Es. 2.2020 (Gennaio)

(i) $L_{pal} = \{w \in \{0,1\}^* \mid w = w^R\}$

L_{pal} regolare $\Rightarrow$ $0^n 1^n 0^n = xyz \mid |xy| \leq n,\ y \neq \varepsilon,\ xy^i z \in L_{pal}$

$\forall i \in \mathbb{N} \Rightarrow xz \in L_{pal}$ ↯. L_{pal} non è regolare.

$P \rightarrow \varepsilon \mid 0 \mid 1 \mid 0P0 \mid 1P1$

$L_{pal} = L(G)$:

- $L_{pal} \subset L(G)$
  - $|w| \leq 1$, base.
  - $|w| = n$. $w = 0d0$: $P \Rightarrow d \Rightarrow 0d0 \Rightarrow w$.
    $w = 1d1$: $P \Rightarrow d \Rightarrow 1d1 \Rightarrow w$.

- $L(G) \subset L_{pal}$
  - $\varepsilon, 0, 1 \in L_{pal}$
  - $P \Rightarrow 0P0 \mid 1P1$. $(0P0)^R = 0P^R0 = 0P0$.
    $(1P1)^R = 1P^R1 = 1P1 \Rightarrow w \in L_{pal}$. ↩

(ii) Per il PL $0^n 1^n 2^n$.

es. 2.2020 (Febbraio)

(i) $L_1 = \{ b^2 a^n b^m a^3 \mid m,n \geq 0 \}$ bba^*b^*aaa reg $\rightarrow$ CFL

(ii) $L_2 = \{ a^n w \mid w \in \{a,b\}$ t.c. $|w| = n,\ n \geq 0 \}$

Per il PL, $a^n b^n$; non è regolare.

$P \Rightarrow \varepsilon \mid aPa \mid aPb$. E' CFL.

(iii) $L_3 = \{ a^i b^j c^k \mid i,j \geq 0,\ k = \max(i,j) \}$.

$a^n b^n c^n = stuvx$

$tuv = a^n \Rightarrow st^2uv^2x \notin L_3$

$tuv = b^n \Rightarrow st^2uv^2x \notin L_3$

$tuv = c^n \Rightarrow st^2uv^2x \notin L_3$

$tuv \ni a,b \Rightarrow sux \notin L_3$.

$tuv \ni b,c \rightarrow sux \notin L_3$

$\Rightarrow \neg$CFL ($\Rightarrow \neg$reg)

es. 5.2020 (Febbraio)

$$max(L) = \{ w \in L \mid \nexists x \neq \varepsilon \text{ t.c. } wx \in L \}$$

(i) L regolare $\Rightarrow$ max(L) regolare.

Copiare il DFA di L. Normalizzare gli stati da cui sono raggiungibili altri stati finali.

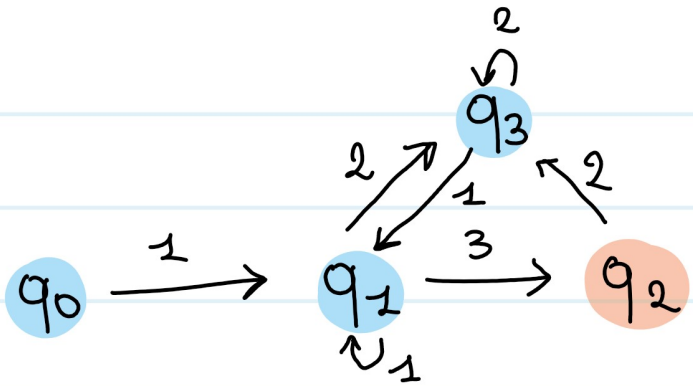
(ii) $L = \{ a^i b^j c^k \mid k \leq i \vee k \leq j \}$

$$P \rightarrow aBc \mid aPc \mid aP$$
$$B \rightarrow b \mid bB$$

$Max(L) = \{ a^i b^j c^{max(i,j)} \}$ non CFL.

es. 1.2019 (Gennaio)

$\Sigma = \{1, 2, 3\}$



$$1(1+22^*1)^*3\left(22^*1(1+22^*1)^*3\right)^*$$

$$P=\{q_0 \to 1q_1,\ q_1 \to 1q_1 \mid 2q_3 \mid 3q_2,$$
$$q_2 \to 2q_3 \mid \varepsilon,\ q_3 \to 2q_3 \mid 1q_1\}$$

$$G=(\{q_0,\dots,q_3\},\{1,2,3\},P,q_0)$$

es. 2. 2019 (Gennaio)

(i) $L_1 = \{0^i 1^j 2^j 3^i \mid i \geq 1, j \geq 1\}$

Per il PL, L_1 non reg.

$$\left.\begin{aligned} E &\to 0I3 \\ I &\to 12 \mid 1I2 \end{aligned}\right\} \text{libero}$$

(ii) $L_2 = \{ 0^i 1^j 2^j 3^j \mid i \geq 1, j \geq 1 \}$

Per il PL con $i = 1$, L_2 non libero.

es. 2. 2019 (Giugno)

(i) $L_1 = \{ 0^n 1^{2n} \mid n \geq 1 \}$

Per PL non è reg. con $0^n 1^{2n}$.

