Assignment - 3

Q1 Compare PDA and FSM

Soln:-

FSM	PDA
- FSM stands for Finite Machine.	- PDA Stands for push Down Automata.
- It doesnot have capability to remember previous input	- contains stack, it can already read input.
- Constructed for type-3 grammar.	- Constructed for type-2 grammar.
- NFSM and FSM are equivalent.	- NPDA has more capability than PDA.

Q2: Design and draw Deterministic PDA Accepting "Balance string of Bracket" which are accepted by following CFG.

$$S \to SS \mid [S] \mid \{S\} \mid \wedge .$$

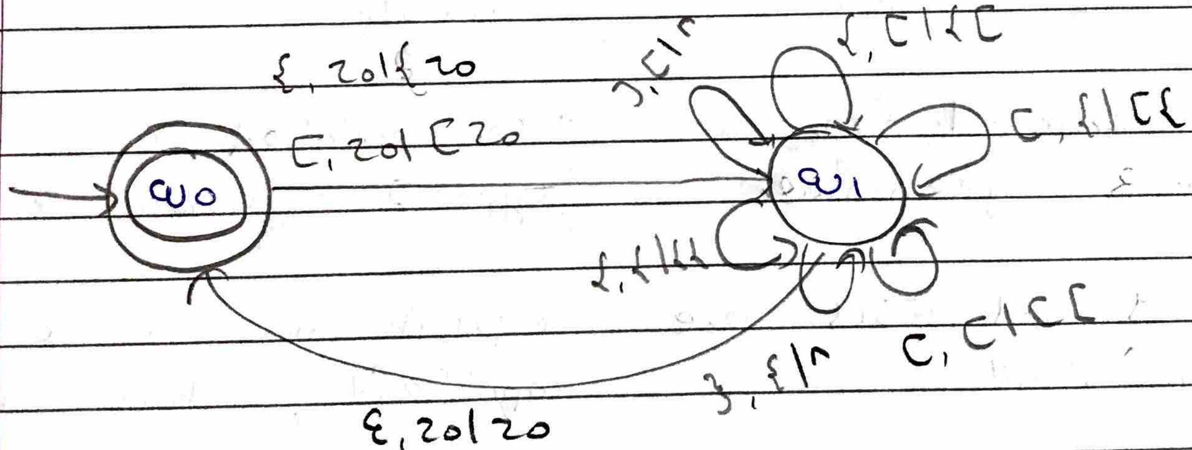
$$\delta(q_0, [, Z_0) = (q_1, [Z_0)$$
$$\delta(q_0, \{, Z_0) = (q_1, \{Z_0)$$

$$\delta(q_1, [, [) = (q_1, [[)$$
$$\delta(q_1, \{, \{) = (q_1, \{\{)$$

$$\delta(q_1, [, \{) = (q_1, [\{)$$
$$\delta(q_1, \{, [) = (q_1, \{[)$$

$$\delta(q_1,], [) = (q_1, \varepsilon)$$
$$\delta(q_1, \}, \{) = (q_1, \varepsilon)$$

$$\delta(q_1, \varepsilon, Z_0) = (q_0, Z_0).$$



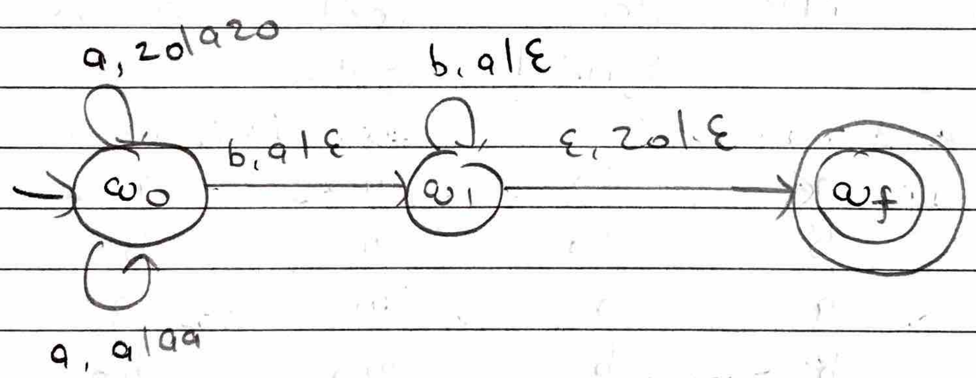
Q3 Design a PDA to accept

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

Soln:-

This is a language in which equal number of a's are followed by equal number of b's. The logic is: first we push all a's onto the stack. Then on reading every single b each a is popped. And at last if stack is empty then string will be accepted.

