CSC-257
Theory Of Computation
(BSc CSIT, TU)

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Instantaneous Description of PDA (ID)

- Instantaneous Description(ID) of a PDA is an informal notation of how a PDA "computes" a input string and makes a decision that string is accepted or rejected.
- A ID is a triple (q, w, α), where :

  q – current State

  w – Remaining Input

  α – Stack Content

Instantaneous Description of PDA (ID)

- ⊢ sign is called a "turnstile notation"(right tack) and represents one move.
- ⊢* sign represents a sequence of moves
- Eg : (p, b, T) ⊢ (q, w, α). This implies that while taking a transition from state p to state q, the input symbol 'b' is consumed, and the top of the stack 'T' is replaced by a new string 'α'

Instantaneous Description of PDA (ID)

- For the PDA described earlier accepting language of equal a's and b's, the accepting sequence of ID's for string baab can be shown as :

- $(q_0, baab, \epsilon) \vdash (q_1, baab, z_0)$

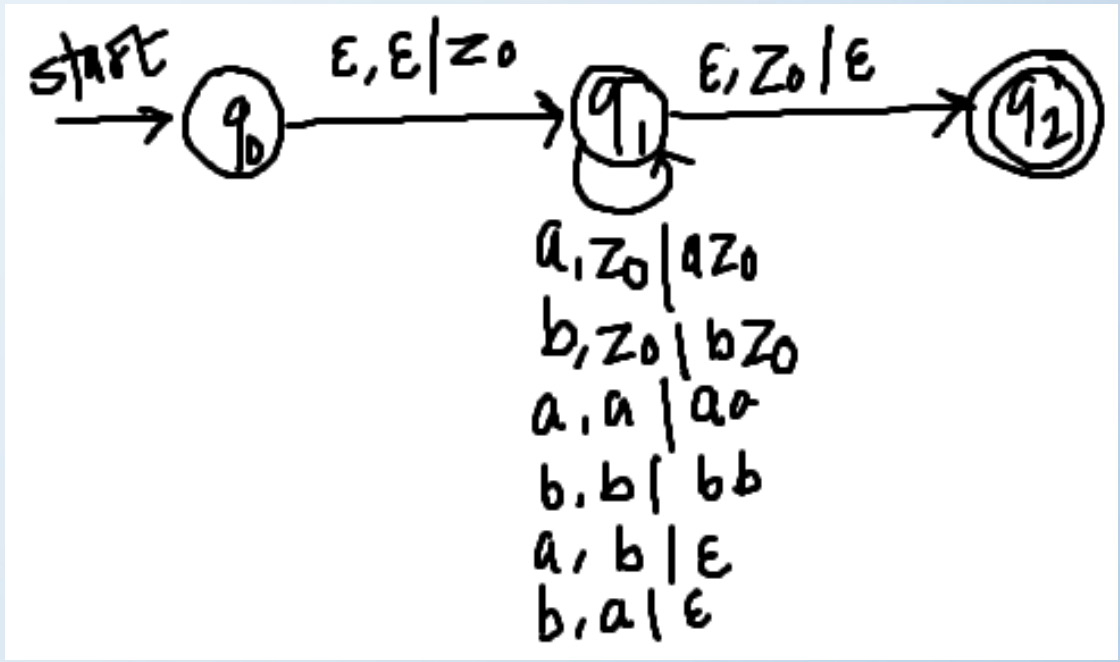
  $\vdash (q_1, aab, bz_0)$

  $\vdash (q_1, ab, z_0)$

  $\vdash (q_1, b, az_0)$

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

  $\vdash (q_2, \epsilon , \epsilon)$ Accepted



- Therefore, $(q_0, baab, z_0) \vdash^* (q_2, \epsilon, \epsilon)$

Language of a PDA

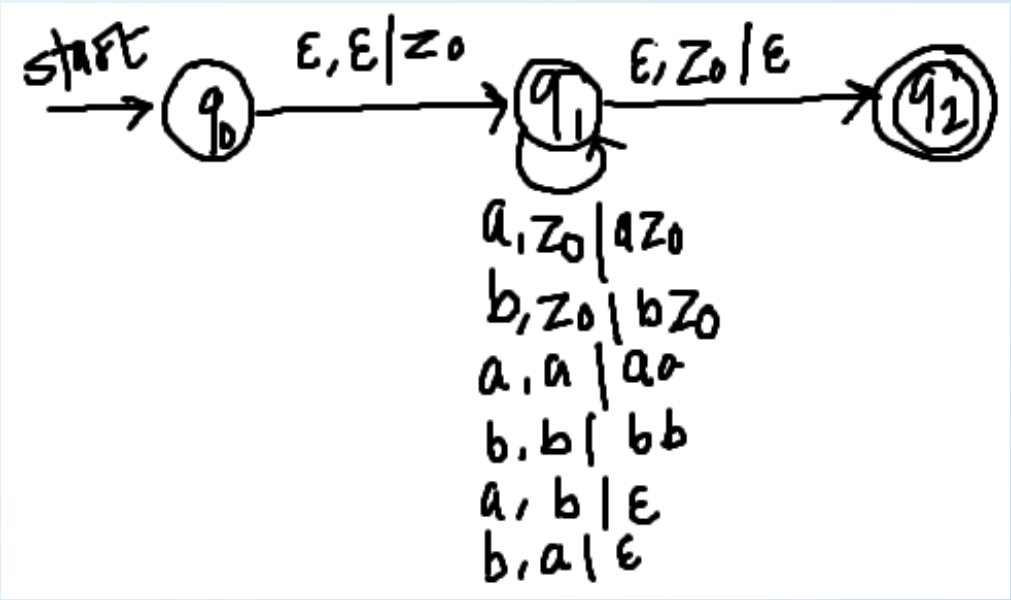
- We can define acceptance of any string by a PDA in two ways :
  - **Acceptance by final state :** Given a PDA P, the language accepted by final state, L(P) is - $\{w \mid (p, w, z_0) \vdash^* (q, \epsilon, \gamma)\}$ where $q \in F$ and $\gamma \in \Gamma^*$
  - **Acceptance by empty stack :** Given a PDA P, the language accepted by empty stack, L(P), is - $\{w \mid (p, w, z_0) \vdash^* (q, \epsilon, \epsilon)\}$ where $q \in Q$.

