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Regular Expression

$\cdot$ $a \cdot b$

$+$ $(1 - \infty)$

$*$ $(0 - \infty)$

$a^+ = \{a, aa, aaa \ldots\}$

$a^* = \{\text{' '}, a, aa, aaa \ldots\}$

$(a \cdot b)^* = \{\text{' '}, ab, abab, \ldots\}$

$(a+b) = \{a, b\}$

$(aa+bb) = \{aa, bb\}$

$(a+b)^* = \{\overset{0}{\text{' '}}, \overset{1}{a}, \overset{1}{b}, \overset{2}{aa}, \overset{2}{ab}, \overset{2}{bb}, \overset{2}{ba}, \ldots\}$

Q. Write a regular expression for language l $\Sigma(a, b)$ where it denotes all the strings ending with abb.

Regular Expression : $(a+b)^* abb$

Q. Write a RE for language l $\Sigma(a, b)$ where it denote all string starts with abb or ends with bbb

$abb(a+b)^* + (a+b)^* bbb$

abbb

→ String either starting with abb or ending with bbb.

$$\Big[abb\,(a+b)^*\,(aaa+aab+abb+bba+baa+bab+aba)\Big] + \Big[(aaa+aab\,(a+b)^*\,bbb + aba+bbb + bba+bab + baa)\Big]$$

$$+\, abb + bbb.$$

→ All the odd binary numbers

$(0+1)^*\,1$

→ RE for even length string.

$(0+1)^* \cdot (0+1)^*$ Ans. $(00+11+01+10)^*$

010 $\big((0+1)\cdot(0+1)\big)^*$

→ RE for odd length string.

$(00+11+01+10)^*\,(0+1)$

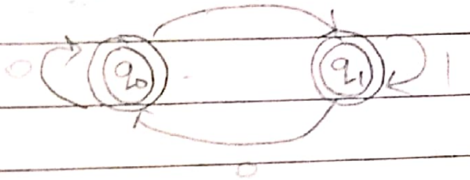
$\big((0+1)(0+1)\big)^*\,(0+1)$

HW

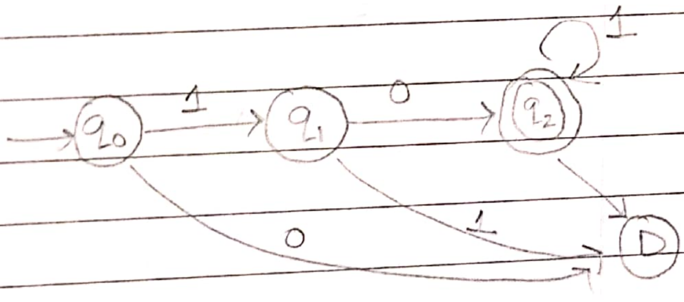
→ Design an expression for a language where binary number generates all numbers divisible by 3