$E \rightarrow 011 \mid 0E11 \Rightarrow$ CFL

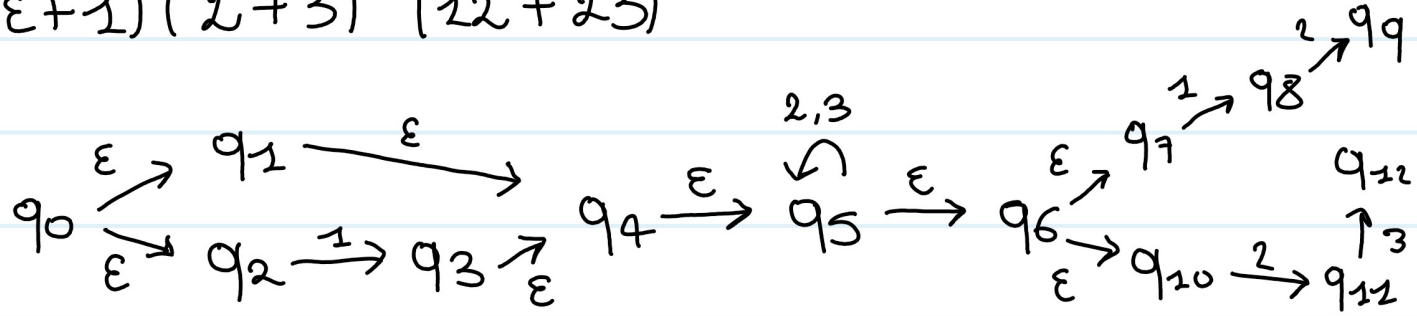
(ii) $L_2 = \{ ww \mid w \in \{a,b\}^* \}$

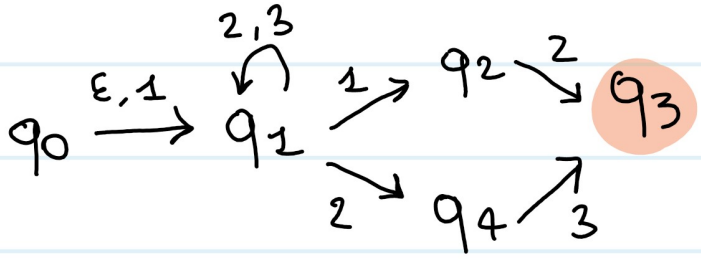
$a\, b^n\, a\, b^n$ per il PL $\Rightarrow \neg$CFL $\Rightarrow \neg$ reg.

es. 1. 2018

$\Sigma = \{1, 2, 3\}$

$(\varepsilon + 1)(2 + 3)^* (12 + 23)$





$\{q_0, q_2\}$ $\{q_2\}$ $\{q_2\}$ $\{q_3\}$ $\{q_4\}$

	1	2	3		1	2	3
$\{q_0, q_2\}$	$\{q_1, q_2\}$	$\{q_1, q_4\}$	$\{q_1\}$	$\{q_3\}$	$\emptyset$	$\emptyset$	$\emptyset$
$\{q_1\}$	$\{q_2\}$	$\{q_1, q_4\}$	$\{q_1\}$	$\{q_4\}$	$\emptyset$	$\emptyset$	$\{q_3\}$
$\{q_2\}$	$\emptyset$	$\{q_3\}$	$\emptyset$				

$\{q_1, q_2\}$ $\{q_2\}$ $\{q_4, q_3, q_4\}$ $\{q_1\}$

$\{q_1, q_4\}$ $\{q_2\}$ $\{q_1, q_4\}$ $\{q_1, q_3\}$

. . .

es. 1. 2018 (6:ugua)

