

## Homework 3\_Solutions

### Problem 1 (10pts)

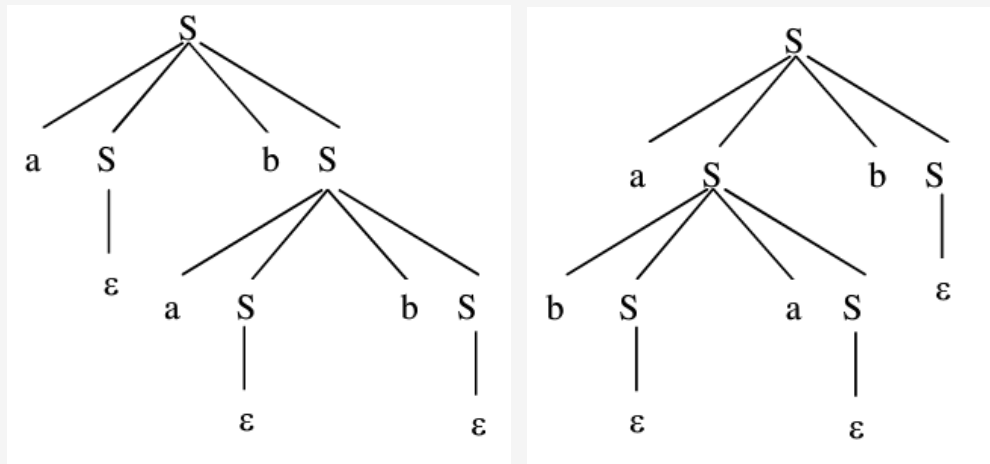
What is ambiguous grammars? Is the following grammar ambiguous? Justify your answer.

$$S \rightarrow aSbS \mid bSaS \mid \epsilon$$

An ambiguous grammar is a context-free grammar for which there exists a string that can have more than one leftmost derivation or parse tree.

$S \rightarrow aSbS \mid bSaS \mid \epsilon$  is an ambiguous grammar.

For input "abab", there are two parse trees:

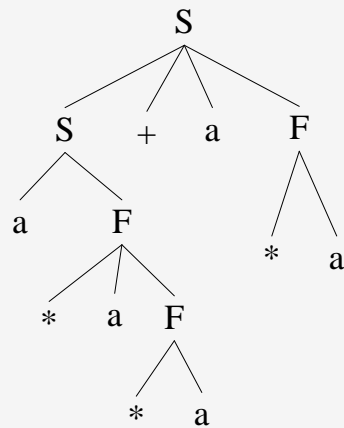


### Problem 2 (10pts)

Given the grammar  $G(S)$ :  $S \rightarrow S+aF \mid aF \mid +aF$   $F \rightarrow *aF \mid *a$

- (1) Give the parse tree for the string  $a*a*a+a*a$
- (2) Give the canonical reduction for the string  $a*a*a+a*a$ , and the handle of each sentential form at each step.

(1)



(2)

		Handle
$a*a*a+a*a$	$F \rightarrow *a$	$*a$
$a*aF+a*a$	$F \rightarrow *aF$	$*aF$
$aF+a*a$	$S \rightarrow aF$	$aF$
$S+a*a$	$F \rightarrow *a$	$*a$
$S+aF$	$S \rightarrow S+aF$	$S+aF$
$S$		

### Problem 3 (15pts)

Given the grammar  $G[E]$ :  $E \rightarrow (L)|a$        $L \rightarrow L, E | E$

(1) Try to modify the given grammar to LL(1) grammar.

(2) Compute FIRST and FOLLOW of the result grammar.

(3) Construct a predictive parse table for the result grammar.

