

Teoria da Computação Lista 2

1. Mostre que:

- a) cada linguagem abaixo não é regular,
b) cada linguagem abaixo é livre de contexto,
c) Apresente um autômato de pilha **não determinístico** que as reconheça, **por estado final e por pilha vazia ao mesmo tempo**.

$$L_1 = \{ a^i b^j \mid i = j, i \geq 1, j \geq 1 \} \quad L_2 = \{ a^i b^j \mid j = 2i, i \geq 1, j \geq 1 \}$$

$$L_3 = \{ a^i b^j \mid i \leq j, i \geq 1, j \geq 1 \} \quad L_4 = \{ a^i b^j \mid i \geq j, i \geq 1, j \geq 1 \}$$

$$L_5 = \{ a^i b^j \mid i = j, i \geq 0, j \geq 0 \} \quad L_6 = \{ a^i b^j \mid j = 2i, i \geq 0, j \geq 0 \}$$

$$L_7 = \{ a^i b^j \mid i \leq j, i \geq 0, j \geq 0 \} \quad L_8 = \{ a^i b^j \mid i \geq j, i \geq 0, j \geq 0 \}$$

$$L_9 = \{ a^i b^j c^k \mid i = j, i \geq 1, j \geq 1, k \geq 1 \}$$

$$L_{10} = \{ a^i b^j c^k \mid i = k, i \geq 1, j \geq 1, k \geq 1 \}$$

$$L_{11} = \{ a^i b^j c^k \mid j = k, i \geq 1, j \geq 1, k \geq 1 \}$$

$$L_{12} = \{ a^i b^j c^k \mid i \leq j, i \geq 1, j \geq 1, k \geq 1 \}$$

$$L_{13} = \{ a^i b^j c^k \mid i \leq k, i \geq 1, j \geq 1, k \geq 1 \}$$

$$L_{14} = \{ a^i b^j c^k \mid j \leq k, i \geq 1, j \geq 1, k \geq 1 \}$$

$$L_{15} = \{ a^i b^j c^k \mid i \geq j, i \geq 1, j \geq 1, k \geq 1 \}$$

$$L_{16} = \{ a^i b^j c^k \mid i \geq k, i \geq 1, j \geq 1, k \geq 1 \}$$

$$L_{17} = \{ a^i b^j c^k \mid j \geq k, i \geq 1, j \geq 1, k \geq 1 \}$$

$$L_{18} = \{ a^i b^j c^k \mid i = j + k, i \geq 1, j \geq 1, k \geq 1 \}$$

$$L_{19} = \{ a^i b^j c^k \mid k = i + j, i \geq 1, j \geq 1, k \geq 1 \}$$

$$L_{20} = \{ a^i b^j c^k \mid i = j, i \geq 0, j \geq 0, k \geq 0 \}$$

$$L_{21} = \{ a^i b^j c^k \mid i = k, i \geq 0, j \geq 0, k \geq 0 \}$$

$$L_{22} = \{ a^i b^j c^k \mid j = k, i \geq 0, j \geq 0, k \geq 0 \}$$

$$L_{23} = \{ a^i b^j c^k \mid i \leq j, i \geq 0, j \geq 0, k \geq 0 \}$$

$$L_{24} = \{ a^i b^j c^k \mid i \leq k, i \geq 0, j \geq 0, k \geq 0 \}$$

$$L_{25} = \{ a^i b^j c^k \mid j \leq k, i \geq 0, j \geq 0, k \geq 0 \}$$

$$L_{26} = \{ a^i b^j c^k \mid i \geq j, i \geq 0, j \geq 0, k \geq 0 \}$$

$$L_{27} = \{ a^i b^j c^k \mid i \geq k, i \geq 0, j \geq 0, k \geq 0 \}$$

$$L_{28} = \{ a^i b^j c^k \mid j \geq k, i \geq 0, j \geq 0, k \geq 0 \}$$

$$L_{29} = \{ a^i b^j c^k \mid i = j + k, i \geq 0, j \geq 0, k \geq 0 \}$$

$$L_{30} = \{ a^i b^j c^k \mid k = i + j, i \geq 0, j \geq 0, k \geq 0 \}$$

$$L_{31} = \{ a^i b^j c^m d^n \mid i = n, j = m, i \geq 1, j \geq 1, m \geq 1, n \geq 1 \}$$

$$L_{32} = \{ a^i b^j c^m d^n \mid i = n, j = m, i \geq 0, j \geq 0, m \geq 0, n \geq 0 \}$$

$$L_{33} = \{ a^i b^j c^m d^n \mid i \leq n, j = m, i \geq 1, j \geq 1, m \geq 1, n \geq 1 \}$$

$$L_{34} = \{ a^i b^j c^m d^n \mid i \leq n, j = m, i \geq 0, j \geq 0, m \geq 0, n \geq 0 \}$$

$$L_{35} = \{ a^i b^j c^m d^n \mid i = n, j \leq m, i \geq 1, j \geq 1, m \geq 1, n \geq 1 \}$$

$$L_{36} = \{ a^i b^j c^m d^n \mid i = n, j \leq m, i \geq 0, j \geq 0, m \geq 0, n \geq 0 \}$$

