

TASK #04

LR(0) Parser

$$E \rightarrow E + T$$

$$E \rightarrow T$$

$$T \rightarrow TF$$

$$T \rightarrow F$$

$$F \rightarrow F *$$

$$F \rightarrow a$$

$$F \rightarrow b$$

Augmented Grammer: →

$$E' \rightarrow \cdot E$$

$$E' \rightarrow \cdot E + T$$

$$E' \rightarrow \cdot T$$

$$T \rightarrow \cdot TF$$

$$T \rightarrow \cdot F$$

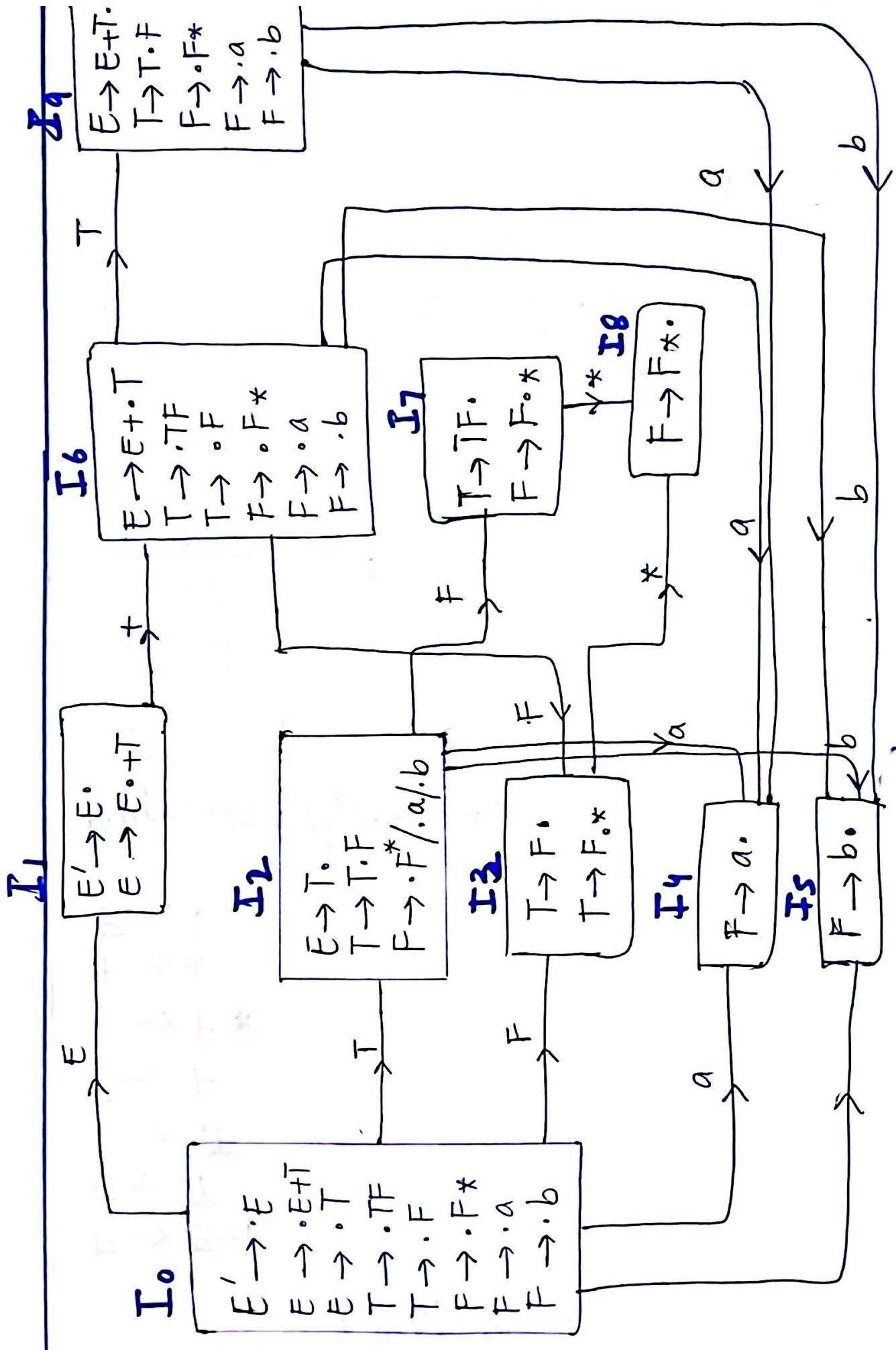
$$F \rightarrow \cdot Fx$$

$$F \rightarrow \cdot a$$

$$F \rightarrow \cdot b$$

Now, we'll make canonical collection.

