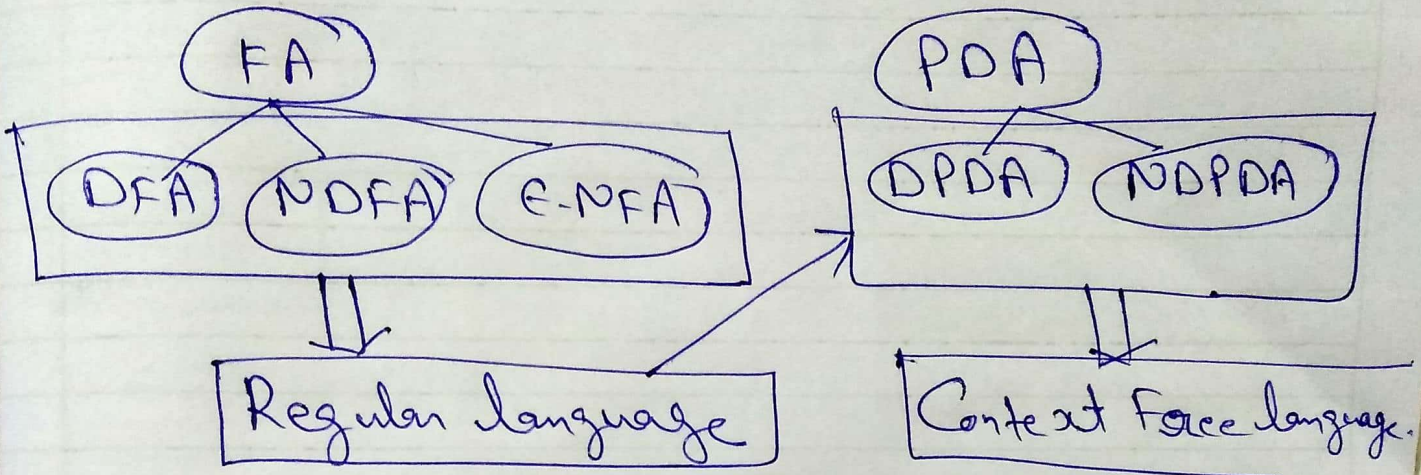
UNIT-4 (Push Down Automata) (PDA)

PDA :- A PDA is a F.A with extra Memory Called Stack which helps PDA to recognize CFL.



* PDA is more powerful then F.A
* R.L also accept PDA. PDA is a

PDA = FA + Stack

A PDA has three Components
1) an Input tape
2) a Control Unit
3) a Stack with infinite Size.

A Stack that two operation.

1) **PUSH** :- a new Symbol is added at the Top
2) **POP** :- The top Symbol is read and removed.

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* A PDA may or may not be read input symbol, but it has to read the top of the stack in every transaction.

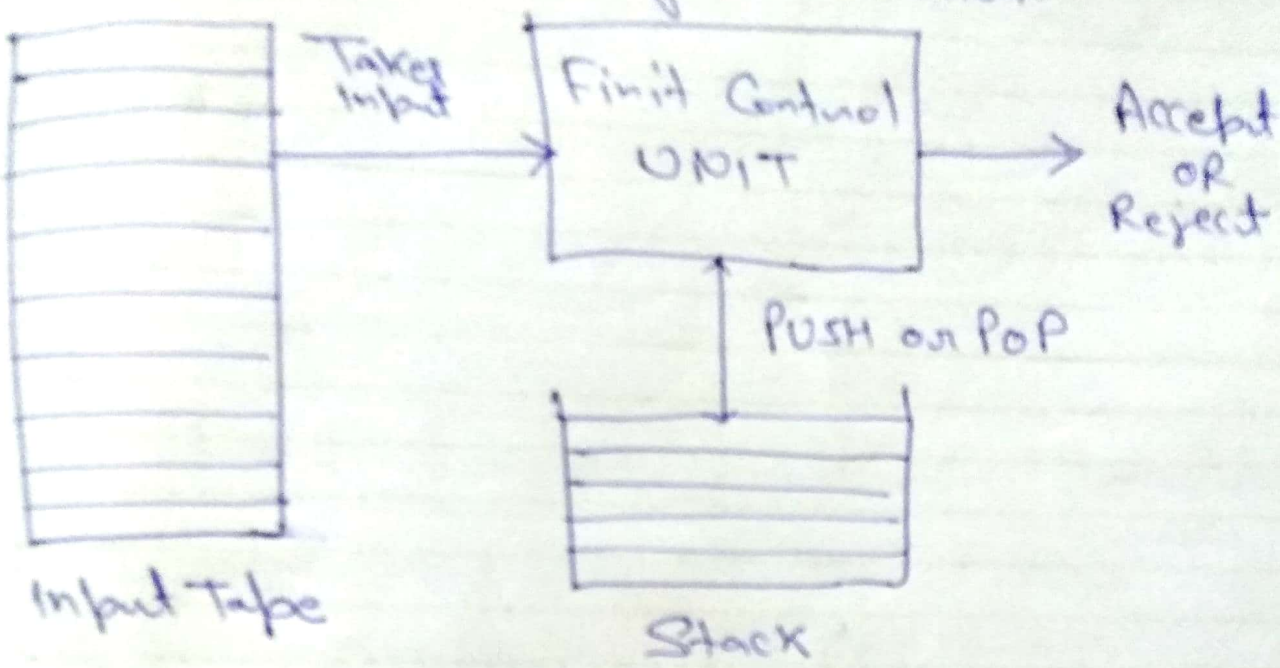

fig: Structre of PDA

A PDA can be described as 7-tuple

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

Q = finit no of states
Σ = Input symbols
Γ = Stack symbols
δ = Transition function $Q \times (\Sigma \cup \epsilon) \times \Gamma \to Q \times \Gamma^*$
q_0 = initial state ($q_0 \in Q$)
Z_0 = initial stack symbol
F = accepting states ($F \in Q$)

