Instituto Politécnico Nacional

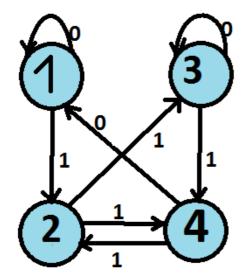
Escuela Superior de Cómputo

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2CM4

Expresiones regulares:

1- Ejercicio 1.



$$\begin{array}{l} k=0 \\ \mathbf{R}_{11}^0=0+\in=0 \\ \mathbf{R}_{12}^0=1 \\ \mathbf{R}_{13}^0=\oslash \\ \mathbf{R}_{14}^0=\oslash \end{array}$$

$$R_{21}^{0} = \emptyset$$

$$R_{22}^{0} = \in$$

$$R_{23}^{0} = 1$$

$$R_{24}^{0} = 1$$

$$\begin{array}{l} R^0_{31} = \oslash \\ R^0_{32} = \oslash \\ R^0_{33} = \in +0 = 0 \\ R^0_{34} = 1 \end{array}$$

$$\begin{array}{l} R^0_{41} = 1 \\ R^0_{42} = 1 \\ R^0_{43} = \oslash \\ R^0_{44} = \in \end{array}$$

$$\begin{array}{l} k=1 \\ \mathbf{R}_{11}^1 = R_{11}^0 + R_{11}^0 (R_{11}^0)^* R_{11}^0 = 0 + 0(0)^* 0 = 0^* \\ \mathbf{R}_{12}^1 = R_{12}^0 + R_{11}^0 (R_{11}^0)^* R_{12}^0 = 1 + 0^* 1 = 0^* 1 \\ \mathbf{R}_{13}^1 = R_{13}^0 + R_{11}^0 (R_{11}^0)^* R_{13}^0 = \varnothing \\ \mathbf{R}_{14}^1 = R_{14}^0 + R_{11}^0 (R_{11}^0)^* R_{14}^0 = \varnothing \end{array}$$

$$\begin{array}{l} R_{21}^1 = R_{21}^0 + R_{21}^0 (R_{11}^0)^* R_{11}^0 = \oslash \\ R_{22}^1 = R_{22}^0 + R_{21}^0 (R_{11}^0)^* R_{12}^0 = \in \\ R_{23}^1 = R_{23}^0 + R_{21}^0 (R_{11}^0)^* R_{13}^0 = 1 \\ R_{24}^1 = R_{24}^0 + R_{21}^0 (R_{11}^0)^* R_{14}^0 = 1 \end{array}$$

$$\begin{array}{l} R_{31}^1 = R_{31}^0 + R_{31}^0 (R_{11}^0)^* R_{11}^0 = \oslash \\ R_{32}^1 = R_{32}^0 + R_{31}^0 (R_{11}^0)^* R_{12}^0 = \oslash \\ R_{33}^1 = R_{33}^0 + R_{31}^0 (R_{11}^0)^* R_{13}^0 = 0 \\ R_{34}^1 = R_{34}^0 + R_{31}^0 (R_{11}^0)^* R_{14}^0 = 1 \end{array}$$

$$\begin{array}{l} R_{41}^1 = R_{41}^0 + R_{41}^0(R_{11}^0)^*R_{11}^0 = 10^* \\ R_{42}^1 = R_{42}^0 + R_{41}^0(R_{11}^0)^*R_{12}^0 = 10^*1 \\ R_{43}^1 = R_{43}^0 + R_{41}^0(R_{11}^0)^*R_{13}^0 = \oslash \\ R_{44}^1 = R_{44}^0 + R_{41}^0(R_{11}^0)^*R_{14}^0 = \in \end{array}$$

$$k = 2$$

$$\begin{split} R_{11}^2 &= R_{11}^1 + R_{12}^1 (R_{22}^1)^* R_{21}^1 = 0^* \\ R_{12}^2 &= R_{12}^1 + R_{12}^1 (R_{22}^1)^* R_{22}^1 = 0^* 1 \\ R_{13}^2 &= R_{13}^1 + R_{12}^1 (R_{22}^1)^* R_{23}^1 = 0^* 11 \\ R_{14}^2 &= R_{14}^1 + R_{12}^1 (R_{22}^1)^* R_{24}^1 = 0^* 11 \end{split}$$

$$\begin{array}{l} R_{21}^2 = R_{21}^1 + R_{22}^1 (R_{22}^1)^* R_{21}^1 = \oslash \\ R_{22}^2 = R_{22}^1 + R_{22}^1 (R_{22}^1)^* R_{22}^1 = \in \\ R_{23}^2 = R_{23}^1 + R_{22}^1 (R_{22}^1)^* R_{23}^1 = 1 \\ R_{24}^2 = R_{24}^1 + R_{22}^1 (R_{22}^1)^* R_{24}^1 = 1 \end{array}$$

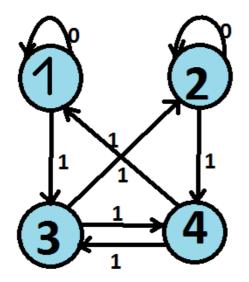
$$\begin{array}{l} R_{31}^2 = R_{31}^1 + R_{32}^1 (R_{22}^1)^* R_{21}^1 = \oslash \\ R_{32}^2 = R_{32}^1 + R_{32}^1 (R_{22}^1)^* R_{22}^1 = \oslash \\ R_{33}^2 = R_{33}^1 + R_{32}^1 (R_{22}^1)^* R_{23}^1 = 0 \\ R_{34}^2 = R_{34}^1 + R_{32}^1 (R_{22}^1)^* R_{24}^1 = 1 \end{array}$$

$$\begin{array}{l} R_{41}^2 = R_{41}^1 + R_{42}^1 (R_{22}^1)^* R_{21}^1 = 10^* \\ R_{42}^2 = R_{42}^1 + R_{42}^1 (R_{22}^1)^* R_{22}^1 = 10^*1 \\ R_{43}^2 = R_{43}^1 + R_{42}^1 (R_{22}^1)^* R_{23}^1 = 10^*11 \\ R_{44}^2 = R_{44}^1 + R_{42}^1 (R_{22}^1)^* R_{24}^1 = 10^*11 \end{array}$$

