

Theory of Automata
(CSAL3253)
Assignment no 3



Submitted to
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Section: F3
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Problem 1.

Find a regular expression corresponding to each of the following subsets of $[a,b]^*$.

1. The language of all strings with no a's containing exactly two a's.

$$b^* a b^* a b^*$$

2. The language of all strings containing at least two a's.

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

3. The language of all strings that do not end with ab.

$$(a+b)^* (bb + aa + ba) \\ (a+b)^* (a+bb)$$

4. The language of all strings that begin or end with aa or bb.

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

5. The language of strings not containing the substring aa.

$$b^* (ab^*)^*$$

6. The language of all string in which no of a's is even.

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

7. The language of all strings in which every a is followed immediately by bb .

$$(b + abb)^*$$

8. The language of all strings containing both bb and aba as substring.

$$(a+b)^* bb (a+b)^* aba (a+b)^* + (a+b)^* aba (a+b)^* bb (a+b)^*$$

9. The language of all strings not containing the substring aaa .

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

10. The language of all string not containing the substring bba .

$$(a+ba)^* \{ \epsilon + b(l+b^*) \}$$

11. The language of all strings containing both bab and aba as substring.

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

Problem #2:

1) Consider following regular expression.

$$\{ (aa+bb) + (ab+ba)(aa+bb)^* (ab+ba) \}^*$$

2) Generate strings aabbababbbbba what will be value at outer star and inner star during generating the string show complete generation.

1 outer 1 inner 0

aa

2 at outer 2 inner 0

aabb

3 at outer 3 inner 2

aabbabaaaabbaba

4 outer 4 inner 0

aabbabaaaabbbaaa

Overall:

$$\{ (aa+bb) + (ab+ba)(aa+bb)^* (ab+ba) \}^G$$

b Generate strings $a\bar{b}a\bar{a}bbbaabbaaa$ what will be value ----?

1 Outer 1 inner 1

$a\bar{b}a\bar{a}$

2 Outer 1 + inner 2

$a\bar{b}a\bar{a}bbba$

3 Outer 2 inner 2

$a\bar{b}a\bar{a}bbba\bar{a}\bar{b}ba$

4 Outer 3 inner 2

$a\bar{b}a\bar{a}bbba\bar{a}bbbaas$

Overall

$$[(aa+bb)+(ab+ba)(aa+bb)(ab+ba)]$$

2 Consider following regular expression $(aa+aab)^*b$

Generate the string $aabbbaabb$ what will value of '*'.

$$(aa+aab)^3 b$$

Hence star value is 3

Problem 3.

Describe following regular expression which types of string will be generated.

P - mean decimal point.

d - means digit.

E - mean Exponent.

$$Sdd^* (A + pd^*) (1 + E Sdd^*)$$

$$S = \{1, +, -\}$$

$$d = \{0, 1, \dots, 9\}$$

Generate at least 5 valid strings.

1 - 75

2 0.88E-5

3 434

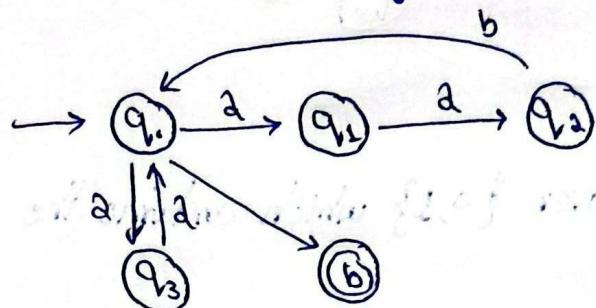
4 +38

5 - 2.75E+2

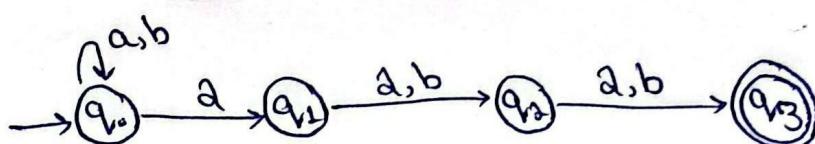
Problem 4.

