CS 311 ASSIGNMENT-3

Due date: **Friday, January 10th, 2003, 6:30pm**

But since we are having midterms this week therefore you can submit the assignment till **Monday, January 13th 2003 WITHOUT ANY PENALTY**

This assignment is to be done *individually*, you may only consult the TA or the Instructor.

**Question 1:**

a) The right quotient of two languages \(L_1\) and \(L_2\) is defined as:

\[ L_1 / L_2 = \{ x : xy \in L_1 \text{ for some } y \in L_2 \} \]

where \(L_1\) and \(L_2\) are languages on the same alphabet.

You have done an example on how to find the right quotient of two regular languages. In this part you are required to device a general algorithm that will find \(L_1 / L_2\) for any two regular languages \(L_1\) and \(L_2\).

b) Now that you have the algorithm for finding \(L_1 / L_2\) we define the left quotient as

\[ L_2 \setminus L_1 = \{ y : x \in L_1 , xy \in L_2 \} \]

where \(L_1\) and \(L_2\) are languages on the same alphabet.

In this part you are required to device a general algorithm that will find \(L_2 \setminus L_1\) for any two regular languages \(L_1\) and \(L_2\).

c) Now use the algorithms that you have deviced to find \(L_1 / L_2\) and \(L_1 \setminus L_2\) for the following languages.

\[ L_1 = L(r_1) \text{ where } r_1 = a^*ba^*b(a+b)^* \]

\[ L_2 = L(r_2) \text{ where } r_2 = a^*b^*baab \]

**Question 2:**

Using the pumping lemma or otherwise, *prove* that the language

\[ L = \{ a^m : m = n^3 \text{ for } n \geq 0 \} \]

is *irregular*.

**Question 3:**

Using the pumping lemma or otherwise, *prove* that the language

\[ L = \{ a^n : n \geq 2 \text{ and } n \text{ is a prime number} \} \]

is *irregular*. 

**Question 4:**

Write the regular expression for all words that DO NOT have the substrings bba and abb.

\[ S = \{a, b\} \]

**Question 5:**

Write the regular expression \( r \) for all strings \( w \) on \( \{0, 1\} \) such that \( w \in L(r) \) if and only if the value of the string, interpreted as a binary representation of an integer, is zero modulo five.