$$\delta(q_0, a, z_0) = (q_0, az_0)$$
$$\delta(q_0, a, a) = (q_0, aa)$$
$$\delta(q_0, b, a) = (q_1, \varepsilon)$$
$$\delta(q_1, b, a) = (q_1, \varepsilon)$$
$$\delta(q_1, \varepsilon, z_0) = (q_f, \varepsilon)$$



Q4 Give Transition tables for Deterministic PDA recognizing following language:

$$L = \{ x \in \{a,b\}^* \mid n_a(x) \neq n_b(x) \}$$

Trace it for the string abbaababbb

Soln:-

$$\delta(q_0, a, z_0) = (q_0, az_0)$$
$$\delta(q_0, b, z_0) = (q_0, bz_0)$$

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

$$\delta(q_0, a, b) = (q_0, \varepsilon)$$
$$\delta(q_0, b, a) = (q_0, \varepsilon)$$

$$\delta(q_0, \varepsilon, a) = (q_f, a)$$
$$\delta(q_0, \varepsilon, b) = (q_f, b)$$

current state	i/p	stack symbol	next state	move
q_0	a	z_0	q_0	az_0
q_0	b	z_0	q_0	bz_0
q_0	a	a	q_0	aa
q_0	b	b	q_0	bb
q_0	b	a	q_0	$\wedge$
q_0	a	b	q_0	$\wedge$
q_0	ε	a	q_f	a
q_0	ε	b	q_f	b

Trace it for the string abb aababbb.

$\delta(q_0, abbaababbb, z_0) = \delta(q_0, bbaababbb, az_0) =$

$- \delta(q_0, baababbb, z_0)$
$- \delta(q_0, aababbb, bz_0)$
$- \delta(q_0, ababbb, z_0)$
$- \delta(q_0, babbb, az_0)$
$- \delta(q_0, abbb, z_0)$
$- \delta(q_0, bbb, az_0)$
$- \delta(q_0, bb, z_0)$
$- \delta(q_0, b, bz_0)$
$- \delta(q_0, \varepsilon, bbz_0)$

$- \delta(q_f, b)$ - Accepted.

2) Q5 For the PDA $(\{q_0, q_1\}, \{0, 1\}, \{0, 1, z_0\}, \delta, q_0, z_0, \phi)$, where δ is

$\delta(q_0, \varepsilon, z_0) = \{(q_1, \varepsilon)\}$
$\delta(q_0, 0, z_0) = (q_0, 0z_0)$
$\delta(q_0, 0, 0) = (q_0, 00)$
$\delta(q_0, 1, 0) = (q_0, 10)$
$\delta(q_0, 1, 1) = (q_0, 11)$
$\delta(q_0, 0, 1) = (q_1, \varepsilon)$
$\delta(q_1, 0, 1) = (q_1, \varepsilon)$
$\delta(q_1, 0, 0) = (q_1, \varepsilon)$
$\delta(q_1, \varepsilon, z_0) = (q_1, \varepsilon)$.

obtain CFG accepted by the above PDA.

Sol^n :-

1) $S \rightarrow (q_0, z_0, q_0)$
   $S \rightarrow (q_0, z_0, q_1)$

2) For $\delta(q_0, \varepsilon, z_0) = (q_1, \varepsilon)$

$(q_0, z_0, q_1) \rightarrow \varepsilon$.

