ROLL NO.: 200225014 0017

Serial No.	Date	Title

FIRST SESSIONAL EXAM - May 2021 Date 10-5-21

SUBJECT - Theory of Automata

SECTION - A

[Answer - 1]

Difference b/w DFA & NDFA

DFA	NDFA
It stand for Deterministic finite automata.	* It stand for Non-Deterministic finite automata
DFA require more space.	* NDFA require less space.
The transition takes place from a state to a single particular state for each input symbol.	* for each input symbol, the transition can be to multiple next states.
There are no empty string transition in DFA. Ex- $\delta : Q \times \Sigma \rightarrow Q$	* Empty string transition are also permitted. Ex- $\delta : Q \times \Sigma \rightarrow 2^Q$

[Answer - 2]

Step-1: Suppose L is regular. Let n be the number of states in FA.

Step 2: Let P be a prime number greater than n.

Let $w = a^P$ by pumping lemma

$|w| = |a^P|$

$|w| = P > n$

[Answer - 11]

1: Let $\omega = a^n b^n c^{3n}$
Suppose L be the regular.. let n be the num of states in FA.

2- Let $\omega = a^n b^n c^{3n}$

$|\omega| = n + n + 3n$

$= 5n > n$

using P.L

$\omega = xyz$ with $|xy| \leq n$ & $|y| > 0$

now

$\omega = xyz = a^n b^n c^{3n}$

$xyz = a^n b^n c^k c^{3n-k}$ $k > 0$

$x = a^n b^n$

$y = c^k$

$z = c^{3n-k}$

ep-3: Let $i = 0$

$xy^i z = xy^0 z$

$= a^n b^n c^{3n-k}$

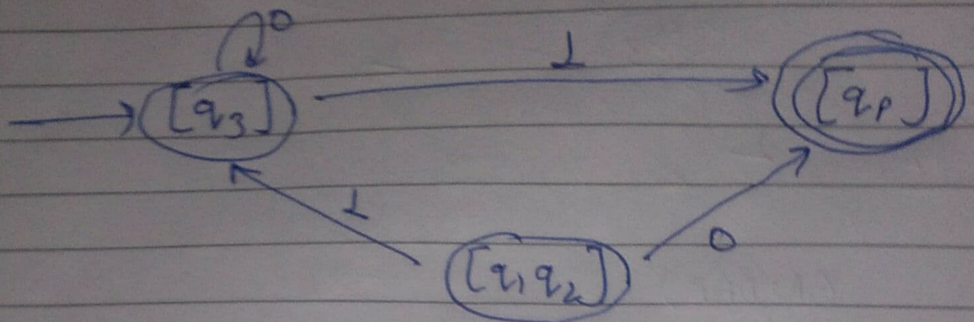
$|xy^i z| = n + n + 3n - k$

$= 5n - k \neq 5n$

$\therefore$ $xy^i z \notin L$ hence by contradiction

$L = \{a^i b^j c^k : k > i + j\}$ isn't regular.

The Transition Diagram



Answer - 12(b)

L.H.S -

$(1+00^*1)+(1+00^*1)(0+10^*1)^*(0+10^*1)$

Using $I_{12} \rightarrow (1+00^*1)(\Lambda+(0+10^*1)^*(0+10^*1))$

now,

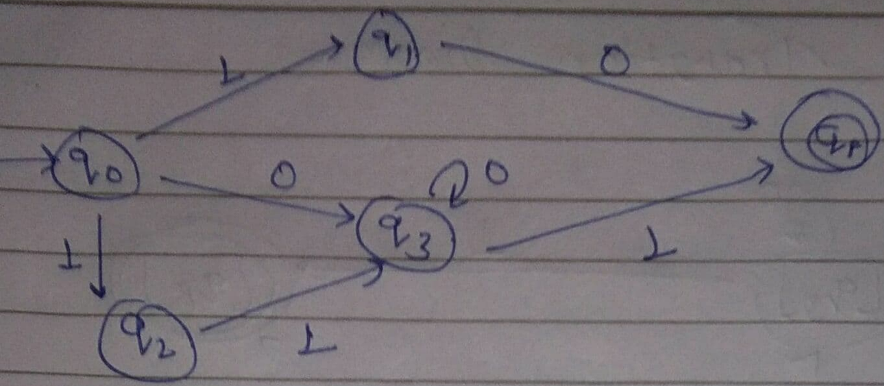
using $I_9 \rightarrow (1+00^*1)(0+10^*1)^*$

