

Page (1) ID No = 6946

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Paper :- Theory of Automata

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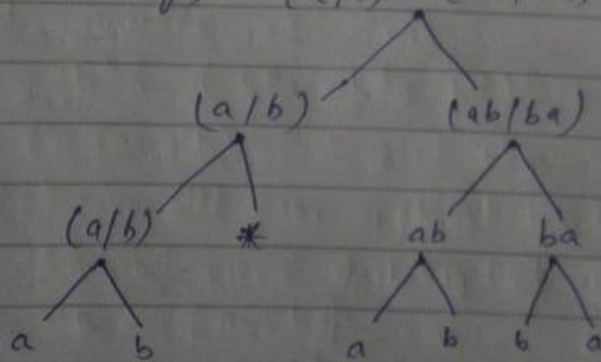
Q. (1) Parse the given RE into its individual / Atomic symbols and then design an NFA.

$(a/b)^* (ab/ba)$

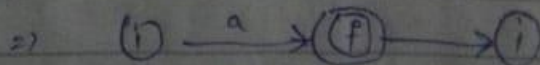
Ans

(1) $(a/b)^* (ab/ba)$

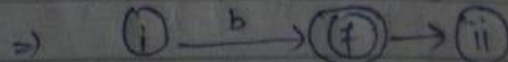
⇒ Parsing: $(a/b)^* (ab/ba)$



⇒ NFA for AS a;

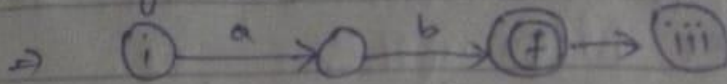


⇒ NFA for AS B;

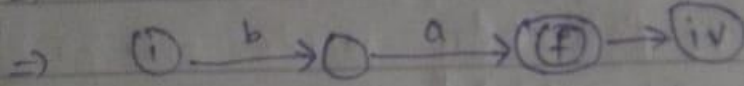


⇒ Now NFA for ab;

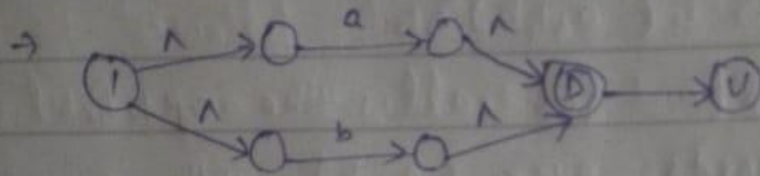
Combining (i) and (ii)



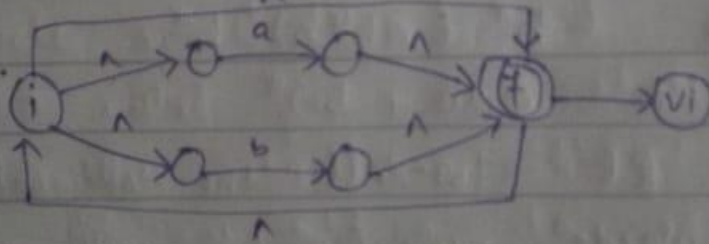
Now NFA for ba;



Now, NFA for a/b;

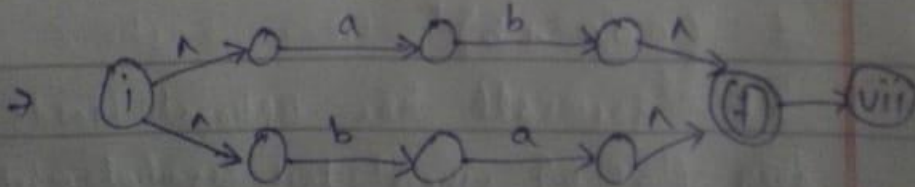


Now, NFA for (a/b)*

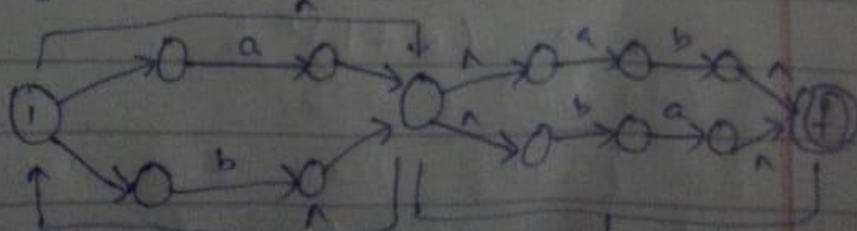


NFA for (ab/ba)

So combine (iii) ϵ_1 (iv)



Major NFA : (vi) ϵ_1 (vii)



Q: (2) Design RE for each of the following;

(i) RE for all optional words over $\{a, b\}$.

