

Tutorial-2

PAGE NO.

DATE / /

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U20CSD005

1. Construct predictive parsing table for following grammar. And verify (give moves of the parser) for the string "id+id*id"

$$E \rightarrow TE'$$

$$E' \rightarrow +TE' | \epsilon$$

$$T \rightarrow FT'$$

$$T' \rightarrow *FT' | \epsilon$$

$$F \rightarrow (E) | id$$

$$\rightarrow First(E) = First(TE') = First(FT'E') = First((E)TE') + First(idT'E')$$

$$First(E) = \{ (, id \}$$

$$First(E') = \{ +, \epsilon \}$$

$$First(T) = First(FT') = \{ (, id \}$$

$$First(T') = \{ *, \epsilon \}$$

$$First(F) = \{ (, id \}$$

ϵ

$$Follow(E) = \{ \$,) \}$$

$$Follow(E') = Follow(E) = \{ \$,) \}$$

$$Follow(T) = First(E') = \{ +, Follow(E) \} = \{ +, \$,) \}$$

$$Follow(T') = Follow(T), Follow(T') = \{ +, \$,) \}$$

$$Follow(F) = First(T'), Follow(T) = \{ +, *, \$,) \}$$

ϵ	First	Follow
E	(, id	\$,)
E'	+, ϵ	\$,)
T	(, id	+, \$,)
T'	*, ϵ	+, \$,)
F	(, id	+, *, \$,)

1) $E \rightarrow TE'$

5) $T' \rightarrow *FT'$

2) $E' \rightarrow +TE'$

6) $T' \rightarrow \epsilon$

3) $E' \rightarrow \epsilon$

7) $F \rightarrow (E)$

4) $T \rightarrow FT'$

8) $F \rightarrow id.$

	+	*	()	id	\$
E	1		1		1	
E'	2			3		3
T			4		4	
T'	5	5		6		6
F			7		8	

Stack	I/p	O/p
\$E	id+id*id\$	$E \rightarrow TE'$
\$E'T	id+id*id\$	$T \rightarrow FT'$
\$E'T'F	id+id*id\$	$F \rightarrow id$
\$E'T'id	id+id*id\$	
\$E'T'	+id*id\$	$T' \rightarrow \epsilon$
\$E'	+id*id\$	$E' \rightarrow +TE'$
\$E'T+	+id*id\$	
\$E'T	id*id\$	$T \rightarrow FT'$
\$E'T'F	id*id\$	$F \rightarrow id$
\$E'T'id	id*id\$	
\$E'T'*	*id\$	$T' \rightarrow *FT'$
\$E'T'F*	*id\$	
\$E'T'F	id\$	$F \rightarrow id$
\$E'T'id	id\$	
\$E'T'	\$	$T' \rightarrow \epsilon$
\$E'	\$	$E' \rightarrow \epsilon$
\$	\$	

id+id*id is accepted under given grammar

2. Check the grammar is LL(1) or not:

$$a) S \rightarrow AaAb \mid BbBa$$

$$A \rightarrow \epsilon$$

$$B \rightarrow \epsilon$$

$$b) S \rightarrow \epsilon \mid ESS'$$

$$S' \rightarrow eS \mid \epsilon$$

$$E \rightarrow b$$

$$\rightarrow a) S \rightarrow AaAb \mid BbBa$$

$$A \rightarrow \epsilon$$

$$B \rightarrow \epsilon$$

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

$$\text{First}(A) = \epsilon$$

$$\text{First}(B) = \epsilon$$

Follow

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

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

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

	First	Follow
S	a, b	\$
A	ϵ	a, b
B	ϵ	a, b

$$1) S \rightarrow AaAb$$

$$3) BA \rightarrow \epsilon$$

$$2) S \rightarrow BbBa$$

$$4) B \rightarrow \epsilon$$

	a	b	\$
S	1	2	
A	3	3	
B	4	4	

This grammar is LL(1) grammar.

$$b) S \rightarrow iEtSS'$$

$$S' \rightarrow eS \mid \epsilon$$

$$E \rightarrow b$$

	First	Follow
S	i	\$, e
S'	e, ϵ	\$, e
E	b	t

$$1) S \rightarrow iEtSS'$$

$$3) S' \rightarrow \epsilon$$

$$2) S' \rightarrow eS$$

$$4) E \rightarrow b$$

	i	t	e	b	\$
S	1				
S'			2, 3		3
E				4	

This grammar is not LL(1) grammar as multiple entries are present in parse table.

3. Given the grammar

$$S \rightarrow a(L)$$

$$L \rightarrow L, S \mid S$$

(i) Is the above grammar LL(1)? Justify your answer

(ii) What changes are necessary to make it suitable for LL(1) parser?

