

Teoria da Computação

Exercício 1

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Questão 1

1) b) Relação \leq

PARA TODO x , $x \leq x$ REFLEXIVA ✓

SE $x \leq y$ E $y \leq z$, ENTÃO $x \leq z$ TRANSITIVA ✓

SE $x \leq y$, $y \leq z$? NÃO SEMPRE. SIMÉTRICA X

a) Relação $x+1 \geq y$

PARA TODO x , $x+1 \geq x$ REFLEXIVA ✓

SE $x+1 \geq y$ E $y+1 \geq z$, ENTÃO $x+1 \geq z$? NÃO SEMPRE. TRANSITIVA X

$\left\{ \begin{array}{l} 1+1 \geq 2 \checkmark \\ 2+1 \geq 3 \checkmark \\ 1+1 \geq 3 \text{ X} \end{array} \right.$

PARA TODO $x+1 \geq y$, $y+1 \geq x$ TAMBÉM É VERDADE. SIMÉTRICA ✓

c) Relação \neq

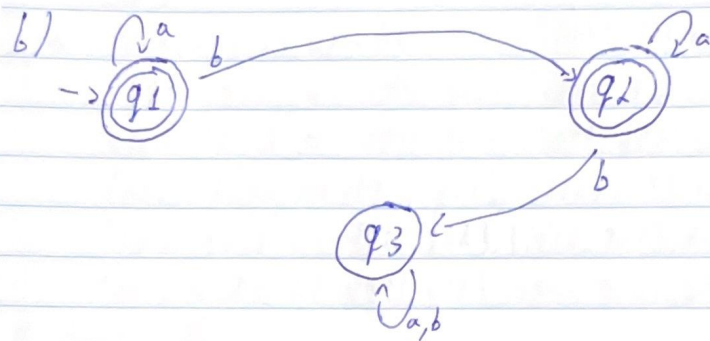
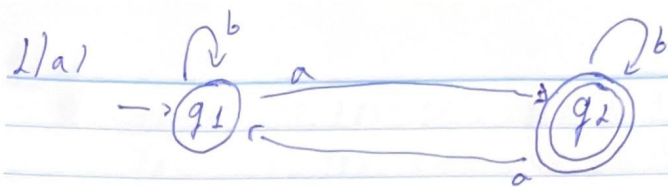
PARA QUALQUER x , $x \neq x$ É FALSO. REFLEXIVA X

SE $x \neq y$ E $y \neq z$, ENTÃO $x \neq z$. TRANSITIVA ✓

SE $x \neq y$ ENTÃO $y \neq x$. SIMÉTRICA ✓

Questão 2

Letras A e B



Letra C

c) M:

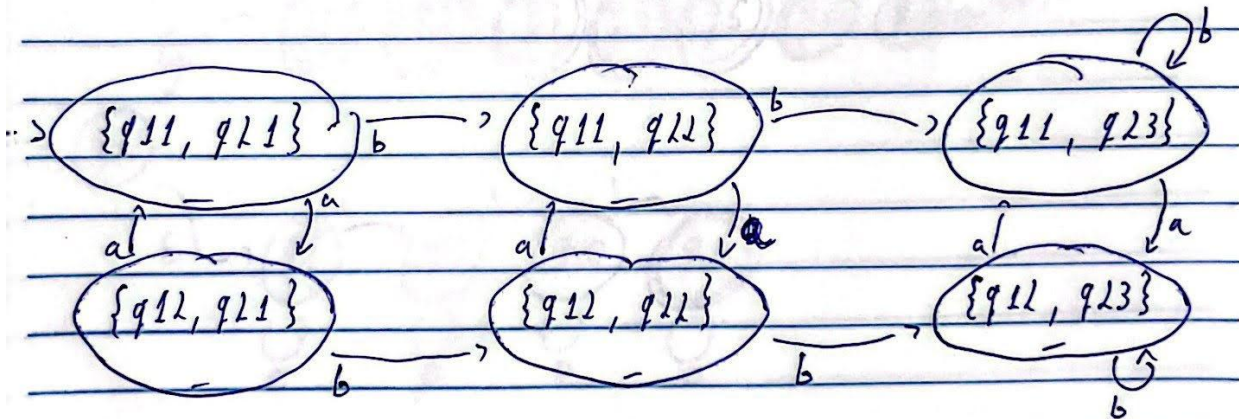
$$Q = \{\{q_{11}, q_{21}\}, \{q_{11}, q_{22}\}, \{q_{11}, q_{23}\}, \{q_{12}, q_{21}\}, \{q_{12}, q_{22}\}, \{q_{12}, q_{23}\}\}$$

