

28-8-19

if β read then there must point of β (blank)

FSM \rightarrow FA

$$PDSM \rightarrow PDA$$

UNIT 4: - pushdown Automata
and post machine

- * pushdown stack memory machines -

It is a machine which uses stack as a memory

- PDA: -

pushdown automata is a mathematical model of pushdown memory . that has 7 tuples.

$$M = (Q, \Sigma, \Gamma, q_0, z_0, F, \delta)$$

where,

Q \rightarrow Finite set of state

$\Sigma \rightarrow$ Finite set of inputs

$F \rightarrow$ stack alphabet

$q_0 \rightarrow$ initial state

20 \rightarrow , symbol which is in ϵ start

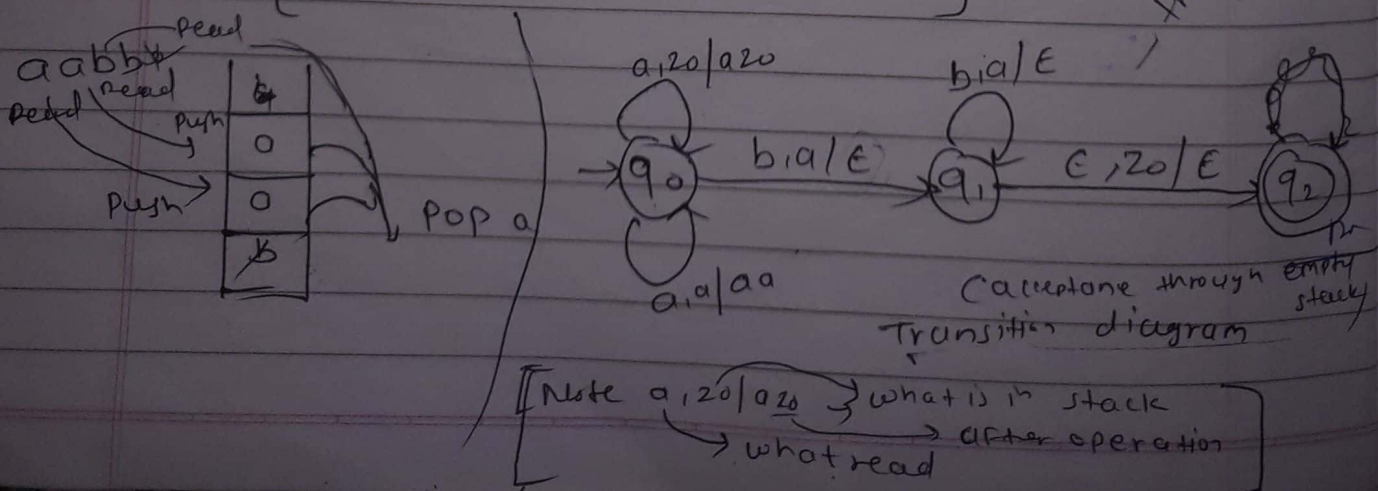
$F \rightarrow$ finite set of final state

