

第二章

P36-6

(1)

$L(G_1)$ 是 0~9 组成的数字串

(2)

最左推导:

$$N \Rightarrow ND \Rightarrow NDD \Rightarrow NDDD \Rightarrow DDDD \Rightarrow 0DDD \Rightarrow 01DD \Rightarrow 012D \Rightarrow 0127$$

$$N \Rightarrow ND \Rightarrow DD \Rightarrow 3D \Rightarrow 34$$

$$N \Rightarrow ND \Rightarrow NDD \Rightarrow DDD \Rightarrow 5DD \Rightarrow 56D \Rightarrow 568$$

最右推导:

$$N \Rightarrow ND \Rightarrow N7 \Rightarrow ND7 \Rightarrow N27 \Rightarrow ND27 \Rightarrow N127 \Rightarrow D127 \Rightarrow 0127$$

$$N \Rightarrow ND \Rightarrow N4 \Rightarrow D4 \Rightarrow 34$$

$$N \Rightarrow ND \Rightarrow N8 \Rightarrow ND8 \Rightarrow N68 \Rightarrow D68 \Rightarrow 568$$

P36-7

$G(S)$

$$O \rightarrow 1|3|5|7|9$$

$$N \rightarrow 2|4|6|8|O$$

$$D \rightarrow 0|N$$

$$S \rightarrow O|AO$$

$$A \rightarrow AD|N$$

P36-8

文法:

$$E \rightarrow T|E+T|E-T$$

$$T \rightarrow F|T*F|T/F$$

$$F \rightarrow (E)|i$$

最左推导:

$$E \Rightarrow E+T \Rightarrow T+T \Rightarrow F+T \Rightarrow i+T \Rightarrow i+T*F \Rightarrow i+F*F \Rightarrow i+i*F \Rightarrow i+i*i$$

$$E \Rightarrow T \Rightarrow T*F \Rightarrow F*F \Rightarrow i*F \Rightarrow i*(E) \Rightarrow i*(E+T) \Rightarrow i*(T+T) \Rightarrow i*(F+T)$$

$$\Rightarrow i*(i+T) \Rightarrow i*(i+F) \Rightarrow i*(i+i)$$

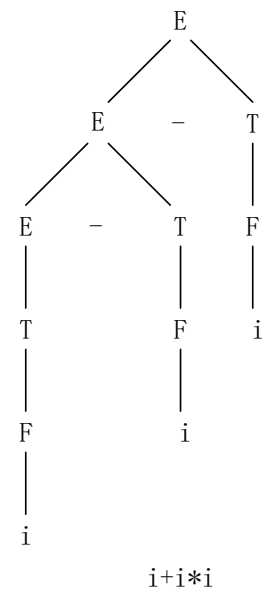
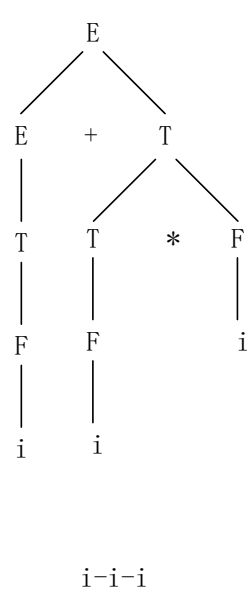
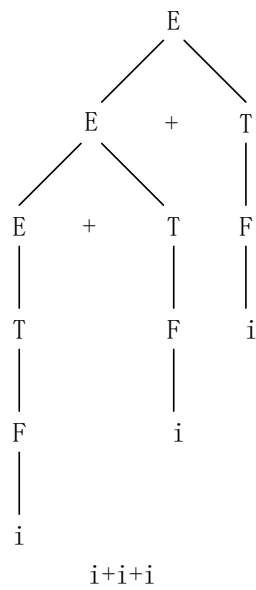
最右推导:

$$E \Rightarrow E+T \Rightarrow E+T*F \Rightarrow E+T*i \Rightarrow E+F*i \Rightarrow E+i*i \Rightarrow T+i*i \Rightarrow F+i*i \Rightarrow i+i*i$$

$$E \Rightarrow T \Rightarrow F*T \Rightarrow F*F \Rightarrow F*(E) \Rightarrow F*(E+T) \Rightarrow F*(E+F) \Rightarrow F*(E+i)$$

$$\Rightarrow F*(T+i) \Rightarrow F*(F+i) \Rightarrow F*(i+i) \Rightarrow i*(i+i)$$

语法树： /*****



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P36-9

句子 iiiei 有两个语法树：

$S \Rightarrow iSeS \Rightarrow iSei \Rightarrow iiSei \Rightarrow iiiei$
 $S \Rightarrow iS \Rightarrow iiSeS \Rightarrow iiSei \Rightarrow iiiei$

P36-10

/*****

$S \rightarrow TS \mid T$
 $T \rightarrow (S) \mid ()$

*****/

P36-11

/*****

L1:

$S \rightarrow AC$
 $A \rightarrow aAb \mid ab$
 $C \rightarrow cC \mid \varepsilon$

L2:

$S \rightarrow AB$
 $A \rightarrow aA \mid \varepsilon$
 $B \rightarrow bBc \mid bc$

L3:

$S \rightarrow AB$

$A \rightarrow aAb \mid \varepsilon$

$B \rightarrow aBb \mid \varepsilon$

L4:

$S \rightarrow A \mid B$

$A \rightarrow 0A1 \mid \varepsilon$

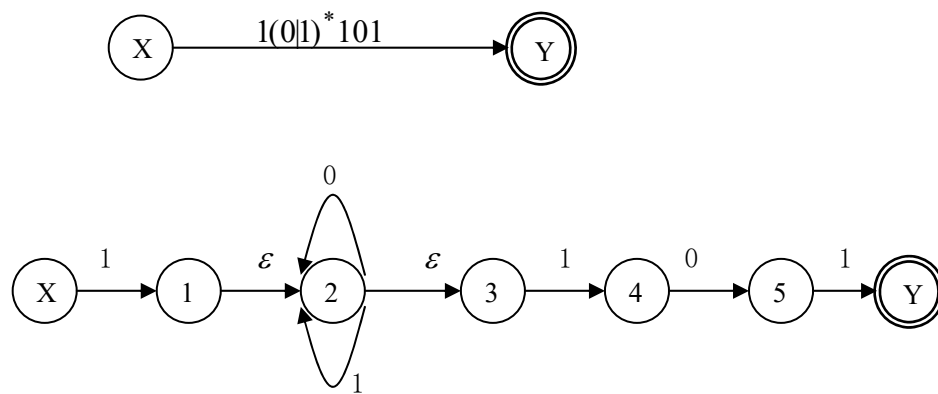
$B \rightarrow 1B0 \mid A$

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第三章

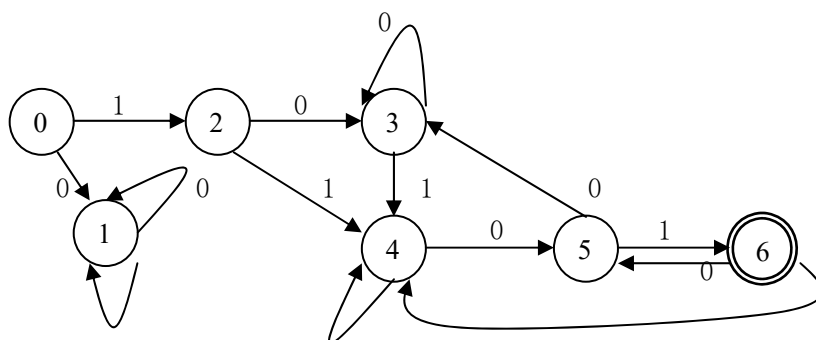
P64 - 7

(1)



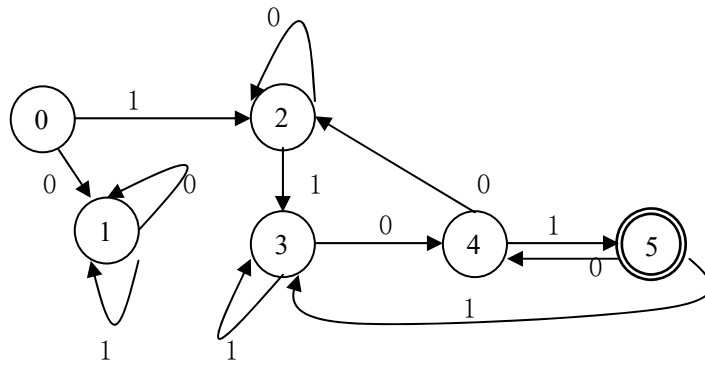
确定化:

	0	1
{X}	ϕ	{1, 2, 3}
ϕ	ϕ	ϕ
{1, 2, 3}	{2, 3}	{2, 3, 4}
{2, 3}	{2, 3}	{2, 3, 4}
{2, 3, 4}	{2, 3, 5}	{2, 3, 4}
{2, 3, 5}	{2, 3}	{2, 3, 4, Y}
{2, 3, 4, Y}	{2, 3, 5}	{2, 3, 4}



最小化:

$\{0,1,2,3,4,5\}, \{6\}$
 $\{0,1,2,3,4,5\}_0 = \{1,3,5\} \quad \{0,1,2,3,4,5\}_1 = \{1,2,4,6\}$
 $\{0,1,2,3,4\}, \{5\}, \{6\}$
 $\{0,1,2,3,4\}_0 = \{1,3,5\}$
 $\{0,1,2,3\}, \{4\}, \{5\}, \{6\}$
 $\{0,1,2,3\}_0 = \{1,3\} \quad \{0,1,2,3\}_1 = \{1,2,4\}$
 $\{0,1\}, \{2,3\}, \{4\}, \{5\}, \{6\}$
 $\{0,1\}_0 = \{1\} \quad \{0,1\}_1 = \{1,2\}$
 $\{2,3\}_0 = \{3\} \quad \{2,3\}_1 = \{4\}$
 $\{0\}, \{1\}, \{2,3\}, \{4\}, \{5\}, \{6\}$



P64 - 8

(1)

$(1|0)^*01$

(2)

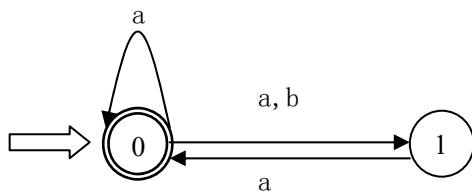
$(1|2|3|4|5|6|7|8|9)(0|1|2|3|4|5|6|7|8|9)^*(0|5)|(0|5)$

(3)

$0^*1(0|10^*1)^*|1^*0(0|10^*1)^*$

P64 - 12

(a)