(P.T.O)



(Q3) sketch grammar Parsing Table (LR(0)):

State	a	b	*	+	\$	E	T	F
0	S_4	S_5				1	2	3
1				S_6	Accept			
2	S_4/γ_2	S_5/γ_2	γ_2	γ_2	γ_2			7
3	γ_4	γ_4	S_8/γ_4	γ_4	γ_4			
4	γ_6	γ_6	γ_6	γ_6	γ_6			
5	γ_7	γ_7	γ_7	γ_7	γ_7			
6	S_4	S_5					9	7
7	γ_3	γ_3	S_8/γ_3	γ_3	γ_3			
8	γ_5	γ_5	γ_5	γ_5	γ_5			
9	S_4/γ_1	S_5/γ_1	γ_1	γ_1	γ_1			3

SLR(1) :

First, we'll find the follow of non-terminals

Non-Terminal

E

T

F

Follow

{+, \$}

{+, \$, a, b}

{+, \$, a, b, *}

Parsing Table (SLR(1))

State	a	b	*	+	\$	E	T	F
0	s_4	s_5				1	2	3
1				s_6	Accept			
2	s_4	s_5		s_2	s_2			7
3	s_4	s_4	s_8	s_4	s_4			
4	s_6	s_6	s_6	s_6	s_6			
5	s_7	s_7	s_7	s_7	s_7			
6	s_4	s_5					9	3
7	s_3	s_3	s_8	s_3	s_3			
8	s_5	s_5	s_5	s_5	s_5			
9	s_4	s_5		s_1	s_1			3

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Task 5

CLR(1) and LALR parsing table.

Parse string ababc (if conflict point out)

$$S \rightarrow abABC/DE$$

$$A \rightarrow a/\epsilon$$

$$B \rightarrow bA/\epsilon$$

$$D \rightarrow d/(E)$$

$$E \rightarrow e/\epsilon$$

CLR(1) Parser:

1) Augmented Grammar:

$$S' \rightarrow S$$

$$S \rightarrow .abABC/DE$$

$$A \rightarrow .a/\epsilon$$

$$B \rightarrow .bA/\epsilon$$

$$D \rightarrow .d/(E)$$

$$E \rightarrow .e/\epsilon$$

2) Canonical Form:

Creating canonical LR(1) item.

We already know that LR(1) item = LR(0) item + Lookahead. The additional thing added to LR(0) is the Lookahead which makes it a LR(1) items.
For the grammar,