$$\Sigma = \{a, b\}$$

$$\delta = \{(\{q_{11}, q_{21}\}, a) \rightarrow \{q_{12}, q_{21}\}, (\{q_{11}, q_{21}\}, b) \rightarrow \{q_{11}, q_{22}\}, (\{q_{11}, q_{22}\}, a) \rightarrow \{q_{12}, q_{22}\}, (\{q_{11}, q_{22}\}, b) \rightarrow \{q_{11}, q_{23}\}, (\{q_{11}, q_{23}\}, a) \rightarrow \{q_{12}, q_{23}\}, (\{q_{11}, q_{23}\}, b) \rightarrow \{q_{11}, q_{21}\}, (\{q_{12}, q_{21}\}, a) \rightarrow \{q_{11}, q_{21}\}, (\{q_{12}, q_{21}\}, b) \rightarrow \{q_{12}, q_{22}\}, (\{q_{12}, q_{22}\}, a) \rightarrow \{q_{11}, q_{22}\}, (\{q_{12}, q_{22}\}, b) \rightarrow \{q_{12}, q_{23}\}, (\{q_{12}, q_{23}\}, a) \rightarrow \{q_{11}, q_{23}\}, (\{q_{12}, q_{23}\}, b) \rightarrow \{q_{12}, q_{21}\}\}$$

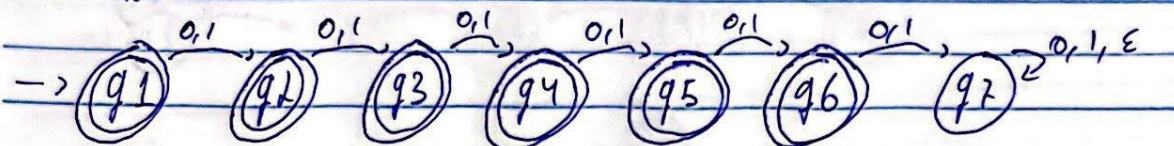
$$q_0 = \{q_{11}, q_{21}\}$$

$$F = \{\{q_{12}, q_{21}\}, \{q_{12}, q_{22}\}, \{q_{12}, q_{23}\}, \{q_{11}, q_{21}\}, \{q_{11}, q_{22}\}\}$$

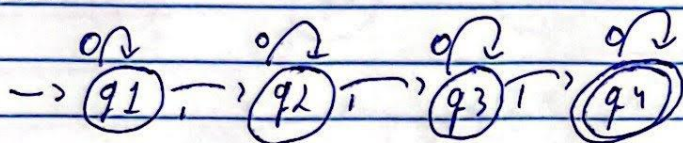


Questão 3
Letra A

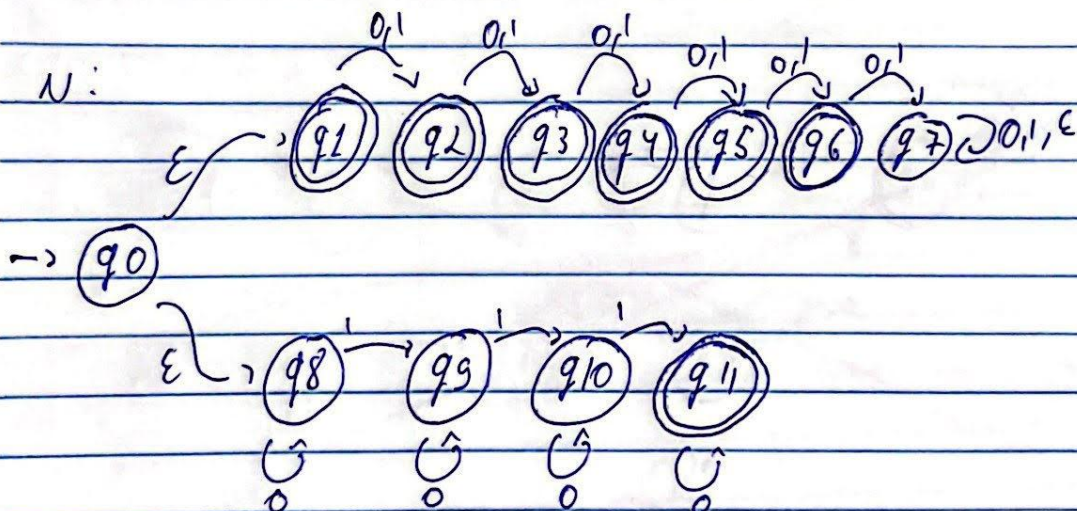
3) a) N1:



N2:

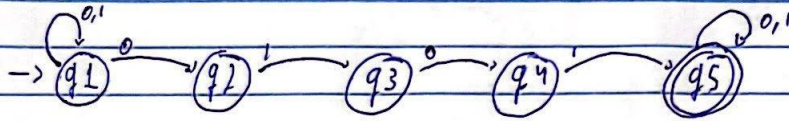


N:

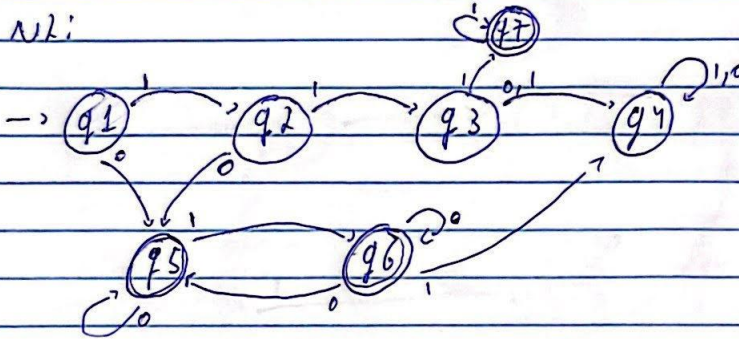


Letra B

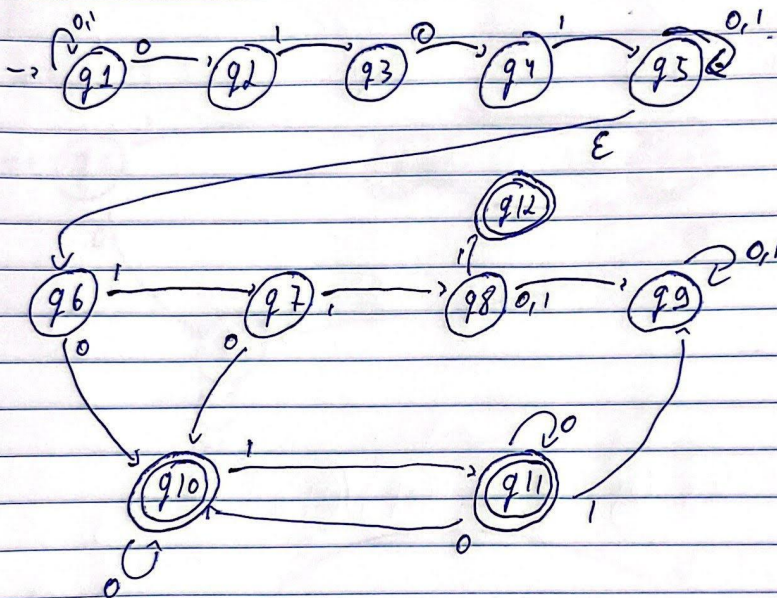
b) N1:



N2:



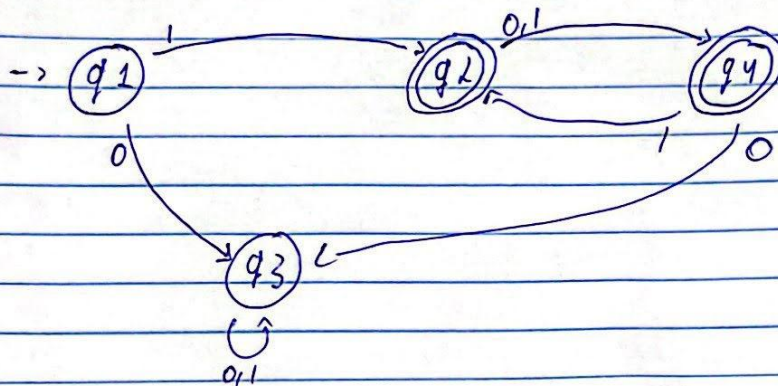
N:



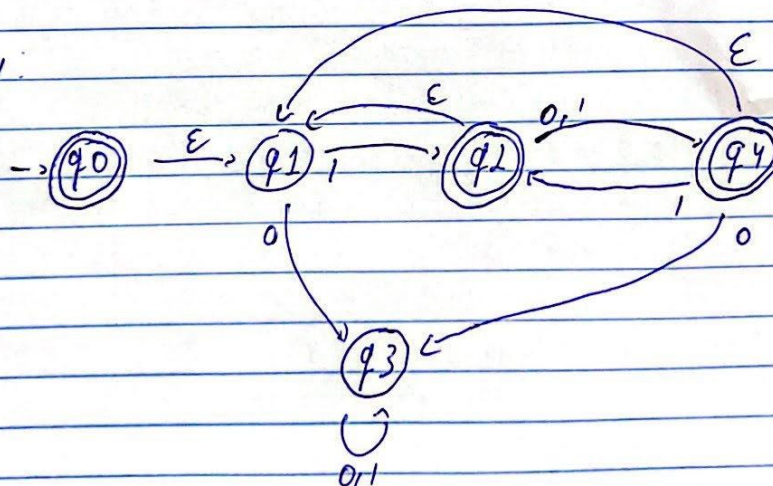
Letra C

3/c1

N1:



N:



Questão 4

$$N = (\{q_1, q_2, q_3\}, \{a, b\}, \emptyset, q_1, \{q_1\})$$

$$\delta = \{(q_1, a) \rightarrow \{q_1, q_3\}, (q_1, b) \rightarrow \{q_3\}, (q_1, \epsilon) \rightarrow \emptyset, \\ (q_2, a) \rightarrow \{q_1\}, (q_2, b) \rightarrow \emptyset, (q_2, \epsilon) \rightarrow \{q_1\}, \\ (q_3, a) \rightarrow \emptyset, (q_3, b) \rightarrow \{q_1\}, (q_3, \epsilon) \rightarrow \emptyset\}$$

$M =$

$$Q = \{\emptyset, \{q_1\}, \{q_2\}, \{q_3\}, \{q_1, q_2\}, \{q_1, q_3\}, \{q_2, q_3\}, \{q_1, q_2, q_3\}\}$$

$E(R) =$

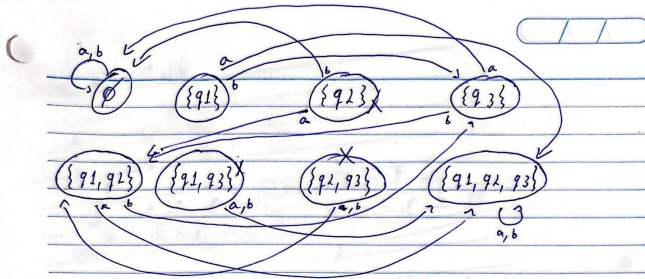
$$\begin{aligned} E(\emptyset) &= \emptyset & E(\{q_1, q_2\}) &= \{q_1, q_2\} \\ E(\{q_1\}) &= \{q_1\} & E(\{q_1, q_3\}) &= \{q_1, q_3\} \\ E(\{q_2\}) &= \{q_1, q_2\} & E(\{q_2, q_3\}) &= \{q_1, q_2, q_3\} \\ E(\{q_3\}) &= \{q_3\} & E(\{q_1, q_2, q_3\}) &= \{q_1, q_2, q_3\} \end{aligned}$$

$$\delta = \emptyset$$

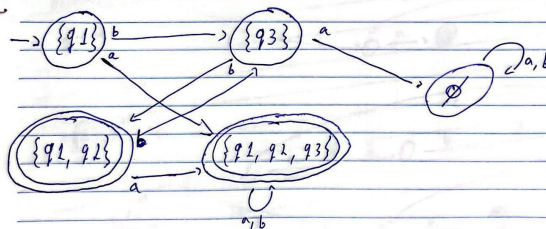
$$\begin{aligned} \delta &= \{(\emptyset, a) \rightarrow \emptyset, (\emptyset, b) \rightarrow \emptyset, \\ &(\{q_1\}, a) \rightarrow \{q_1, q_2, q_3\}, (\{q_1\}, b) \rightarrow \{q_3\}, \\ &(\{q_2\}, a) \rightarrow \{q_1, q_2\}, (\{q_2\}, b) \rightarrow \emptyset, \\ &(\{q_3\}, a) \rightarrow \emptyset, (\{q_3\}, b) \rightarrow \{q_1, q_2\}, \\ &(\{q_1, q_2\}, a) \rightarrow \{q_1, q_2, q_3\}, (\{q_1, q_2\}, b) \rightarrow \{q_3\}, \\ &(\{q_1, q_3\}, a) \rightarrow \{q_1, q_2, q_3\}, (\{q_1, q_3\}, b) \rightarrow \{q_1, q_2, q_3\}, \\ &(\{q_2, q_3\}, a) \rightarrow \{q_1, q_2\}, (\{q_2, q_3\}, b) \rightarrow \{q_1, q_2\}, \\ &(\{q_1, q_2, q_3\}, a) \rightarrow \{q_1, q_2, q_3\}, (\{q_1, q_2, q_3\}, b) \rightarrow \{q_1, q_2, q_3\}\} \end{aligned}$$

