# Teoria da Computação

# Mini-Teste 2 A

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1. Consider the alphabet $BIT \stackrel{\text{def}}{=} \{0,1\}$. Specify a Deterministic Finite Automaton (DFA) over the alphabet $BIT$ that checks if a word over $BIT$ has a 0 after every 1.

   (a) x

   $$S \stackrel{\text{def}}{=} \{1\},\ q \stackrel{\text{def}}{=} 1,\ F \stackrel{\text{def}}{=} \{1\}$$

   | $\delta$ | 0 | 1 |
   |---|---|---|
   | 1 | 1 | 2 |
   | 2 | 1 | - |

   (b) x

   $$S \stackrel{\text{def}}{=} \{1,2\},\ q \stackrel{\text{def}}{=} 1,\ F \stackrel{\text{def}}{=} 1$$

   | $\delta$ | 0 | 1 |
   |---|---|---|
   | 1 | 1 | 2 |
   | 2 | 1 | - |

   (c) x

   $$S \stackrel{\text{def}}{=} \{1,2\},\ q \stackrel{\text{def}}{=} 1,\ F \stackrel{\text{def}}{=} \{1\}$$

   | $\delta$ | 0 | 1 |
   |---|---|---|
   | 1 | 1 | 2 |
   | 2 | 1 | 1 |

   (d)

   $$S \stackrel{\text{def}}{=} \{1,2\},\ q \stackrel{\text{def}}{=} 1,\ F \stackrel{\text{def}}{=} \{1\}$$

   | $\delta$ | 0 | 1 |
   |---|---|---|
   | 1 | 1 | 2 |
   | 2 | 1 | - |

   (e) x

   $$S \stackrel{\text{def}}{=} \{1,2\},\ q \stackrel{\text{def}}{=} 1,\ F \stackrel{\text{def}}{=} \{2\}$$

   | $\delta$ | 0 | 1 |
   |---|---|---|
   | 1 | 1 | 2 |
   | 2 | 1 | - |

2. The previous automaton accepts the word 010 because:

   (a) $\hat{\delta}(2,010) = 1 \in F$ x

   (b) $\hat{\delta}(1,010) = 1 \in F$

   (c) $\hat{\delta}(2,010) = 2 \notin F$ x

   (d) $\hat{\delta}(1,010) = 1 \notin F$ x

   (e) $\delta(1,010) = 1 \in F$ x

3. The previous automaton does not accept the word 01 because:

   (a) $\hat{\delta}(2, 01) = \perp$ x

   (b) $\hat{\delta}(2, 01) = 2 \notin F$ x

   (c) $\delta(1, 01) = \perp$ x

   (d) $\hat{\delta}(1, 01) = \perp$ x

   (e) $\hat{\delta}(1, 01) = 2 \notin F$

4. If an automaton has an empty alphabet and the initial state is not final, its language is:

   (a) empty, as it is able of accepting all possible words. x

   (b) empty, as it is not able of accepting any word.

   (c) the set of all possible words, as it is not able of accepting any word. x

   (d) the set of all possible words, as it is able of accepting all possible words. x

   (e) the set of all possible words, as it has no transitions. x

5. Define a regular expression whose language is the set of words over $\{a, b\}$ that after a $b$ have an even number of $a$s or have only an odd number of $a$s.

   (a) $a^*(b(aa)^*) + a(aa^*)$ x

   (b) $a^*(b(aa)^*)^* + a(aa^*)$ x

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

   (d) $a^*(b(aa)^*) + a(aa)^*$ x

   (e) $a^*(b(aa))^* + a(aa)^*$ x

6. Define the language of the regular expression $(aba)^* + (b)^*$, considering that, for instance, $w^3 = w\,w\,w$.

   (a) $\{(aba)^n \mid n \in \mathbb{N}\} \cup \{b\}^*$ x

   (b) $\{(aba)^n \mid n \in \mathbb{N}\} \cdot \{b\}^*$ x

   (c) $\{(aba)^n \mid n \in \mathbb{N}_0\} \cup \{b\}^*$

   (d) $\{(aba)^n \mid n \in \mathbb{N}_0\} \cap \{b\}^*$ x

   (e) $\{(aba)^n \mid n \in \mathbb{N}_0\} \cdot \{b\}^*$ x

7. Select the correct justification.

   (a) $ca \in \mathcal{L}(c^+a^*b^*)$, since $ca = ca\epsilon$, $\epsilon \in \mathcal{L}(b^*)$, $a \in \mathcal{L}(a^*)$, and $c \in \mathcal{L}(c^+)$.

   (b) $ca \in \mathcal{L}(c^+a^*b^*)$, since $ca = \epsilon ca$, $\epsilon \in \mathcal{L}(b^*)$, $a \in \mathcal{L}(a^*)$, and $c \in \mathcal{L}(c^+)$. x

   (c) $ca \in \mathcal{L}(c^+a^*b^*)$, since $aab = \epsilon ca$, $\epsilon \in \mathcal{L}(c^+)$, $a \in \mathcal{L}(a^*)$, and $b \in \mathcal{L}(b^*)$. x

   (d) $ca \in \mathcal{L}(c^+a^*b^*)$, since $ca = ca\epsilon$, $c \in \mathcal{L}(c^*)$, $a \in \mathcal{L}(a^+)$, and $\epsilon \in \mathcal{L}(b^*)$. x

   (e) $ca \in \mathcal{L}(c^+a^*b^*)$, since $ca = \epsilon ca$, $\epsilon \in \mathcal{L}(c^+)$, $a \in \mathcal{L}(a)$, and $b \in \mathcal{L}(b)$. x

8. Select the correct justification.

   (a) $ac \notin \mathcal{L}(a^*bc^*)$, since $b$ must appear in a word of the language.

   (b) $ac \notin \mathcal{L}(a^*bc^*)$, since $c$ is not in the alphabet of the language. x

   (c) $ac \notin \mathcal{L}(a^*bc^*)$, since $c$ is in the alphabet of the language. x

   (d) $ac \notin \mathcal{L}(a^*bc^*)$, since $a$ and $c$ should not appear in a word of the language. x

   (e) $ac \in \mathcal{L}(a^*bc^*)$, since $b$ may appear in a word of the language. x