Draw NFAs of the following languages.

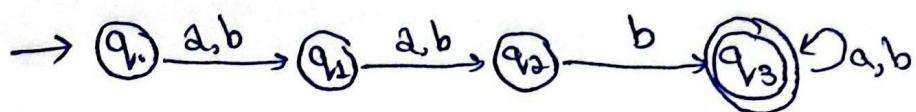
1 $\{aa + aab\}^* \{b\}$



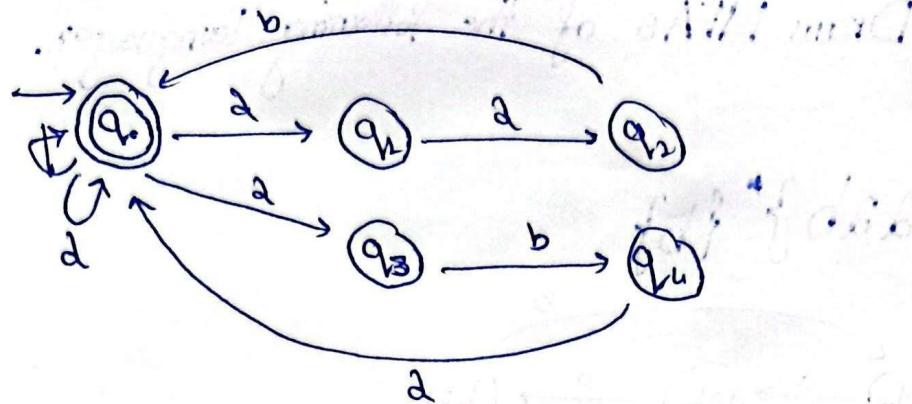
- 2 Design an NFA of languages over $\{a,b\}$ which contains the string with third last alphabet is a.



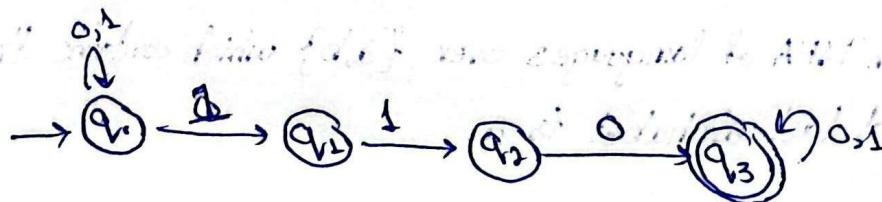
- 3 Design an NFA of languages over $\{a,b\}$ which contains the string with third alphabets is b.



4 $\{aab\}^* \{a, aba\}$



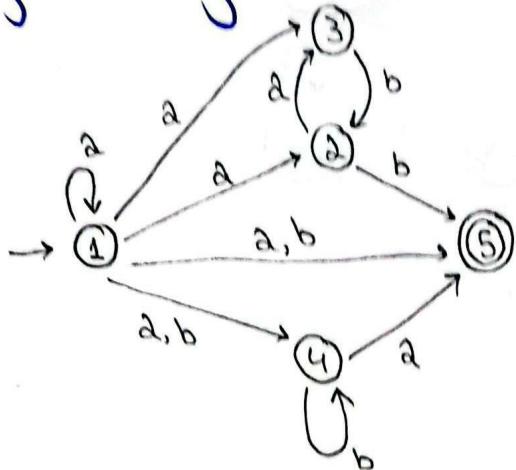
5 Design NFA of language over $\{0,1\}$ which contains the substring 110.



Problem 4.