$\{0, 1, 2, 3\}$ $\{4\}$

a: $\{q_0, q_1, q_3\}$ $\{q_2, q_5\}$ $\{4\}$
b: $\{0, 1, 2, 3, 5\}$ $\{4\}$

$\{0, 1, 3\}$ $\{2, 5\}$ $\{4\}$

a: $\{0, 1, 3\}$ $\{2, 5\}$ $\{4\}$
b: $\{0, 3\}$ $\{1\}$ $\{2, 5\}$ $\{4\}$

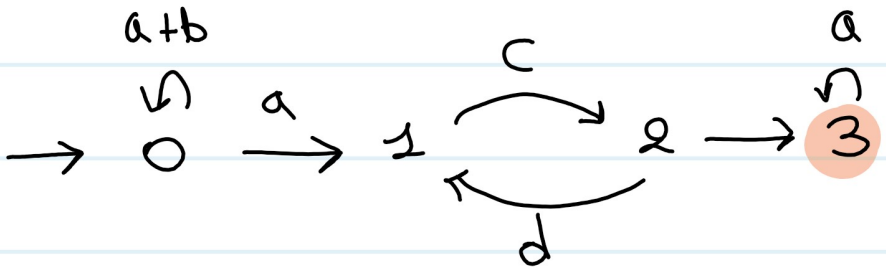
$\{0, 3\}$ $\{1\}$ $\{2, 5\}$ $\{4\}$ ✓

a: " " " "

b: " " . "

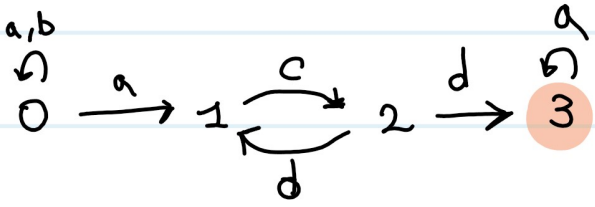
$$\left.\begin{aligned} E &\to aIc \mid aEc \\ I &\to \varepsilon \mid bIc \end{aligned}\right\} \quad a^n b^m c^m c^n \quad a^n b^m c^{n+m},\ n>0,\ m\geq 0$$

es. 1.2018 (Luglio)

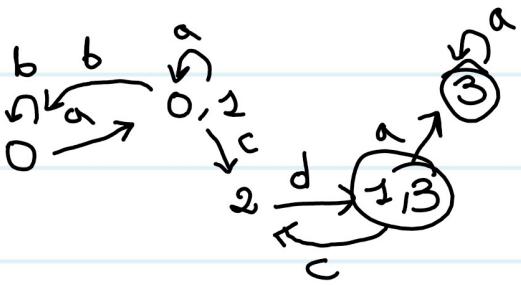


$$(a+b)^* a (cd)^* c a^*$$

es. 1. 2014 (Gennaio)



$(a+b)^* a\,(cd)^* c\,d\,a^*$



	a	b	c	d
0	0,1	0	/	/
1	/	/	2	/
2	/	/	/	1,3
3	3	/	/	/
0,1	0,1	0	2	/
1,3	3	/	2	/

$\{q_0 \to bq_0 \mid aq_1,\ q_1 \to bq_0 \mid aq_1,\ q_2 \to dq_3,\ q_3 \to cq_2 \mid$
$\mid aq_4 \mid \varepsilon,\ q_4 \to aq_4 \mid \varepsilon\}$

es. 1. 2013 (Gennaio)

$\Sigma_1 = \{a, b, c\}$

$a^{n^+}(a^k b^+)\, b^{n^+} \equiv a^m b^n,\ n \geq 2,\ m \geq 1$

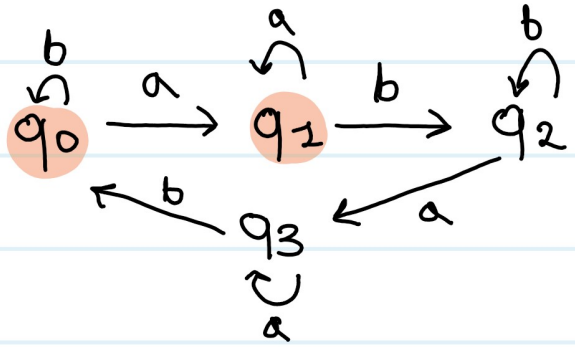
$S \to aSb \mid aAb$ $\quad aa^*b^+b$

$A \to aA \mid B\ \}\ a^*b^+$

$B \to bB \mid b\ \}\ b^+$

es. 1. 2013 (Luglio)

