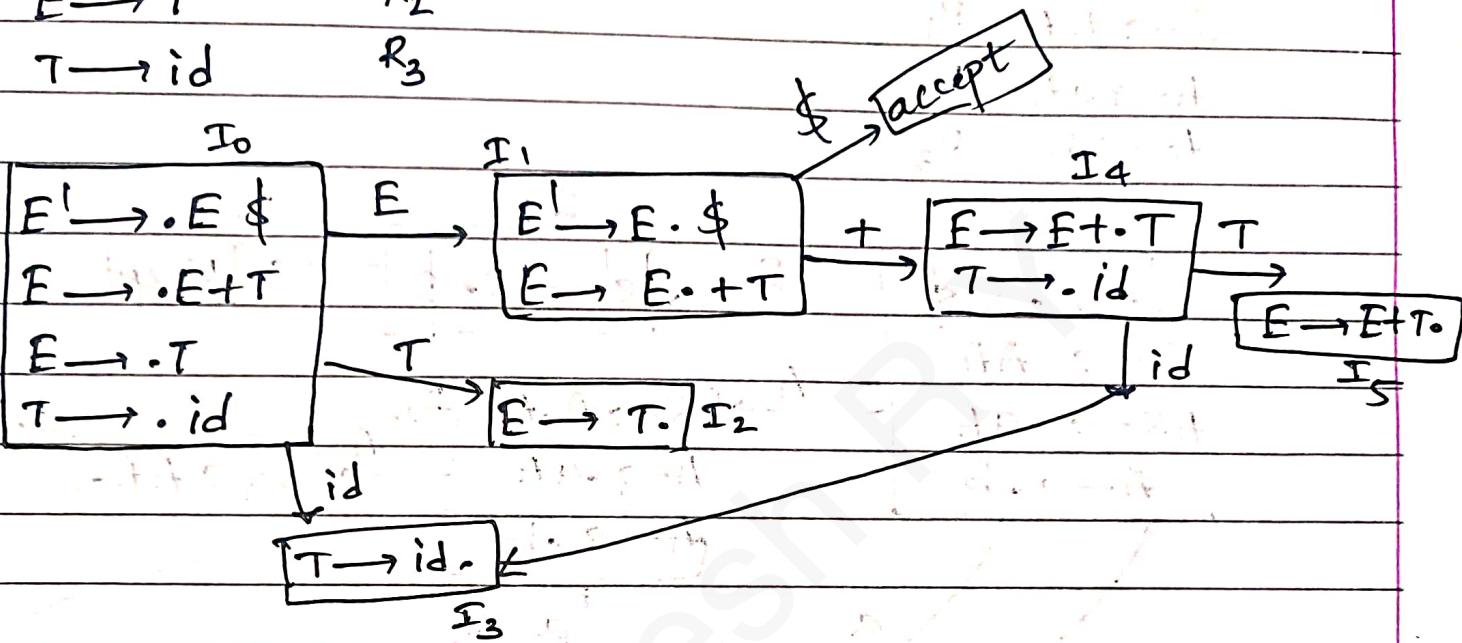


Check LR(0) or not:-

$$\begin{array}{ll} 01) E \rightarrow E + T & R_1 \\ E \rightarrow T & R_2 \\ T \rightarrow id & R_3 \end{array}$$



State	id	$+$	$\$$	E	T
I_0	S_3			1	2
I_1		S_4	Accept		
I_2	r_2	r_2	r_2		
I_3	r_3	r_3	r_3		
I_4	S_3				5
I_5	r_1	r_1	r_1		

yes the given grammar is LR(0).

(Q2)

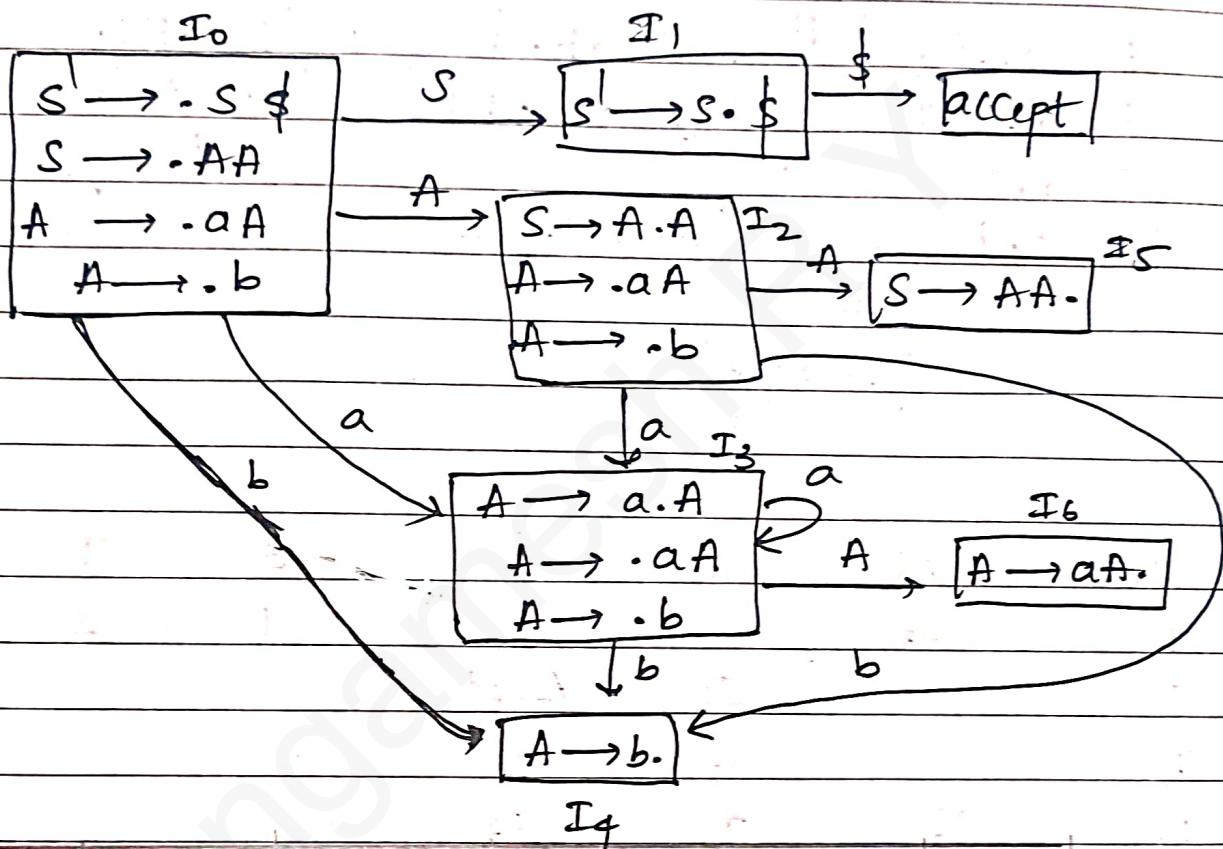
$$S \rightarrow AA$$

$$A \rightarrow aA/b.$$

$$S \rightarrow AA \quad R_1$$

$$A \rightarrow aA \quad R_2$$

$$A \rightarrow b \quad R_3$$



State	a	b	\$	S	A
I_0	s_3	s_4		1	2
I_1					Accept
I_2	s_3	s_4			5
I_3	s_3	s_4			6
I_4	r_3	r_3	r_3		
I_5	r_1	r_1	r_1		
I_6	r_2	r_2	r_2		

Yes, the given grammar is $LR(0)$.

Example input:- aabb

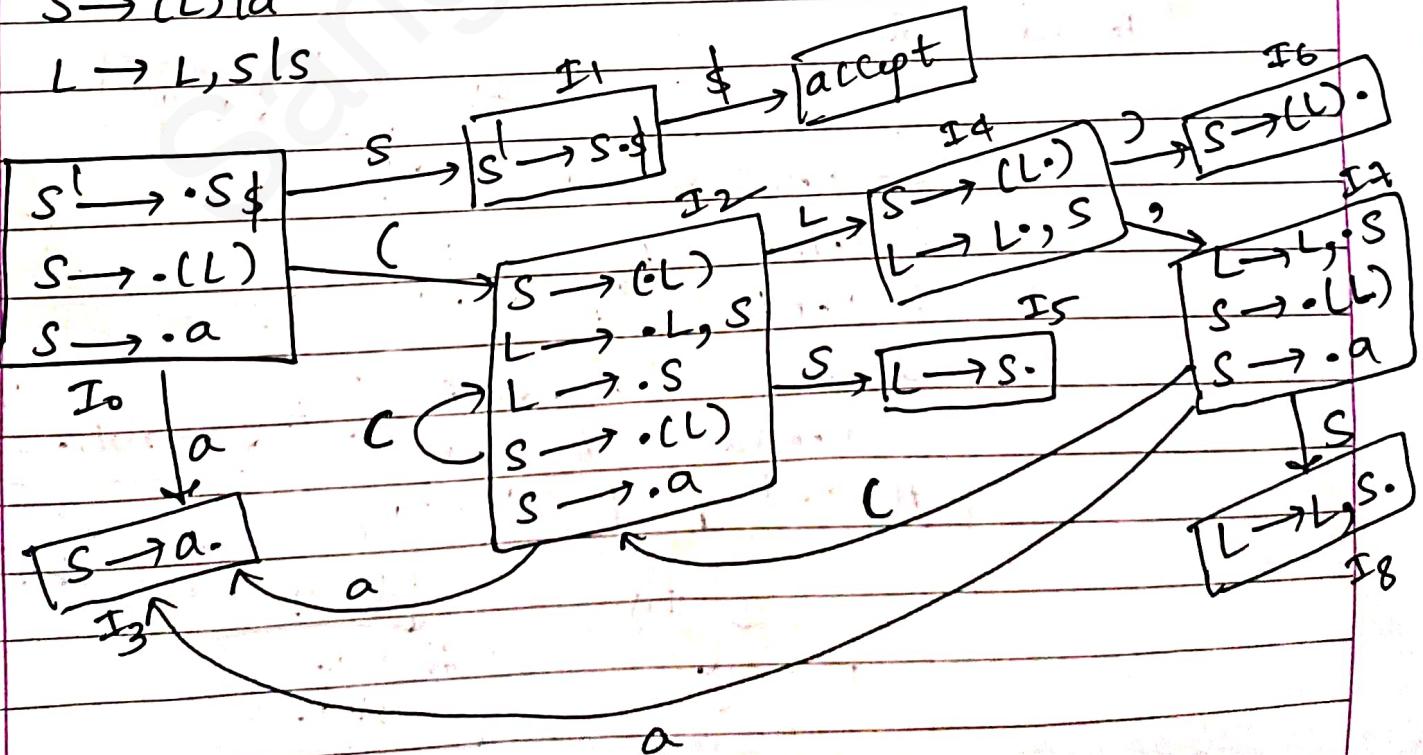
Stack	input
\$0	aabb\$
\$0a3	abb\$
\$0a3a3	bb\$
\$0a3a3b4	b\$
\$0a3a3A6	b\$
\$0a3A6	b\$
\$0A2	b\$
\$0A2b4	b\$
\$0A2A5	\$
\$0S1	\$

