6) TM to recoguise ~~odd length palindrome~~

$L = \{ w c w^R \mid w \in \{0,1\}^* \}$

e.g. 100c001.

	0	1	c	B
q_0	$(q_0, 0, R)$	$(q_0, 1, L)$	(q_0, c, L)	(q_1, B, R)
q_1	(q_2, B, R)	(q_4, B, R)	(q_6, B, R)	–
q_2	$(q_2, 0, R)$	$(q_2, 1, R)$	(q_2, c, R)	(q_3, B, L)
q_3	(q_0, B, L)	–	–	–
q_4	$(q_4, 0, R)$	$(q_4, 1, R)$	(q_4, c, R)	(q_5, B, L)
q_5	–	(q_0, B, L)	–	–
q_6	~~F.S~~ –	–	–	(q_7, B, R)
q_7	F.S.			

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TM

(7) Which compares two unary numbers a & b & if a<b writes 'l' at end if a=b writes 'e' at end & if a>b writes 'g' at end.

	1	;	X	B
q_0	(q_1, X, R)	$(q_5, ;, R)$	–	
q_1	$(q_1, 1, R)$	$(q_2, ;, R)$	–	
q_2	(q_3, X, L)	–	(q_2, X, R)	$(q_7,$
q_3	–	$(q_4, ;, L)$	(q_3, X, L)	
q_4	$(q_4, 1, L)$	–	(q_0, X, R)	
q_5	$(q_6, 1, R)$	–	(q_5, X, R)	$(q_7,$
q_6	$(q_6, 1, R)$	–	–	$(q_7,$
q_7	F.S.			

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(8) Design TM to find $\log_2 n$ ..

$\log_1 2 = 1$ $\log_2 4 = 2$ $\log_2 8 = 3$.

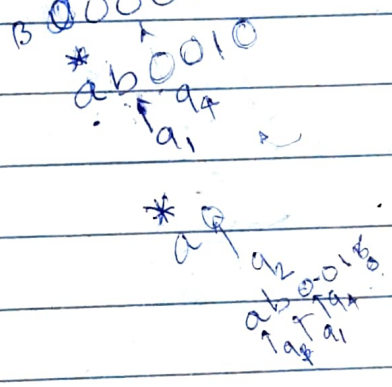
$\log_2 4 = 2$.

B00001B.
 **

B*0001B
 ab 0

B**0010B
 aabb 0

B****100.



	0	1	*	a	b	B
q_0	$(q_1, *, R)$	-	-	-	-	-
q_1	-	-	(q_2, a, R)	-	(q_4, b, R)	-
q_2	(q_3, b, L)	$(q_f, 1, R)$	$(q_2, *, R)$	-	(q_2, b, R)	-
q_3	-	-	$(q_3, *, L)$	(q_1, a, R)	(q_3, b, L)	-
q_4	$(q_4, 0, R)$	$(q_4, 1, R)$	-	-	(q_4, b, R)	$(q_5, 0, L)$
q_5	$(q_5, 0, L)$	$(q_5, 1, L)$	-	(q_5, a, L)	(q_5, b, L)	(q_1, B, R)
q_f	Final state					

000000001
 **

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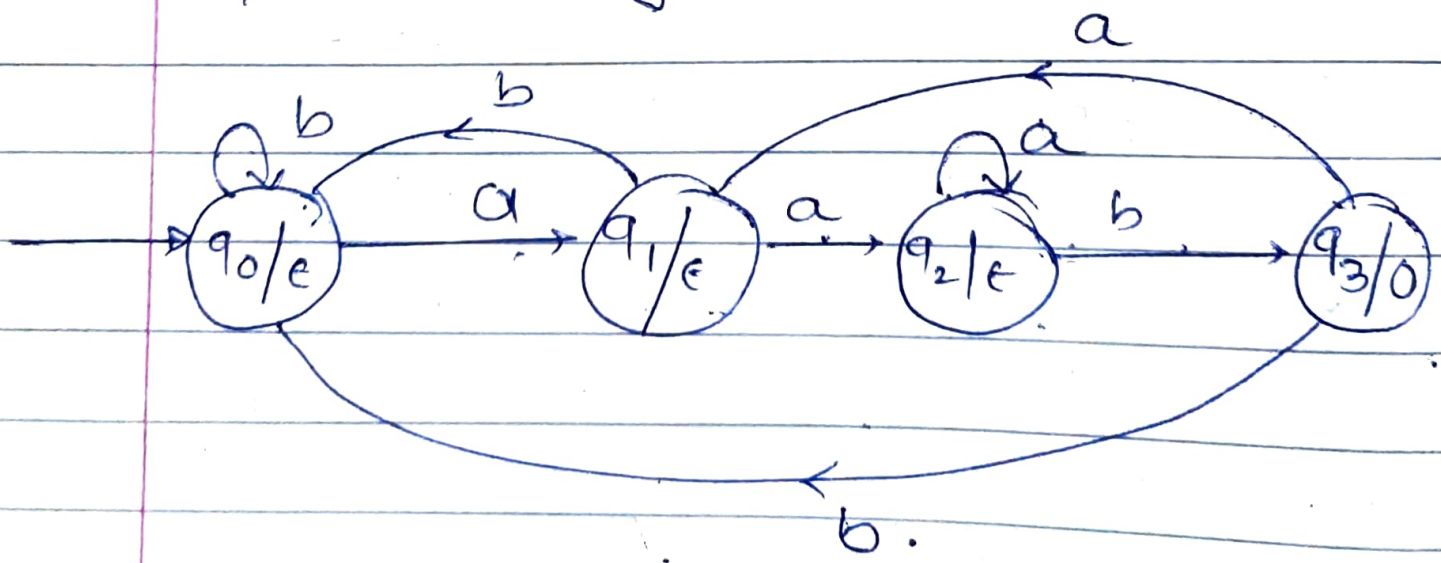
Nov. '04.

Q. Design Moore m/c to count the no. of times the substring "aab" appears in i/p in unary.



e.g. i/p ⇒ aaabbaab.

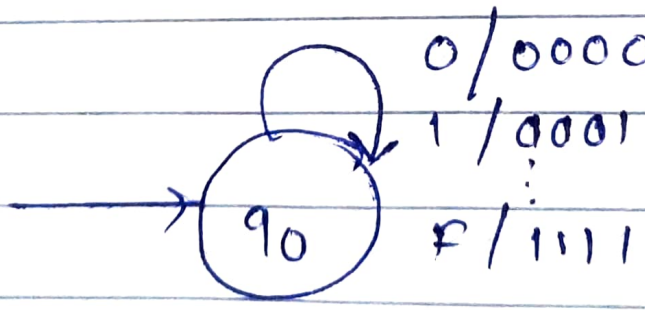
o/p ⇒ $\epsilon\epsilon\epsilon 0\epsilon\epsilon\epsilon 0$

June '06

Q. Design Mealy m/c to convert HEX to

Logic: 1) Convert HEX to Binary
2) Binary to Octal.

step 1)



Hex to Binary.