 $\phi \rightarrow$ state function

①. Design a PDA for language

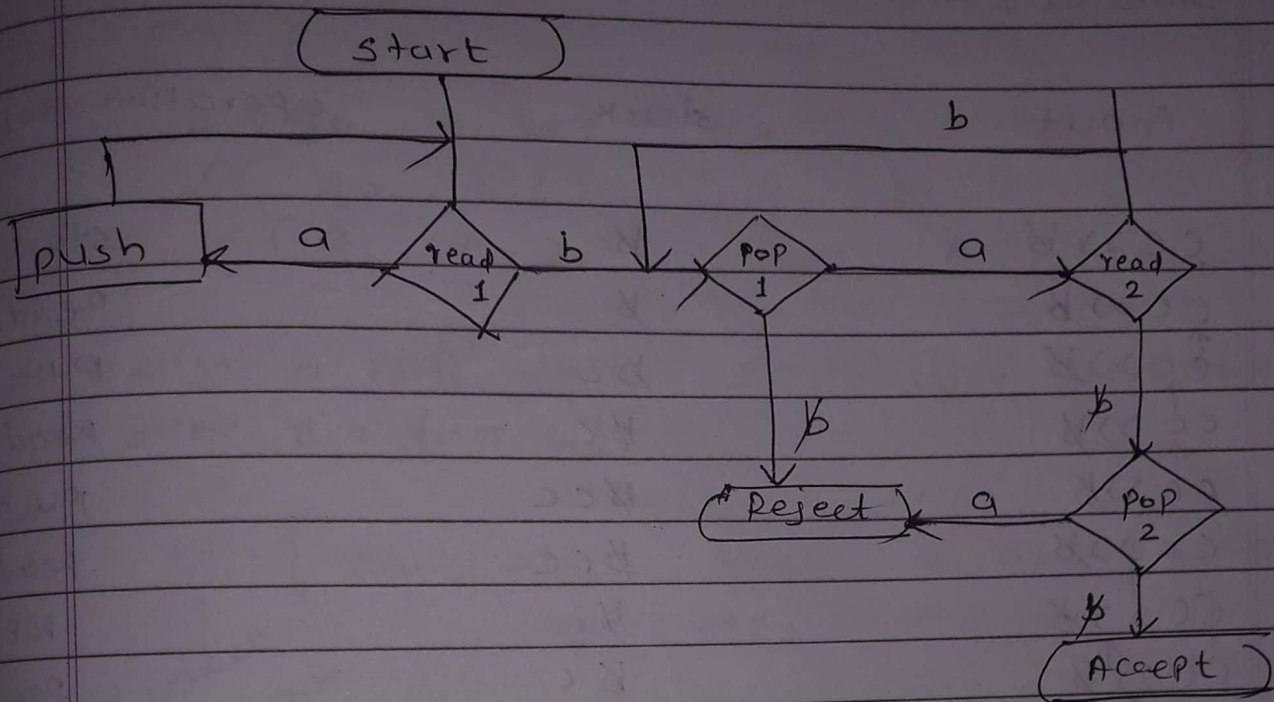
$$L = \{ a^n b^n \text{ where } n \geq 1 \}$$

