INSHA SAMNANI
20K-0247

TOA ASSIGNMENT 3

Date________

QUESTION 1:

①

Step 1: Draw the transition table of the FA if FA is only given. (using intersection FA)

Q	$\delta(Q,0)$	$\delta(Q,1)$
$\pm Z_1$	Z_2	Z_3
Z_2	Z_1	Z_4
Z_3	Z_5	Z_1
Z_4	Z_6	Z_2
Z_5	Z_3	Z_5
Z_6	Z_4	Z_6

Step 2: Build table to compare each unordered pair of distinct states. Initialize all enteries as unmarked and with no dependencies.

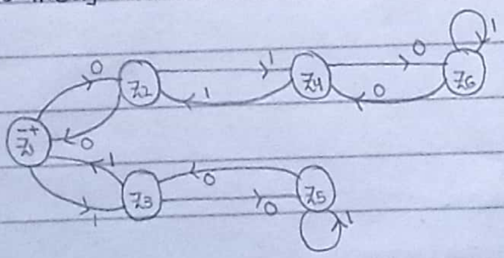
Z_2	(Z_1,Z_2)				
Z_3	(Z_1,Z_3)	(Z_2,Z_3)			
Z_4	(Z_1,Z_4)	(Z_2,Z_4)	(Z_3,Z_4)		
Z_5	(Z_1,Z_5)	(Z_2,Z_5)	(Z_3,Z_5)	(Z_4,Z_5)	
Z_6	(Z_1,Z_6)	(Z_2,Z_6)	(Z_3,Z_6)	(Z_4,Z_6)	(Z_5,Z_6)
	Z_1	Z_2	Z_3	Z_4	Z_5

Step 3: Mark all pairs of finals and non finals states.

Step 4: Start marking the pairs whose pairs of 0's or 1's from transition table are marked in this.

Step 5: Coalesce unmarked pairs of states. then draw the resulting transition table and DFA.

DFA was already minimized. Same transition table as shown above will be used.



Date.

②

Step 1: Draw the transition table of FA if FA is only given. (using concatenation FA).

q	$\delta(q,0)$	$\delta(q,1)$
$\mp z_1$	z_2	z_3
$+z_2$	z_1	z_4
$+z_3$	z_5	z_3
z_4	z_6	z_2
$+z_5$	z_3	z_7
$+z_6$	z_8	z_9
z_7	z_9	z_5
$+z_8$	z_6	z_8
$+z_9$	z_{10}	z_9
$+z_{10}$	z_9	z_{10}

Step 2: Build table to compare each unordered pairs of distinct states. Initialize all enteries as unmarked and with no dependencies.

Step 3: Mark all pairs of finals and nonfinals states.

Step 4: Start marking pairs whose pairs of 0's and 1's from transition table are marked in this.

z_2 (z_1,z_2)

z_3 (z_1,z_3) (z_2,z_3)

z_4 (z_1,z_4) (z_2,z_4) (z_3,z_4)

z_5 (z_1,z_5) (z_2,z_5) (z_3,z_5) (z_4,z_5)

z_6 (z_1,z_6) (z_2,z_6) (z_3,z_6) (z_4,z_6) (z_5,z_6)

z_7 (z_1,z_7) (z_2,z_7) (z_3,z_7) (z_4,z_7) (z_5,z_7) (z_6,z_7)

z_8 (z_1,z_8) (z_2,z_8) (z_3,z_8) (z_4,z_8) (z_5,z_8) (z_6,z_8) (z_7,z_8)

z_9 (z_1,z_9) (z_2,z_9) (z_3,z_9) (z_4,z_9) (z_5,z_9) (z_6,z_9) (z_7,z_9) (z_8,z_9)

z_{10} (z_1,z_{10}) (z_2,z_{10}) (z_3,z_{10}) (z_4,z_{10}) (z_5,z_{10}) (z_6,z_{10}) (z_7,z_{10}) (z_8,z_{10}) (z_9,z_{10}).

z_1 z_2 z_3 z_4 z_5 z_6 z_7 z_8 z_9

Step 5: Coalesce unmarked pairs of states and draw the resulting transition table and DFA.

