(3) Design the PDA for the language
$L = \{ a^n b^n c^m d^m \mid n, m \geq 1 \}$

Acceptance by NULL store

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

$Q = \{ q_0, q_1, q_2, q_3 \}$

$\Sigma = \{ a, b, c, d \}$

$\Gamma = \{ a, b, c, d, Z_0 \}$

$q_0 = \{ q_0 \}$

$Z_0 = \{ Z_0 \}$

$F = \phi$

δ is defined by

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

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

$\delta(q_0, b, a) \vdash (q_1, \lambda)$

$\delta(q_1, b, a) \vdash (q_1, \lambda)$

$\delta(q_1, c, Z_0) \vdash (q_2, cZ_0)$

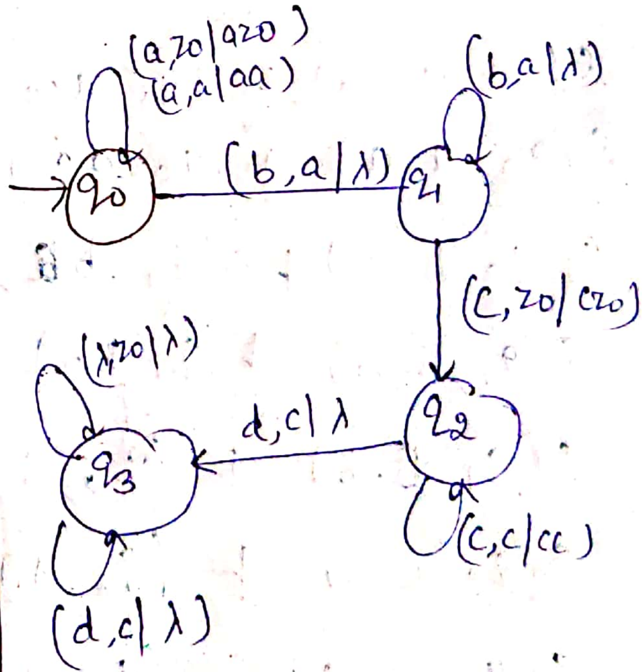
$\delta(q_2, c, c) \vdash (q_2, cc)$

$\delta(q_2, d, c) \vdash (q_3, \lambda)$

$\delta(q_3, d, c) \vdash (q_3, \lambda)$

$\delta(q_3, \lambda, Z_0) \vdash (q_3, \lambda)$

State - transition diagram



(4). Write the PDA for the language

$L = \{a^n b^m c^m d^n \mid n, m \geq 1\}$

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

Acceptance by Null store

~~δ is defined by~~

$Q = \{q_0, q_1, q_2, q_3\}$

$\Sigma = \{a, b, c, d\}$

$\Gamma = \{a, b, Z_0\}$

$q_0 = \{q_0\}$

$Z_0 = \{Z_0\}$

$F = \phi$

δ is defined

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

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

$\delta(q_0, b, a) \vdash (q_1, ba)$

$\delta(q_1, b, b) \vdash (q_1, bb)$

$\delta(q_1, c, b) \vdash (q_2, \lambda)$

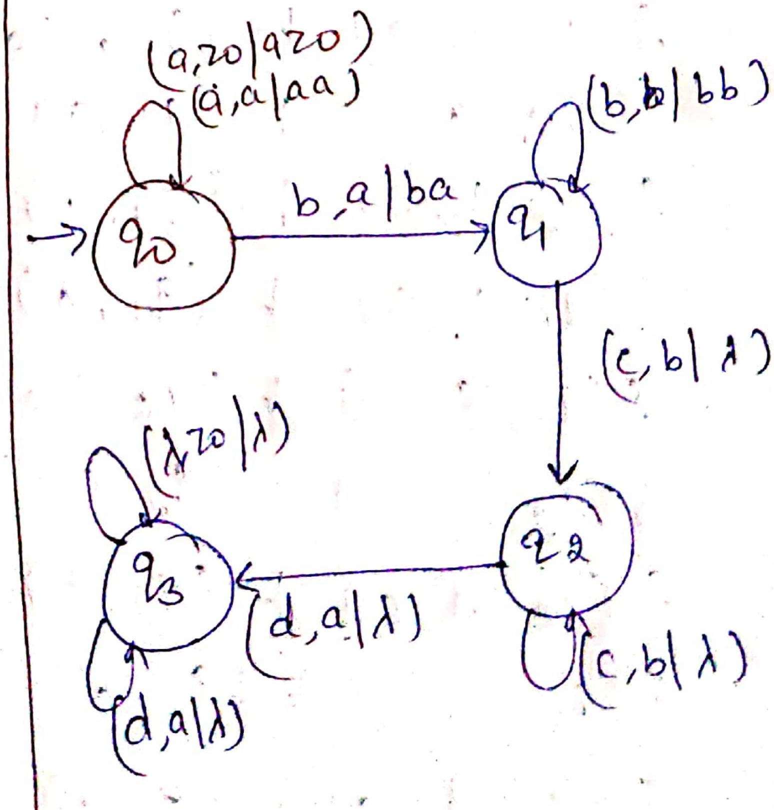
$\delta(q_2, c, b) \vdash (q_2, \lambda)$

