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U19CS076

AFL Tutorial - 10

Q1] What do you understand by Turing recognizable and turing decidability.

Ans Turing recognizability is a property of any language if and only if these exist a Turing machine such that

→ When encountering a string in that language the machine terminates and accepts that string
→ When encountering a string not in that language. The machine terminates the string or it rejects it or does not terminate at all.

Turing decidability is property of a language if and if only if there exists a turing machine such that

→ When encountering a string in that language the machine terminates and accepts that string
→ When encountering a string not in that language the machine terminates and runs forever.

The "turing decidability" is stronger criteria than "turing recognizability" because if language is turing decidable then its turing machine does not run forever.

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Q2] Design a turing machine that accepts set of string over {0, 1} with equal number of 0s and 1s

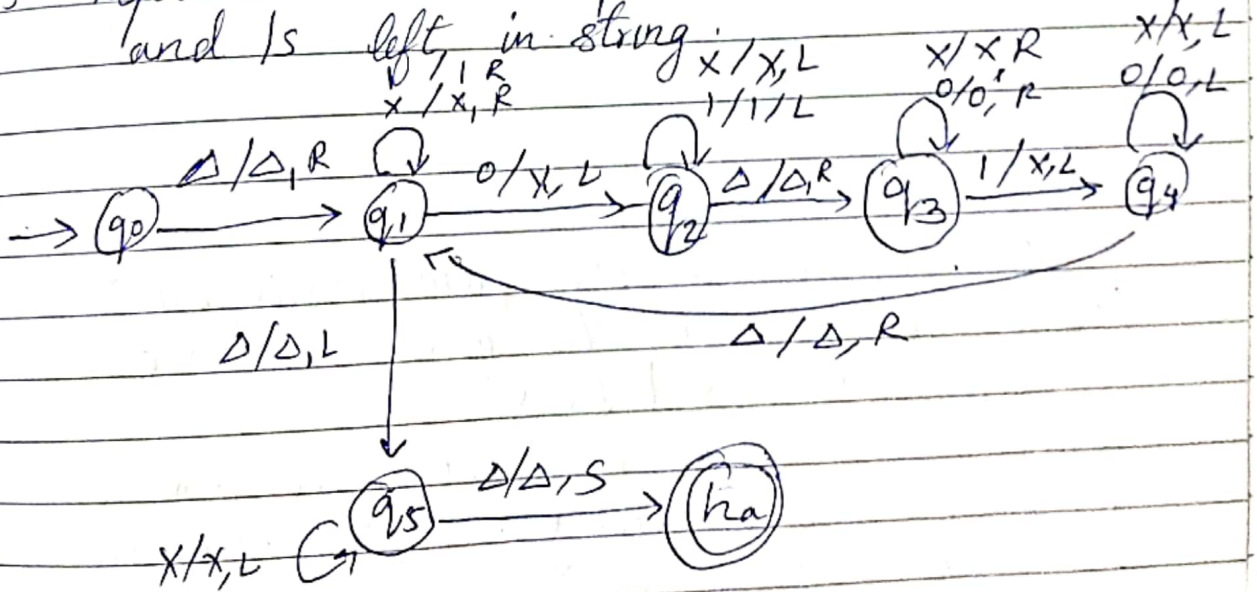
Ans. L = Same number of 0's and 1's

L = {01, 10, 0101, 1010, 1100 ....}

Logic

String → Δ (string) Δ

1. Keep moving right, read first element leftmost 0, replace 0 with x (0 → x)
2. Keep moving to left until you encounter Δ.
3. Move right, read first leftmost 1, replace 1 with x (1 → x)
4. Keep moving left until you encounter Δ.
5. Repeat the above steps until no more 0s and 1s left in string.