$$\rightarrow L = \{ ab, aabb, aaabbb, \dots \}$$

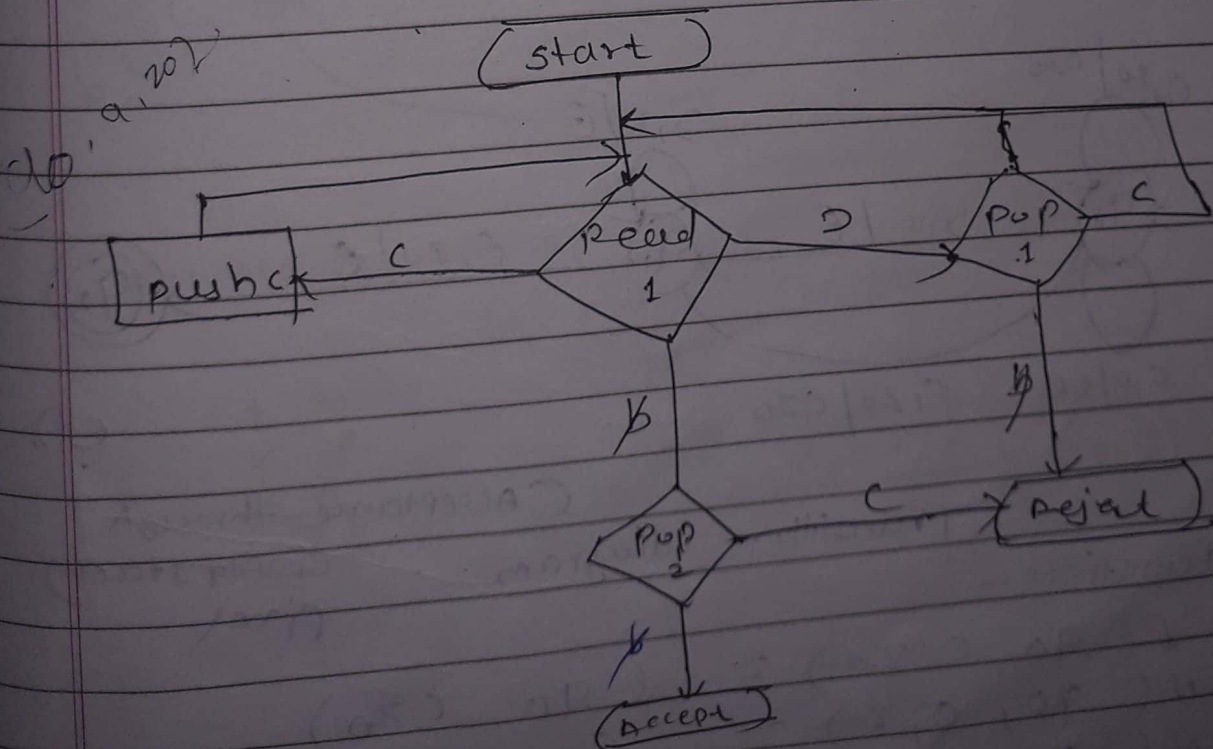


$\delta(q_0, a, z_0) = (q_0, a z_0)$ next state after op
 $\delta(q_0, a, a) = (q_0, a a)$ next state after op
 $\delta(q_0, b, a) = (q_1, \epsilon)$ next state after op
 $\delta(q_1, b, a) = (q_1, \epsilon)$
 $\delta(q_1, \epsilon, z_0) = (q_2, \epsilon)$

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Q. Design a PDA for well formedness of parenthesis.
 $L = \{ ((()) , () , () (()) , (() ()) \}$



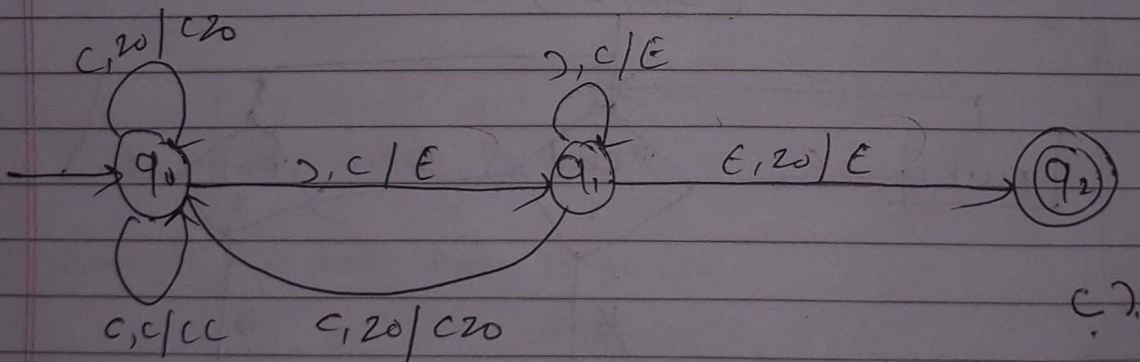
acceptance through empty stack (ϵ)

acceptance through final state

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simulation: -

input	stack	operation stack
c c >> b	b	start
c c >> b	b	Read 1
c c >> b	b c	push c
c c >> b	b c	Read 1
c c >> b	b c c	push c
c c >> b	b c c	Read 1
c c >> b	b c	pop 1
c c >> b	b c	Read 1
c c >> b	b	pop 1
c c >> b	b	Read 1
c c >> b	-	pop 2
c c >> b	-	Accept



Transition diagram
(Acceptance through empty stack)
final

Transition Function: -

$$\begin{aligned}
 \delta(q_0, c, z_0) &= (q_0, cz_0) \\
 \delta(q_0, c, c) &= (q_0, cc) \\
 \delta(q_0, c, c) &= (q_1, c) \\
 \delta(q_1, c, c) &= (q_1, c) \\
 \delta(q_1, c, z_0) &= (q_0, cz_0) \\
 \delta(q_1, \epsilon, z_0) &= (q_2, \epsilon)
 \end{aligned}$$

every FA is a PDA

every PDA is not Finite automata

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$$\delta(q_0, \epsilon, z_0) = q_0, z_0$$

