Tutorial 5

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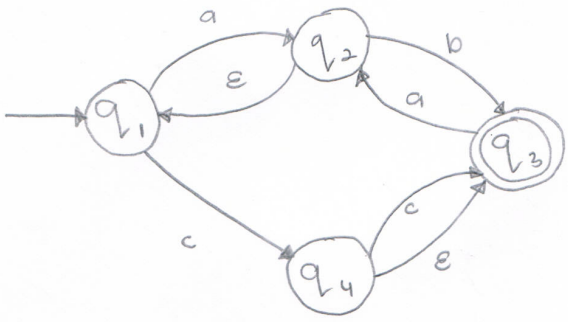
1. Consider the following NFA. Determine whether the following strings are IN or NOT IN the language by putting / writing them in the right column in Table 2.

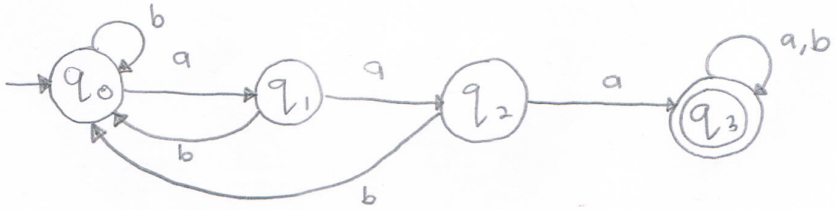


a, b, c, ab, ac, bc, aab, acc, acab, ca, cb, abab, abaab, cc, cab, caab, caa, ccab, ccaa, abacab.

Table 2

IN the language	NOT IN the language
a, c, ab, ac, aab, acc, ca, abab, abaab, cc, caab, caa, ccab, ccaa, abacab	b, bc, acab, cb, cab, ~~caab~~

2. Let M be the FA with state diagram.



(a) Construct the transition table of M. Is this a deterministic FA or not?

δ	a	b
q_0	q_1	q_0
q_1	q_2	q_0
q_2	q_3	q_0
q_3	q_3	q_3

= M is a deterministic FA

(b) Trace the computations that process the strings aaa, aab and baaab

$[q_0, aaa] \vdash [q_1, aa]$
$\vdash [q_2, a]$
$\vdash [q_3, \lambda]$ * Accepted

$[q_0, aab] \vdash [q_1, ab]$
$\vdash [q_2, b]$
$\vdash [q_0, \lambda]$
* Rejected

$[q_0, baaab] \vdash [q_0, aaab]$
$\vdash [q_1, aab]$
$\vdash [q_2, ab]$
$\vdash [q_3, b]$
$\vdash [q_3, \lambda]$ * Accepted.

(c) Which of the strings from (b) are accepted by M?

Strings aaa and baaab **

(d) Give a regular expression for L(M)

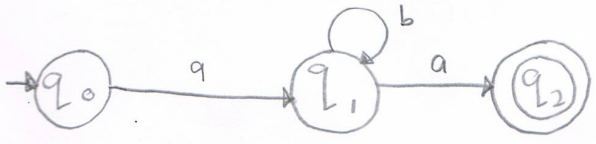
= $b^*aaa(a+b)^*$ **

3. Let M be a finite automaton defined by

$Q = \{q_0, q_1, q_2\}$
$\Sigma = \{a, b\}$
$q_0 = q_0$; $F = \{q_2\}$

δ	a	b
q_0	q_1	-
q_1	q_2	q_1
q_2	-	-

(a) Give a state diagram (FA) for this state table. Is this a deterministic FA or not?



= The state table is not deterministic due to undefined ~~trasi~~ transitions of L

(b) Trace the computations that process the strings aa, bb, and abba.

$[q_0, aa] \vdash [q_1, a]$

$\vdash [q_2, \lambda]$

* Accepted

$[q_0, bb] \vdash$ * Rejected

$[q_0, abba] \vdash [q_1, bba]$

$\vdash [q_1, ba]$

$\vdash [q_1, a]$

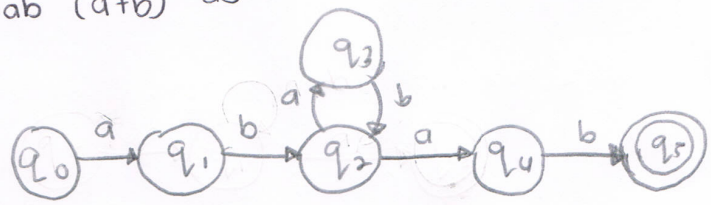
$\vdash [q_2, \lambda]$ * Accepted.

(c) Give a regular expression for the language accepted by M.

$= ab^*a$

4. Write a regular expression and a finite automata for $L_1 = \{wuw : |w| = 2; w, u \in \Sigma^*\}. \Sigma = \{a, b\}$.

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



Consider the languages in Table 2. Match them with the Regular Expressions (RE) from Table 3 and Finite Automata (FA) from Table 4. The alphabet is $\Sigma = \{a, b\}$.