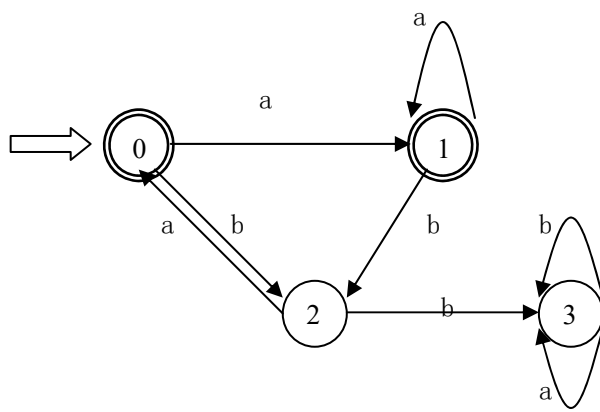
确定化:

	a	b
--	---	---

$\{0\}$	$\{0, 1\}$	$\{1\}$
$\{0, 1\}$	$\{0, 1\}$	$\{1\}$
$\{1\}$	$\{0\}$	Φ
Φ	Φ	Φ

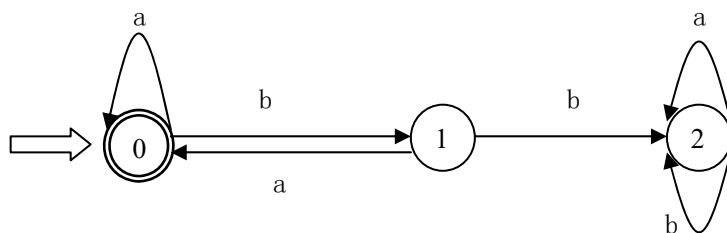
给状态编号：

	a	b
0	1	2
1	1	2
2	0	3
3	3	3

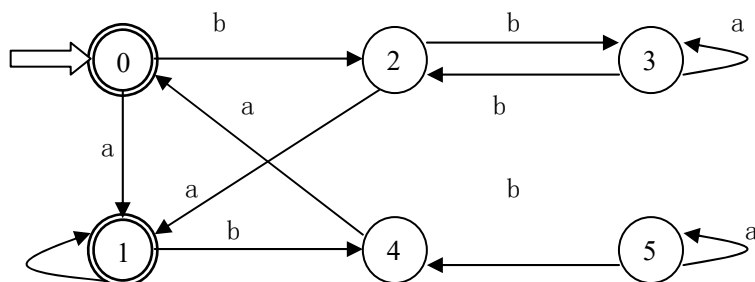


最小化：

$\{0,1\}, \{2,3\}$
 $\{0,1\}_a = \{1\} \quad \{0,1\}_b = \{2\}$
 $\{2,3\}_a = \{0,3\} \quad \{2,3\}_b = \{3\}$
 $\{0,1\}, \{2\}, \{3\}$



(b)





已经确定化了, 进行最小化

最小化:

$\{\{0,1\}, \{2,3,4,5\}\}$

$\{0,1\}_a = \{1\}$ $\{0,1\}_b = \{2,4\}$

$\{2,3,4,5\}_a = \{1,3,0,5\}$ $\{2,3,4,5\}_b = \{2,3,4,5\}$

$\{2,4\}_a = \{1,0\}$ $\{2,4\}_b = \{3,5\}$

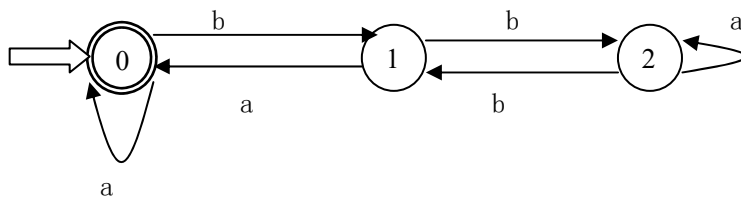
$\{3,5\}_a = \{3,5\}$ $\{3,5\}_b = \{2,4\}$

$\{\{0,1\}, \{2,4\}, \{3,5\}\}$

$\{0,1\}_a = \{1\}$ $\{0,1\}_b = \{2,4\}$

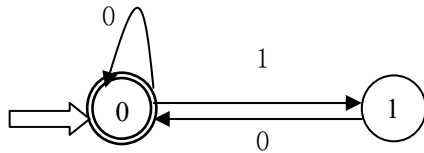
$\{2,4\}_a = \{1,0\}$ $\{2,4\}_b = \{3,5\}$

$\{3,5\}_a = \{3,5\}$ $\{3,5\}_b = \{2,4\}$

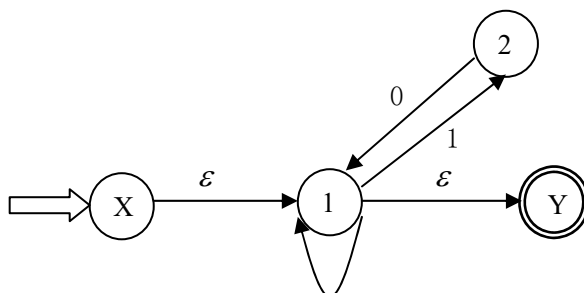
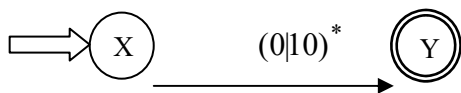


P64 - 14

(1)



(2) :