Accept
=

Q2) Check SLR(1) or not

$$S \rightarrow CL|a$$

$$L \rightarrow L, S|S$$

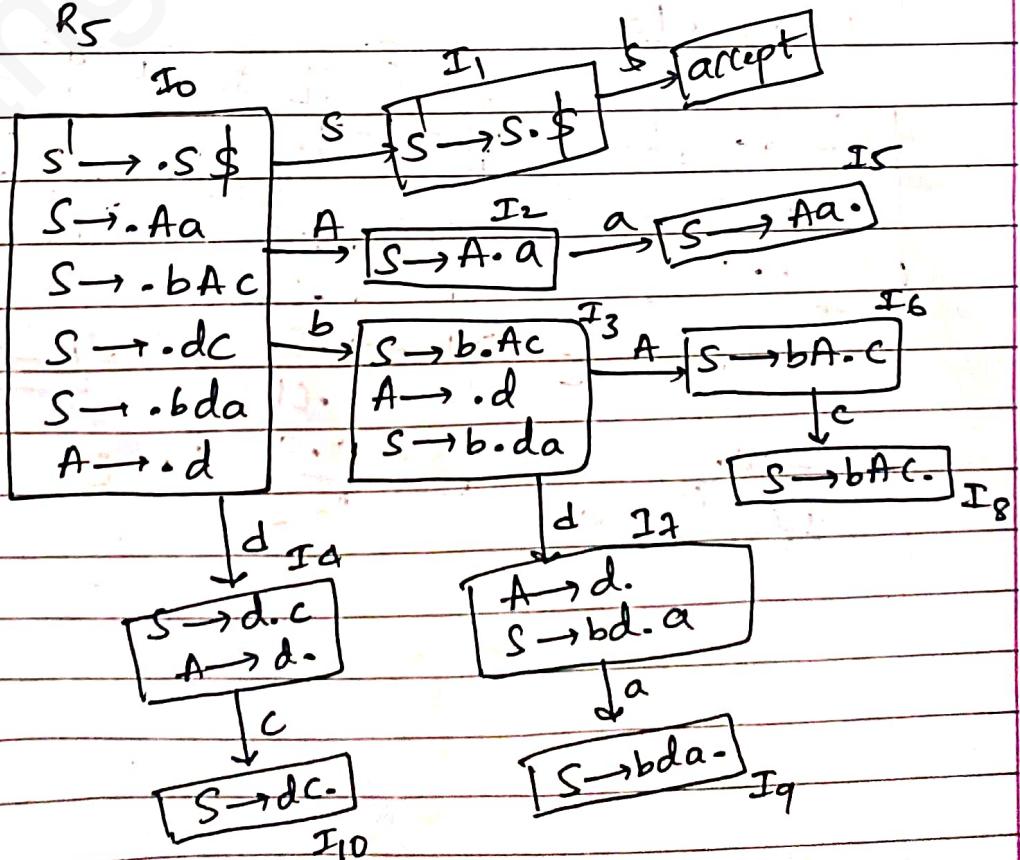


State	()	a	,	\$	S	L
I ₀	S ₂		S ₃			1	
I ₁					Accept	5	4
I ₂	S ₂		S ₃				
I ₃		R ₂			R ₂	R ₂	
I ₄		S ₆			S ₇		
I ₅		R ₄			R ₄		
I ₆		R ₁			R ₁	R ₁	
I ₇	S ₂		S ₃			8	
I ₈		R ₃			R ₃		

the given grammar is SLR(0) parser

(04) $S \rightarrow Aa \quad R_1$
 $\quad \quad \quad bAc \quad R_2$
 $\quad \quad \quad ldc \quad R_3$
 $\quad \quad \quad bda \quad R_4$
 $A \rightarrow d \quad R_5$

follow(S) = { \$ }
follow(A) = { a, c }



State	a	b	c	d	\$	s	A
I ₀					S ₄	1	2
I ₁						Accept	
I ₂	S ₅						
I ₃				S ₇			6
I ₄	R ₅			S ₁₀ R ₅			
I ₅						R ₁	
I ₆			S ₈				
I ₇	S ₉ R ₅		R ₅				
I ₈					R ₂		
I ₉					R ₄		
I ₁₀					R ₃		

Since, there are 2 shift-reduce conflicts, the given grammar is not SLR(1).

(05) $S \rightarrow AS \mid b$

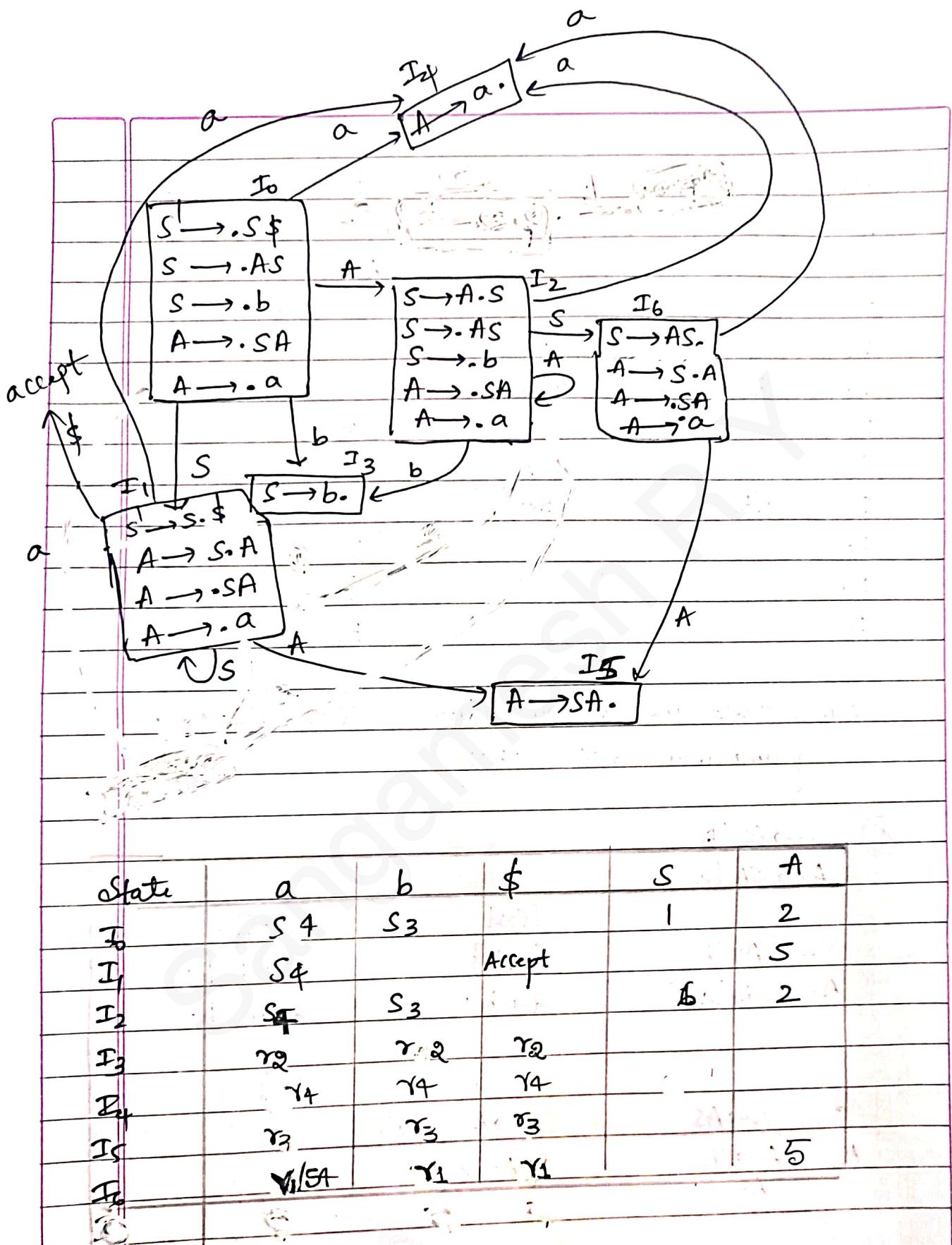
$A \rightarrow SA \mid a$

	First	Follow
$S \rightarrow AS \mid b$	$\{a, b\}^*$	$\{a, b, \$\}^*$
$A \rightarrow SA \mid a$	$\{a\}^*$	$\{a, b, \$\}^*$

	a	b	\$
S	$S \rightarrow AS$	$S \rightarrow AS, S \rightarrow b$	
A	$A \rightarrow SA$ $A \rightarrow a$	$A \rightarrow SA$	

the given grammar is not LLL(1).

