Theory of Automata and Formal Language

Lecture-35

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Construction of TM

In this section, we shall see how TM's can be constructed.

Ex. Construct TM for the following languages:-

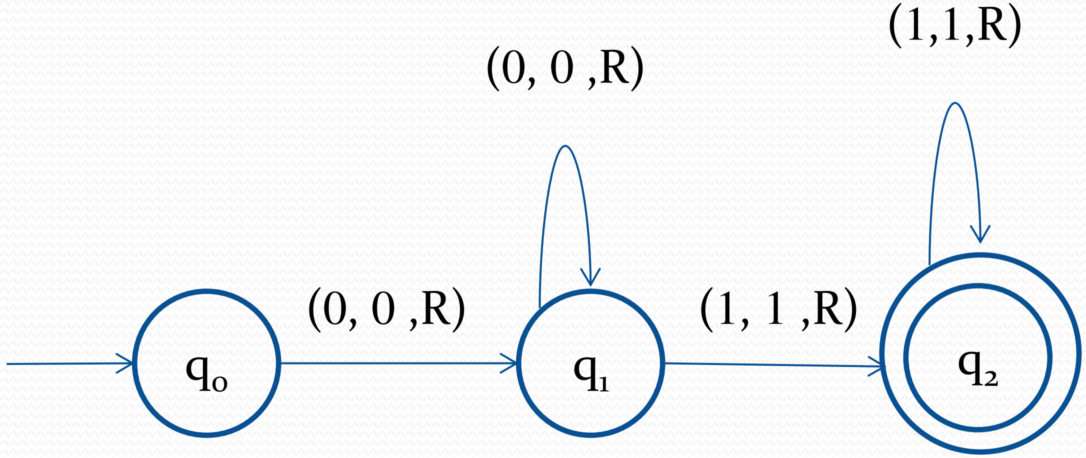
1) L = { $0^m 1^n$! m, n ≥ 1}
2) L= the set of all strings of 0 and 1 which contain 001 as a substring.
3) L= the set of all strings of 0 and 1 ending with 101.
4) L= the set of strings of a and b which contains at least one a's and exactly two b's.

Ex. L = { $0^m 1^n$! m, n ≥ 1}

Solution:

Procedure: First check given language is regular or not. If language is regular then first construct DFA for that language. After, convert it into TM.

Since this language is regular, Therefore the TM for this language will be



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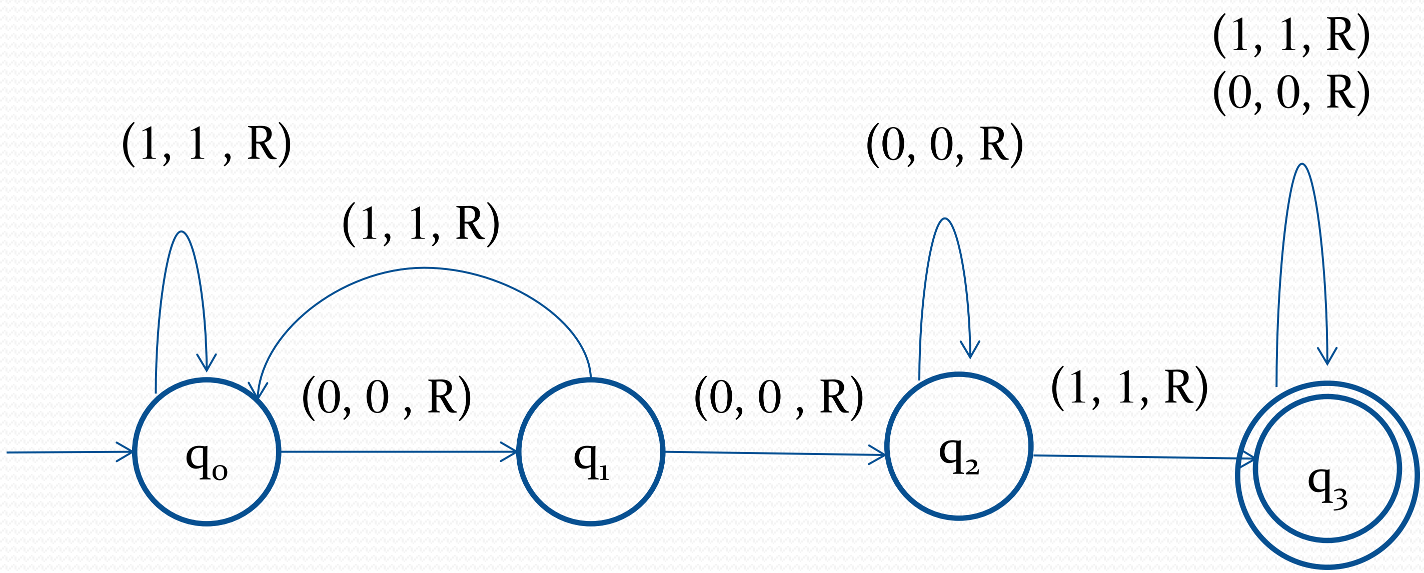


Ex. Construct Turing machine for the language

$$L = \{ 0^n1^n \; ! \; n \geq 1 \}.$$

Solution:

To construct Turing for a language, first we have to identify the pattern of strings belongs in to L. Some strings are 01, 0011, 000111 etc.

Now, you have to think, how machine move from initial ID to final ID.

Procedure: Initially machine starts at the initial state q_o. machine scan the tape string. If the current tape symbol is 0, then machine change its state, replace the current input symbol 0 by another tape symbol and also the head of machine move in the right direction.