$$\begin{split} R_{11}^1 &= R_{11}^2 + R_{13}^2 (R_{33}^2)^* R_{31}^2 = 0^* \\ R_{13}^2 &= R_{12}^2 + R_{13}^2 (R_{33}^2)^* R_{32}^2 = 0^{*1} \\ R_{13}^2 &= R_{14}^2 + R_{13}^2 (R_{33}^2)^* R_{32}^2 = 0^{*1} 10^* \\ R_{14}^3 &= R_{14}^2 + R_{13}^2 (R_{33}^2)^* R_{34}^2 = 0^{*1} 10^{*1} \\ R_{21}^3 &= R_{21}^2 + R_{23}^2 (R_{33}^2)^* R_{34}^2 = 0^{*1} 10^{*1} \\ R_{22}^3 &= R_{22}^2 + R_{23}^2 (R_{33}^2)^* R_{32}^2 = 0^{*1} \\ R_{23}^3 &= R_{24}^2 + R_{23}^2 (R_{33}^2)^* R_{34}^2 = 10^{*1} \\ R_{34}^3 &= R_{24}^2 + R_{23}^2 (R_{33}^2)^* R_{24}^2 = 0^{*1} \\ R_{34}^3 &= R_{24}^3 + R_{23}^3 (R_{33}^2)^* R_{24}^2 = 0^{*1} \\ R_{34}^3 &= R_{24}^3 + R_{23}^3 (R_{23}^3)^* R_{24}^2 = 0^{*1} \\ R_{34}^3 &= R_{34}^2 + R_{33}^3 (R_{33}^2)^* R_{24}^2 = 0^{*1} \\ R_{34}^3 &= R_{34}^2 + R_{33}^3 (R_{33}^2)^* R_{24}^2 = 0^{*1} \\ R_{34}^4 &= R_{34}^2 + R_{33}^2 (R_{33}^2)^* R_{24}^2 = 0^{*1} \\ R_{34}^4 &= R_{34}^2 + R_{33}^2 (R_{33}^2)^* R_{24}^2 = 10^{*1} \\ R_{34}^4 &= R_{34}^2 + R_{34}^2 (R_{33}^2)^* R_{24}^2 = 10^{*1} \\ R_{34}^4 &= R_{34}^2 + R_{34}^2 (R_{33}^2)^* R_{22}^2 = 10^{*1} \\ R_{34}^4 &= R_{34}^2 + R_{34}^2 (R_{33}^2)^* R_{22}^2 = 10^{*1} \\ R_{34}^4 &= R_{34}^2 + R_{34}^2 (R_{33}^2)^* R_{22}^2 = 10^{*1} \\ R_{34}^4 &= R_{34}^2 + R_{34}^2 (R_{33}^2)^* R_{22}^2 = 10^{*1} \\ R_{34}^4 &= R_{34}^2 + R_{34}^2 (R_{33}^2)^* R_{22}^2 = 10^{*1} \\ R_{34}^4 &= R_{34}^2 + R_{34}^2 (R_{34}^2)^* R_{33}^2 = 0^{*1} + 0^{*1} + 0^{*1} 10^{*1} (0^{*1} + 0^{*1} 10^{*1})^{*0} \\ R_{44}^4 &= R_{14}^3 + R_{14}^3 (R_{34}^3)^* R_{23}^2 = 0^{*1} + 0^{*1} 1 + 0^{*1} 10^{*1} \\ R_{13}^4 &= R_{13}^3 + R_{14}^3 (R_{34}^3)^* R_{33}^2 = 0^{*1} 10^{*} + 0^{*1} 1 + 0^{*1} 10^{*1} \\ R_{14}^4 &= R_{14}^3 + R_{14}^3 (R_{34}^3)^* R_{33}^2 = 0^{*1} 1 + 0^{*1} 10^{*1} 1 + 0^{*1} 10^{*1} \\ R_{14}^4 &= R_{14}^3 + R_{14}^3 (R_{34}^3)^* R_{33}^2 = 0^{*1} 1 + 0^{*1} 10^{*1} 1 + 0^{*1} 10^{*1} 1 \\ R_{22}^4 &= R_{22}^3 + R_{23}^3 (R_{34}^3)^* R_{33}^3 = 10^{*1} 1 + 10^{*1} 10^{*1} 1 + 0^{*1} 10^{*1} 1^{*0} \\ R_{22}^2 &= R_{22}^3 + R_{23}^3 (R_{34}^3)^* R_{33}^3 = 10^{*1} 1 + 10^{*1} 10^{*$$

2- Ejercicio 2.

0*110*1(0*11+0*110*1)*0*11+0*110



$$k = 0$$

$$\begin{array}{l} R_{11}^0 = \in +0 = 0 \\ R_{12}^0 = 1 \\ R_{13}^0 = \oslash \\ R_{14}^0 = \oslash \end{array}$$

$$R_{12}^{\circ} = 1$$

$$R_{13}^0 = \emptyset$$

$$R_{14}^0 = \emptyset$$

$$R_{21}^{0} = \emptyset$$

$$R_{22}^{0} = \in$$

$$R_{23}^{0} = 1$$

$$R_{24}^{0} = 1$$

$$R_{22}^0 = \in$$

$$R_{23}^0 = 1$$

$$R_{24}^0 = 1$$

$$R_{\rm ol}^0 = \emptyset$$

$$\mathbf{p}_0^0 = 0$$

$$\begin{array}{l} R^0_{31} = \oslash \\ R^0_{32} = \oslash \\ R^0_{33} = 0 + \in = 0 \\ R^0_{34} = 1 \end{array}$$

$$R_{24}^0 = 1$$

$$R^0_{11} = 0$$

$$R_{42}^0 = 1$$

$$\begin{array}{l} R^0_{41} = 0 \\ R^0_{42} = 1 \\ R^0_{43} = \oslash \\ R^0_{44} = \in \end{array}$$

$$R_{44}^{0} = \in$$

$$R_{11}^1 = R_{11}^0 + R_{11}^0 (R_{11}^0)^* R_{11}^0 = 0^*$$

$$\begin{array}{l} R_{11}^1 = R_{11}^0 + R_{11}^0 (R_{11}^0)^* R_{11}^0 = 0^* \\ R_{12}^1 = R_{12}^0 + R_{11}^0 (R_{11}^0)^* R_{12}^0 = 0^* 1 \\ R_{13}^1 = R_{13}^0 + R_{11}^0 (R_{11}^0)^* R_{13}^0 = \oslash \\ R_{14}^1 = R_{14}^0 + R_{11}^0 (R_{11}^0)^* R_{14}^0 = \oslash \end{array}$$

$$R_{10}^{12} = R_{10}^{02} + R_{10}^{01} (R_{10}^{01}) * R_{10}^{02} = \emptyset$$

$$R_{14}^{\bar{1}} = R_{14}^{\bar{0}} + R_{11}^{\bar{0}} (R_{11}^{\bar{0}})^* R_{14}^{\bar{0}} = \emptyset$$

$$R_{01}^1 = R_{01}^0 + R_{01}^0 (R_{01}^0)^* R_{01}^0 = \emptyset$$

$$\begin{array}{l} R_{21}^1 = R_{21}^0 + R_{21}^0 (R_{11}^0)^* R_{11}^0 = \oslash \\ R_{22}^1 = R_{22}^0 + R_{21}^0 (R_{11}^0)^* R_{12}^0 = \in \\ R_{23}^1 = R_{23}^0 + R_{21}^0 (R_{11}^0)^* R_{13}^0 = 1 \\ R_{24}^1 = R_{24}^0 + R_{21}^0 (R_{11}^0)^* R_{14}^0 = 1 \end{array}$$

$$R_{1}^{1} - R_{0}^{0} + R_{0}^{0}(R_{0}^{0})*R_{0}^{0} -$$

$$R_{0}^{1} = R_{0}^{0} + R_{0}^{0} (R_{0}^{0}) * R_{0}^{0} = 1$$

$$R_{31}^1 = R_{31}^0 + R_{31}^0 (R_{11}^0)^* R_{11}^0 = \emptyset$$

$$\begin{split} \mathbf{R}_{32}^1 &= R_{32}^0 + R_{31}^0(R_{11}^0)^*R_{12}^0 = \oslash \\ \mathbf{R}_{33}^1 &= R_{33}^0 + R_{31}^0(R_{11}^0)^*R_{13}^0 = 0 \\ \mathbf{R}_{34}^1 &= R_{34}^0 + R_{31}^0(R_{11}^0)^*R_{14}^0 = 1 \end{split}$$

$$\begin{aligned} R_{41}^1 &= R_{41}^0 + R_{41}^0(R_{11}^0)^*R_{14}^0 = 0^* \\ \mathbf{R}_{42}^1 &= R_{42}^0 + R_{41}^0(R_{11}^0)^*R_{12}^0 = 0 + 0^*1 = 0^*1 \\ \mathbf{R}_{43}^1 &= R_{43}^0 + R_{41}^0(R_{11}^0)^*R_{13}^0 = \oslash \\ \mathbf{R}_{44}^1 &= R_{44}^0 + R_{41}^0(R_{11}^0)^*R_{13}^0 = \oslash \end{aligned}$$

