**In20-S4-CS3063 – Theory of Computing**

# Assignment 01

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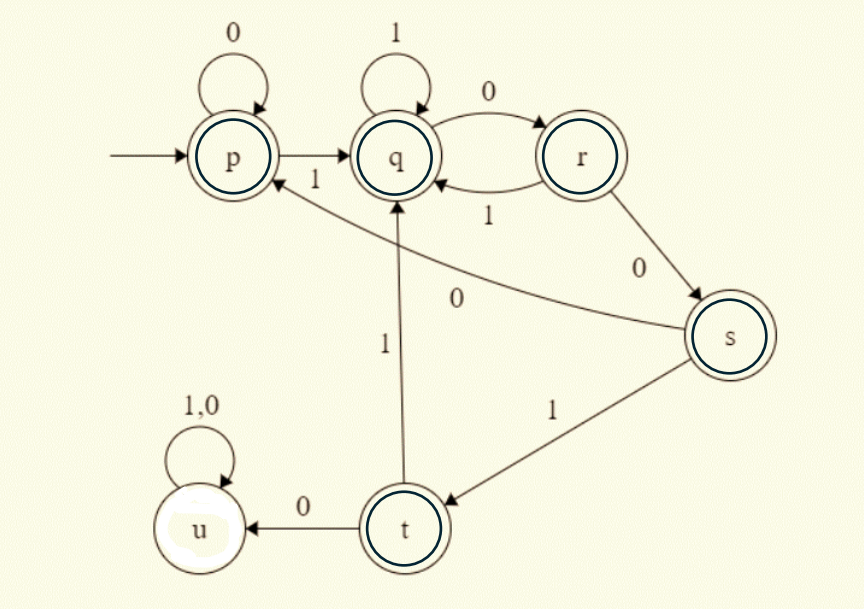
QUESTION 01

a) The regular expression for the given DFA is (0|1)*10010(0|1)* . In simple terms, the language L1 consists of all strings that:
   - Start with any combination of 0s and 1s including none at all, denoted by the "*".
   - Followed by the sequence "10010".
   - Ends with any combination of 0s and 1s including none at all, again denoted by "*".

   So essentially L1 is a string containing the sequence "10010". For example, "10010", "0110010", "0100100110".

b) L2 contains all strings over the alphabet Σ that are not in L1. That means any string which doesn't contain the sequence "10010".
   Eg. "11010", "110", "11111"

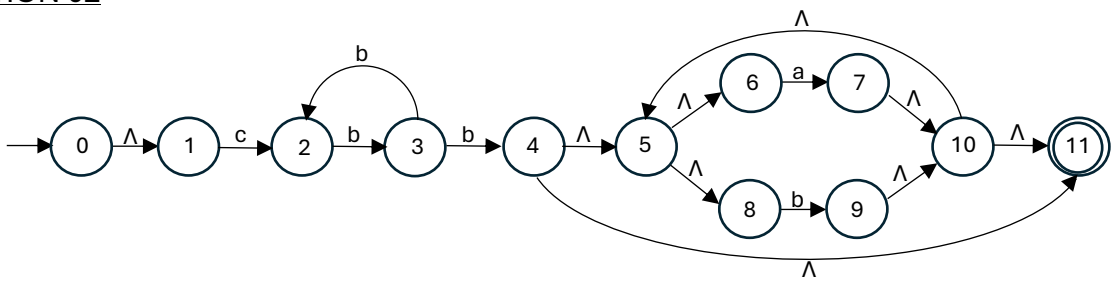
c) To get the complement of a DFA we need to change the Final states to non-final states and vice-versa.



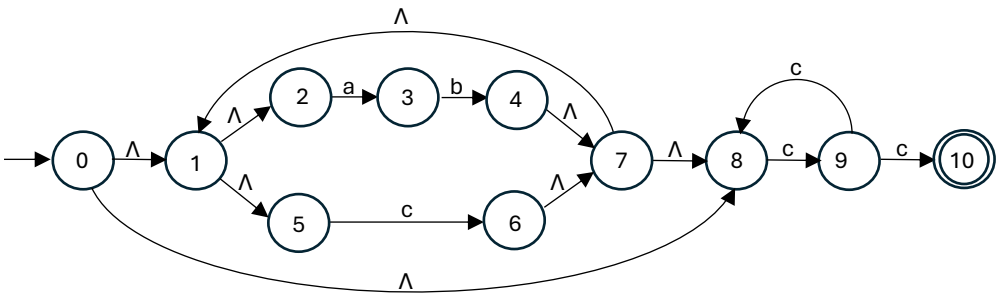
QUESTION 02

a)

