编译原理 - 作业(2)：语法分析 LL

Q1: (p206, Exercise 4.2.1) Consider the context-free grammar:

$$S \rightarrow SS+ \mid SS* \mid a$$

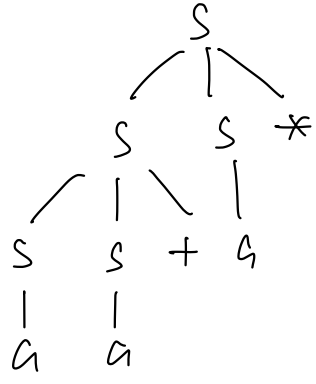
and the string aa + a*.

a) Give the leftmost derivation for the string.
b) Give the rightmost derivation for the string.
c) Give a parse tree for the string.
d) Is the grammar ambiguous or unambiguous? Justify your answer.
e) Describe the language generated by this grammar.

a) $S \rightarrow SS* \rightarrow SS+S* \rightarrow aS+S* \rightarrow aa+S* \rightarrow aa+a*$

b) $S \rightarrow SS* \rightarrow Sa* \rightarrow SS+a* \rightarrow Sa+a* \rightarrow aa+a*$

c)



d) 无二义性。因为这种文法对于极左推导或者极右推导，都只能构造一棵 parse tree

e) 所有由加法和乘法组成的后缀表达式

Q2: (p216, Exercise 4.3.1) The following is a grammar for regular expressions over symbols a and b only, using + in place of | for union, to avoid conflict with the use of vertical bar as a metasymbol in grammars:

$rexpr \rightarrow rexpr + rterm \mid rterm$
$rterm \rightarrow rterm\, rfactor \mid rfactor$
$rfactor \rightarrow rfactor * \mid rprimary$
$rprimary \rightarrow$ a | b

a) Left factor this grammar.
b) Does left factoring make the grammar suitable for top-down parsing?
c) In addition to left factoring, eliminate left recursion from the original grammar.
d) Is the resulting grammar suitable for top-down parsing?

a) 无左公因子

b) 不适合

c) rexpr → rterm A

A → + rterm A | ε

rterm → rfactor B

B → rfactor B | ε

rfactor → rprimary C

C → * C | ε

rprimary → a | b

d) 适合

Q3: Construct LL(1) parse table of the following grammar. Note: please list the detailed steps.

$E \rightarrow -E$
$E \rightarrow (E) \mid \text{Var}\ T$
$T \rightarrow -E \mid \varepsilon$
$\text{Var} \rightarrow \text{id}\ V$
$V \rightarrow (E) \mid \varepsilon$

First(E) = {−, (, id}　　Follow(E) = {$,)}

First(T) = {−, ε}　　Follow(T) = {$,)}

First(V) = {(, ε}　　Follow(V) = {−, $,)}

First(Var) = {id}　　Follow(Var) = {−, $,)}

	−	(	)	id	$
E	E→−E	E→(E)		E→VarT	
T	T→−E		T→ε		T→ε
V	V→ε	V→(E)	V→ε		V→ε
Var				Var→idV	

Q4: Check whether the following G[S] grammar is an LL(1) grammar:

$E \rightarrow T\,E'$
$E' \rightarrow A\,T\,E' \mid \varepsilon$
$T \rightarrow F\,T'$
$T' \rightarrow M\,F\,T' \mid \varepsilon$
$F \rightarrow (E) \mid \mathrm{i}$
$A \rightarrow + \mid -$
$M \rightarrow * \mid /$

	First	Follow
E	(, i	$,)
E'	ε, +, −	$,)
T	(, i	+, −, $,)
T'	ε, *, /	+, −, $,)
F	(, i	*, /, +, −, $,)
A	+, −	(, i
M	*, /	(, i

	(	)	i	+	−	*	/	$
E	E→TE′		E→TE′					
E′		E′→ε		E→ATE′	E→ATE′			E′→ε
T	T→FT′		T→FT′					
T′		T′→ε		T′→ε	T′→ε	T′→MFT′	T′→MFT′	T′→ε
F	F→(E)		F→i					
A				A→+	A→−			
M						M→*	M→/	

发现没有冲突，所以是LL(1)文法