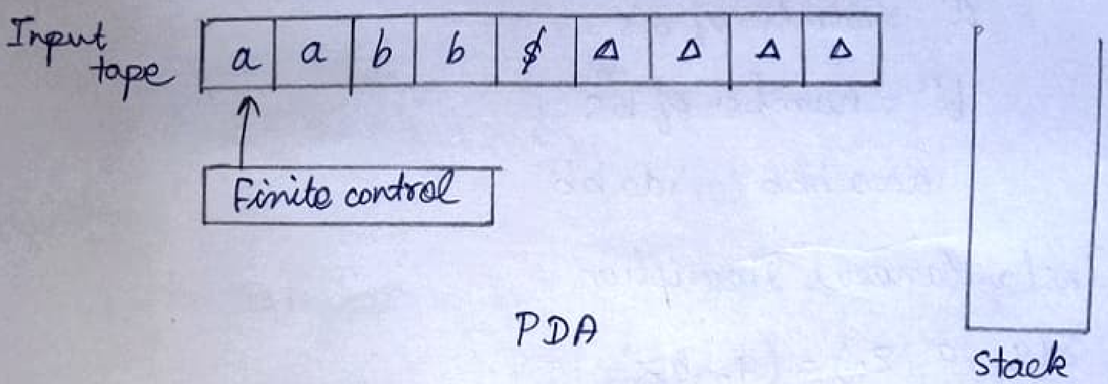
Push down Automata:-

Definition:

It have input tape, finite control and stack



PDA defined 7 components

Q -> The finite set of states

Σ -> Input set

Γ -> stack alphabet

q_0 -> Initial state

z_0 -> start symbol, which is in 7

F -> Final states

δ -> Mapping function used to mainly from current state to next state

Design a PDA for accepting a language
$\{L = a^n b^n / n \geq 1\}$

Given :

$L = a^n b^n / n \geq 1$

Solution :

a^n = number of a's

b^n = number of b's

aaabbb (or) aabb

Instantaneous Description

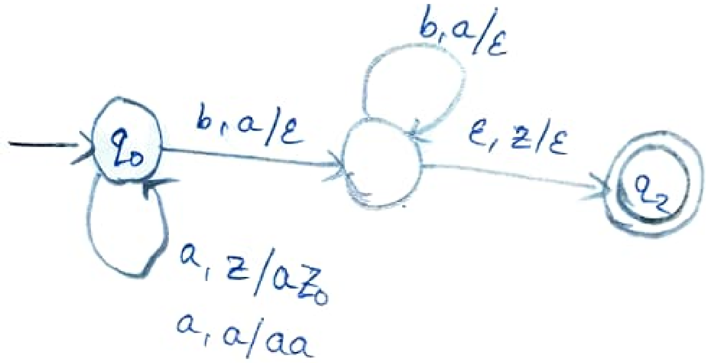
$\delta(q_0, a, Z_0) = (q_0, aZ_0)$

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

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

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

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



CHOMSKY'S NORMAL FORM (CNF)

Non-terminal → Non terminal x non terminal

Non-terminal → Terminal

Convert the following CFG into CNF

$S \rightarrow aaaaS$

$S \rightarrow aaaa$

Solution:

Non Terminals → Nonterminal x Nonterminal

Non terminals → Terminal

CFG given is

$S \rightarrow aaaaS$ rule 1

$S \rightarrow aaaa$ rule 2

$A \rightarrow a$ is in CNF

rule 1 and 2 becomes

$A \rightarrow AAAAS$

$S \rightarrow AAAA$

$S \rightarrow A\boxed{AAAS}$ can be replaced by P_1

$P_1 \rightarrow AAAS$

$S \rightarrow AP_1$ is in CNF

The rule P_1 is not CNF, So convert it

$P_1 \to A\boxed{AAS}$ can be replaced by P_2

$P_1 \to AP_2$ which is in CNF

$P_2 \to AAS$ which is not in CNF, So let us convert it to CNF

$P_2 \to A\boxed{AS}$ can be replaced by P_3

$P_2 \to AP_3$ where $P_3 \to AS$

$S \to AP_1$

$P_1 \to AP_2$

$P_2 \to AP_3$

$P_3 \to AS$

Now consider rule 2

$S \to AAAA$

If we break the rule 2 as

$$S \to \underbrace{\boxed{AA}}_{P_4} \; \underbrace{\boxed{AA}}_{P_5}$$

The rule becomes

$S \to P_4 \; P_5$

is in CNF

... P_4 and P_4 indicates the same rule. So we can eliminate either of them

Rule 2 becomes

$$S \to P_4 P_4$$

Finally we can collectively show the CFG converted to CNF as

$$S \to AP_1$$

$$P_1 \to AP_2$$

$$P_2 \to AP_3$$

$$P_3 \to AS$$

$$S \to P_4 P_4$$

$$P_4 \to AA$$

$$A \to a$$

GREIBACH NORMAL FORM:

Non Terminal → One terminal x set of non terminal

$$NT \to T \times NT$$

Convert the given CNF to CFG

$S \to ABA$

$A \to aA / \varepsilon$

$B \to bB / \varepsilon$

Solution:

Step 1:

There is ε- Production, So we will simplify the given grammar as follows.

$S \to ABA \mid BA \mid AB \mid AA \mid A \mid B$

$A \to aA \mid a$

$B \to bB \mid b$

Now eliminate unit productions

$S \to A \mid B$

So,

$S \to ABA \mid BA \mid AB \mid AA \mid aA \mid a \mid bB \mid b$

$A \to aA \mid a$

$B \to bB \mid b$

Step 2:

*. In above grammar the rules for A and B non-terminals are already in GNF.

*. Infact, Some of the rules of S are also in GNF

*. He we will handle

$S \to ABA \mid BA \mid AB \mid AA$

By symply substituting the values of A and B here we need not have to bring grammar in ascending order of $A_i, A_j, A_k \ldots$

Step 3: We will then get

$S \to ABA$	$S \to aABA \mid aBA$
$S \to BA$	$S \to bAB \mid bA$
$S \to AB$	$S \to aAB \mid aB$
$S \to AA$	$S \to aAA \mid aB$

Step 4:

Thus now all the rules are in GNF. To summarize

$S \to aABA \mid aBA \mid bBA \mid bA \mid aAB \mid aB \mid aAA \mid aA$

$S \to aA \mid a \mid bB \mid b$

$A \to aA \mid a$

$B \to bB \mid b$