(1)  $E \rightarrow (L) | a$      $L \rightarrow EL'$      $L' \rightarrow , EL' | \epsilon$

(2)

	First	Follow
E	{ ( , a }	{ \$ , , }
L	{ ( , a }	{ ) }
L'	{ , , $\epsilon$ }	{ ) }

(3)

	(	)	a	,	\$
E	$E \rightarrow (L)$		$E \rightarrow a$		
L	$L \rightarrow EL'$		$L \rightarrow EL'$		
L'		$L' \rightarrow \epsilon$		$L' \rightarrow EL'$	

#### Problem 4 (15pts)

Given the grammar G[E]:  $E \rightarrow (L) | a$      $L \rightarrow L, E | E$

(1) Construct LR(0) automaton for G[E]

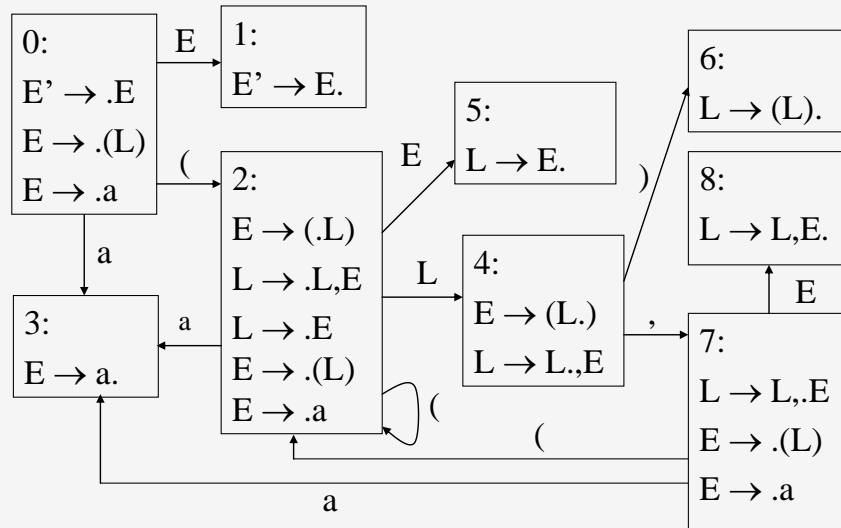
(2) Using the LR(0) automaton to parse the input string **(a, (a, a))** .

(3) Construct SLR(1) parsing table for G[E].

(1)The augmented grammar:

$E' \rightarrow E$      $E \rightarrow (L) | a$      $L \rightarrow L, E | E$

The LR(0) automaton:



(2)

	STACK	SYMBOLS	INPUT
1	$\emptyset$	\$	$(a,(a,a))\$$
2	$\emptyset 2$	$\$($	$a,(a,a))\$$
3	$\emptyset 23$	$\$(a$	$, (a,a))\$$
4	$\emptyset 25$	$\$(E$	$, (a,a))\$$
5	$\emptyset 24$	$\$(L$	$, (a,a))\$$
6	$\emptyset 247$	$\$(L,$	$(a,a))\$$
7	$\emptyset 2472$	$\$(L,($	$a,a))\$$
8	$\emptyset 24723$	$\$(L,(a$	$,a))\$$
9	$\emptyset 24725$	$\$(L,(E$	$,a))\$$
10	$\emptyset 24726$	$\$(L,(L$	$,a))\$$
11	$\emptyset 247247$	$\$(L,(L,$	$a))\$$
12	$\emptyset 2472473$	$\$(L,(L,a$	$))\$$
13	$\emptyset 2472478$	$\$(L,(L,E$	$))\$$
14	$\emptyset 24724$	$\$(L,(L$	$))\$$
15	$\emptyset 247246$	$\$(L,(L)$	$)\$$

16	02478	\$(L,E	)\$
17	024	\$(L	)\$
18	0248	\$(L)	\$
19	01	\$E	\$

(3)

0:  $E' \rightarrow E$     1:  $E \rightarrow (L)$     2:  $E \rightarrow a$     3:  $L \rightarrow L,E$     4:  $L \rightarrow E$

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

State	Action					GoTo	
	a	,	(	)	\$	E	L
0	S3		S2			1	
1					acc		
2	S3		S2			5	4
3		r3		r2	r3		
4		S7		S6			
5		r4		r4			
6		r1		r1	r1		
7	S3		S2			8	
8		r3		r3			