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TE: IT-A
Roll No: 61

Subject :- AT

Experiment / Tutorial / Assignment No. :- 6

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Q.1) $L = \{a^m b^n c^{m+n} \mid m, n \geq 1\}$

$Q = \{q_0, q_1, q_2, q_3, q_f\}$

$\Sigma = \{a, b, c\}$

$\Gamma = \{Z, A, B\}$

$\delta q_0 = \{q_0\}$

$Z_0 = \{Z\}$

$F = \{q_f\}$

① For each 'a', push A :

$\delta(q_0, a, Z) = (q_1, AZ)$

$\delta(q_1, a, A) = (q_1, AA)$

② For each 'b', push B :

$\delta(q_1, b, A) = (q_2, BA)$

$\delta(q_2, b, B) = (q_2, BB)$

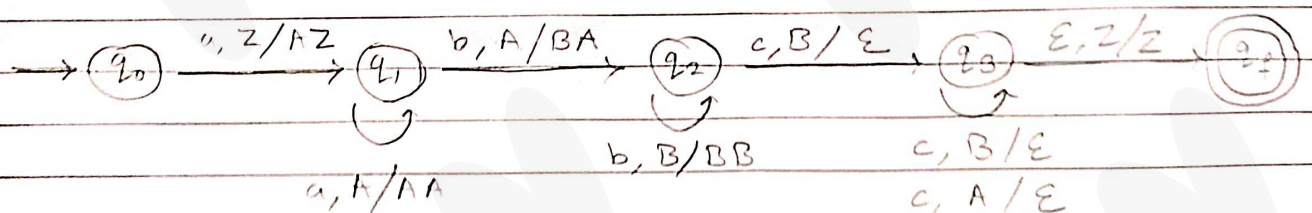
③ For each 'c', pop A / B :

$\delta(q_2, c, B) = (q_3, \epsilon)$

$\delta(q_3, c, B) = (q_3, \epsilon)$

$\delta(q_3, c, A) = (q_3, \epsilon)$

④ $\delta(q_3, \epsilon, Z) = (q_f, Z)$



Diagrams are optional to draw for all sums

$$Q.2) L = \{ (ab)^n c^n \mid n \geq 1 \}$$

$$Q = \{ q_0, q_1, q_2, q_3, q_f \}$$

$$\Sigma = \{ a, b, c \}$$

$$\Gamma = \{ Z, B \}$$

$$q_0 = \{ q_0 \}$$

$$Z_0 = \{ Z \}$$

$$F = \{ q_f \}$$

① For 1st 'ab', push B:

$$\delta(q_0, a, Z) = (q_1, Z)$$

$$\delta(q_1, b, Z) = (q_2, BZ)$$

② For remaining 'ab', push B:-

$$\delta(q_2, a, B) = (q_1, B)$$

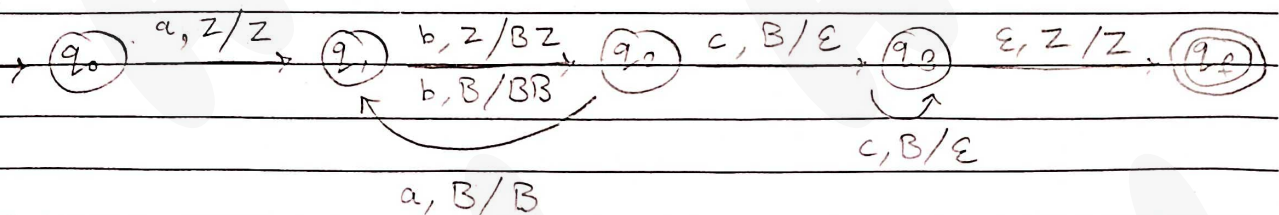
$$\delta(q_1, b, B) = (q_2, BB)$$

③ For each 'c', pop B:

$$\delta(q_2, c, B) = (q_3, \epsilon)$$

$$\delta(q_3, c, B) = (q_3, \epsilon)$$

④ $\delta(q_3, \epsilon, Z) = (q_f, Z)$



Q.3)

$$S \rightarrow aSa / bSb / c$$

As it is not in CNF form, we need to make it first in CNF form.