→ Regular Expression to DFA

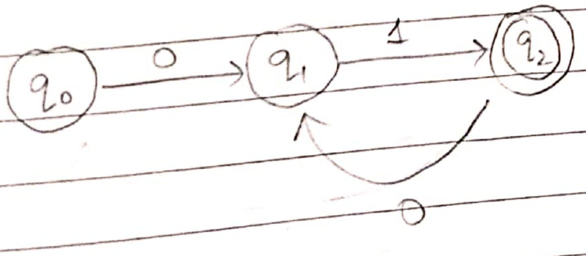
$(0+1)^*$ →



101^* →

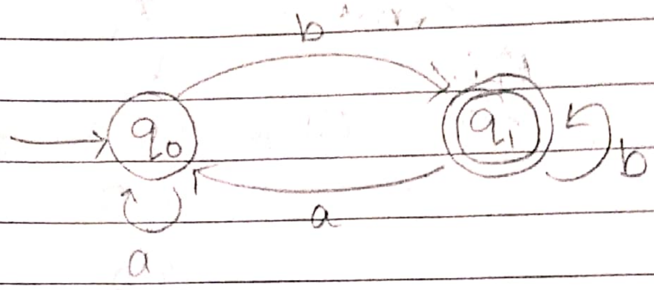


$(01)^*$ → '' , 01 , 0101,

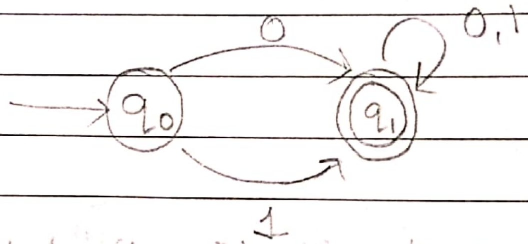


$(a+b)^* abb$ '', a, b, ab, aa, ba, bb

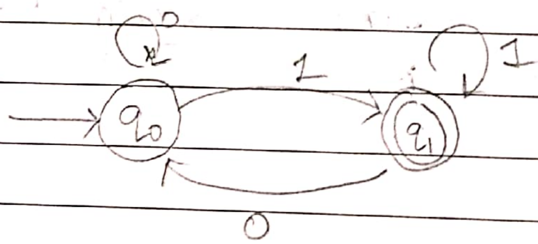
ababb



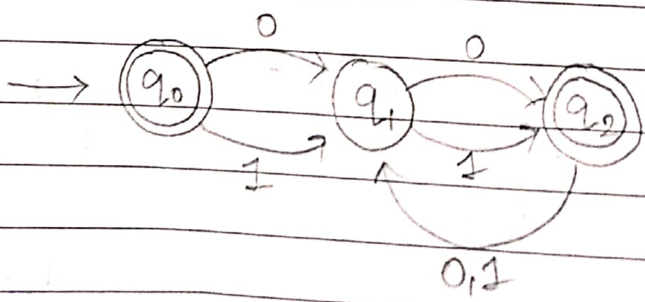
$(0+1)^+$

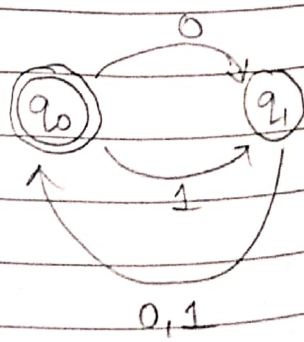


$(0+1)^* 1 \rightarrow$

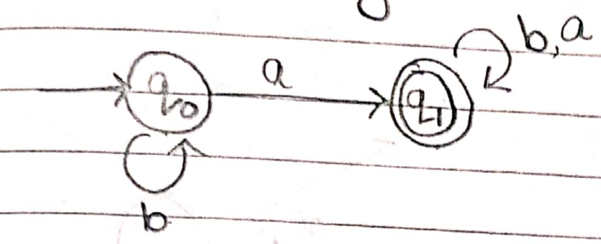


$(01 + 10 + 11 + 00)^*$

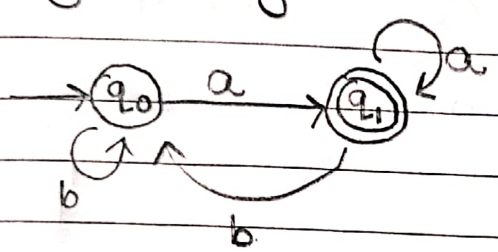




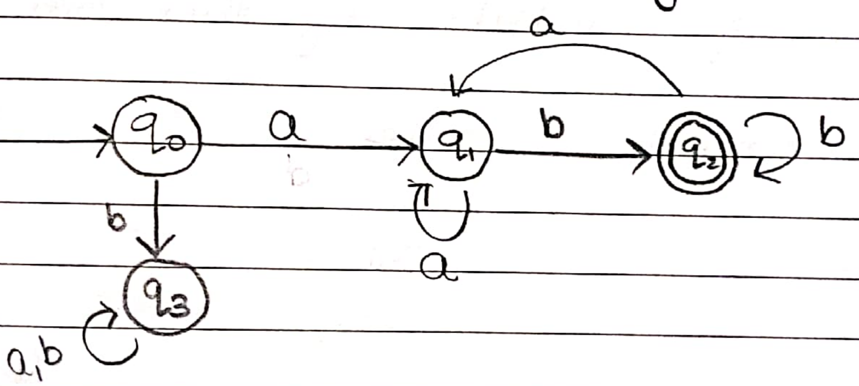
* String Containing 'a'



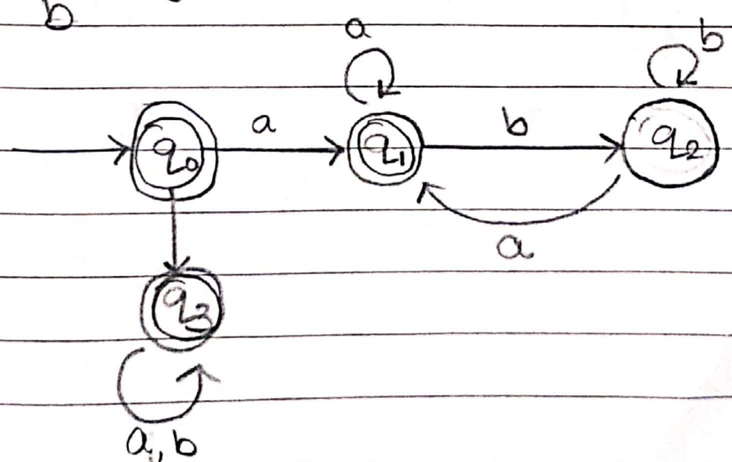
* String ending with 'a'



* Starting with 'a' and ending with 'b'.