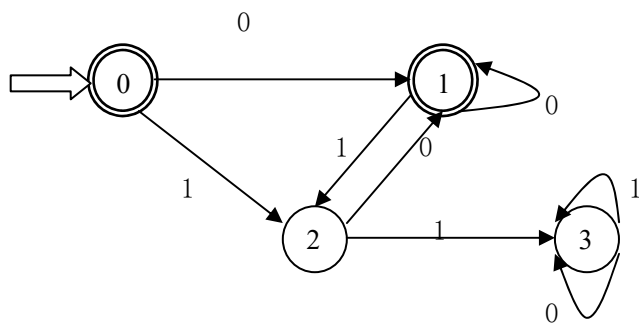
0

确定化:

	0	1
$\{X, 1, Y\}$	$\{1, Y\}$	$\{2\}$
$\{1, Y\}$	$\{1, Y\}$	$\{2\}$
$\{2\}$	$\{1, Y\}$	Φ
Φ	Φ	Φ

给状态编号:

	0	1
0	1	2
1	1	2
2	1	3
3	3	3



最小化:

$\{0, 1\}, \{2, 3\}$

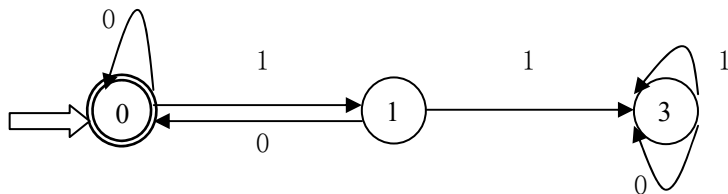
$\{0, 1\}_0 = \{1\}$

$\{0, 1\}_1 = \{2\}$

$\{2, 3\}_0 = \{1, 3\}$

$\{2, 3\}_1 = \{3\}$

$\{0, 1\}, \{2\}, \{3\}$



第四章

P81 - 1

(1) 按照 T, S 的顺序消除左递归

$G'(S)$

$S \rightarrow a \mid (T)$

$T \rightarrow ST'$

$T' \rightarrow ,ST' \mid \varepsilon$

递归子程序:

procedure S;

begin

 if sym='a' or sym='^'

 then advance

 else if sym='('

 then begin

 advance;T;

 if sym=')' then advance;

 else error;

 end

 else error

end;

procedure T;

begin

 S;T'

end;

procedure T';

begin

 if sym=','

 then begin

 advance;

 S;T'

 end

end;

其中:

sym: 是输入串指针 IP 所指的符号

advance: 是把 IP 调至下一个输入符号

error: 是出错诊察程序

(2)

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

$\text{FIRST}(T) = \{a, \wedge, (\}$

$\text{FIRST}(T') = \{, , \varepsilon\}$

$\text{FOLLOW}(S) = \{), , , \#\}$

$\text{FOLLOW}(T) = \{)\}$

$\text{FOLLOW}(T') = \{)\}$

预测分析表

	a	\wedge	()	,	#
S	$S \rightarrow a$	$S \rightarrow \wedge$	$S \rightarrow (T)$			
T	$T \rightarrow ST'$	$T \rightarrow ST'$	$T \rightarrow ST'$			
T'				$T' \rightarrow \varepsilon$	$T' \rightarrow ,ST'$	

是 LL(1) 文法

P81 - 2

文法:

$E \rightarrow TE'$

$E' \rightarrow +E \mid \varepsilon$

$T \rightarrow FT'$

$T' \rightarrow T \mid \varepsilon$

$F \rightarrow PF'$

$F' \rightarrow *F' \mid \varepsilon$

$P \rightarrow (E) \mid a \mid b \mid \wedge$

(1)

$\text{FIRST}(E) = \{ (, a, b, \wedge \}$

$\text{FIRST}(E') = \{ +, \varepsilon \}$

$\text{FIRST}(T) = \{ (, a, b, \wedge \}$

$\text{FIRST}(T') = \{ (, a, b, \wedge, \varepsilon \}$

$\text{FIRST}(F) = \{ (, a, b, \wedge \}$

$\text{FIRST}(F') = \{ *, \varepsilon \}$

$\text{FIRST}(P) = \{ (, a, b, \wedge \}$

$\text{FOLLOW}(E) = \{ \#,) \}$

$\text{FOLLOW}(E') = \{ \#,) \}$

$\text{FOLLOW}(T) = \{ +,), \# \}$

$\text{FOLLOW}(T') = \{ +,), \# \}$

$\text{FOLLOW}(F) = \{ (, a, b, \wedge, +,), \# \}$

$\text{FOLLOW}(F') = \{ (, a, b, \wedge, +,), \# \}$

$\text{FOLLOW}(P) = \{ *, (, a, b, \wedge, +,), \# \}$

(2)

考虑下列产生式:

$$E' \rightarrow +E | \varepsilon$$

$$T' \rightarrow T | \varepsilon$$

$$F' \rightarrow *F' | \varepsilon$$

$$P \rightarrow (E) | ^a | b$$

$$\text{FIRST}(+E) \cap \text{FIRST}(\varepsilon) = \{+\} \cap \{\varepsilon\} = \phi$$

$$\text{FIRST}(+E) \cap \text{FOLLOW}(E') = \{+\} \cap \{\#, \wedge\} = \phi$$

$$\text{FIRST}(T) \cap \text{FIRST}(\varepsilon) = \{(\wedge, a, b, \wedge\} \cap \{\varepsilon\} = \phi$$

$$\text{FIRST}(T) \cap \text{FOLLOW}(T') = \{(\wedge, a, b, \wedge\} \cap \{+, \wedge, \#\} = \phi$$

$$\text{FIRST}(*F') \cap \text{FIRST}(\varepsilon) = \{*\} \cap \{\varepsilon\} = \phi$$

$$\text{FIRST}(*F') \cap \text{FOLLOW}(F') = \{*\} \cap \{(\wedge, a, b, \wedge, +, \wedge, \#) = \phi$$

$$\text{FIRST}((E)) \cap \text{FIRST}(a) \cap \text{FIRST}(b) \cap \text{FIRST}(\wedge) = \phi$$

所以, 该文法为 LL(1) 文法.

