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コンピューターサイエンス演習 I

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中間テスト

1. Prove or disprove the following assertions.

   (1.1) There is algorithm which on input any regular grammar $\mathcal{G}$ decides whether or not $L(\mathcal{G}) = \emptyset$.

   (1.2) There is algorithm which on input any regular grammars $\mathcal{G}_1$, $\mathcal{G}_2$ decides whether or not $L(\mathcal{G}_1) \subseteq L(\mathcal{G}_2)$.

   (1.3) There is algorithm which on input any regular grammars $\mathcal{G}_1$, $\mathcal{G}_2$ decides whether or not $L(\mathcal{G}_1) = L(\mathcal{G}_2)$.

2. Let $\Sigma = \{a, b\}$ and let $L \subseteq \Sigma^*$ be the language defined by the following conditions: $w \in L$ if and only if $w \in \Sigma^*$ and

   (i) 3 divides $|w|$;

   (ii) w starts with a and ends with b;

   (iii) for all strings q, $r \in \Sigma^*$ we have $w \neq qaaar$.

   Prove or disprove L to be regular. If L is regular, construct a DFA $\mathcal{A}$ such that $L = L(\mathcal{A})$.

3. Let $L = \{0^n \text{bin}(n) \mid n \in \mathbb{N}^+\}$, where $\text{bin}(n)$ denotes the *binary representation* of n and the leftmost bit of it is 1.

   (3.1) Prove or disprove L to be context-free.

   (3.2) Provide a grammar $\mathcal{G}$ such that $L = L(\mathcal{G})$ and show the correctness of your grammar.

4. Consider the following language $L = \{ww \mid w \in \{a, b\}^*\}$. Prove or disprove L to be context-free.