CFG to PDA

1)

$S \to aABC$

$A \to aB \mid a$

$B \to bA \mid b$

$C \to a$

Sol: first we have to check, whether the given grammar is in GNF. This grammar is in GNF

(1) $\delta(q_0, \epsilon, Z_0) = (q_1, SZ_0)$

(2)

$S \to aABC$	$\delta(q_1, a, S) = (q_1, ABC)$
$A \to aB$	$\delta(q_1, a, A) = (q_1, B)$
$A \to a$	$\delta(q_1, a, A) = (q_1, \epsilon)$
$B \to bA$	$\delta(q_1, b, B) = (q_1, A)$
$C \to a$	$\delta(q_1, a, C) = (q_1, \epsilon)$
$B \to b$	$\delta(q_1, b, B) = (q_1, \epsilon)$
	$\delta(q_1, \epsilon, Z_0) = (q_2, Z_0)$

final state

$S \to aABC$

$\delta(q_1, a, S) = (q_1, ABC)$

Derive the string,

$S \Rightarrow aABC$

$\Rightarrow aaBC$ ($\because A \to a$)

$\Rightarrow aabC$ ($\because B \to b$)

$\Rightarrow aaba$ ($\because C \to a$)

Instantaneous description

$\delta(q_0, aaba, Z_0) \vdash (q_1, aaba, SZ_0)$ $[\because \delta(q_0, \epsilon, Z_0) = (q_1, SZ_0)]$

$\epsilon aaba, Z_0$

$\vdash (q_1, aba, ABCZ_0)$ $[\because \delta(q_1, a, S) = (q_1, ABC)]$

'a' is removed — 'S' is removed and replaced with ABC

$\vdash (q_1, ba, BCZ_0)$ $[\because \delta(q_1, a, A) = (q_1, \epsilon)]$

'a' is removed — 'A' is removed and replaced with ϵ.

$\vdash (q_1, a, CZ_0)$ $[\because \delta(q_1, b, B) = (q_1, \epsilon)]$

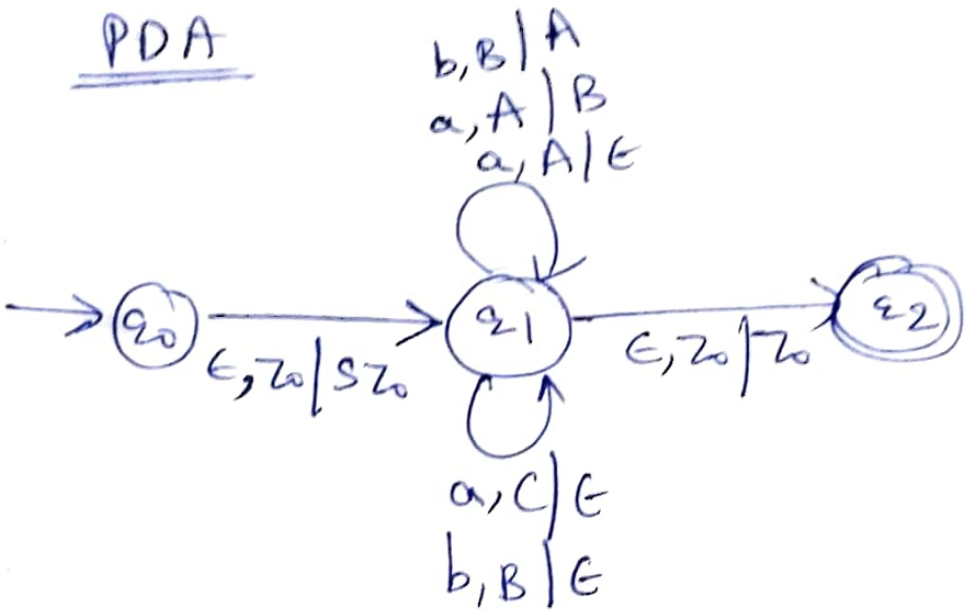
'b' is removed — 'B' is removed and replaced with ϵ

$\vdash (q_1, \epsilon, Z_0)$ $[\because \delta(q_1, a, C) = (q_1, \epsilon)]$

'a' is removed — 'C' is removed and replaced with ϵ

$\vdash (q_2, Z_0)$ $[\because \delta(q_1, \epsilon, Z_0) = (q_2, Z_0)]$

PDA



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

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

$\Gamma = \{S, A, B, C, Z_0\}$

q_0 = start state

$F = q_2$ - final state

Z_0 - initial symbol on stack.