$$\mathbf{R}_{44}^1 &= R_{44}^0 + R_{41}^0(R_{11}^0)^*R_{14}^0 = \oslash$$

$$\begin{split} R_{11}^2 &= R_{11}^1 + R_{12}^1 (R_{22}^1)^* R_{21}^1 = 0^* \\ R_{12}^2 &= R_{13}^1 + R_{12}^1 (R_{22}^1)^* R_{22}^1 = 0^* 1 \\ R_{13}^2 &= R_{13}^1 + R_{12}^1 (R_{22}^1)^* R_{23}^1 = 0^* 11 \\ R_{14}^2 &= R_{14}^1 + R_{12}^1 (R_{22}^1)^* R_{24}^1 = 0^* 11 \\ R_{21}^2 &= R_{21}^1 + R_{22}^1 (R_{22}^1)^* R_{24}^1 = 0^* 11 \\ R_{22}^2 &= R_{22}^1 + R_{22}^1 (R_{22}^1)^* R_{22}^1 = \in R_{23}^2 = R_{23}^1 + R_{22}^1 (R_{22}^1)^* R_{23}^1 = 1 \\ R_{24}^2 &= R_{24}^1 + R_{22}^1 (R_{22}^1)^* R_{24}^1 = 1 \\ R_{31}^2 &= R_{31}^1 + R_{32}^1 (R_{22}^1)^* R_{21}^1 = \emptyset \\ R_{32}^2 &= R_{32}^1 + R_{32}^1 (R_{22}^1)^* R_{23}^1 = \emptyset \\ R_{33}^2 &= R_{33}^1 + R_{32}^1 (R_{22}^1)^* R_{23}^1 = \emptyset \\ R_{34}^2 &= R_{34}^1 + R_{32}^1 (R_{22}^1)^* R_{24}^1 = 1 \\ R_{41}^2 &= R_{41}^1 + R_{42}^1 (R_{22}^1)^* R_{21}^1 = 0^* \\ R_{42}^2 &= R_{42}^1 + R_{42}^1 (R_{22}^1)^* R_{21}^1 = 0^* 1 \\ R_{42}^2 &= R_{43}^1 + R_{42}^1 (R_{22}^1)^* R_{23}^1 = 0^* 1 \\ R_{43}^2 &= R_{43}^1 + R_{42}^1 (R_{22}^1)^* R_{23}^1 = 0^* 1 \\ R_{43}^2 &= R_{43}^1 + R_{42}^1 (R_{22}^1)^* R_{23}^1 = 0^* 1 \\ R_{43}^2 &= R_{43}^1 + R_{42}^1 (R_{22}^1)^* R_{23}^1 = 0^* 1 \end{split}$$

k = 3

$$\begin{split} R_{11}^3 &= R_{11}^2 + R_{13}^2 (R_{33}^2)^* R_{31}^2 = 0^* \\ R_{12}^3 &= R_{12}^2 + R_{13}^2 (R_{33}^2)^* R_{32}^2 = 0^*1 \\ R_{13}^3 &= R_{13}^2 + R_{13}^2 (R_{23}^2)^* R_{33}^2 = 0^*110^* \\ R_{14}^3 &= R_{14}^2 + R_{13}^2 (R_{23}^2)^* R_{34}^2 = 0^*11 + 0^*110^*1 \\ R_{21}^3 &= R_{21}^2 + R_{23}^2 (R_{33}^2)^* R_{31}^2 = \oslash \\ R_{22}^3 &= R_{22}^2 + R_{23}^2 (R_{33}^2)^* R_{32}^2 = \in \\ R_{23}^3 &= R_{23}^2 + R_{23}^2 (R_{33}^2)^* R_{33}^2 = 10^* \\ R_{24}^3 &= R_{24}^2 + R_{23}^2 (R_{33}^2)^* R_{34}^2 = 1 + 10^*1 \\ R_{31}^3 &= R_{31}^2 + R_{23}^2 (R_{33}^2)^* R_{21}^2 = \oslash \\ R_{32}^3 &= R_{32}^2 + R_{33}^2 (R_{33}^2)^* R_{22}^2 = \oslash \\ R_{33}^3 &= R_{33}^2 + R_{33}^2 (R_{33}^2)^* R_{23}^2 = 0^* \\ R_{34}^3 &= R_{34}^2 + R_{23}^2 (R_{33}^2)^* R_{24}^2 = 0^*1 \\ R_{34}^4 &= R_{41}^2 + R_{43}^2 (R_{33}^2)^* R_{21}^2 = 0^* \\ R_{34}^3 &= R_{24}^2 + R_{23}^2 (R_{33}^2)^* R_{21}^2 = 0^* \\ R_{34}^3 &= R_{24}^2 + R_{23}^2 (R_{33}^2)^* R_{21}^2 = 0^* \\ R_{34}^3 &= R_{24}^2 + R_{23}^2 (R_{33}^2)^* R_{21}^2 = 0^* \\ R_{34}^3 &= R_{24}^2 + R_{23}^2 (R_{33}^2)^* R_{21}^2 = 0^* \\ R_{34}^2 &= R_{42}^2 + R_{43}^2 (R_{33}^2)^* R_{22}^2 = 0^*1 \end{split}$$

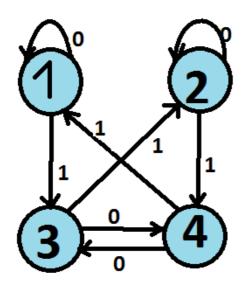
 $R_{44}^2 = R_{44}^1 + R_{42}^1 (R_{22}^1)^* R_{24}^1 = 0^* 11$

$$\begin{array}{l} \mathbf{R}^3_{43} = R^2_{43} + R^2_{43} (R^2_{33})^* R^2_{23} = 0^* 110^* \\ \mathbf{R}^3_{44} = R^2_{44} + R^2_{43} (R^2_{33})^* R^2_{24} = 0^* 11 + 0^* 110^* 1 \end{array}$$

