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演習第八

1. Consider the following homomorphism $\varphi: \{a, b\}^* \rightarrow \{a, b\}^*$ defined by $\varphi(a) = b$ and $\varphi(b) = ab$. Furthermore, we set $\varphi^1(w) = \varphi(w)$ and $\varphi^{n+1}(w) = \varphi(\varphi^n(w))$ for every $n \in \mathbb{N}$, $n \geq 1$, and $w \in \{a, b\}^*$.

Determine the length of the string $\varphi^n(a)$ in dependence on n , where $n \in \mathbb{N}^+$.

2. Prove or disprove that the regular languages are closed under homomorphism.
3. Consider the following language

$$L = \{0^{2^n}1^{2^n} \mid n \in \mathbb{N}\} \cup \{w \mid w \in \{0, 1\}^*, w = w^T\}.$$

(3.1) Prove that L is context-free.

(3.2) Determine a number $n \in \mathbb{N}$, a homomorphism h and a regular language R_L such that $L = h(D_n \cap R_L)$. Prove your assertion.