(06) Since, there is indirect left recursion, the given grammar is not LLL(1).



Since, there is shift-reduce conflict, the given grammar is $\text{not LR}(0)$.

STUDENT NAME		TOTAL MARKS
CLASS	SUBJECT	
ROLL NO.	DATE	

$$\text{Follow}(S) = \{a, b, \$\}$$

$$\text{Follow}(A) = \{a, b\}$$

There are shift-reduce conflicts, as each state with a reduce action reduces on the appropriate FOLLOW set symbols, & shift actions do conflict. Thus, the grammar is ^{not} SLR(1).

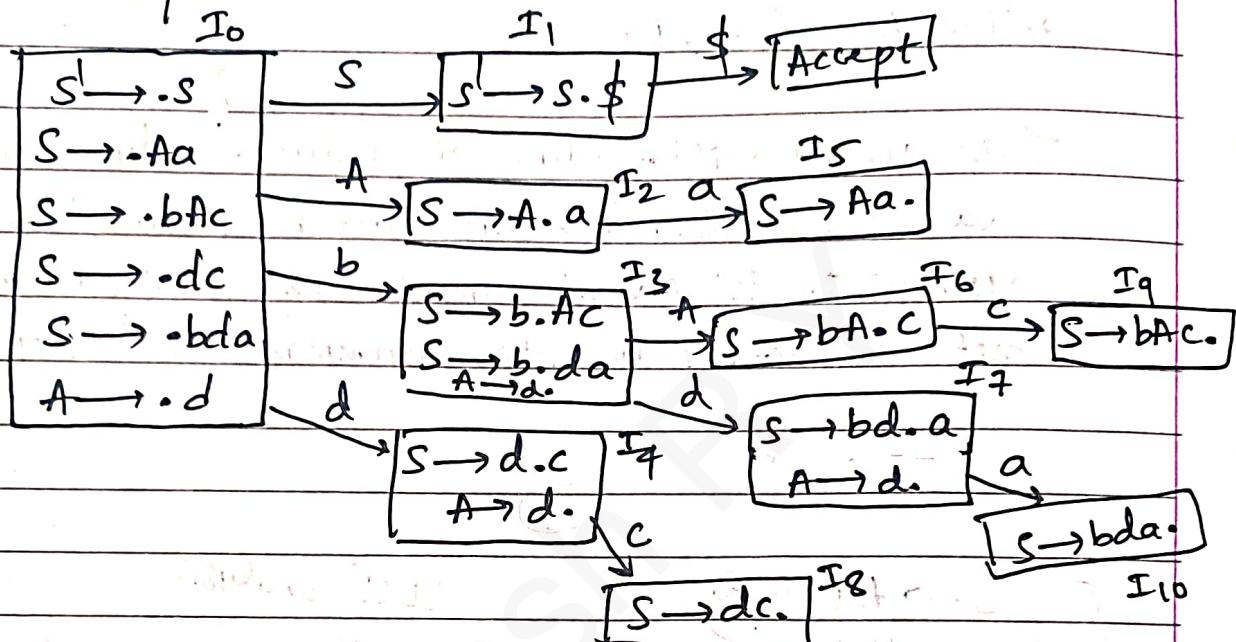
(Q6) $S \rightarrow Aa \quad R_1$ LL(1) analysis
 $\quad \quad \quad |bAc \quad R_2$
 $\quad \quad \quad |dc \quad R_3$
 $\quad \quad \quad |bda \quad R_4$
 $A \rightarrow d \quad R_5$

	First	Follow
$S \rightarrow Aa$	$\{d\}$	$\{\$\}$
$S \rightarrow bAc$	$\{b\}$	$\{\$\}$
$S \rightarrow dc$	$\{d\}$	$\{\$\}$
$S \rightarrow bda$	$\{b\}$	$\{\$\}$
$A \rightarrow d$	$\{d\}$	$\{a, c\}$

	a	b	c	d	\$
S		$S \rightarrow bAc$		$S \rightarrow Aa$	
		$S \rightarrow bda$		$S \rightarrow dc$	
A				$A \rightarrow d$	

the given grammar is ^{not} LL(1).

LR(0) analysis :-

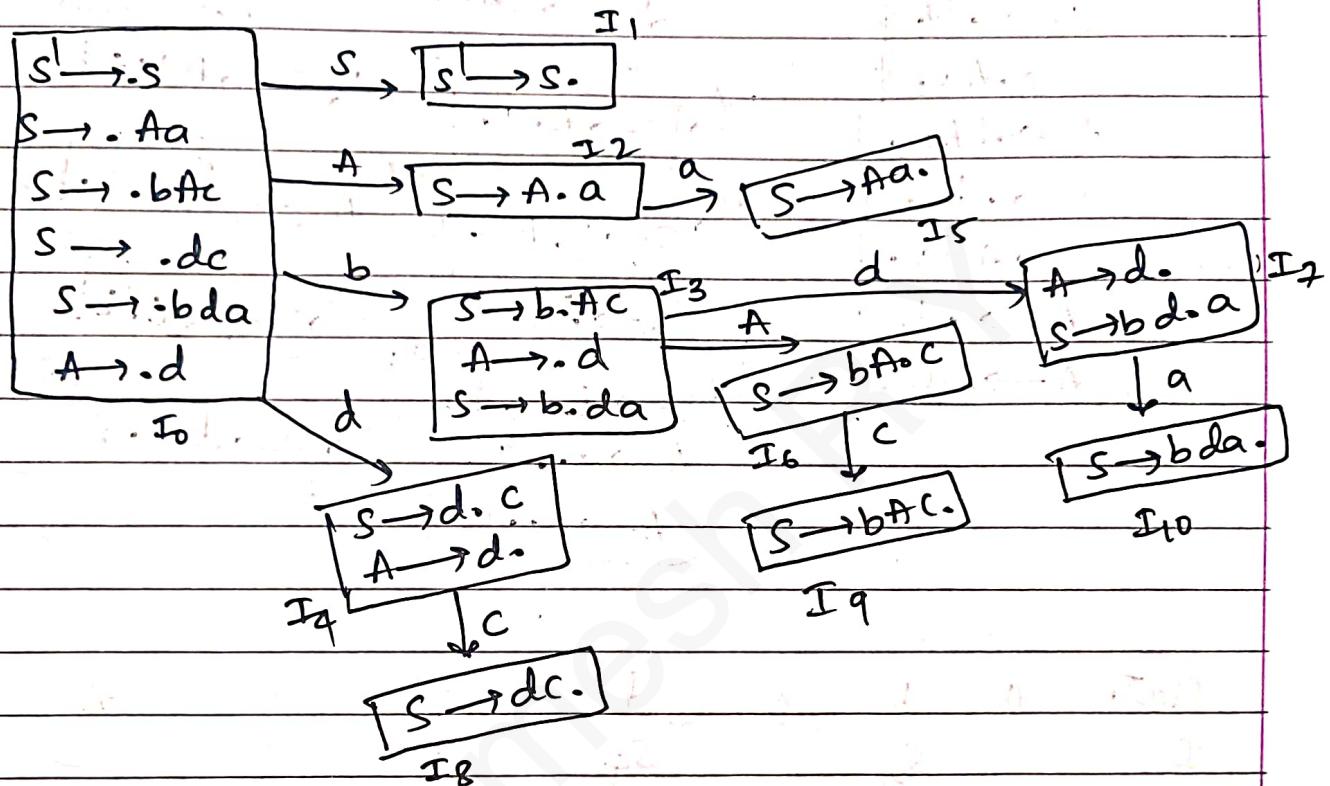


State	a	b	c	d	\$	S	A
I ₀			S ₃		S ₄		1
I ₁						accept	2
I ₂		S ₅					
I ₃				S ₇			6
I ₄	r ₅	r ₅	S ₈ /r ₅	r ₅	r ₅		
I ₅	r ₁	r ₁		r ₁	r ₁	r ₁	
I ₆				S ₉			
I ₇	S ₁₀ /r ₅	r ₅	r ₅	r ₅	r ₅		
I ₈	r ₃	r ₃	r ₃	r ₃	r ₃		
I ₉	r ₂	r ₂	r ₂	r ₂	r ₂		
I ₁₀	r ₄	r ₄	r ₂	r ₂	r ₂		

The given grammar is not LR(0) due to shift-reduce conflicts.