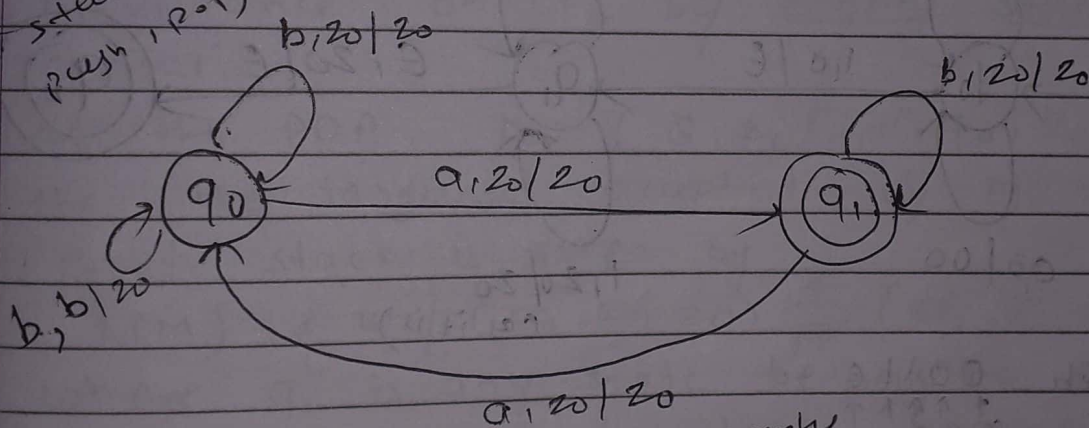
$$\delta(q_0, a, \epsilon) = q_1, \epsilon$$

$$\delta(q_1, \epsilon, z_0) = \underline{q_2}, \epsilon \quad \text{Final state}$$

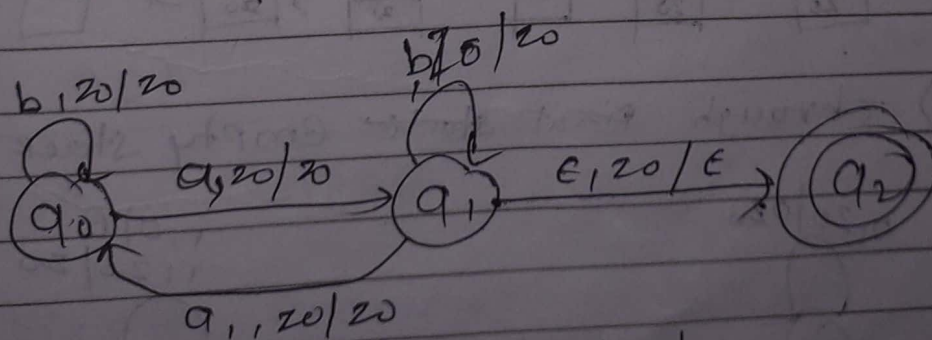
Q Design a PDA which accepts only odd no. of a's over $\Sigma = \{a, b\}$.

→ $L = \{aaa, abaa, baab, a, ab, ba, aabab, abb, bba, ababa, \dots\}$

(No use of stack, no push, P-P)



