

SPCC Assignment 1

Q.1. $E \rightarrow E + E \mid E - E \mid E * E \mid E / E \mid E \uparrow E \mid (E) \mid id.$

	id.	+	-	*	/	\uparrow	()	\$
id	$\neq E_1$	\rightarrow	\rightarrow	\rightarrow	\rightarrow	\rightarrow	$\rightarrow E_1$	\rightarrow	\rightarrow
+	$<$	\rightarrow	\rightarrow	$<$	$<$	$<$	$<$	\rightarrow	\rightarrow
-	$<$	\rightarrow	\rightarrow	$<$	$<$	$<$	$<$	\rightarrow	\rightarrow
*	$<$	\rightarrow	\rightarrow	\rightarrow	\rightarrow	$<$	$<$	\rightarrow	\rightarrow
/	$<$	\rightarrow	\rightarrow	\rightarrow	\rightarrow	$<$	$<$	\rightarrow	\rightarrow
\uparrow	$<$	\rightarrow	\rightarrow	\rightarrow	\rightarrow	$<$	$<$	\rightarrow	\rightarrow
(	E_1	\neq	$<$	$<$	$<$	$<$	$<$	\neq	E_2
)	$\neq E_1$	\rightarrow	\rightarrow	\rightarrow	\rightarrow	\rightarrow	E_1	\rightarrow	\rightarrow
\$	$<$	$<$	$<$	$<$	$<$	$<$	$<$	E_3	Accept

 $E_1 := \text{Missing Operator except } E_2 := \text{Missing Right Parenthesis}$ $E_3 := \text{Missing Left Parenthesis}$

Algorithm:

Let $a = \text{stack symbol};$ ~~do~~ $= \text{I/P symbol};$

repeat {

if (I/P scanned completely and stack contains start var only) {

ACCEPT();

}

else if ($a < b$ || $a \neq b$) {

shift;

}

else if ($a > b$) {

reduce;

}

else

ERROR();

}

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Example:

Stack	I/P	a	b	Action
\$	(id+id)*(id-id)\$	\$	(Shift
\$(id+id)*(id-id)\$	(id	Shift
\$(id	+id)*(id-id)\$	id	+	Reduce
\$(E	+id)*(id-id)\$	(	+	Shift
\$(E+	id)*(id-id)\$	+	id	Shift
\$(E+id	)*(id-id)\$	id	)	Reduce
\$(E+E	)*(id-id)\$	+	)	Reduce
\$(E	)*(id-id)\$	(	)	Shift
\$(E)	*(id-id)\$	)	*	Reduce
\$E	*(id-id)\$	\$	*	Shift
\$E*	(id-id)\$	*	(	Shift
\$E*(	id-id)\$	(	id	Shift
\$E*(id	-id)\$	id	-	Reduce
\$E*(E	-id)\$	(	-	Shift
\$E*(E-	id)\$	-	id	Shift
\$E*(E-id	)\$	id	)	Reduce
\$E*(E-E	)\$	-	)	Reduce
\$E*(E	)\$	(	)	Shift
\$E*(E)	\$	)	\$	Reduce
\$E*E	\$	*	\$	Reduce
\$E	\$	\$	\$	ACCEPT();