$= (\Lambda+00^*)1(0+10^*1)^*$ using I_{12} for

$1+00^*1$

$\Rightarrow \boxed{0^*1(0+10^*1)^*}$ using I_9

LHS = RHS



(NDFA)

Transition Table

State	0	1
→ q_0	q_3	q_1, q_2
q_1	q_F	–
q_2	–	q_3
q_3	q_3	q_F
q_F	–	–

$M' = \{Q', \Sigma', \delta', q_0, F\}$

where

$Q' = \{[q_3]\ [q_1 q_2]\ [q_F]\}$

$\delta' = \{0, 1\}$

$q_0 = [q_0]$

$F = [q_F]$

The Transition Table for DFA

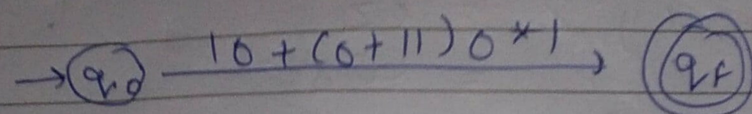
State	0	1
$[q_3]$	$[q_3]$	$[q_F]$
$[q_F]$		
$[q_1, q_2]$	$[q_F]$	$[q_3]$

[Answer - 10]

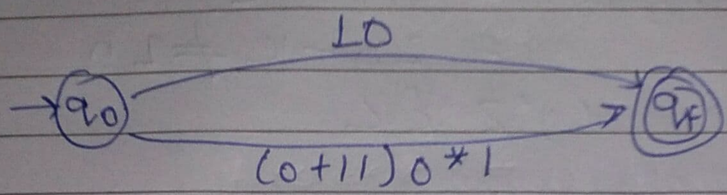
Q. Construct a DFA .... expression

$10 + (0+11)0^*1$

Solution:-



(2)



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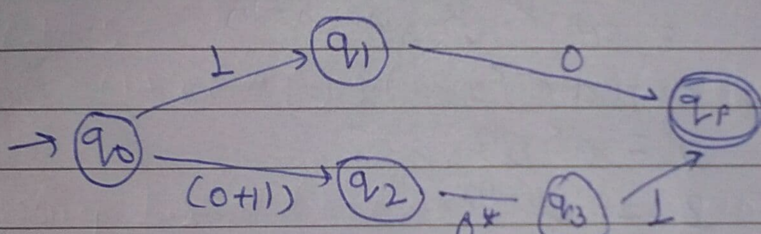

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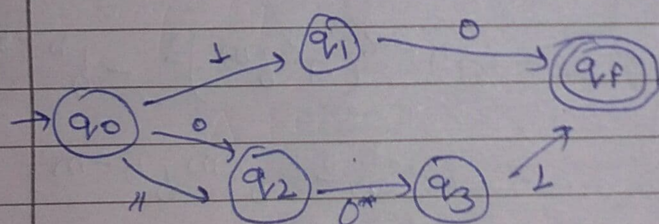

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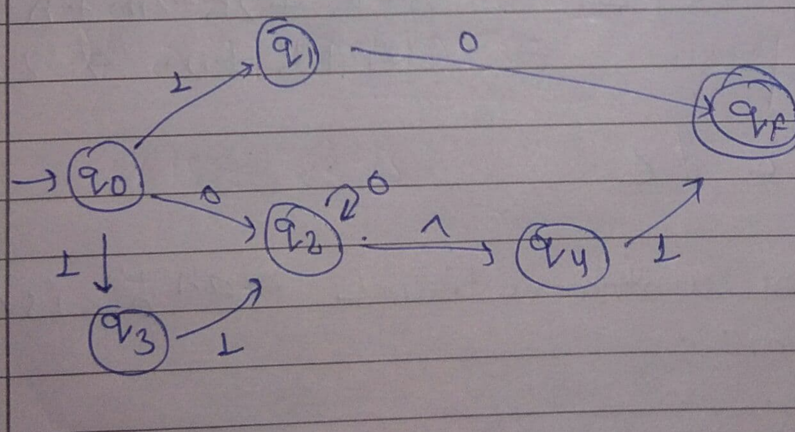


(6) Remove Λ

$x = a^n$
$y^i = b^k$
$z = b^{n-k}$

for $i = 0$,

$xy^0z = xz$
$= a^n b^{n-k}$
$|xy^0z| = n + n - k$
$= 2n - k \neq 2n$
$\therefore xy^iz \notin L$

3: $xy^iz = a^n b^n$
$= a^{n-k} a^k b^m b^{n-m}$
$x = a^{n-k}$
$y^i = a^k b^m$
$z = b^{n-m}$

for $i = 2$

$xy^2z = a^{n-k}(a^k b^m)^2 - b^{n-m}$

$= a^{n-k} a^{2k} b^{2m} b^{n-m}$

$|xy^2z| = n - k + 2k + 2m + n - m$
$= 2n + k + m \neq 2n$

$\therefore xy^iz \notin L$

hence by contradiction $L = a^n b^n$ is not regular.