$\delta(q_2, d, a) \vdash (q_3, \lambda)$

$\delta(q_3, d, a) \vdash (q_3, \lambda)$

$\delta(q_3, \lambda, Z_0) \vdash (q_3, \lambda)$

State-trans. diagram



(5) Design the PDA for the language

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

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

$Q = \{q_0, q_1, q_2\}$

$\Sigma = \{a, b, c\}$

$\Gamma = \{a, Z_0\}$

$q_0 = \{q_0\}$

$Z_0 = \{Z_0\}$

$F = \phi$

instead of push a, push 2a at one time

or

instead of ~~pop~~ 2b pop 1a

δ is defined by

$\delta(q_0, a, Z_0) \vdash (q_0, aaZ_0)$

$\delta(q_0, a, a) \vdash (q_0, aaa)$

$\delta(q_0, c, a) \vdash (q_1, a)$

$\delta(q_1, b, a) \vdash (q_2, \lambda)$

$\delta(q_2, b, a) \vdash (q_2, \lambda)$

$\delta(q_2, \lambda, Z_0) \vdash (q_2, \lambda)$

check that string w = aaacbbbbbb is accepted by above PDA

$\delta(q_0, aaacbbbbbb, Z_0) \vdash$

$\vdash q_0, aacbbbbbb; aaZ_0)$

$\vdash q_0, acbbbbbb, aaaaZ_0)$

$\vdash q_0, cbbbbbb, aaaaaaZ_0$

$\vdash q_1, bbbbbb, aaaaaaZ_0$

$\vdash q_2, bbbbb, aaaaaZ_0$

$\vdash q_2, bbbb, aaaaZ_0$

$\vdash q_2, bbb, aaaZ_0$

$\vdash q_2, bb, aaZ_0$

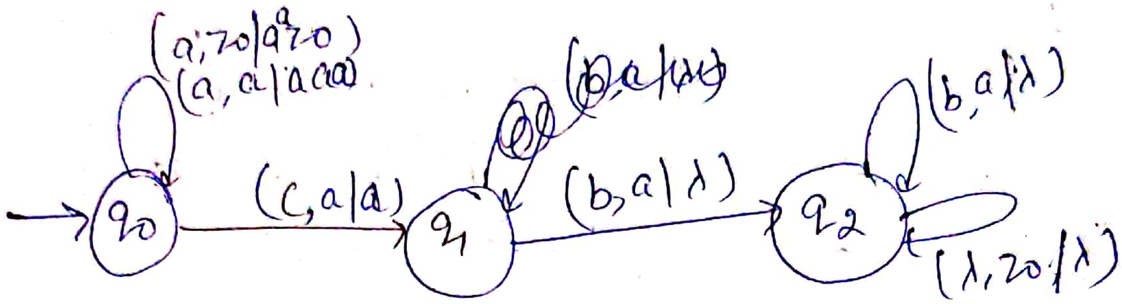
$\vdash q_2, b, aZ_0$

$\vdash q_2, \lambda, Z_0$

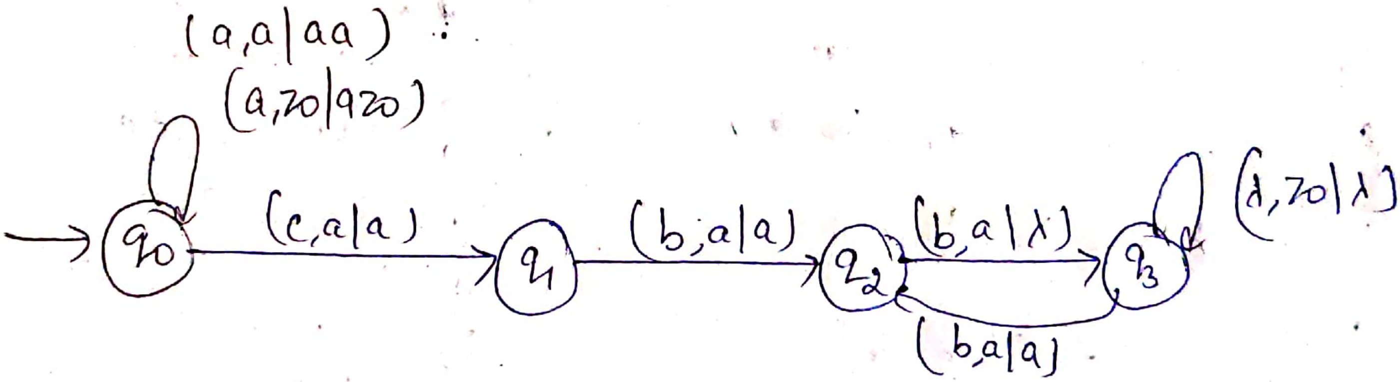
$\vdash q_2, \lambda$

State transition diagram

$a^n c b^{2n}$



or



(6) Design the PDA for the language

$L = \{ w c w^r \mid w \in (a,b)^* \}$ or wcw^R

PDA $A(Q, \Sigma, \delta, \Gamma, q_0, z_0, F)$

abcba

$Q = \{q_0, q_1\}$

$\Sigma = \{a, b, c\}$

δ : —

$\Gamma = \{a, b, z_0\}$

$q_0 = \{q_0\}$

$z_0 = \{z_0\}$

$F = \phi$

δ is defined by :