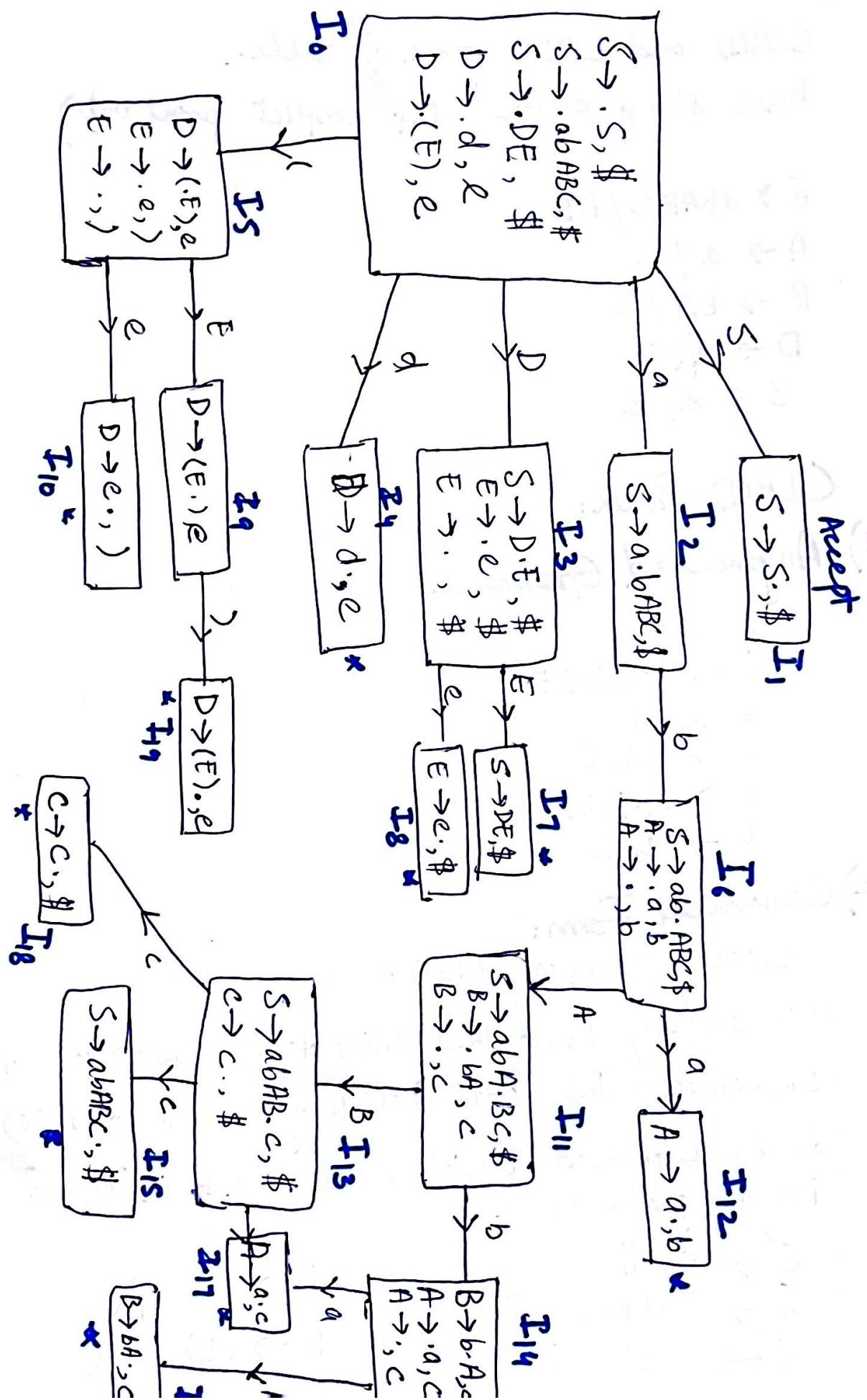
$$S' \rightarrow .S, \$$$

$$S \rightarrow .abABC, \$$$

$$S \rightarrow .DE, \$$$

$$D \rightarrow .d, d/($$

$$D \rightarrow (E), d/($$



We know that in CLR(1), we put reduce only under lookahead on that production.

For example: $A \rightarrow a \cdot, \$$

It is reduced item

You have to write δ_1 on only $\$$

So, Number the production

$$S \rightarrow abABC/DE \quad ①$$

$$A \rightarrow a/\epsilon \quad ②$$

$$B \rightarrow bA/\epsilon \quad ③$$

$$C \rightarrow c \quad ④$$

$$D \rightarrow \epsilon/(E) \quad ⑤$$

$$E \rightarrow \epsilon/\epsilon \quad ⑥$$

3) Parsing Table

State	a	b	c	d	e	()	\$	S	A	B	C	D	E
0	s_2	1	3
1	Accept
2	.	s_6	7
3	s_8
4	δ_8
5	s_{10}	.	.	δ_{11}	9
6	.	s_{12}	δ_4	11
7
8	δ_{10}
9	s_{19}
10	δ_{10}
11	.	.	s_{14}	δ_6
12	.	.	δ_3
13	.	.	.	s_{18}	δ_4	15
14	.	s_{17}	.	.	δ_5	δ_7	.	.	.	16
15	δ_5	δ_7
16

We know that in CLR(1), we put reduce only under lookahead on that production.