$z_1 = z_3$

$z_2 = z_5$

$z_4 = z_7$

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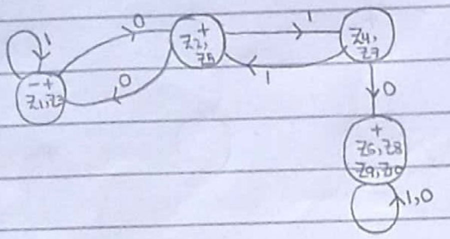
$Z_6 = Z_8 = Z_9 = Z_{10}$

B	$\delta(B,0)$	$\delta(B,1)$
$\mp$ (Z_1, Z_3)	(Z_2, Z_5)	(Z_1, Z_3)
$+$ (Z_2, Z_5)	(Z_1, Z_3)	(Z_4, Z_7)
(Z_4, Z_7)	(Z_6, Z_8, Z_9, Z_{10})	(Z_2, Z_5)
$+$ (Z_6, Z_8, Z_9, Z_{10})	(Z_6, Z_8, Z_9, Z_{10})	(Z_6, Z_8, Z_9, Z_{10})



QUESTION 2:

RG's:

a- $S \to AB \mid aAbB$
$A \to aaA \mid \lambda$
$B \to bbB \mid \lambda$

b- $S \to aaaaBA$
$B \to aB \mid \lambda$
$A \to b \mid bb \mid bbb \mid \lambda$

c- $S \to AB$
$A \to a \mid aa \mid aaa \mid \lambda$
$B \to b \mid bb \mid bbb \mid \lambda$

d- $S \to A00B \mid A000B$
$A \to 1A \mid 01A \mid 101A \mid \lambda$
$B \to 1B \mid 10B \mid 101B \mid \lambda$

e- $S \to AaAbA \mid AbAaA$
$A \to aA \mid bA \mid \lambda$

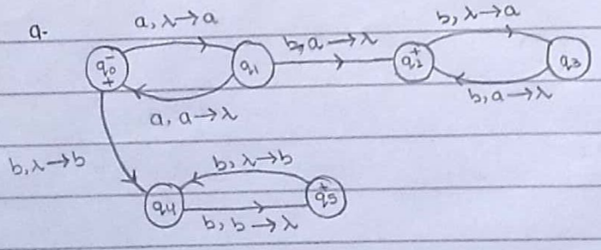
f- $S \to \lambda$

g- $S \to AaaAaaA$
$A \to aA \mid bA \mid \lambda$

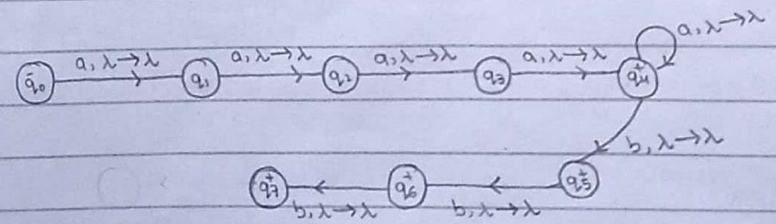
h- $S \to SaSaSaS \mid \lambda$

PDA's:

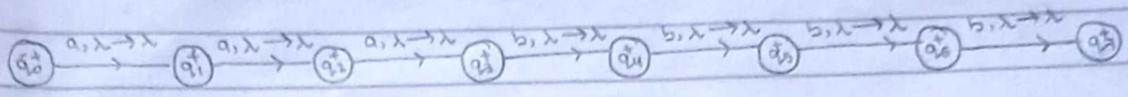
a-



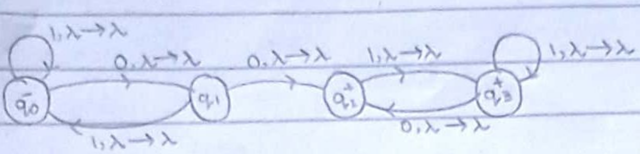
b-



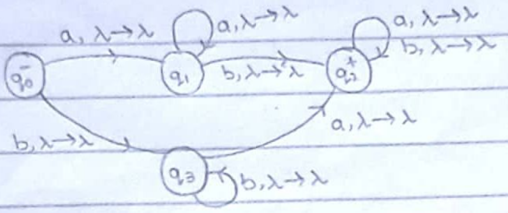
c-


a, λ→λ
a, λ→λ
a, λ→λ
b, λ→λ
b, λ→λ
b, λ→λ
b, λ→λ

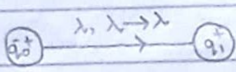
d-


1, λ→λ
0, λ→λ
0, λ→λ
1, λ→λ
1, λ→λ
1, λ→λ
0, λ→λ

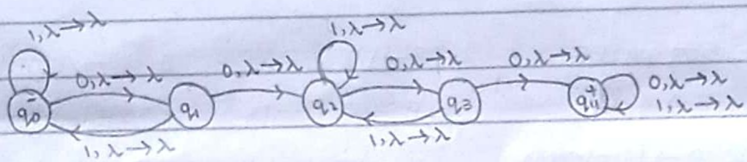
e-


a, λ→λ
a, λ→λ
a, λ→λ
b, λ→λ
b, λ→λ
a, λ→λ
b, λ→λ
b, λ→λ

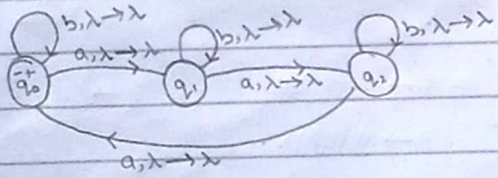
f-


λ, λ→λ

g-


1, λ→λ
0, λ→λ
0, λ→λ
1, λ→λ
0, λ→λ
0, λ→λ
0, λ→λ
1, λ→λ
1, λ→λ
1, λ→λ

h-


b, λ→λ
a, λ→λ
b, λ→λ
a, λ→λ
b, λ→λ
a, λ→λ

Date

QUESTION 3:

1- CFG's

a- S → 1S1|0S0|λ

b- S → 1A1|0A0|1|0

c- S → 1A1|0A0|1|0|λ

d- S → aSa|b ; n≥0

S → aSa|aba ; n≥1

f- S → A|B|λ

A → aAc|B|λ

B → bBc|λ

g- S → A|B|λ

A → aAc|B|λ

B → aBb|λ

h- S → AB|A|B|λ

A → aAb|λ

B → bBc|λ

i- S → AB

A → aA|λ

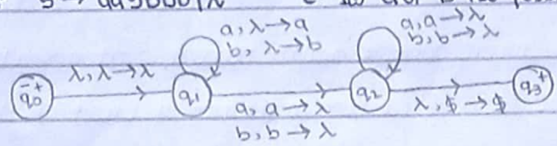
B → bbB|λ

j- S → aaSbbb|λ

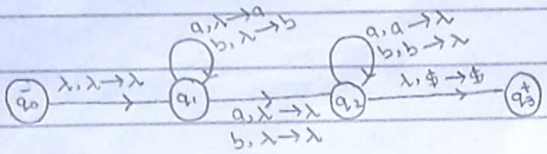
e- This CFG is not possible.

PDA's:

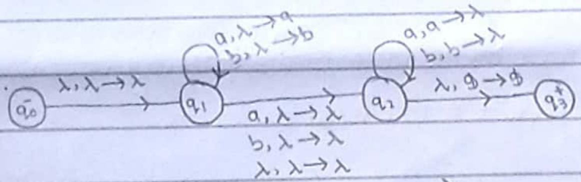
a-



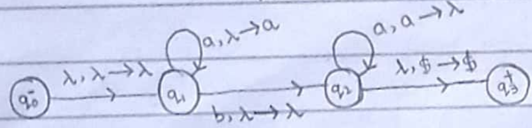
b-



c-

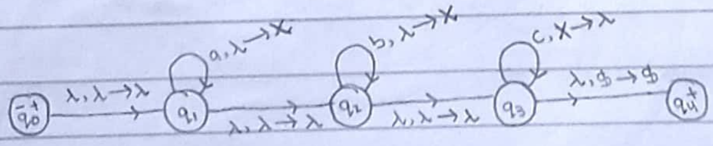


d-

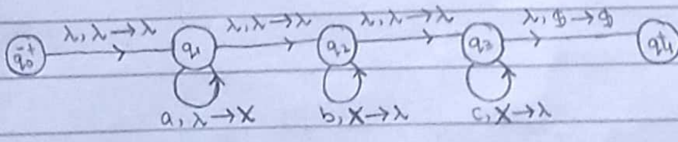


e- IF CFG not exist, then PDA will also not exist.

