MODULE 2

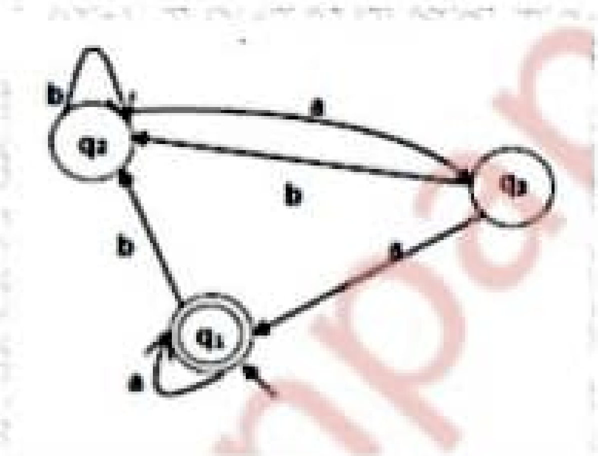
1. Represent RE epsilon for L = {w : w has prefix bab and suffix abb and w is a string over {a,b}. Design NFA with epsilon moves for accepting L. Convert it to minimized DFA.

2. Explain Pumping Lemma for regular languages. Prove that given language is not a regular language. L={ a^n b^ n+1 | n>=1}.

3. Explain Pumping Lemma with the help of a diagram to prove that given language is not a regular language. L={0m 1 m+1 | m>0}.

4. State pumping lemma theorem . Find out whether the language L= {x^n y ^n z^n | n ≥1} is context free or not.

5. (a) Obtain a regular expression for FA Show in the picture below:

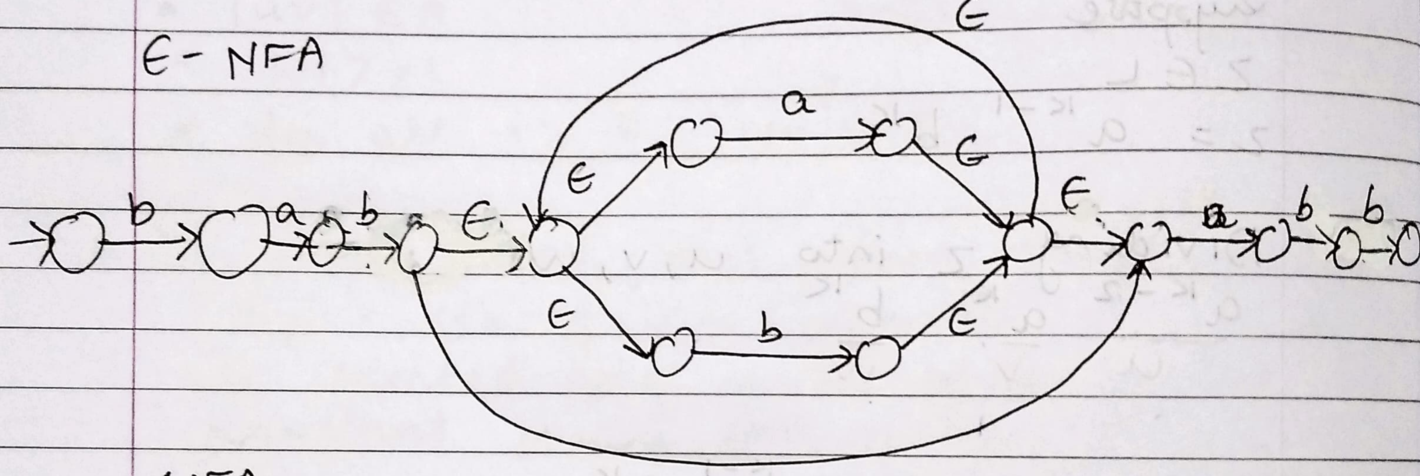


PYQ's on module 2

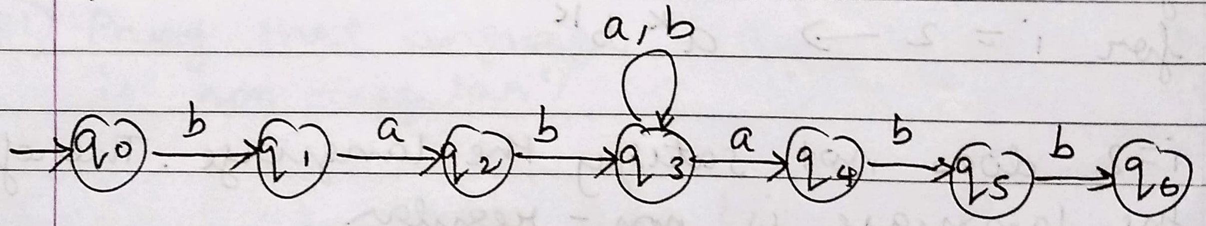
Q1)