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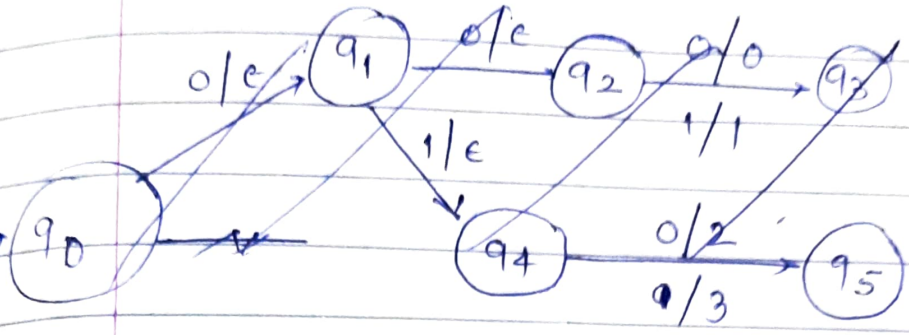
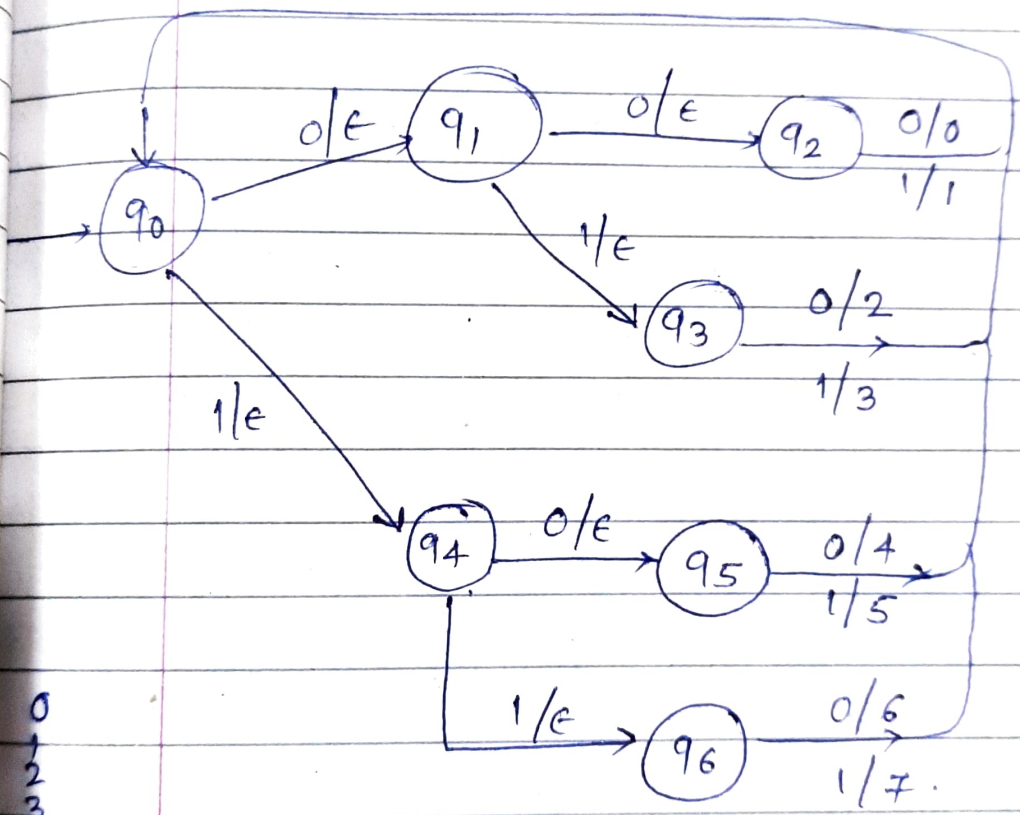
Step 2: Binary to Octal





0
1
2
3
4
5
6
7
8
9
A 1010
B 1011
1100
1101
1110
1111

0 (##)
0000 1111
0 8
(0 1 7)$_8$

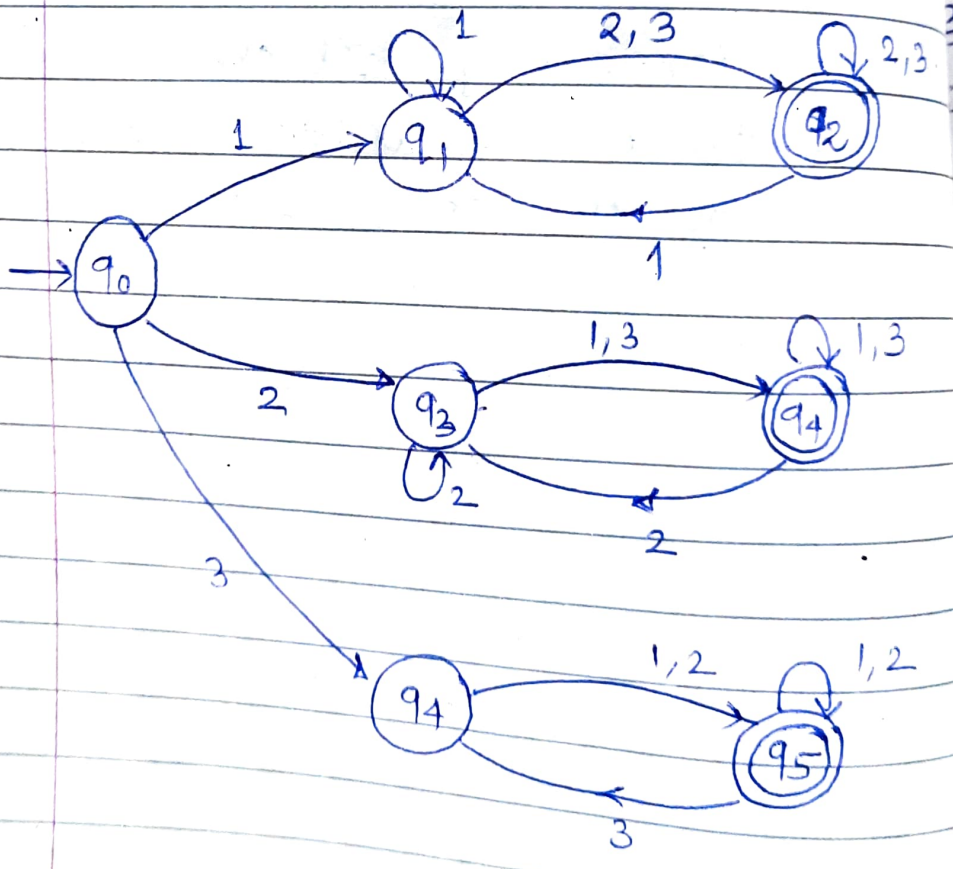
(A)
0001 1010.
0 7 2

DFA :-

Q. Construct DFA for accepting following language :-

① $L = \{ x \in \{1,2,3\}^* \mid x$ begins & e
with different symb

Soln :-



Q. Construct dfa accepting languages of all legal infix arithmetic expressions over alphabet $\Sigma = \{a, b, +, -, *, /\}$.