SLR(1) analysis :-

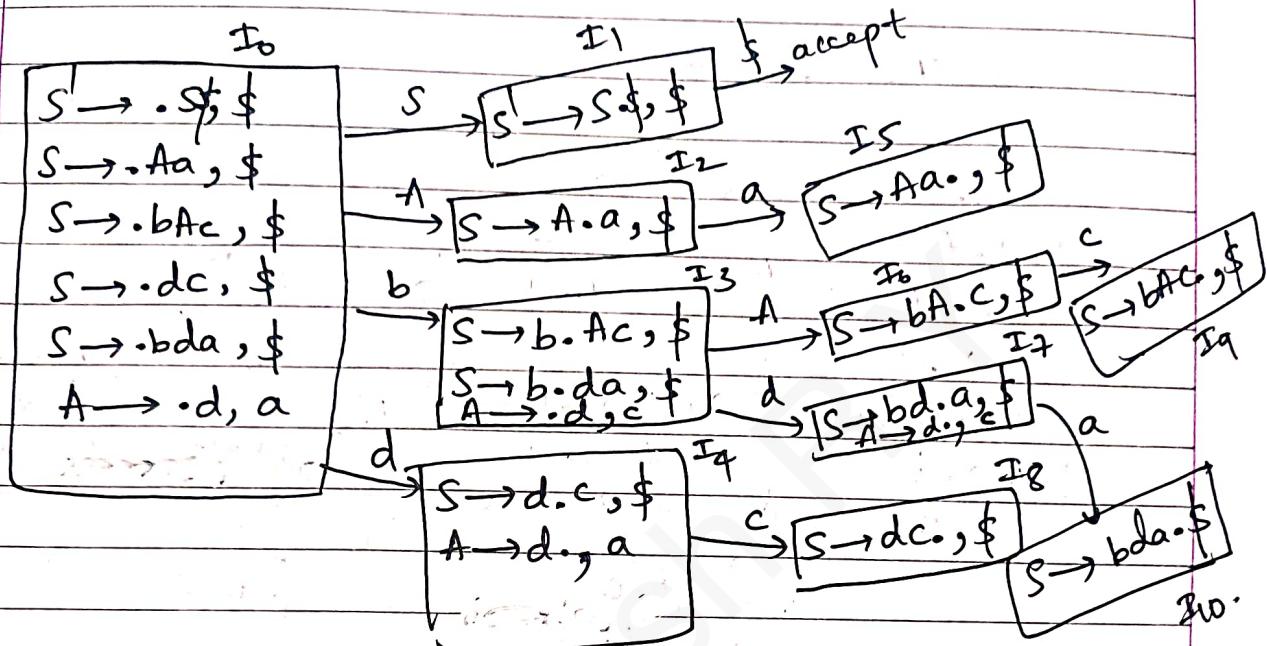
Follow(A) = {a, c}



State	a	b	c	d	\$	S	A
I ₀		S_3		S_4		1	2
I ₁						Accept	
I ₂	S_5						
I ₃				S_7			6
I ₄	r_5	r_5	S_8/r_5	r_5	r_5		
I ₅	r_1	r_1	r_1	r_1	r_1		
I ₆				S_9			
I ₇	S_{10}/r_5	r_5	r_5	r_5	r_5		
I ₈	r_3	r_3	r_3	r_3	r_3		
I ₉	r_2	r_2	r_2	r_2	r_2		
I ₁₀	r_4	r_4	r_4	r_4	r_4		

The grammar is not SLR(1) due to shift-reduce conflicts in states 4 & 7.

LR(0) analysis:-

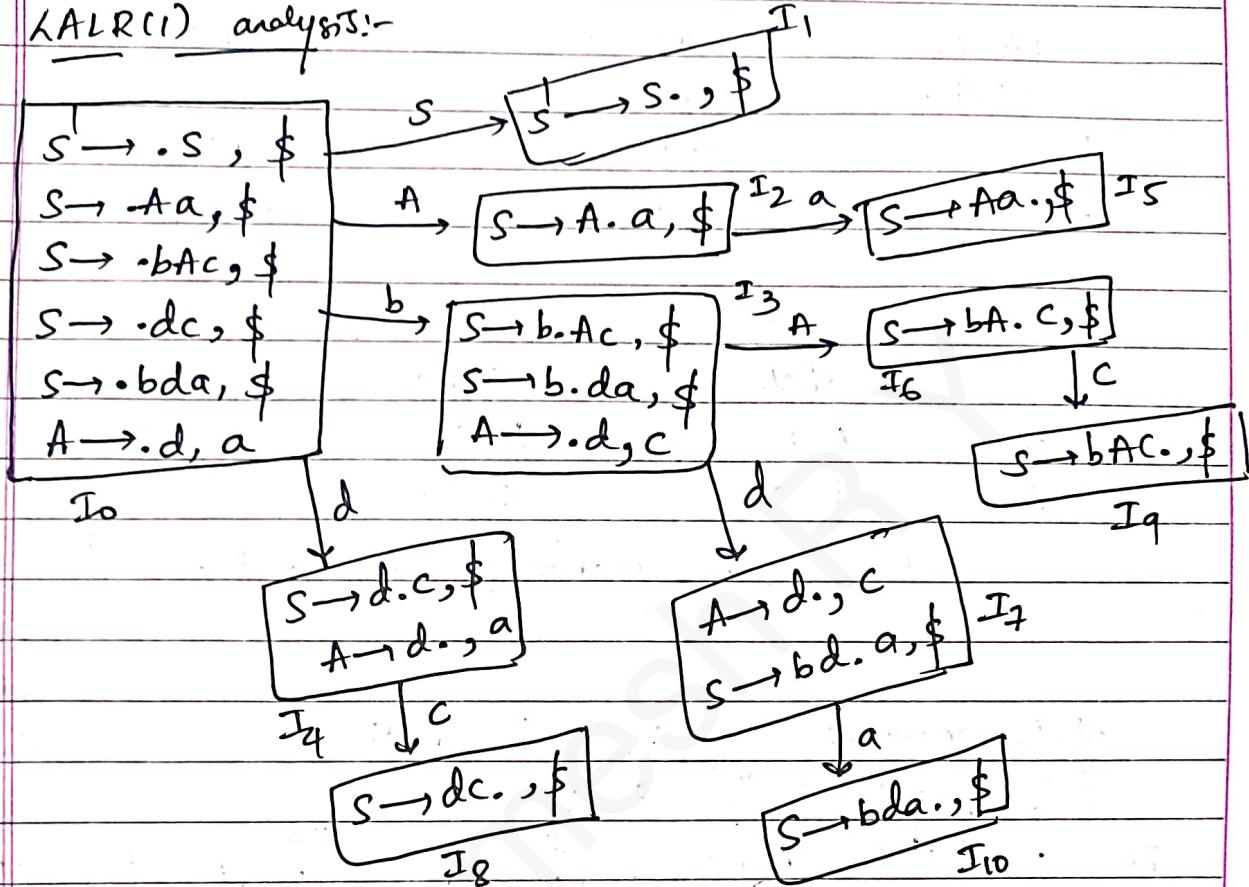


state	a	b	c	d	\$	S	A
I ₀					S ₃		
I ₁						S _q	Accept
I ₂		S ₅					
I ₃				S ₇			
I ₄	R ₅						
I ₅					R ₁		
I ₆			S _q				
I ₇	S ₁₀		R ₅				
I ₈					R ₃		
I ₉					R ₂		
I ₁₀					R _q		

Since, there is no conflicts, the given grammar is LR(0).

STUDENT NAME		TOTAL MARKS
CLASS	SUBJECT	
ROLL NO.	DATE	

LALR(1) analysis:-



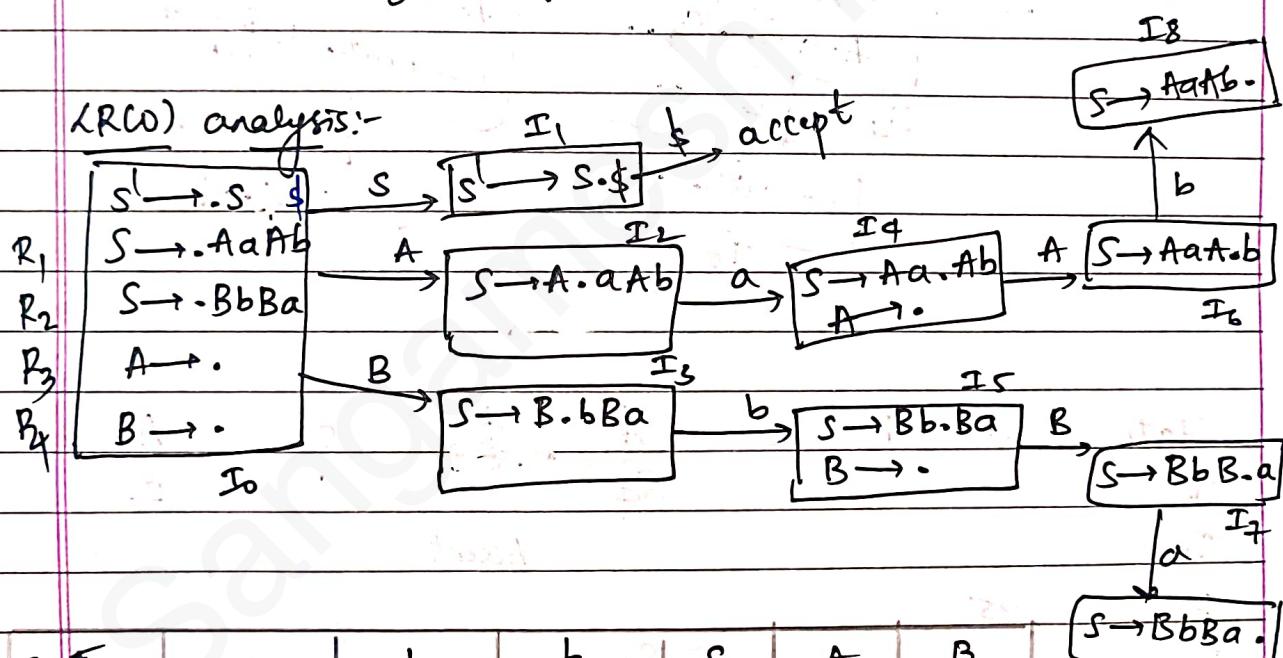
State	a	b	c	d	\$	s	A
I0						1	2
I1						Accept	
I2							6
I3							
I4	R5						
I5							
I6							
I7	S10						
I8							
I9							
I10							

Since there is no same canonical core items it is LALR(1).

	First	Follow
(D)	$S \rightarrow AaAb BbBa$	$\{a, b\}$
	$A \rightarrow \epsilon$	$\{a\}$
	$B \rightarrow \epsilon$	$\{a, b\}$

	a	b	$\$$
S	$S \rightarrow AaAb$	$S \rightarrow BbBa$	
A	$A \rightarrow \epsilon$	$A \rightarrow \epsilon$	
B	$B \rightarrow \epsilon$	$B \rightarrow \epsilon$	

The given grammar is LL(1).



State	a	b	$\$$	S	A	B	
I_0	$r_3 r_4$	$r_3 r_4$	$r_3 r_4$	1	2	3	I_9
I_1				accept			
I_2				S_4			
I_3				S_5			
I_4	r_3	r_3	r_3				6
I_5	r_4	r_4	r_4				7
I_6				S_8			
I_7				S_9			
I_8	r_1	r_1	r_1				
I_9	r_2	r_2	r_2				

The grammar is not LR(0).

(4)

STUDENT NAME		TOTAL MARKS
CLASS	SUBJECT	
ROLL NO.	DATE	

SLR(1) analysis:-

$$\text{Follow}(S) = \{ \$ \}$$

$$\text{Follow}(A) = \{ a, b \}$$

$$\text{Follow}(B) = \{ a, b \}$$

"ab" & "ba" can be determined by "a" & "b", so it is LL(1).

In SLR, consider state 0:

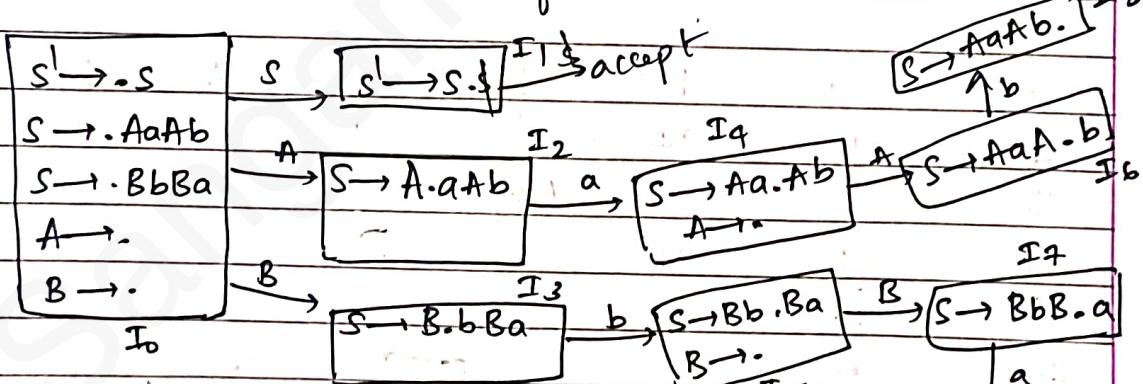
$$S \rightarrow .AaAb$$

$$S \rightarrow .BbBa$$

$$A \rightarrow E.$$

$$B \rightarrow E.$$

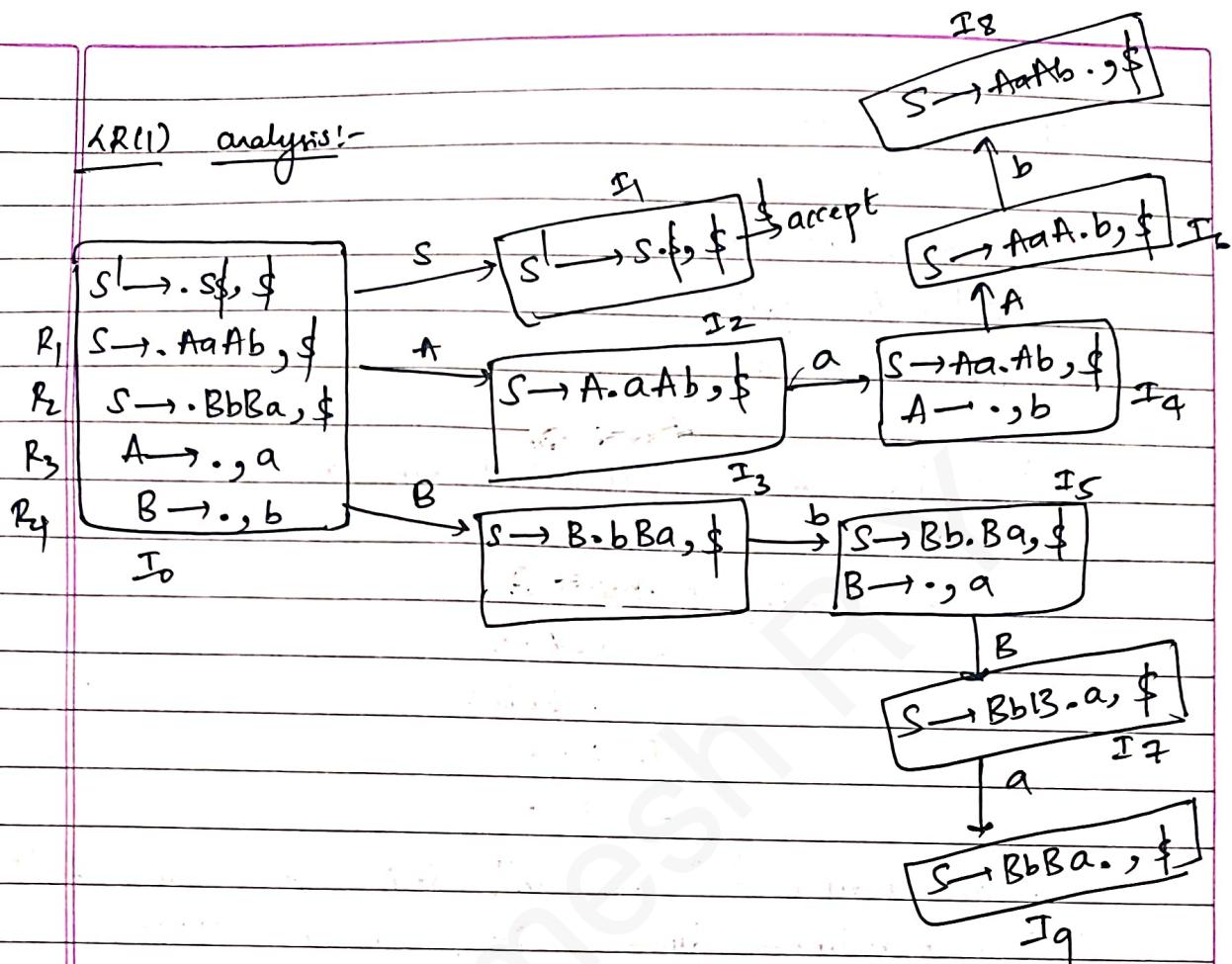
When we reduce "e", we can't decide to reduce A/B, this is a reduce-reduce conflict, S is not SLR(1).



State	a	b	\$	S	A	B
I ₀	r ₃ , r ₄	r ₃ , r ₄	r ₃ , r ₄	1	2	3
I ₁				Accept		
I ₂	S ₄					
I ₃		S ₅				
I ₄	r ₃	r ₃	r ₃			
I ₅	r ₄	r ₄	r ₄			
I ₆		S ₈				
I ₇	S ₉					
I ₈	r ₁	r ₁	r ₁			
I ₉	r ₂	r ₂	r ₂			

The given grammar is not SLR(1). chandra

LR(1) analysis:-



State	a	b	\$	s	A	B
I ₀	r ₃	r ₄		1	2	3
I ₁				Accept		
I ₂	S ₄					
I ₃		r ₅				
I ₄		r ₃			6	
I ₅	r ₄	-				7
I ₆		S ₈				
I ₇	S ₉					
I ₈			r ₁			
I ₉			r ₂			

The given grammar is LR(1).

And hence it is LALR(1) also since no core items are same in a state.

a) Operator precedence parser

$$E \rightarrow E+E \mid E+E \mid id;$$

input = id + id + id \$

function mapping

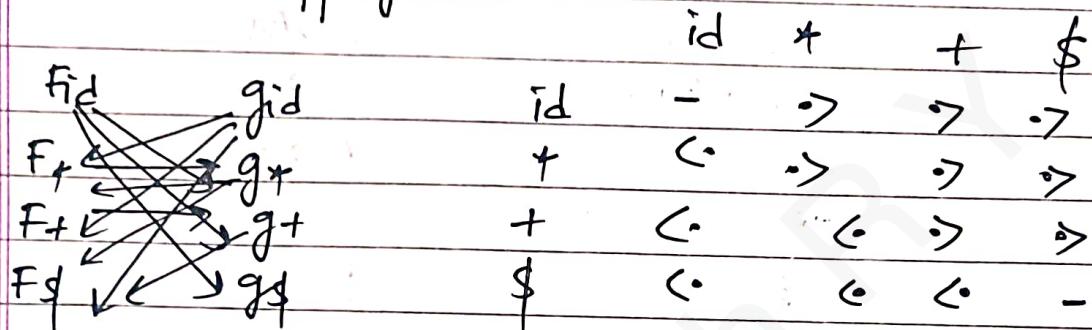


Table for longest path to \$

Current Stack Symbol	id	+	*	\$
f	4	2	4	0
g	5	1	3	0

Start

input

\$	id + id + id \$	(0 < 5)	E
\$ id	id + id + id \$	(4 > 1)	E + E
\$	E + id + id \$	(0 < 1)	E + E
\$ 4	E + id + id \$	(4 < 5)	id
\$ 4 id	E + id + id \$	(4 > 1)	id
\$ *	E + E + id \$	(4 > 1)	E + E
\$	E + id \$	(0 < 1)	E
\$ +	E + id \$	(2 < 5)	E + E
\$ + id	E + id \$	(4 > 0)	E + E
\$ +	E + E \$	(2 > 0)	E + E
\$	E \$	(0 > 0)	E

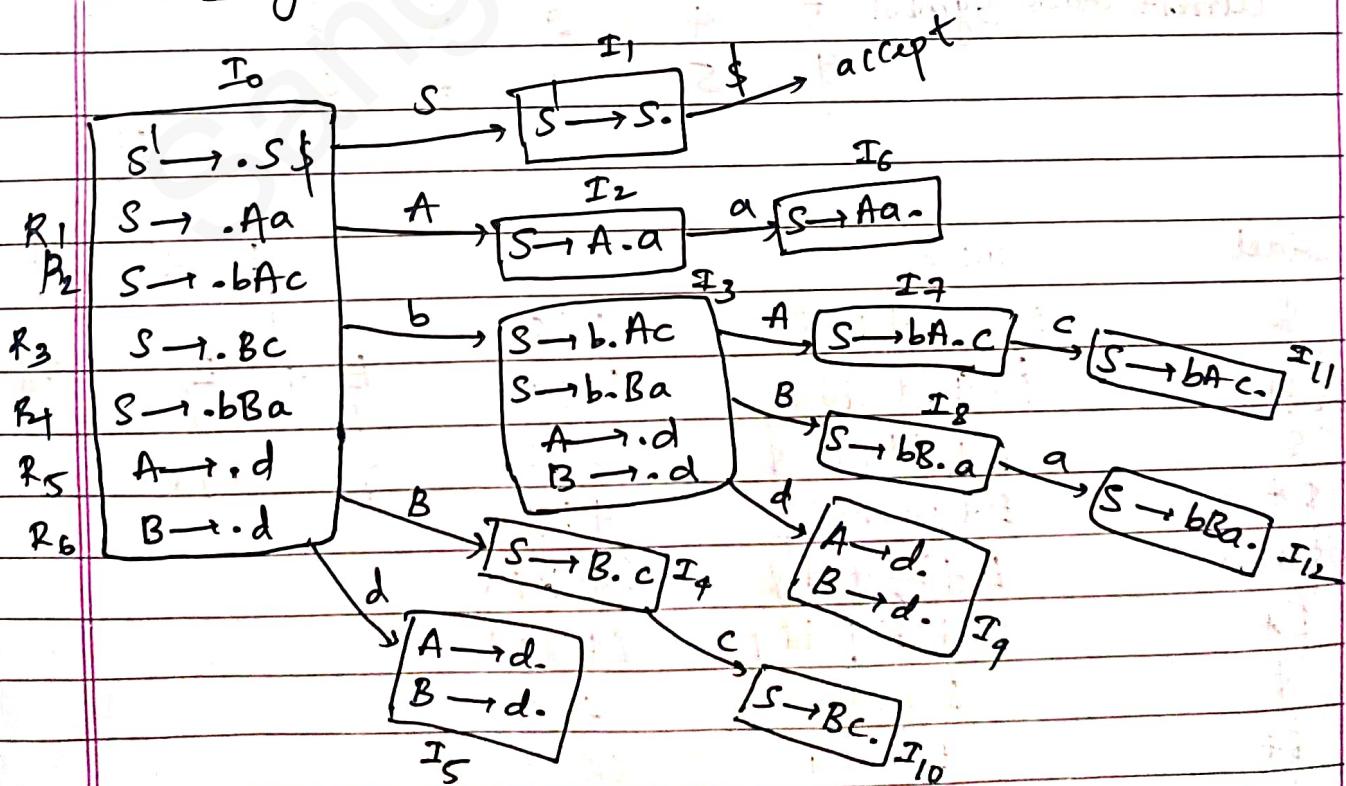
Token accepted
chandra's

	First	Follow
(Q8) $S \rightarrow Aa$	$\{d\}$	$\{\$\}$
$S \rightarrow bAc$	$\{b\}$	$\{\$\}$
$S \rightarrow Bc$	$\{d\}$	$\{\$\}$
$S \rightarrow bBa$	$\{b\}$	$\{\$\}$
$A \rightarrow d$	$\{d\}$	$\{a, c\}$
$B \rightarrow d$	$\{d\}$	$\{a, c\}$

	a	b	c	d	\$
S		$S \rightarrow bAc$		$S \rightarrow Aa$	
		$S \rightarrow bBa$		$S \rightarrow Bc$	
A				$A \rightarrow d$	
B				$B \rightarrow d$	

the given grammar is not LL(1).

LRLW analysis:-



State	a	b	c	d	\$	s	A	B
I ₀			S ₃		S ₅	1	2	4
I ₁						accept		
I ₂		S ₆						
I ₃					S ₉		7	8
I ₄				S ₁₀				
I ₅	r _{5, r₆}							
I ₆	r ₁	r ₁	r ₁	m	r ₁			
I ₇			S ₁₁					
I ₈	S ₁₂							
I ₉	r _{5, r₆}							
I ₁₀	r ₃	r ₃						
I ₁₁	r ₂	r ₂						
I ₁₂	r ₄	r ₄						

The grammar is not LR(0) due to reduce-reduce conflicts.