$b = \{a^n b^n, n \geq 1\}$ isn't a regular.

Section B

(Answer – 6)

Step-1: Suppose L is a regular. Let n be the num of state in the FA.

Step-2: Let $\omega = a^n b^n$, then

$|\omega| = n + n = 2n > n$

using pumping lemma

$\omega = xyz$ with $|xy| \le n$ & $|y| > 0$

Step-3: find suitable integer

$xy^iz \notin L$

Let $xy^iz = a^n b^n$

here 3 cases arise -

CASE 1: $xy^iz = a^{n-k} a^k b^n$

$x = a^{n-k}$

$y = a^k$

$z = b^n$

for $i = 0$

$xy^0z = xz$

$= a^{n-k} b^n$

$|xy^0z| = |a^{n-k}| + |b^n|$

$= n - k + n$

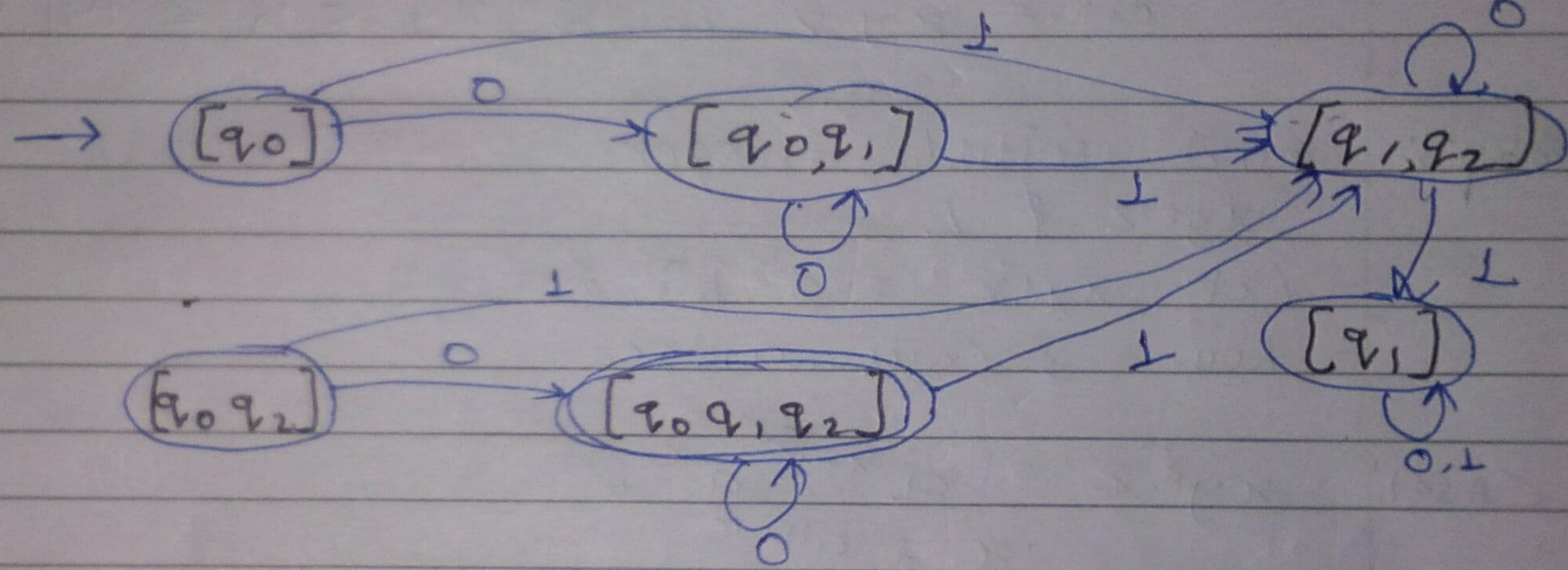
$= 2n - k \neq 2n$

$\therefore xy^iz \notin a^n b^n \Rightarrow xy^iz \notin L.$

CASE-2: $xy^iz = a^n b^k b^{n-k}$ $\quad k > 0$

$[q_0, q_2]$	$[q_0, q_1, q_2]$	$[q_1, q_2]$
$[q_0 q_1 q_2]$	$[q_0 q_1 q_2]$	$[q_1 q_2]$

Transition Diagram



Comparison Table

States (q, q')	c (q_c, q_c')	d (q_d, q_d')
(q_1, q_4) (q_2, q_5)	(q_1, q_4) (q_3, q_1)	(q_2, q_5) (q_1, q_6)

here, q_1 & q_6 are de reachable from q_2 & q_5 respectively.