Acceptance through final state



Acceptance through empty stack

3-9-19

* Acceptance of CFL by empty stack and final state:-

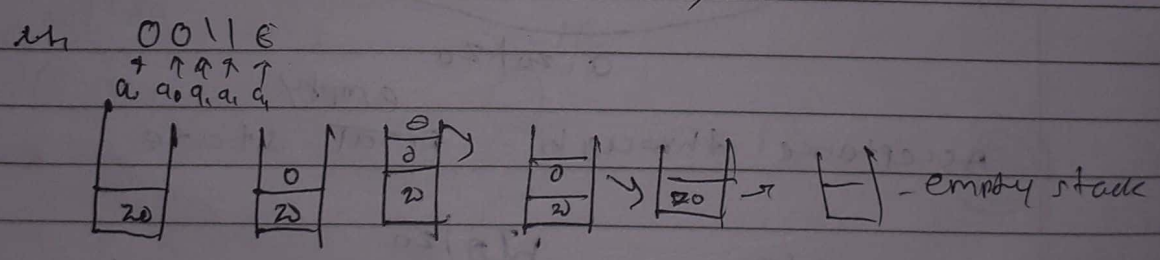
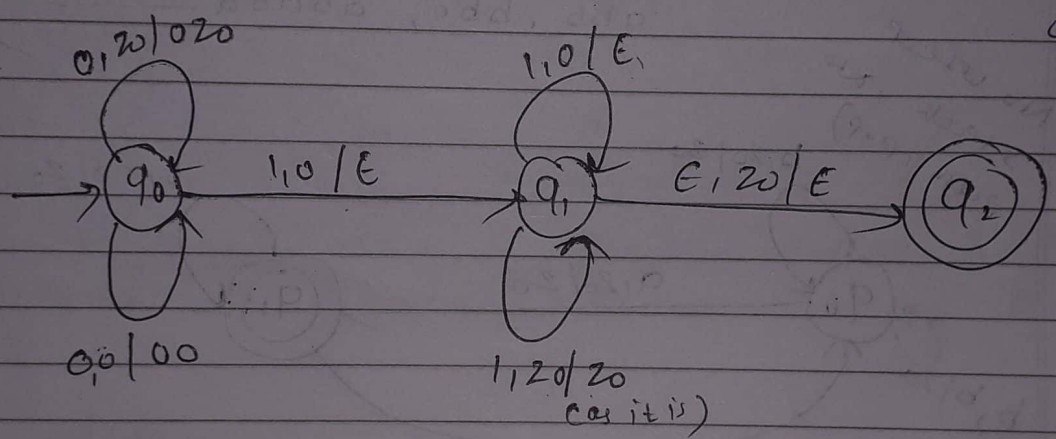
1) construct a PDA to accept a language

$$L = \{ 0^n 1^m \mid n \leq m \}$$

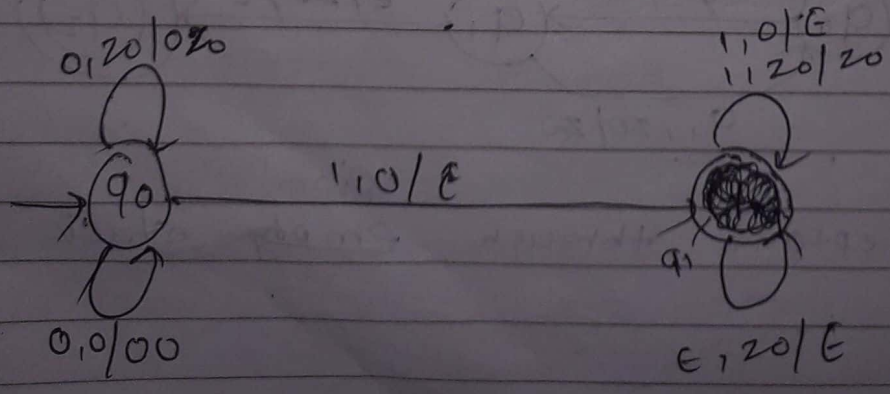
- I) through empty stack
- II) through final state

→ $L = \{ 01, 011, 0011, 00111, 0111 \dots \}$

I) Through empty stack: final state:-



II) Through final state: Empty stack:-



- Acceptance of CFL by Final state :-
Defination:-

Let the PDA $M = (Q, \Sigma, \Gamma, \delta, q_0, z_0, F)$
then the language accepted by M through
final state is given by.

$$L(M) = \{ w \mid (q_0, w, z_0) \xRightarrow{*} (q_1, \epsilon, \alpha) \}$$

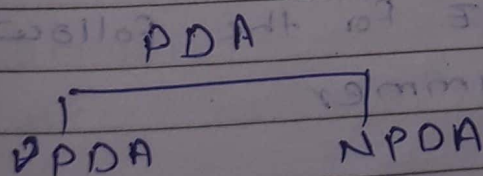
where state $(q_1 \text{ belongs to } F)$ $q_1 \in F$,
 α is the final contents of stack are irrelevant
as string accepted through final state

- Acceptance of CFL by empty stack:-
Defination:-

Let the PDA, $M = (Q, \Sigma, \Gamma, \delta, q_0, z_0, \emptyset)$
then the language accepted by M through
empty stack is given by

$$L(M) = \{ w \mid (q_0, w, z_0) \xRightarrow{*} (q_1, \epsilon, \epsilon) \}$$

where q_1 is any state belong to Q ($q_1 \in Q$)
($q_1 \rightarrow$ any state) and stack becomes empty
on appln of input string w .