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Some legal arithmetic expressions using precedence rules are:-

a, a, b, a+b, a-b, a * b, a/b+c, etc

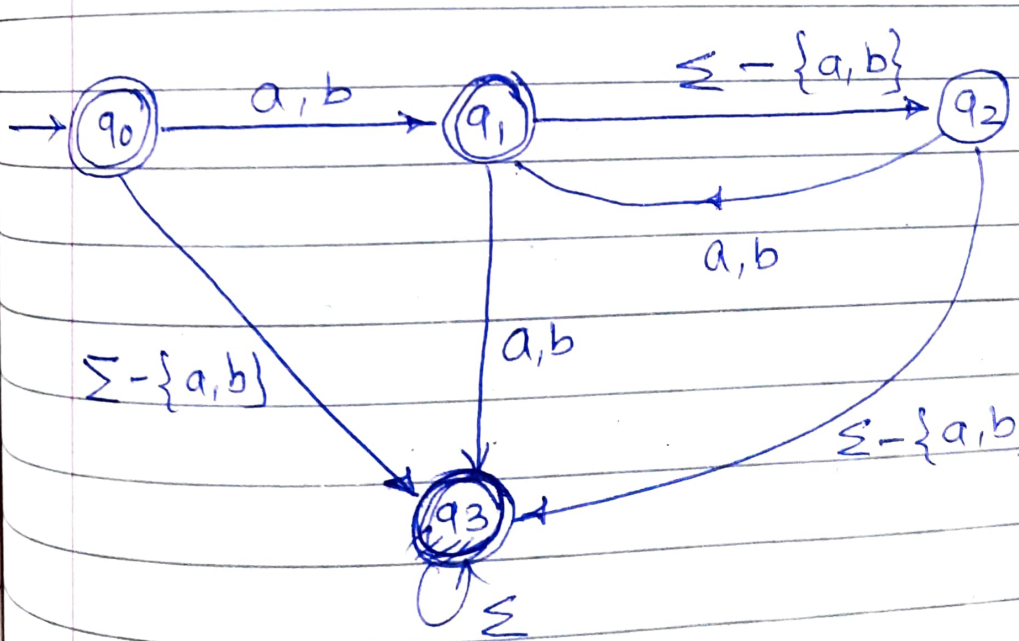
+a-b, *b/a, */ab etc are invalid infix expressions.

3 cases:-

First input symbol cannot be any of operators +, *, *, -.

There can not be more than one occurance of 2 operands & 2 operators together.

$$\Sigma = \{a, b, *, +, -, /\}.$$



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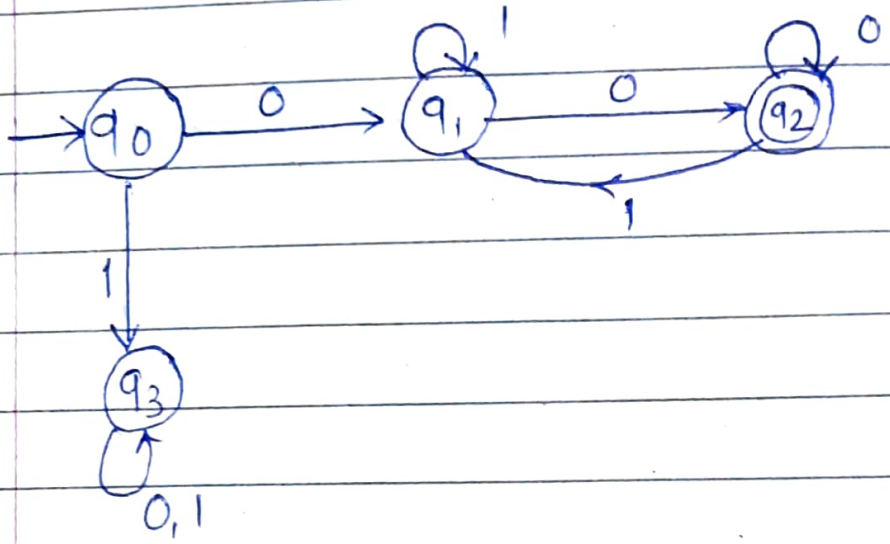
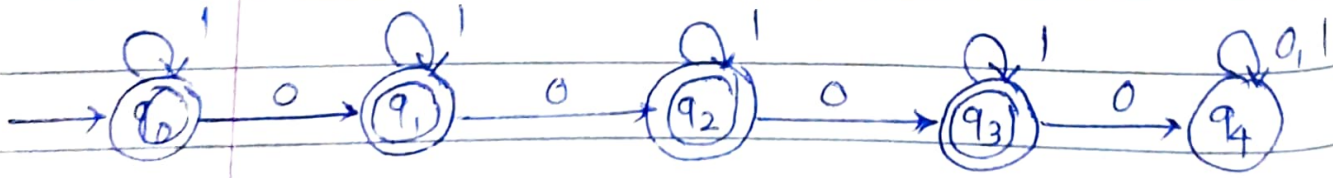
Q. Find DFA for language:-

1) $L = \{ 0x0 \mid x \in \{0,1\}^* \}$.



2) $L = \{ x \in \{0,1\}^* \mid x$ doesn't contain more than 3 0s $\}$.



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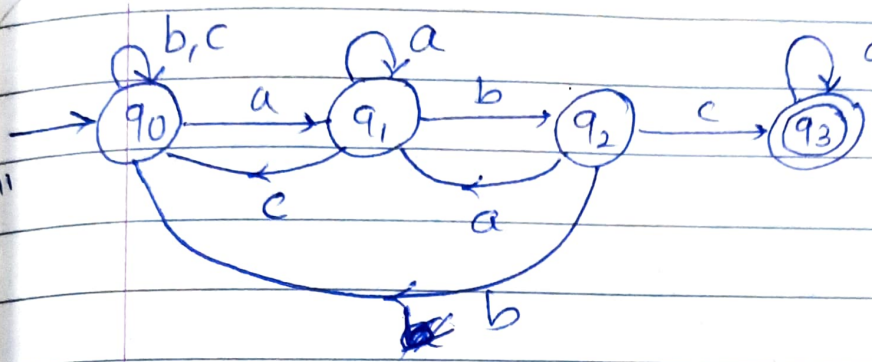
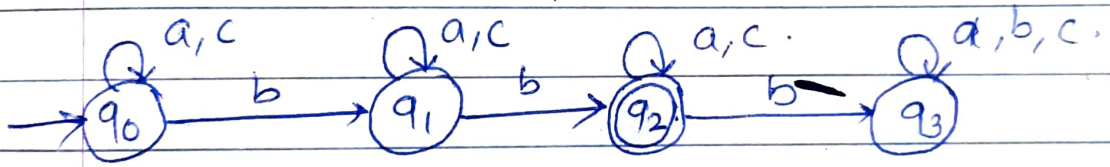
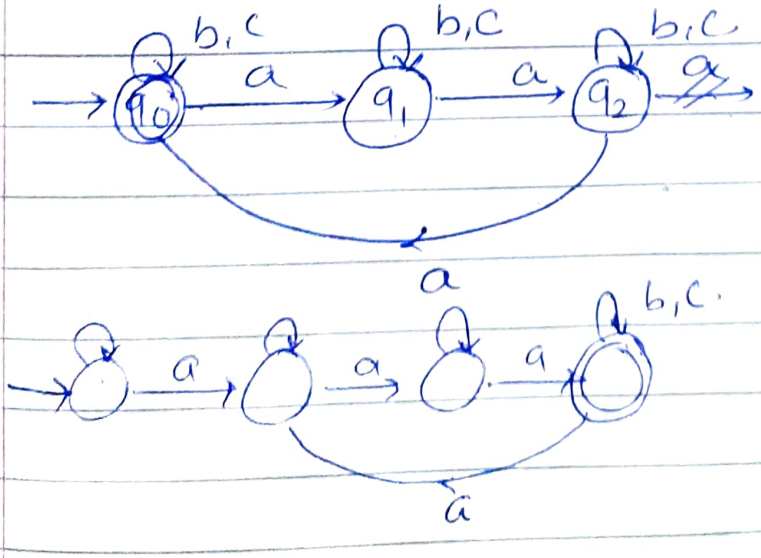
$L = \{ x \in \{a,b,c\} \mid abc \text{ is a substring of } x \}$