(i) $L = \{ w \in \{a,b\} \mid$ occ. di ab pari$\}$

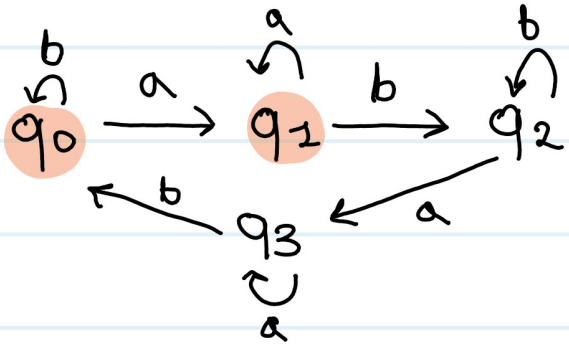


$\{q_0, q_1\}$ $\{q_2, q_3\}$

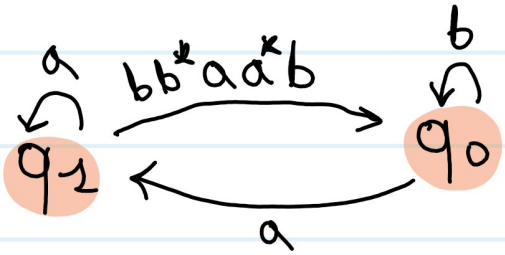
a: $\{q_0, q_1\}$ $\{q_2, q_3\}$

b: $\{q_0\}$ $\{q_1\}$ $\{q_2\}$ $\{q_3\}$

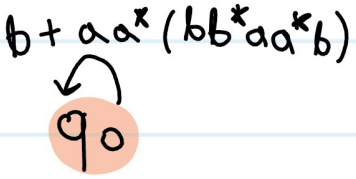
$\{q_0\}$ $\{q_1\}$ $\{q_2\}$ $\{q_3\}$ ✓



I.



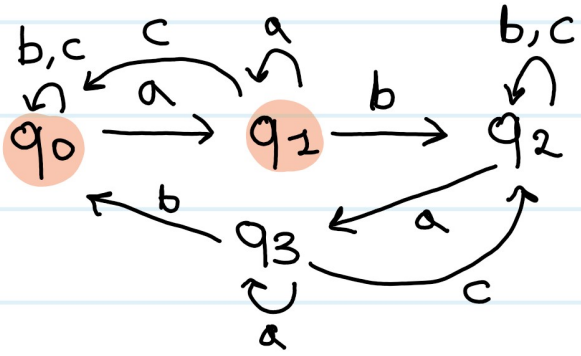
II.



$$(b + aa^*(bb^*aa^*b))^* (\varepsilon + aa^*)$$

$$\{E \to 1 \mid 1E0 \mid 0E1 \mid 10E \mid 01E \mid E10 \mid E01 \mid 1E \mid E1\}$$

~~1 1 1 1 0 0 0 1~~



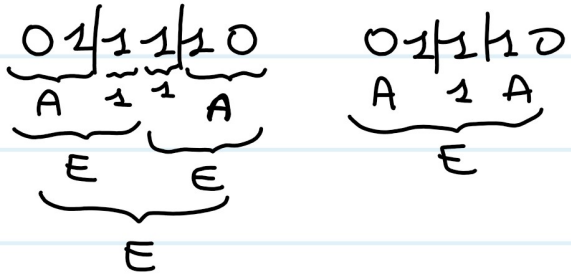
$\{q_0, q_1\}$ $\{q_2, q_3\}$

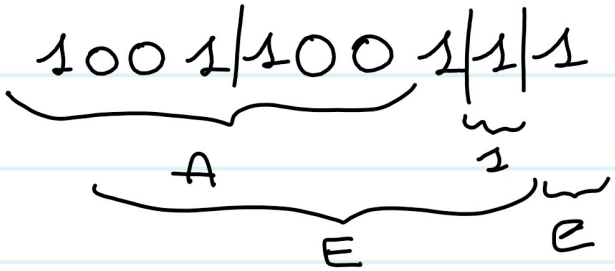
00111100

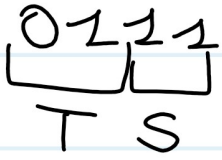
10111100100

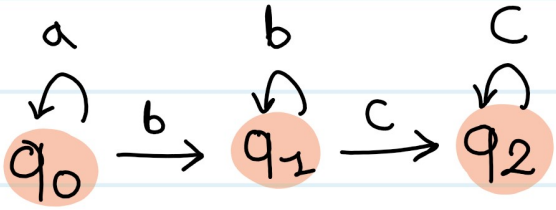
$\{ E \to A1A \mid EE \mid AEA,$
$A \to \varepsilon \mid 0A1 \mid 1A0 \mid AA \}$

0011100



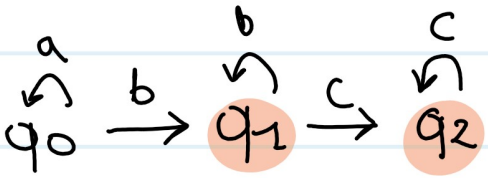






$$a^n b^{n+1} c^{n+2}$$

$$\begin{cases} E \to aIb \mid aEb \\ I \to \varepsilon \mid bIc \end{cases}$$



es. 2. 2018 (Febbraio)

$3n \equiv 0 \ (2) \Rightarrow$
$n \equiv 0 \ (2)$

$$L = \{ c^{2n} d^{6n} \mid n > 0 \}$$

$$P \to c^2 d^6 \mid c^2 P d^6$$

$$\begin{cases} E \to 1T \mid 1E \mid TE \\ T \to \varepsilon \mid 0T1 \mid 1T0 \mid TT \end{cases}$$