$\delta(q_0, a, z_0) \vdash (q_0, a z_0)$

$\delta(q_0, b, z_0) \vdash (q_0, b z_0)$

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

$\delta(q_0, b, b) \vdash (q_0, bb)$

$\delta(q_0, a, b) \vdash (q_0, ab)$

$\delta(q_0, b, a) \vdash (q_0, ba)$

$\delta(q_0, \cancel{a}c, a) \vdash (q_1, a)$

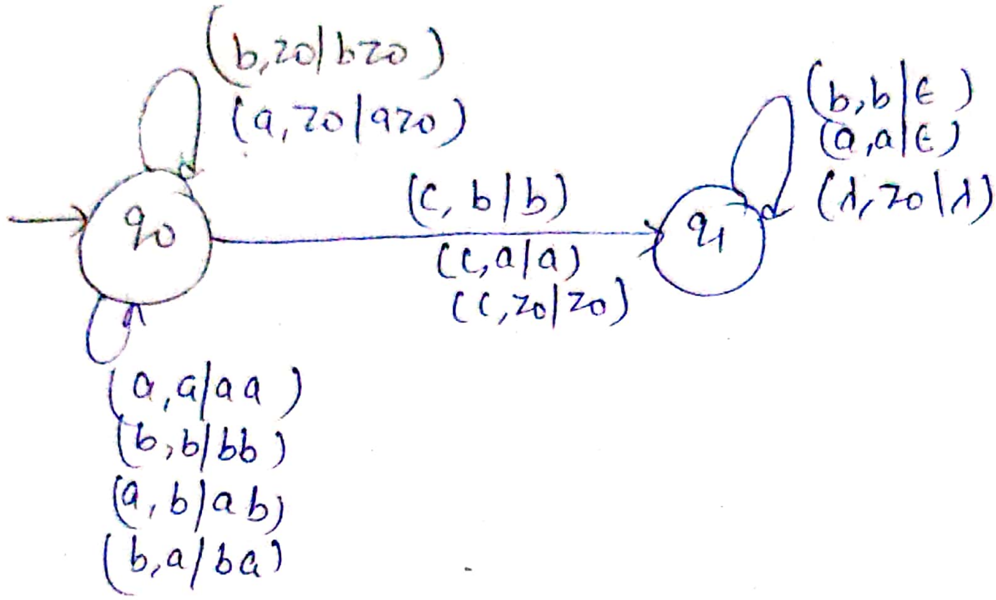
$\delta(q_0, c, b) \vdash (q_1, b)$

$\delta(q_0, c, z_0) \vdash (q_1, z_0)$

$\delta(q_1, b, b) \vdash (q_1, \lambda)$

$\delta(q_1, a, a) \vdash (q_1, \lambda)$

$\delta(q_1, \lambda, z_0) \vdash (q_1, \lambda)$

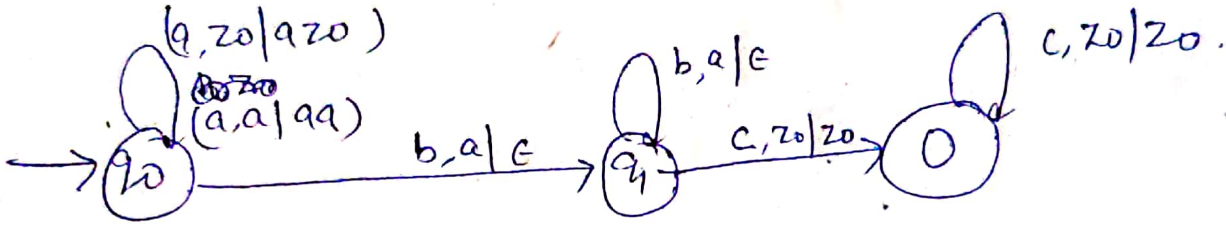


state-transition diagram of

$$\frac{wcw^R}{w \in (a,b)^*}$$

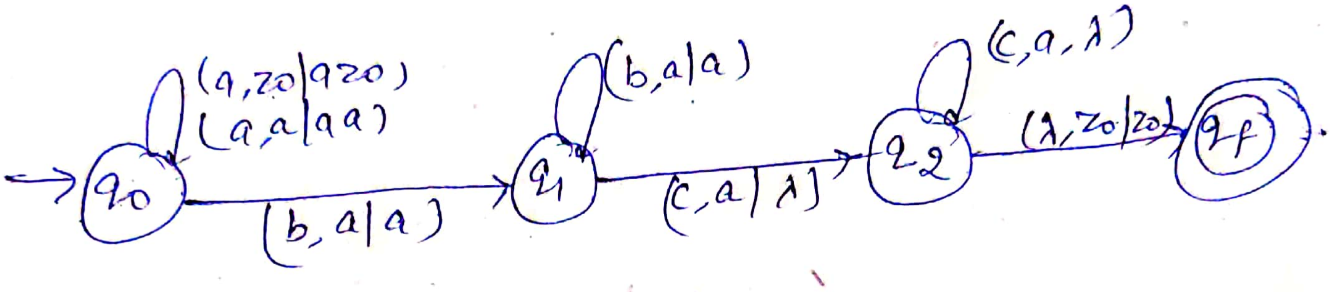
(7) State transition diagram of PDA for the language $a^n b^n c^m \mid n, m \geq 1$.

