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BSC 5th sem TOC

26/11/2021.

Answer ③ <u>Turing machine</u> :- Turing machine was invented by Alan Turing in 1936. it is used to Accept Recursive Enumerable languages.

A Turing machine consist of a tape of infinite length on which read and write operation can be performed. The tape consist of infinite cells on which each cell either contains input symbol or a special symbol called blank. It also consist of a head pointer which move in both directions. A Turing machine is expressed as 7 Tupple $(Q, T, B, \Sigma, \delta, q_0, f)$

where → Q = finite set of state

δ = transition function.

T = Tape alphabate

B = Blank symbol

Σ = input symbol

q_0 = Initial state

f = final state.

Answer ⑤ The intersection of two regular set is regular.

<u>proof</u> → let us take two regular expression

$RE_1 = a(a^*)$ and $RE_2 = (aa)^*$

so, $L_1 = \{a, aa, aaa, aaaa ...\}$ (strings of all possible length excluding null)

$L_2 = \{\epsilon, aa, aaaa, aaaaaa ...\}$ (string including null)

$L_1 \cap L_2 = \{aa, aaaa, aaaaaa ...\}$

$RE(L_1 \cap L_2) = aa(aa)^*$ which is a regular itself

Hence prooved

Ans(7) Let take a Binary No.

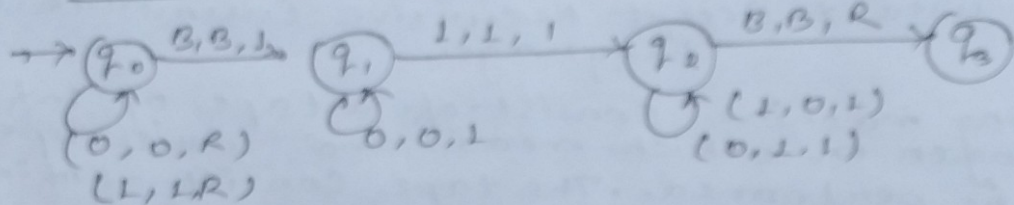
01011000

1's → 10100111

+1

2's → 10101000

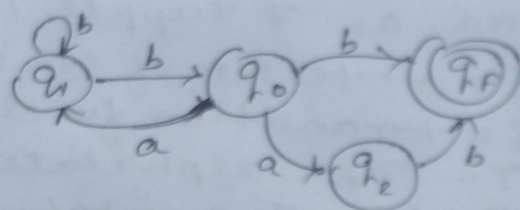
B	B	0	1	0	1	1	0	0	0	B	B



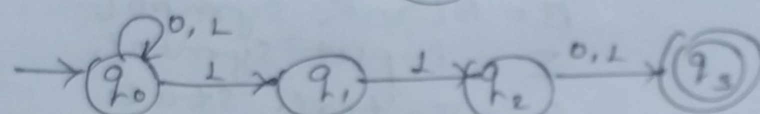
B	B	1	0	1	0	1	0	0	0	B	B

Answer(8) NFA for $(ab^*)^*b + ab$

(a)



(b)



Answer(9) $S \to a \mid absb \mid aAb$

$A \to bs \mid aAAb.$

(1) $S \to a$

(2) $S \to absb$ (not in CNF)

$S \to x_1 x_2$ (in CNF)

$x_1 \to ab$ (not in CNF)

$x_2 \to Sb$ (not in CNF)

$x_1 \to S x_3$ (in CNF)(where $S \to a$, $x_3 \to b$)

$x_2 \to S x_3$ (in CNF)(where $x_3 \to b$)

(3) $S \to aAb$ (not in CNF)

$S \to S x_4$ (in CNF)

$x_4 \to a$ (in CNF)

$x_4 \to Ab$ (not in CNF)

$x_4 \to A x_3$ (In CNF)

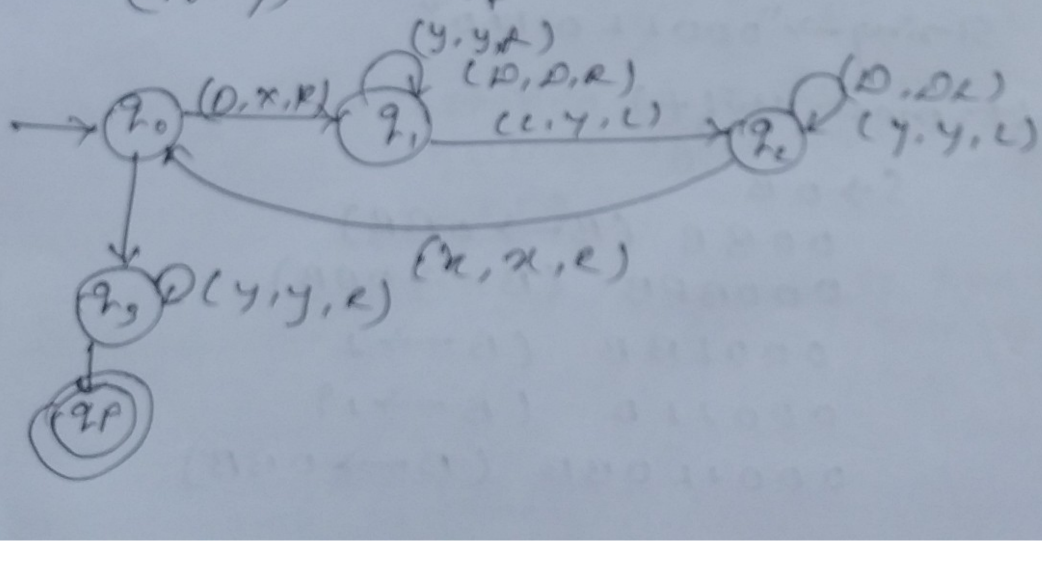
④ $A \rightarrow bS$ (not in CNF)
$A \rightarrow x_3 S$ (in CNF)