Ambiguity Grammar

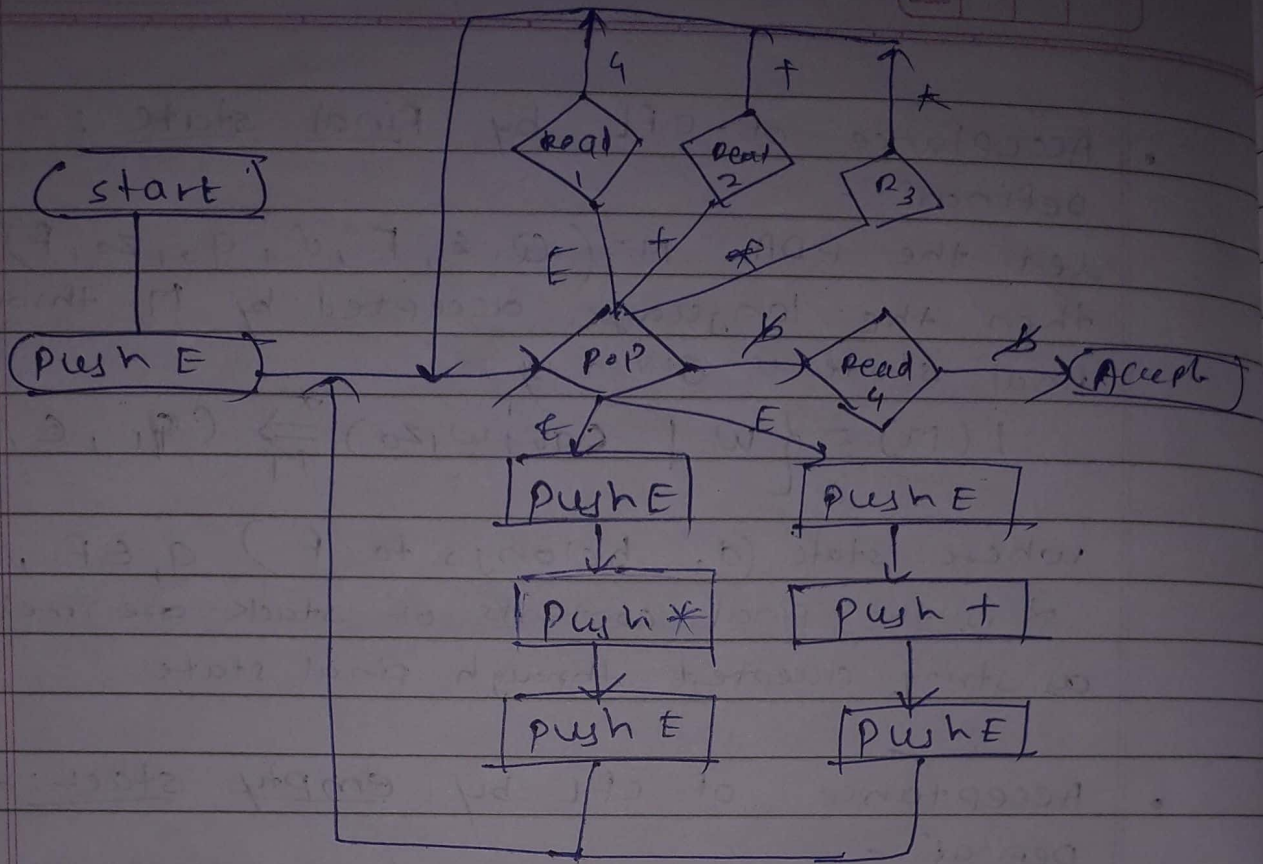
$$E \rightarrow E + E$$

$$E \rightarrow E * E$$

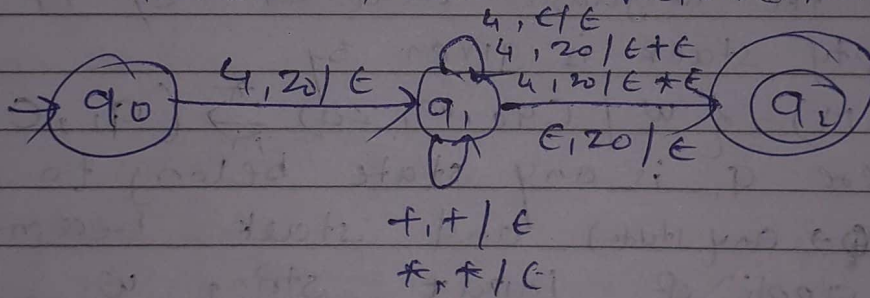
$$E \rightarrow 4$$

$$G = (\{E\}, \{+, *, 4\}, \{P, E\})$$

$$L = \{4, 4+4, 4*4, *\}$$



NPDA pictorial representation



Q.) construct the PDE for the following content free grammar

