Problem Set 4 – Due Friday, April 26, 2013

Problem 1. Using the procedure shown in class, convert the following NFA into a regular expression for the same language.

![NFA Diagram]

Problem 2. Imagine converting an n-state, c-character DFA $M = (Q, \Sigma, \delta, q_0, F)$ into a (fully parenthesized, explicit concatenation symbol) regular expression $\alpha$ for the same language. Upper bound $|\alpha|$ in terms of $n$ and $c$.

Problem 3. Using the pumping lemma, show that the following languages are not regular.

(a) $L = \{a^{2^n} : n \geq 0\}$.
(b) $L = \{www : w \in \{a, b\}^*\}$.
(c) $L = \{0^n1^m0^n : m, n \geq 0\}$.

Problem 4. Let $L = \{w \in \{0, 1\}^* : w$ is a palindrome$\}$. In class we proved, using the pumping lemma, that $L$ is not regular. Prove the same result using the Myhill-Nerode theorem.

Problem 5. Define $A = \{x \in \{a, b, \#\}^* : x$ contains an equal number of $a$’s and $b$’s or $x$ contains consecutive $\#$’s or consecutive letters$\}$.

(a) Can you use the pumping lemma to prove that $A$ is not regular? Explain.
(b) Prove that $A$ is not regular.

Problem 6. Are the following statements true or false? Either prove the statement or give a simple counter-example.

(a) If $L \cup L'$ is regular then $L$ and $L'$ are regular.
(b) If $L^*$ is regular then $L$ is regular.
(c) If $LL'$ is regular then $L$ and $L'$ are regular.
(d) If $L$ and $L'$ agree on all but a finite number of strings, then one is regular iff the other is regular.
(e) If $R$ is regular, $L$ is not regular, and $L$ and $R$ are disjoint, then $L \cup R$ is not regular.
(f) If $L$ differs from a non-regular language $A$ by a finite number of strings $F$, then $L$ itself is not regular.