Pushdown Automata

- Pushdown Automata is a Finite Automata with extra memory in the form of a **Stack**.
- Pushdown automata can recognize **Context Free Languages** unlike finite automata that can only recognize regular language.
- A Pushdown Automata (PDA) is defined by 7 tuples m= (Q, $\sum$, Γ, q_0, z_0, F, δ):

  - **Q** is the set of states
  - $\sum$ is the set of input symbols
  - **Γ** is the set of stack symbols
  - **q_0** is the initial state
  - **z_0** is the initial pushdown symbol
  - **F** is the set of final states
  - **δ** is a transition function that maps **Q x {$\Sigma \cup \epsilon$} x Γ into Q x Γ***.

- There are two types of pushdown automata:
  1. Non-Deterministic pushdown automata
  2. Deterministic pushdown automata

Non-Deterministic Pushdown Automata

For every input with the current state, we can have multiple moves.

Deterministic Pushdown Automata

There is only one state transition from one state to another state for an input symbol.

Examples:

  i. $L = \{a^n b^{2n} / n <= 1\}$
  ii. $L = \{wcw^r / w \in (a+b)^*\}$

Construction of a DPDA

Example:

$$L = \{a^n b^n \,/\, n <= 1\}$$

Rules:

1. Push all a's into the stack
2. Pop at b (and change state for 1st time only)
3. Repeat step 2 until stack is empty