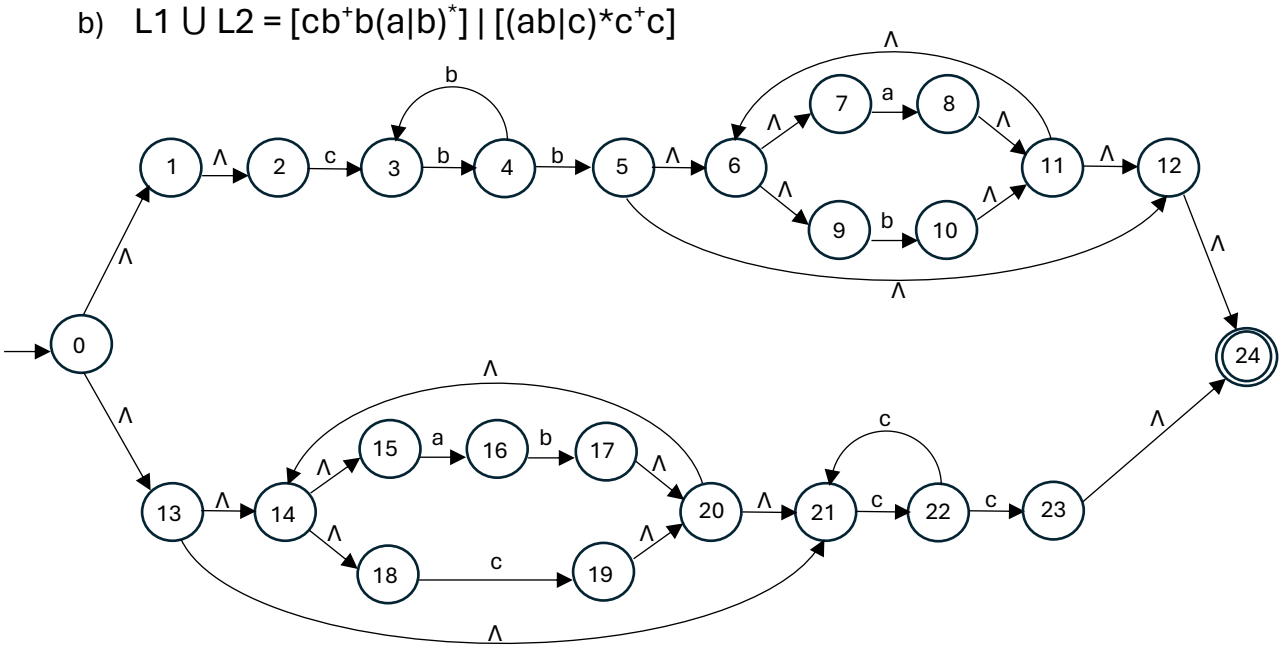
i)




ii)