RE = bab $(a+b)^*$ abb

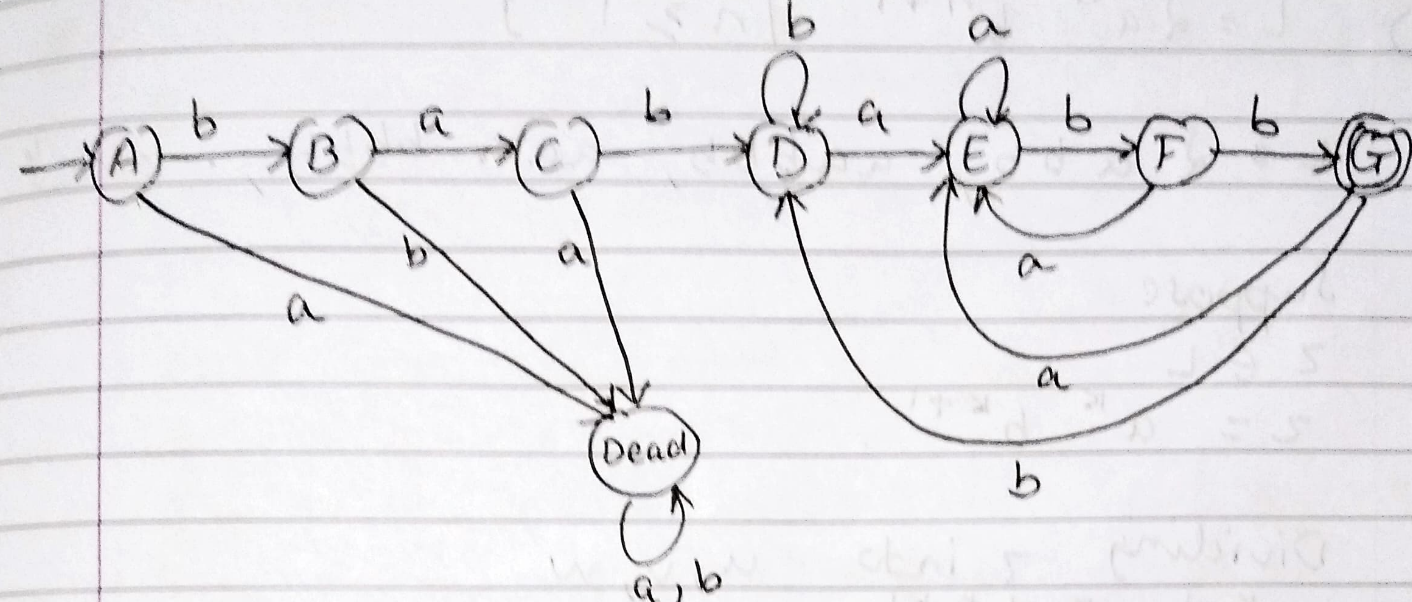
ε - NFA



NFA



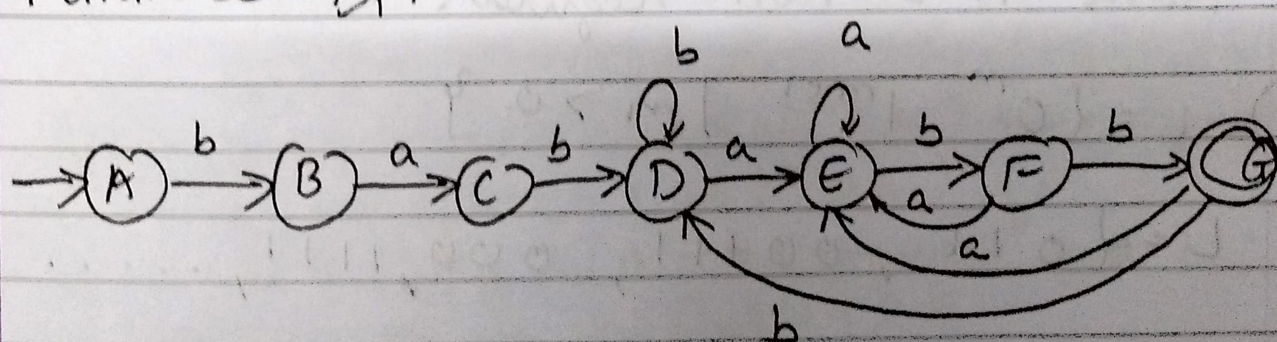
		a	b
A	q_0	ϕ	q_1
B	q_1	q_2	ϕ
C	q_2	ϕ	q_3
D	q_3	q_3, q_4	q_3
E	q_3, q_4	q_3, q_4	q_3, q_5
F	q_3, q_5	q_3, q_4	q_3, q_6
G	q_3, q_6	q_3, q_4	q_3



