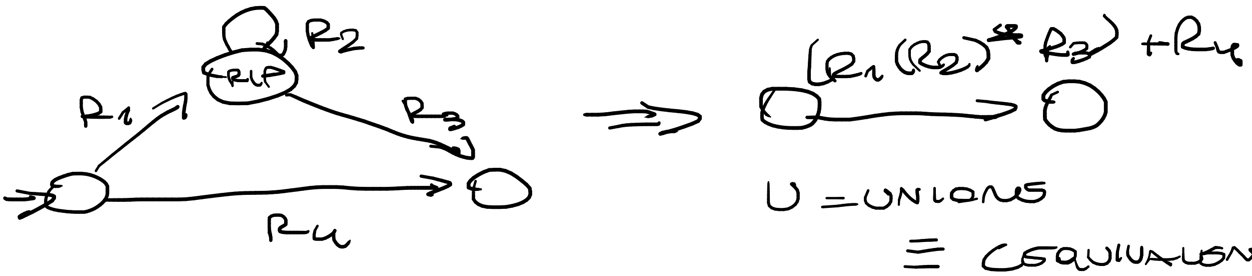
24/03/2025

- GNFA e conversioni
- Pumping lemma per linguaggi regolari

<u>GNFA</u> → NFA generalizzato

- ∃! stato iniziale
- ∃! stato finale

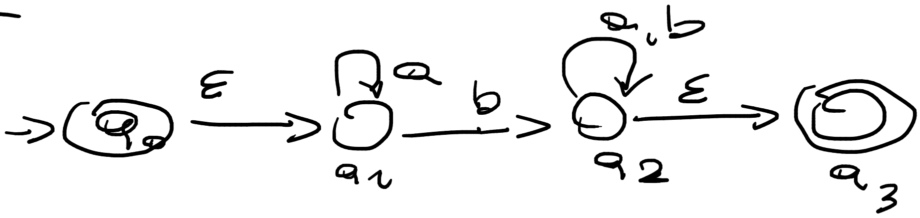


U = unione

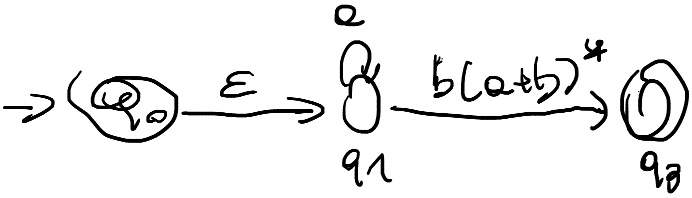
≡ (equivalente)

\+ somma

[DFA → ER] - 1°

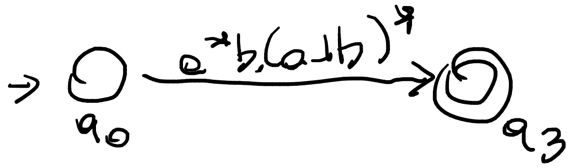


[START]

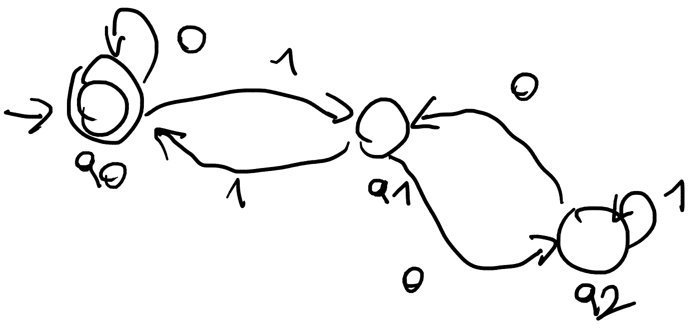


[TOLGO q_2]

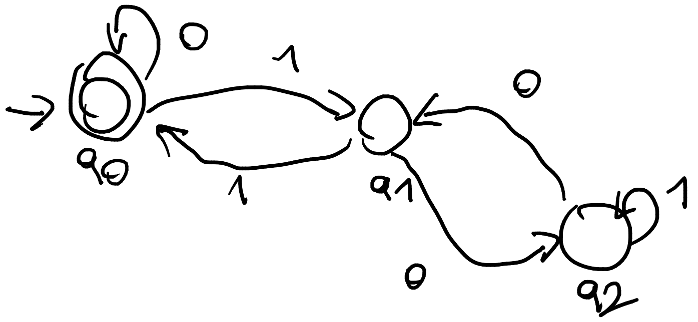
$b(a+b)^*, \varepsilon \equiv b(a+b)^+$



[TOLGO q_1]