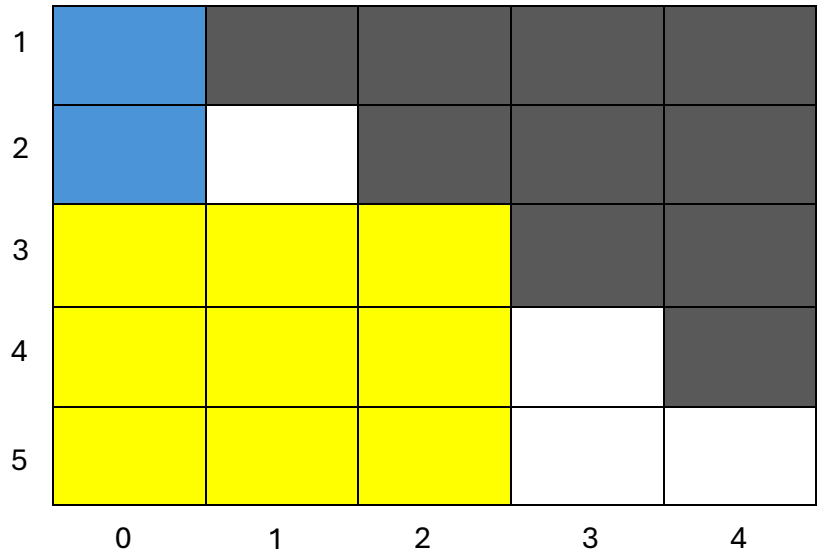



b) $L1 \cup L2 = [cb^{+}b(a|b)^{*}] \mid [(ab|c)*c^{+}c]$



QUESTION 03

a) Yellow – 1st Pass
Blue – 2nd Pass
No 3rd Pass



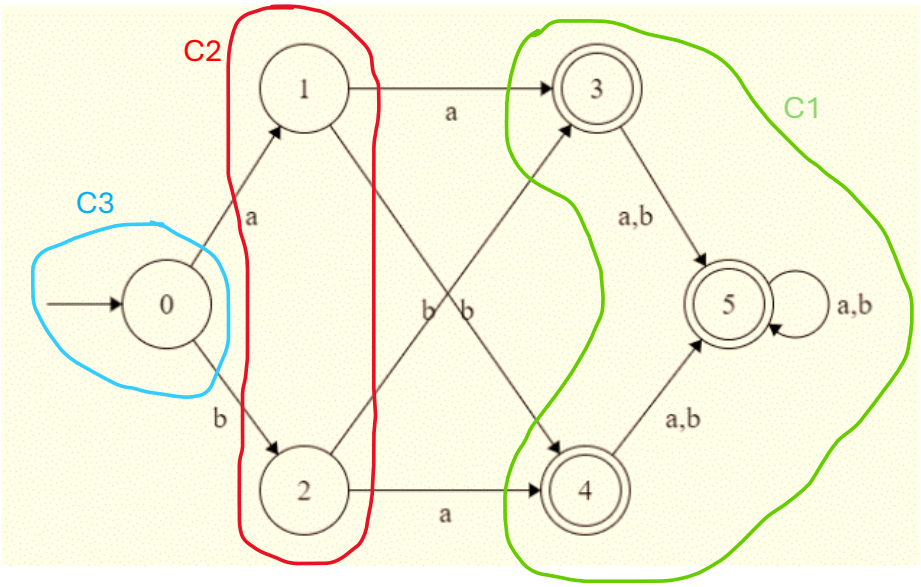

Equivalence Classes;

**{3,4,5}**

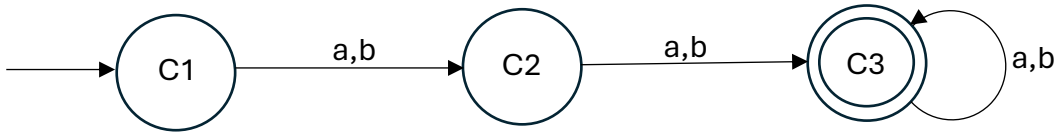
**{1,2}**

**{0}**

b)