(3)

	+	*	(	)	a	b	^	#
E			$E \rightarrow TE'$		$E \rightarrow TE'$	$E \rightarrow TE'$	$E \rightarrow TE'$	
E'	$E' \rightarrow +E$			$E' \rightarrow \varepsilon$				$E' \rightarrow \varepsilon$
T			$T \rightarrow FT'$		$T \rightarrow FT'$	$T \rightarrow FT'$	$T \rightarrow FT'$	
T'	$T' \rightarrow \varepsilon$		$T' \rightarrow T$	$T' \rightarrow \varepsilon$	$T' \rightarrow T$	$T' \rightarrow T$	$T' \rightarrow T$	$T' \rightarrow \varepsilon$
F			$F \rightarrow PF'$		$F \rightarrow PF'$	$F \rightarrow PF'$	$F \rightarrow PF'$	
F'	$F' \rightarrow \varepsilon$	$F' \rightarrow *F'$	$F' \rightarrow \varepsilon$	$F' \rightarrow \varepsilon$	$F' \rightarrow \varepsilon$	$F' \rightarrow \varepsilon$	$F' \rightarrow \varepsilon$	$F' \rightarrow \varepsilon$
P			$P \rightarrow (E)$		$P \rightarrow a$	$P \rightarrow b$	$P \rightarrow ^$	

(4)

procedure E;

begin

 if sym='(' or sym='a' or sym='b' or sym='^'

 then begin T; E' end

 else error

end

procedure E' ;

begin

 if sym='+'

 then begin advance; E end

 else if sym='>' and sym<>'#' then error

end

procedure T;

begin

```

        if sym='(' or sym='a' or sym='b' or sym='^'
            then begin F; T' end
            else error
end

procedure T' ;
begin
    if sym='(' or sym='a' or sym='b' or sym='^'
        then T
        else if sym='*' then error
end

procedure F;
begin
    if sym='(' or sym='a' or sym='b' or sym='^'
        then begin P; F' end
        else error
end

procedure F' ;
begin
    if sym='*'
        then begin advance; F' end
end

procedure P;
begin
    if sym='a' or sym='b' or sym='^'
        then advance
        else if sym='(' then
            begin
                advance; E;
                if sym=')' then advance
                else error
            end
        else error
end;

```

P81 - 3

/*****

- (1) 是，满足三个条件。
- (2) 不是，对于 A 不满足条件 3。
- (3) 不是，A、B 均不满足条件 3。

(4) 是，满足三个条件。

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第五章

P133 - 1

$$E \Rightarrow E + T \Rightarrow E + T * F$$

短语: $E+T*F$, $T*F$,

直接短语: $T*F$

句柄: $T*F$

P133 - 2

文法:

$$S \rightarrow a|^{\wedge}|(T)$$

$$T \rightarrow T,S|S$$

(1)

最左推导:

$$\begin{aligned} S &\Rightarrow (T) \Rightarrow (T,S) \Rightarrow (S,S) \Rightarrow (a,S) \Rightarrow (a,(T)) \Rightarrow (a,(T,S)) \Rightarrow (a,(S,S)) \Rightarrow (a,(a,S)) \Rightarrow (a,(a,a)) \\ S &\Rightarrow (T,S) \Rightarrow (S,S) \Rightarrow ((T),S) \Rightarrow ((T,S),S) \Rightarrow ((T,S,S),S) \Rightarrow ((S,S,S),S) \Rightarrow (((T),S,S),S) \\ &\Rightarrow (((T,S),S,S),S) \Rightarrow (((S,S),S,S),S) \Rightarrow (((a,S),S,S),S) \Rightarrow (((a,a),S,S),S) \\ &\Rightarrow (((a,a),^{\wedge},S),S) \Rightarrow (((a,a),^{\wedge},(T)),S) \Rightarrow (((a,a),^{\wedge},(S)),S) \Rightarrow (((a,a),^{\wedge},(a)),S) \\ &\Rightarrow (((a,a),^{\wedge},(a)),a) \end{aligned}$$

最右推导:

$$\begin{aligned} S &\Rightarrow (T) \Rightarrow (T,S) \Rightarrow (T,(T)) \Rightarrow (T,(T,S)) \Rightarrow (T,(T,a)) \Rightarrow (T,(S,a)) \Rightarrow (T,(a,a)) \\ &\Rightarrow (S,(a,a)) \Rightarrow (a,(a,a)) \\ S &\Rightarrow (T,S) \Rightarrow (T,a) \Rightarrow (S,a) \Rightarrow ((T),a) \Rightarrow ((T,S),a) \Rightarrow ((T,(T)),a) \Rightarrow ((T,(S)),a) \\ &\Rightarrow ((T,(a)),a) \Rightarrow ((T,S,(a)),a) \Rightarrow ((T,^{\wedge},(a)),a) \Rightarrow ((S,^{\wedge},(a)),a) \Rightarrow (((T),^{\wedge},(a)),a) \\ &\Rightarrow (((T,S),^{\wedge},(a)),a) \Rightarrow (((T,a),^{\wedge},(a)),a) \Rightarrow (((S,a),^{\wedge},(a)),a) \Rightarrow (((a,a),^{\wedge},(a)),a) \end{aligned}$$