⑤ $A \rightarrow aAAb$ (not in CNF)
$A \rightarrow x_5 x_4$ (in CNF)
$x_5 \rightarrow aA$ (not in CNF)
$x_5 \rightarrow SA$ (in CNF).

Answer ⑯ for string DDDCCC

B	B	D	D	D	C	C	C	B	B

$(q_0, D) \rightarrow (x, q_1, R)$
$(q_1, D) \rightarrow (D, q_1, R)$
$(q_1, C) \rightarrow (y, q_2, L)$
$(q_2, D) \rightarrow (D, q_2, L)$
$(q_2, x) \rightarrow (x, q_0, L)$
$(q_0, D) \rightarrow (x, q_1, R)$
$(q_1, D) \rightarrow (D, q_1, R)$
$(q_1, y) \rightarrow (y, q_1, R)$
$(q_1, C) \rightarrow (y, q_2, L)$
$(q_2, y) \rightarrow (y, q_2, L)$
$(q_2, x) \rightarrow (x, q_0, R)$
$(q_0, D) \rightarrow (x, q_1, R)$
$(q_1, y) \rightarrow (y, q_1, R)$
$(q_1, C) \rightarrow (y, q_2, L)$
$(q_2, y) \rightarrow (y, q_2, L)$
$(q_0, y) \rightarrow q_f$



Answer (8) **NFA** :- Nondeterministic finite Automata. A finite Automata, is said to be non deterministic, if there is more than one possible transition from one state on the same input symbol. A nondeterministic finite automata is also set of five tuple.

$$m = \{Q, \Sigma, \delta, q_0, f\}$$

Difference between NFA & DFA

DFA	NFA
→ DFA stands for Deterministic finite Automata.	→ stands for non Deterministic finite Automata.
→ DFA cannot use Empty string transition.	→ NFA can use Empty string transition
→ DFA can be understood as one machine.	→ NFA can be under-stood as multiple little machine computing at the same time.
→ time needed for executing an input string is less.	→ ~~of~~ Time needed for executing an input string is more
→ Difficult to construst	→ Easy to construct

Answer (13) $S \rightarrow 0B \mid 1A$

$A \rightarrow 0S \mid 1AA \mid 0$

$B \rightarrow 1S \mid 0BB \mid 1$

String → "000110110"

(left most shift)

$S \rightarrow 0B$

$00BB \quad (B \rightarrow 0BB)$

$000BBB \quad (B \rightarrow 0BB)$

$0001BB \quad (B \rightarrow 1$

$00011B \quad (B \rightarrow 1)$

$000110BB \quad (B \rightarrow 0BB)$

000110 1B (B → 1)

00011011 S (B → 1S)

000110111A (S → A)

000110 1110 (A → 0)

(Right most shift)

S → 0B

00BB (B → 0BB)

00B1S (B → 1S)

00B11A (S → 1A)

00B110 (A → 0)

000BB110 (B → 0BB)

000B1S110 (B → 1S)

000B10B110 (S → 0B)

000B101110 (B → 1

0001101110 (B → 1)

Answer (12)

Alphabet → An alphapate is any finite set of symbols.

Ex → $\Sigma = \{a, b, c, d\}$ is an alphabet set where a, b, c, d are symbol.

String → A string is a finite sequence of symbols taken from Σ.

Ex → CabCad is a valid string on the alphapate set $\Sigma = \{a, b, c, d\}$

Substring → substring is a contiguous sequence of characters within a string.

empty string → Every alphabate has a special string called empty string which means the string with zero Occurrences of Symbols.

Final state → one that terminates transitions.
Initial state → The machine goes to one state only.