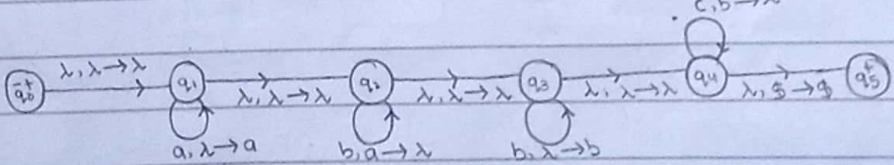
f-



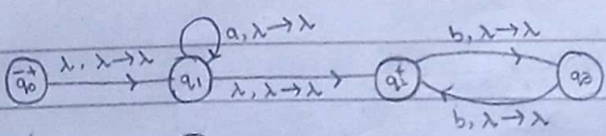
g-



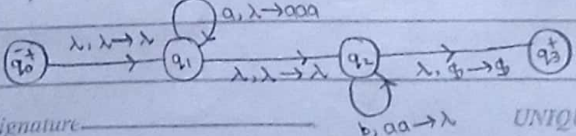
h-



i-



j-



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2- d- $a^n b a^n$ let $n=3$

$\underbrace{a}_{x}\underbrace{a}_{y}abaaa$ $y>0$ and $|xy| \leq 3$

y^0 (pumping y 0th time): abaa which is not having equal no of a's before and after b hence it is not a regular language and it will never make them equal if we keep on pumping y. except y^1 that is an obvious case.

e. ww let $w = a^n b^n$ so $ww = a^n b^n a^n b^n$. let $n=3$

$\underbrace{a}_{x}\underbrace{a}_{y}abbbaaabbb$ $y>0$ and $|xy| \leq 3$

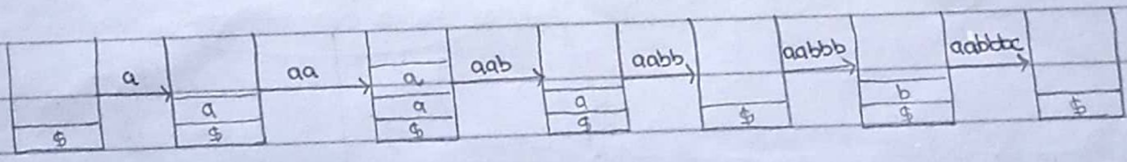
y^0 (pumping y 0th time): aabbbaaabbb where aabbb ≠ aaabbb hence it is not a regular language and it will never concatenate two same words if we keep on pumping y. except y^1 that is an obvious case.

j- $a^{2n} b^{3n}$ let $n=3$

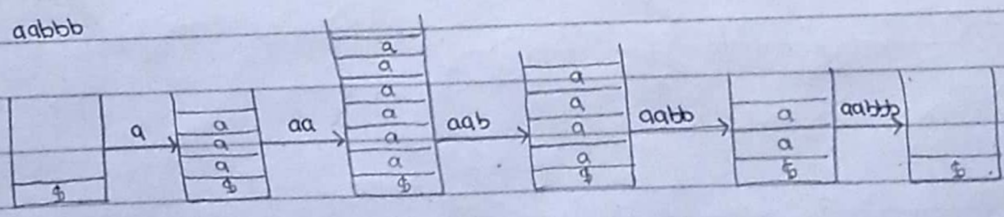
$\underbrace{a}_{x}\underbrace{a}_{y}aaaabbbbbbbbb$ $y>0$ and $|xy| \leq 3$

y^0(pumping y 0th time): aaaaabbbbbbbbb where a's are not 6 for $n=3$ and a's will increase and at a time a's will increase from b's if we keep on pumping y. except y^1 that is an obvious case.