Q2 $S \rightarrow Aa$

$A \rightarrow BD$

$B \rightarrow b|e$

$D \rightarrow d|e$

a	b	d	\$
3	2	1	0

consider,

$\text{first}(S) = \{a, d, e\}$

$\text{first}(A) = \{b, d, e\}$

$\text{first}(B) = \{b, e\}$

$\text{first}(D) = \{d, e\}$

Now consider,

$\text{follow}(S) =$

$\therefore \text{follow}(S) = \{\$ \} = 0$

$\text{follow}(A) = \{a\} = 3$

$\text{follow}(B) = \{a, d\} = 31$

$\text{follow}(D) = \{a\} = 3$

Q3. $S \rightarrow Aa$

$A \rightarrow BD$

$B \rightarrow b|e$

$D \rightarrow d|e$

$\text{first}(S) = \{a, b, d, e\}$

$\text{first}(A) = \{b, d, e\}$

$\text{first}(B) = \{b, e\}$

$\text{first}(D) = \{d, e\}$

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

$\text{follow}(A) = \{a\}$

$\text{follow}(B) = \{a, d\}$

$\text{follow}(D) = \{a\}$

Q2) $P \rightarrow xQRS$

$Q \rightarrow yz|z$

$R \rightarrow w|e$

$S \rightarrow y$

$\text{first}(P) = \{x\}$

$\text{first}(Q) = \{y, z\}$

$\text{first}(R) = \{w, e\}$

$\text{first}(S) = \{y\}$

$\text{follow}(P) = \{\$ \}$

$\text{follow}(Q) = \{w, y\}$

$\text{follow}(R) = \{y\}$

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

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Q3) $S \rightarrow aBDh$
 $B \rightarrow eC$
 $C \rightarrow bC \mid e$
 $D \rightarrow EF$
 $E \rightarrow g \mid e$
 $F \rightarrow f \mid e$

$\text{first}(S) = \{a\}$	$\text{follow}(S) = \{\#\}$
$\text{first}(B) = \{e\}$	$\text{follow}(B) = \{b, g, h\}$
$\text{first}(D) = \{g, b, e\}$	$\text{follow}(C) = \{b, g, h\}$
$\text{first}(E) = \{g, e\}$	$\text{follow}(D) = \{h\}$
$\text{first}(F) = \{f, e\}$	$\text{follow}(E) = \{b, h\}$
$\text{first}(C) = \{b, e\}$	$\text{follow}(F) = \{h\}$

Q4)

$S \rightarrow FR$
 $S \rightarrow aAbB \mid bAaB \mid e$
 $A \rightarrow S$
 $B \rightarrow S$

$\text{first}(S) = \{a, b, e\}$	$\text{follow}(S) = \{\#, a, b\}$
$\text{first}(A) = \{a, b, e\}$	$\text{follow}(A) = \{a, b\}$
$\text{first}(B) = \{a, b, e\}$	$\text{follow}(B) = \{\#, a, b, \#\}$

Parse table:

	a	b	#
S	$S \rightarrow aAbB$ $S \rightarrow bAaB$	$S \rightarrow bAaB$ $A \rightarrow S$	$S \rightarrow e$
A	$A \rightarrow S$	$A \rightarrow S$	ERROR
B	$B \rightarrow S$	$B \rightarrow S$	$B \rightarrow S$

$\therefore E1 = \{S \rightarrow aAbB, S \rightarrow e\}$ $E3 = \{B \rightarrow S\}$
 $E2 = \{S \rightarrow bAaB, S \rightarrow e\}$

Q.5. G1) $S \rightarrow FR$.

$R \rightarrow S \mid E$.

$F \rightarrow id$.

$first(S) = \{id\}$ | $follow(S) = \{\$ \}$

$first(R) = \{id, E\}$ | $follow(R) = \{\$ \}$

$first(F) = \{id\}$ | $follow(F) = \{id, \$ \}$.

Parser Table:

	id	\$
S	$S \rightarrow FR$	ERROR()
R	$R \rightarrow S$	$R \rightarrow E$
F	$F \rightarrow id$	ERROR()

Algorithm:

Let $X = \text{tas}$ (start variable);

$a = \text{I/P}$.

repeat {

if $(X = a = \$)$ {

ACCEPT();

else if $(X = a \neq \$)$ {

pop(X);

} Remove a from I/P;

else if $(M[X, a] = X \rightarrow X_1 X_2 \dots X_n)$ {

pop(X);

Push $X_1 X_2 \dots X_n$ into I/P;

}

else

ERROR();