Answer (15) Grammar:— A phrase-structure grammar or a type 0 grammar is a 4-tuple G = (N, T, P, S) where N is a finite set of nonterminal symbols called the nonterminal alphabate, T is a infinite set of terminal symbols called the terminal alphate, S ∈ N is the start symbol and P is a set of productions of the form u→v, where $u \in (N \cup T)^* N (N \cup T)^*$ and $v \in (N \cup T)^*$.

Derivation tree:— We have considered the defition of a grammar and derivation. Each derivation can be represented by a tree called a derivation tree. A derivation tree for the derivation considered in previous example with grammar.

$S \to aSc$, $S \to aAc$, $A \to b$ is.

Ans (17)

(a) ab + b + bb + aaa

(c) RE = 00 + 11

(b) $b(bb)^*$

~~(c) (0+1)* 11 (0+1)* + (0+1)* 00 (0+1)*~~

(d) ab

(e) $1(0+1)^*0$.

Answer (7) Turing machine to find 2's complement of a binary number.

2's complement of a binary no. is 1 added to the 1's complement of the binary number.

Example

Input →	B	1	0	1	1	1	1	1	0	B
output →	B	0	1	0	0	0	0	1	0	B

Approach:-

① scanning input string from right to left

② pass all consecutive 0's

③ for first '1' comes do nothing

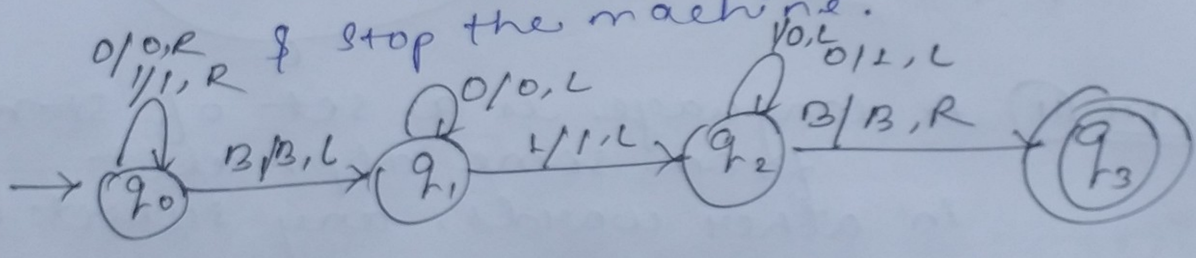
④ After that, converting 1's into 0's and converting 0's into 1's

⑤ stop blank is reached.

steps:- 1) first ignore all 0's and 1's and go to right & then if B found go to left

2) ~~step~~ Then ignore all 0's & go left if 1 found go to left.

3) convert all 0's into 1's and all 1's into 0's and go to left & if B found go to right. & stop the machine.



Answer (19) substracting "110"

NFA table

State	0	1
$\rightarrow q_0$	q_0	$\{q_0, q_1\}$
q_1	ϕ	q_2
q_2	q_3	ϕ
$*q_3$	q_3	q_3

DFA table

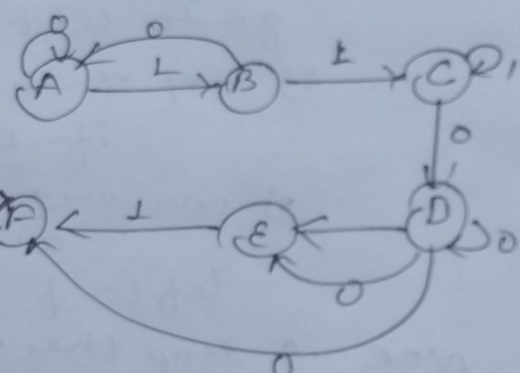
State	0	1
q_0	$\{q_0\}$	$\{q_0, q_1\}$
$\{q_0, q_1\}$	$\{q_0\}$	$\{q_0, q_1, q_2\}$
$\{q_0, q_1, q_2\}$	$\{q_0, q_3\}$	$\{q_0, q_1, q_2\}$
* $\{q_0, q_3\}$	$\{q_0, q_3\}$	$\{q_0, q_1, q_3\}$
* $\{q_0, q_1, q_3\}$	$\{q_0, q_3\}$	$\{q_0, q_1, q_2, q_3\}$
* $\{q_0, q_1, q_2, q_3\}$	$\{q_0, q_3\}$	$\{q_0, q_1, q_2, q_3\}$

Let $A = q_0$, $B = \{q_0, q_1\}$, $C = \{q_0, q_1, q_2\}$

$D = \{q_0, q_3\}$ $F = \{q_0, q_1, q_2, q_3\}$

$E = \{q_0, q_1, q_3\}$

State	0	1
A	A	B
B	A	C
C	D	C
* D	D	E
* E	D	F
* F	D	F



Answer (11) A language is a set of strings from some alphabet in other words, any subset L of Σ^* is a language in TOC.

Some special language are:-

→ { } The empty set

→ {s} A language containing on string.

Operations on language:-

- Union
- Intersection
- Difference
- Concatenation
- Kleen * closure.