Minimized DFA

a
{A, B, C, D, E, F}, {Dead}, {G}
b

Minimized DFA



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Q2) $L = \{a^n b^{n+1} \mid n \geq 1\}$

$L = \{abb, aabbb, aaabbbb, \ldots\}$

Suppose

$z \in L$

$z = a^K b^{K+1}$

Dividing z into u, v, w

$a^{K-1} \quad a \quad b^{K+1}$

for $i = 1$

$z = a^K b^{K+1}$

for $i = 2$

$z = a^{K+1} b^{K+1}$

$i = 2$ doesnt satisfy the language

Hence it is non regular

Q3) $L = \{0^m 1^{m+1} \mid m > 0\}$

$L = \{011, 00111, 0001111, \ldots\}$

Suppose

$z \in L$

$z = 0^K 1^{K+1}$

Dividing z into u, v, w

$0^{K-1} \quad 0 \quad 1^{K+1}$

for $i = 0$

$z = 0^{K-1} 1^{K+1}$

$i = 0$ doesnt satisfy the language

Hence it is non regular

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Q5)

$q_1 = q_1 a + q_3 a + \epsilon$

$q_2 = q_2 b + q_3 b + q_1 b$

$q_3 = q_2 a$

Now, lets consider eq^n q_2

$q_2 = q_2 b + q_3 b + q_1 b$

$q_2 = q_2 b + q_2 ab + q_1 b \quad (\because q_3 = q_2 a)$

$q_2 = q_2 (b + ab) + q_1 b$

$q_2 = q_1 b + q_2 (b + ab)$

Comparing with $R = Q + RP$

Here $R = q_2$, $Q = q_1 b$, $P = (b + ab)$

Using Arden's theorem

$R = QP^*$

$q_2 = q_1 b (b + ab)^* \quad - (1)$

Now, let's consider eq^n q_1

$q_1 = q_1 a + q_3 a + \epsilon$

$q_1 = q_1 a + q_2 aa + \epsilon \quad (\because q_3 = q_2 a)$

$q_1 = q_1 a + q_1 (b (b + ab)^* aa) + \epsilon \quad$ - from (1)

$q_1 = q_1 (a + b (b + ab)^* aa) + \epsilon$

$q_1 = \epsilon + q_1 (a + b (b + ab)^* aa)$

Comparing with $R = Q + RP$

Here $R = q_1$, $Q = \epsilon$, $P = (a + b(b + ab)^* aa)$

Using Arden's theorem

$R = QP^*$

$q_1 = \epsilon (a + b (b + ab)^* aa)^*$

$q_1 = (a + b (b + ab)^* aa)^*$

Q6) Prove that the following languages is not regular $L = \{ w r w^r \mid w \in \{a,b\}^*, r \in \{c\}, |w| \geq 1 \}$