Deterministic Pushdown Automata (DPDA)

- While the PDAs are by definition, allowed to be Non-deterministic, the deterministic PDA is quite important.
- In practice, the parsers generally behave like Deterministic PDA, so the class of language accepted by these PDAs are practically important.
- DPDA are suitable for use in programming languages.
- A deterministic PDA is one in which there is exactly one choice of action for a given state, input symbol and stack symbol

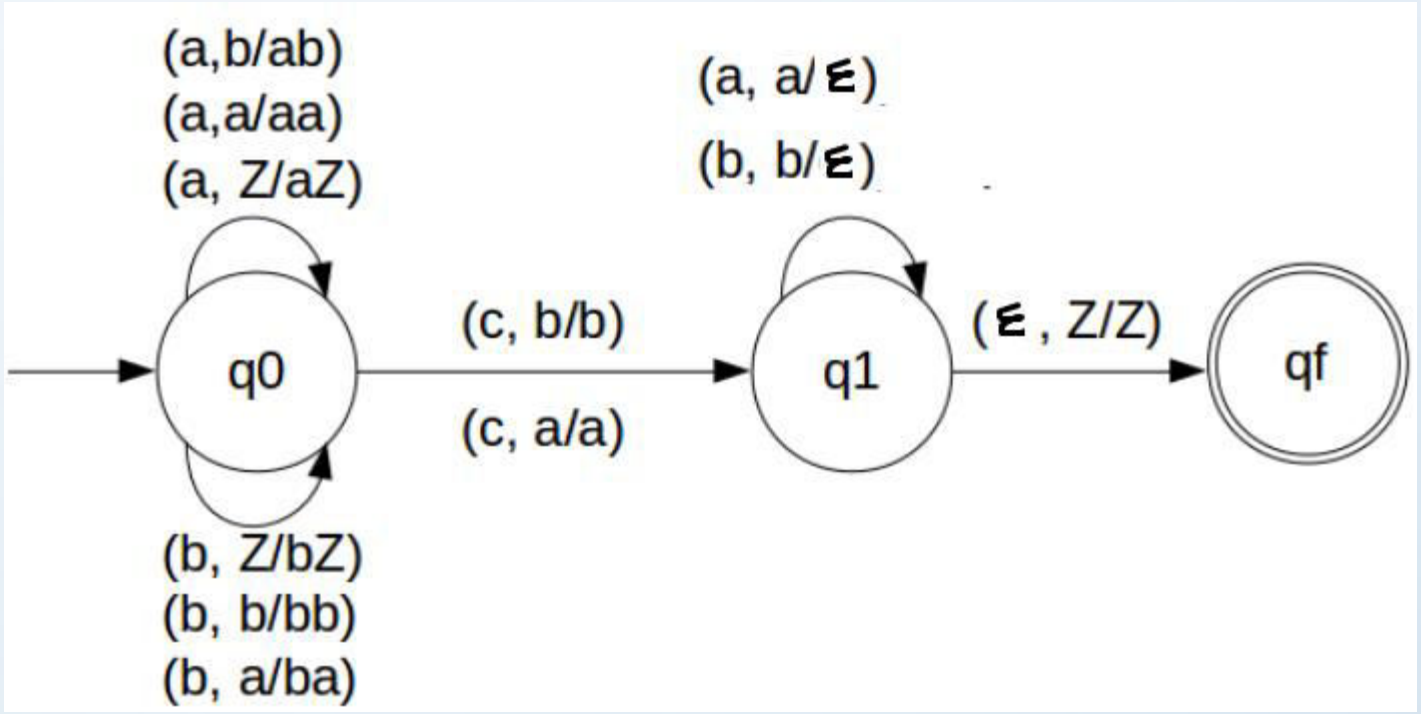
Deterministic Pushdown Automata (DPDA)

- A pushdown automata P = (Q, Σ, Γ, δ, q_0, z_0, F) is DPDA if there is no configuration for which P has a choice of more than one moves. i.e. P is deterministic if following two conditions are satisfied :
  - For any q ε Q, x ε Γ, If δ(q, a, x) ≠ Φ for some a ε Σ then δ(q, Є, x) = Φ. i.e. if δ(q, a, x) is non-empty for some a, then δ(q, Є, x) must be empty.
  - For any q ε Q, a ε Σ U {Є} and x ε Γ, δ(q, a, x) has at most one element
- Example :



Deterministic Pushdown Automata (DPDA)

- Example : A DPDA accepting language L = {w c w^R | w ε (a+b)+}



Non - Deterministic Pushdown Automata (NPDA)

- Example : A NPDA accepting language L = {ww^R | w ε (a+b)+}