Machine move in the right direction until 1 appears in the tape. As soon as 1 appears in the tape, machine replaces 1 by some another tape symbol, return to back i.e. move in the left direction and change its state.

$L = \{ 0^n 1^n ! n \geq 1 \}$

Machine move in the left direction till leftmost 0 appears in tape. As soon as, machine be reached at leftmost 0, its state becomes q_o.

we repeat the whole process till any 0 in the tape. As soon as, all 0's are deleted from tape, we check number of 1's in tape. If there is any 1's in the tape, then machine reject the string otherwise machine may accept the string.

Therefore, the TM corresponding to this language will be

$M=(\{q_o,q_1,q_2,q_3, q_4\}, \{0, 1\}, \{0, 1, x, y, B\}, q_o, B, \{q_4\})$

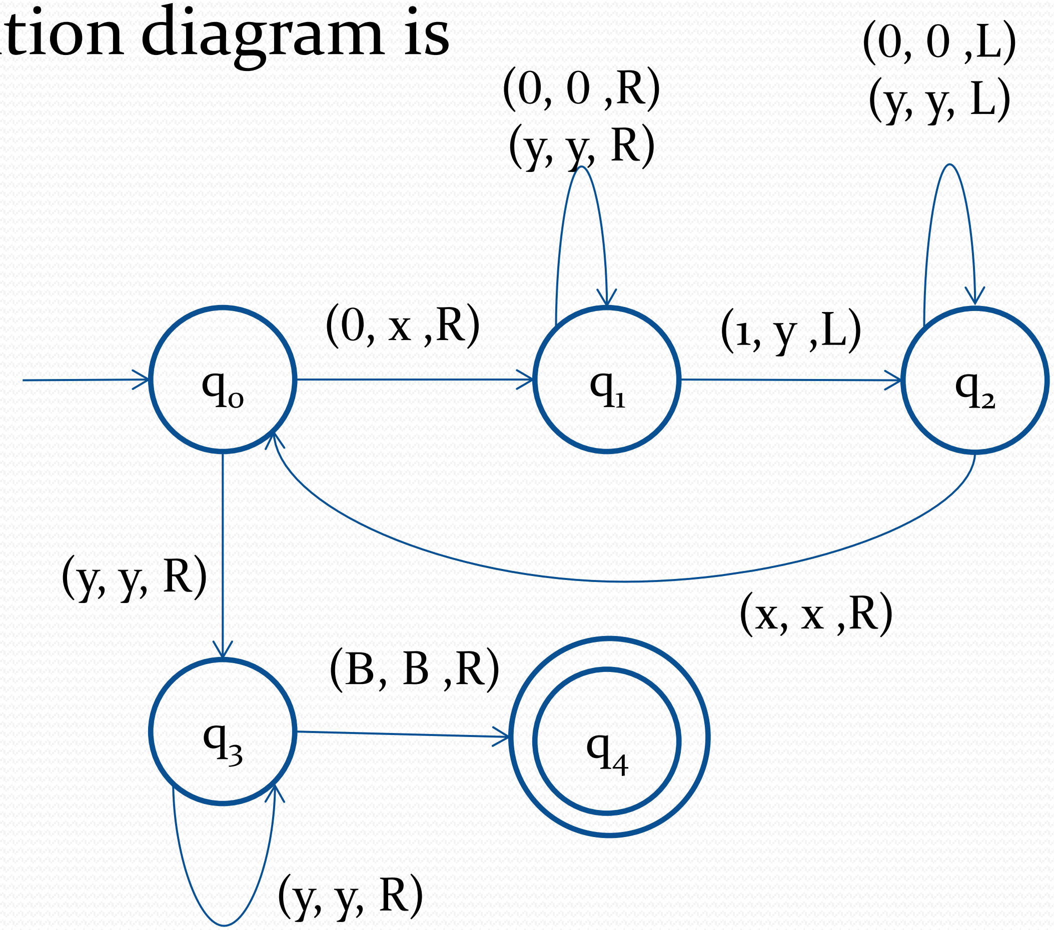
$L = \{ 0^n 1^n ! n \geq 1 \}$

Transition table is

δ	Tape symbols				
States	**0**	**1**	**x**	**y**	**B**
q_0	(q_1, x, R)			(q_3, y, R)	
q_1	$(q_1, 0, R)$	(q_2, y, L)		(q_1, y, R)	
q_2	$(q_2, 0, L)$		(q_0, x, R)	(q_2, y, L)	
q_3				(q_3, y, R)	(q_4, B, R)
q_4					

$L = \{ 0^n1^n \mid n \geq 1 \}$

Transition diagram is



Processing and Verification of TM

Acceptance

Consider string w = 0011 .

$q_0 0011 \vdash xq_1 011 \vdash x0q_1 11 \vdash xq_2 0y1 \vdash q_2 x0y1 \vdash xq_0 0y1 \vdash xxq_1 y1 \vdash xxyq_1 1 \vdash xxq_2 yy \vdash xq_2 xyy \vdash xxq_0 yy \vdash xxyq_3 y \vdash xxyyq_3 B \vdash xxyyBq_4 B$ (machine halts at final state)

Since machine halts at final state, therefore this string is accepted by TM.

Rejection

Consider string w = 011 .

$q_0 011 \vdash xq_1 11 \vdash q_2 xy1 \vdash xq_0 y1 \vdash xyq_3 1$ (machine halts at non-final state)

Since machine halts at non-final state, therefore this string is not accepted by TM.