Q3] Design a deterministic turing machine that decides languages

$$\{ 0^n \mid 2^n \mid n >= 1 \}$$

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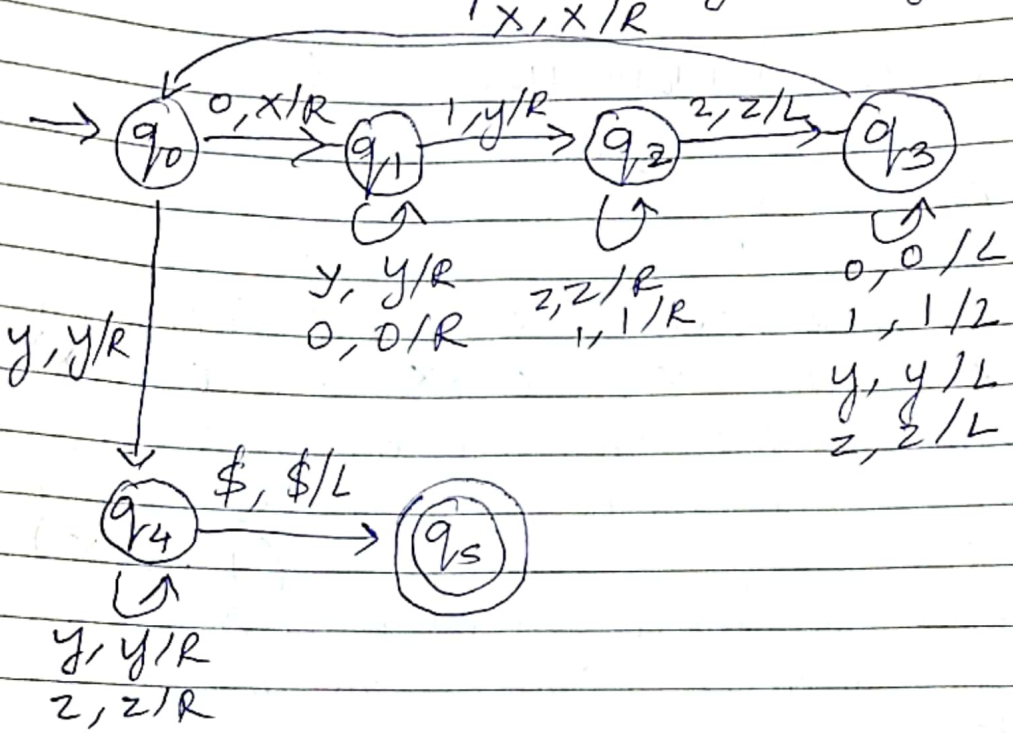
Ans Input eg :- 001122 ⇒ accepted

Assumption

We will replace 0 by X, 1 by Y and 2 by Z



Logic

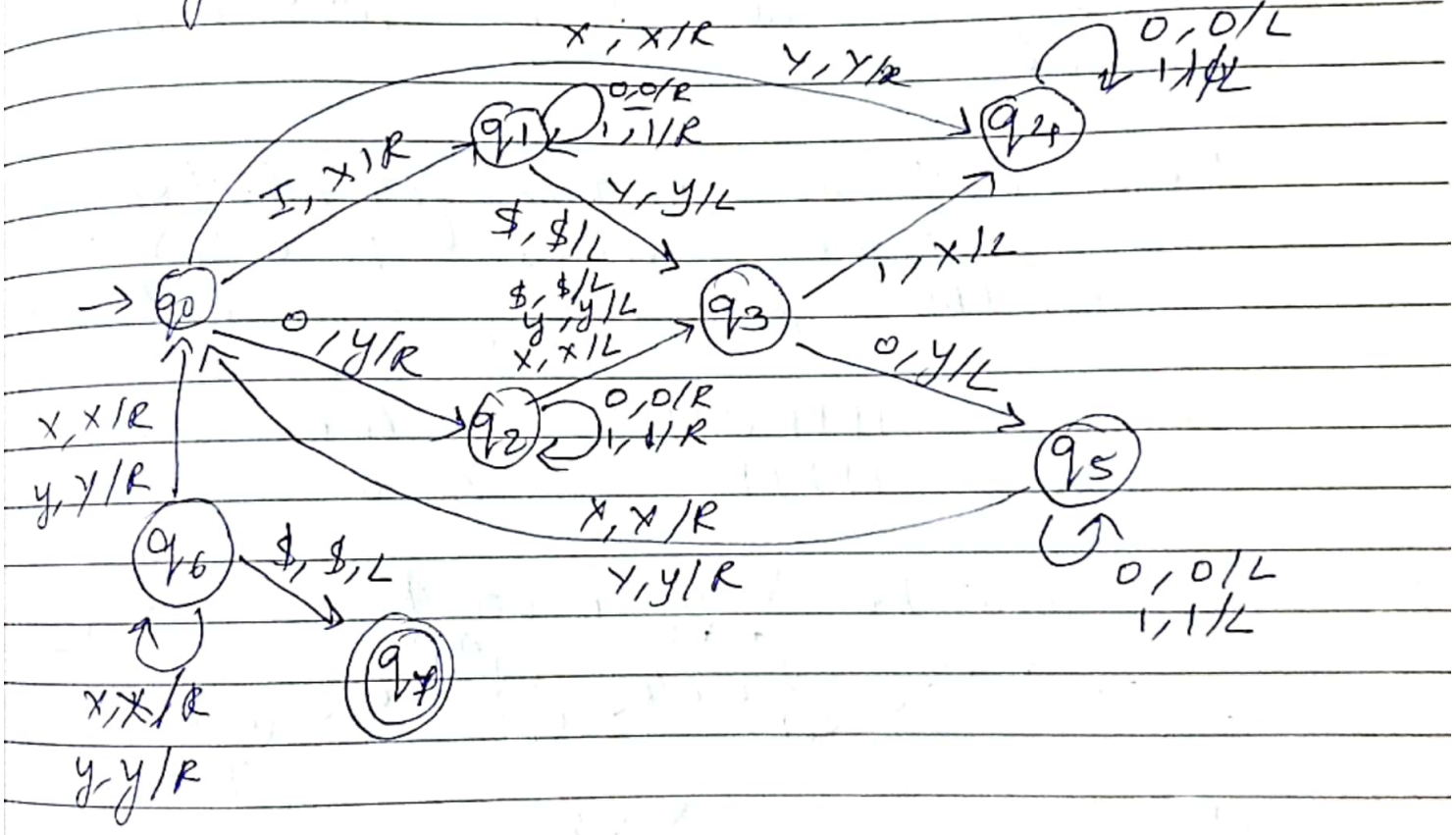
→ First replace a zero from front by X
→ Keep moving right till you find a 1 and replace this 1 by Y.
→ Keep moving right till you find a 2 replace it by Z and move left. Now keep moving left till you find X.
→ When you find X move a right and follow same procedure as above.
→ A condition comes when you find a X immediately followed by a Y; At this point we keep moving right and check that all 1's and 2's