Acceptance by final state



(8) $L = a^n b^m c^n \mid n, m \geq 1$

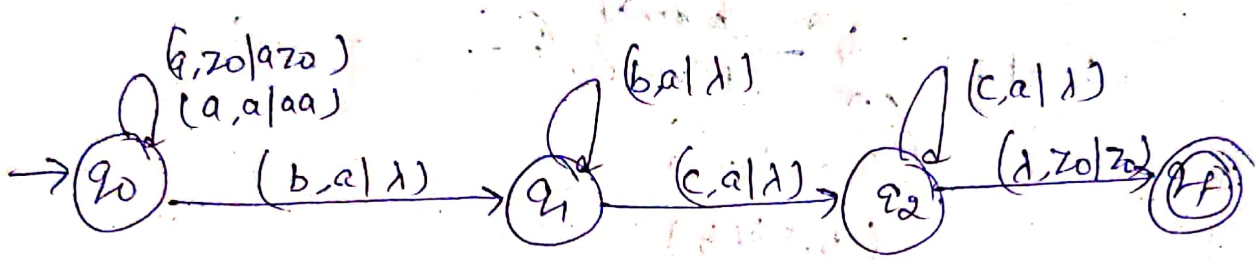
Acceptance by final state



(9) $a^{m+n} b^m c^n \mid m, n \geq 1$

so we break the string

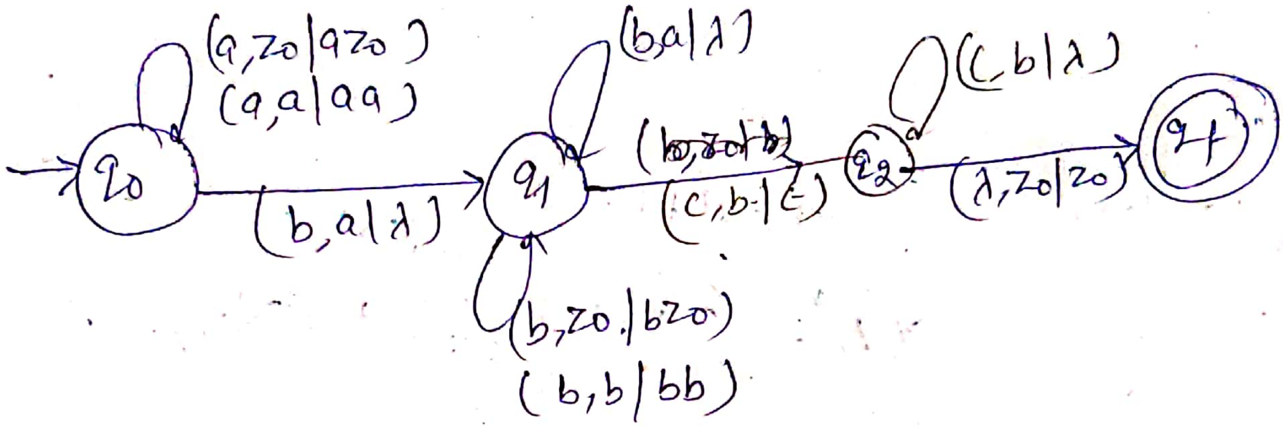
