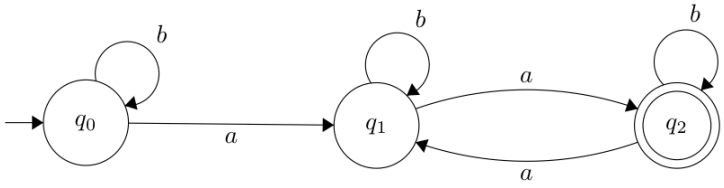
RELACIÓN 2b - Conversiones.

1.



Método 1 - Ecuaciones: $Ax + b = A^*b$

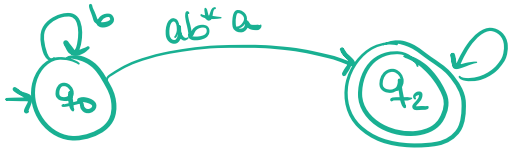
$$\begin{cases} x_0 = bx_0 + ax_1 = bx_0 + a(b+ab^*a)^*ab^* = b^*a(b+ab^*a)^*ab \\ x_1 = bx_1 + ax_2 \\ x_2 = ax_1 + bx_2 + \varepsilon = bx_2 + ax_1 + \varepsilon = b^*(ax_1 + \varepsilon) \end{cases}$$

$$x_1 = bx_1 + ab^*(ax_1 + \varepsilon) = (b + ab^*a)x_1 + ab^*$$

$$= (b+ab^*a)^*ab^*$$

$$x_0 = bx_0 + a(b+ab^*a)^*ab^* = \boxed{b^*a(b+ab^*a)^*ab^*}$$

Método 2 - Eliminando estados



$$\boxed{b^*ab^*a(b+ab^*a)^*}$$

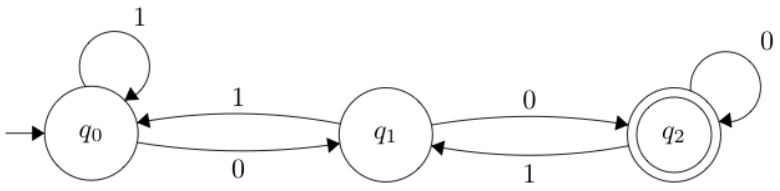
Gramática lineal por la derecha:

$Q_0 \rightarrow bQ_0 \mid aQ_1$

$Q_1 \rightarrow bQ_1 \mid aQ_2$

$Q_2 \rightarrow bQ_2 \mid aQ_1$

2.



Método 1 - Ecuaciones.

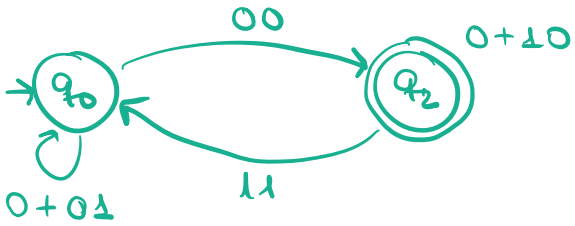
$$\begin{cases} X_0 = 1X_0 + 0X_1 = 1^* 0X_1 \\ X_1 = 0X_2 + 1X_0 = 11^*0X_1 + 0X_2 = (11^*0)^* 0X_2 \\ X_2 = 0X_2 + 1X_1 + \varepsilon = 0X_2 + 1(11^*0)^*0X_2 + \varepsilon \end{cases}$$

$$= (0 + 1(11^*0)^*0)X_2 + \varepsilon = (0+1(11^*0)^*0)^*$$

$$\hookrightarrow X_1 = (11^*0)^*0\,(0+1(11^*0)^*0)^*$$

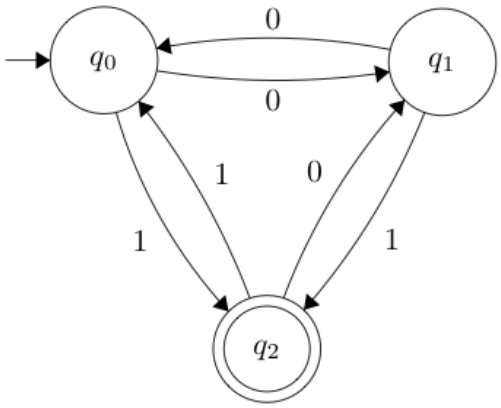
$$\hookrightarrow X_0 = 1^*0(11^*0)^*0(0+1(11^*0)^*0)^*$$

Método 2 - Eliminación estados



$$\underbrace{(0+01+00(0+10)^*11)^*}_{\text{formas de volver a } q_0}\,00\,(0+10)^*$$

3.