(2)

$$\begin{aligned} &(((\underline{a}), a), ^{\wedge}, (a)), a) \\ &(((\underline{S}), a), ^{\wedge}, (a)), a) \\ &(((T, \underline{a}), ^{\wedge}, (a)), a) \\ &(((\underline{T}, \underline{S}), ^{\wedge}, (a)), a) \\ &(((\underline{T}), ^{\wedge}, (a)), a) \\ &((\underline{S}), ^{\wedge}, (a)), a) \\ &((T, ^{\wedge}, (a)), a) \\ &((\underline{T}, \underline{S}), (a)), a) \\ &((T, (\underline{a})), a) \\ &((T, (\underline{S})), a) \\ &((T, (\underline{T})), a) \\ &((\underline{T}, \underline{S}), a) \end{aligned}$$

((T), a)

(S, a)

(T, S)

(T)

S

“移进-归约”过程:

步骤	栈	输入串	动作
0	#	((<u>a</u> , a), ^, (a)), a)#	预备
1	#(	((<u>a</u> , a), ^, (a)), a)#	进
2	#((	(<u>a</u> , a), ^, (a)), a)#	进
3	#(((	<u>a</u> , a), ^, (a)), a)#	进
4	#(((a	, a), ^, (a)), a)#	进
5	#(((S	, a), ^, (a)), a)#	归
6	#(((T	, a), ^, (a)), a)#	归
7	#(((T,	a), ^, (a)), a)#	进
8	#(((T, a	), ^, (a)), a)#	进
9	#(((T, S	), ^, (a)), a)#	归
10	#(((T	), ^, (a)), a)#	归
11	#(((T)	, ^, (a)), a)#	进
12	#((S	, ^, (a)), a)#	归
13	#((T	, ^, (a)), a)#	归
14	#((T,	^, (a)), a)#	进
15	#((T, ^	, (a)), a)#	进
16	#((T, S	, (a)), a)#	归
17	#((T	, (a)), a)#	归
18	#((T,	(a)), a)#	进
19	#((T, (	a)), a)#	进
20	#((T, (a	)), a)#	进
21	#((T, (S	)), a)#	归
22	#((T, (T	)), a)#	归
23	#((T, (T)	), a)#	进
24	#((T, S	), a)#	归
25	#((T	), a)#	归
26	#((T)	, a)#	进
27	#(S	, a)#	归
28	#(T	, a)#	归
29	#(T,	a)#	进
30	#(T, a	)#	进
31	#(T, S	)#	归
32	#(T	)#	归
33	#(T)	#	进
34	#S	#	归

P133 - 3

(1)

$FIRSTVT(S) = \{a, ^, (\}$
 $FIRSTVT(T) = \{, , a, ^, (\}$
 $LASTVT(S) = \{a, ^,)\}$
 $LASTVT(T) = \{, , a, ^,)\}$

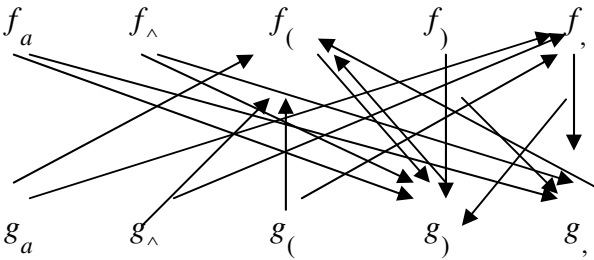
(2)

	a	^	()	,
a				>	>
^				>	>
(<	<	<	=	<
)				>	>
,	<	<	<	>	>

G_6 是算符文法，并且是算符优先文法

(3) 优先函数

	a	^	()	,
f	4	4	2	4	4
g	5	5	5	2	3



(4)

栈	输入字符串	动作
#	(a, (a, a)) #	预备
#(	a, (a, a)) #	进
#(a	, (a, a)) #	进
#(s	, (a, a)) #	归
#(t	, (a, a)) #	归
#(t,	(a, a)) #	进
#(t, (	a, a)) #	进
#(t, (a	, a)) #	进

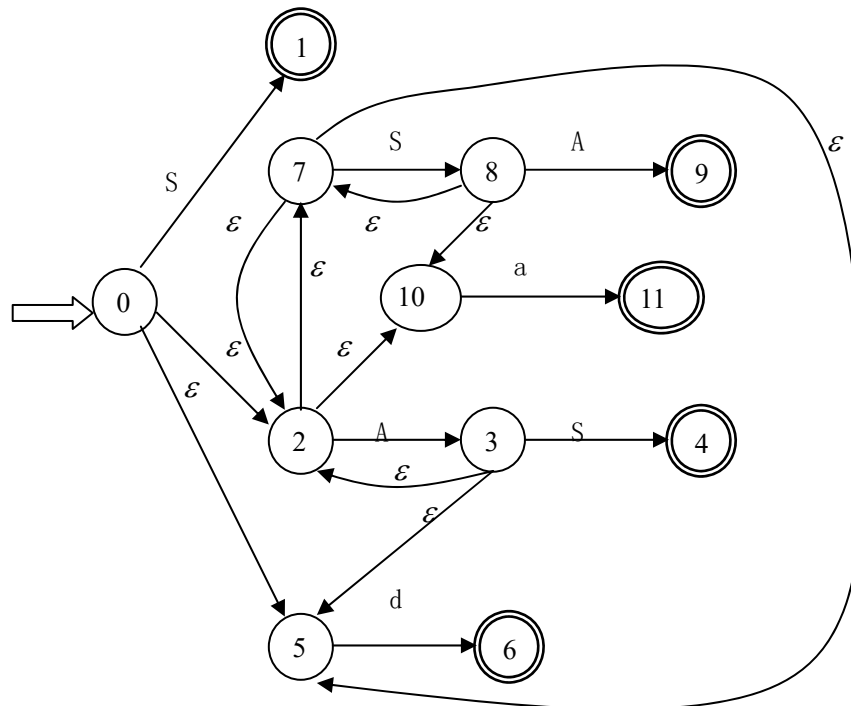
# (t, (s	, a)) #	归
# (t, (t	, a)) #	归
# (t, (t,	a)) #	进
# (t, (t, a	) #	进
# (t, (t, s	) #	归
# (t, (t	) #	归
# (t, (t)	) #	进
# (t, s	) #	归
# (t	) #	归
# (t)	#	进
# s	#	归
success		