$$\therefore S \rightarrow aSA / bSB / c$$

$$A \rightarrow a$$

$$B \rightarrow b$$

$$\therefore Q = \{q_0, q_1, q_f\}$$

$$\Sigma = \{a, b, c\}$$

$$\Gamma = \{Z, S, A, B, a, b, c\}$$

$$q_0 = \{q_0\}; \quad Z_0 = \{Z\}; \quad F = \{q_f\}$$

① Push start symbol 'S' to the stack:

$$\delta(q_0, \epsilon, Z) = (q_1, SZ)$$

② For $S \rightarrow aSA / bSB / c$

$$\delta(q_1, \epsilon, S) = \{(q_1, aSA), (q_1, bSB), (q_1, c)\}$$

③ For $A \rightarrow a$ & $B \rightarrow b$

$$\delta(q_1, \epsilon, A) = (q_1, a)$$

$$\delta(q_1, \epsilon, B) = (q_1, b)$$

④ For input symbols:

$$\delta(q_1, a, a) = (q_1, \epsilon)$$

$$\delta(q_1, b, b) = (q_1, \epsilon)$$

$$\delta(q_1, c, c) = (q_1, \epsilon)$$

$$\textcircled{5} \quad \delta(q_1, \epsilon, Z) = (q_f, Z)$$

a.4)

$$S \rightarrow aAA$$

$$A \rightarrow aS / bS / a$$

$$Q = \{q_0, q_1, q_f\}$$

$$\Sigma = \{a, b\}$$

$$\Gamma = \{Z, S, A, a, b\}$$

$$q_0 = \{q_0\}$$

$$Z_0 = \{Z\}$$

$$F = \{q_f\}$$

① Push start symbol 'S' to the stack:

$$\delta(q_0, \epsilon, Z) = (q_1, SZ)$$

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② For $S \rightarrow aAA$:

$$\delta(q_1, \epsilon, S) = (q_1, aAA)$$

③ For $A \rightarrow aS / bS / a$

$$\delta(q_1, \epsilon, A) = \{(q_1, aS), (q_1, bS), (q_1, a)\}$$

④ For input symbols:

$$\delta(q_1, a, a) = (q_1, \epsilon)$$

$$\delta(q_1, b, b) = (q_1, \epsilon)$$

$$\textcircled{5} \quad \delta(q_1, \epsilon, Z) = (q_f, Z)$$

a, a / ϵ

b, b / ϵ



$\epsilon, S / aAA$

$\epsilon, A / aS$

$\epsilon, A / bS$

$\epsilon, A / a$

$$0.5) L = \{a^n b^{2n} \mid n \geq 1\}$$

$$Q = \{q_0, q_1, q_2, q_3, q_f\}$$

$$\Sigma = \{a, b\}$$

$$\Gamma = \{Z, A\}$$

$$q_0 = \{q_0\}$$

$$Z_0 = \{Z\}$$

$$F = \{q_f\}$$

① For each 'a', push A:

$$\delta(q_0, a, Z) = (q_1, AZ)$$

$$\delta(q_1, a, A) = (q_1, AA)$$

② For odd 'b', no change:

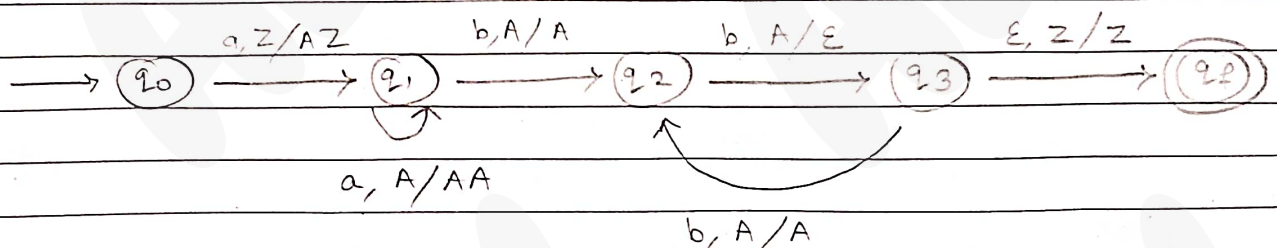
$$\delta(q_1, b, A) = \delta(q_2, A)$$

$$\delta(q_3, b, A) = \delta(q_2, A)$$

③ For even 'b', pop A:

$$\delta(q_2, b, A) = \delta(q_3, \epsilon)$$

$$④ \delta(q_3, \epsilon, Z) = (q_f, Z)$$



Q 6) $L = \{a^n b^m a^n \mid m, n \geq 1\}$

$$Q = \{q_0, q_1, q_2, q_3, q_f\}$$

$$\Sigma = \{a, b\}$$

$$\Gamma = \{Z, A\}$$

$$q_0 = \{q_0\}$$

$$Z_0 = \{Z\}$$

$$F = \{q_f\}$$

① For each 'a' (before b), push A:

$$\delta(q_0, a, Z) = (q_1, AZ)$$

$$\delta(q_1, a, A) = (q_1, AA)$$

② For each 'b', no change:

$$\delta(q_1, b, A) = (q_2, A)$$

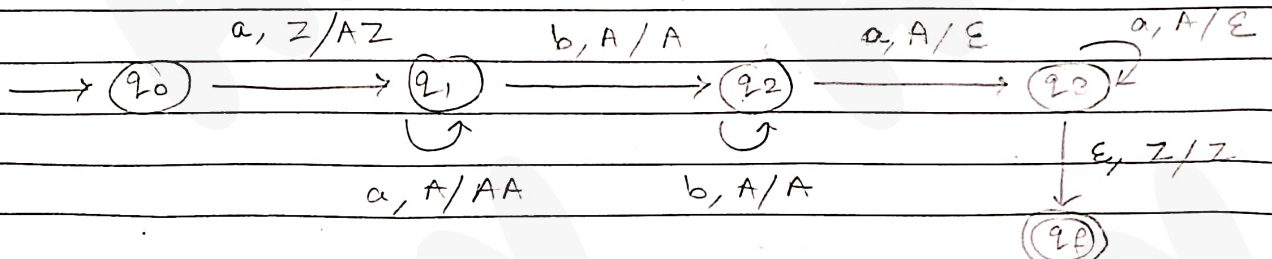
$$\delta(q_2, b, A) = (q_2, A)$$

③ For each 'a' (after b), pop A:

$$\delta(q_2, a, A) = (q_3, \epsilon)$$

$$\delta(q_3, a, A) = (q_3, \epsilon)$$

④ $\delta(q_3, \epsilon, Z) = (q_f, Z)$



Q.7)

 $S \rightarrow OBB$ $B \rightarrow OS / IS / O$ $Q = \{q_0, q_1, q_f\}$ $\Sigma = \{0, 1\}$ $\Gamma = \{Z, S, O, I\}$ $q_0 = \{q_0\}$ $Z_0 = \{Z\}$ $F = \{q_f\}$

① Push start symbol 'S' to the stack :

 $\delta(q_0, \epsilon, Z) = (q_1, SZ)$ ② For $S \rightarrow OBB$: $\delta(q_1, \epsilon, S) \rightarrow (q_1, OBB)$ ③ For $B \rightarrow OS / IS / O$ $\delta(q_1, \epsilon, B) = \{(q_1, OS), (q_1, IS), (q_1, O)\}$

④ For input symbols :

 $\delta(q_1, 1, 1) = (q_1, \epsilon)$ $\delta(q_1, 0, 0) = (q_1, \epsilon)$ ⑤ $\delta(q_1, \epsilon, Z) = (q_f, Z)$ 