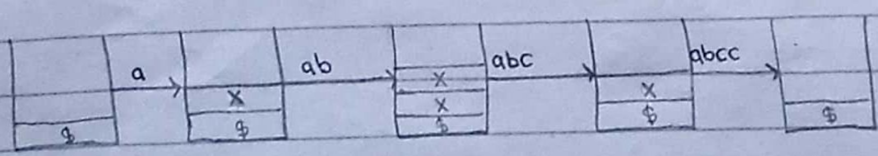
3- h- aabbbc



J- aabbb



F- abcc



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QUESTION 4:

SIMPLIFICATION:

1- S→ abS | abA | abB

A→ cd

B → aB

C→ dc Remove the production C→dc as it is useless (unreachable)

= S→ abS | abA | abB

A→ cd

B → aB Remove the production B→aB as it is useless (cannot derive the word completely)

= S→abS | abA | abB Remove the production S→abB as there is no production B.

A→ cd.

= S→ abS | abA

A →cd.

2- S → ABC | a = Remove the production E→e as it is useless (unreachable) = Remove the production F→f as it is useless (unreachable) = Remove the production G→g as it is useless (unreachable).

A→ b

B→ c

C→d

E→e

F→f

G→g

S→ ABC | a

A→b

B→c

C→d

F→f

G→g

S→ ABC | a

A→b

B→c

C→d

G→g

= S→ ABC | a

A→ b

B→ c

C →d

3- S→ aB | bX

A→ Bad | bSX | a Remove the production A→ Bad | bSX | a as it is useless (unreachable)

B → aSB | bBX

X → SBD | aBX | ad.

= S→ aB | bX

B→ aSB | bBX

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$X \rightarrow SBD \mid aBX \mid ad$ Remove the production $X \rightarrow SBD$ as there is no production D.

$= S \rightarrow aB \mid bX$

$B \rightarrow aSB \mid bBX$ Remove the production $B \rightarrow aSB \mid bBX$ as it is useless (cannot derive the word completely)

$X \rightarrow aBX \mid ad$

$= S \rightarrow aB \mid bX$ Remove the production $S \rightarrow aB$ as there is no production B

$X \rightarrow aBX \mid ad$

$= S \rightarrow bX$

$X \rightarrow aBX \mid ad$ Remove the production $X \rightarrow aBX$ as there is no production B.

$= S \rightarrow bX$

$X \rightarrow ad$

CONVERTING SIMPLIFIED CFG'S INTO CNF'S:

1- $S \rightarrow abS \mid abA$

$A \rightarrow cd$

Adding S_1

$= S_1 \rightarrow S$

$S \rightarrow abS \mid abA$

$A \rightarrow cd$

Removing $S_1 \rightarrow S$

$= S_1 \rightarrow abS \mid abA$

$S \rightarrow abS \mid abA$

$A \rightarrow cd$

let $X \rightarrow ab$, $Y \rightarrow c$, and $Z \rightarrow d$

$= S_1 \rightarrow XS \mid XA$

$S \rightarrow XS \mid XA$

$A \rightarrow YZ$

$X \rightarrow ab$

$Y \rightarrow c$

$Z \rightarrow d$

let $U \rightarrow a$ and $V \rightarrow b$

$= S_1 \rightarrow XS \mid XA$

$S \rightarrow XS \mid XA$

$A \rightarrow YZ$

$X \rightarrow UV$

$Y \rightarrow c$

$Z \rightarrow d$

$U \rightarrow a$

2- $S \rightarrow ABC \mid a$

$A \rightarrow b$

$B \rightarrow c$

$C \rightarrow d$

Adding S_1

$= S_1 \rightarrow S$

$S \rightarrow ABC \mid a$

$A \rightarrow b$

$B \rightarrow c$

$C \rightarrow d$

Removing $S_1 \rightarrow S$

$= S_1 \rightarrow ABC \mid a$

$S \rightarrow ABC \mid a$

$A \rightarrow b$

$B \rightarrow c$

$C \rightarrow d$

let $X \rightarrow AB$

$= S_1 \rightarrow XC \mid a$

$S \rightarrow XC \mid a$

$A \rightarrow b$

$B \rightarrow c$

$C \rightarrow d$

$X \rightarrow AB$

3- $S \rightarrow bX$

$X \rightarrow ad$

Adding S_1

$= S_1 \rightarrow S$

$S \rightarrow bX$

$X \rightarrow ad$

Removing $S_1 \rightarrow S$.