$L = a^n a^m b^m c^n$



(10) $a^n b^{m+n} c^m \mid n, m \geq 1$

or.

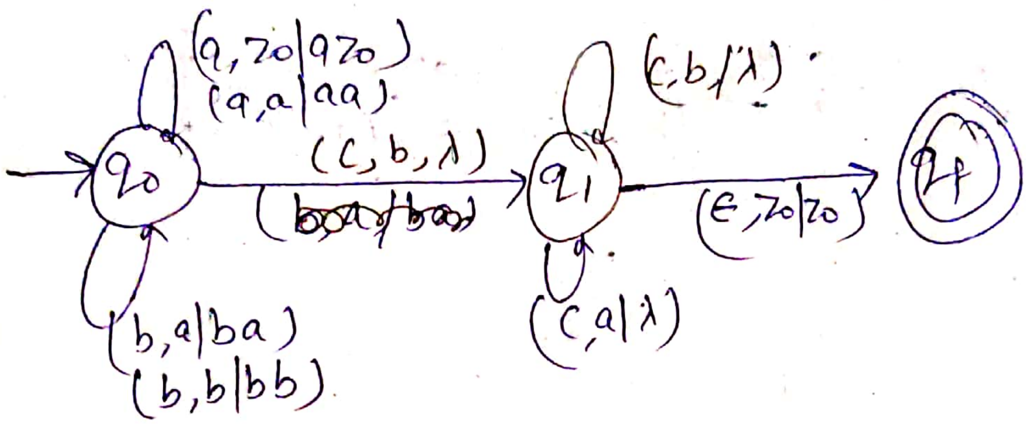
$a^n b^n b^m c^m \mid n, m \geq 1$



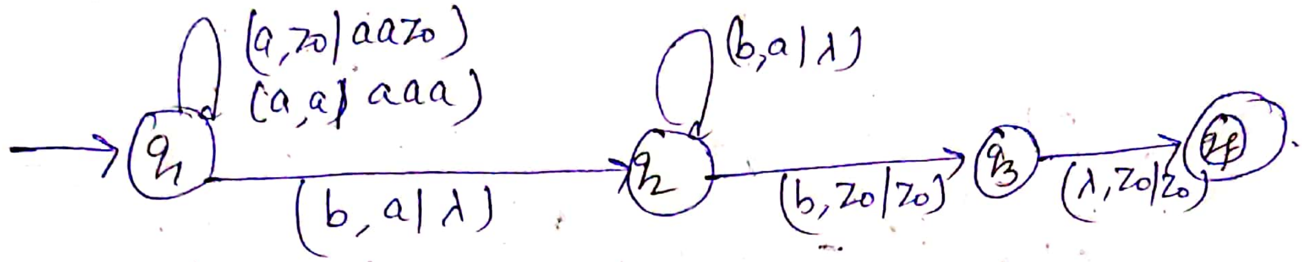
(11) $a^n b^m c^{n+m} \mid n, m \geq 1$

or.