Transition Diagram for minimized DFA



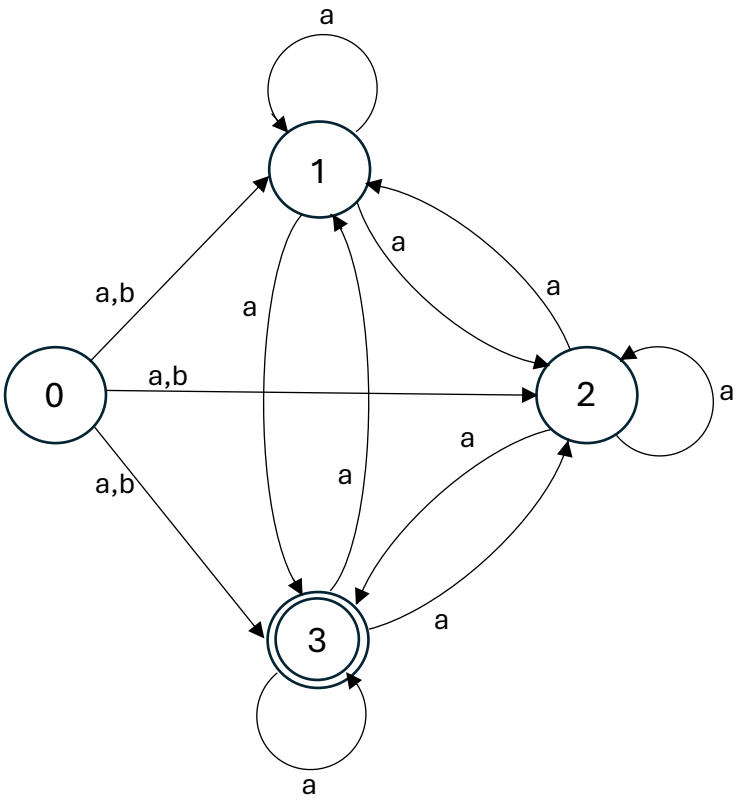

c) It will accept a or b (a|b) and another a or b (a|b) and anything afterwards $(a|b)^*$. This means it will accept any string of length >= 2 for the given language.

**Regular Expression : (a|b)(a|b)(a|b)* or (a|b)(a|b)+**

QUESTION 04

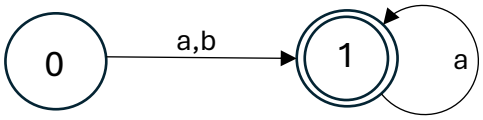
a)

| q | δ(q, Λ) | δ(q, a) | δ(q, b) | $\delta^*$(q, a) | $\delta^*$(q, b) |
|---|---|---|---|---|---|
| 0 | Ø | {1} | {3} | {1,2,3} | {1,2,3} |
| 1 | {2,3} | Ø | Ø | {1,2,3} | Ø |
| 2 | Ø | {3} | Ø | {1,2,3} | Ø |
| 3 | {1} | Ø | Ø | {1,2,3} | Ø |



b)

| q | $\delta^*(q, a)$ | $\delta^*(q, b)$ |
|---|---|---|
| {0} | {1,2,3} | {1,2,3} |
| {1,2,3} | {1,2,3} | Ø |




QUESTION 05

## a) $(a|bab^*a|bb)^*b$

$P \to aP \quad Q \to aR \quad R \to aP$
$\to bQ \quad \to bP \quad \to bR$
$\to \Lambda$

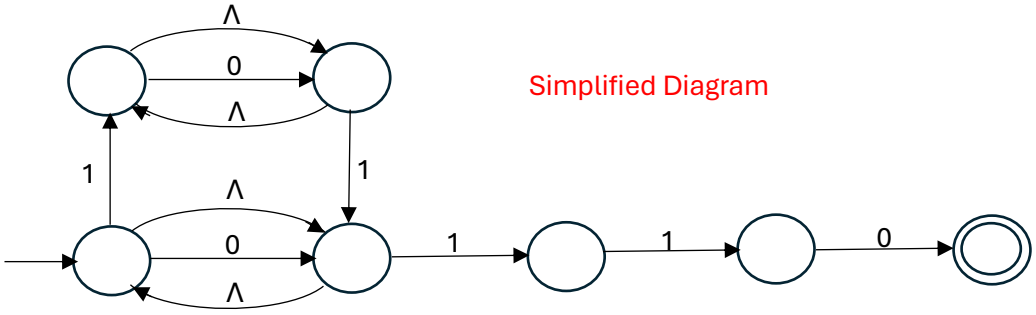
$R = aP + bR = b^*aP$
$Q = aR + bP + \Lambda = ab^*aP + bP + \Lambda = (ab^*a + b)P + \Lambda$
$P = aP + bQ$
$= aP + b\big((ab^*a + b)P + \Lambda\big)$
$= (a + bab^*a + bb)P + b$
$= (\boldsymbol{a|bab^*a|bb})^*\boldsymbol{b}$

## b) $(a|ab^+|b^+ab^*)a$

$0 \to a2 \quad 1 \to a3 \quad 2 \to a \quad 3 \to a$
$0 \to b1 \quad 1 \to b1 \quad 2 \to b3 \quad 3 \to b3$

$3 = a + b3 = b^*a$
$2 = a + b3 = a + bb^*a$
$1 = a3 + b1 = ab^*a + b1 = b^*ab^*a$
$0 = a2 + b1 = a(a + bb^*a) + b(b^*ab^*a)$
$= (aa|abb^*a|bb^*ab^*a)$
$= (\boldsymbol{a|ab^+|b^+ab^*})\boldsymbol{a}$

## c) $(10^*1|0)^*110$




Simplified Diagram

QUESTION 06

INPUT / OUTPUT