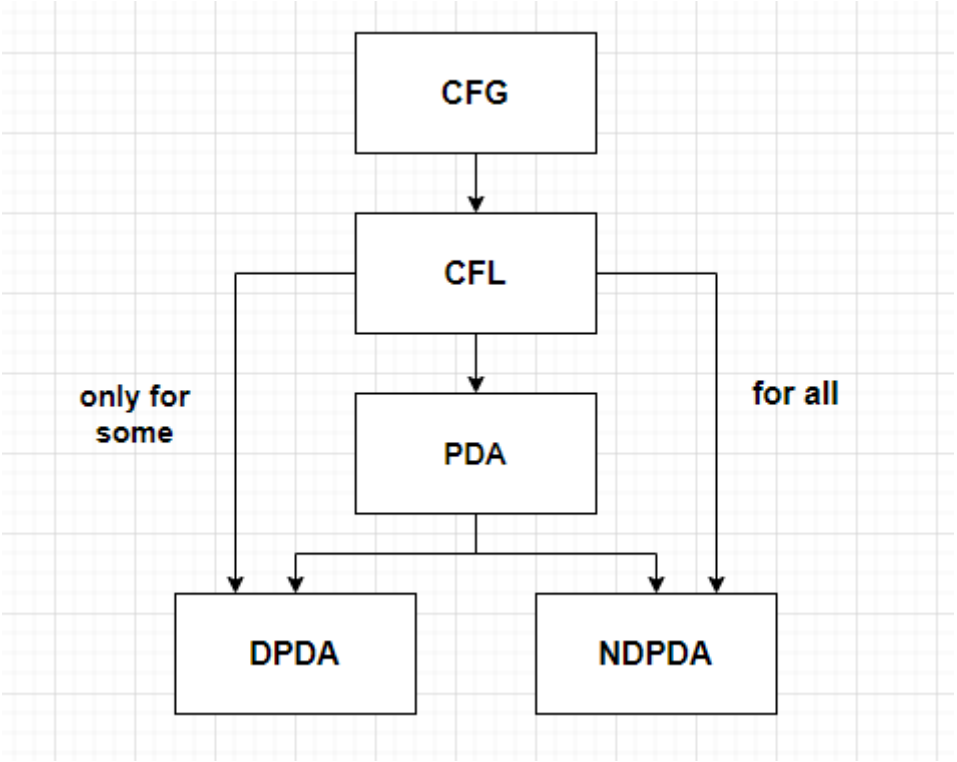
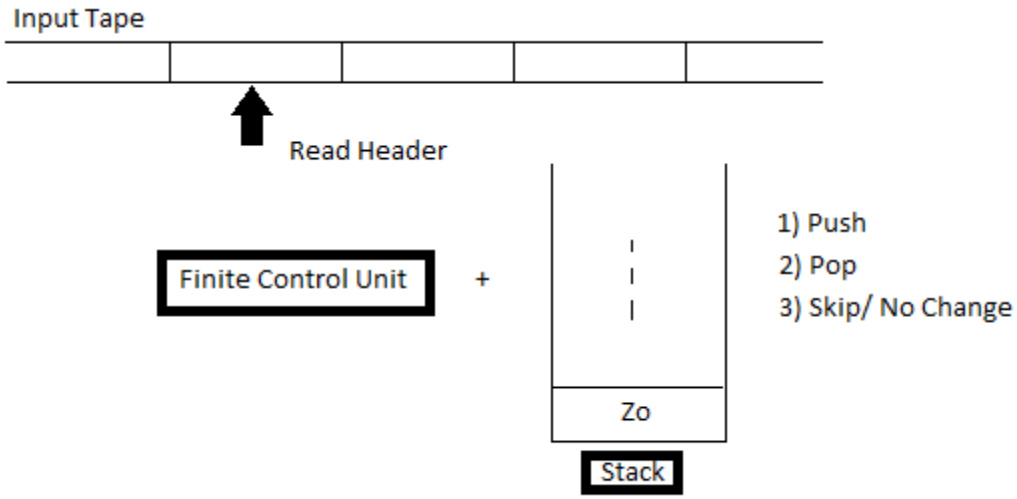


- **Push Down Automata (PDA)**



**** Why stack? Why not other data structures like array, tree, heap, linked list, queue?**

- No indexing required on Push or Pop
- Not affected with overflow problem
- Infinite element can be stored
- Required underflow checking during Pop

