PDA accepted by → Empty Stack / Final State

Date __/__/____

Saathi

Conversion of CFG to PDA

It will be two form

(i) When CFG in the form of GNF

(ii) NOT form of GNF

* When Grammar is not form of GNF

Eg:

$S \rightarrow aSb$

$S \rightarrow ab$

rule :-

(1) $\delta(q, \epsilon, S) = (q, aSb)$

(2) $\delta(q, \epsilon, S) = (q, ab)$

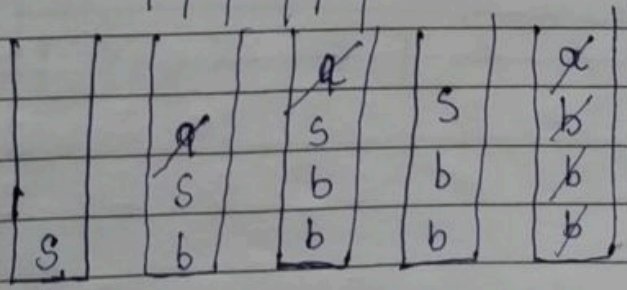
} for Variable

for terminal

(3) $\delta(q, a, a) = (q, \epsilon)$

(4) $\delta(q, b, b) = (q, \epsilon)$

$w = aaabbb$



Start variable

S → replace by aSb

Date __/__/____

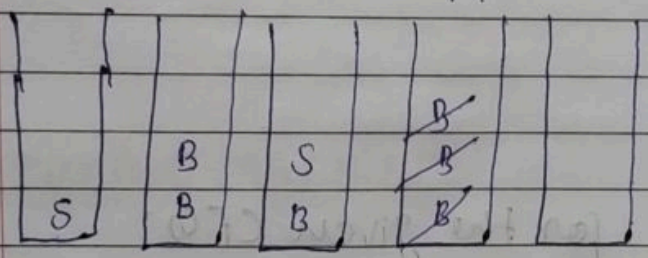
When Grammar in the form of GNF:

Eg: $S \to 0BB$
$B \to 0S \mid 1S \mid 0$

$\delta(q, 0, S) = (q, BB)$
$\delta(q, 0, B) = (q, S)$
$\delta(q, 1, B) = (q, S)$
$\delta(q, 0, B) = (q, \epsilon)$

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

$\omega = 010^4 \Rightarrow 010000$



Ques Construct a PDA from the following CFG. $G = (\{S, X\}, \{a, b\}, P, S)$ where the productions are
$S \to XS \mid \epsilon$
$A \to aXb \mid Ab \mid ab$

Rule 1: for each variable A
$\delta(q, \epsilon, A) = (q, \beta)$

where $A \to \beta$ is a production of Grammar

Rule 2: For each terminal "a"
$\delta(q, a, a) = (q, \epsilon)$

Date __/__/____

Saath

$S \rightarrow XS \mid \epsilon$

$A \rightarrow aXb \mid Ab \mid ab$

{for variable S & A}

$\delta(q, \epsilon, S) = (q, XS), (q, \epsilon)$

$\delta(q, \epsilon, A) = (q, aXb), (q, Ab)\ (q, ab)$

for terminal (a, b, ϵ)

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

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

$\delta(q, \epsilon, \epsilon) = (q, \epsilon)$

Ques: $S \rightarrow 0S1 \mid 00 \mid 11$

Equivalent PDA for the given CFG:

for variable S

$\delta(q, \epsilon, S) = (q, 0S1)\ (q, 00)\ (q, 11)$

for terminal (0, 1)

$\delta(q, 0, 0) = (q, \epsilon)$

$\delta(q, 1, 1) = (q, \epsilon)$

Date __/__/__

Saathi

* Conversion PDA To CFG *

* if $A = (Q, \Sigma, \Gamma, \delta, q_0, Z_0, F)$ is a PDA then CFG is defined as $G = (V, \Sigma, P, S)$

⇒ Rules

① Construction of Set of Nonterminal

$V = \{S\} \cup \{[q, z, q'] \mid (q, q' \in Q), (Z \in \Gamma)\}$

② (i) S-Production

$S \rightarrow [q_0, Z_0, q] \quad , q \in Q$

(ii) For Pop operation

$\delta(q, a, Z) \rightarrow (q' \wedge)$

$[q, Z, q'] \rightarrow a$

(iii) for Push and No operation

$\delta(q, a, Z] \rightarrow (q_1, Z_1 Z_2 \ldots Z_m)$

$[q, Z, q'] \rightarrow a[q_1, Z_1, q_2][q_2, Z_2, q_3]$
$\ldots\ldots [q_m, Z_n, q']$

where

$q', q_1, q_2, q_3 \ldots q_m \in Q$

Date __/__/____

Saathi

Q. Construct CFG from PDA $A=(\{q_0, q_1\}, \{a, b\}, \{z_0, z\}, \delta, q_0, z_0$

$\delta(q_0, b, z_0) = (q_0, zz_0)$
$\delta(q_0, b, z) = (q_0, zz)$
$\delta(q_1, b, z) = (q_1, \wedge)$
$\delta(q_0, \wedge, z_0) = (q_0, \wedge)$
$\delta(q_0, a, z) = (q_1, z)$
$\delta(q_1, a, z_0) = (q_0, z_0)$

$Q = \{q_0, q_1\}$ $\quad \Sigma = \{a, b\}$, $\Gamma = \{z_0, z\}$

① Construction of set of Non-terminal

$V = S$, $[q_0, z_0, q_0]$ $[q_0, z_0, q_1]$
$[q_0, z_1, q_0]$ $[q_0, z_1, q_1]$
$[q_1, z_0, q_0]$ $[q_1, z_0, q_1]$
$[q_1, z_1, q_0]$ $[q_1, z_1, q_1]$

② (iii) for Push operation

$\delta(q_0, b, z_0) = (q_0, zz_0)$
$[q_0, z_0, q_0] \Rightarrow b[q_0, z, q_0]\ [q_0, z_0, q_0]$
$[q_0, z_0, q_0] \Rightarrow b[q_0, z, q_1]\ [q_1, z_0, q_0]$
$[q_0, z_0, q_1] \Rightarrow b[q_0, z, q_0]\ [q_0, z_0, q_1]$
$[q_0, z_0, q_1] \Rightarrow b[q_0, z, q_1]\ [q_1, z_0, q_1]$

$\delta(q_0, b, z) = (q_0, zz)$
$[q_0, z, q_0] \Rightarrow b[q_0, z, q_0]\ [q_0, z, q_0]$
$[q_0, z, q_0] \Rightarrow b[q_0, z, q_1]\ [q_1, z, q_0]$
$[q_0, z, q_1] \Rightarrow b[q_0, z, q_0]\ [q_0, z_0, q_1]$
$[q_0, z, q_1] \Rightarrow b[q_0, z, q_1]\ [q_1, z_0, q_1]$

Page No.

Date __/__/____

(2) (i) S-production

$S \to [q_0, Z_0, q_0]$

$S \to [q_0, Z_0, q_1]$

$\delta(q_0, \wedge, Z_0) = (q_0, \wedge)$ [POP]

for pop operation

$\delta[q_0, \wedge, Z_0] = (q_0, \wedge)$

$[q_0, Z_0, q_0] \to \wedge$

$\delta(q_1, b, Z) = (q_1, \wedge)$ [Pop]

$[q_1, Z, q_1] \to b$

(2) $\delta(q_0, a, Z) = (q_1, Z)$ [No operation]

(iii) for no operation

$[q_0, Z, q_0] \to a[q_1, Z, q_0]$

$[q_0, Z, q_1] \to a[q_1, Z, q_1]$

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

for no operation

$[q_1, Z_0, q_0] \to a[q_0, Z_0, q_0]$

$[q_1, Z_0, q_1] \to a[q_0, Z_0, q_1]$

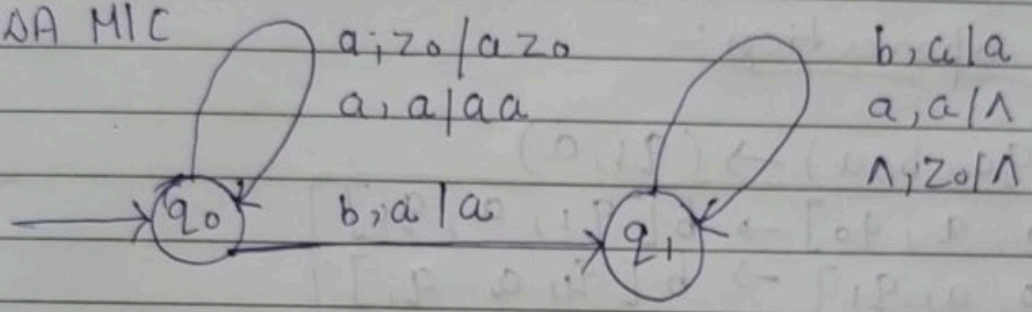
Date __/__/____

Saathi

Q) Construct a PDA Accepting $\{a^n b^m a^n \mid m, n \geq 1\}$ by NULL STORE and construct CFG accepting same.

L = {aba, aabbaa, aabaa ---}

PDA M1C



Transition function

$\delta(q_0, a, z_0) \rightarrow (q_0, az_0)$
$\delta(q_0, a, a) \rightarrow (q_0, aa)$
$\delta(q_0, b, a) \rightarrow (q_1, a)$
$\delta(q_1, b, a) \rightarrow (q_1, a)$
$\delta(q_1, a, a) \rightarrow (q_1, \wedge)$
$\delta(q_1, \wedge, z_0) \rightarrow (q_1, \wedge)$

(2) $S \rightarrow [q_0, z_0, q_0] \mid [q_0, z_0, q_1]$

PUSH⇒ $\delta(q_0, a, z_0) \rightarrow (q_0, az_0)$

$[q_0, z_0, q_0] \rightarrow a[q_0, a, q_0][q_0, z_0, q_0]$
$[q_0, z_0, q_0] \rightarrow a[q_0, a, q_1][q_1, z_0, q_0]$

$[q_0, z_0, q_1] \rightarrow a[q_0, a, q_0][q_0, z_0, q_1]$
$[q_0, z_0, q_1] \rightarrow a[q_0, a, q_1][q_1, z_0, q_1]$

Date ___/___/___

$\delta(q_0, a, a) \rightarrow (q_0, a\ q_1)$

$[q_0, a, q_0] \rightarrow a[q_0, a, q_0][q_0, a, q_0]$
$[q_0, a, q_0] \rightarrow a[q_0, a, q_1][q_1, a, q_0]$
$[q_0, a, q_1] \rightarrow a[q_0, a, q_0][q_0, a, q_1]$
$[q_0, a, q_1] \rightarrow a[q_0, a, q_1][q_1, a, q_1]$

for No operation :-

$\delta(q_0, b, a) \rightarrow (q_1, a)$

$[q_0, a, q_0] \rightarrow b[q_1, a, q_0]$
$[q_0, a, q_1] \rightarrow b[q_1\ a\ q_1]$

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

$[q_1, a, q_0] \rightarrow b[q_1, a, q_0]$
$[q_1, a, q_1] \rightarrow b[q_1, a, q_1]$

for POP operation :-

$\delta(q_1, a, a) \rightarrow (q_1, \wedge)$

$[q_1, a, q_1] \rightarrow a$

$\delta(q_1, \wedge, Z_0) \rightarrow (q_1, \wedge)$

$[q_1, Z_0, q_1] \rightarrow \wedge$