[Answer - 5]

state	0	1
$\rightarrow q_0$	$q_0 q_1$	$q_1 q_2$
q_1	q_1	q_1
q_2	q_2	–

Solution:- Let $M' = \{ Q', \Sigma', \delta', q_0, F' \}$ be the NDPA equivalent to DFA.

$Q' = 2^3 = \{ \phi, [q_1] [q_0] [q_2], [q_1 q_2] [q_0 q_1] [q_0 q_2] [q_1 q_0 q_2] \}$

$\Sigma' = \{0, 1\}$
$q_0 = [q_0]$
$F' = \{ [q_2], [q_1, q_2], [q_0 q_2], [q_0 q_1 q_2] \}$

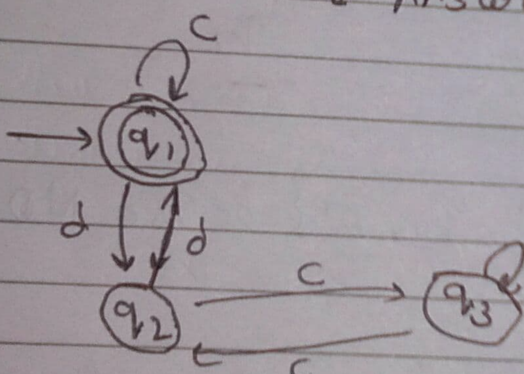
δ : Transition Table

⇒ aabbabS
⇒ aabbabbA   S → bA
⇒ aabbabba   A → a

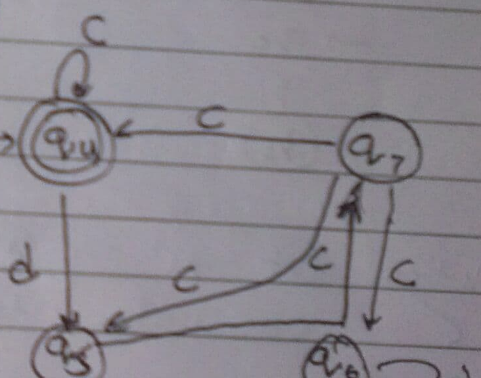
Right most Derivation

S ⇒ aB
⇒ aaBB   B → aBB
⇒ aaBbS   B → bS
⇒ aaBbbA   S → bA
⇒ aaBbba   A → a
⇒ aabSbba   B → bS
⇒ aabbAbba   S → bA
⇒ aabbabba   A → a

[Answer-4]



(a) M



(b) M'

→ The initial states in M & M' are q_1 & q_4, respectively.
The final state in M & M' are q_1 & q_4 repectively.
The first element of the first column in the comparison table is (q_1, q_4).
q_2 & q_5 are d-reachable from q_1 & q_4.

$w = xyz$ with $|xy| \leq n$ & $|y| \geq 0$

now

$w = xyz = a^P = a^{P-m-n} a^m a^n$

$x = a^{P-n-m}$, $y = a^m$, $z = a^n$

Step-3: Let $i = P+1$ then

$xy^iz = xyz * y^{i-1}$

$|xy^iz| = |xyz| + |y^{i-1}|$

$= |a^P| + |y^{i-1}|$

$= P + |(a^m)^{P+1-1}|$

$= P + Pm$

$|xy^iz| = P(1+m)$

Since P is prime but $P(1+m)$ isn't a prime num.

so $xy^iz \notin L$ hence by contradiction

$L = \{a^P = P \text{ is prime}\}$ is not regular.

[Answer-3]

Consider the CFG

$S \rightarrow aB \mid bA$

$A \rightarrow a \mid aS \mid bAA$

$B \rightarrow b \mid bS \mid aBB$

Solve- i) Left most Derivation

$S \Rightarrow a\underline{B}$	$B \rightarrow aBB$
$\Rightarrow aa\underline{B}B$	$B \rightarrow b$
$\Rightarrow aab\underline{B}$	$B \rightarrow bS$
$\Rightarrow aabb\underline{S}$	$S \rightarrow aB$
$\Rightarrow aabba\underline{B}$	$B \rightarrow bS$