}

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Example: $i/p = id\ id.$

Stack	I/P
\$S	<u>id</u> id \$
\$R <u>F</u>	id <u>id</u> \$
\$R <u>id</u>	id id \$
\$R	<u>id</u> \$
\$ <u>S</u>	<u>id</u> \$
\$R <u>F</u>	<u>id</u> \$
\$R <u>id</u>	<u>id</u> \$
\$R	\$
\$	\$
ACCEPT()	

 $\therefore i/p = id\ id$ is valid.Q2) $S \rightarrow iEISS' \mid a$ $S' \rightarrow eS \mid \epsilon$ $E \rightarrow b$ $first(S) = \{i, a\}$ $first(S') = \{e, \epsilon\}$ $first(E) = \{b\}$ $follow(S) = \{\$, \epsilon\}$ $follow(S') = \{\$, \epsilon\}$ $follow(E) = \{t\}$ Parse table:

	a	b	e	i	t	\$
S	$S \rightarrow a$	-	-	$S \rightarrow iEISS'$	-	-
S'	-	-	$S' \rightarrow eS, S' \rightarrow \epsilon$	-	-	$S' \rightarrow \epsilon$
E	-	-	-	-	-	-

Here, the cell at row 'S' and column 'e' bears two production rules, i.e. there is an ambiguity in parsing. Hence, a parser for above set of production rules is not possible.

Q.6. (i) $S \rightarrow (L) | id.$

$L \rightarrow L, S | S$

Step 1:

$S' \rightarrow S$

① $S \rightarrow (L)$

$follow(S') = \{\$, \}$

② $S \rightarrow id.$

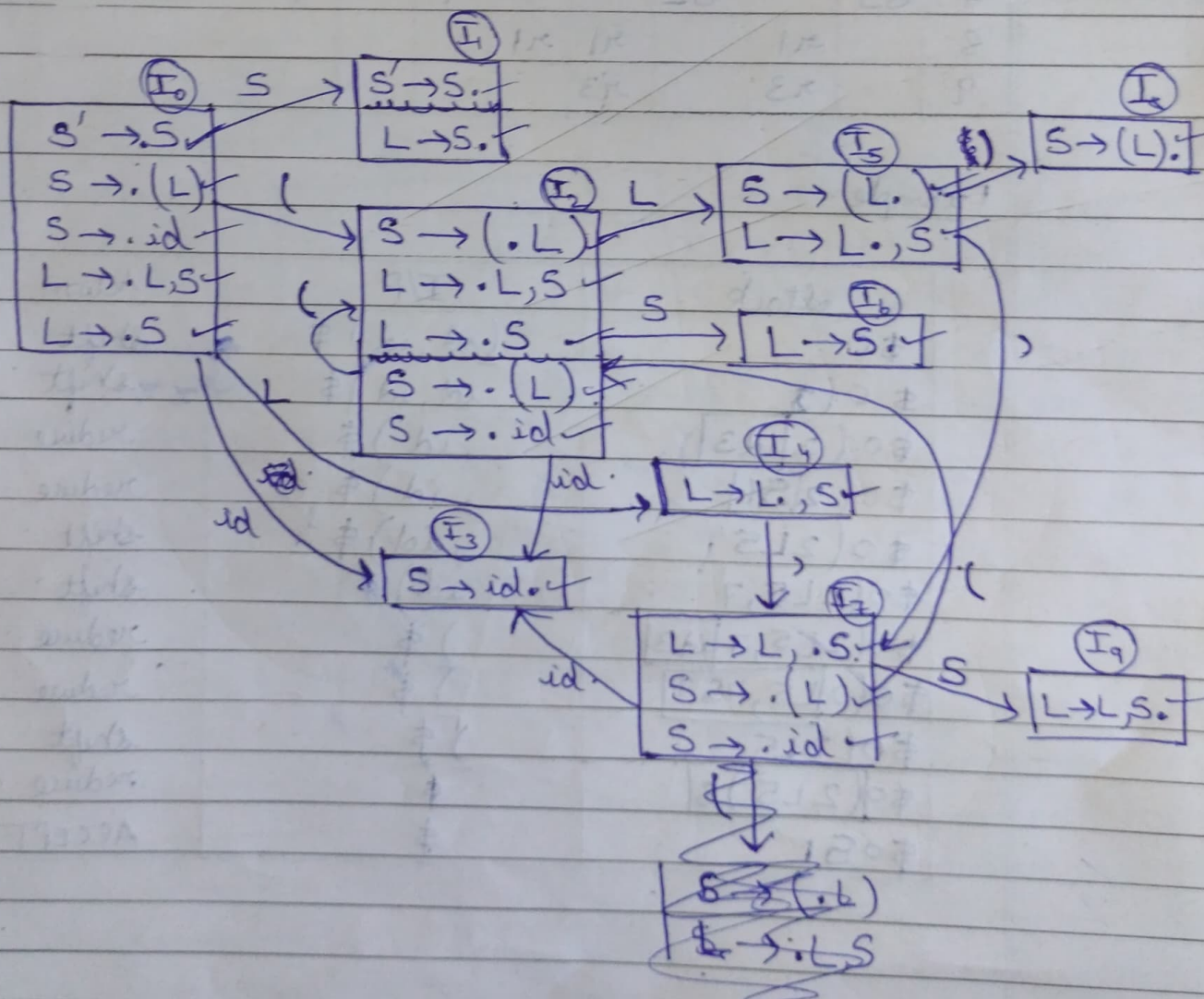
$follow(S) = \{ , , \$,) \}$

③ $L \rightarrow L, S$

$follow(L) = \{) , , \}$

④ $L \rightarrow S$

Step 2: Prepare goto table.



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Step 3: Parser table.

	id	,	()	\$	S	L
0	s3		s2			1	4.
1					ACCEPT		
2	s3		s2			6	5.
3		r2	(, #	r2	r2		
4	s	s7					
5		s7		s8			
6		r4		r4			
7	s3		s2			9.	
8		r1		r1	r1		
9		r3		r3			

Example:

Stack	I/P	Action
\$0	(id, id) \$	shift
\$0(2	id, id) \$	shift
\$0(2 id3	, id) \$	reduce
\$0(2 56	, id) \$	reduce
\$0(2 L5	, id) \$	shift
\$0(2 L5, 7	id) \$	shift
\$0(2 L5, 7 id3	) \$	reduce
\$0(2 L5, 7 59	) \$	reduce
\$0(2 L5	) \$	shift
\$0(2 L5) 8	\$	reduce
\$0 51	\$	ACCEPT

(ii) $S \rightarrow aCD e$

$C \rightarrow Cbc$

$C \rightarrow b$

$D \rightarrow d$

Step 1:

$S' \rightarrow S$

① $S \rightarrow aCD e$

$\text{follow}(S') = \{\#\}$

② $C \rightarrow Cbc$

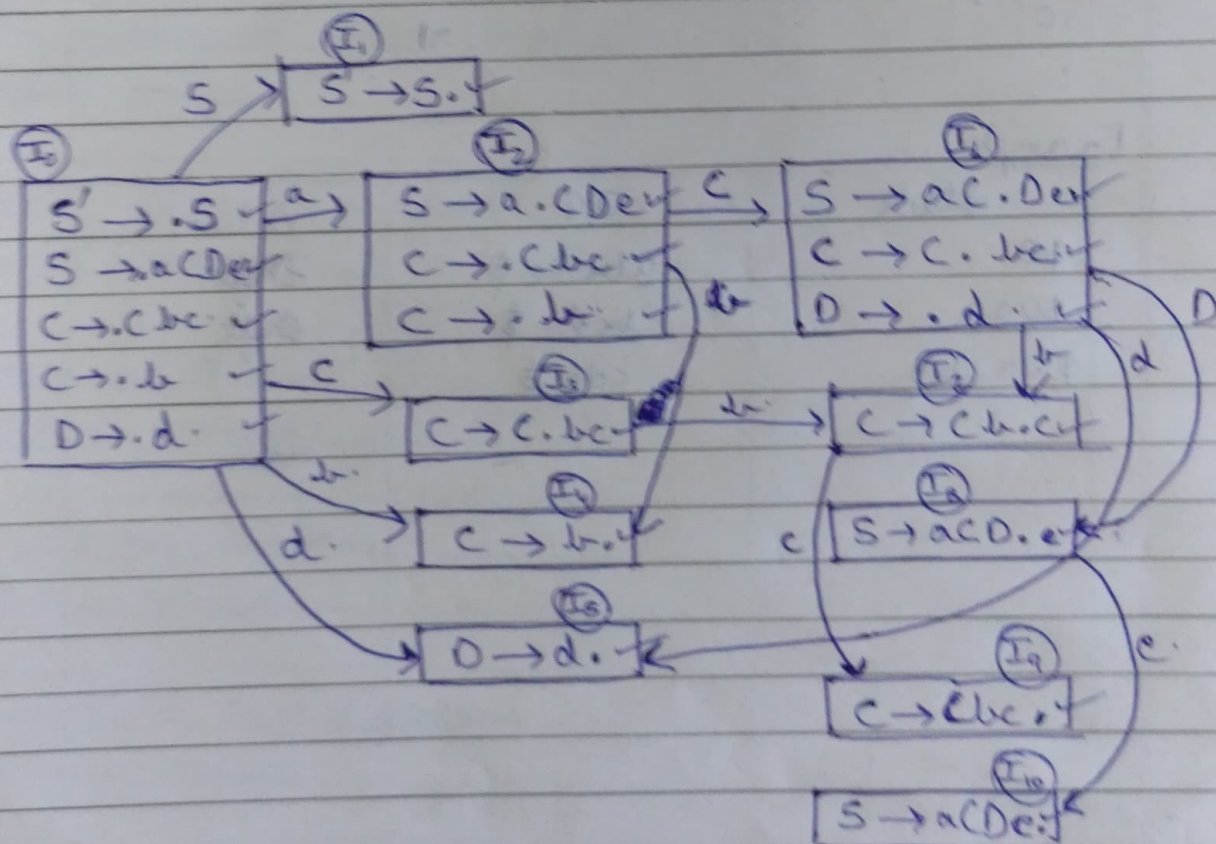
$\text{follow}(C) = \{d, b\}$

③ $C \rightarrow b$

$\text{follow}(D) = \{e\}$

④ $D \rightarrow d$

Step 2: Prepare goto table.



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Step 3: Parser table.

	a	b	c	d	e	S	C	D	\$
0	s2	s4		s5		1	3		
1									ACCEPT
2		s4					6		
3		s7							
4		r3		r3	x3				
5					r4				
6		s7		s5			8		
7			s9						
8					s10				
9		r2		r2	x4				
10									r1

Example:

Stack	I/P	Action
\$0	abcde\$	shift
\$0a2	bcde\$	shift
\$0a2b4	cde\$	

Q.7.

1. Exceeding length of identifier or numeric constants
→ Lexical analyser.
2. Not matching actual arguments with a formal one.
→ Semantic analyser.
3. Missing operator
→ Syntax analyser.
4. Misspelled keywords.
→ Syntax analyser.
5. The appearance of illegal characters.
→ Lexical analyser.
6. End of comment is present but beginning is not present
→ Lexical analyser.
7. Errors in structure
→ Syntax analyser.
8. Unbalanced parenthesis.
→ Syntax analyser.
9. Incompatible type of operands.
→ Semantic analyser.
10. Undeclared variables.
→ Semantic analyser.