Banaras Hindu University
Institute of Science
Department of Computer Science

Assignment Title: "Push Down Automata"

Assignment No.: 4

Subject:

"Theory Of Computation (CS202)"

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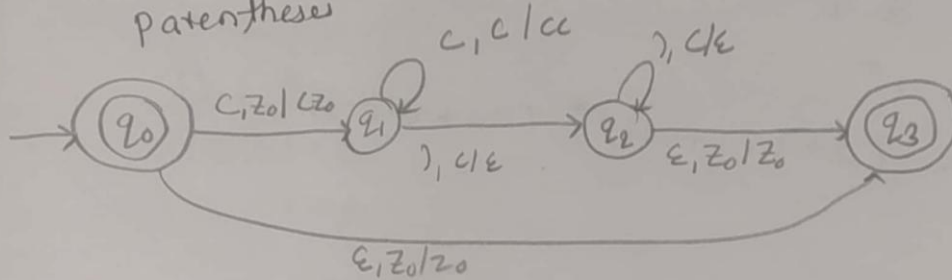
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Q.N 1⟩

Design a PDA for the language

$L = \{ a^n b^m c^m d^n \}$

$L = \{ (^n)^n \mid n \geq 0 \}$, which contains balanced parentheses

$Q = \{ q_0, q_1, q_2, q_3 \}$ $\Sigma = \{ (,) \}$.

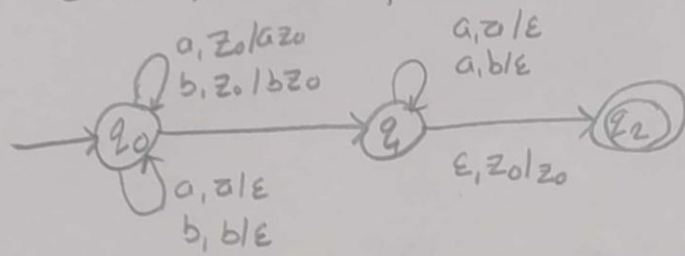$q_0 = q_0$ (initial state) $f = q_3$ (final states)

Transition steps:

$\delta(q_0, (, Z_0) = (q_0, (Z_0))$ $\delta(q_1,), () = (q_2, \epsilon)$

$\delta(q_1, (, () = (q_1, (())$ $\delta(q_2,), () = (q_2, \epsilon)$

$\delta(q_2, \epsilon, Z_0) = (q_3, Z_0)$ $\delta(q_0, \epsilon, Z_0) = (q_3, Z_0)$

(2) Design a PDA for language $L = \{w \mid w$ is a palindrome over the alphabet $\{a, b\}\}$.

$a, Z_0/aZ_0$
$b, Z_0/bZ_0$

$a, a/\varepsilon$
$b, b/\varepsilon$

$a, a/aa$
$b, b/bb$
$a, b/ab$
$b, a/ba$

$a, a/\varepsilon$
$a, b/\varepsilon$

$\varepsilon, Z_0/Z_0$

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

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

$q_0 = q_0$ (initial state)

$q_f = q_2$ (final state)

Transition steps:

$\delta(q_0, a, Z_0) = (q_0, a Z_0)$

$\delta(q_0, b, Z_0) = (q_0, b Z_0)$

$\delta(q_0, a, a) = (q_0, aa)$ 　 $\delta(q_0, b, b) = (q_0, bb)$

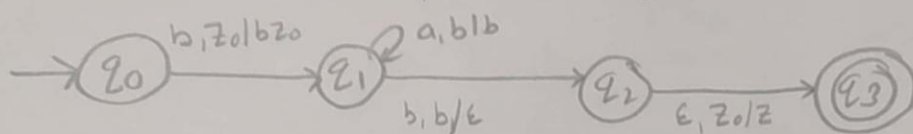$\delta(q_0, a, b) = (q_0, ab)$ 　 $\delta(q_0, b, a) = (q_0, ba)$

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

$\delta(q_1, \varepsilon, Z_0) = (q_2, Z_0)$

③ Design a PDA for the language
$$L = \{ b\, a^n\, b \mid n \geq 0 \}$$

$Q = \{ q_0, q_1, q_2, q_3 \}$ $\Sigma = \{ a, b \}$

$q_0 = q_0$ (initial state) $q_f = q_3$ (final state)

Transition steps:

$\delta (q_0, b, Z_0) = (q_1, b Z_0)$

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

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

$\delta (q_2, \varepsilon, Z_0) = (q_3, Z_0)$

④ Design a PDA for the language
$$L = \{ a^n b^n c^m \mid n, m \geq 0 \},$$
where the number of a's and b's are equal and any number of c's follow them.
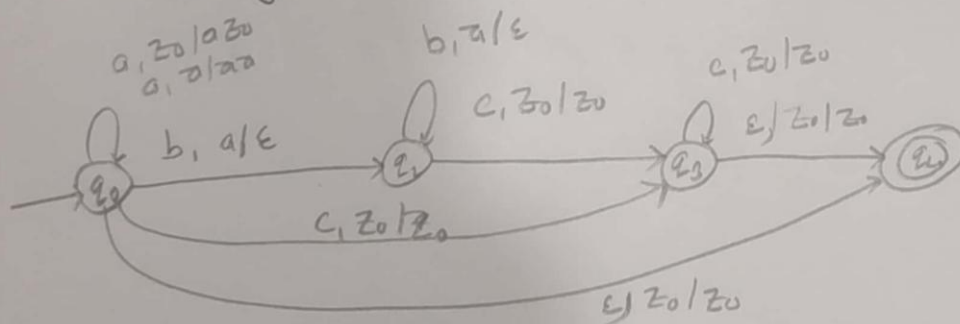
$\Sigma = \{a, b, c\}, \qquad Q = \{q_0, q_1, q_3, q_4\}$

$q_0 = q_0$ (initial state) $\qquad q_f = q_4$ (final state)

Transition steps:

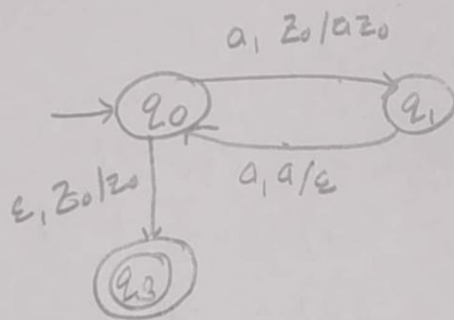$\delta(q_0, a, Z_0) = (q_0, a Z_0) \quad \delta(q_0, a, a) = (q_0, a)$

$\delta(q_0, b, a) = (q_2, \epsilon) \quad \delta(q_2, b, a) = (q_2, \epsilon)$

$\delta(q_2, c, Z_0) = (q_3, Z_0) \quad \delta(q_3, c, Z_0) = (q_3, Z_0)$

$\delta(q_0, \epsilon, Z_0) = (q_4, Z_0) \quad \delta(q_3, Z_0) = (q_4, Z_0)$

Q.5) Design a PDA for $L = \{w/w$ contains an even no. of $a's\}$

a, Z_0/aZ_0

$\epsilon, Z_0/Z_0$

$a, a/\epsilon$

$\Sigma = \{a\}$

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

$q_0 = q_0$ (initial state)

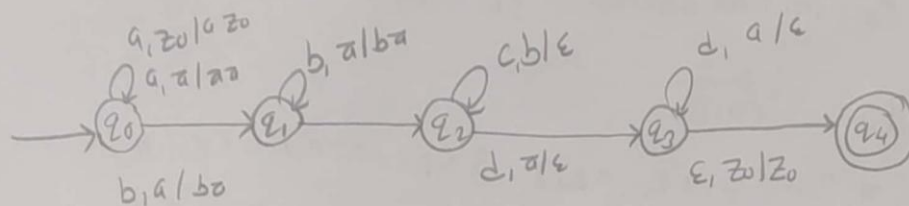$q_f = q_3$ (final state)

Transition steps

$\delta(q_0, a, Z_0) = (q_1, a Z_0) \qquad \delta(q_0, \epsilon, Z_0) = (q_3, Z_0)$

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

⑥ Design a PDA for the language

$$L = \{a^n b^m c^m d^n \mid n, n \geq 1\}$$

$Q = \{q_0, q_1, q_2, q_3, q_4\}$ $\Sigma = \{a, b, c, d\}$

$q_0 = q_0$ (initial state) $q_f = q_4$ (final state)

Transition steps:

$$\delta(q_0, a, Z_0) = (q_0, a Z_0)$$ $$\delta(q_0, b, a) = (q_1, ba)$$

$$\delta(q_0, a, a) = (q_0, aa)$$ $$\delta(q_1, b, a) = (q_1, ba)$$

$$\delta(q_1, c, b) = (q_2, \varepsilon)$$ $$\delta(q_2, d, a) = (q_3, \varepsilon)$$

$$\delta(q_2, c, b) = (q_2, \varepsilon)$$ $$\delta(q_3, d, a) = (q_3, \varepsilon)$$

$$\delta(q_3, \varepsilon, Z_0) = (q_4, Z_0)$$