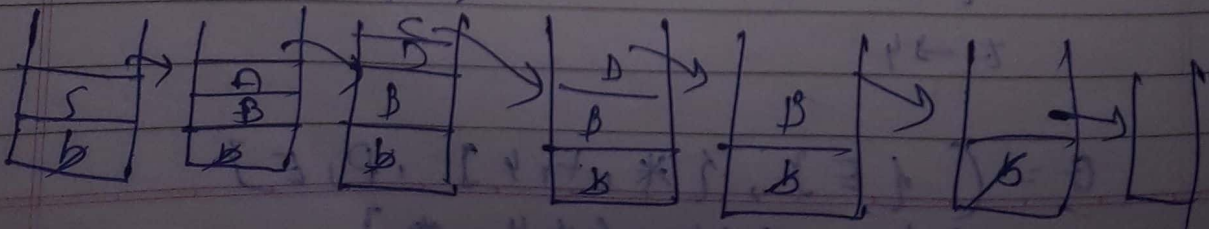
$$S \rightarrow AB$$

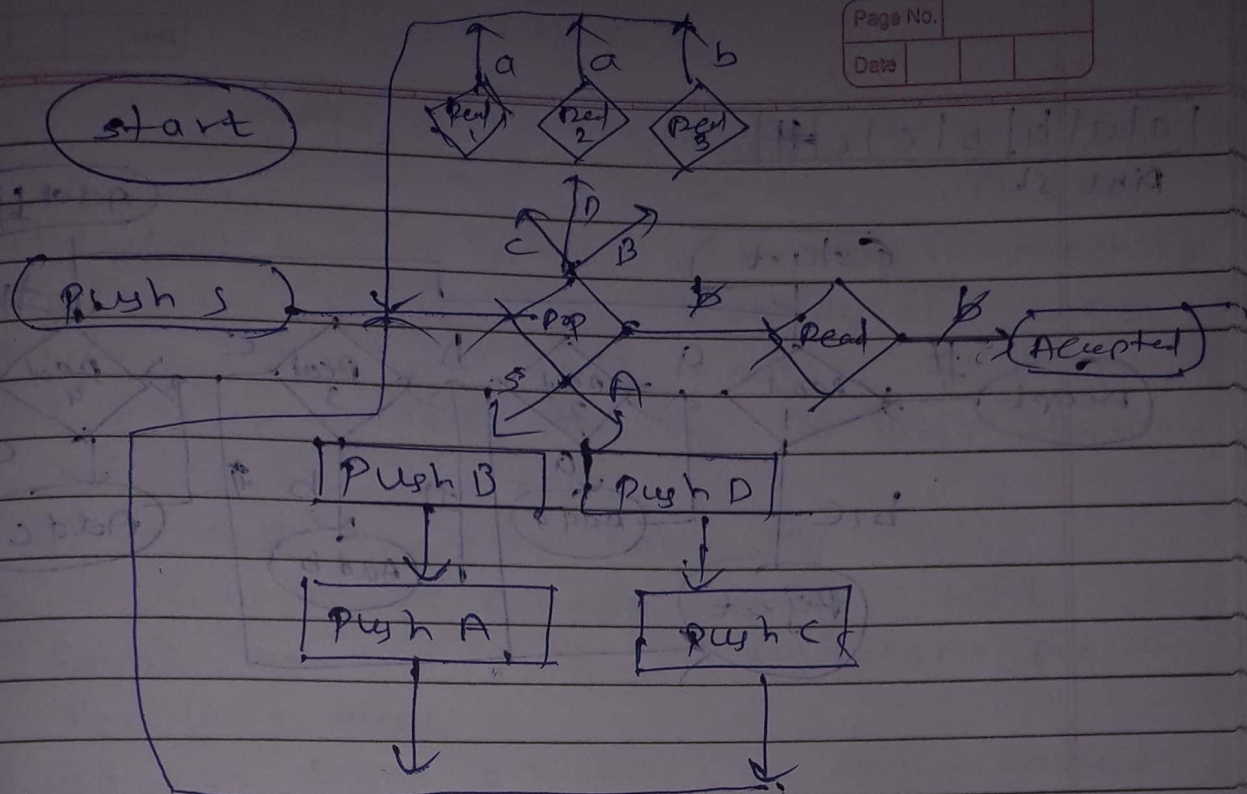
$$A \rightarrow CD$$

$$B \rightarrow b$$

$$C \rightarrow a$$

$$D \rightarrow c$$





Post machine: - $\{ a^n b^n c^n \mid n \geq 0 \}$
PDA can not expect context sensitive language.

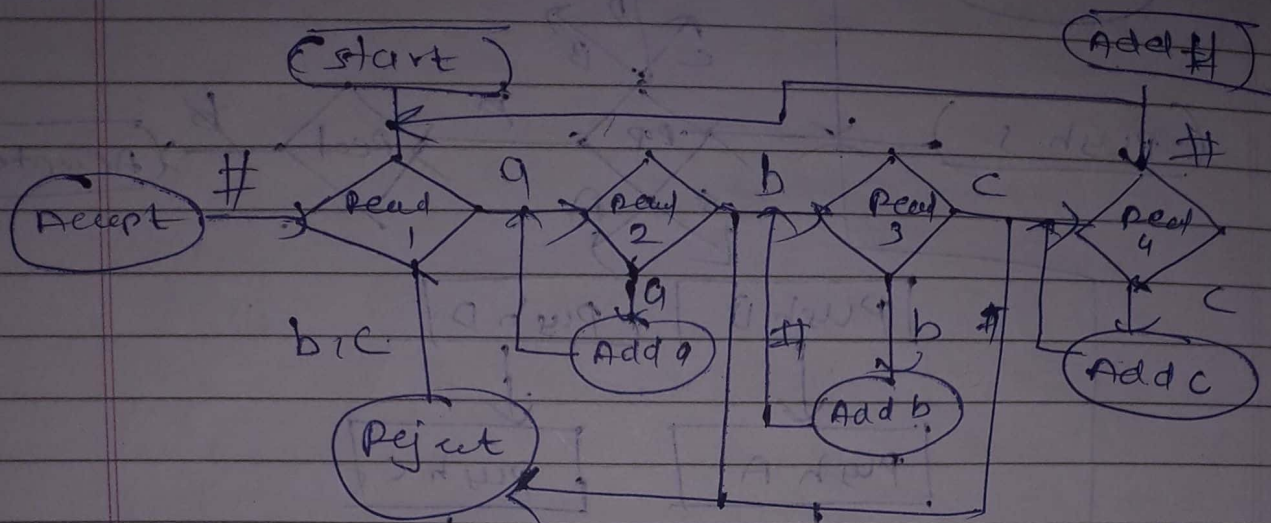
In 1936 Emil Post introduced post machine each accept regular non-regular, context free and non-context free languages.

Q) Can construct the post machine for the $L = \{ a^n b^n c^n \mid n \geq 0 \}$

$\Rightarrow L = \{ aabbcc, aaabbbccc, \dots \}$

1 a | a | b | b | c | c | #

Ans 56



Q) Construct the post machine to check well boundance of parenthesis.

(()) H () # H = (() (()) H () # #