3) For $\delta(q_0, 0, z_0) = (q_0, 0z_0)$

$(q_0, z_0, q_0) \rightarrow 0(q_0, 0, q_0)(q_0, z_0, q_0)$
$(q_0, z_0, q_0) \rightarrow 0(q_0, 0, q_1)(q_1, z_0, q_0)$
$(q_0, z_0, q_1) \rightarrow 0(q_0, 0, q_0)(q_0, z_0, q_1)$
$(q_0, z_0, q_1) \rightarrow 0(q_0, 0, q_1)(q_1, z_0, q_1)$

4) For $\delta(q_0, 0, 0) = (q_0, 00)$

$(q_0, 0, q_0) = 0(q_0, 0, q_0)(q_0, 0, q_0)$
$(q_0, 0, q_0) = 0(q_0, 0, q_1)(q_1, 0, q_0)$
$(q_0, 0, q_1) = 0(q_0, 0, q_0)(q_0, 0, q_1)$
$(q_0, 0, q_1) = 0(q_0, 0, q_1)(q_1, 0, q_1)$

5) For $\delta(q_0, 1, 0) = (q_0, 10)$,

$(q_0, 0, q_0) = 1(q_0, 1, q_0)(q_0, 0, q_0)$
$(q_0, 0, q_0) = 1(q_0, 1, q_1)(q_1, 0, q_0)$
$(q_0, 0, q_1) = 1(q_0, 1, q_0)(q_0, 0, q_1)$

$(q_0, 0, q_1) \to 1\ (q_0, 1, q_1)(q_1, 0, q_1)$

6) For $\delta(q_0, 1, 1) = (q_0, 11)$

$(q_0, 1, q_0) = 1\ (q_0, 1, q_0)(q_0, 1, q_0)$
$(q_0, 1, q_0) = 1\ (q_0, 1, q_1)(q_1, 1, q_0)$
$(q_0, 1, q_1) = 1\ (q_0, 1, q_0)(q_0, 1, q_1)$
$(q_0, 1, q_1) = 1\ (q_0, 1, q_1)(q_1, 1, q_1)$.

7) For $\delta(q_0, 0, 1) = (q_1, \varepsilon)$

$(q_0, 1, q_1) \to 0$

8) For $\delta(q_1, 0, 1) = (q_1, \varepsilon)$

$(q_1, 1, q_1) \to 0$

9) For $\delta(q_1, 0, 0) = (q_1, \varepsilon)$

$(q_1, 0, q_1) \to 0$

10) For $\delta(q_1, \varepsilon, z_0) = (q_1, \varepsilon)$

$(q_1, z_0, q_1) \to \varepsilon$.

Now,

(q_0, z_0, q_0) - A
(q_0, z_0, q_1) - B
(q_1, z_0, q_0) - C
(q_1, z_0, q_1) - D

$(q_0, 0, q_0)$ - E
$(q_0, 0, q_1)$ - F
$(q_1, 0, q_0)$ - G
$(q_1, 0, q_1)$ - H

$(q_0, 1, q_0)$ - I
$(q_0, 1, q_1)$ - J
$(q_1, 1, q_0)$ - K
$(q_1, 1, q_1)$ - L.

Now,

$S \to A \mid B$
$\cancel{B} \to \varepsilon$
$A \to 0\ E\ \cancel{H}\ A$
$A \to 0\ F\ C$
$B \to 0\ E\ B$
$B \to 0\ F\ D$
$E \to 0\ E\ E$
$E \to 0\ F\ G$
$F \to 0\ E\ F$
$F \to 0\ F\ H$

$E \to 1\ I\ E$
$E \to 1\ J\ G$
$F \to 1\ I\ F$
$F \to 1\ J\ H$
$I \to 1\ I\ I$
$I \to 1\ J\ K$
$J \to 1\ I\ J$
$J \to 1\ J\ L$

$J \to 0$
$L \to 0$
$H \to 0$
$D \to \varepsilon$

So simplified CFG is:

$S \rightarrow A \mid B$

$A \rightarrow 0EA \mid 0FC \mid \varepsilon$

$B \rightarrow 0EB \mid 0FD \mid \varepsilon$

$E \rightarrow 0EE \mid 0FG \mid 1IE \mid 1JG$

$F \rightarrow 0EF \mid 0FH \mid 1IF \mid 1JH$

$I \rightarrow 1II \mid 1JK$

$J \rightarrow 1IJ \mid 1JL \mid 0$

$L \rightarrow 0$

$H \rightarrow 0$

$D \rightarrow \phi \ \varepsilon$