- PDA = {Q, Σ, q_0, F, Z_0, Γ, δ}
  - Q = finite set of states
  - Σ = input alphabet
  - q_0 = initial state
  - F = final states
  - Z_0 = initial stack symbol
  - Γ = stack alphabet
  - δ = transition function

** Tape symbols is not same as Stack symbol

** Input string should be consumed fully + stack should be empty

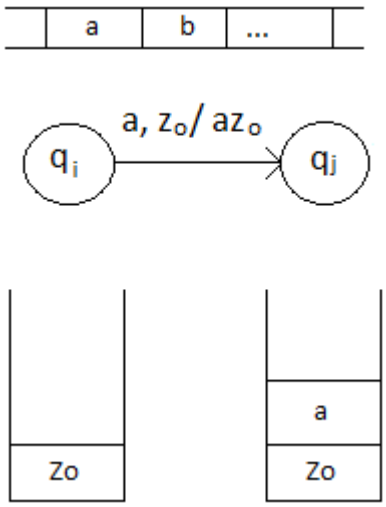
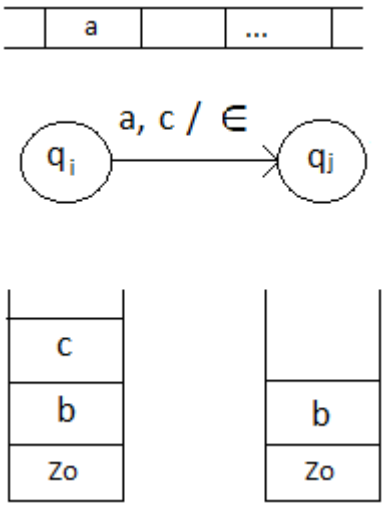
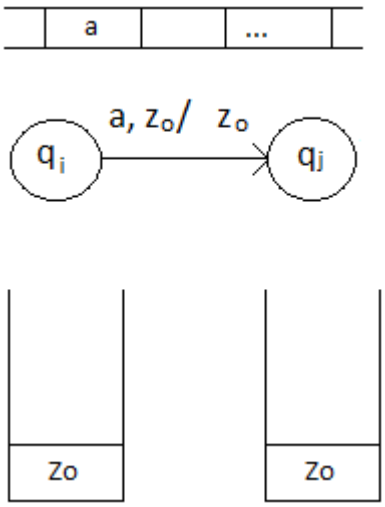
Transition function δ:

- DPDA:
  - Current state: Q
  - Input symbol: Σ
  - Topmost element of the stack: Γ

$$\delta(Q, \Sigma, \Gamma) = (Q, \Gamma^*)$$

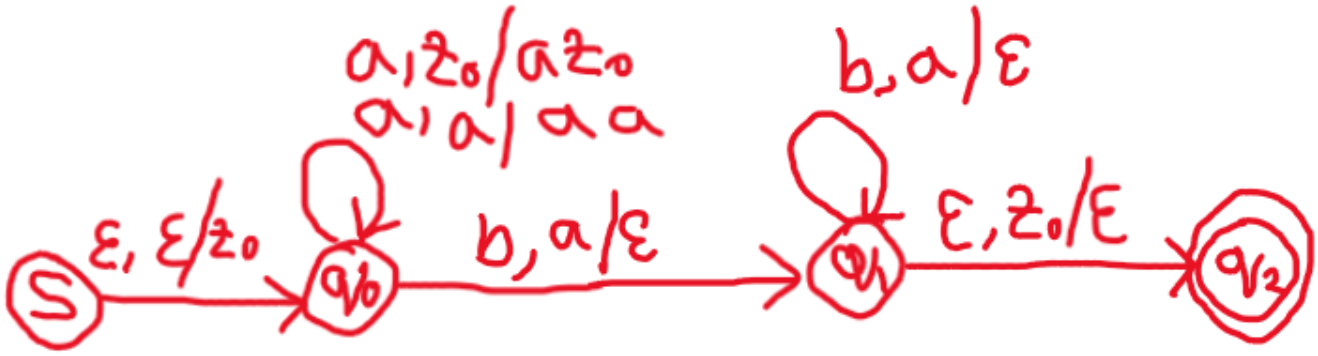
- NDPDA:
- Current state: Q
- Input symbol: Σ
- Topmost element of the stack: Γ

$$\delta(Q, \Sigma, \Gamma) = (2^{Q,\ \Gamma^*})$$

Push	Pop	Skip/ No change
		
$\delta(q_i, a, z_o) = (q_j, az_o)$	$\delta(q_i, a, c) = (q_j, \in)$	$\delta(q_i, a, z_o) = (q_j, z_o)$