$= S_1 \rightarrow bX$

$S \rightarrow bX$

$X \rightarrow ad$

let $T \rightarrow b$, $U \rightarrow a$, and $V \rightarrow d$

$= S_1 \rightarrow TX$

$S \rightarrow TX$

$X \rightarrow UV$

$T \rightarrow b$

$U \rightarrow a$

$V \rightarrow d$

Date

QUESTION 5:

a- Remove all useless productions:

$S \to XS \mid \lambda$

$A \to aXb \mid Ab \mid ab$

Remove $S \to XS$ as it is useless (no production of X exists)

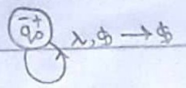
$S \to \lambda$

$A \to aXb \mid Ab \mid ab$

Remove $A \to aXb$ as it is useless (no production of X exists)

$S \to \lambda$ $\quad = S \to \lambda$

$A \to Ab \mid ab$



b- $S \to S+X \mid X$

$X \to X*Y \mid Y$

$Y \to S$

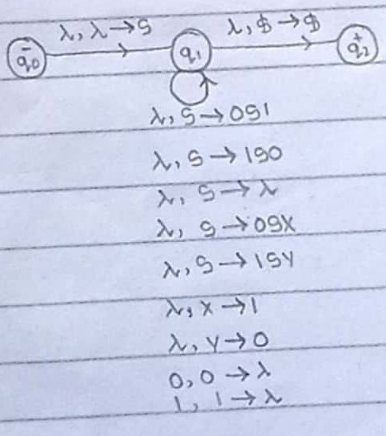
All productions will be removed as there is no termination in each production. No strings will be generated hence there will be no PDA.

c- $S \to 0S1 \mid 1S0 \mid \lambda$

$S \to 0SX \mid 1SY \mid \lambda$

$X \to 1$

$Y \to 0$



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QUESTION 6:

1- $S \to ABC$

$A \to a$

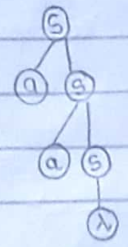
$B \to b$

$C \to c$

Can be reduced to $S \to abc$ Hence it is generating only one string so no ambiguity.

2- $S \to aS \mid \lambda$ language: a^* String: aa

derivation tree:

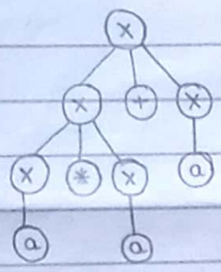


No other possible derivation and derivation tree can derive the word aa as $S \to aS \to aaS \to aa\lambda \to aa$ hence no ambiguity.

3- $X \to X+X \mid X*X \mid X \mid a$ String: $a*a+a$

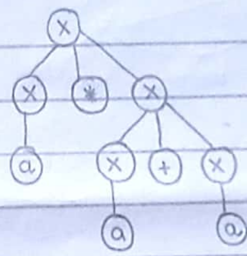
Derivation 1:

$X \to X+X \to X*X+a \to a*a+a$



Derivation 2:

$X \to X*X \to a*X+X \to a*a+a$



As there are two derivations and derivation trees for a single string hence there is ambiguity and it is an ambiguous CFG.

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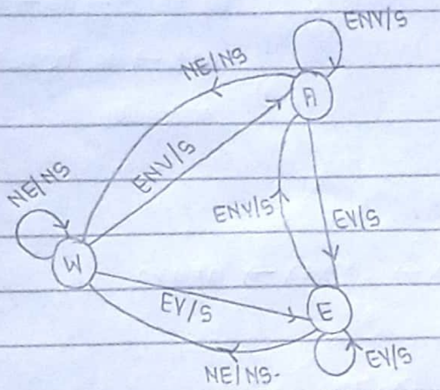
Date

QUESTION 1:

States: Wander: W | Inputs: Not enemies: NE | Outputs: Shoot: S

Evade: E | Enemies and not vulnerable: ENV | Not shoot: NS.

Attack: A | Enemies and vulnerable: EV



QUESTION 2: