Required Exercises

Exercise 1

> Consider the following context-free grammar G:
>
> $$S \rightarrow SS+\,|\,SS*\,|\,a$$
>
> 1. Is the string $a + a * a$ in L(G)? [10 points]
>
> 2. Give a leftmost derivation for the string $aa * aa + *$. [10 points]
>
> 3. Give a rightmost derivation for the string $aa * aa + *$. [10 points]
>
> 4. Give a parse tree for the string $aa * aa + *$. [10 points]
>
> 5. Give an equivalent grammar without immediate left recursions. [10 points]
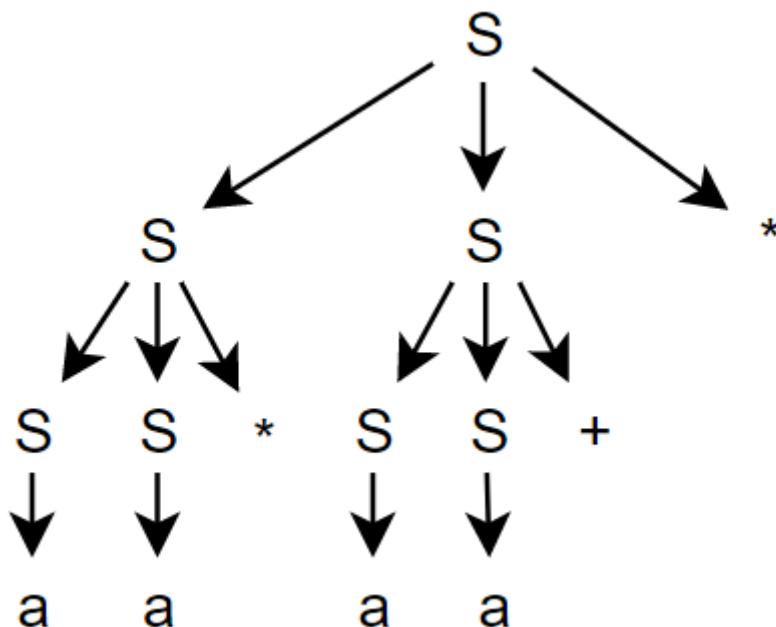
1. 不符合文法，该文法只能接受单独的a或者以+或*结束的字符串。

2.

```
1   S -> SS* -> SS*S* -> aS*S* -> aa*S* -> aa*SS+* -> aa*aS+* -> aa*aa+*
```

3.

```
1   S -> SS* -> SSS+* -> SSa+* -> Saa+* -> SS*aa+* -> Sa*aa+* -> aa*aa+*
```

4.

5.

```
1   S -> aS'
2   S' -> S+S'|S*S'|ε
```

Exercise 2

Consider the following grammar G:

$$S \to aB$$

$$B \to S + B | \epsilon$$

1. Construct the predictive parsing table for G. Please put down the detailed steps, including the calculation of FIRST and F OLLOW sets. [25 points]

2. Is the grammar LL(1)? [5 points]

3. Can an LL(1) parser accept the input string $aaaa + {}+{}+$? If yes, please list the moves made by the parser; otherwise, state the reason. Before parsing, please resolve conflicts in the parsing table if any. [20 points]

1.

FIRST sets

```
1   FIRST(S) = {a}
2   FIRST(B) = FIRST(S) ∪ {ε} = {a, ε}
3   FIRST(+) = {+}
```

FOLLOW sets

```
1   FOLLOW(S) = {+, $}
2   FOLLOW(B) = {+, $}
```

for S → aB

FIRST(aB) = {a}，那么添加S → aB到M[S, a]

for B → S+B

FIRST(S+B) = {a}，那么添加B → S+B到M[B, a]

for B → ε

FIRST(ε) = {ε}，FOLLOW(B) = {+, $}, 那么添加 B → ε到M[B, +]， 添加 B → ε到M[B, $],

Non-terminal symbol	Input symbols		
	a	+	$
S	S → aB		
B	B → S+B	B → ε	B → ε

2. 是LL(1)文法，因为预测表中不存在包含两个及以上产生式的单元格

3. 该LL(1)分析器可以接受串$aaaa + {}+{}+$。

步骤	分析栈	输入栈	产生式或匹配
1	$S	aaaa+++$	S → aB
2	$Ba	aaaa+++$	"a"匹配

步骤	分析栈	输入栈	产生式或匹配
3	$B	aaa+++$	B → S+B
4	$B+S	aaa+++$	S → aB
5	$B+Ba	aaa+++$	"a"匹配
6	$B+B	aa+++$	B → S+B
7	$B+B+S	aa+++$	S → aB
8	$B+B+Ba	aa+++$	"a"匹配
9	$B+B+B	a+++$	B → S+B
10	$B+B+B+S	a+++$	S → aB
11	$B+B+B+Ba	a+++$	"a"匹配
12	$B+B+B+B	+++$	B → ε
13	$B+B+B+	+++$	"+"匹配
14	$B+B+B	++$	B → ε
15	$B+B+	++$	"+"匹配
16	$B+B	+$	B → ε
17	$B+	+$	"+"匹配
18	$B	$	B → ε
19	$	$	"$"匹配

Optional Exercises

Exercise 1

Consider the following context-free grammar:

短语 → 人 | 短语动词短语

动词 → 喜欢 | 讨厌

人 → 你 | 我 | 他

The grammar can produce sentences such as "我喜欢你". Is the grammar ambiguous? If yes, please give one sentence and its multiple parse trees. If no, state the reason. [5 points for the yes/no answer and 15 points for the justification]

存在二义性，如下图所示，左图表示"我喜欢（你讨厌他）"；右图表示"我喜欢你并且讨厌他"。

短语

短语 → 我

动词 → 喜欢

短语

短语 → 你

动词 → 讨厌

短语 → 他

短语

短语

短语 → 我

动词 → 喜欢

短语 → 你

动词 → 讨厌

短语 → 他