For example, $A \rightarrow a \cdot, \$$

It is reduced item

You have to write δ_1 on only $\$$

So, Number the production

$$S \rightarrow abABC / DE \quad ②$$

$$A \rightarrow a / \epsilon \quad ④$$

$$B \rightarrow bA / \epsilon \quad ⑤$$

$$C \rightarrow c \quad ⑦$$

$$D \rightarrow d / (E) \quad ⑨$$

$$E \rightarrow e / \epsilon \quad ⑪$$

3)

Parsing Table

State	a	b	c	d	e	()	\$	S	A	B	C	D	E
0	s_2													
1		.												
2			s_6											
3														
4														
5														
6				s_{12}	γ_4									
7														
8														
9														
10														
11														
12														
13														
14														
15														
16														

18

e

#

19

89

#

LALR(1) parser: (Min)

Step 1-3 are same as CLR(1) parser.

Step 4

Create LALR(1) parsing table using LR(1)
canonical items

To get LALR, we merge those canonical items having
same LR(0) but different lookahead.

For this grammar

$I_8 \quad [E \rightarrow c, \$]$

$Z_{8/0} \quad a \cdot b c d e () \$ \#$
 $\gamma_{8/0}$

$R_0 \quad [E \rightarrow e, ()]$

$Z_{8/0} \quad \gamma_{8/0}$

$\Rightarrow \quad T_{8/0}$

$a \cdot b c d e () \$ \#$
 $\gamma_{8/0} \quad \gamma_{8/0}$

One more case

$Z_{12} : A \rightarrow \cdot a, b$

$Z_{17} : A \rightarrow \cdot a, c$

$Z_{12} \quad a \cdot b c d e () \$ \# \quad A B C D E S$
 γ_3

$Z_{17} \quad \gamma_3$

b c

$I_{12/17} \quad \gamma_3 \mid \gamma_3$

\Rightarrow No, reduce-reduce
conflict because the reduction no
is same but lookahead diff.

LR(1) item.	a	b	c	d	e	()	\$	A	B	C	D	E	xs
I ₀	s ₂			s ₄		s ₅				reject			3.
I ₁													
I ₂		s ₆											7
I ₃							s ₈			g ₁₁			
I ₄													
I ₅							s ₁₀			g ₁₁			9
I ₆		s ₂ s ₇								.11			
I ₇										r ₂			
I ₈₁₀								s ₉					
I ₉								s ₁₀ s ₁₀	g ₀ s ₁₀				
I ₁₀								s ₁₀ s ₁₀	s ₁₀ s ₁₀				
I ₁₁		s ₄										13	
I ₁₂₇		s ₃		s ₃									
I ₁₃				s ₁₈									15
I ₁₄	s ₁₂₇			s ₄						g ₄			16
I ₁₅										s ₁			
I ₁₆					s ₅								
I ₁₇					s ₃	r ₃							
I ₁₈										r ₇			
I ₁₉							r ₉						

After merging and removing and taking unions of canonical items, the final LALR(1) parser is:

So, above CLR(1) and LALR(1) as there are no conflicts at all in both CLR(1) and LALR(1) parsing table.

(b)

Parsing a string ababc CLR(1)

Input

\$ 0

\$ 0 a₂ b₆

\$ 0 a₂ b₆ a₁₂

\$ 0 a₂ b₆ A₁₁

\$. 0 a₂ b₆ A₁₁ b₁₄

\$ 0 a₂ b₆ A₁₁ B₁₃

\$ 0 a₂ b₆ A₁₁ B₁₃ C₁₅

0 \$ 1

Stack

abab \$

bab \$

bc \$

bc \$

c \$

c \$

\$

\$

Action

Shift to S₂

Shift b to S₆

reduce at I_{12,2},
 $A \rightarrow a$

reduce

Shift c, S₁₄

reduce •I₁₆ | $\frac{c}{rs}$

reduce

reduce I₁₅ | $\frac{\$}{\$}$

Accept