$L = \{ x \in \{a,b,c\} \mid |x|_b = 2 \}$



$L = \{ x \in \{a,b,c\} \mid |x|_a \equiv \text{divisible by } 3 \}$



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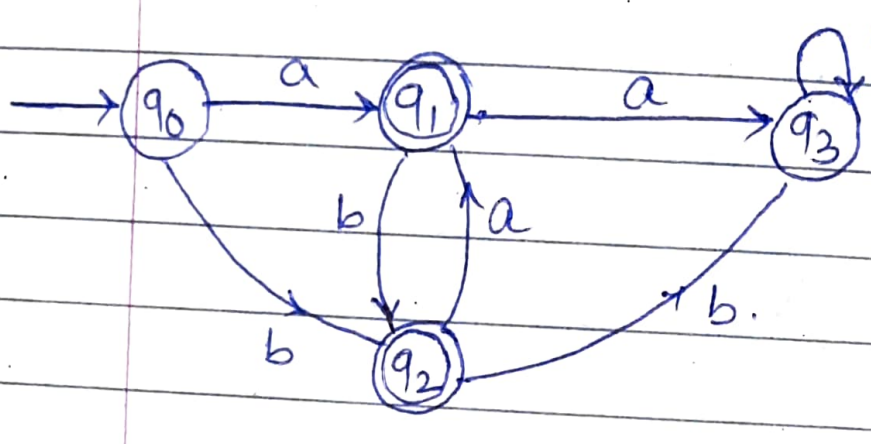
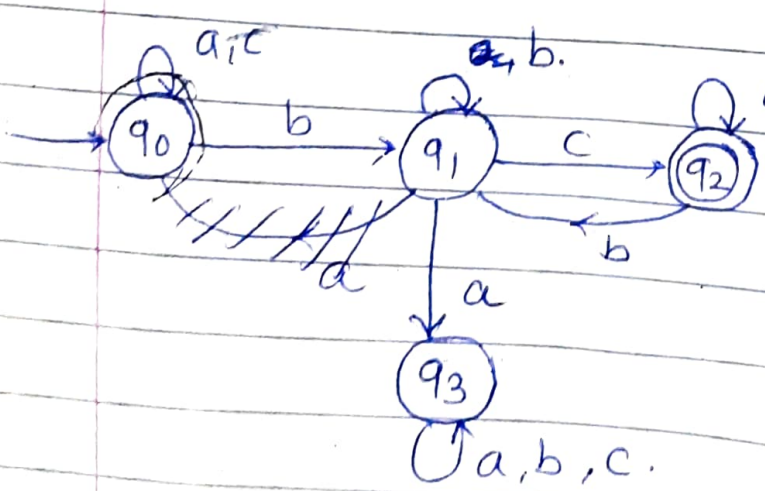
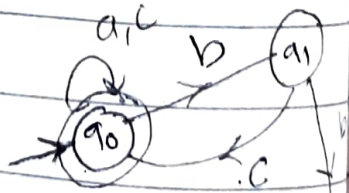
✓

Q. 6) $L = \{ x \in \{a,b\}^* \mid x$ has neither consecutive a's nor cons. b's $\}$

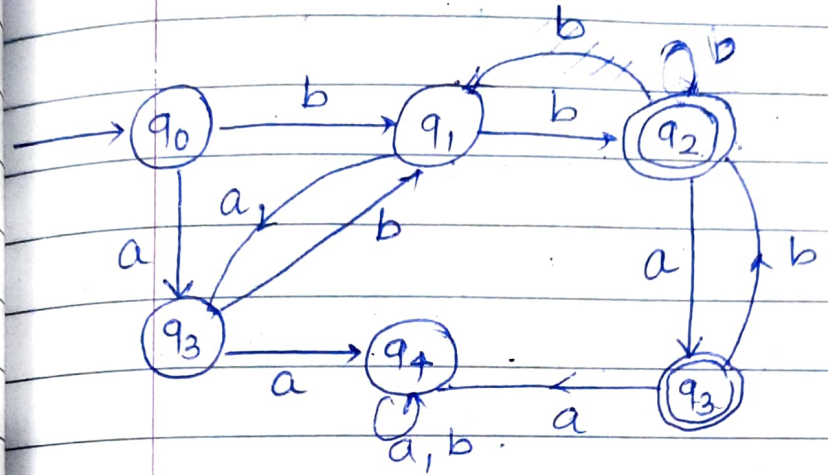


7) $L = \{ x \in \{a,b,c\}^* \mid$ every b in x is immediately followed by c $\}$.

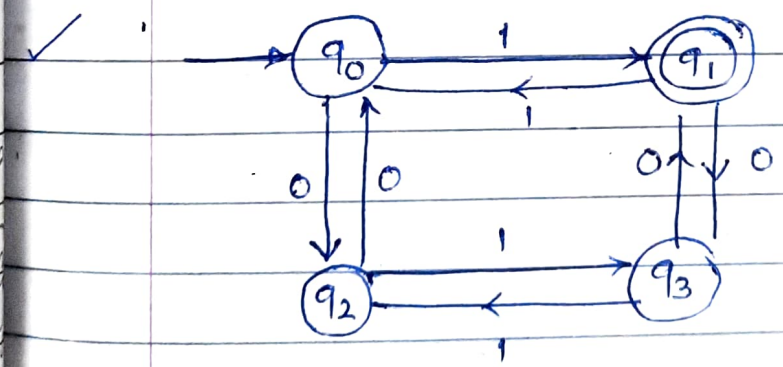




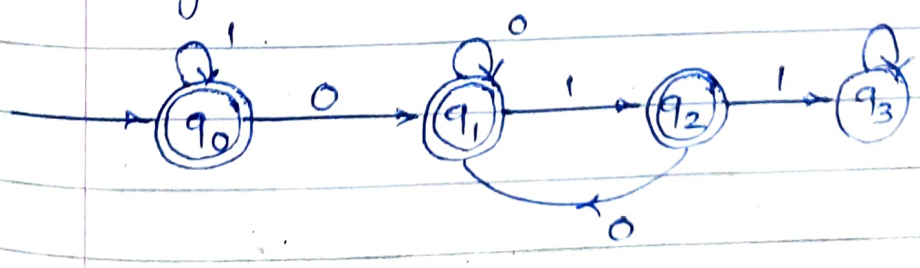
8) $L = \{ x \in \{a,b\}^* \mid x$ contains at least 2 consec b's $\}$ x doesn't contain 2 cons. a's $\}$



(9) F.A. ~~contain~~ for strings having even no. of zeroes & odd no. of 1s.



(10) strings not containing 011 as substring.



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* TM to subtract two unary numbers.

B | 1 | 1 | 1 | ; | 1 | 1 | B.

B | 1 | 1 | ; | 1 | 1 | B

	1	;	B
q_0	$(q_0, 1, R)$	$(q_0, ;, R)$	(q_1, B, L)
q_1	(q_2, B, L)	(q_4, B, L)	
q_2	$(q_2, 1, L)$	$(q_2, ;, L)$	(q_3, B, R)
q_3	(q_0, B, R)		
q_4	$(q_4, 1, N)$		$(q_f, 0, N)$

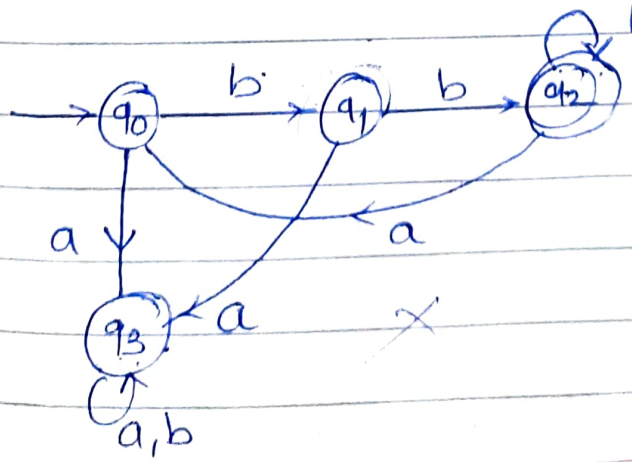
B 1 1 ; 1 B B
B B 1 ; 1 B B
B B 1 ; B B B

B 1 1 ; 1 1 B
B 1 1 ; 1 B B
B B 1 ; 1 B B
B 1 ; B
B ; B
0
1

1 1 ; 1 1 B
1 1 ; 1 1 B B

B 1 ; 1 1 B
B 1 ; 1 B B
B B ; 1 B B
q_1
B ; B

2. $\Sigma = \{a, b\}$. Every 'a' is immediately followed & preceeded by 'bb'.



doesn't accept 'b'

bab
bbabb

Dec. 2007

(R)

write R.E. for the following:-

i) $L = \{ a^n b^m : (n+m) \text{ is even} \}$

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

ii) $L = \{ w \in \{a,b\} : (\text{no. of } a\text{'s in } w) \bmod 3 = 0 \}$

$(b^* a b^* a b^* a b^*)^* + b^*$.