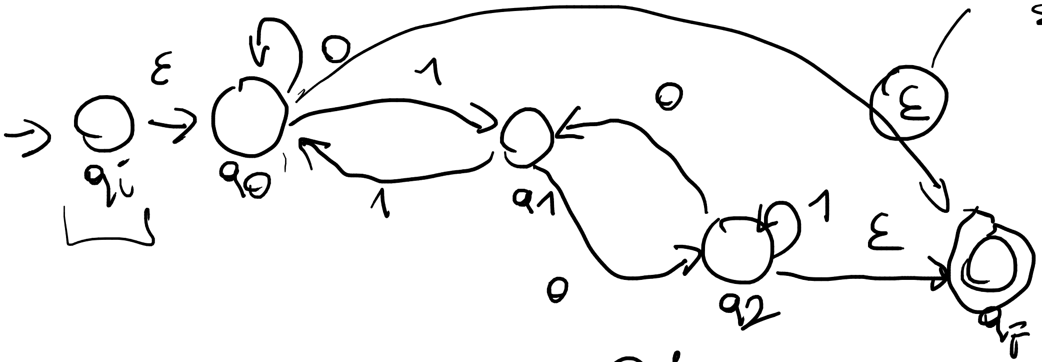


DFA - num. binari divisibili per 3

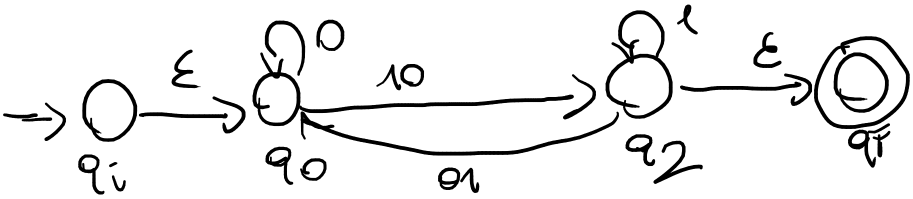


[STATO INIZIALE $\rightarrow q_i$
STATO FINALE $\rightarrow q_F$]

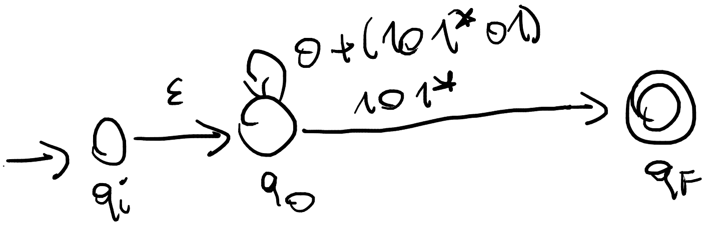
AGGIUNTA DEGLI STATI ENTRAMBI PER OGNI SINGOLO STATO



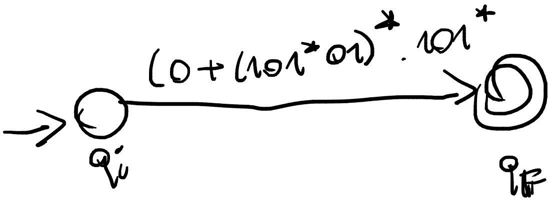
[TOLGO q_1]



[TOLGO q_2]



[ELIMINO q_0]



PUMPING LEMMA PER LINGUAGGI REGOLARI

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

$L = \{0^n 1^n \mid n \geq 0\}$

↓

ENUNCIATO

PUMPING LENGTH

- $w = xyz$
- $x = a_1 \dots a_m$
- $y = a_{m+1} \dots a_m$ $(\neq \varepsilon)$
- $|xy| \leq k$

GIOCO DEL PUMPING LEMMA

$K \to$ LUNGHEZZA

$w = xyz$

$xy^i z \notin L$

(1) $L = \{ w \in \{a, b\}^* \mid$ NUMERO DI $a >$ NUMERO DI b

$(\# a > \# b)$

$K > 0 \Rightarrow w = xyz$

$w = a^{p+1} b^p \qquad |w| = p+1+p = 2p+1 \geq K$

$|xy| \leq K, \ |y| \neq \varepsilon$

$x = \varepsilon, \ y = a^{p+1}, \ z = b^p$

$(i=0) \to \# a > \# b \mid$ DIPENDE DA p

$xy^0z = xz = a^{p+1-q} b^p \qquad q > 0$

se $q \geq 1 \mid (p+1-q) \leq p$

ESERCIZIO 4

$L = \{ 0^{n^2} \mid n \geq 0 \}$

$w = xyz$

$y \neq \varepsilon$

xy^iz

$K = 1, \ x = \varepsilon, \ z = \varepsilon$

$y = 0$

$n \in \mathbb{N} \mid xy^2z \quad 00$

$n \geq 1 \qquad |xy| \leq K$

ESERCIZIO 2

$L = \{a^L b^M a^N \mid L+M=N\}$ $\quad \mid L, M, N \geq 0$ $\qquad N =$

$\left[\begin{array}{l} w = x y^i z \\ y \neq \varepsilon \end{array}\right]$ $\qquad K = N, \; x = a^L, \; y = b^M, \; z = a^{(L+M)}$

$\left[\begin{array}{l} |xy| \leq \underset{N}{K} \end{array}\right]$

$i = 2 \mid w = x y^2 z = a^L b^{2M} a^{L+M}$

$L + 2M = L + M$

$M > 0, \; M \neq \varepsilon$

$L = \{0^m 1^n \mid \frac{m}{n}$ NUMERO INTERO, $\frac{m}{n} \in \mathbb{Z}\}$

DIMOSTRA L NON REGOLARE $\qquad K = m, \; x = 0^{m-1}, \; y = 0$

$\left[\begin{array}{l} w = x y^i z \\ y \neq \varepsilon, \; i \geq 0 \end{array}\right]$ $\qquad z = 1^n$

$i = 2, \; w = x y^2 z = 0^{(m-1)} 0^2 1^n$

$\frac{m}{n} \mid \frac{(m-1+2)}{n}$ $\qquad |xy| \leq K$

$n \neq 1$

LUNGHEZZA MINIMA PUMPING $\qquad 0001^*$

$001 \cup 0^* 1^*$

DIMOSTRA L CHE SIA REGOLARE $\;\Big\{$ SHUFFLE / SHUFFLE PERFETTO

$L = \{ w \mid w = a_1 b_1 \ldots a_k b_k \mid (a_1, \ldots, a_k) \in A,$
$(b_1 \ldots b_k) \in B \}$

CLASSE L. REGOLARE

È CHIUSA

RISPETTO A SHUFFLE PERFETTO

DFA → A

DFA → B

> OUTPUT $(a_1, b_1) \ldots (a_k, b_k)$