CS476: Automata Theory and Formal Languages

Homework 1

Due: October 11, 2013 17.00

Questions

1. (12pts) State whether the following statements are true or not. You must give a **brief** explanation or show a counter example to receive full credit.

   (a) (3pts) If infinitely many subsets of a language are regular then the language itself is also regular.

   (b) (3pts) Any NFA with all accept states accepts Σ^*.

   (c) (3pts) r and s being regular expressions, $(rs + r)^* r = r(sr + r)^*$.

   (d) (3pts) With pumping lemma, we can prove that $L = \{w : w = 1\}$ is a regular language.

2. (16pts) Give a DFA for each of the following languages.

   (a) (8pts) $L = \{w \in \{0,1\}^* : (2n_0(w) + 2n_1(w)) \bmod 3 < 1\}$.

   (b) (8pts) $L = \{w \in \{0,1\}^* : w$, when read, as a binary number, is a multiple of $3\}$.

3. (16pts) Give an NFA for each of the following languages.

   (a) (8pts) $L = \{0101^n : n \geq 0\} \cup \{010^n : n \geq 0\}$.

   (b) (8pts) $L = \{w \in \{0,1,2\}^* :$ The leftmost symbol of w is not equal to any other symbol of $w\}$.

4. (16pts) Give a regular expression for each of the following languages.

   (a) (8pts) $L = \{0^m 1^n : m, n \geq 0, m + n$ is odd$\}$.

   (b) (8pts) $L = \{w \in \{0,1\}^* : n_0(w)$ and $n_1(w)$ are both even$\}$.

5. (20pts) Prove or disprove that the following languages are regular.

   (a) (10pts) $L = \{wu\overline{w} : w, u \in \{0,1\}^+, \overline{w}$ is the string obtained by taking bit-wise complement of $w\}$.

   (b) (10pts) $L = \{w1^n : |w| = n, w \in 0, 1^*\}$.

6. **Perl:** (20pts) *Perl* is a language with a lot of scripting capabilities. It provides powerful text processing facilities. In this exercise, you will use the regular expression capabilities of *Perl*. You will write a script such that given a file the script displays the following information about the strings in the file:

   (a) The number of strings that does not contain 110.

   (b) The number of strings that contains at least three 0s and at most two 1s.

   (c) The number of strings that ends with the two symbols that it starts with.

   (d) The number of strings that does not contain more than one occurence of the string 101. (The string 10101 should be viewed as containing two occurences of 101.)

   The alphabet is $\Sigma = \{0,1\}$; hence the strings are binary strings. The strings can be separated by any kind of whitespaces, i.e., tab, space, newline etc.

Answers for questions 1-5 should be returned in hard copy to your TA. The answer (perl script) for question 6 should be e-mailed to your TA at `acer@cs.bilkent.edu.tr`, with the subject line cs476hw1, as an attachment zip file named *NameSurname.zip* including NameSurname.pl. Good luck to all.