Assignment - 1

Total Marks: 150

Deadline: 20 November 2024, 11:59pm

1. **Draw a DFA for the following regular languages. [30 marks]**

   a. L = $\{w \in \{0,1\}^*, w \text{ contains exactly one "00" as a substring}\}$

   b. L = $\{w \in \{0,1\}^*, w \text{ contains even number of "0"s and odd number of "1"s}\}$

   c. L = $\{w \in \{0,1\}^*, \text{every 3rd symbol in } w \text{ is "1"}\}$

   d. L = $\{w \in \{a,b\}^*, w \text{ contains at least two "ab"s}\}$

   e. L = $\{w \in \{0,1\}^*, \text{length of } w \text{ is a multiple of 2 or 3}\}$

   f. L = $\{w \in \{0,1,2\}^*, \text{sum of the symbols in } w \text{ is a multiple of 3}\}$

   g. L = $\{w \in \{0,1\}^*, \text{the decimal equivalent of } w \text{ is a multiple of 5}\}$

   h. L = $\{w \in \{a,b\}^*, \text{each "b" in } w \text{ is followed by at least one "a"}\}$

   i. L = $\{w \in \{a,b,c\}^*, w \text{ is } a^l b^m c^n. \text{ where } l, m, n \geq 1\}$

   j. L = $\{w \in \{a,b\}^*, w \text{ contains } 01^m0 \text{ as a substring where}$
      $m \text{ leaves a remainder of 2 when divided by 3 }\}$

2. $L_1 = \{w \in \{0,1\}^*, w \text{ contains equal number of occurrences of substring "01" and "10"}\}$

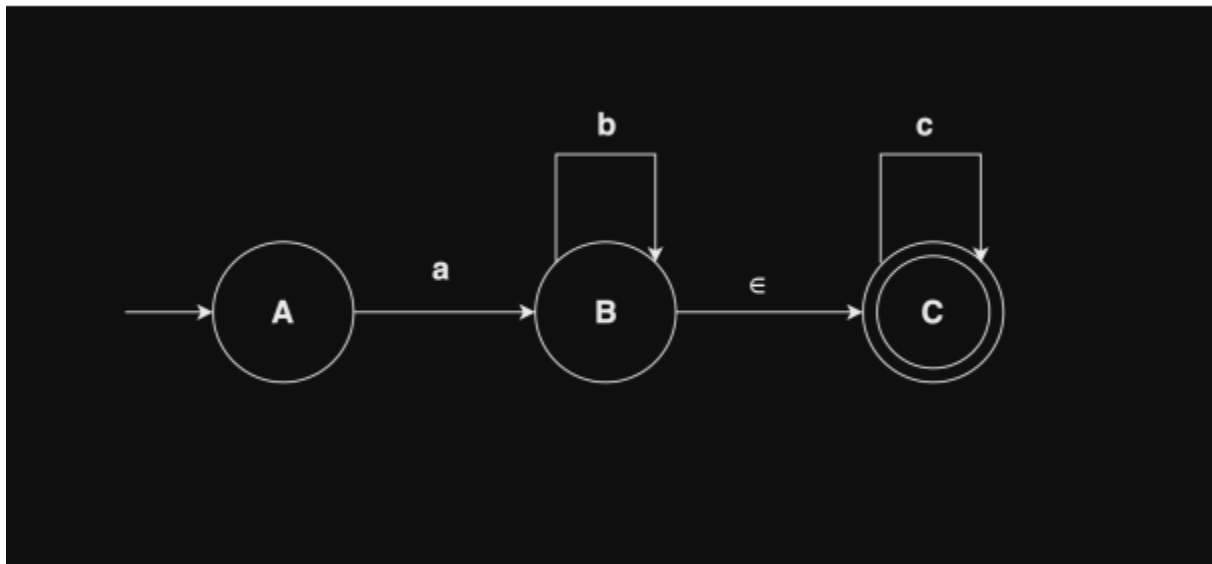 $L_2 = \{w \in \{0,1\}^*, \text{length of } w \text{ is odd}\}$

   Draw a DFA for the following regular languages. [30 marks]

   a. $L = L_1 \cup L_2$

   b. $L = L_1 \cap L_2$

   c. $L = L_1'$

   d. $L = L_2'$

   e. $L = (L_1 \cup L_2)'$

   f. $L = L_1 \cap L_2'$

3. **Draw an NFA for the following regular languages. [10 marks]**

   a. L = $\{w \in \{0,1\}^*, \text{3rd symbol of } w \text{ is "1"}\}$

   b. L = $\{w \in \{0,1\}^*, \text{3rd last symbol of } w \text{ is "1"}\}$

   c. L = $\{w \in \{x,y,z\}^*, w \text{ contains "xyz" as a substring}\}$

   d. L = $\{w \in \{x,y,z\}^*, w \text{ starts with "xyz"}\}$

   e. L = $\{w \in \{x,y,z\}^*, w \text{ ends with "xyz"}\}$

4. Convert NFA to DFA. [10 marks]

5. $L_1 = \{w \in \{0,1\}^*, w \text{ contains equal number of occurrences of substring "01" and "10"}\}$

$L_2 = \{w \in \{0,1\}^*, \text{ length of } w \text{ is odd}\}$

Draw a DFA for the following regular languages. [30 marks]

a. $L = L_1 \cup L_2$

b. $L = L_1 L_2$

c. $L = L_1 L_2$

d. $L = L_1^*$

e. $L = L_2^*$

f. $L = (L_1 L_2)^*$

6. Write a regular expression for the following regular languages. [30 marks]

a. $L = \{w \in \{0,1\}^*, w \text{ contains exactly one "00" as a substring}\}$

b. $L = \{w \in \{0,1\}^*, w \text{ contains equal number of occurrences of substring "01" and "10"}\}$

c. $L = \{w \in \{0,1\}^*, \text{ every 3rd symbol in } w \text{ is "1"}\}$

d. $L = \{w \in \{a,b\}^*, w \text{ contains at least two "ab"s}\}$

e. $L = \{w \in \{0,1\}^*, \text{ length of } w \text{ is a multiple of 2 or 3}\}$

f. $L = \{w \in \{0,1\}^*, \text{ sum of the symbols in } w \text{ is a multiple of 3}\}$

g. $L = \{w \in \{0,1\}^*, \text{ the decimal equivalent of } w \text{ is a multiple of 2}\}$

h. $L = \{w \in \{a,b\}^*, \text{ each "b" in } w \text{ is followed by at least one "a"}\}$

i. $L = \{w \in \{a,b,c\}^*, w \text{ is } a^l b^m c^n. \text{ where } l, m, n \geq 1\}$

j. $L = \{w \in \{a, b\}^*, w$ contains 01^m0 as a substring where m leaves a remainder of 2 when divided by 3 $\}$

7. Convert regular expressions to NFA. [10 marks]
   a. 1 0 (0 1 + 0)*
   b. (0 + 0 1* 0)* 0 1* 0