$$q_0 = E(q_1) = \{q_1\}$$

$$F = \{\{q_2\}, \{q_1, q_2\}, \{q_2, q_3\}, \{q_1, q_2, q_3\}\}$$



$M:$



Questão 5

Letra A

((

5) a) $a(abb)^* \cup b$

$a \rightarrow \textcircled{0} \xrightarrow{a} \textcircled{0}$

$b \rightarrow \textcircled{0} \xrightarrow{b} \textcircled{0}$

$abb \rightarrow \textcircled{0} \xrightarrow{a} \textcircled{0} \xrightarrow{\epsilon} \textcircled{0} \xrightarrow{b} \textcircled{0} \xrightarrow{\epsilon} \textcircled{0} \xrightarrow{b} \textcircled{0}$

$(abb)^* \rightarrow \textcircled{0} \xrightarrow{\epsilon} \textcircled{0} \xrightarrow{a} \textcircled{0} \xrightarrow{\epsilon} \textcircled{0} \xrightarrow{b} \textcircled{0} \xrightarrow{\epsilon} \textcircled{0} \xrightarrow{b} \textcircled{0}$

ϵ

$a(abb)^* \rightarrow \textcircled{0} \xrightarrow{\epsilon} \textcircled{0} \xrightarrow{a} \textcircled{0} \xrightarrow{\epsilon} \textcircled{0} \xrightarrow{b} \textcircled{0} \xrightarrow{\epsilon} \textcircled{0} \xrightarrow{b} \textcircled{0}$

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ϵ

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$\textcircled{0} \xrightarrow{a} \textcircled{0}$

$a(abb)^* \cup b$

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ϵ

$\textcircled{0}$

$\textcircled{0} \xrightarrow{a} \textcircled{0}$

ϵ

$\textcircled{0} \xrightarrow{b} \textcircled{0}$

Letra B

b) $a^+b^+(a^+ \cup b)$

$a \rightarrow 0 \xrightarrow{a} \odot$

$b \rightarrow 0 \xrightarrow{b} \odot$

$a^* \rightarrow 0 \xrightarrow{\epsilon} 0 \xrightarrow{a} \odot$

$b^* \rightarrow 0 \xrightarrow{\epsilon} 0 \xrightarrow{b} \odot$

$a^+ \rightarrow 0 \xrightarrow{a} 0 \xrightarrow{\epsilon} \odot \xrightarrow{\epsilon} 0 \xrightarrow{a} \odot$

$b^+ \rightarrow 0 \xrightarrow{b} 0 \xrightarrow{\epsilon} \odot \xrightarrow{\epsilon} 0 \xrightarrow{b} \odot$

$(a^+ \cup b)$

$\xrightarrow{\epsilon} 0 \xrightarrow{a} 0 \xrightarrow{\epsilon} \odot \xrightarrow{\epsilon} 0 \xrightarrow{a} \odot$

$\xrightarrow{\epsilon} 0 \xrightarrow{b} \odot$

a^+b^+

$\rightarrow 0 \xrightarrow{a} 0 \xrightarrow{\epsilon} \odot \xrightarrow{\epsilon} 0 \xrightarrow{a} \odot$