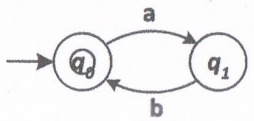
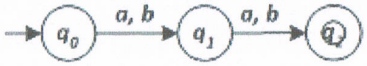
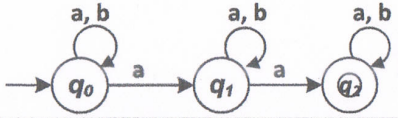
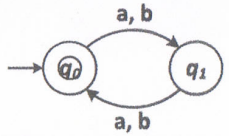
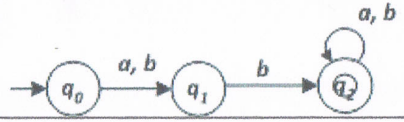
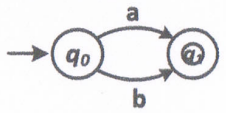
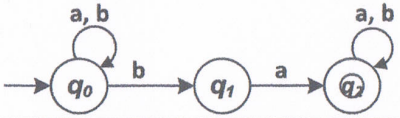
Table 2.

o.	The language of ...
1.	All strings.
2.	All strings except empty string.
3.	All strings that start with zero or more *a*'s and followed by zero or more *b*'s.
4.	All strings that contain only zero or more substring *ab*.
5.	All strings that contain of one *a* or one *b* only.
6.	All strings that contain the substring *ba*.
7.	All strings starting with *ba*.

Table 3.

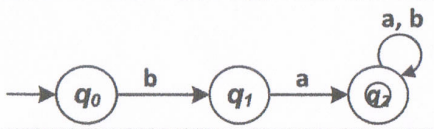
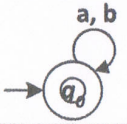
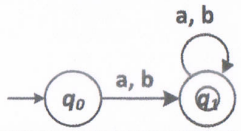
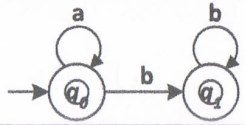
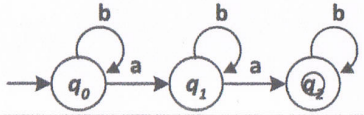
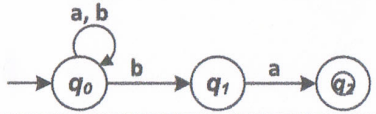
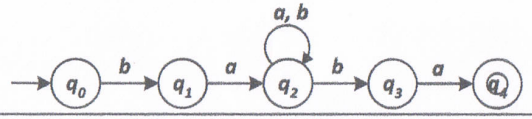
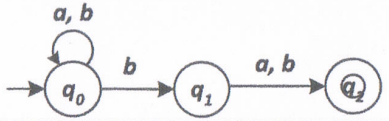
Matched no.	Regular Expressions (RE)
5	(a + b)
6	(a + b)*ba(a + b)*
7	ba(a + b)*
1	(a + b)*
2	$(a + b)^+$
4	a*b*
3	(ab)*

Table 4.

Matched no.	Finite Automata(FA)
3	
2	
12	
10	
15	
5	
6	

6.	All strings ending with *ba*.
7.	All strings that begin AND end with *ba*.
10.	All strings of even length
1.	All strings containing exactly two *a*'s.
12.	All strings containing at least two *a*'s.
3.	All strings of length two.
4.	The language of all strings with *b* as the second last letter.
5.	The language of all strings with *b* as the second letter.

12	$(a + b)^*a(a + b)^*a(a + b)^*$
13	((a + b)(a + b))
14	$(a + b)^*b(a + b)$
15	$(a + b)b(a + b)^*$
8	(a + b)*ba
9	ba(a + b)*ba
10	((a + b)(a + b))*
11	$b^*ab^*ab^*$

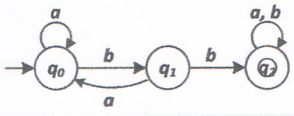
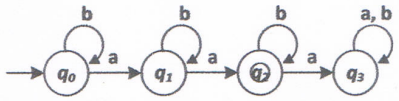
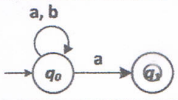
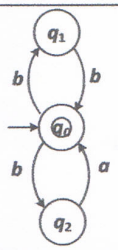
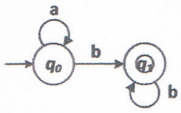
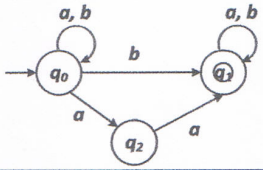
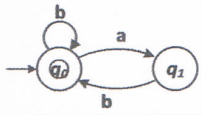
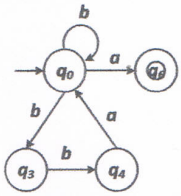
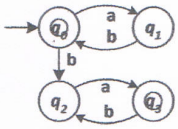
7	
1	
13	
4	
11	
8	
9	
14	

6. Consider the Regular Expressions in Table 8. Match them with the Finite Automata (FA) from Table 9. The alphabet is $\Sigma = \{a, b\}$.

Table 8.

No.	Regular Expressions (RE)
~~1.~~	(a + b)*a
~~2.~~	a*b$^+$
~~3.~~	b*ab*ab*
4.	(a + b)*bb(a + b)*
~~5.~~	(*bb* + *ba*)*
~~6.~~	(ab)*ba
7.	(ab)*(ba)*
~~8.~~	(*b* + *bba*)**a*
~~9.~~	(*a* + *b*)*(*b* + *aa*)(*a* + *b*)*
~~10.~~	(b + ab)*

Table 9.

Matched No.	Finite Automata (FA)
4	
3	
1	
5	
2	
9	
10	
8	
7	
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