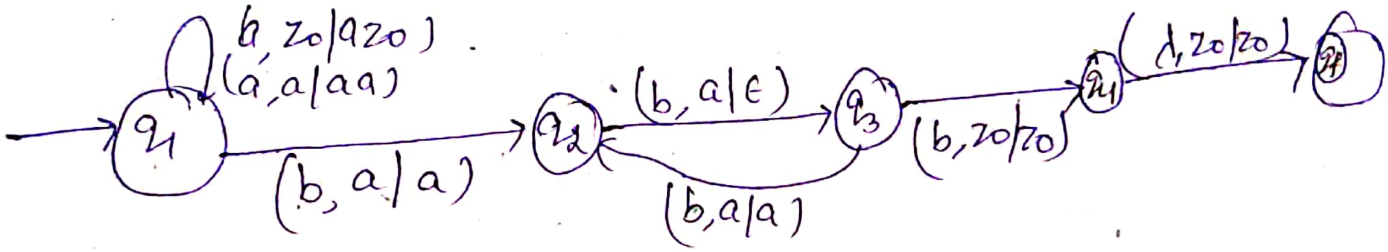
$a^n b^m c^m c^n \mid n, m \geq 1$



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



or.



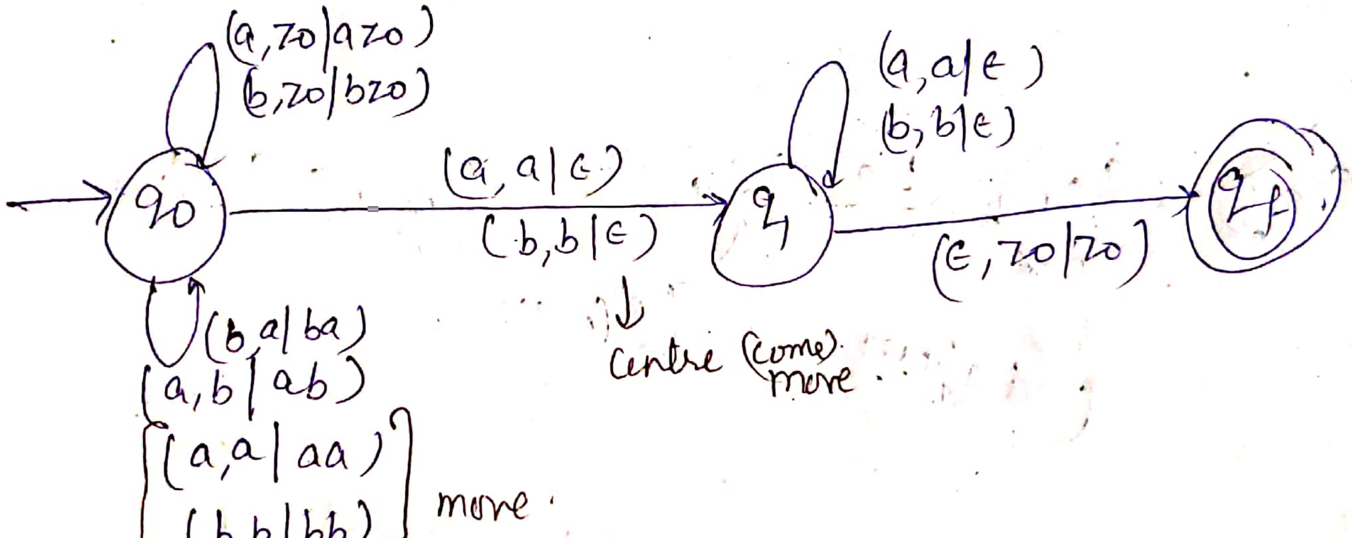
NDPDA

$\{ w w^R \mid w \in (a,b)^+ \}$

Set of all even length Palindrome

$\underbrace{aba}_{w}\ \underbrace{aba}_{w^R}$ $\underbrace{ab}_{w}\underbrace{ba}_{w^R}$ $\underbrace{ba}_{w}\ \underbrace{ab}_{w^R}$ $\underbrace{aa}_{w}\ \underbrace{aa}_{w^R}$

we need a non-deterministic machine, no centre. its a problem.