$b^*(a b^* a b^* a b^*)^*$

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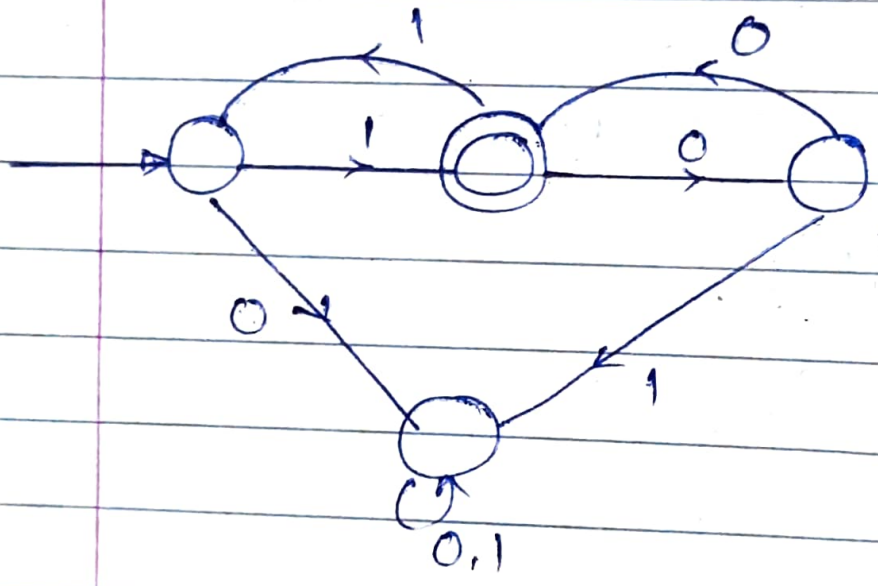
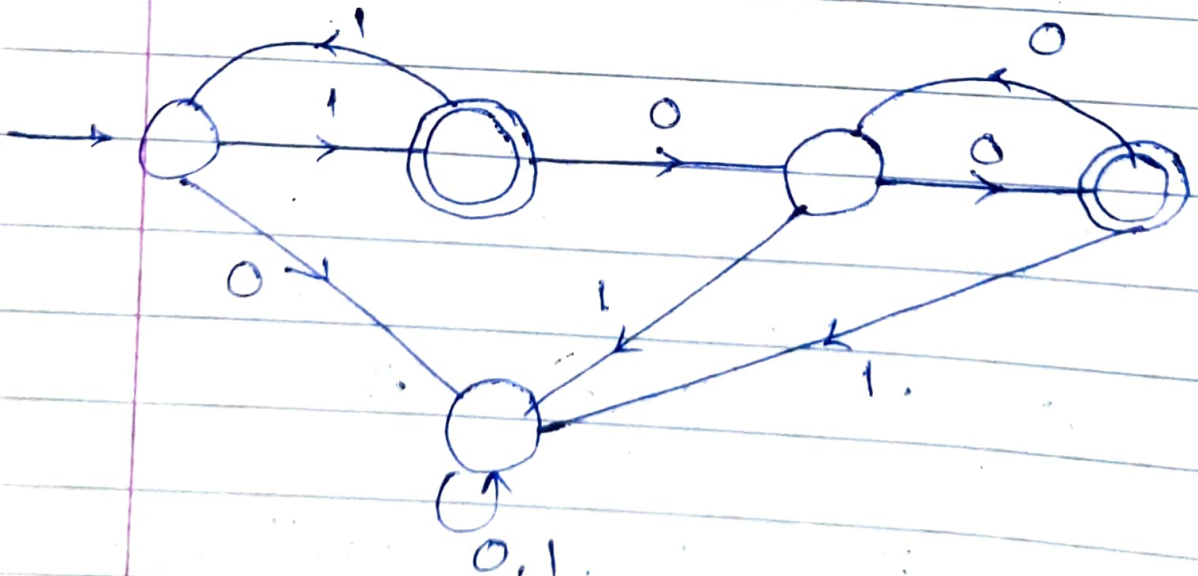
(2)

Dec. 2006

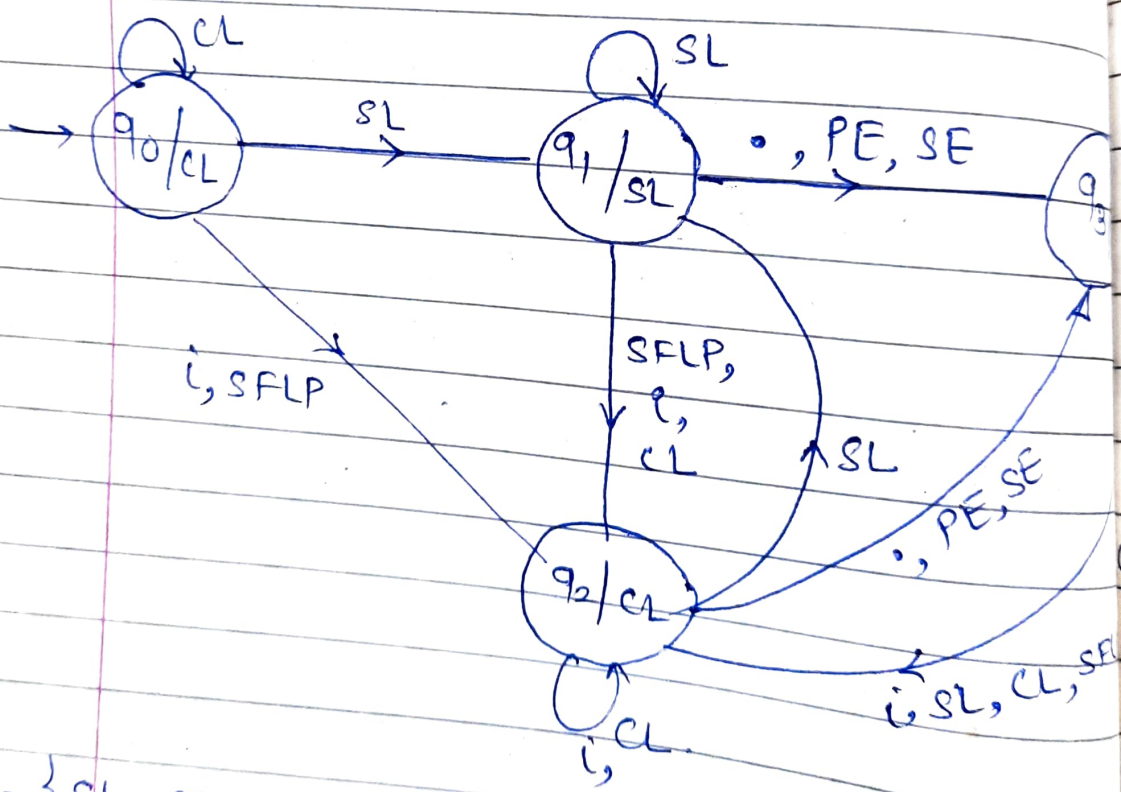
✓ Design DFA accepting set of all strings with odd no. of 1's followed by even no. of 0's.



