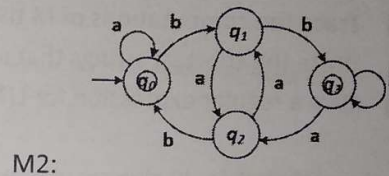
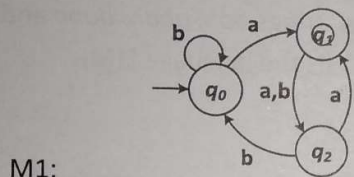


TUTORIAL 3

SCSJ3203 THEORY OF COMPUTER SCIENCE

Question 1

The following are the state diagrams of two DFA's, M1 and M2. Answer the following questions about each of these machines.



- What is the start state for M1 and M2?
- What is their set of accepting states?
- What is sequence of states does the machines go through on input *aabb*?
- Do the machines accept the string *aabb*?
- Do the machines accept the string ϵ ?
- Give the formal description of the machines M1 and M2.

Question 2

Let M be a finite automaton defined by

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

- Give a state diagram (FA) for this state table.
- Trace the computations that process the strings *abbb*, *bbb*, *baa* and *baab*.

Sample Answer: b)

$[q_0, \mathbf{abbb}] \vdash [q_1, \mathbf{bbb}]$
 $\vdash [q_0, \mathbf{bb}]$
 $\vdash [q_1, \mathbf{b}]$
 $\vdash [q_0, \mathbf{\lambda}]$

Stop at q_0 (final state) and all alphabet is traced (string is empty);
Hence, string **abbb** is **accepted** by the machine.

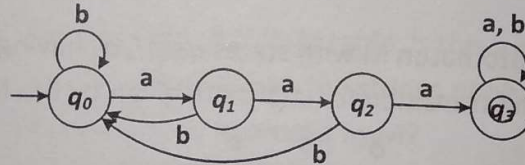
$[q_0, \mathbf{bbb}] \vdash [q_1, \mathbf{bb}]$
 $\vdash [q_0, \mathbf{b}]$
 $\vdash [q_1, \mathbf{\lambda}]$

All alphabet is traced (string is empty) but stop at q_1 (not final state) ;
Hence, string **bbb** is **not accepted** by the machine.

- c) Which of the strings in (b) are accepted by M?
- d) Give a regular expression for the language accepted by M.

Question 3

Let M be the FA with state diagram



- a) Construct the transition table of M. Is this a deterministic FA or not?
- b) Trace the computations of M that process the strings *aaa*, *aab* and *baaab*.
- c) Which of the strings from (b) are accepted by M?
- d) Give a regular expression for L(M).

Question 4

For the alphabet $\{a, b\}$ give regular expression and draw finite automata for the following languages:

- a) $L_1 =$ All strings.
- b) $L_2 =$ All strings except empty string.
- c) $L_3 =$ All strings starting with *ba*.
- d) $L_4 =$ All strings ending with *ba*.
- e) $L_5 =$ All strings that begin AND end with *ba*.
- f) $L_6 =$ All strings that begin OR end with *ba*.
- g) $L_7 =$ All strings that contain the substring *ab*.
- h) $L_8 =$ All strings that contain the substring *ba*.
- i) $L_9 =$ All strings that contain the substring *ab* or *ba*.
- j) $L_{10} =$ All strings containing exactly two *b*'s.
- k) $L_{11} =$ All strings containing at least two *b*'s.

Sample Answer:

a) $(a+b)^*$	<pre>graph LR; q0(((q0))) -- "a, b" --> q0</pre>
b) $(a+b)^+$	<pre>graph LR; q0((q0)) -- "a, b" --> q1(((q1))) q1 -- "a, b" --> q1</pre>

Question 5

Give the state diagram of an FA that accepts the following languages.

- a) $(a+b)^*a$
- b) $(bb+ba)^*$
- c) $(ab)^*ba$
- d) $(ab)^*(ba)^*$
- e) $(ab^*a)^*$