$$k = 4$$

$$\begin{split} R^4_{11} &= R^3_{11} + R^3_{14}(R^3_{44})^* R^3_{41} = (0^*11 + 0^*110^*1)^*0^* \\ R^4_{12} &= R^3_{12} + R^3_{14}(R^3_{44})^* R^3_{42} = (0^*11 + 0^*110^*1)^*0^*1 \\ R^4_{13} &= R^3_{13} + R^3_{14}(R^3_{44})^* R^3_{43} = (0^*11 + 0^*110^*1)^*0^*110^* \\ R^4_{14} &= R^3_{14} + R^3_{14}(R^3_{44})^* R^3_{44} = (0^*11 + 0^*110^*1)^* \\ R^2_{14} &= R^3_{14} + R^3_{14}(R^3_{44})^* R^3_{44} = (1 + 10^*1)(0^*11 + 0^*110^*1)^*0^* \\ R^4_{22} &= R^3_{22} + R^3_{24}(R^3_{44})^* R^3_{42} = (1 + 10^*1)(0^*11 + 0^*110^*1)^*0^*1 \\ R^4_{23} &= R^3_{23} + R^3_{24}(R^3_{44})^* R^3_{43} = (1 + 10^*1)(0^*11 + 0^*110^*1)^*0^*110^* \\ R^4_{24} &= R^3_{24} + R^3_{24}(R^3_{44})^* R^3_{44} = (1 + 10^*1)(0^*11 + 0^*110^*1)^*0^*110^* \\ R^4_{24} &= R^3_{31} + R^3_{34}(R^3_{44})^* R^3_{44} = (1 + 10^*1)(0^*11 + 0^*110^*1)^*0^* \\ R^4_{32} &= R^3_{32} + R^3_{34}(R^3_{44})^* R^3_{42} = 0^*(0^*11 + 0^*110^*1)^*0^*1 \\ R^4_{33} &= R^3_{33} + R^3_{34}(R^3_{44})^* R^3_{43} = 0^*(0^*11 + 0^*110^*1)^*0^*110^* \\ R^4_{34} &= R^3_{34} + R^3_{34}(R^3_{44})^* R^3_{43} = 0^*(0^*11 + 0^*110^*1)^*0^*110^* \\ R^4_{41} &= R^3_{34} + R^3_{34}(R^3_{44})^* R^3_{44} = (0^*11 + 0^*110^*1)^*0^* \\ R^4_{42} &= R^3_{42} + R^3_{44}(R^3_{44})^* R^3_{42} = (0^*11 + 0^*110^*1)^*0^* \\ R^4_{42} &= R^3_{43} + R^3_{44}(R^3_{44})^* R^3_{42} = (0^*11 + 0^*110^*1)^*0^* \\ R^4_{43} &= R^3_{43} + R^3_{44}(R^3_{44})^* R^3_{43} = (0^*11 + 0^*110^*1)^*0^* \\ R^4_{43} &= R^3_{43} + R^3_{44}(R^3_{44})^* R^3_{43} = (0^*11 + 0^*110^*1)^*0^* 110^* \\ R^4_{43} &= R^3_{43} + R^3_{44}(R^3_{44})^* R^3_{43} = (0^*11 + 0^*110^*1)^*0^*110^* \\ R^4_{44} &= R^3_{43} + R^3_{44}(R^3_{44})^* R^3_{43} = (0^*11 + 0^*110^*1)^*0^*110^* \\ R^4_{44} &= R^3_{44} + R^3_{44}(R^3_{44})^* R^3_{43} = (0^*11 + 0^*110^*1)^*0^*110^* \\ R^4_{44} &= R^3_{44} + R^3_{44}(R^3_{44})^* R^3_{43} = (0^*11 + 0^*110^*1)^*0^*110^* \\ R^4_{44} &= R^3_{44} + R^3_{44}(R^3_{44})^* R^3_{43} = (0^*11 + 0^*110^*1)^*0^*110^* \\ R^4_{44} &= R^3_{44} + R^3_{44}(R^3_{44})^* R^3_{43} = (0^*11 + 0^*110^*1)^*0^*110^* \\ R^4_{44} &= R^3_{44} + R^3_{44}$$

3- Ejercicio 3.



$$k = 0$$

$$\begin{array}{l} R_{11}^0 = \in +0 \\ R_{12}^0 = \oslash \\ R_{13}^0 = 1 \end{array}$$

$$R_{14}^0=\oslash$$

$$\begin{array}{l} R_{21}^0 = \oslash \\ R_{22}^0 = 0 + \in \\ R_{23}^0 = 1 \\ R_{24}^0 = \oslash \end{array}$$

$$\begin{array}{l} R^0_{31} = \oslash \\ R^0_{32} = 1 \\ R^0_{33} = \in + \oslash \\ R^0_{34} = 0 \end{array}$$

$$\begin{array}{l} R^0_{41} = 1 \\ R^0_{42} = \oslash \\ R^0_{43} = 0 \\ R^0_{44} = \in + \oslash \end{array}$$

$$\begin{array}{l} R_{11}^1 = R_{11}^0 + R_{11}^0(R_{11}^0)^*R_{11}^0 = 0^* \\ R_{12}^1 = R_{12}^0 + R_{11}^0(R_{11}^0)^*R_{12}^0 = \oslash \\ R_{13}^1 = R_{13}^0 + R_{11}^0(R_{11}^0)^*R_{13}^0 = 1 + 0^*1 = 0^*1 \\ R_{14}^1 = R_{14}^0 + R_{11}^0(R_{11}^0)^*R_{14}^0 = \oslash \end{array}$$

$$\begin{array}{l} R_{21}^1 = R_{21}^0 + R_{21}^0 (R_{11}^0)^* R_{11}^0 = \oslash \\ R_{22}^1 = R_{22}^0 + R_{21}^0 (R_{11}^0)^* R_{12}^0 = (0+\in) + \oslash = 0 \\ R_{23}^1 = R_{23}^0 + R_{21}^0 (R_{11}^0)^* R_{13}^0 = \oslash \\ R_{24}^1 = R_{24}^0 + R_{21}^0 (R_{11}^0)^* R_{14}^0 = 1 \end{array}$$

$$\begin{array}{l} R_{31}^1 = R_{31}^0 + R_{31}^0 (R_{11}^0)^* R_{11}^0 = \oslash \\ R_{32}^1 = R_{32}^0 + R_{31}^0 (R_{11}^0)^* R_{12}^0 = 1 + \oslash = 1 \\ R_{33}^1 = R_{33}^0 + R_{31}^0 (R_{11}^0)^* R_{13}^0 = \in + \oslash + \oslash = \in \\ R_{34}^1 = R_{34}^0 + R_{31}^0 (R_{11}^0)^* R_{14}^0 = 0 \end{array}$$

$$\begin{array}{l} R_{41}^1 = R_{41}^0 + R_{41}^0 (R_{11}^0)^* R_{11}^0 = 1 + 1 (\in +0)^* (\in +0)^* = 10^* \\ R_{42}^1 = R_{42}^0 + R_{41}^0 (R_{11}^0)^* R_{12}^0 = \oslash + 1 (\in +0)^* \oslash = \oslash \\ R_{43}^1 = R_{43}^0 + R_{41}^0 (R_{11}^0)^* R_{13}^0 = 0 + 1 (\in +0)^* 1 = 0 + 10^* 1 \\ R_{44}^1 = R_{44}^0 + R_{41}^0 (R_{11}^0)^* R_{14}^0 = \in +1 (\in +0) \oslash = \in \end{array}$$

$$\begin{array}{l} R_{11}^2 = R_{11}^1 + R_{12}^1 (R_{22}^1)^* R_{21}^1 = 0^* \\ R_{12}^2 = R_{12}^1 + R_{12}^1 (R_{22}^1)^* R_{22}^1 = \oslash \\ R_{13}^2 = R_{13}^1 + R_{12}^1 (R_{22}^1)^* R_{23}^1 = 0^* 1 \\ R_{14}^2 = R_{14}^1 + R_{12}^1 (R_{22}^1)^* R_{24}^1 = \oslash \end{array}$$

$$\begin{array}{l} R_{21}^2 = R_{21}^1 + R_{22}^1 (R_{22}^1)^* R_{21}^1 = \oslash \\ R_{22}^2 = R_{22}^1 + R_{12}^1 (R_{12}^1)^* R_{22}^1 = 0^* \\ R_{23}^2 = R_{23}^1 + R_{12}^1 (R_{22}^1)^* R_{23}^1 = \oslash \\ R_{24}^2 = R_{24}^1 + R_{12}^1 (R_{12}^1)^* R_{24}^1 = 0^* 1 \end{array}$$

$$\begin{split} R_{31}^2 &= R_{31}^1 + R_{32}^1 (R_{22}^1)^* R_{21}^1 = \varnothing \\ R_{32}^2 &= R_{32}^1 + R_{32}^1 (R_{22}^1)^* R_{22}^1 = 10^* \\ R_{33}^2 &= R_{33}^1 + R_{32}^1 (R_{22}^1)^* R_{23}^1 = \in \\ R_{34}^2 &= R_{34}^1 + R_{32}^1 (R_{22}^1)^* R_{24}^1 = 0 + 10^* 1 \\ \end{split}$$

