

Logical Complexity

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1. Construct a non-deterministic finite automaton for the language $L \subseteq \{a, b\}^*$ given by the following regular expression: $(ab \cup aab)^*$. Motivate your answer.
2. Consider the alphabet $\Sigma = \{ (,), [,] \}$ of two different sorts of brackets. Let L be the language in Σ consisting of balanced bracket expressions in Σ such as $[] [()]$ and $(([]) [() ()])$, but not $([() []])$.
 - (a) Invent a general definition of balanced bracket expression.
 - (b) Define L by a context-free grammar.
 - (c) Show that L is not regular.
3. Let $f : \mathbb{N} \rightarrow \mathbb{N}$ be a total computable function and let $X \subseteq \mathbb{N}$ be an r.e. set. Show that $\{x \in \mathbb{N} : f(x) \in X\}$ is r.e.
4. Is the class of decidable languages closed under $*$?