Convert following NFAs to DFAs:

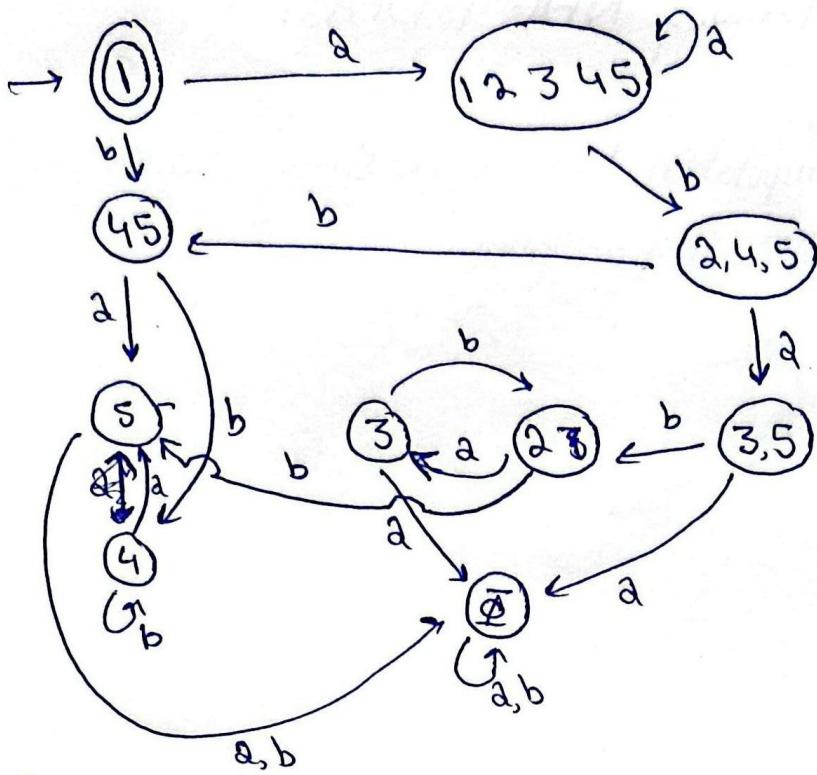
- 1) Also draw the computation tree of the string (aaababb) using following NFA. Is it accepted.



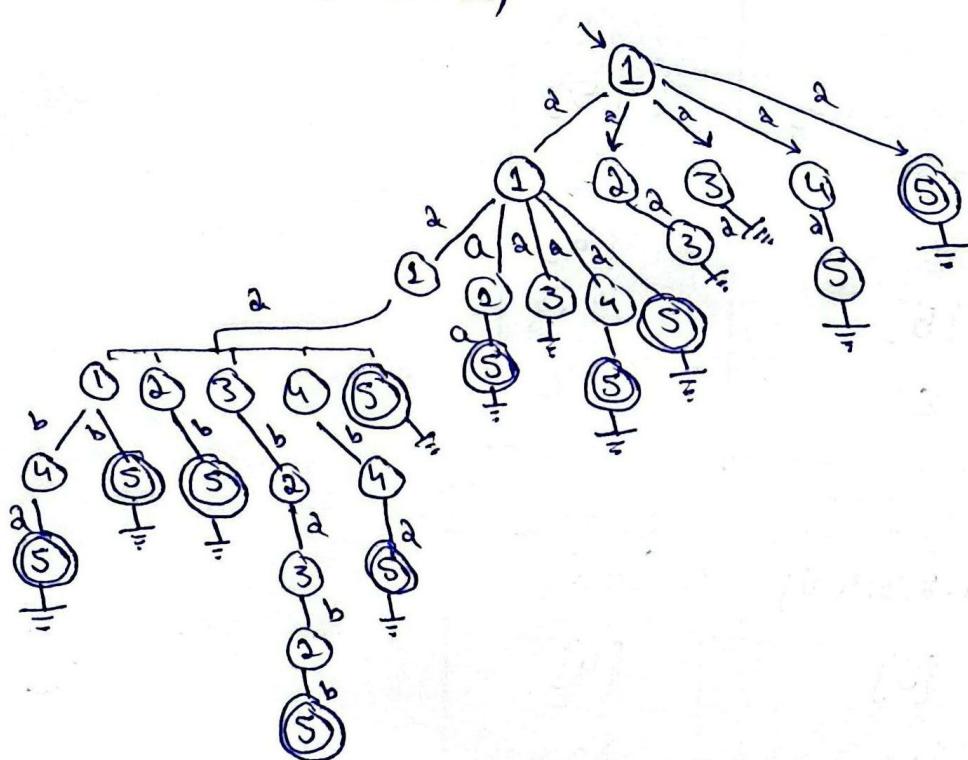
q	$\delta(q, a)$	$\delta(q, b)$
1	{1, 2, 3, 4, 5}	{4, 5}
2	{3}	{5}
3	\emptyset	{2}
4	{5}	{4}
5	\emptyset	\emptyset

