

Exercise 5.1

- Given the following grammar

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

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

- Construct an LL(1) parsing table for the grammar
 - Note: you must eliminate the left recursion first.
- Draw the detailed process of the parsing of the sentence $(a, (a, a))$, follow the style in the previous slides.

(1) 首先消除左递归可得:

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

$$L \rightarrow SL'$$

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

所以可得:

$$\text{FIRST}(S) = \{ (, a \} , \quad \text{FOLLOW}(S) = \{ \$, ,,) \}$$

$$\text{FIRST}(L) = \{ (, a \} , \quad \text{FOLLOW}(L) = \{) \}$$

$$\text{FIRST}(L') = \{ ,, \epsilon \} , \quad \text{FOLLOW}(L') = \{) \}$$

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

(2) 如下所示:

Step	Stack	Input	Action	Output
1	\$S	(a,(a,a))	derive	$S \rightarrow (L)$
2	\$)L(	(a,(a,a))	match	
3	\$)L	a,(a,a))	derive	$L \rightarrow SL'$
4	\$)L'S	a,(a,a))	derive	$S \rightarrow a$
5	\$)L'a	a,(a,a))	match	
6	\$)L'	,(a,a))	derive	$L' \rightarrow ,SL'$
7	\$)L'S	,(a,a))	match	
8	\$)L'S	(a,a))	derive	$S \rightarrow (L)$
9	\$)L')L(	(a,a))	match	
10	\$)L')L	a,a))	derive	$L \rightarrow SL'$
11	\$)L')L'S	a,a))	derive	$S \rightarrow a$
12	\$)L')L'a	a,a))	match	
13	\$)L')L'	,a))	derive	$L \rightarrow ,SL'$
14	\$)L')L'S	,a))	match	
15	\$)L')L'S	a))	derive	$S \rightarrow a$
16	\$)L')L'a	a))	match	
17	\$)L')L'	))	derive	$L' \rightarrow \varepsilon$
18	\$)L')	))	match	
19	\$)L'	)	derive	$L' \rightarrow \varepsilon$
20	\$)	)	match	

21	\$	\$	accept	
----	----	----	--------	--

Exercise 5.2 **

- Given the following grammar

$$A \rightarrow B \mid BC$$

$$B \rightarrow aB \mid \varepsilon$$

$$C \rightarrow ab$$

- Left factor the grammar.
- After left factoring, is the grammar an LL(1) grammar? or is it an LL(k) grammar? and why?
 - Note: you may try the input string **ab**.

(1)

Left factor:

$$A \rightarrow BA'$$

$$A' \rightarrow C \mid \varepsilon$$

$$B \rightarrow aB \mid \varepsilon$$

$$C \rightarrow ab$$

(2) 因为有:

$$A \rightarrow BC \rightarrow \varepsilon C \rightarrow C \rightarrow ab$$

$$A \rightarrow B \rightarrow aB$$

第 1 个都是 a, 所以显然不是 LL(1)文法。

同时易证它是 LL(2)的文法 (即 LL(k)), 因为:

$$\text{FIRST}_2(A) = \{a, aa\} \quad \text{FOLLOW}_2(A) = \{\$ \}$$

$$\text{FIRST}_2(A') = \{ab, \varepsilon\} \quad \text{FOLLOW}_2(A') = \{\$ \}$$

$$\text{FIRST}_2(B) = \{a, aa\} \quad \text{FOLLOW}_2(B) = \{ab\}$$

$$\text{FIRST}_2(C) = \{ab\} \quad \text{FOLLOW}_2(C) = \{\$ \}$$

$$\text{此时有 } B \rightarrow aB \mid \varepsilon, \quad \text{FIRST}(aB) \cap \text{FOLLOW}(B) = \emptyset$$

同时可检验其余产生式也满足 LL(2)文法条件，所以得证是 LL(k) 文法。