Método 1 - Equações

$$\begin{cases} x_0 = 0x_1 + 1x_2 \\ x_1 = 0x_0 + 1x_2 \\ x_2 = 0x_1 + 1x_0 + \varepsilon \end{cases} \longrightarrow$$

$$x_1 = 0x_0 + 1(0x_1 + 1x_0 + \varepsilon) =$$

$$= 10x_1 + (0+11)x_0 + 1$$

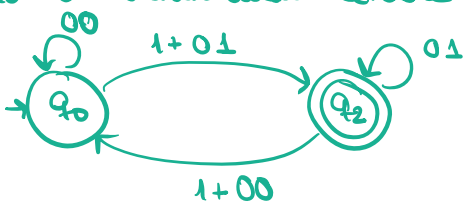
$$= (10)^*[(0+11)x_0 + 1]$$

$$x_0 = 0(10)^*\left((0+11)x_0 + 1\right) + 10(10)^*[(0+11)x_0 + 1] + 11x_0 + 1$$

$$= \left[0(10)^*(0+11) + 10(10)^*(0+11) + 11\right]x_0 + 0(10)^*1 + 10(10)^*1 + 1$$

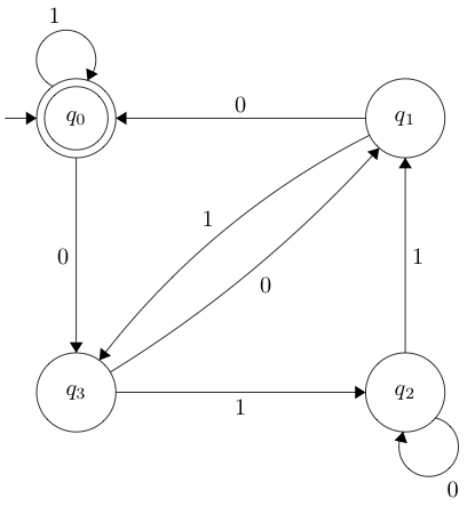
$$= \left[0(10)^*(0+11) + 10(10)^*(0+11) + 11\right]^*\left[0(10)^*1 + 10(10)^*1 + 1\right]$$

Método 2 - Eliminando estados



$$(00 + (1+01)(01)^*(1+00))^*(1+01)(01)^*$$

4.



Método 1 - Equações

$$\begin{cases} x_0 = 1x_0 + 0x_3 + \varepsilon \\ x_1 = 1x_2 + 0x_0 \\ x_2 = 1x_1 + 0x_2 = 0^*1x_1 \\ x_3 = 1x_2 + 0x_1 = 10^*1x_1 + 0x_1 = (10^*1 + 0)x_1 \end{cases}$$

$$x_1 = 1(10^*1+0)x_1 + 0x_0 = [1(10^*1+0)]^*0x_0$$

$$\hookrightarrow x_3 = (10^*1+0)[1(10^*1+0)]^*0x_0$$

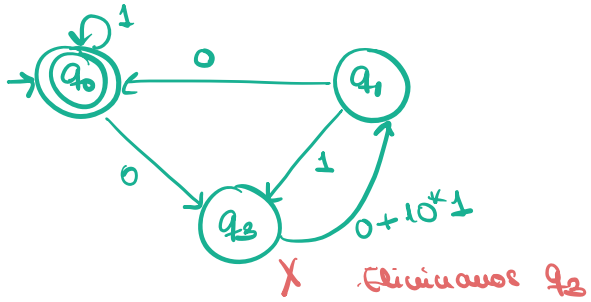
$$\hookrightarrow x_0 = 1x_0 + 0(10^*1+0)[1(10^*1+0)]^*0x_0 + \varepsilon$$

$$= [1 + 0(10^*1+0)[1(10^*1+0)]^*0]x_0 + \varepsilon$$

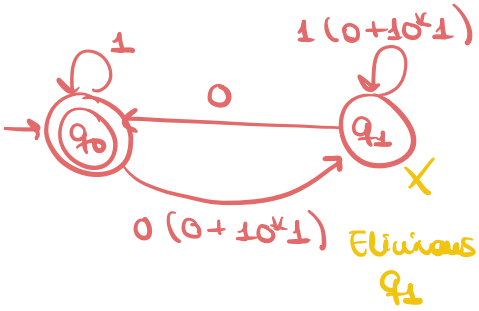
$$= [1 + 0(10^*1+0)[1(10^*1+0)]^*0]^*\varepsilon$$

Método 2 - Eliminación de estados

- Eliminamos q_2



Eliminamos q_2

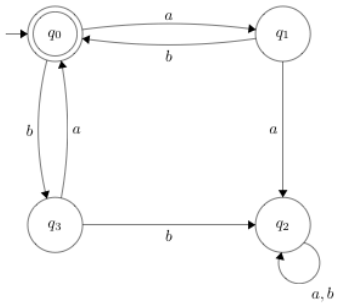


Eliminamos q_1

$$1 + 0(0+10^*1)[1(0+10^*1)]^*0$$

$$\text{REGEX} = \left[1 + 0(0+10^*1)[1(0+10^*1)]^*0\right]^*$$

5.

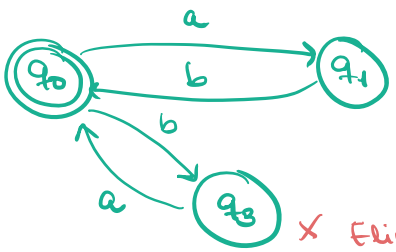


Método 1 - Equações

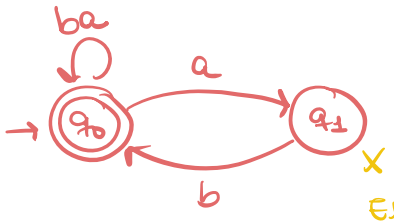
$$\begin{cases} x_0 = ax_1 + bx_3 + \varepsilon \\ x_1 = ax_2 + bx_0 \quad = bx_0 \\ x_2 = (a+b)x_2 + \emptyset = (a+b)^* \emptyset = \emptyset \\ x_3 = ax_0 + bx_2 \quad = ax_0 \end{cases}$$

$$x_0 = abx_0 + bax_0 + \varepsilon = (ab+ba)x_0 + \varepsilon = \boxed{(ab+ba)^*}$$

Eliminamos q_2: →



X Eliminamos q_3



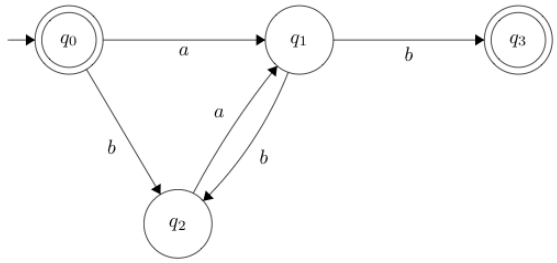
X

Eliminamos q_1

⇒

Regex: $\boxed{(ba+ab)^*}$

6.



Método 1 - Ecuaciones

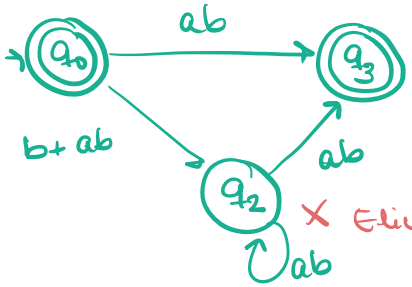
$$\begin{cases} x_0 = ax_1 + bx_2 + \varepsilon \\ x_1 = bx_3 + bx_2 \\ x_2 = ax_1 \\ x_3 = \varepsilon \end{cases}$$

$x_1 = b + bax_1 = (ba)^*b \longrightarrow x_2 = a(ba)^*b$

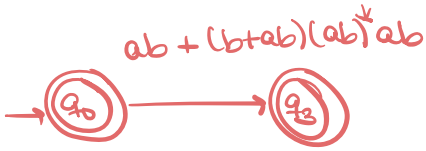
$x_0 = \boxed{a(ba)^*b + ba(ba)^*b + \varepsilon}$

Método 2 - Eliminando estados.

- Elimino q_1



✕ Elimino q_2



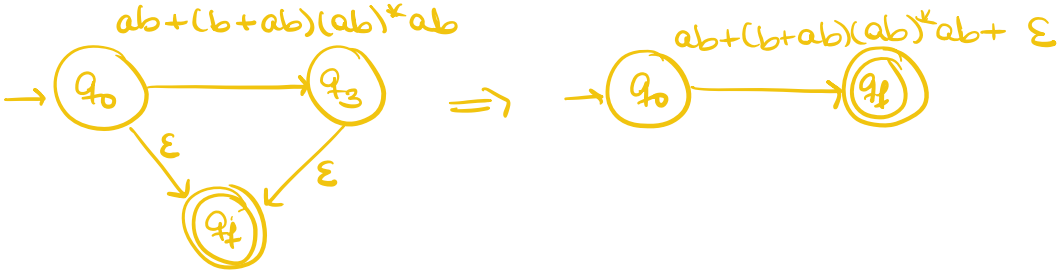
Como hay dos estados finales

$r = r_0 + r_3$

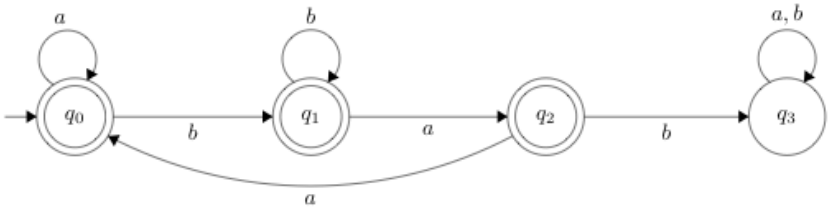
$$\boxed{r = ab + (b+ab)(ab)^*ab + \varepsilon}$$

$$\begin{cases} r_0 = \varepsilon \\ r_3 = ab + (b+ab)(ab)^*ab \end{cases}$$

* Otra forma: añadiendo un único estado final



7.



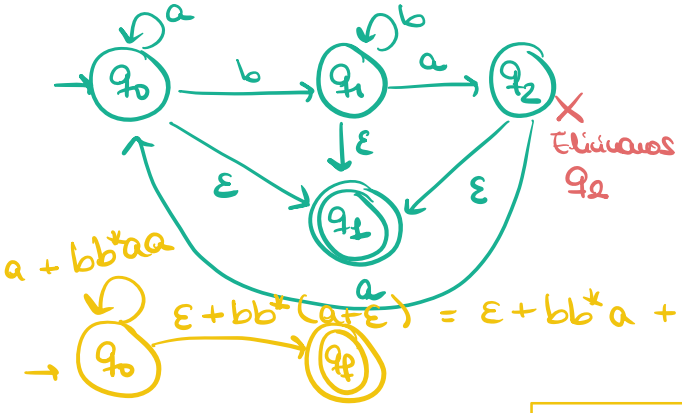
Método 1 - Ecuaciones

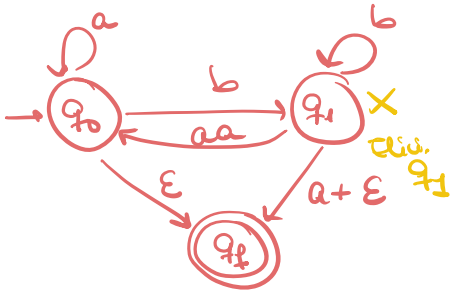
$$\begin{cases} x_0 = ax_0 + bx_1 + \varepsilon \\ x_1 = bx_1 + ax_2 + \varepsilon = bx_1 + aax_0 + a + \varepsilon = b^*(aax_0 + a + \varepsilon) \\ x_2 = bx_3 + ax_0 + \varepsilon = ax_0 + \varepsilon \\ x_3 = (a+b)x_3 + \emptyset \longrightarrow (a+b)^*\emptyset = \emptyset \end{cases}$$

$$x_0 = ax_0 + bb^*(aax_0 + a + \varepsilon) + \varepsilon = (a + bb^*aa)x_0 + bb^*a + bb^* + \varepsilon = \boxed{(a+bb^*aa)^*(bb^*a + bb^* + \varepsilon)}$$

Método 2 - Eliminando estados

- Eliminamos q_2 y unificamos finales





$$r = \boxed{(a+bb^*aa)^*(\varepsilon + bb^*a + bb^*)}$$