SLR(1) analysis:-

$$\text{Follow}(S) = \{ \$ \}$$

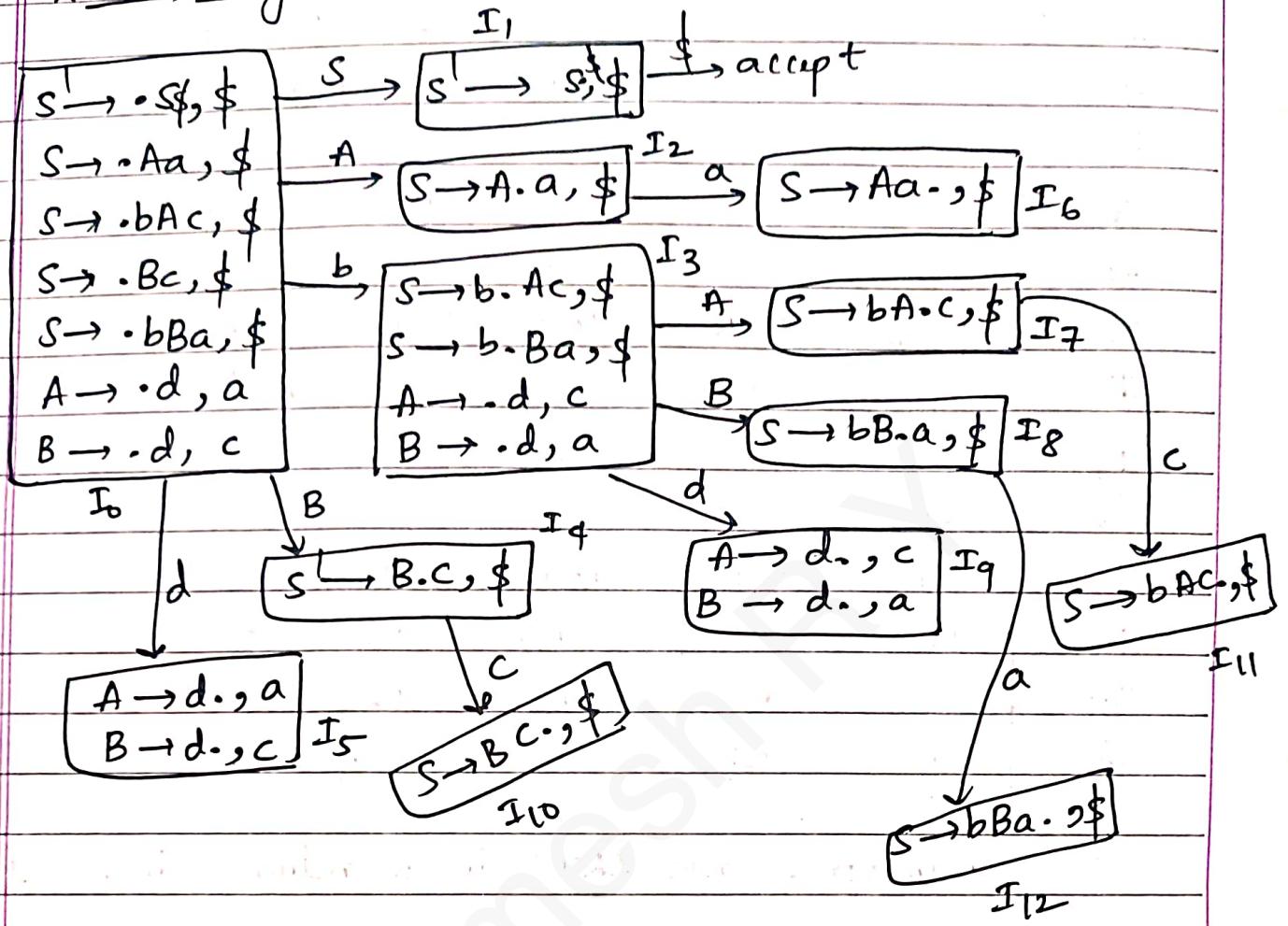
$$\text{Follow}(A) = \{ a, c \}$$

$$\text{Follow}(B) = \{ a, c \}$$

State	a	b	c	d	\$	s	A	B
I ₀		S ₃		S ₅		1	2	4
I ₁						accept		
I ₂		S ₆						
I ₃				S ₉			7	8
I ₄			S ₁₀					
I ₅	r _{5, r₆}		r _{5, r₆}					
I ₆	r ₁							
I ₇			S ₁₁					
I ₈	S ₁₂							
I ₉	r _{5, r₆}		r _{5, r₆}					
I ₁₀	r ₃							
I ₁₁	r ₂							
I ₁₂	r ₄							

this is not SLR(1) grammar
Chandras

LR(1) analysis:-



State	a	b	c	d	\$	s	A	B
I ₀		S ₃		S ₅		1	2	4
I ₁						Accept		
I ₂	S ₆							
I ₃					S ₉		7	8
I ₄			S ₁₀					
I ₅	r ₅		r ₆			r ₁		
I ₆								
I ₇				S ₁₁				
I ₈	S ₁₂							
I ₉		r ₆		r ₅				
I ₁₀						r ₃		
I ₁₁						r ₂		
I ₁₂						r ₄		

The given grammar is LR(1)

STUDENT NAME		TOTAL MARKS
CLASS	SUBJECT	
ROLL NO.	DATE	

LALR(1) — analysis:-

State	a	b	c	d	\$	s	A	B
I ₀		s_3			s_5	1	2	4
I ₁						accept		
I ₂		s_6						
I ₃					s_5		7	8
I ₄					s_9			
I ₅		r_5/r_6			r_5/r_6			
I ₆						r_1		
I ₇					s_{10}			
I ₈		s_{11}						
I ₉					r_3			
I ₁₀					r_2			
I ₁₁					r_4			

Reduce-reduce conflicts, this grammar is not LALR(1).

Because when we meet "bd", we can't determine whether reduce to "ba" or "bB".

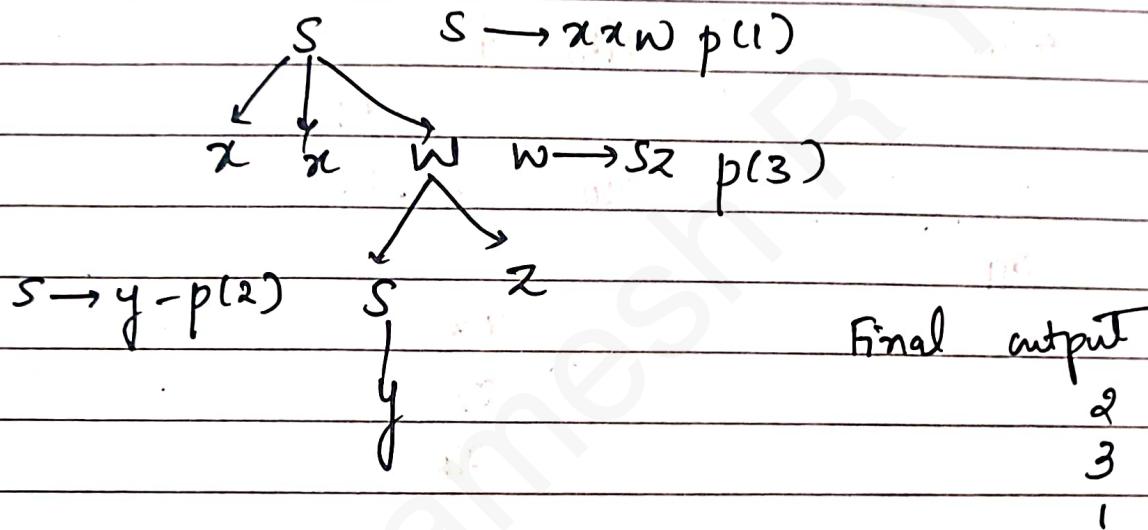
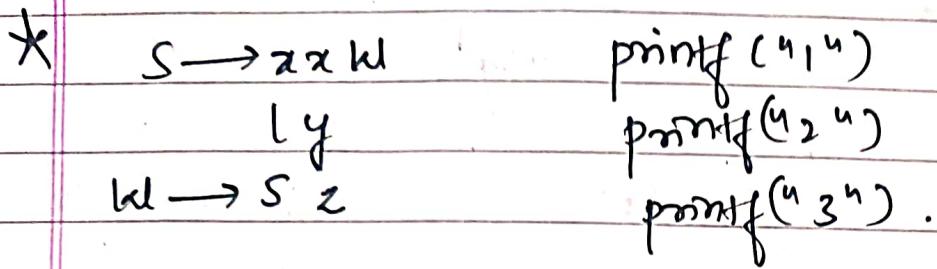
① Since we can combine the states I₅ & I₉ as they have same left item,

So it is LALR(1) grammar.

The given grammar is not LALR(1).

SDD

Draw annotated parse tree & evaluate the attributes
productions & semantic rules.



+ if ($(E_1.\text{type} == E_2.\text{type}) \& (S(E_1.\text{type} == E_2.\text{type}))$)
 $E \rightarrow E_1 + E_2$ then $E.\text{type} = \text{int}$ else ERROR .

| $E_1 == E_2$ then $E.\text{type} = \text{bool}$ else ERROR

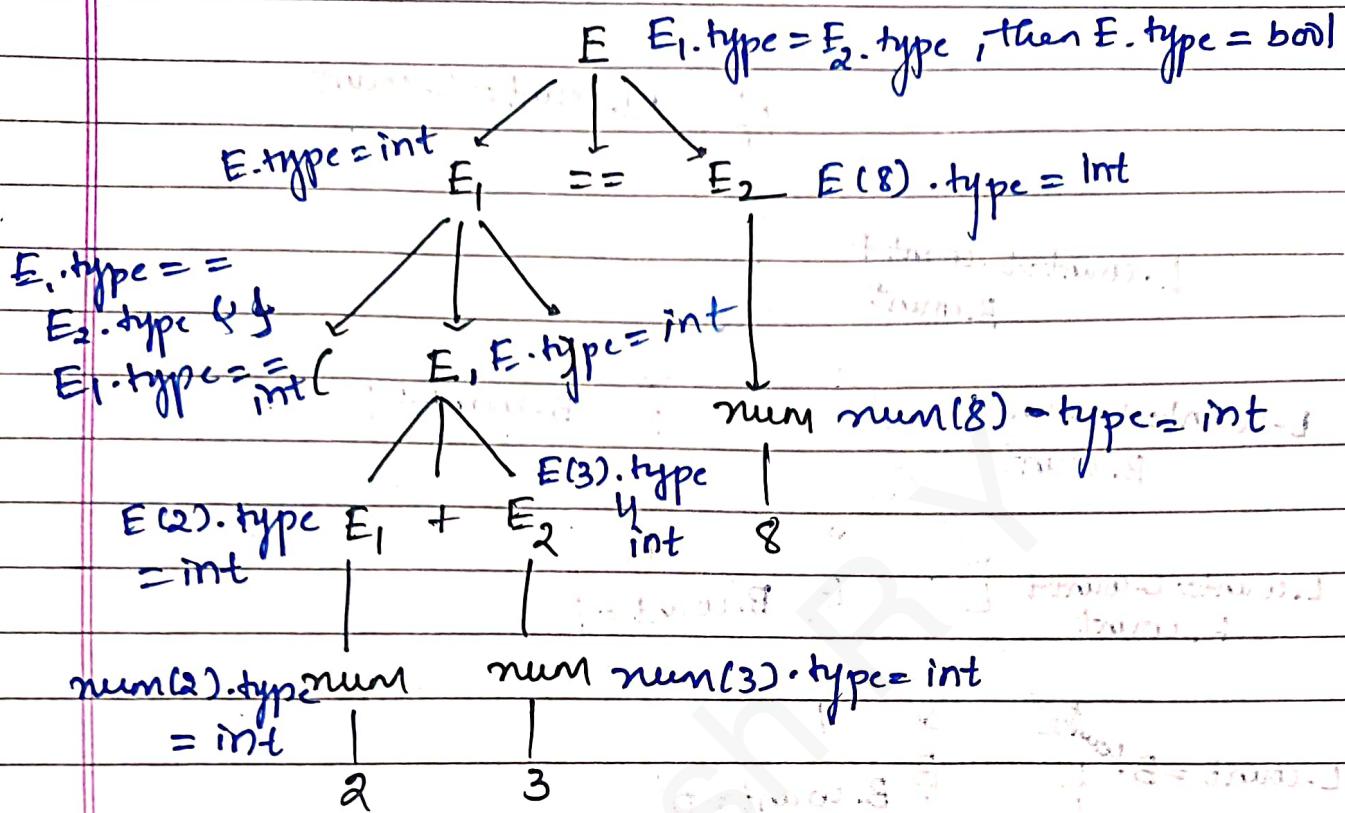
| (E_1) $E.\text{type} = E_1.\text{type}$

| num $E.\text{type} = \text{int}$

| True $E.\text{type} = \text{bool}$

| False $E.\text{type} = \text{bool}$.

