# Assignment 5

4.6.2

**练习4.6.2：**为练习4.2.1中的（增广）文法构造SLR项集。计算这些项集的GOTO函数。给出这个文法的语法分析表。这个文法是SLR文法吗?

练习**4.2.1**：考虑上下文无关文法：

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

答:

1、增广文法

```
(0) S' -> S
(1) S -> SS+
(2) S -> SS*
(3) S -> a
```

2、LR(0)项集族

```
I0
S' -> ·S
S -> ·SS+
S -> ·SS*
S -> ·a

I1
S' -> S·
S -> S·S+
S -> S·S*
S -> ·SS+
S -> ·SS*
S -> ·a

I2
S -> a·

I3
S -> SS·+
S -> SS·*
S -> S·S+
S -> S·S*
S -> ·SS+
S -> ·SS*
S -> ·a

I4
S -> SS+·

I5
S -> SS*·
```

3、GOTO函数

```
GOTO(I0, S) = I1    GOTO(I0, a) = I2
GOTO(I1, S) = I3    GOTO(I1, a) = I2    GOTO(I1, $) = acc
GOTO(I3, S) = I3    GOTO(I3, a) = I2    GOTO(I3, +) = I4    GOTO(I3, *) = I5
```

4、语法分析表

FOLLOW(S') = FOLLOW(S) = {+, *, a, $}

| 状态 | ACTION | ACTION | ACTION | ACTION | GOTO | | | |
|---|---|---|---|---|---|---|---|---|
| | + | * | a | $ | S | a | + | * |
| 0 | | | s2 | | 1 | 2 | | |
| 1 | | | s2 | acc | 3 | 2 | | |
| 2 | r3 | r3 | r3 | r3 | | | | |
| 3 | s4 | s5 | s2 | | 3 | 2 | 4 | 5 |
| 4 | r1 | r1 | r1 | r1 | | | | |
| 5 | r2 | r2 | r2 | r2 | | | | |

这个文法是SLR文法，因为语法分析表中没有重复的条目。

4.6.3

**练习4.6.3：**利用练习4.6.2得到的语法分析表，给出处理输入aa * a +时的各个动作。

答:

| | 栈 | 符号 | 输入 | 动作 |
|---|---|---|---|---|
| (1) | 0 | $ | aa*a+$ | s2 |
| (2) | 02 | $a | a*a+$ | r3 |
| (3) | 01 | $S | a*a+$ | s2 |
| (4) | 012 | $Sa | *a+$ | r3 |
| (5) | 013 | $SS | *a+$ | s5 |
| (6) | 0135 | $SS* | a+$ | r2 |
| (7) | 0133 | $S | a+$ | s2 |
| (8) | 01332 | $Sa | +$ | r3 |
| (9) | 01333 | $SS | +$ | s4 |
| (10) | 013334 | $SS+ | $ | r1 |
| (11) | 01 | $S | $ | acc |

4.6.6

**练习4.6.6：**说明下面的文法

$$S \longrightarrow S\,A \mid A$$
$$A \longrightarrow a$$

是SLR（1），但不是LL（1）的。

答：

1、LL(1)

FIRST(SA) = FIRST(A) = {a}，所以该文法不是LL(1)的。

2、SLR(1)

①增广文法

```
(0) S' -> S
(1) S -> SA
(2) S -> A
(3) A -> a
```

②LR(0)项集族

```
I0
S' -> ·S
S -> ·SA
S -> ·A
A -> ·a

I1
S' -> S·
S -> S·A
A -> ·a

I2
S -> A·

I3
A -> a·

I4
S -> SA·
```

③GOTO函数

```
GOTO(I0, S) = I1    GOTO(I0, A) = I2    GOTO(I0, a) = I3
GOTO(I1, A) = I4    GOTO(I1, a) = I3    GOTO(I1, $) = acc
```

④语法分析表

FOLLOW(A) = FOLLOW(S) = {a, $}

| 状态 | ACTION | ACTION | GOTO | GOTO | | |
|---|---|---|---|---|---|---|
| | a | $ | S | A | a | $ |
| 0 | s2 | | 1 | 2 | 3 | |
| 1 | s3 | acc | | 4 | 3 | acc |
| 2 | r2 | r2 | | | | |
| 3 | r3 | r3 | | | | |
| 4 | r1 | r1 | | | | |

该文法是SLR(1)，因为语法分析表中没有重复的条目。

4.7.1

**练习4.7.1：** 为练习4.2.1的文法S→S S + | S S * | a构造

1）规范LR项集族。

2）LALR项集族。

答：

（1）

```
I0
S' -> ·S,$
S -> ·SS+,$/a
S -> ·SS*,$/a
S -> ·a,$/a

I1
S' -> S·,$
S -> S·S+,$/a
S -> S·S*,$/a
S -> ·SS+,+/*/a
S -> ·SS*,+/*/a
S -> ·a,+/*/a

I2
S -> a·,$/a

I3
S -> SS·+,$/a
S -> SS·*,$/a
S -> S·S+,+/*/a
S -> S·S*,+/*/a
S -> ·SS+,+/*/a
S -> ·SS*,+/*/a
S -> ·a,+/*/a

I4
S -> a·,+/*/a
```

```
I5
S -> SS+·,$/a

I6
S -> SS*·,$/a

I7
S -> SS·+,+/*/a
S -> SS·*,+/*/a
S -> S·S+,+/*/a
S -> S·S*,+/*/a
S -> ·SS+,+/*/a
S -> ·SS*,+/*/a
S -> ·a,+/*/a

I8
S -> SS+·,+/*/a

I9
S -> SS*·,+/*/a
```

(2)

```
I0
S' -> ·S,$
S -> ·SS+,$/a
S -> ·SS*,$/a
S -> ·a,$/a

I1
S' -> S·,$
S -> S·S+,$/a
S -> S·S*,$/a
S -> ·SS+,+/*/a
S -> ·SS*,+/*/a
S -> ·a,+/*/a

I24
S -> a·,$/a/+/*

I37
S -> SS·+,$/a/+/*
S -> SS·*,$/a/+/*
S -> S·S+,+/*/a
S -> S·S*,+/*/a
S -> ·SS+,+/*/a
S -> ·SS*,+/*/a
S -> ·a,+/*/a

I58
S -> SS+·,$/a/+/*

I69
S -> SS*·,$/a/+/*
```

4.7.5

！练习**4.7.5**：说明下面的文法

$S \rightarrow A\ a \mid b\ A\ c \mid B\ c \mid b\ B\ a$

$A \rightarrow d$

$B \rightarrow d$

是LR（1）的，但不是LALR（1）的。

答:

1、LR(1)

①增广文法

```
(0) S' -> S
(1) S -> Aa
(2) S -> bAc
(3) S -> Bc
(4) S -> bBa
(5) A -> d
(6) B -> d
```

②LR(1)项集族

```
I0
S' -> ·S,$
S -> ·Aa,$
S -> ·bAc,$
S -> ·Bc,$
S -> ·bBa,$
A -> ·d,a
B -> ·d,c

I1
S' -> S·,$

I2
S -> A·a,$

I3
S -> b·Ac,$
S -> b·Ba,$
A -> ·d,c
B -> ·d,a

I4
S -> B·c,$

I5
A -> d·,a
B -> d·,c

I6
S -> Aa·,$
```

```
I7
S -> bA·c,$

I8
S -> bB·a,$

I9
A -> d.,c
B -> d.,a

I10
S -> Bc·,$

I11
S -> bAc·,$

I12
S -> bBa·,$
```

③GOTO函数

```
GOTO(I0, S) = I1  GOTO(I0, A) = I2  GOTO(I0, b) = I3  GOTO(I0, B) = I4  GOTO(I0,
d) = I5
GOTO(I2, a) = I6
GOTO(I3, A) = I7  GOTO(I3, B) = I8  GOTO(I3, d) = I9
GOTO(I4, c) = I10
GOTO(I7, c) = I11
GOTO(I8, a) = I12
```

④语法分析表

| 状态 | ACTION | ACTION | ACTION | ACTION | ACTION | GOTO | GOTO | GOTO |
|---|---|---|---|---|---|---|---|---|
| | a | b | c | d | $ | S | A | B |
| 0 | | s3 | | s5 | | 1 | 2 | 4 |
| 1 | | | | | acc | | | |
| 2 | s6 | | | | | | | |
| 3 | | | | s9 | | | 7 | 8 |
| 4 | | | s10 | | | | | |
| 5 | r5 | | r6 | | | | | |
| 6 | | | | | r1 | | | |
| 7 | | | s11 | | | | | |
| 8 | s12 | | | | | | | |
| 9 | r6 | | r5 | | | | | |
| 10 | | | | | r3 | | | |
| 11 | | | | | r2 | | | |
| 12 | | | | | r4 | | | |

该文法是LR(1)文法，因为语法分析表中没有重复的条目。

2、LALR(1)

①合并同心集

```
I0
S' -> ·S,$
S -> ·Aa,$
S -> ·bAc,$
S -> ·Bc,$
S -> ·bBa,$
A -> ·d,a
B -> ·d,c

I1
S' -> S·,$

I2
S -> A·a,$

I3
S -> b·Ac,$
S -> b·Ba,$
A -> ·d,c
B -> ·d,a

I4
S -> B·c,$

I59
A -> d·,a/c
B -> d·,c/a

I6
S -> Aa·,$

I7
S -> bA·c,$

I8
S -> bB·a,$

I10
S -> Bc·,$

I11
S -> bAc·,$

I12
S -> bBa·,$
```

②GOTO函数

```
GOTO(I0, S) = I1  GOTO(I0, A) = I2  GOTO(I0, b) = I3  GOTO(I0, B) = I4  GOTO(I0,
d) = I59
GOTO(I2, a) = I6
GOTO(I3, A) = I7  GOTO(I3, B) = I8  GOTO(I3, d) = I59
GOTO(I4, c) = I10
GOTO(I7, c) = I11
GOTO(I8, a) = I12
```

③语法分析表

| 状态 | ACTION | ACTION | ACTION | ACTION | ACTION | GOTO | GOTO | GOTO |
|---|---|---|---|---|---|---|---|---|
| | a | b | c | d | $ | S | A | B |
| 0 | | s3 | | s59 | | 1 | 2 | 4 |
| 1 | | | | | acc | | | |
| 2 | s6 | | | | | | 7 | 8 |
| 3 | | | | s59 | | | | |
| 4 | | | s59 | | | | | |
| 59 | r5\|r6 | | r6\|r5 | r3 | | | | |
| 6 | | | | | r1 | | | |
| 7 | | | s10 | | | | | |
| 8 | s11 | | | | | | | |
| 10 | | | | r2 | | | | |
| 11 | | | | r4 | | | | |

该文法不是LALR(1)文法，因为语法分析表中有重复的条目。