q	$\delta(q, a)$	$\delta(q, b)$
1	{1, 2, 3, 4, 5}	{4, 5}
{4, 5}	{5}	{4}
{1, 2, 3, 4, 5}	{1, 2, 3, 4, 5}	{2, 4, 5}
{3, 5}	\emptyset	{5}

DFA:

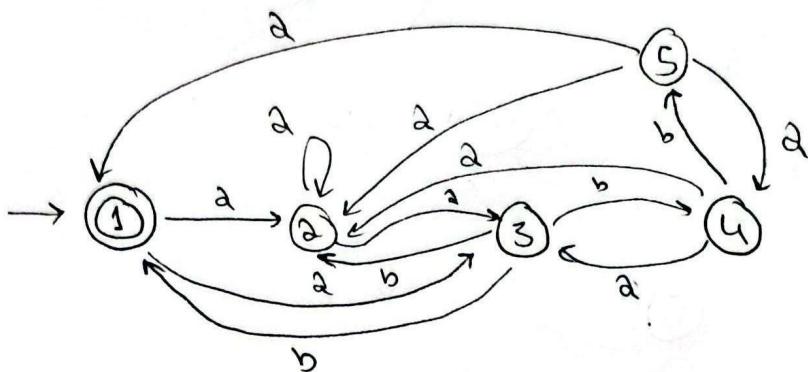


Tree of NFA ($aabbabb$)



Yes, the string is accepted.

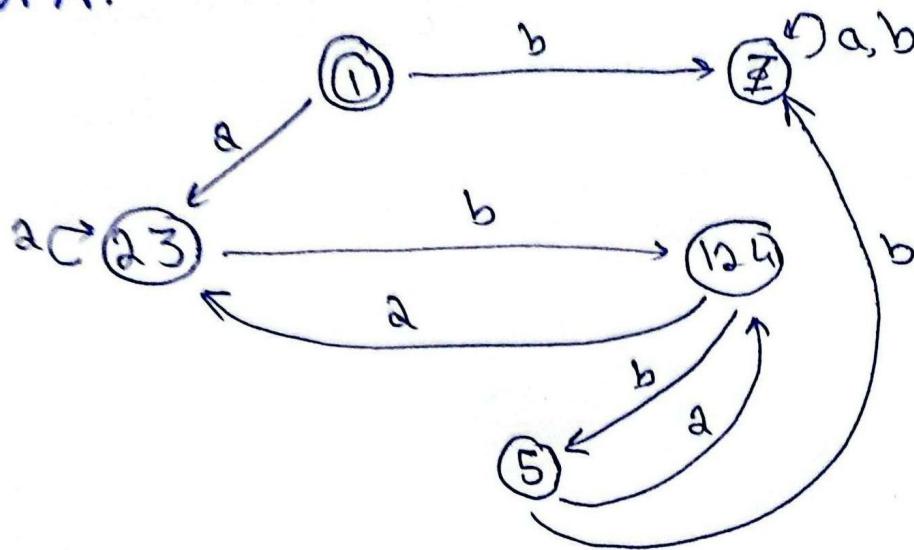
2) Also draw the computation tree of string (aababbbaaa)
Using following NFA. Is it accepted.