CLASS	SUBJECT
ROLL NO.	DATE



$$E_1 + E_2 = 2 + 3 = 5$$

(E) : $E.val = 5$

$E_1 == E_2 \Rightarrow E.val = (5 == 8) = False$

*

$N \rightarrow L$

$N.count = L.count$

$L \rightarrow LB$

$L.count = L.count + B.count$

LB

$L.count = B.count$

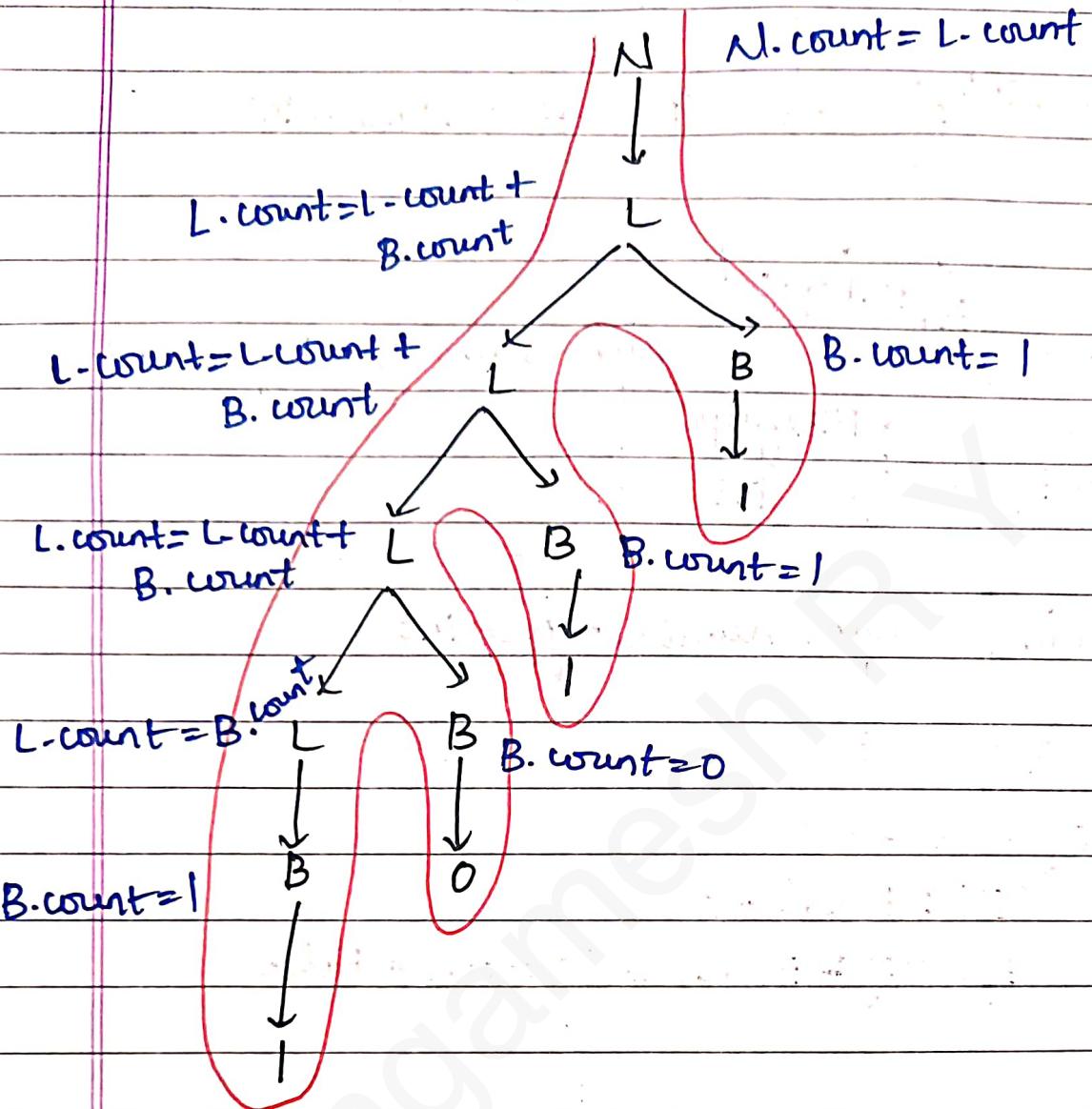
$B \rightarrow 0$

$B.count = 0$

$|$

$B.count = 1$

Input: 1011



*

$$E \rightarrow E \# T \quad E \cdot \text{val} = E \cdot \text{val} + T \cdot \text{val}$$

|
T

$$E \cdot \text{val} = T \cdot \text{val}$$

$$T \rightarrow T \& F$$

$$T \cdot \text{val} = T \cdot \text{val} + F \cdot \text{val}$$

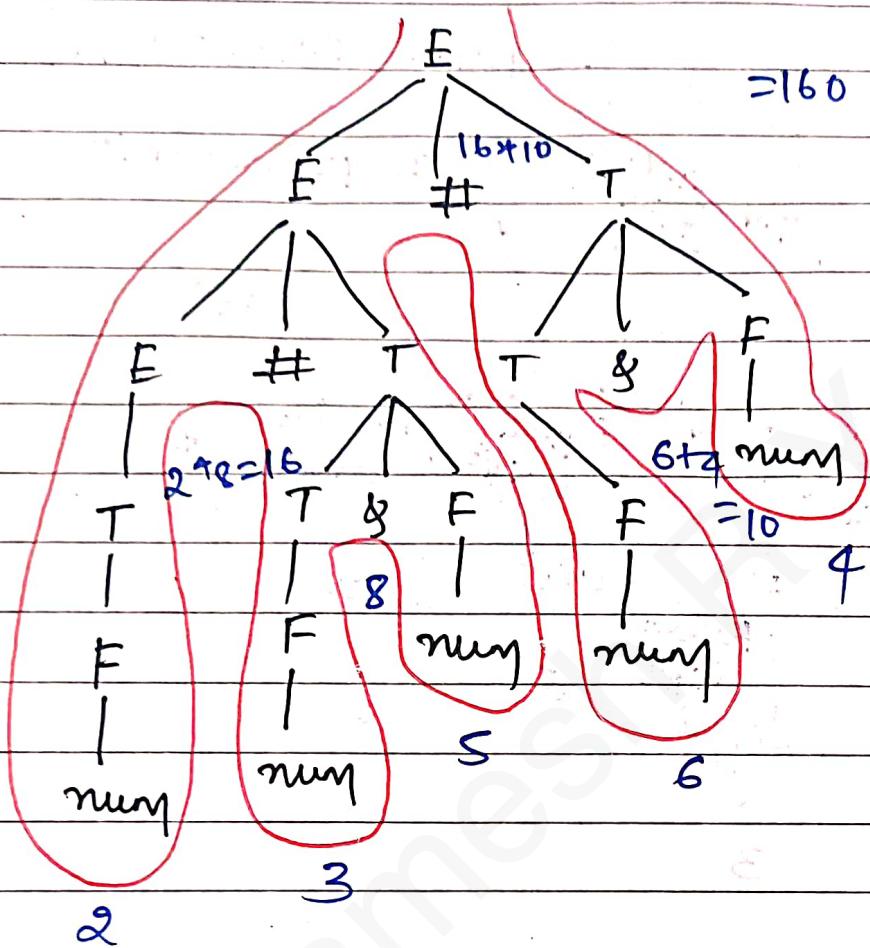
|
F

$$T \cdot \text{val} = F \cdot \text{val}$$

$$F \rightarrow \text{num}$$

$$F \cdot \text{val} = \text{num} \cdot \text{val}$$

Input = 2 # 3 & 5 # 6 & 4



* SDD for a simple calculator.

$$E \rightarrow E + T$$

$$E.\text{val} = E.\text{val} + T.\text{val}$$

$$E \rightarrow T$$

$$F\text{-val} = T\text{-val}$$

$$T \rightarrow T + F$$

T-val = T-val + F-val

T → F

$$T\text{-val} = F\text{-val}$$

$F \rightarrow (E)$

$$F\text{-val} = F\text{.val}$$

$F \rightarrow$ digit

F-val = digit

Ex:- Input :- 2+3+5+6+4