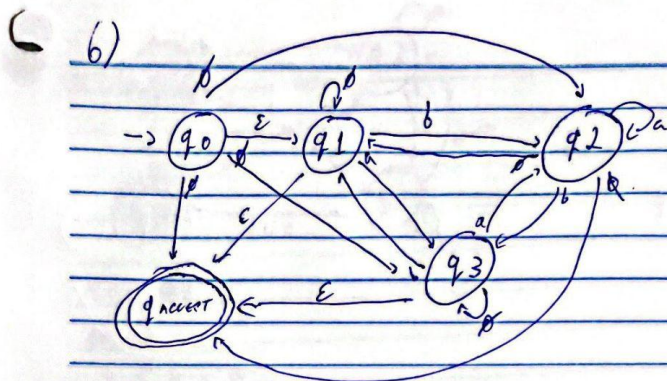
$0 \xrightarrow{b} 0 \xrightarrow{\epsilon} \odot \xrightarrow{\epsilon} 0 \xrightarrow{b} \odot$

$a^+b^+(a^+ \cup b)$

$\xrightarrow{\epsilon} 0 \xrightarrow{a} 0 \xrightarrow{\epsilon} 0 \xrightarrow{\epsilon} \odot \xrightarrow{\epsilon} 0 \xrightarrow{a} \odot \xrightarrow{\epsilon} 0 \xrightarrow{b} 0 \xrightarrow{\epsilon} \odot \xrightarrow{\epsilon} 0 \xrightarrow{a} \odot$

$\xrightarrow{\epsilon} 0 \xrightarrow{b} \odot$

Questão 6



KILL Q1

q_0, q_1

$$\epsilon \cdot \emptyset^* \cdot b \cup \emptyset = b$$

q_0, q_3

$$\epsilon \cdot \emptyset^* \cdot a \cup \emptyset = a$$

q_0, q_4

$$\epsilon \cdot \emptyset^* \cdot \epsilon \cup \emptyset = \epsilon$$

q_2, q_2

$$\emptyset \cdot \emptyset^* \cdot b \cup a = a$$

q_2, q_3

$$\emptyset \cdot \emptyset^* \cdot a \cup b = b$$

q_2, q_4

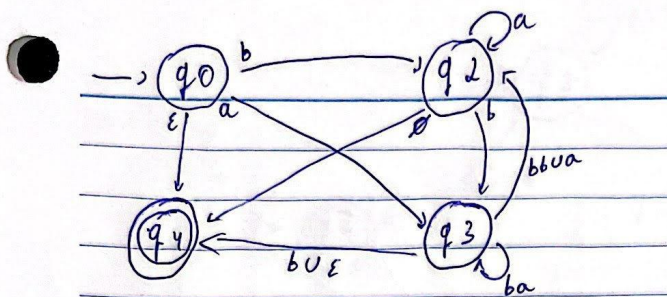
$$\emptyset \cdot \emptyset^* \cdot \epsilon \cup \emptyset = \emptyset$$

q_3, q_3

$$b \cdot \emptyset^* \cdot a \cup \emptyset = ba$$

q_3, q_2

$$b \cdot \emptyset^* \cdot b \cup a = bb \cup a$$



KILL q_2

q_0, q_3

$b \cdot a^* \cdot b \cup a$

q_0, q_4

$\epsilon \cup b \cdot a^* \cdot \emptyset$

ϵ

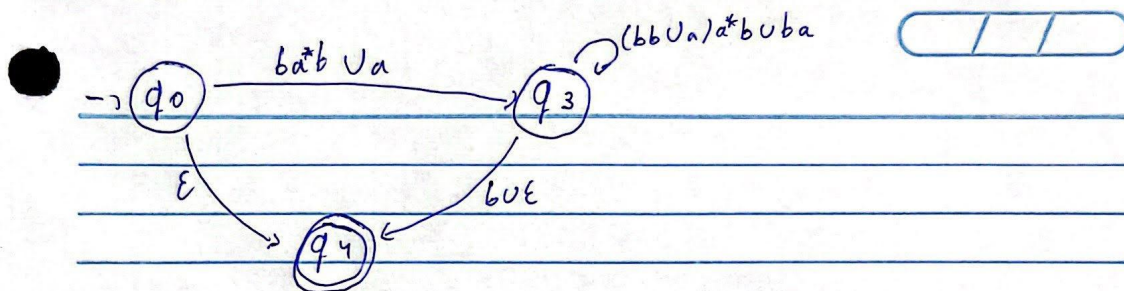
q_3, q_3

$(bbua) \cdot a^* \cdot b \cup ba$

q_3, q_4

$(bbua) \cdot a^* \cdot \emptyset \cup (b \cup \epsilon)$

$b \cup \epsilon$



KILL q_3 :

q_0, q_4

$(ba^*b \cup a)((bbua)a^*buba)^*(b \cup \epsilon) \cup \epsilon$