(iii) Show the moves made by LL(1) predictive parser on input (a, (a, a)).

$$\rightarrow S \rightarrow a(L)$$

$$L \rightarrow L, S \mid S$$

(i) The above grammar is not LL(1) as left recursion is present in rule $L \rightarrow L, S \mid S$.

(ii) To make grammar suitable for LL(1) parser, remove left recursion,

$$S \rightarrow a(L)$$

$$L \rightarrow SL'$$

$$L' \rightarrow ,SL' \mid \epsilon$$

	First	Follow
S	a, (\$, , ,)
L	a, ()
L'	, ε)

1) $S \rightarrow a$

4) $L' \rightarrow , SL'$

2) $S \rightarrow (L)$

5) $L' \rightarrow \epsilon$

3) $L \rightarrow SL'$

	a	()	,	\$
S	1	2			
L	3	3			
L'			5	4	

Stack	Input	Output
\$S	(a, (a, a))\$	$S \rightarrow (L)$
\$(L)	(a, (a, a))\$	
\$(L	a, (a, a))\$	$L \rightarrow SL'$
\$(L'S	a, (a, a))\$	$S \rightarrow a$
\$(L'a	a, (a, a))\$	
\$(L'	, (a, a))\$	$L' \rightarrow , SL'$
\$(L'S,	, (a, a))\$	
\$(L'S	(a, a))\$	$S \rightarrow (L)$
\$(L'(L)	(a, a))\$	
\$(L'(L	a, a))\$	$L \rightarrow SL'$
\$(L'(L'S	a, a))\$	$S \rightarrow a$
\$(L'(L'a	a, a))\$	
\$(L'(L'	, a))\$	$L' \rightarrow , SL'$
\$(L'(L'S,	, a))\$	
\$(L'(L'S	a))\$	$S \rightarrow a$
\$(L'(L'a	a))\$	
\$(L'(L')\$	$L' \rightarrow \epsilon$
\$(L'(\$)\$ \$	$L' \rightarrow \epsilon$

4) Consider a grammar α as follows:

$$S \rightarrow W$$

$$W \rightarrow ZXY | XY$$

$$Y \rightarrow c | \epsilon$$

$$Z \rightarrow a | d$$

$$X \rightarrow Xb | \epsilon$$

Draw the LL(1) parsing table for the given grammar.

$$\rightarrow S \rightarrow W$$

$$W \rightarrow ZXY | XY$$

$$Y \rightarrow c | \epsilon$$

$$Z \rightarrow a | d$$

$$X \rightarrow Xb | \epsilon$$

	First	Follow
S	a, b, c, d, ϵ	\$
W	a, b, c, d, ϵ	\$
X	b, ϵ	b, c, \$
Y	c, ϵ	\$
Z	a, d	b, c, \$

$$1) S \rightarrow W \quad a$$

$$2) W \rightarrow ZXY$$

$$3) W \rightarrow XY$$

$$4) Y \rightarrow c$$

$$5) Y \rightarrow \epsilon$$

$$6) Z \rightarrow a$$

$$7) Z \rightarrow d$$

$$8) X \rightarrow Xb$$

$$9) X \rightarrow \epsilon$$

	a	b	c	d	\$
S	1	1	1	1	1
W	2	3	3	2	3
X		8, 9	9		9
Y			4		5
Z	6			7	

5. Consider the following grammar G

$$S \rightarrow Ae$$

$$A \rightarrow CbD$$

$$C \rightarrow BC|E$$

$$B \rightarrow cdD|acdD$$

$$D \rightarrow c|E$$

In LL(1) parse table of above grammar G , how many cells have multiple entries?

$$\begin{array}{ll} \rightarrow S \rightarrow Ae & B \rightarrow cdD|acdD \\ A \rightarrow CbD & D \rightarrow c|E \\ C \rightarrow BC|E & \end{array}$$

	First	Follow
S	a, b, c	\$
A	a, b, c	e
B	a, c	a, b, c
C	a, c, E	b
D	c, E	a, b, c, e

1) $S \rightarrow Ae$

4) $B \rightarrow cdD$

2) $A \rightarrow CbD$

5) $B \rightarrow acdD$

3) $C \rightarrow BC$

6) $D \rightarrow c$

8) $C \rightarrow E$

7) $D \rightarrow E$

	a	b	c	d	e	\$
S	1	1	1			
A	2	2	2			
B	3, 5		4			
C	3	8	3			
D	7	7	6, 7		7	

Only one cell is having multiple entry.