Ans(i) $(a/b)^*$
 $\rightarrow (a+b)^*$

(ii) RE for all the optional words over $\{a, b\}$ with an even number of "a".

Ans(ii) $b^* (ab^*a)^+ b^*$
 $\rightarrow (aa + b)^*$

(iii) RE for all the optional words over $\{a, b\}$ with an odd number of "a".

Ans(iii) $b^* a (b^* a b^* a b^*)^*$
 $\rightarrow (aaa + b)^*$

(iv) RE for all the optional words over $\{a, b\}$ where last symbol must be b.

Ans $\rightarrow b [a, b]^*$
 $\rightarrow (a+b)^* b$

(P-T-O)



(v) RE for all the optional words over $[a, b]$ where first symbol must be b or b^* .

Ans $\rightarrow b(a+b)^*$

Q. (3) Prove that $(a/b)^* \neq a^*b^*$

Ans (3) Part (a)

$$(a/b)^* \neq a^*b^*$$

\rightarrow for $(a/b)^*$

$$(a/b)^* = \Lambda$$

$$(a/b)^2 = a^0b^1, a^1b^0, a^2b^2, \dots$$

$$(a/b)^2 = aa, ab, ba, bb, \dots$$

$$\text{So } (a/b)^* = \{\Lambda, a, b, aa, ab, ba, bb, \dots\} \rightarrow \text{①}$$

$$a^*b^* = \{\Lambda, a, ab, b, bb, \dots\} \rightarrow \text{②}$$

for a^*b^*

$$a^*b^* = \Lambda = \Lambda$$

$$a^1b^0 = a$$

$$a^1b^1 = ab$$

$$a^0b^1 = b$$

$$a^*b^* = \{\Lambda, a, ab, b, bb, \dots\} \rightarrow \text{②}$$

Hence prove that $(a/b)^* \neq a^*b^*$.

Now $(a/b)^*$ mean no sure sequence.

It can be aa, ab, ba, bb whereas

a^*b^* mean $ab, aabb, abb$

Hence proved that

$$(a/b)^* \neq a^*b^*$$

Q. (3) Part (b) Derive language (statements) for the following RE.

(i) $(a/b)(a/b)b(a/b)^*$

language for words over $\{a, b\}$ which starts with 'aa' or 'ab' or 'ba' or 'bb' followed by b and ends with any letters.

(ii) $(a/b)^* b (a/b)(a/b)$

$L = \{a, b\}$ where string starts with any letter followed by 'b' and ends with 'aa' or 'ab' or 'ba' or 'bb'.

(iii) $(a/b)^* (aa/bb)$

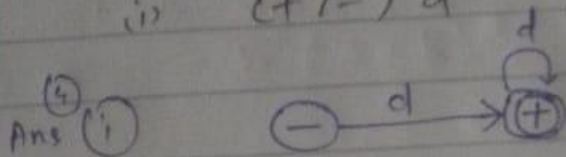
$L = \{a, b\}$ where last symbol must be two 'aa' or two b's. string must end with 'aa' or 'bb'.

(iv) $(aa/bb)(a/b)^*$

$L = \{a, b\}$ where first symbol must be aa or bb string must start with 'aa' or 'bb'.

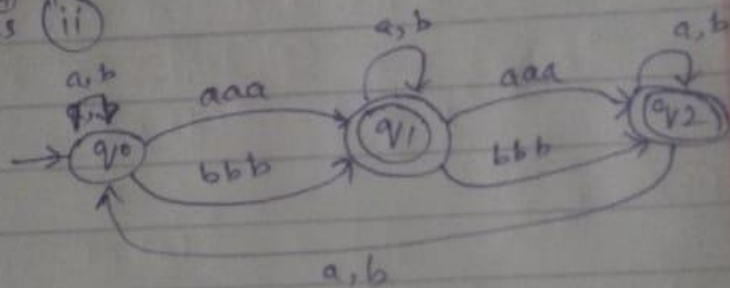
Q. (4) Design NFA for the following without parsing.

i) $(+/-) d^+$



ii) $(a/b)^* (aaa/bbb)(a/b)^*$

Ans (4) (ii)



The End

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