are converted to Y and Z. If not then string is not accepted. If we reach that string is accepted.

Q4] Design a turing machine that accepts language $\{WW^R : W \in \{0,1\}\}$

Ans- The language $L = \{WW^R \mid W \in \{0,1\}\}$ represents a language where we use only 2 characters.

Eg: input :- 00111100 ⇒ Accepted.



Assumption - We will replace 0 by Y and 1 by X

Logic - First check the first symbol, if its 0 then replace it by Y and by X if it's 1. The

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go to end of string. So last symbol is same as first we replace it also by X or Y depending on it.

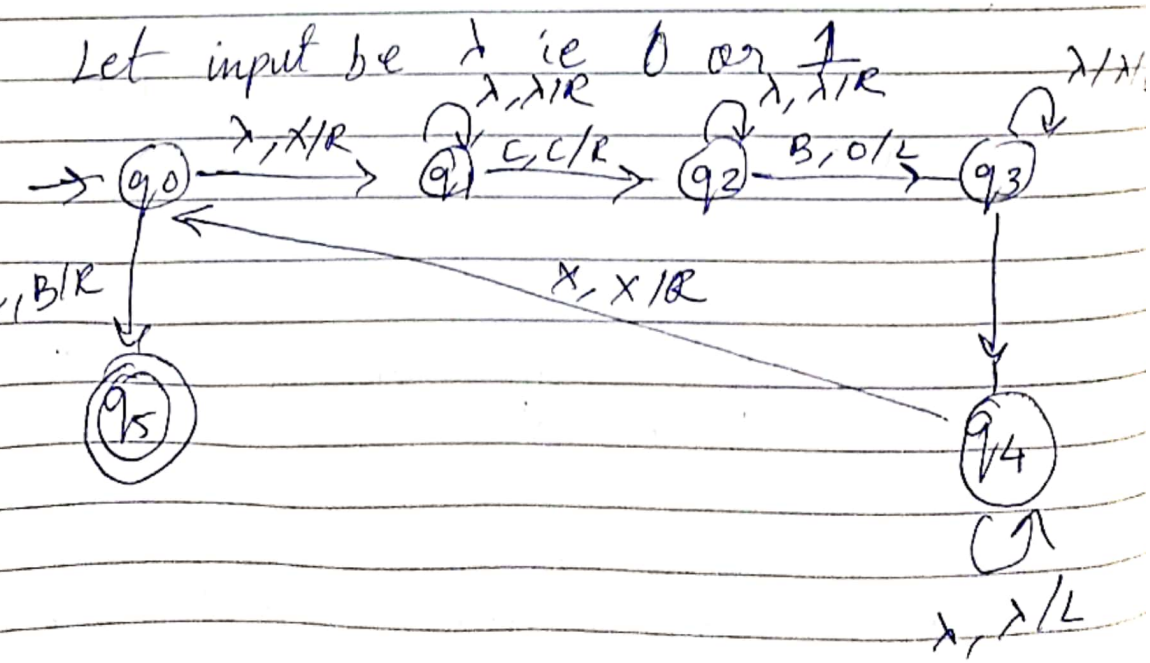
Now again come back to position next to symbol replace from starting and repeat same process as told above

One important thing is to note that since w^r is reverse of w of both of them will have equal number of symbols, every time we replace n^{th} symbol from begining of string replace a corresponding n^{th} symbol from end.

Q5] Design a turing machine for addition of binary string seperated by a 'c' considering TM follow unary format (0/1)

Input 111 c 11 ∴ 4 + 2
Output 111111 ∴ 6

Ans Let input be λ ie 0 or 1



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Approach

convert a 1 (or or 1) in first number to x and then traverse entire input and convert first blank encountered to 1, Then move left ignoring all 1s and c, come the position just next to x and then repeat the same procedure till time we get a 'c' o instead of x on returing convert c into blanks and addition is done.

Steps

1. Convert 1 into x and goto step 2, if symbol is c then convet to blank (B), move right, goto Step -6.
2. Keep ignoring A and move right Ignore C move right go to step 3.
3. Keep ignoring 0 and move right converd blank to 1 and move left. Go to step 4.
4. Keep ignoring 1's and move towards left Ignore c move left goto step 3.
5. Keep ignoring 1s and move left. Ignore a x, move left goto step F.
6. END.