Example 1:

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

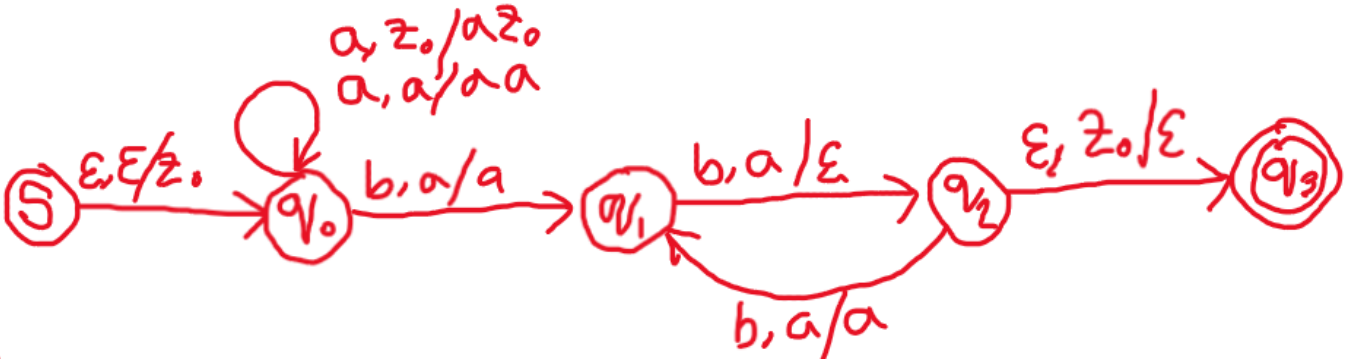


Example 2:

$L = \{a^n b^n \mid n \geq 0\}$

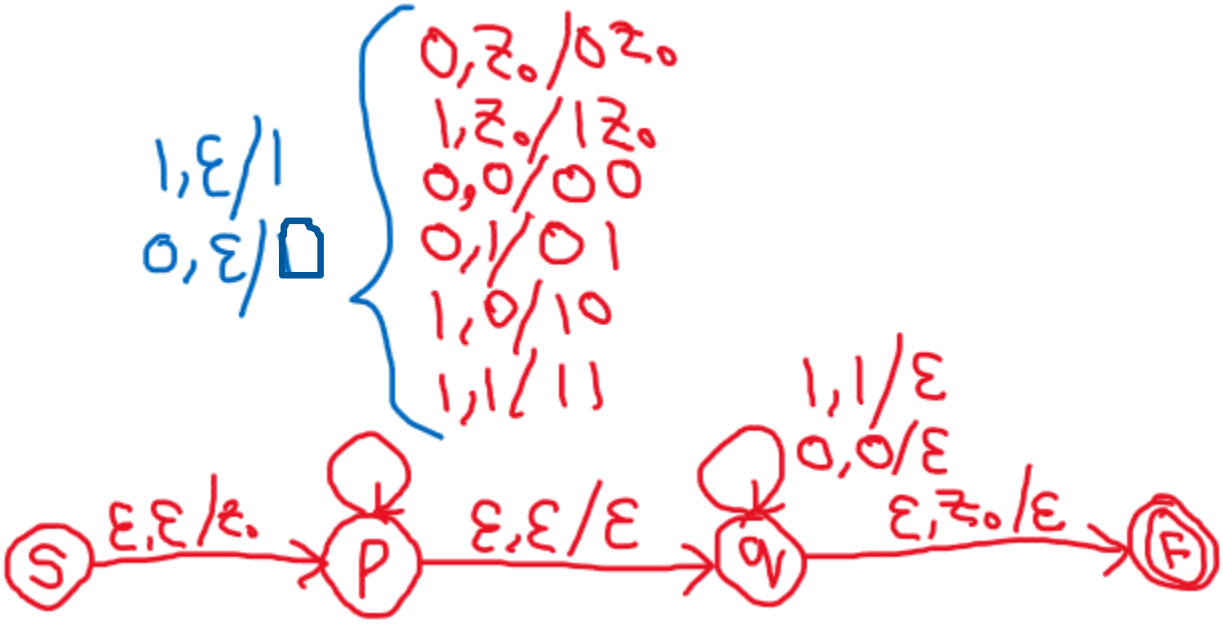
Example 3:

$L = \{a^n b^{2n} \mid n \geq 1\}$



Example 4:

L = {w w^r}



Example 5:

L = {wcw^r}