

CSE331: Automata and Computability

Fall'24 | Assignment 1

Deadline: 21st November, 2024

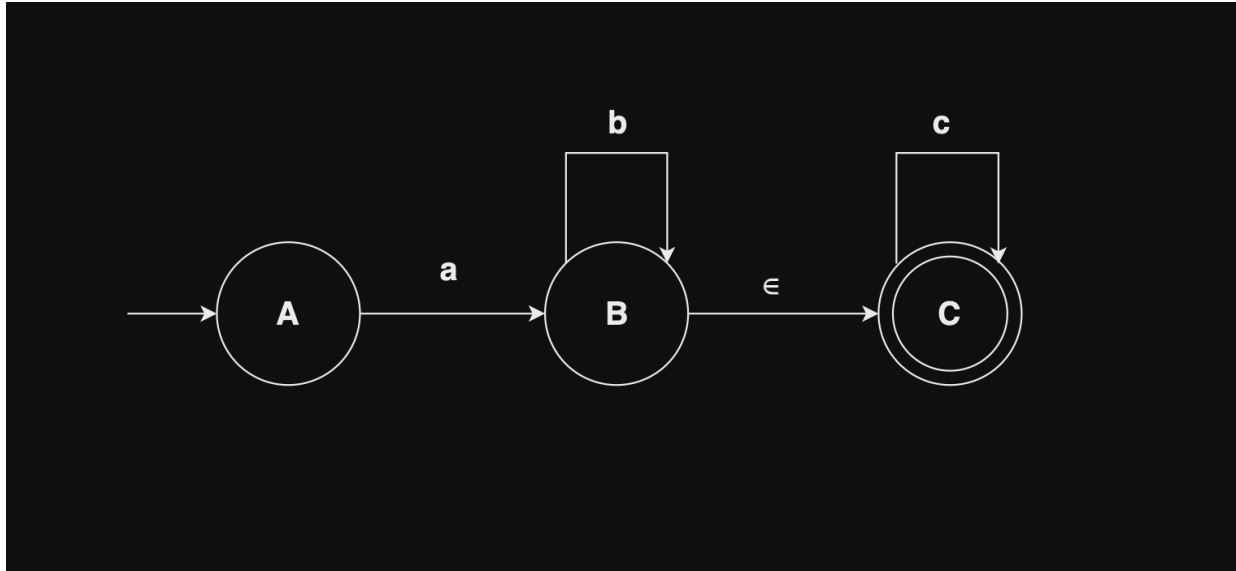
Question 1 [45 marks]

Draw state diagram for a DFA of the following regular languages:

- A. $L_1 = \{w \in \text{string that has "b" in the second last digit}\}, \Sigma = \{a, b\}$
- B. $L_2 = \{w \in \text{a string starts with 'ba' and contains 'bba'}\}, \Sigma = \{a, b\}$
- C. $L_3 = \{w \in \text{a binary string that is divisible by 4}\}, \Sigma = \{0, 1\}$
- D. $L_4 = \{w \in \text{a string has even number of 0s}\}, \Sigma = \{0, 1\}$
- E. $L_5 = \{w \in \text{a string ends with "11"}\}, \Sigma = \{0, 1\}$
- F. $L_6 = L_4 \cap L_5$, *by using cross-product rule*, $\Sigma = \{0, 1\}$
- G. $L_7 = \{w \in \text{a string where 0 is followed by at least one 1}\}, \Sigma = \{0, 1\}$
- H. $L_8 = \{w \in \text{a string which contains of odd length}\}, \Sigma = \{0, 1\}$
- I. $L_9 = L_7 \cap L_8$, $\Sigma = \{0, 1\}$
- J. $L_{10} = \{w \in \text{A string has substring of '101'}\}, \Sigma = \{0, 1\}$
- K. $L_{11} = \{w \in \text{start and ends with same symbol}\}, \Sigma = \{0, 1\}$
- L. $L_{12} = L_{10} \cap \overline{L_{11}}, \Sigma = \{a, b\}$
- M. $L_{13} = \{w \in \{0, 1\} \mid w \text{ ends with 0 and does not contain the substring 11}\}$
- N. $L_{14} = \{w \in \{a, b\} : w \text{ length of } w \text{ is multiple of 3} \cap \text{contains at least two a's}\}$
- O. $L_{15} = \{w \in \{a, b\} : w \text{ a string contains 'ab' } \cup \text{contains 'ba'}\}$

Question 2 [10 marks]

Convert this ϵ -NFA to DFA. Show required steps.



Question 3 [15 marks]

Draw state diagram for a NFA of the following regular languages:

- A. $L_1 = \{w \in \text{a string that contains 'aba'} \cap \text{ends with 'aab'}\}, \Sigma = \{a, b\}$
- B. $L_2 = \{w \in \text{starts with 'a'} \cap \text{the string ends with 'a' or, 'b'}\}, \Sigma = \{a, b\}$
- C. $L_3 = \{w \in \text{a string where third last symbol is 'b'}\}, \Sigma = \{a, b\}$
- D. Convert language, L_3 into its representative DFA
- E. $L_4 = \{w \in \{a, b\} : w \text{ length of } w \text{ is multiple of } 3 \cup w \text{ length of } w \text{ is multiple of } 4\}$

Question 4 [30 marks]

Let $\Sigma = \{0, 1\}$. Give regular expressions generating each of the following languages over Σ .

- (a) $\{w : w \text{ starts with a 1 and ends in a 0}\}$
- (b) $\{w : \text{the length of } w \text{ is even}\}$
- (c) $\{w : \text{every 1 in } w \text{ is followed by an even number of 0s}\}$
- (d) $\{w : w \text{ does not contain } 10\}$
- (e) $\{w : 10 \text{ appears in } w \text{ exactly once}\}$
(Hint: If $w = x10y$, what can you say about x and y ?)
- (f) $\{w : w \text{ containing strings where 0's and 1's are alternate}\}$
- (g) $\{w : w \text{ containing strings where every third position in } w \text{ is 1}\}$
- (h) $\{w : w \text{ containing strings where every 1 in } w \text{ is followed by at least two 0}\}$
- (i) $\{w : w \text{ containing strings where every third position in } w \text{ is 1} \cap \text{every 1 in } w \text{ is followed by at least two 0}\}$
- (j) $\{w : w \text{ containing strings that end in three consecutive 1's}\}$