Automata and Computability (Mid Assignment)

Course Code: CSE331
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Problem 1.(30) $\Sigma = \{0, 1\}$

$L_1 = \{w : \text{the number of 0s in w is a multiple of three}\}$
$L_2 = \{w : \text{every 1 in w is followed by at least one 0}\}$
$L_3 = \{w : \text{w does not contain 01 as a substring}\}$
$L_4 = \{0^m : \text{ m} \geq 0\}$
$L_5 = \{1^n : \text{n is even}\}$
$L_6 = \{w : \text{length of w is two more than multiple of four}\}$
$L_7 = \{w : \text{every even position letter in w is different from first letter of w}\}$
$L_8 = \{w : \text{w doesn't contain 11}\}$
$L_9 = \{w : w = 0^m 1^n, \text{where } m, n \geq 0\}$
$L_{10} = \{w : 1 \text{ doesn't appear at any even position in } w\}$
$L_{11} = \{w : \text{length of w is exactly three}\}$
$L_{12} = \{w : \text{w starts and ends with different letters}\}$
$L_{13} = \{w : \text{w is divisible by 5 if it is treated like a binary number}\}$
$L_{14} = \{w : \text{w has equal number of '01' and '10'}\}$
$L_{15} = \{w : \text{the third last digit of w is 1}\}$
$L_{16} = \{w : \text{w ends with 010 and has 011 somewhere in the preceding}\}$

(a) Give the state diagram of DFA for L_1 to L_{14}.
(b) Give the state diagram of DFA for $L_1 \cap L2$
(c) Give the state diagram of DFA for $L_3 \cap (L_4 \circ L_5)$
(d) Give the state diagram of DFA for $L_9 \cap L_{10}$.
(e) Give the state diagram of NFA for L_{15} and L_{16}.

Problem 2(30) : For L_1 to L_8 $\Sigma = \{a, b\}$, for L_9 to L_{11} $\Sigma = \{0, 1\}$

$L_1 = \{w : \text{w contains no consecutive 'a'}\}$
$L_2 = \{w : \text{last two symbols of w are different}\}$
$L_3 = \{w : \text{if w starts with 'a', it contains exactly two b}\}$
$L_4 = \{w : \text{w contains no consecutive 'b'}\}$
$L_5 = \{w : \text{the first and last letters of w are 'a' and 'b' respectively}\}$
$L_6 = \{w : \text{every 'a' in w is followed by even number of b's}\}$
$L_7 = \{w : \text{w does not contain 'ab'}\}$
$L_8 = \{w : \text{'ab' appears in w exactly once }\}$
$L_9 = \{w : \text{length of w is exactly 3}\}$
$L_{10} = \{w : \text{the third last digit of w is 1}\}$
$L_{11} = \{w : \text{w contains at most two 00}\}$

(a) Give regular expressions for each of the above languages.(11 regular expressions)

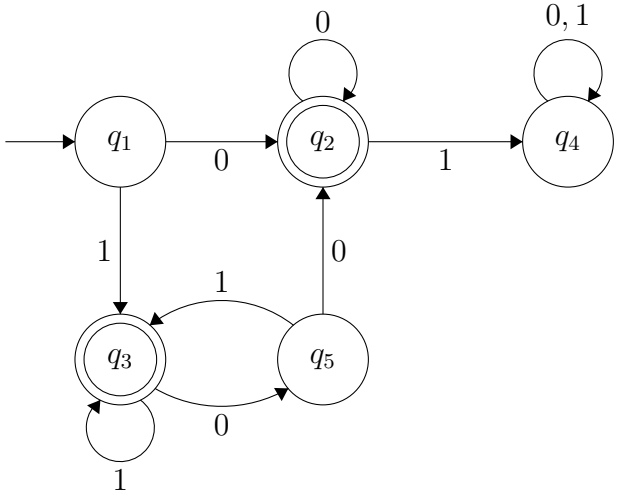
(b) Give a regular expression that generates $L_1 \cap L_4$

(c) Give a regular expression that generates $L_8 \cap L_4$

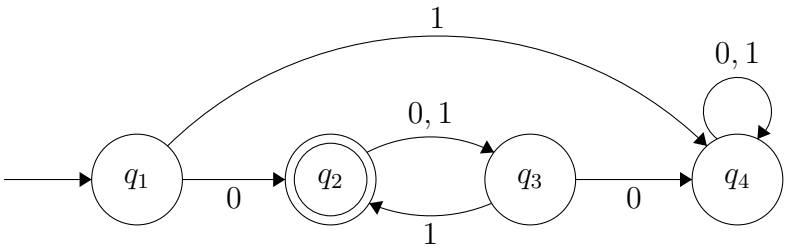
(d) Give a regular expression that generates $\overline{L_9^* \cap L_{10}}$.

Problem 3(20) :

(a) Convert the following finite automata into an equivalent regular expression using the state elimination method. You must eliminate q_2 first, then q_4, then q_3, and finally q_5. Show each step of the process.



(a) Convert the following finite automata into an equivalent regular expression using the state elimination method. You must eliminate q_2 first, then q_3, and finally q_4. Show each step of the process.



Problem 4(20) :

(a) Convert the following regular expression over $\Sigma = \{a, b, c\}$ into an equivalent NFA. Note that $R_1 + R_2$ is the same as $R_1 \cup R_2$.

$((ab + c)^* + bc^*)ac$

(b) Convert the following regular expression over $\Sigma = \{a, b\}$ into an equivalent NFA. Note that $R_1 + R_2$ is the same as $R_1 \cup R_2$.

$(bb + a^*b)^*a + b(aa)^*$