$$L_{37} = \{ a^i b^j c^m d^n \mid i \leq n, j \leq m, i \geq 1, j \geq 1, m \geq 1, n \geq 1 \}$$

$$L_{38} = \{ a^i b^j c^m d^n \mid i \leq n, j \leq m, i \geq 0, j \geq 0, m \geq 0, n \geq 0 \}$$

$$L_{39} = \{ a^i b^j c^m d^n \mid i \geq n, j = m, i \geq 1, j \geq 1, m \geq 1, n \geq 1 \}$$

$$L_{40} = \{ a^i b^j c^m d^n \mid i \geq n, j = m, i \geq 0, j \geq 0, m \geq 0, n \geq 0 \}$$

$$L_{41} = \{ a^i b^j c^m d^n \mid i = n, j \geq m, i \geq 1, j \geq 1, m \geq 1, n \geq 1 \}$$

$$L_{42} = \{ a^i b^j c^m d^n \mid i = n, j \geq m, i \geq 0, j \geq 0, m \geq 0, n \geq 0 \}$$

$$L_{43} = \{ a^i b^j c^m d^n \mid i \geq n, j \geq m, i \geq 1, j \geq 1, m \geq 1, n \geq 1 \}$$

$$L_{44} = \{ a^i b^j c^m d^n \mid i \geq n, j \leq m, i \geq 0, j \geq 0, m \geq 0, n \geq 0 \}$$

$$L_{45} = \{ a^i b^{2j} c^{3k} \mid i = j, i \geq 1, j \geq 1, k \geq 1 \}$$

$$L_{46} = \{ a^i b^{2j} c^{3k} \mid i = j, i \geq 0, j \geq 0, k \geq 0 \}$$

$$L_{47} = \{ a^i b^{3j} c^k \mid i = k, i \geq 1, j \geq 1, k \geq 1 \}$$

$$L_{48} = \{ a^i b^{3j} c^k \mid i = k, i \geq 0, j \geq 0, k \geq 0 \}$$

$$L_{49} = \{ a^{3i} b^j c^k \mid j = k, i \geq 1, j \geq 1, k \geq 1 \}$$

$$L_{50} = \{ a^{3i} b^j c^k \mid j = k, i \geq 0, j \geq 0, k \geq 0 \}$$

$$L_{51} = \{ a^i b^{3j} c^{2k} \mid i = k, i \geq 1, j \geq 1, k \geq 1 \}$$

$$L_{52} = \{ a^i b^{3j} c^{2k} \mid i = k, i \geq 0, j \geq 0, k \geq 0 \}$$

3. Mostre que são ou não regulares, ou que são ou não livres de contexto as seguintes linguagens, com o auxílio dos lemas do bombeamento:

$$L_{3a} = \{ a^i b^j \mid i, j \geq 0 \}$$

$$L_{3b} = \{ a^i b^i \mid i \geq 0 \}$$

$$L_{3c} = \{ a^i b^j \mid i \geq j \geq 0 \}$$

$$L_{3d} = \{ a^i b^j \mid i \geq 1, j \geq 1 \}$$

$$L_{3e} = \{ a^i b^j \mid 0 \leq i \leq j \}$$

$$L_{3f} = \{ a^i b^j c^i \mid i \geq 1 \}$$

$$L_{3g} = \{ w.w \mid w \in \{a,b\}^* \}$$

$$L_{3h} = \{ w.w^R \mid w \in \{a,b\}^* \}$$

4. Utilizando a mT M_4 , $M_4 = (K, \Sigma, \Gamma, \delta, i, F)$, em que $K = \{ q_0, q_1, q_2, q_3, q_4 \}$, $\Sigma = \{ a, b \}$, $\Gamma = \{ a, b, X, Y, \square \}$, $i = q_0$, $F = \{ q_4 \}$ e

δ	a	b	X	Y	\square
q_0	q_1XR			q_3YR	q_4XR
q_1	q_1aR	q_2YL		q_1YR	
q_2	q_2aL		q_0XR	q_2YL	
q_3				q_3YR	q_4XR
q_4					

Verifique se as cadeias aab e abbaa são aceitas por esta mT M_4 , mostrando a sequência de configurações assumidas por M_6 ao tentar reconhecer cada cadeia.

5.a) Construa uma mT M_5 que reconheça as cadeias da linguagem $L_5 = \{ a^n b^n c^{2n} \mid n \geq 1 \}$.

6.a) Tente definir a gramática G_6 , para a linguagem $L_6 = \{ a^i b^j c^k \mid i < j < k, i \geq 1 \}$, com base na gramática sensível ao contexto $G_6 = \langle \{S, B, C\}, \{a, b, c\}, P, S \rangle$, que gera a linguagem $L_6 = \{ a^n b^n c^n \mid n \geq 1 \}$, cujas regras encontram-se, a seguir:

$$S \rightarrow aSBC \quad S \rightarrow aBC$$

$$CB \rightarrow BC \quad aB \rightarrow ab$$

$$bB \rightarrow bb \quad bC \rightarrow bc$$

$$cC \rightarrow cc$$

7.a) Encontre uma gramática para as linguagens:

$$L_1 = \{ a^i : i = k^2, k \text{ um inteiro positivo} \}.$$

$$L_2 = \{ xx : x \in \{a,b\}^* \}.$$