⇒ Not allowed, accepts 11001100.



Q. Design a Moore m/c for editing a text. The m/c should ensure that a letter after a full stop '.' is capital, not change the case. If an "I" exists it is capital, else change the case, & first letter in every paragraph is capital. All ensure that all sentences & paras end with a full stop.



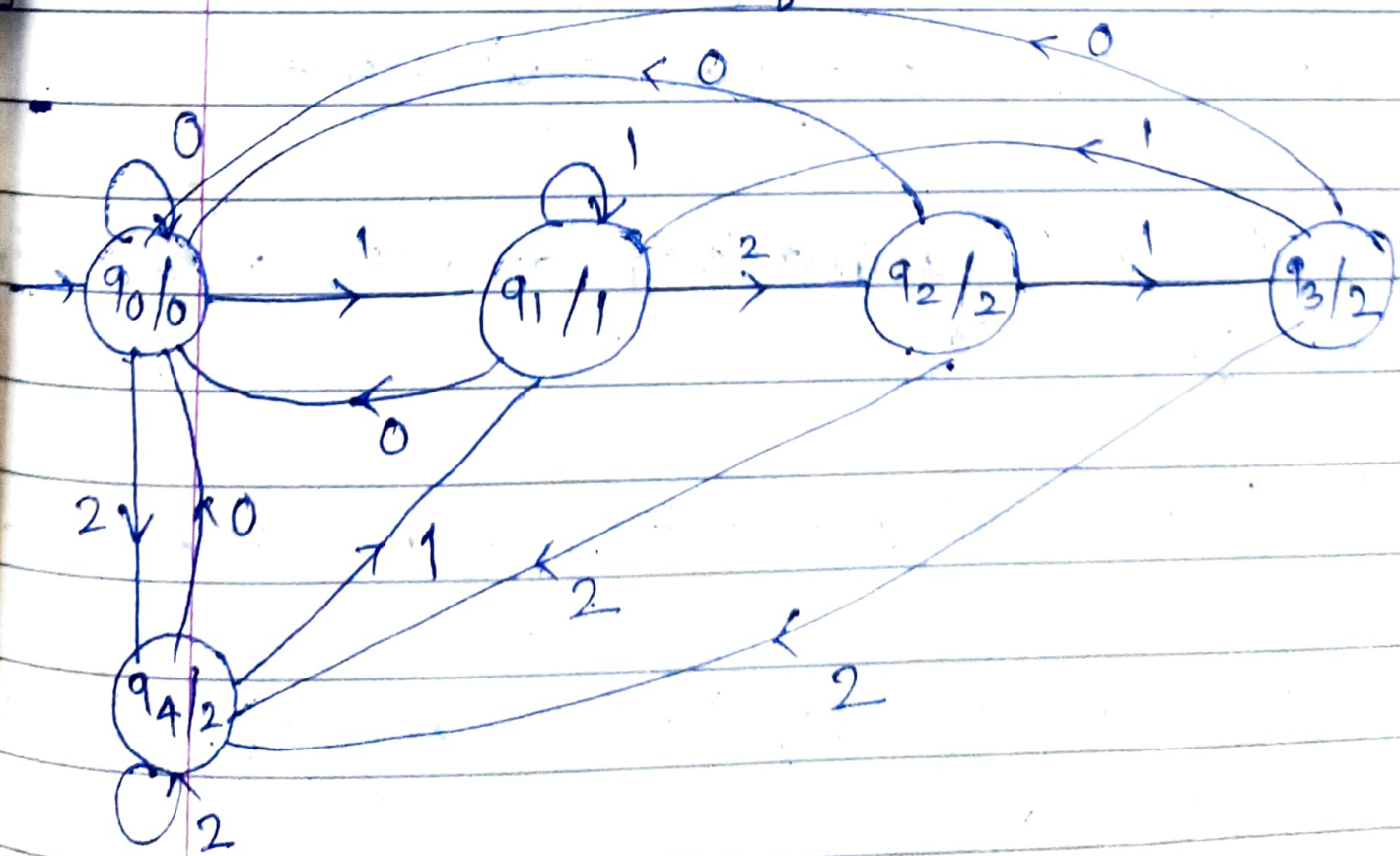
$\Sigma = \{SL, CL, ., i, SFLP, PE, SE\}$.

SL: small letter; CL: cap. letter; .: full stop; i: small first letter of paragraph; SFLP: small first letter of paragraph; PE: Paragraph end.; SE: Sentence end.

$\Delta = \{SL, CL, .\}$.

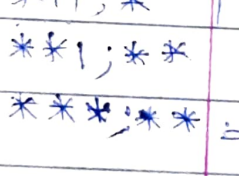
Moore & Mealy

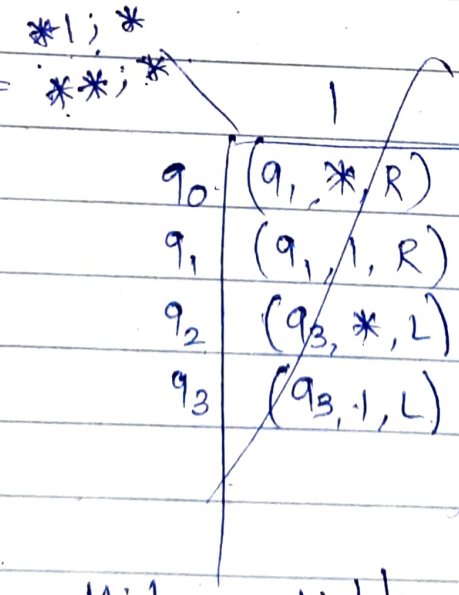
Q. Convert occurance of 121 to 122 over $\Sigma = \{0,1,2\}$

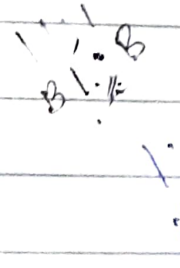


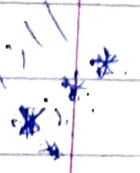
Q. Let x & y be two positive integers. Construct TM which will halt in a final state if $x > y$.

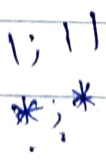
	1	;	*	B
q_0	$(q_1, *, R)$		$(q_0, *, R)$	-
q_1	$(q_1, 1, R)$	$(q_2, ;, R)$		
q_2	$(q_3, *, L)$		$(q_2, *, R)$	$(q_4, B$
q_3	$(q_3, 1, L)$	$(q_3, ;, L)$	$(q_3, *, L)$	$(q_0, B$
q_4	Final state.			