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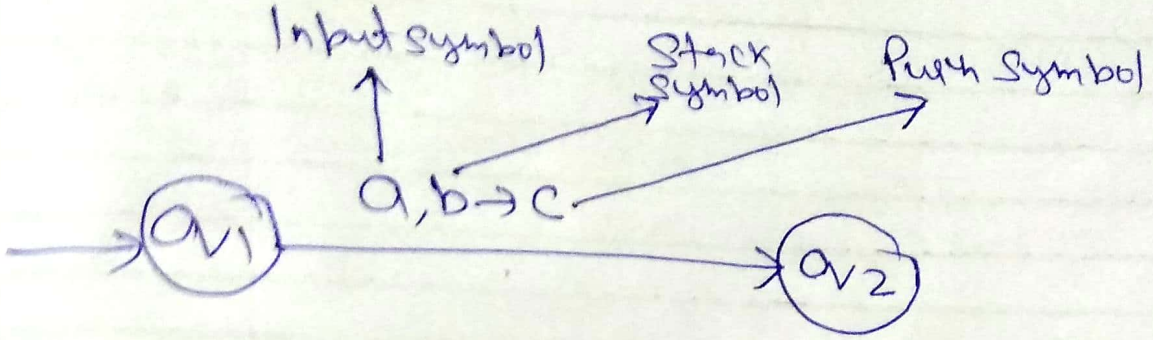
The following diagram shows a transition in a PDA from a state q_1 to q_2 labeled as $a, b \to c$:



This means at state q_1, if we encounter an input 'a' and top symbol of the stack is b, then we pop 'b', push 'c' on top of the stack and move to state q_2.

Transition Function:

$$\delta(q_0, a, Z_0) \to q_1, aZ_0)$$

* Turnstile Notation:

* It is denoted by $(\vdash)$
* It is represent one or many moves of PDA. It is called process of transition.

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Ex 1: Let PDA $(Q, \Sigma, S, \delta, q_0, F)$

$Q = (q_0, q_1, q_f)$, $\Sigma = \{a, b\}$, $S = \{a, z_0\}$

$F = \{q_f\}$

$\delta(q_0, a, z_0) = \{(q_0, az_0)\}$

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

$\delta(q_0, b, a) = \{(q_1, \wedge\}$

$\delta(q_0, b, a) = \{(q_1, \wedge)\}$

$\delta(q_f, \wedge, z_0) = \{(q_f, \wedge)\}$

Input String aabb

Soln:

$\delta(q_0, aabb, z_0) \vdash (q_0, abb, az_0)$

$\vdash (q_0, bb, aaz_0)$

$\vdash (q_1, b, az_0)$

$\vdash (q_1, \wedge, z_0)$

$\vdash (q_0, \wedge, \wedge)$

String is accepting because Pushdown Stone (PDS) is empty.

* PDA is accepting by empty Stack

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Ex 2: (PDA)

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

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

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

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

$\delta(q_1, \wedge, Z_0) = (q_f, Z_0)$

Input String aaabbb

Sol:

$(q_0, aaabbb, Z_0) \vdash (q_0, aabbb, aZ_0)$

$\vdash (q_0, abbb, aaZ_0)$

$\vdash (q_0, bbb, aaaZ_0)$

$\vdash (q_1, bb, aaZ_0)$

$\vdash (q_1, b, aZ_0)$

$\vdash (q_1, \wedge, Z_0)$

$\vdash (q_f, \wedge, Z_0)$

String accepting.

* PDA is accepting by final state

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Instantaneous Description :-

1) Graphical Representation
2) Tuple Representation.

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

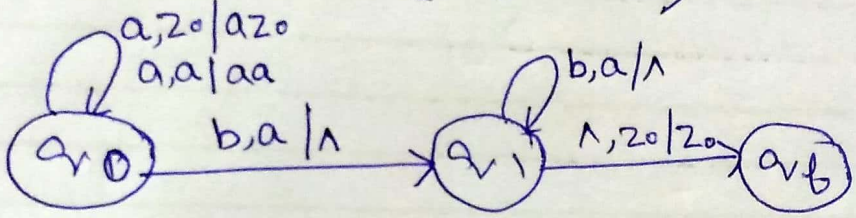
$\delta(q_0, a, a) = (q_0, aa)$

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

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

$\delta(q_1, \wedge, Z_0) = (q_f, Z_0)$

Soln:



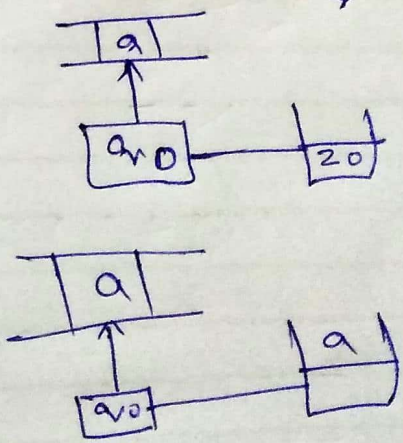
→ Graphical Representation ↓

Tuple Representation.

$\delta(q_0, a, Z_0)$

⋮

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



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