$$\begin{aligned} R_{41}^2 &= R_{41}^1 + R_{42}^1 (R_{22}^1)^* R_{24}^1 = 10^* \\ R_{42}^2 &= R_{42}^1 + R_{42}^1 (R_{22}^1)^* R_{22}^1 = \varnothing \\ R_{43}^2 &= R_{43}^1 + R_{42}^1 (R_{22}^1)^* R_{23}^1 = 0 + 10^* 1 \\ R_{44}^2 &= R_{44}^1 + R_{42}^1 (R_{22}^1)^* R_{23}^1 = 0 + 10^* 1 \\ R_{44}^2 &= R_{44}^1 + R_{42}^1 (R_{22}^1)^* R_{24}^1 = \in \end{aligned}$$

$$\begin{split} R_{11}^3 &= R_{11}^2 + R_{13}^2 (R_{33}^2)^* R_{31}^2 = 0^* \\ R_{12}^3 &= R_{12}^2 + R_{13}^2 (R_{33}^2)^* R_{32}^2 = 0^* 110^* \\ R_{13}^3 &= R_{13}^2 + R_{13}^2 (R_{33}^2)^* R_{33}^2 = 0^* 1 \\ R_{14}^3 &= R_{14}^2 + R_{13}^2 (R_{33}^2)^* R_{34}^2 = 0^* (0 + 10^* 1) \\ \end{split}$$

$$\begin{aligned} R_{14}^3 &= R_{14}^2 + R_{13}^2 (R_{33}^2)^* R_{34}^2 = 0^* (0 + 10^* 1) \\ R_{21}^3 &= R_{21}^2 + R_{23}^2 (R_{33}^2)^* R_{31}^2 = \oslash \\ R_{22}^3 &= R_{22}^2 + R_{23}^2 (R_{33}^2)^* R_{32}^2 = 0^* \\ R_{23}^3 &= R_{23}^2 + R_{23}^2 (R_{33}^2)^* R_{33}^2 = \oslash \\ R_{24}^3 &= R_{24}^2 + R_{23}^2 (R_{33}^2)^* R_{24}^2 = 0^* 1 \\ \end{aligned}$$

$$\begin{aligned} R_{31}^3 &= R_{31}^2 + R_{33}^2 (R_{33}^2)^* R_{21}^2 = \oslash \\ R_{32}^3 &= R_{32}^2 + R_{33}^2 (R_{33}^2)^* R_{22}^2 = 10^* \\ R_{33}^3 &= R_{33}^2 + R_{33}^2 (R_{33}^2)^* R_{23}^2 = & \in \\ R_{34}^3 &= R_{34}^2 + R_{33}^2 (R_{33}^2)^* R_{24}^2 = 0 + 10^* 1 \\ \end{aligned}$$

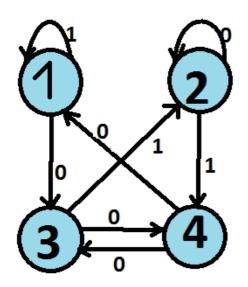
$$\begin{aligned} R_{41}^3 &= R_{41}^2 + R_{43}^2 (R_{33}^2)^* R_{22}^2 = (0 + 10^* 1) 10^* \\ R_{42}^3 &= R_{42}^2 + R_{43}^2 (R_{33}^2)^* R_{23}^2 = 0 + 10^* 1 \\ R_{43}^3 &= R_{44}^2 + R_{43}^2 (R_{33}^2)^* R_{23}^2 = 0 + 10^* 1 \\ R_{43}^3 &= R_{44}^2 + R_{43}^2 (R_{33}^2)^* R_{23}^2 = 0 + 10^* 1 \\ R_{43}^3 &= R_{44}^2 + R_{43}^2 (R_{33}^2)^* R_{23}^2 = 0 + 10^* 1 \\ R_{44}^3 &= R_{44}^2 + R_{43}^2 (R_{33}^2)^* R_{23}^2 = 0 + 10^* 1 \\ R_{44}^3 &= R_{44}^2 + R_{43}^2 (R_{33}^2)^* R_{23}^2 = 0 + 10^* 1 \end{aligned}$$

$$\begin{split} R^4_{11} &= R^3_{11} + R^3_{14}(R^3_{44})^* R^3_{41} = 0^*(0+10^*1)^*10^*) \\ R^4_{12} &= R^3_{12} + R^3_{14}(R^3_{44})^* R^3_{42} = 0^*110^* + 0^*(0+10^*1)^*10^* \\ R^4_{13} &= R^3_{13} + R^3_{14}(R^3_{44})^* R^3_{43} = 0^*1 + 0^*(0+10^*1)^* \\ R^4_{14} &= R^3_{14} + R^3_{14}(R^3_{44})^* R^3_{44} = (0^*(0+10^*1))^* \\ \\ R^2_{14} &= R^3_{14} + R^3_{14}(R^3_{44})^* R^3_{41} = 0^*1(0+10^*1)^*10^* \\ R^4_{22} &= R^3_{22} + R^3_{24}(R^3_{44})^* R^3_{42} = 0^* + 0^*1(0+10^*1)^*10^* \\ R^4_{23} &= R^3_{23} + R^3_{24}(R^3_{44})^* R^3_{43} = 0^*1(0+10^*1)^* \\ R^4_{24} &= R^3_{24} + R^3_{24}(R^3_{44})^* R^3_{43} = 0^*1(0+10^*1)^* \\ R^4_{31} &= R^3_{31} + R^3_{34}(R^3_{44})^* R^3_{41} = (0+10^*1)^*10^* \\ R^4_{32} &= R^3_{32} + R^3_{34}(R^3_{44})^* R^3_{42} = 10^* + (0+10^*1)^*10^* \\ R^4_{33} &= R^3_{33} + R^3_{34}(R^3_{44})^* R^3_{43} = (0+10^*1)^* \\ R^4_{34} &= R^3_{33} + R^3_{34}(R^3_{44})^* R^3_{43} = (0+10^*1)^* \\ R^4_{34} &= R^3_{33} + R^3_{34}(R^3_{44})^* R^3_{43} = (0+10^*1)^* \\ R^4_{34} &= R^3_{34} + R^3_{34}(R^3_{44})^* R^3_{43} = (0+10^*1)^* \\ R^4_{34} &= R^3_{34} + R^3_{34}(R^3_{44})^* R^3_{43} = (0+10^*1)^* \\ R^4_{34} &= R^3_{34} + R^3_{34}(R^3_{44})^* R^3_{43} = (0+10^*1)^* \\ R^4_{34} &= R^3_{34} + R^3_{34}(R^3_{44})^* R^3_{43} = (0+10^*1)^* \\ R^4_{34} &= R^3_{34} + R^3_{34}(R^3_{44})^* R^3_{43} = (0+10^*1)^* \\ R^4_{34} &= R^3_{34} + R^3_{34}(R^3_{44})^* R^3_{43} = (0+10^*1)^* \\ R^4_{34} &= R^3_{34} + R^3_{34}(R^3_{44})^* R^3_{43} = (0+10^*1)^* \\ R^4_{34} &= R^3_{34} + R^3_{34}(R^3_{44})^* R^3_{43} = (0+10^*1)^* \\ R^4_{34} &= R^3_{34} + R^3_{34}(R^3_{44})^* R^3_{43} = (0+10^*1)^* \\ R^4_{34} &= R^3_{34} + R^3_{34}(R^3_{44})^* R^3_{43} = (0+10^*1)^* \\ R^4_{34} &= R^3_{34} + R^3_{34}(R^3_{44})^* R^3_{43} = (0+10^*1)^* \\ R^4_{34} &= R^3_{34} + R^3_{34}(R^3_{44})^* R^3_{43} = (0+10^*1)^* \\ R^4_{34} &= R^3_{34} + R^3_{34}(R^3_{44})^* R^3_{43} = (0+10^*1)^* \\ R^4_{34} &= R^3_{34} + R^3_{34}(R^3_{44})^* R^3_{44} = (0+10^*1)^* \\ R^4_{34} &= R^3_{34} + R^3_{34}(R^3_{44})^* R^3_{44} = (0+10^*1)^* \\ R^4_{34} &= R^3_{34} +$$

$$\begin{array}{l} R_{41}^4 = R_{41}^3 + R_{44}^3 (R_{44}^3)^* R_{41}^3 = 10^* + (0+10^*1)^* 10^* \\ R_{42}^4 = R_{42}^3 + R_{44}^3 (R_{44}^3)^* R_{42}^3 = (0+10^*1)^* 10^* \\ R_{43}^4 = R_{43}^3 + R_{44}^3 (R_{44}^3)^* R_{43}^3 = (0+10^*1)^* \\ R_{44}^4 = R_{44}^3 + R_{44}^3 (R_{44}^3)^* R_{44}^3 = (0+10^*1)^* \end{array}$$

$$\begin{split} R_{11}^2 &= R_{11}^1 + R_{12}^1 (R_{22}^1)^* R_{21}^1 = 1^* + (0+\in)^* = 1^* \\ R_{12}^2 &= R_{12}^1 + R_{12}^1 (R_{22}^1)^* R_{22}^1 = (0+\in)^* (0+\in) \\ R_{13}^2 &= R_{13}^1 + R_{12}^1 (R_{22}^1)^* R_{23}^1 = 1^* 0 + (0+\in)^* = 1^* 0 \\ R_{14}^2 &= R_{14}^1 + R_{12}^1 (R_{22}^1)^* R_{24}^1 = (0+\in)^* 1 \end{split}$$

4 Ejercicio 4.



$$\begin{split} R_{11}^1 &= R_{11}^0 + R_{11}^0(R_{11}^0)^*R_{11}^0 = (1+\in) + (1+\in)(1+\in)^*(1+\in) = (1+\in) + (1+\in)(1)^*(1+\in) = 1^* \\ R_{12}^1 &= R_{12}^0 + R_{11}^0(R_{11}^0)^*R_{12}^0 = (1+\in)(1+\in)^* = (1)^* \\ R_{13}^1 &= R_{13}^0 + R_{11}^0(R_{11}^0)^*R_{13}^0 = 0 + (1+\in)(1+\in)^*0 = 0 + 1^*0 = 1^*0 \\ R_{14}^1 &= R_{14}^0 + R_{11}^0(R_{11}^0)^*R_{14}^0 = \oslash \\ R_{21}^1 &= R_{21}^0 + R_{21}^0(R_{11}^0)^*R_{14}^0 = (1+\in)^*(1+\in) = 1^* \\ R_{22}^1 &= R_{22}^0 + R_{21}^0(R_{11}^0)^*R_{12}^0 = 0 + \in + (1+\in)^* = 0 + \in 0 \\ R_{23}^1 &= R_{23}^0 + R_{21}^0(R_{11}^0)^*R_{13}^0 = (1+\in)^*0 = 1^*0 \\ R_{24}^1 &= R_{24}^0 + R_{21}^0(R_{11}^0)^*R_{14}^0 = 1 + (1+\in)^* = 1^* \\ R_{31}^1 &= R_{31}^0 + R_{31}^0(R_{11}^0)^*R_{14}^0 = 1 + (1+\in)^* = 1^* \\ R_{32}^1 &= R_{32}^0 + R_{31}^0(R_{11}^0)^*R_{12}^0 = 1 + (1+\in)^* = 1^* \\ R_{33}^1 &= R_{33}^0 + R_{31}^0(R_{11}^0)^*R_{13}^0 = \in + (1+\in)^*0 = 1^*0 \\ R_{14}^1 &= R_{34}^0 + R_{31}^0(R_{11}^0)^*R_{13}^0 = 0 + (1+\in)^* = 01^* \\ R_{14}^1 &= R_{34}^0 + R_{31}^0(R_{11}^0)^*R_{14}^0 = 0 + (1+\in)^*(1+\in) = 0 + 01^* = 01^* \\ R_{41}^1 &= R_{41}^0 + R_{41}^0(R_{11}^0)^*R_{12}^0 = 0(1+\in)^* \\ R_{42}^1 &= R_{42}^0 + R_{41}^0(R_{11}^0)^*R_{13}^0 = 0 + 0(1+\in)^*(1+\in)^* = 0 + 01^*0 \\ R_{14}^1 &= R_{44}^0 + R_{41}^0(R_{11}^0)^*R_{13}^0 = 0 + 0(1+\in)^*(0+0)^* \\ R_{14}^1 &= R_{44}^0 + R_{41}^0(R_{11}^0)^*R_{13}^0 = 0 + 0(1+\in)^*(0+0)^* \\ R_{14}^1 &= R_{44}^0 + R_{41}^0(R_{11}^0)^*R_{13}^0 = 0 + 0(1+\in)^*(0+0)^* \\ R_{14}^1 &= R_{44}^0 + R_{41}^0(R_{11}^0)^*R_{13}^0 = 0 + 0(1+\in)^*(0+0)^* \\ R_{14}^1 &= R_{44}^0 + R_{41}^0(R_{11}^0)^*R_{13}^0 = 0 + 0(1+\in)^*(0+0)^* \\ R_{14}^1 &= R_{44}^0 + R_{41}^0(R_{11}^0)^*R_{13}^0 = 0 + 0(1+\in)^*(0+0)^* \\ R_{14}^1 &= R_{44}^0 + R_{41}^0(R_{11}^0)^*R_{13}^0 = 0 + 0(1+\in)^*(0+0)^* \\ R_{14}^1 &= R_{44}^0 + R_{41}^0(R_{11}^0)^*R_{13}^0 = 0 + 0(1+\in)^*(0+0)^* \\ R_{14}^1 &= R_{44}^0 + R_{41}^0(R_{11}^0)^*R_{13}^0 = 0 + 0(1+\in)^*(0+0)^* \\ R_{14}^1 &= R_{44}^0 + R_{41}^0(R_{11}^0)^*R_{14}^0 = 0 + 0(1+\in)^*(0+0)^* \\ R_{14}^1 &= R_{44}^0 + R_{44}^0(R_{11}^0)^*R_{13}^0 = 0 + 0(1+\in)^*(0+0)^* \\ R_{14}^1 &= R_{14}^$$

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R_{21}^2 = R_{21}^1 + R_{22}^1 (R_{22}^1)^* R_{21}^1 = (0 + \in)(0 + \in)^*
R_{22}^2 = R_{22}^1 + R_{22}^1 (R_{22}^1)^* R_{22}^1 = (0 + \epsilon) + (0 + \epsilon)(0 + \epsilon)^* (0 + \epsilon) = 0^*
R_{23}^2 = R_{23}^1 + R_{12}^{\bar{1}} (R_{22}^{\bar{1}})^* R_{23}^{\bar{1}} = (0 + \epsilon)(0 + \epsilon)^*
 R_{24}^2 = R_{24}^1 + R_{22}^1 (R_{22}^1)^* R_{24}^1 = 1 + (0 + \epsilon)(0 + \epsilon)^* 1 = 1 + 0^* 1 = 0^* 1
\begin{array}{l} R_{31}^2 = R_{31}^1 + R_{32}^1 (R_{22}^1)^* R_{21}^1 = 1 (0 + \epsilon)^* \\ R_{32}^2 = R_{32}^1 + R_{32}^1 (R_{22}^1)^* R_{22}^1 = 1 + 1 (0 + \epsilon)^* (0 + \epsilon) = 1 + 10^* = 10^* \\ R_{32}^2 = R_{32}^1 + R_{32}^1 (R_{22}^1)^* R_{22}^1 = 1 + 1 (0 + \epsilon)^* (0 + \epsilon) = 1 + 10^* = 10^* \\ R_{32}^2 = R_{32}^1 + R_{32}^1 (R_{22}^1)^* R_{22}^1 = 1 + 1 (0 + \epsilon)^* (0 + \epsilon) = 1 + 10^* = 10^* \\ R_{32}^2 = R_{32}^1 + R_{32}^1 (R_{22}^1)^* R_{22}^1 = 1 + 1 (0 + \epsilon)^* (0 + \epsilon) = 1 + 10^* = 10^* \\ R_{32}^2 = R_{32}^1 + R_{32}^1 (R_{22}^1)^* R_{22}^1 = 1 + 1 (0 + \epsilon)^* (0 + \epsilon) = 1 + 10^* = 10^* \\ R_{32}^2 = R_{32}^1 + R_{32}^1 (R_{22}^1)^* R_{22}^1 = 1 + 1 (0 + \epsilon)^* (0 + \epsilon) = 1 + 10^* = 10^* \\ R_{32}^2 = R_{32}^1 + R_{32}^1 (R_{32}^1)^* R_{32}^1 = 1 + 1 (0 + \epsilon)^* (0 + \epsilon) = 1 + 10^* = 10^* \\ R_{32}^2 = R_{32}^1 + R_{32}^1 (R_{32}^1)^* R_{32}^1 = 1 + 1 (0 + \epsilon)^* (0 + \epsilon) = 1 + 10^* \\ R_{32}^2 = R_{32}^1 + R_{32}^1 (R_{32}^1)^* R_{32}^1 = 1 + 1 (0 + \epsilon)^* (0 + \epsilon) = 1 + 10^* \\ R_{32}^2 = R_{32}^1 + R_{32}^1 (R_{32}^1)^* R_{32}^1 = 1 + 1 (0 + \epsilon)^* (0 + \epsilon) = 1 + 10^* \\ R_{32}^2 = R_{32}^1 + R_{32}^1 (R_{32}^1)^* R_{32}^1 = 1 + 1 (0 + \epsilon)^* (0 + \epsilon) = 1 + 10^* \\ R_{32}^2 = R_{32}^1 + R_{32}^1 (R_{32}^1)^* R_{32}^1 = 1 + 1 (0 + \epsilon)^* \\ R_{32}^2 = R_{32}^1 + R_{32}^1 (R_{32}^1)^* R_{32}^1 = 1 + 1 (0 + \epsilon)^* \\ R_{32}^2 = R_{32}^1 + R_{32}^1 (R_{32}^1)^* R_{32}^1 = 1 + 1 (0 + \epsilon)^* \\ R_{32}^2 = R_{32}^1 + R_{32}^1 (R_{32}^1)^* R_{32}^1 = 1 + 1 (0 + \epsilon)^* \\ R_{32}^2 = R_{32}^1 + R_{32}^1 (R_{32}^1)^* R_{32}^1 = 1 + 1 (0 + \epsilon)^* \\ R_{32}^2 = R_{32}^1 + R_{32
\begin{array}{l} \mathbf{R}_{33}^2 = R_{33}^{1-} + R_{32}^{1-}(R_{22}^{1-})^*R_{23}^{1-} = \in +1(0+\epsilon)^* = \in \\ \mathbf{R}_{34}^2 = R_{34}^1 + R_{32}^1(R_{22}^1)^*R_{24}^1 = 0 + 1(0+\epsilon)^*1 = 0 + 10^*1 \end{array}
R_{41}^2 = R_{41}^1 + R_{42}^1 (R_{22}^1)^* R_{21}^1 = 01^*
\begin{aligned} \mathbf{R}_{42}^{2} &= R_{42}^{1} + R_{42}^{1}(R_{22}^{1})^{*}R_{22}^{1} = \\ \mathbf{R}_{43}^{2} &= R_{43}^{1} + R_{42}^{1}(R_{22}^{1})^{*}R_{23}^{1} = \\ \mathbf{R}_{44}^{2} &= R_{44}^{1} + R_{42}^{1}(R_{22}^{1})^{*}R_{23}^{1} = 0 + 01^{*}0 \\ \mathbf{R}_{44}^{2} &= R_{44}^{1} + R_{42}^{1}(R_{22}^{1})^{*}R_{24}^{1} = \in \end{aligned}
k = 3
R_{11}^3 = R_{11}^2 + R_{13}^2 (R_{33}^2)^* R_{31}^2 = 1^* = 1^*
R_{12}^3 = R_{12}^2 + R_{13}^2(R_{33}^2)^* R_{32}^2 = 1^* 0 (\in)^* 10^* = 1^* 010^*
\begin{array}{l} R_{13}^{\frac{3}{2}} = R_{13}^{\frac{3}{2}} + R_{13}^{\frac{3}{2}}(R_{33}^{\frac{3}{2}}) * R_{33}^{\frac{3}{2}} = 1 * 0 + 1 * 0 \in \in = 1 * 0 \\ R_{14}^{\frac{3}{2}} = R_{14}^{\frac{3}{2}} + R_{13}^{\frac{3}{2}}(R_{33}^{\frac{3}{2}}) * R_{34}^{\frac{3}{2}} = 1 * 0 \in (0 + 10 * 1) = 1 * 00 + 1 * 010 * 0 \end{array}
\begin{array}{l} R_{21}^3 = R_{21}^2 + R_{23}^2 (R_{33}^2)^* R_{31}^2 = \\ R_{22}^3 = R_{22}^2 + R_{23}^2 (R_{33}^2)^* R_{32}^2 = 0^* \end{array}
\begin{array}{l} R_{23}^{\frac{3}{3}} = R_{23}^{\frac{3}{2}} + R_{23}^{\frac{3}{2}} (R_{33}^{\frac{3}{2}})^* R_{33}^{\frac{3}{2}} = \\ R_{24}^{\frac{3}{2}} = R_{24}^{2} + R_{23}^{2} (R_{33}^{2})^* R_{34}^{2} = 0^* 1 \end{array}
\begin{array}{l} R_{31}^3 = R_{31}^2 + R_{33}^2 (R_{33}^2)^* R_{31}^2 = \in \in = \in \\ R_{32}^3 = R_{32}^2 + R_{33}^2 (R_{33}^2)^* R_{32}^2 = 10^* + 10^* = 10^* \end{array}
R_{33}^3 = R_{33}^2 + R_{33}^2 (R_{33}^2)^* R_{33}^2 = \in
R_{34}^3 = R_{34}^2 + R_{33}^2 (R_{33}^2)^* R_{34}^2 = 0 + 10^* 1
\begin{array}{l} R_{41}^3 = R_{41}^2 + R_{43}^2 (R_{33}^2)^* R_{31}^2 = 10^* + (0+10^*1)\epsilon^* = 10^* \\ R_{42}^3 = R_{42}^2 + R_{43}^2 (R_{33}^2)^* R_{32}^2 = (0+01^*0)(10^*) = 010^* + 01^*010^* \\ R_{42}^3 = R_{42}^3 (R_{43}^3)^* R_{43}^3 = (0+01^*0)(10^*) = 010^* + 01^*010^* \\ R_{43}^3 = R_{44}^3 (R_{43}^3)^* R_{43}^3 = (0+01^*0)(10^*) = 010^* + 01^*010^* \\ R_{43}^3 = R_{44}^3 (R_{43}^3)^* R_{43}^3 = (0+01^*0)(10^*) = 010^* + 01^*010^* \\ R_{43}^3 = R_{44}^3 (R_{43}^3)^* R_{43}^3 = (0+01^*0)(10^*) = 010^* + 01^*010^* \\ R_{44}^3 = R_{44}^3 (R_{43}^3)^* R_{43}^3 = (0+01^*0)(10^*) = 010^* + 01^*010^* \\ R_{44}^3 = R_{44}^3 (R_{43}^3)^* R_{43}^3 = (0+01^*0)(10^*) = 010^* + 01^*010^* \\ R_{44}^3 = R_{44}^3 (R_{43}^3)^* R_{43}^3 = (0+01^*0)(10^*) = 010^* + 01^*010^* \\ R_{44}^3 = R_{44}^3 (R_{43}^3)^* R_{44}^3 = (0+01^*0)(10^*) = 010^* + 01^*010^* \\ R_{44}^3 = R_{44}^3 (R_{43}^3)^* R_{44}^3 = (0+01^*0)(10^*) = 010^* + 01^*010^* \\ R_{44}^3 = R_{44}^3 (R_{44}^3)^* R_{44}^3 = (0+01^*0)(10^*) = 010^* + 01^*010^* \\ R_{44}^3 = R_{44}^3 (R_{44}^3)^* R_{44}^3 = (0+01^*0)(10^*) = 010^* + 01^*010^* \\ R_{44}^3 = R_{44}^3 (R_{44}^3)^* R_{44}^3 = (0+01^*0)(10^*) = 010^* + 01^*010^* \\ R_{44}^3 = R_{44}^3 (R_{44}^3)^* R_{44}^3 = (0+01^*0)(10^*) = 010^* + 01^*010^* \\ R_{44}^3 = (0+01^*0)(10^*) = 010^* + 010^* \\ R_{
R_{43}^3 = R_{43}^2 + R_{43}^2 (R_{33}^2)^* R_{33}^2 = 0 + 01^* 0
R_{44}^3 = R_{44}^2 + R_{43}^2(R_{33}^2)^* R_{34}^2 = \in +(0 + 01^*0)(0 + 10^*1)
= \in +00 + 010*1 + 01*00 + 01*010*1
k = 4
R_{11}^4 = R_{11}^3 + R_{14}^3 (R_{44}^3)^* R_{41}^3 = 0^* + (1^* + (1^*00 + 1^*010^*1)( \in +00 + 010^*1 + 01^*00 + 01^*010^*1)^*01^*
R_{12}^4 = R_{12}^3 + R_{14}^3 (R_{44}^3)^* R_{42}^3 = 1^*010^* + (1^*00 + 1^*010^*1) (\in +00 + 010^*1 + 01^*00 + 01^*010^*1)^* (010 * + 01^*010^*)
\begin{array}{l} R_{13}^{\frac{7}{4}} = R_{13}^{\frac{3}{3}} + R_{14}^{\frac{3}{4}}(R_{44}^{\frac{3}{4}})^*R_{43}^{\frac{3}{3}} = 1^*0 + (1^*00 + 1^*010^*1)(\in +00 + 010^*1 + 01^*00 + 01^*010^*1)^*(0 + 01^*0) \\ R_{14}^{4} = R_{14}^{3} + R_{14}^{3}(R_{44}^{3})^*R_{44}^{3} = 1^*00 + 1^*010^*1 \end{array}
 = (1*00 + 1*010*1)(\in +00 + 010*1 + 01*00 + 01*010*1)*(\in +00 + 010*1 + 01*00 + 01*010*1)
 = (1*00 + 1*010*1)(\in +00 + 010*1 + 01*00 + 01*010*1)*
R_{21}^4 = R_{21}^3 + R_{24}^3 (R_{44}^3)^* R_{41}^3 = 0^* 1 (\epsilon + 00 + 010^* 1 + 01^* 00 + 01^* 010^* 1)^* 01^*
R_{22}^4 = R_{22}^3 + R_{24}^3 (R_{44}^3)^* R_{42}^3
 = 0^* + 0^*1 (\in +00 + 010^*1 + 01^*00 + 01^*010^*1)^* (010 * +01^*010^*)
\begin{array}{l} \mathbf{R}^4_{23} = R^3_{23} + R^3_{24}(R^3_{44})^* R^3_{43} = 0^* 1 (\in +00 + 010^* 1 + 01^* 00 + 01^* 010^* 1)^* (0 + 01^* 0) \\ \mathbf{R}^4_{24} = R^3_{24} + R^3_{24}(R^3_{44})^* R^3_{44} \end{array}
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= 0^*1 + 0^*1 (\in +00 + 010^*1 + 01^*00 + 01^*010^*1)^* (\in +00 + 010^*1 + 01^*00 + 01^*010^*1)
R_{31}^4 = R_{31}^3 + R_{34}^3 (R_{44}^3)^* R_{41}^3 = (0 + 10^*1)(\epsilon + 00 + 010^*1 + 01^*00 + 01^*010^*1)^*01^*
\mathbf{R}^4_{32} = R^3_{32} + R^3_{34}(R^3_{44})^* R^3_{42} = 10^* + (0+10^*1)(\in +00+010^*1+01^*00+01^*010^*1)^* (010*+01^*010^*)
R_{33}^{42} = R_{33}^{32} + R_{34}^{31}(R_{44}^{31}) * R_{43}^{32}
= \in +(0+10*1)(\in +00+010*1+01*00+01*010*1)*(0+01*0)
R_{34}^4 = R_{34}^3 + R_{34}^3 (R_{44}^3)^* R_{44}^3 = (0 + 10^* 1)
+(0+10^*1)(\in +00+010^*1+01^*00+01^*010^*1)^*(\in +00+010^*1+01^*00+01^*010^*1)
= (0 + 10^*1)(\epsilon + 00 + 010^*1 + 01^*00 + 01^*010^*1)^*
R_{41}^4 = R_{41}^3 + R_{44}^3 (R_{44}^3)^* R_{41}^3
= (01^*) + (\in +00 + 010^*1 + 01^*00 + 01^*010^*1)(\in +00 + 010^*1 + 01^*00 + 01^*010^*1)^*(01^*)
= (\in +00 + 010^*1 + 01^*00 + 01^*010^*1)^*(01^*)
R_{42}^4 = R_{42}^3 + R_{44}^3 (R_{44}^3)^* R_{42}^3 = (010^* + 01^* 010^*)
+ (\in +00 + 010^*1 + 01^*00 + 01^*010^*1)(\in +00 + 010^*1 + 01^*00 + 01^*010^*1)^*(010^* + 01^*010^*)
= (\in +00 + 010^*1 + 01^*00 + 01^*010^*1)^*(010^* + 01^*010^*)
R_{43}^4 = R_{43}^3 + R_{44}^3 (R_{44}^3)^* R_{43}^3 = (0 + 01^*0)
+(\in +00 + 010^*1 + 01^*00 + 01^*010^*1)(\in +00 + 010^*1 + 01^*00 + 01^*010^*1)^*(0 + 01^*0)
= (\in +00 + 010^*1 + 01^*00 + 01^*010^*1)^*(0 + 01^*0)
R_{44}^4 = R_{44}^3 + R_{44}^3 (R_{44}^3)^* R_{44}^3 = (\epsilon + 00 + 010^*1 + 01^*00 + 01^*010^*1)
+(\in +00 + 010^*1 + 01^*00 + 01^*010^*1)(\in +00 + 010^*1 + 01^*00 + 01^*010^*1)^*
(\in +00 + 010^*1 + 01^*00 + 01^*010^*1) = (\in +00 + 010^*1 + 01^*00 + 01^*010^*1)^*
```