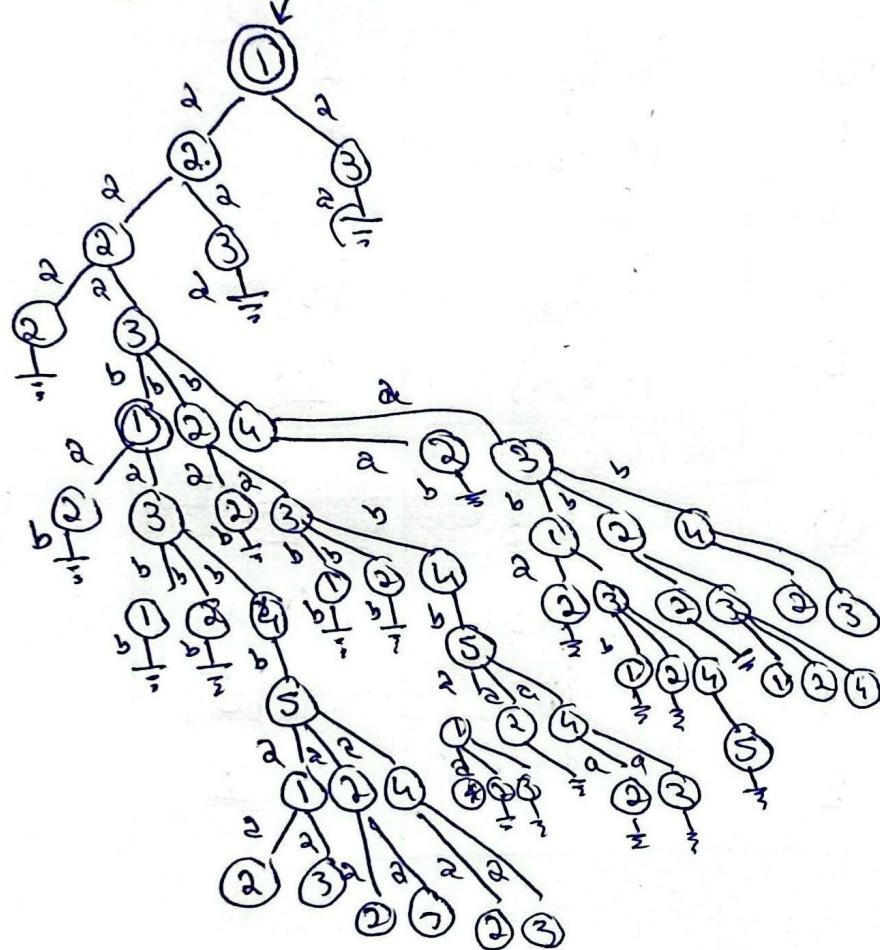
q	$\varrho(q, a)$	$\varrho(q, b)$
$\rightarrow 1$	$\{2, 3\}$	\emptyset
2	$\{2, 3\}$	\emptyset
3	\emptyset	$\{1, 2, 4\}$
4	$\{2, 3\}$	$\{5\}$
5	$\{1, 2, 4\}$	\emptyset

q	$\varrho(q, a)$	$\varrho(q, b)$
1	2 3	\emptyset
2 3	$\{2, 3\}$	$\{1, 2, 4\}$
1 2 4	$\{2, 3\}$	$\{5\}$
5	$\{1, 2, 4\}$	\emptyset

DFA:

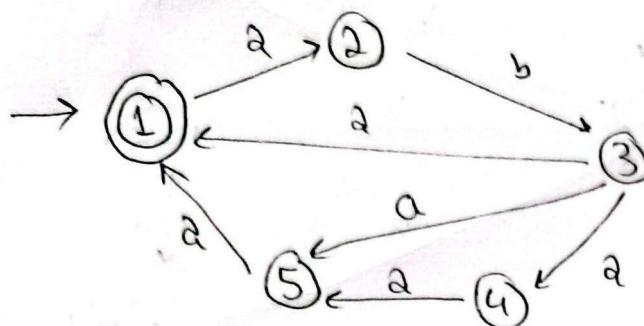


Tree of NFA for string (aaababbbaa)