odd palindrome

$\Rightarrow L = \{ aca, bcb, abcba, \ldots \}$

Suppose,

$z \in L$

$z = a^n c a^n$

Dividing z into u, v, w

$a^{n-1} \quad a \quad c a^n$

These are odd palindromes

let $i = 2$

$|uv^2w| = |uvw| + |v| \quad \ldots \quad 1 \leq |v| \leq n$

Add $|uvw|$ on both sides

$1 + 2n + 1 \leq |uv^2w| \leq n + 2n + 1$

$2n+1 < |uv^2w| < 3n + 2 \quad \ldots \quad n \geq 1$

$|aca| = 3$

$|bcb| = 3$

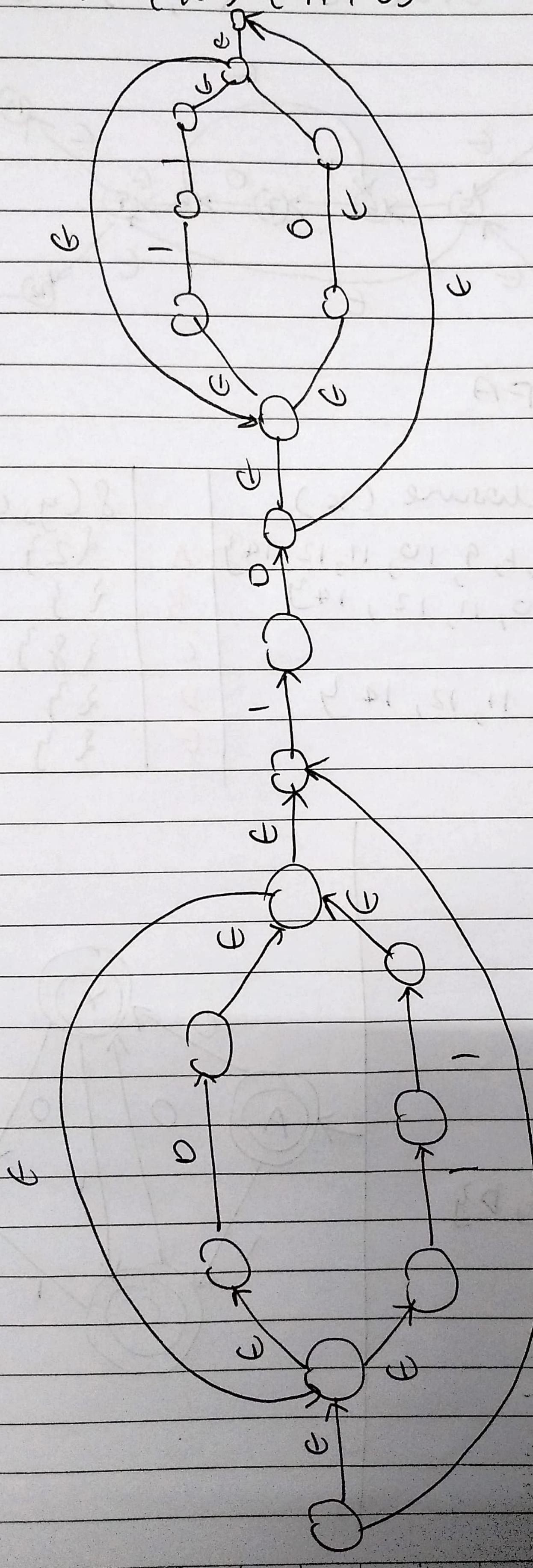
$|abcba| = 5$

$n = 1 \qquad 3 < |uv^2w| < 5$

Since L cannot contain any string of length 4, L is not regular

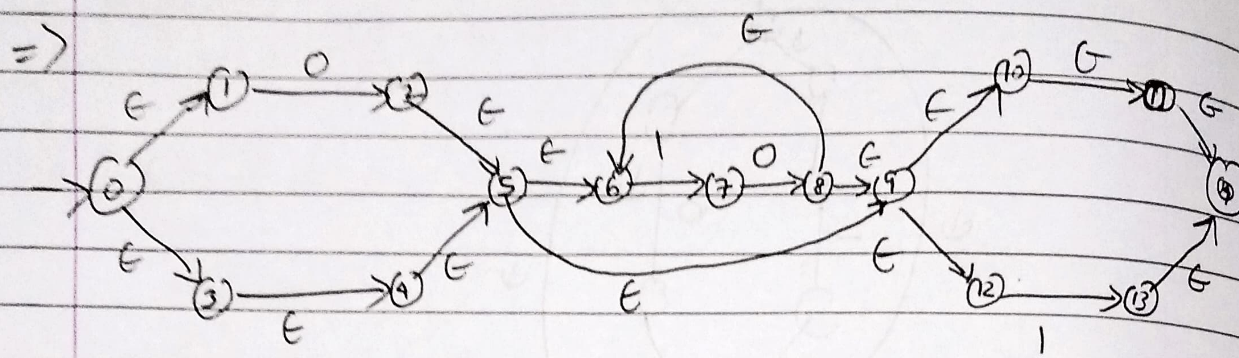
Q7) Convert the following RE to NFA-ε

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



Q8) Convert $(0+\epsilon)(10)^*(\epsilon+1)$ into NFA with ϵ moves over $\Sigma = \{0, 1\}$. Obtain DFA

=>



NFA to DFA

X	y = ε-closure (x)		δ(y, 0)	δ(y, 1)
{0}	{0, 1, 3, 4, 5, 6, 9, 10, 11, 12, 14}	A	{2}	{7, 13}
{2}	{2, 5, 6, 9, 10, 11, 12, 14}	B	{ }	{7, 13}
{7, 13}	{7, 13, 14}	C	{8}	{ }
{8}	{6, 8, 9, 10, 11, 12, 14}	D	{ }	{7, 13}
{ }	{ }	E	{ }	{ }

	a	b
* A	B	C
* B	E	C
* C	D	E
* D	E	C
E	E	E

Let X = {B, D}

	0	1
A*	X	C
X*	E	C
C*	X	E
E	E	E