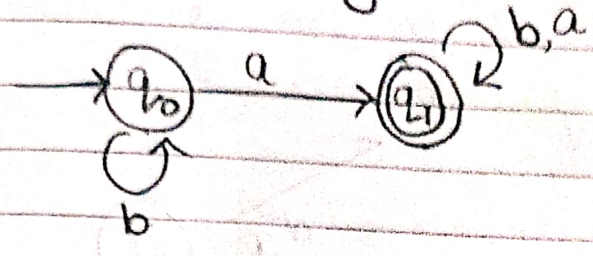


* String not starting with 'a' or not ending with 'b'
We can say this as starting with 'a' and ending with 'b'

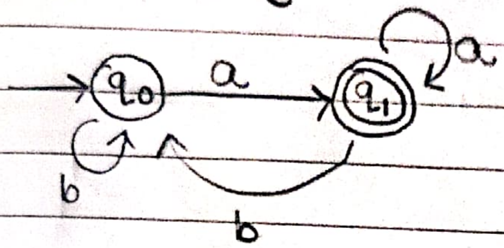


while taking compliment we change final state to not final state and vice versa

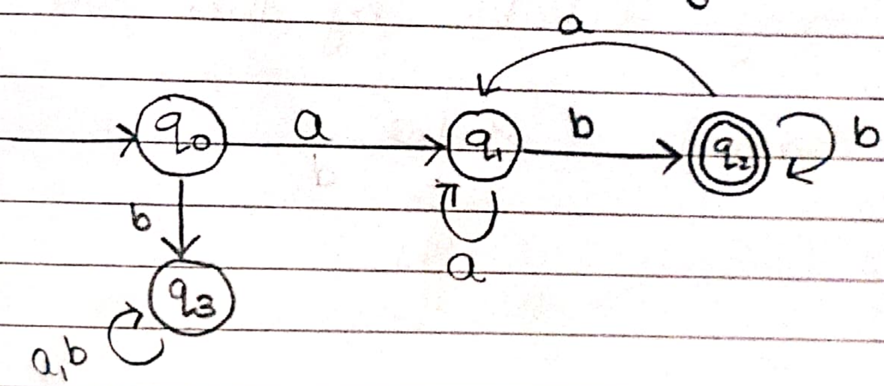
* String Containing 'a'



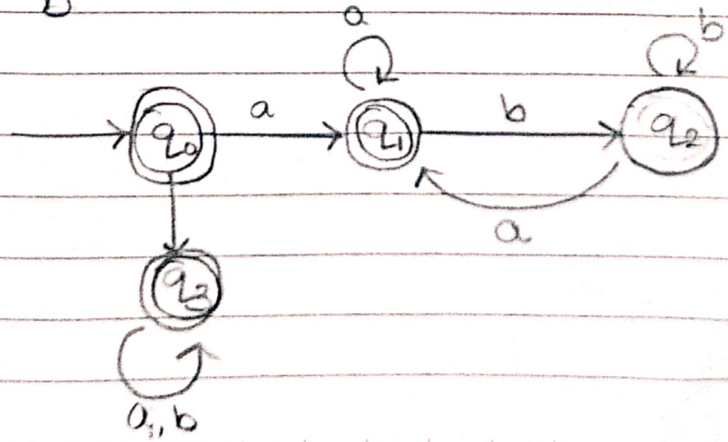
* String ending with 'a'



* Starting with 'a' and ending with 'b'



* String not Starting with 'a' or not ending with 'b'
We can say this as starting with 'a and ending with 'b'



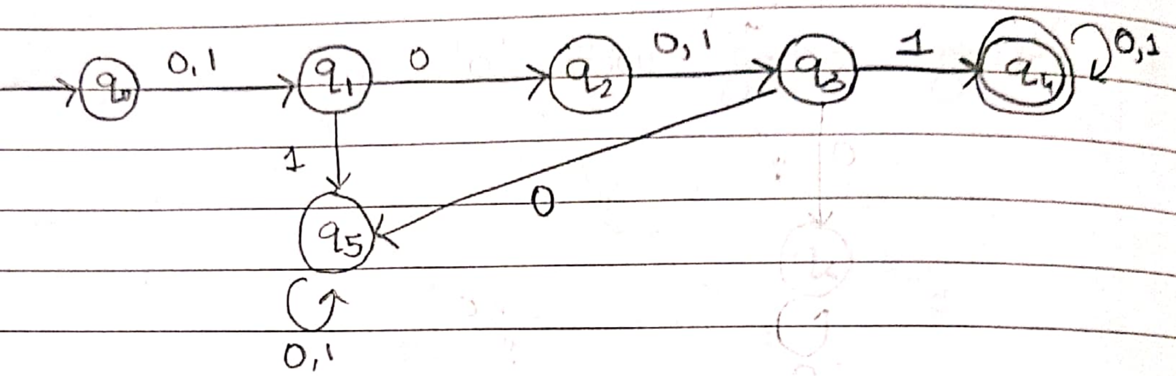
while taking compliment we change final state to not final state and vice versa

Note: In this type of DFA minimum states are $(n+1)$; n = min length of string

* $\Sigma(0,1)$

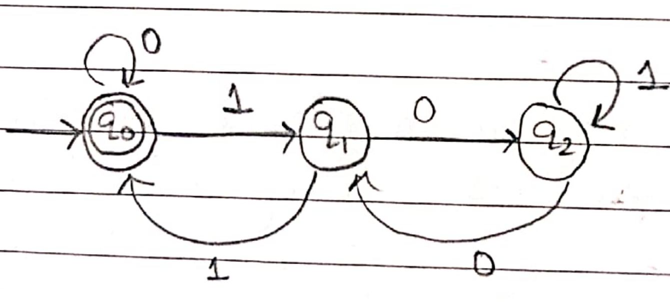
All Strings over (0,1) in which second symbol is '0' and fourth symbol is '1'

_ 0 _ 1



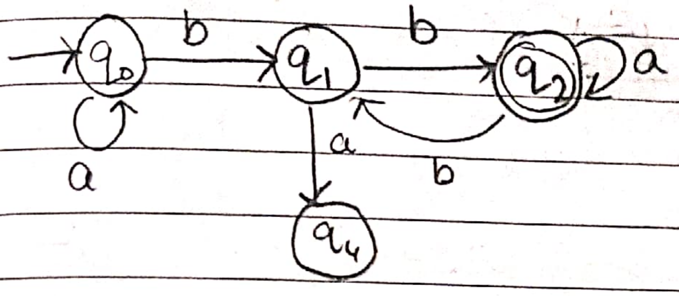
* Construct a DFA which accepts a language of all binary strings divisible by three over $\Sigma(0,1)$

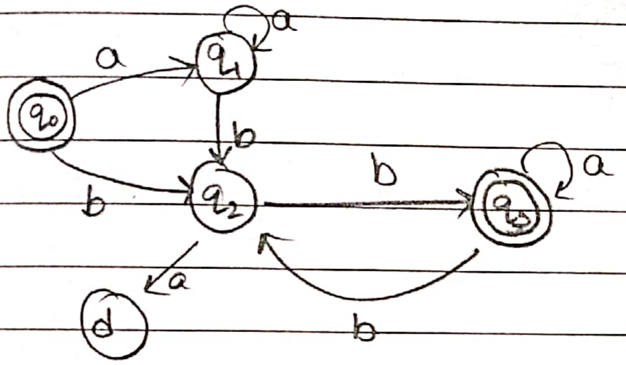
Possible Remainder	States
0	q_0
1	q_1
2	q_2.



① $(a^* bb a^*)^*$

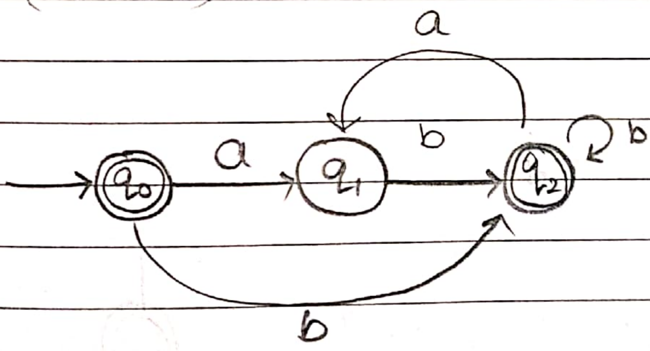
L: always 2 Consecutive b





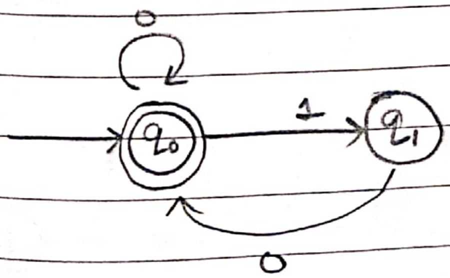
② $(ab+b)^*$

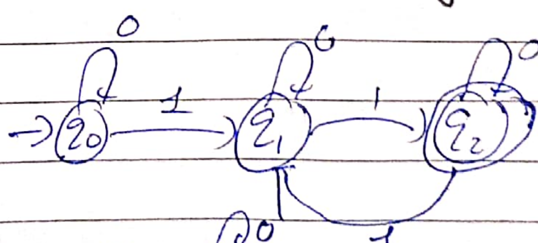
L: one 'a' followed by 'b'

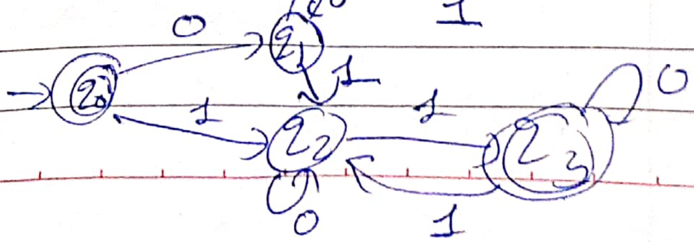


IMP
③ $(0^* 1 0^* 1 0^*)^*$

L: Count of 1 is even







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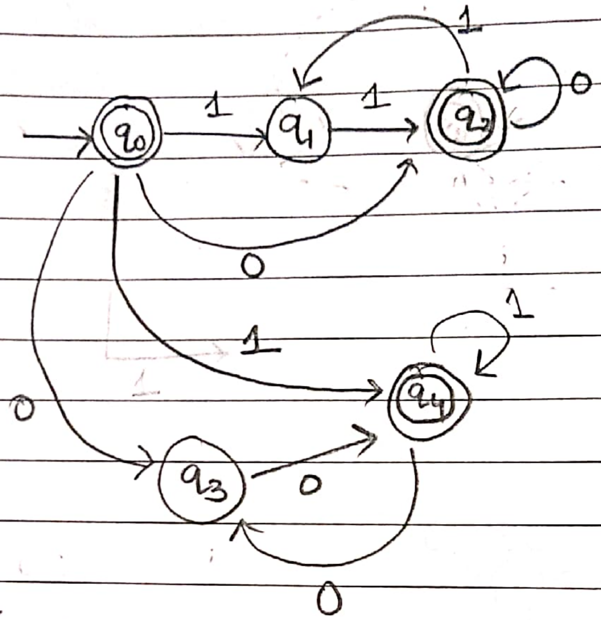
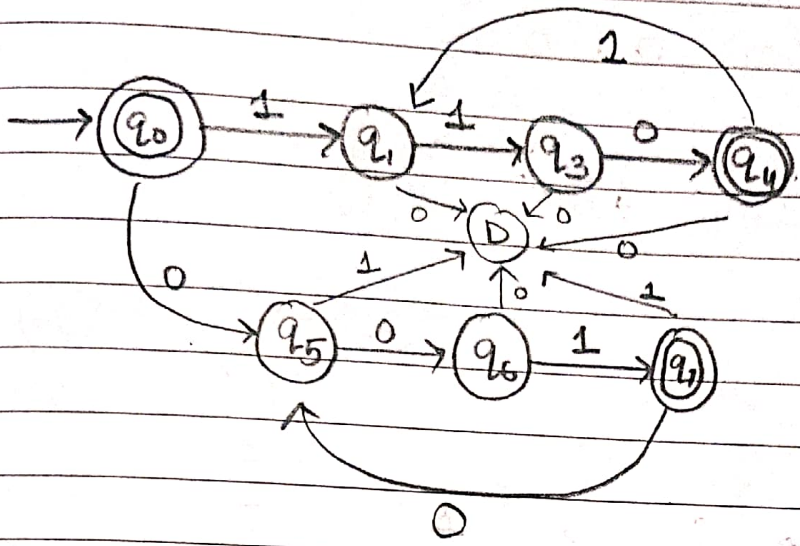
IMP

④ $(11+0)^* + (1+00)^*$



NFA

5. $(110)^* + (001)^*$

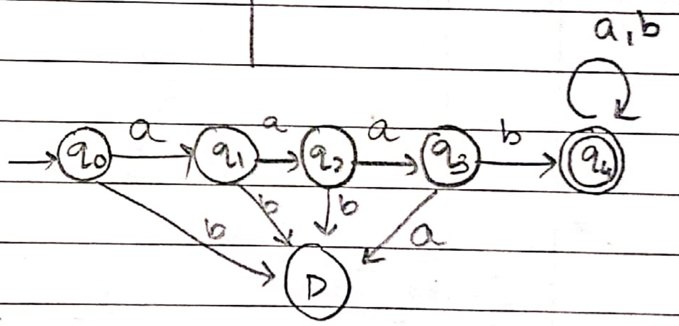


6. $a(aab)^+ ab$

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

$= a(aab)(aab)^*(a+b)^*$

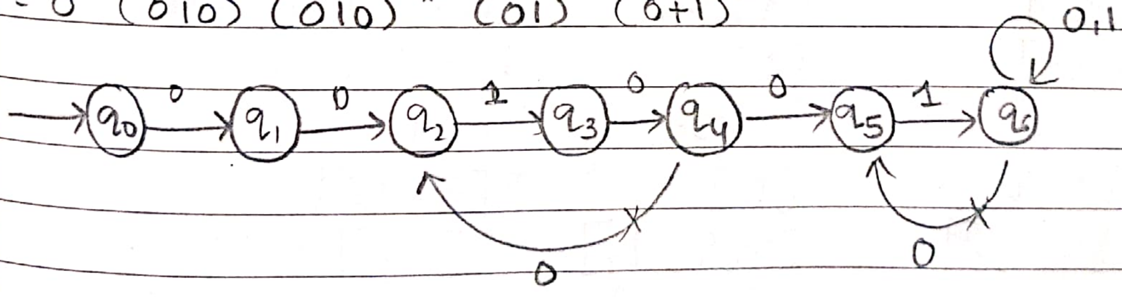
$= a(aab)(a+b)^*$

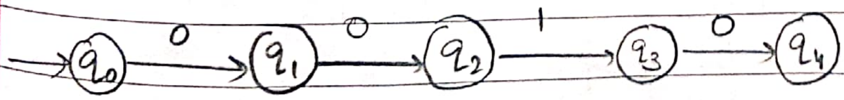


7. $0(010)^+(01)^+(0+1)^*$

0010010

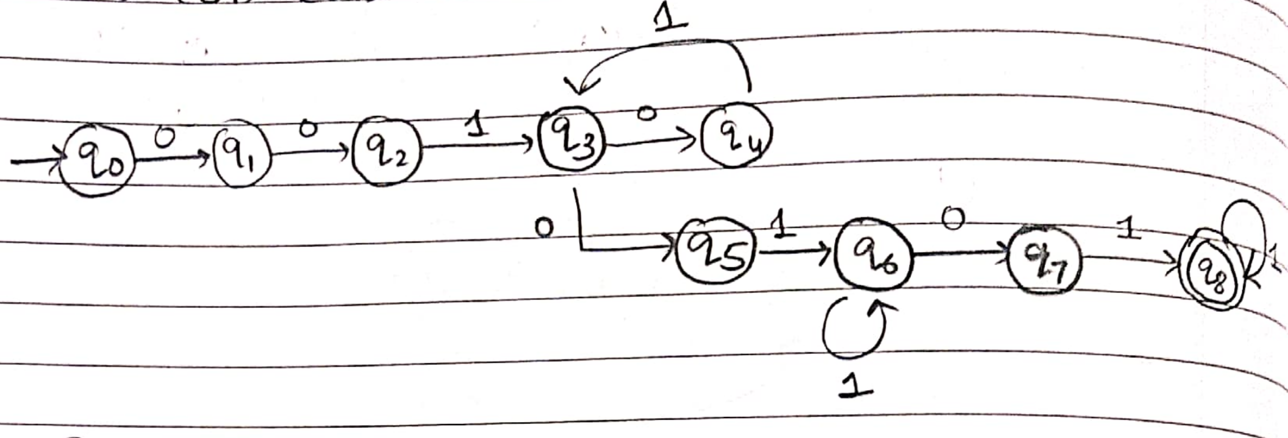
$= 0(010)(010)^*(01)(0+1)^*$





8. $0(01)^+ (01)^* 0 1^+ 0 1^+$

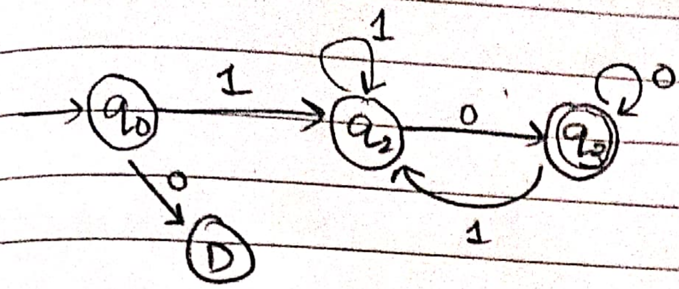
$= 0 (01)(01)^* 0 1^+ 0 1^+$



δ_N	0	1
q_0	$\{q_1\}$	$\{D\}$
q_1	$\{q_2\}$	$\{D\}$
q_2	$\{D\}$	$\{q_3\}$
q_3	$\{q_4, q_5\}$	$\{D\}$
q_4	$\{D\}$	$\{q_3\}$
q_5	$\{D\}$	$\{q_6\}$
q_6	$\{q_7\}$	$\{q_6\}$
q_7	$\{D\}$	$\{q_8\}$
q_8	$\{q_8\}$	$\{q_8\}$

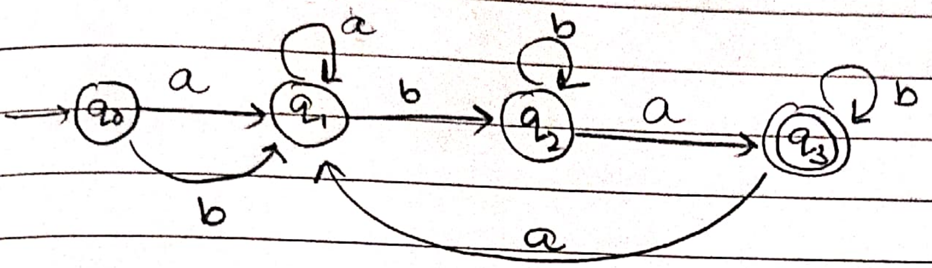
State \ Σ	0	1
$[q_0]$	$[q_1]$	$[D]$
$[q_1]$	$[q_2]$	$[D]$
$[q_2]$	$[D]$	$[q_3]$
$[q_3]$	$[q_4 q_5]$	$[D]$
$[q_4 q_5]$	$[D]$	$[q_3 q_6]$
$[q_3 q_6]$	$[q_4 q_5 q_7]$	$[q_6]$
$[q_4 q_5 q_7]$	$[D]$	$[q_3 q_6 q_8]$
$[q_3 q_6 q_8]$	$[q_4 q_5 q_7 q_8]$	$[q_6 q_8]$
$[q_4 q_5 q_7 q_8]$	$[q_7 q_8]$	$[q_3 q_6 q_8]$
$[q_6 q_8]$	$[q_7 q_8]$	$[q_6 q_8]$
$[q_7 q_8]$	$[q_8]$	$[q_8]$
$[q_8]$	"	"

* DFA to RE

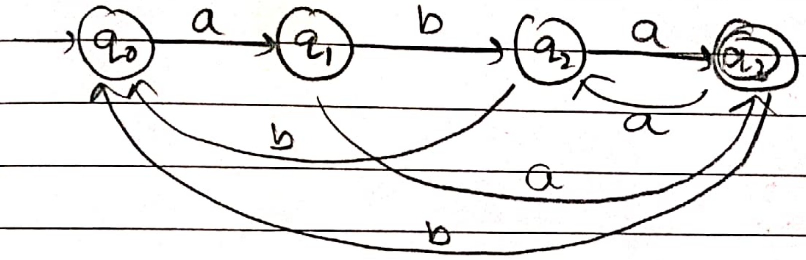
① 

$11^* 00^* (11^* 00^*)^*$

$= 1^+ 0^+ (1^+ 0^+)^*$

2. 

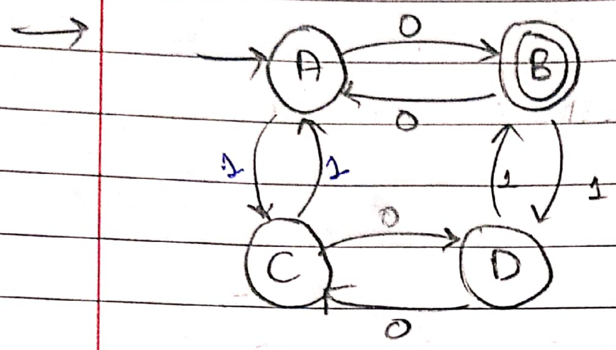
$(a+b)a^* bb^* ab^* (aa^* bb^* ab^*)^*$

3 

$a(ba+a)(aa)^*(ba(ba+a)(aa)^*)^*$

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

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


A
B
C
D
0
0
1
1
1
1
0
0

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Q1 RE for language containing min 4 1's & where every word start with prefix 001

Q2 Draw DFA & RE for lang. where count of 0 is odd and count of 1 is even.

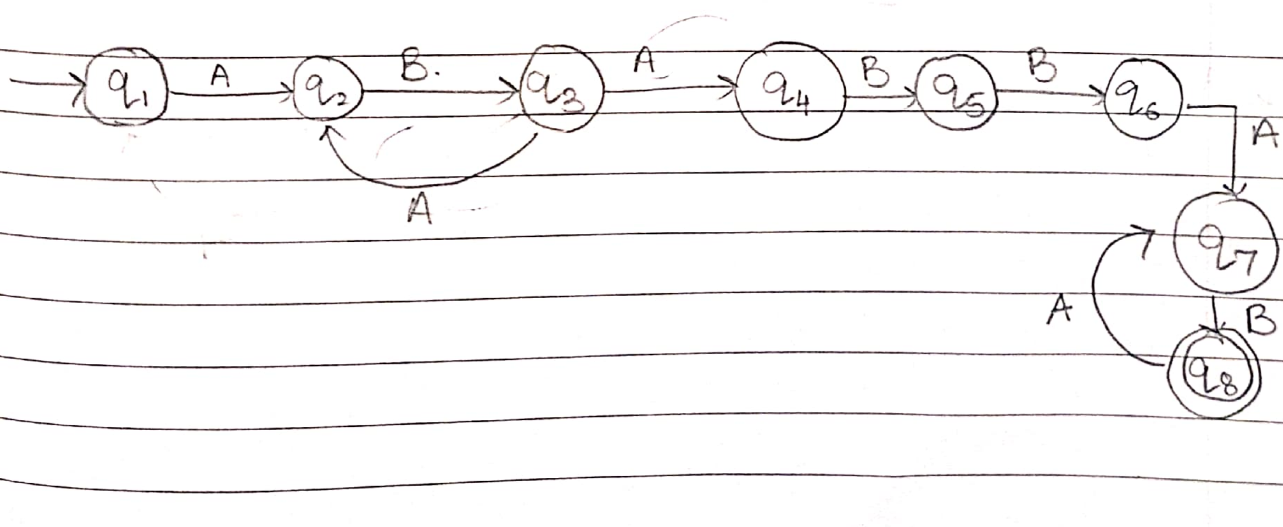
Q3 Convert this RE into DFA
1) $(AB)^+ ABB(AB)^+$
2) $(1^* 0^+ 1)^*$

Q4 Write a regular expression for the lang. containing at most 4 consecutive 1's.

Q5 Write RE & DFA for lang containing 1 in pairs only.

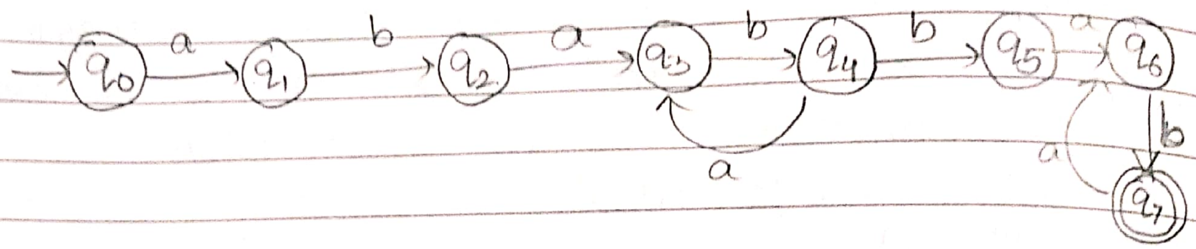
Q6 Write RE & DFA for lang. having minimum 4 1's in the word.

Ans3 1) $(AB)^+ ABB(AB)^+$

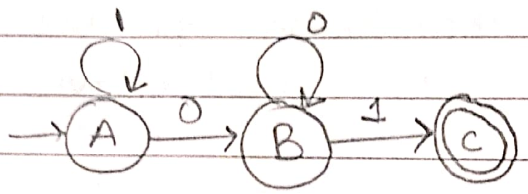


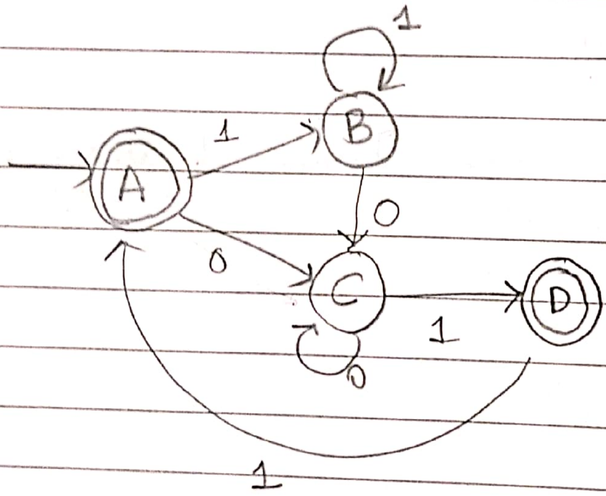
$(ab)^+ \, abb \, (ab)^+$

$= (ab)\,(ab)^+ \, b \, (ab)^+$

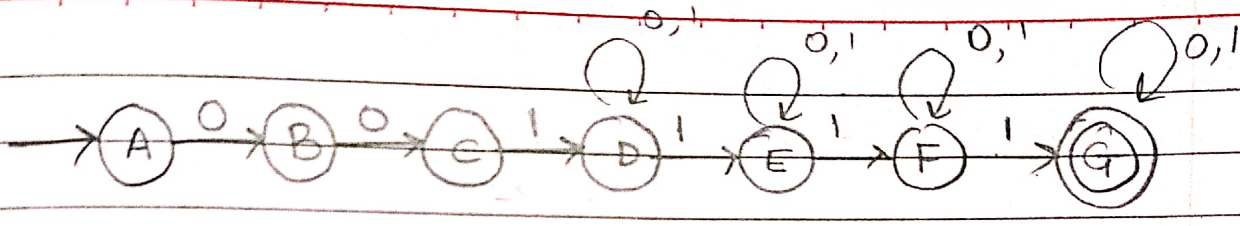


2) $(1^* 0^+ 1)^*$





Q1



Q5 1 in pairs only

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