2) $S \rightarrow aABB \mid aAA$

$A \rightarrow aBB \mid a$

$B \rightarrow bBB \mid A$

$C \rightarrow a$

Sol^n: The grammar should be in GNF.

$B \rightarrow A$ not in GNF

$B \rightarrow A$ < aBB ✓ , a ✓

$B \rightarrow aBB \mid a$

Now,

$S \rightarrow aABB \mid aAA$

$A \rightarrow aBB \mid a$

$B \rightarrow bBB \mid aBB \mid a$

$C \rightarrow a$

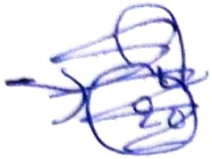
(2) $S \to aABB$
$S \to aAA$
$A \to aBB/a$
$A \to a$
$B \to bBB$
$B \to ABB$
$B \to a$
$C \to a$

(1) $\delta(q_0, \epsilon, z_0) = (q_1, Sz_0)$
$\delta(q_1, a, S) = (q_1, ABB)$
$\delta(q_1, a, S) = (q_1, AA)$
$\delta(q_1, a, A) = (q_1, BB)$
$\delta(q_1, a, A) = (q_1, \epsilon)$
$\delta(q_1, b, B) = (q_1, BB)$
$\delta(q_1, a, B) = (q_1, BB)$
$\delta(q_1, a, B) = (q_1, \epsilon)$
$\delta(q_1, a, C) = (q_1, \epsilon)$
$\delta(q_1, \epsilon, z_0) = (q_2, z_0)$
↓ final state

desire string

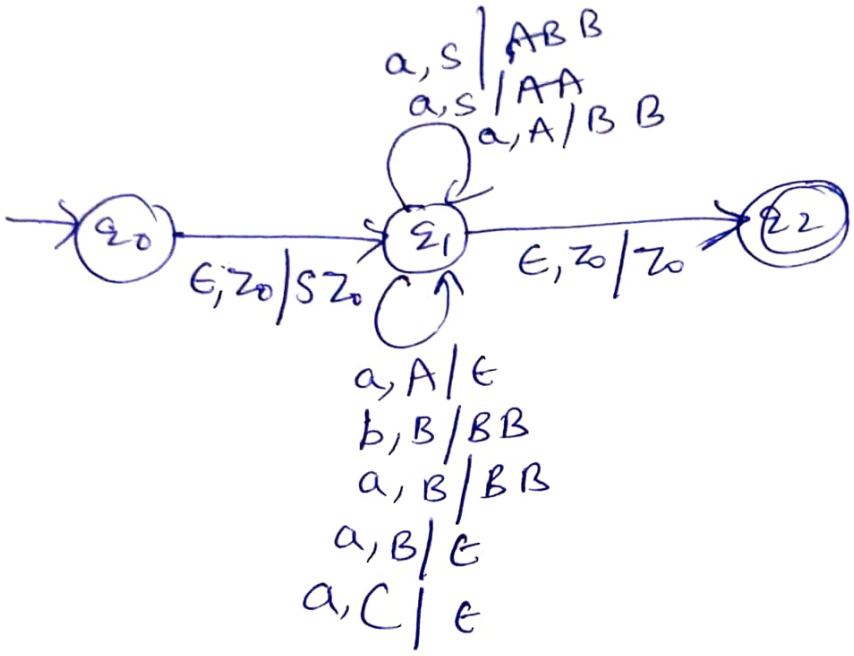
$S \Rightarrow aABB$
$\Rightarrow aaBB$ ($\because A \to a$)
$\Rightarrow aaaB$ ($\because B \to a$)
$\Rightarrow aaaa$ ($\because B \to a$)

$\delta(q_0, aaaa, z_0) \vdash (q_1, aaaa, Sz_0)$
$\vdash (q_1, aaa, ABBz_0)$ ($\because \delta(q_1, a, S) = (q_1, ABB)$)
$\vdash (q_1, aa, BBz_0)$ ($\because \delta(q_1, a, A) = (q_1, \epsilon)$)
$\vdash (q_1, a, Bz_0)$ ($\because \delta(q_1, a, B) = (q_1, \epsilon)$)
$\vdash (q_1, \epsilon, z_0)$ ($\because \delta(q_1, a, B) = (q_1, \epsilon)$)
$\vdash (q_2, z_0)$ accepted
final state



PDA

$M = (Q, \Sigma, \Gamma, \delta, q_0, Z_0, F)$



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

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

$\Gamma = \{S, A, B, C, Z_0\}$

q_0 = start state

Z_0 → initial symbol on Stack

$F \rightarrow q_2$ – final state