Centre hasn't come

check (aaaa)

$\delta(q_0, aaaa, Z_0)$

$\delta(q_0, aaa, Z_0)$ → No Centre

Centre Dead (configuration) $\delta(q_0, aa, Z_0)$

$\vdash (q_0, aa, aaZ_0)$

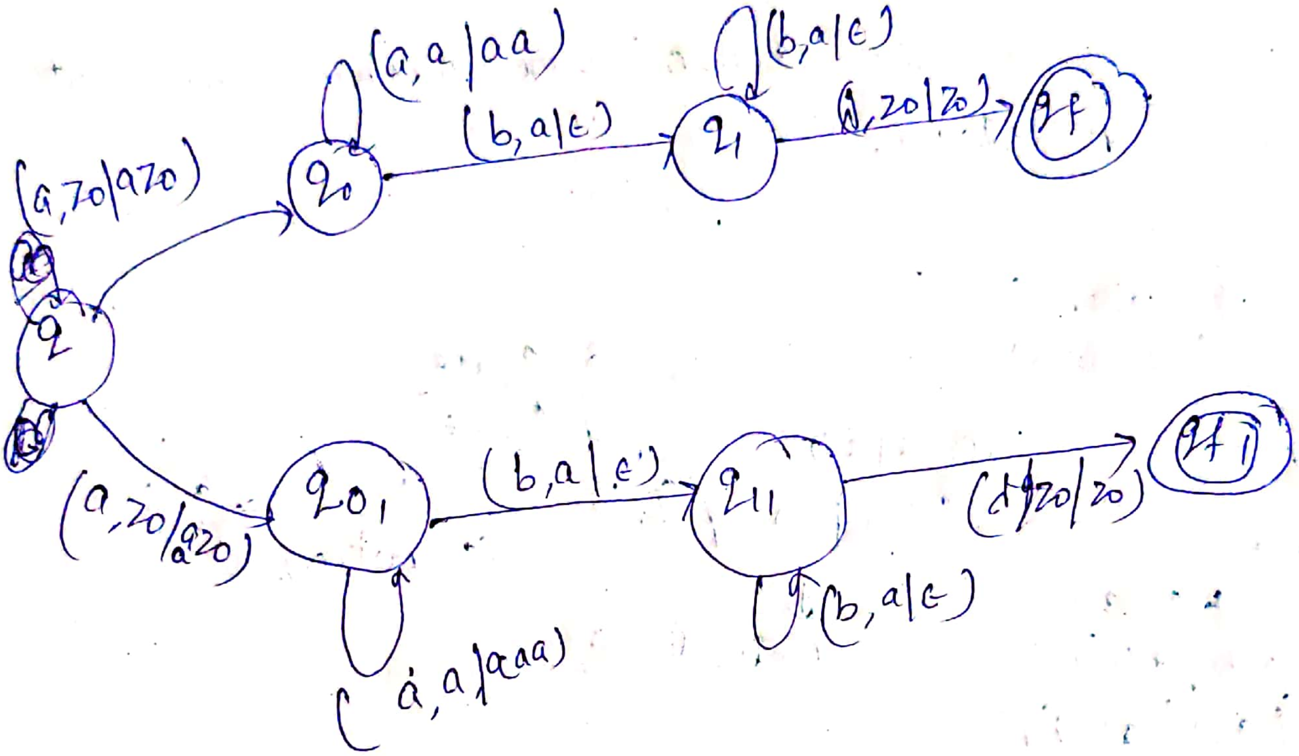
(q_1, a, aZ_0) $(q_0, a, aaaZ_0)$

$(q_1, \lambda, Z_0) \rightarrow (q_f, \lambda, Z_0)$ Acceptance.

Scanned with CamScanner

Union

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



If at least one PDA goes to final state, we can say that the string is accepted.

NDPDA $\subseteq$ DPDA

↓

Accept
More languages.

$wcw^R \mid w \in (a,b)^+$

Set of all ^{odd} palindrome

(odd length)

① $\underbrace{abb}_{Push}\ c\ \underbrace{baa}_{Pop}$

② $\underline{ba}\ c\ \underline{ab}$