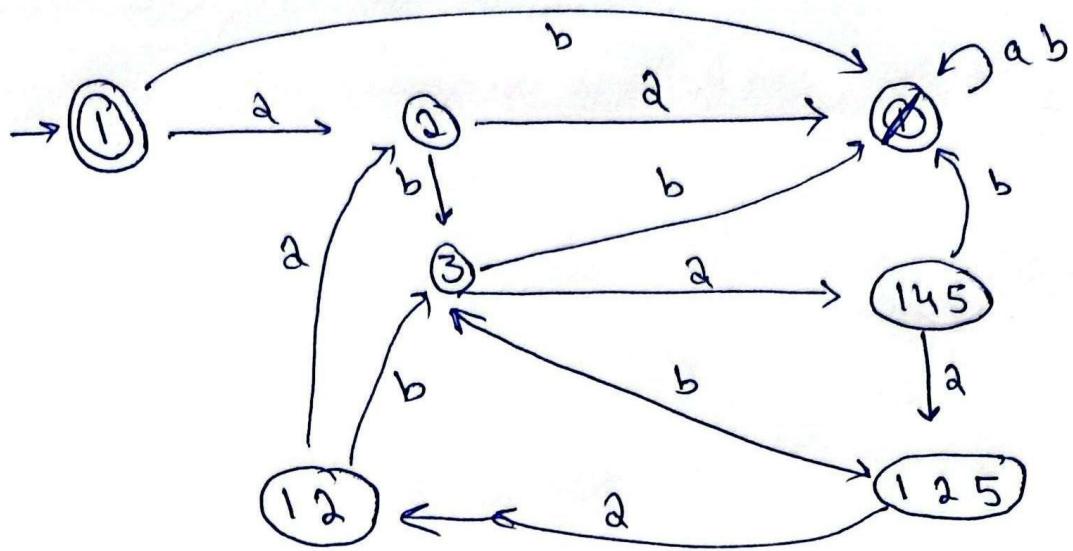
The string not accepted.

3' Also draw the computation of the string (abaaabaaaaaa) Using following NFA. Is it accepted?

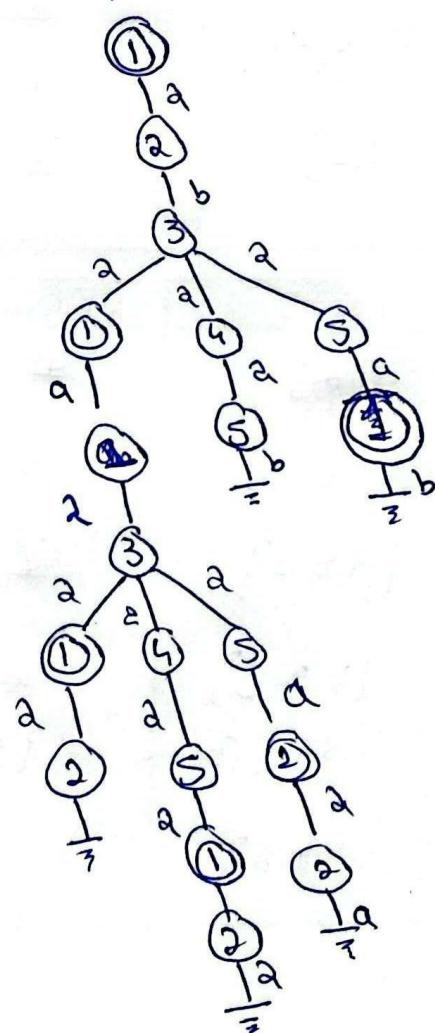


q	$S(q, a)$	$S(q, b)$
$\rightarrow 1$	{2}	\emptyset
2	\emptyset	{3}
3	{4, 5, 1}	\emptyset
4	{5}	\emptyset
5	{1}	\emptyset

q	$S(q, a)$	$S(q, b)$
1	{2}	\emptyset
{2}	\emptyset	{3}
3	{4, 5, 1}	\emptyset
4, 5, 1	{1, 2, 5}	\emptyset
1, 2, 5	{1, 2}	{3}
1, 2	{2}	{3}



Tree of NFA of string abaabaaaaaa



The string is not accepted.