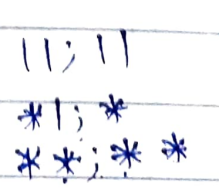












TM to reverse a string. ba^*b

i/p BabbB

o/p bba.

babbB

***bbab

	a	b	*	B
q_0	(q_0, a, R)	(q_0, b, R)		(q_1, B, L)
q_1	$(q_5, *, R)$	$(q_2, *, R)$		
q_2				(q_3, B, R)
q_3	ab			(q_4, b, L)
q_4	**ba		$(q_4, *, L)$	(q_4, B, L)
q_5		(q_5, b, R)	$(q_5, *, R)$	(q_6, B, R)
q_6	baa ***aab			(q_4, a, L)

BabB

**ba

BaabB

**

BaabB

**Bbb

q_4

BaabB

aa*bb.a

*

	a	b	*	B
q_0	(q_0, a, R)	(q_0, b, R)		(q_1, B, L)
q_1	$(q_4, *, R)$	$(q_2, *, R)$	$(q_1, *, L)$ ✓	(q_6, B, N)
q_2	(q_2, a, R)	(q_2, b, R)	$(q_2, *, R)$	(q_3, b, L)
q_3	(q_3, a, L)	(q_3, b, L)	$(q_1, *, L)$	(q_5, a, L)
q_4	(q_4, a, R)	(q_4, b, R)	$(q_4, *, R)$	
q_5	(q_5, a, L)	(q_5, b, L)	$(q_1, *, L)$	
q_6	final state	(q_4, b, N)	(q_6, B, R)	
q_7	(q_7, a, N)			

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TM to recognize ~~more~~ $n_a(x) > n_b(x)$
$x \in \{a, b\}$.

	a	b	*	B
q_0	$(q_1, *, R)$	(q_0, b, R)	$(q_0, *, R)$	—
q_1	(q_1, a, R)	(q_1, b, R)	$(q_1, *, R)$	(q_2, B, L)
q_2	(q_2, a, L)	$(q_3, *, L)$	$(q_2, *, L)$	(q_4, B, R)
q_3	(q_3, a, L)	(q_3, b, L)	$(q_3, *, L)$	(q_0, B, R)
q_4	F.S.			

babaa
b**aa
↑ q_0

bbba
bb**
↑ q_0

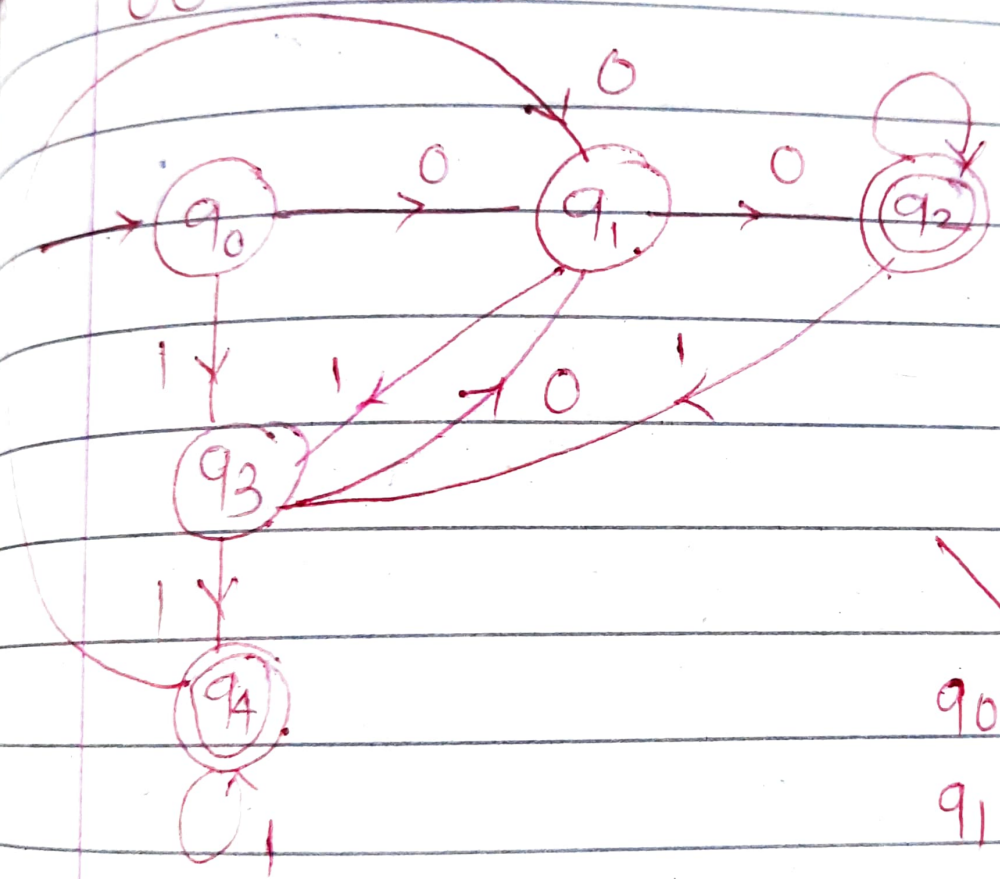
bbba
b**a
b***
****

****a
*****
↑

bbaabaa
****

	0	1	B
q_0	(q_1, B, R)	(q_4, B, R)	
q_1	$(q_1, 0, R)$	$(q_1, 1, R)$	(q_2, B, L)
q_2	(q_3, B, L)	$(q_f, 0, N)$	
q_3	$(q_3, 0, L)$	$(q_3, 1, L)$	(q_0, B, R)
q_4	(q_4, B, R)		$(q_f, 0, N)$ $(q_f, 0, N)$
q_f	final state		

FSM for strings acceptable if end with 00 or 11.



	0	1
q_0	q_1	q_3
q_1	q_2	q_3
q_2	q_2	q_3
q_3	q_1	q_4
q_4	q_1	q_4

Tut - 01.

1) Define grammar with i/p

11;111	1 1 ; 1 1	1 1 ; 1 1
	x 1 ; x	B 1 ; 1 1 B
	x x ; x x	B 1 ; 1 B
		B B ; B B

	1	;	B
q_0	(q_1, B, R)	$(q_4, ;, R)$	~~(q, E, N)~~
q_1	$(q_1, 1, R)$	$(q_2, ;, R)$	
q_2	$(q_2, 1, R)$		(q_3, B, L)
q_3	(q_4, B, L)	$(q_3, ;, L)$	(q_0, B, R)
q_4	$(q_5, 1, R)$		$(\ , E, N)$
q_5			$(\ , L, N)$

1 1 ; 1
B 1 ; B

1 1 ; 1
B 1 ; B
B B ; B

1 1 ; 1 1
B 1 ; 1 1 B
B 1 ; 1 B B

B x 1 ; x 1 B x x
x x ; x x

equal no. of a's & b's.

a b a b a a b b.

	a	b	x	y	B.
q_0	(q_1, X, R)	(q_3, Y, R)	(q_0, X, R)	(q_0, Y, R)	
q_1	(q_1, a, R)	(q_2, Y, L)			
q_2	(q_2, a, L)		(q_0, X, R)		
q_3	(q_4, X, L)	(q_3, b, R)			
q_4		(q_4, b, L)	(q_0, X, R)		

