

Problem Set 4

Problem 1. Find a regular expression representing the encoding of binary numbers divisible by 3. Show your work in systematically devising this regular expression, starting from a DFA for the same language.

Problem 2. Suppose you have a (fully parenthesized, concatenation-explicit) regular expression of α of length n over the binary alphabet. Exhibit (and justify) an explicit bound $b(n)$ such that there is a regular expression β, $|\beta| \le b(n)$, such that $L(\beta) = \overline{L(\alpha)}$.

Problem 3. (Assigned last week) For $n \ge 0$, let $L_n = \{1^i : 0 \le i < n\}$ (where $1^0 = \varepsilon$). Prove that there is a DFA M_n having n final states that accepts L_n. Then prove that L_n cannot be accepted by any DFA having fewer accept states.

Problem 4. Show that the following languages are not regular.

Part A. $L = \{www : w \in \{a, b\}^*\}$.

Part B. $L = \{a^{2^n} : n \ge 0\}$.

Part C. $L = \{0^n 1^m 0^n : m, n \ge 0\}$.