a b a b

X Y ~~X~~ ~~Y~~

b a b a

Y X Y X

a b b a

X Y Y X

a b b b a a

X Y Y Y X

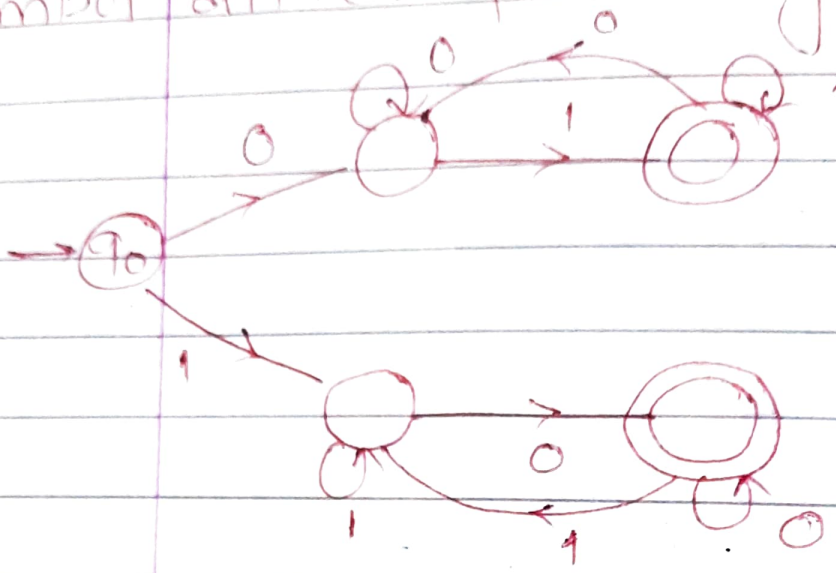
a a b b

X X Y Y

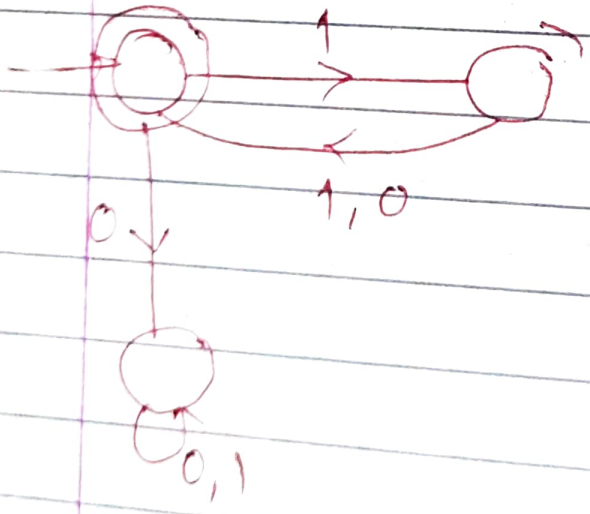
b a a a b b

Y X X Y

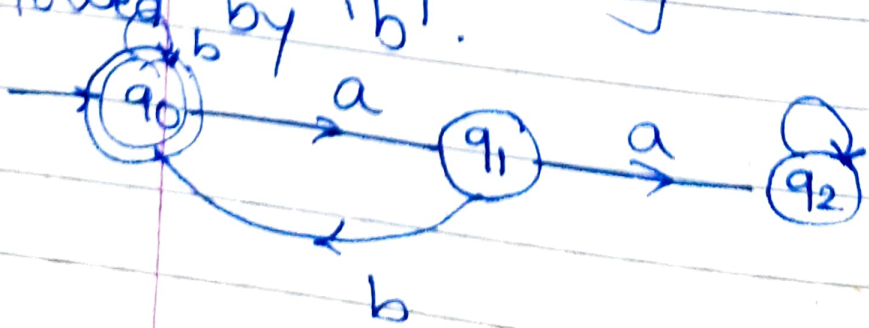
Q.1 DFA for strings in which leftmost symbol differs from rightmost



② for RE $(11+10)^*$



③ $\Sigma = \{a, b\}$ every 'a' is immediately followed by 'b'.



FSM:

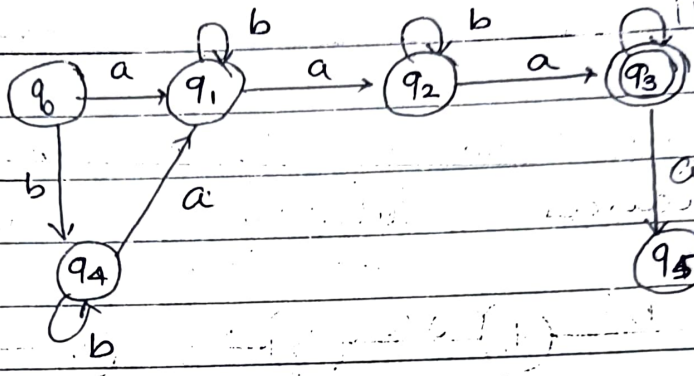
* Design a m/c to check whether a given decimal number is div. by 5.

Ans:

Jan 2003

① Design FSM to accept strig if it contains exactly 3 a's. $\Sigma = \{a, b\}$

Ans:



② Design FSM which checks whether a given ternary number is divisible by 4 or not:

Ans:

Ternary i/p = $\Sigma = \{0, 1, 2\}$.

Dec.	Ternary	four Remainders are possible.
0	0	
1	1	
2	2	q_0 & q_2.
3	$1\times3^1 + 0\times3^0 = 10$	q_1 & q_3.
4	$1\times3^1 + 1\times3^0 = 11$	
5	$1\times3^1 + 2\times3^0 = 12$	
6	$2\times3^1 + 0\times3^0 = 20$	
7	$2\times3^1 + 1\times3^0 = 21$	
8	22	
9	$1\times3^2 + 0\times3^1 + 0\times3^0 = 100$	
10	$1\times3^2 + 0\times3^1 + 1\times3^0 = 101$	

rem.		0	1	2
	q_0	q_0	q_1	q_2
	q_1	q_3	q_0	q_1
	q_2	q_2	q_3	q_0
(10)	q_3	q_1	q_2	q_3

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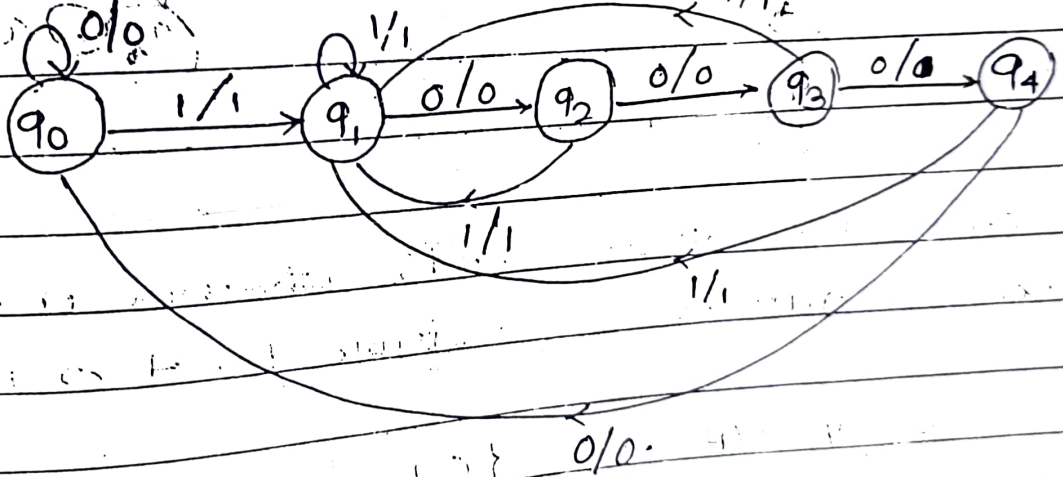
Design Moore & Mealy m/c to convert each occurances of substring 1000 by 1001.



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Design TM for $0^n1^n0^n$.

	0	1	a	b	c	B
q_0	(q_0, a, R)	(q_0, b, R)		(q_0, b, R)	(q_0, c, R)	(q_4, B, L)
q_1	$(q_1, 0, R)$	$(q_2, 1, R)$		(q_1, b, R)	(q_1, c, R)	
q_2	(q_3, c, L)					(q_2, c, R)
q_3	$(q_3, 0, L)$	$(q_3, 1, L)$	(q_0, a, R)	(q_3, b, L)		