P134 - 5

(1)

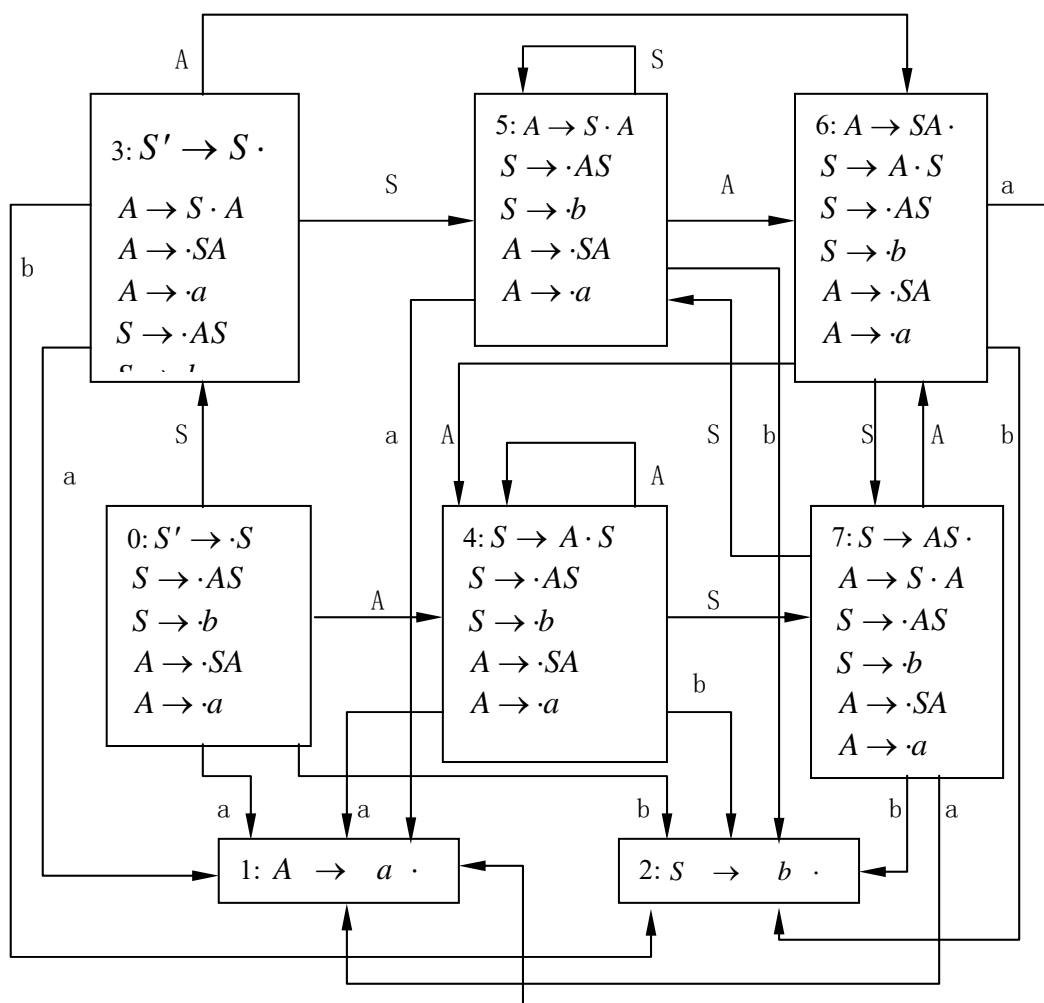
- | | | | |
|------------------------------|-----------------------------|-----------------------------|------------------------------|
| 0. $S' \rightarrow \cdot S$ | 1. $S' \rightarrow S \cdot$ | 2. $S \rightarrow \cdot AS$ | 3. $S \rightarrow A \cdot S$ |
| 4. $S \rightarrow AS \cdot$ | 5. $S \rightarrow \cdot b$ | 6. $S \rightarrow b \cdot$ | 7. $A \rightarrow \cdot SA$ |
| 8. $A \rightarrow S \cdot A$ | 9. $A \rightarrow SA \cdot$ | 10. $A \rightarrow \cdot a$ | 11. $A \rightarrow a \cdot$ |

(2)



确定化:

	S	A	a	b
{0, 2, 5, 7, 10}	{1, 2, 5, 7, 8, 10}	{2, 3, 5, 7, 10}	{11}	{6}
{1, 2, 5, 7, 8, 10}	{2, 5, 7, 8, 10}	{2, 3, 5, 7, 9, 10}	{11}	{6}
{2, 3, 5, 7, 10}	{2, 4, 5, 7, 8, 10}	{2, 3, 5, 7, 10}	{11}	{6}
{2, 5, 7, 8, 10}	{2, 5, 7, 8, 10}	{2, 3, 5, 7, 9, 10}	{11}	{6}
{2, 3, 5, 7, 9, 10}	{2, 4, 5, 7, 8, 10}	{2, 3, 5, 7, 10}	{11}	{6}
{2, 4, 5, 7, 8, 10}	{2, 5, 7, 8, 10}	{2, 3, 5, 7, 9, 10}	{11}	{6}
{11}	ϕ	ϕ	ϕ	ϕ
{6}	ϕ	ϕ	ϕ	ϕ



DFA

构造 LR(0) 项目集规范族也可以用 GO 函数来计算得到。所得到的项目集规范族与上图中的项目集一样：

$$I_0 = \{ S' \rightarrow \cdot S, S \rightarrow \cdot AS, S \rightarrow \cdot b, A \rightarrow \cdot SA, A \rightarrow \cdot a \}$$

$$GO(I_0, a) = \{ A \rightarrow a \cdot \} = I_1$$

$$GO(I_0, b) = \{ S \rightarrow b \cdot \} = I_2$$

$$GO(I_0, S) = \{ S' \rightarrow S \cdot, A \rightarrow S \cdot A, A \rightarrow \cdot SA, A \rightarrow \cdot a, S \rightarrow \cdot AS, S \rightarrow \cdot b \} = I_3$$

$$GO(I_0, A) = \{ S \rightarrow A \cdot S, S \rightarrow \cdot AS, S \rightarrow \cdot b, A \rightarrow \cdot SA, A \rightarrow \cdot a \} = I_4$$

$$GO(I_3, a) = \{ A \rightarrow a \cdot \} = I_1$$

$$GO(I_3, b) = \{ S \rightarrow b \cdot \} = I_2$$

$$GO(I_3, S) = \{ A \rightarrow S \cdot A, S \rightarrow \cdot AS, S \rightarrow \cdot b, A \rightarrow \cdot SA, A \rightarrow \cdot a \} = I_5$$

$$GO(I_3, A) = \{ A \rightarrow SA \cdot, S \rightarrow A \cdot S, S \rightarrow \cdot AS, S \rightarrow \cdot b, A \rightarrow \cdot SA, A \rightarrow \cdot a \} = I_6$$

$$GO(I_4, a) = \{ A \rightarrow a \cdot \} = I_1$$

$$GO(I_4, b) = \{ S \rightarrow b \cdot \} = I_2$$

$$GO(I_4, S) = \{ S \rightarrow AS \cdot, A \rightarrow S \cdot A, S \rightarrow \cdot AS, S \rightarrow \cdot b, A \rightarrow \cdot SA, A \rightarrow \cdot a \} = I_7$$

$$G0(I_4, A) = \{ S \rightarrow A \cdot S, S \rightarrow \cdot AS, S \rightarrow \cdot b, A \rightarrow \cdot SA, A \rightarrow \cdot a \} = I_4$$

$$G0(I_5, a) = \{ A \rightarrow a \cdot \} = I_1$$

$$G0(I_5, b) = \{ S \rightarrow b \cdot \} = I_2$$

$$G0(I_5, S) = \{ A \rightarrow S \cdot A, S \rightarrow \cdot AS, S \rightarrow \cdot b, A \rightarrow \cdot SA, A \rightarrow \cdot a \} = I_5$$

$$G0(I_5, A) = \{ A \rightarrow SA \cdot, S \rightarrow A \cdot S, S \rightarrow \cdot AS, S \rightarrow \cdot b, A \rightarrow \cdot SA, A \rightarrow \cdot a \} = I_6$$

$$G0(I_6, a) = \{ A \rightarrow a \cdot \} = I_1$$

$$G0(I_6, b) = \{ S \rightarrow b \cdot \} = I_2$$

$$G0(I_6, S) = \{ S \rightarrow AS \cdot, A \rightarrow S \cdot A, S \rightarrow \cdot AS, S \rightarrow \cdot b, A \rightarrow \cdot SA, A \rightarrow \cdot a \} = I_7$$

$$G0(I_6, A) = \{ S \rightarrow A \cdot S, S \rightarrow \cdot AS, S \rightarrow \cdot b, A \rightarrow \cdot SA, A \rightarrow \cdot a \} = I_4$$

$$G0(I_7, a) = \{ A \rightarrow a \cdot \} = I_1$$

$$G0(I_7, b) = \{ S \rightarrow b \cdot \} = I_2$$

$$G0(I_7, S) = \{ A \rightarrow S \cdot A, S \rightarrow \cdot AS, S \rightarrow \cdot b, A \rightarrow \cdot SA, A \rightarrow \cdot a \} = I_5$$

$$G0(I_7, A) = \{ A \rightarrow SA \cdot, S \rightarrow A \cdot S, S \rightarrow \cdot AS, S \rightarrow \cdot b, A \rightarrow \cdot SA, A \rightarrow \cdot a \} = I_6$$

项目集规范族为 $C = \{ I_1, I_2, I_3, I_4, I_5, I_6, I_7 \}$

(3) 不是 SLR 文法

状态 3, 6, 7 有移进归约冲突

状态 3: FOLLOW(S') = {#} 不包含 a, b

状态 6: FOLLOW(S) = {#, a, b} 包含 a, b, ; 移进归约冲突无法消解

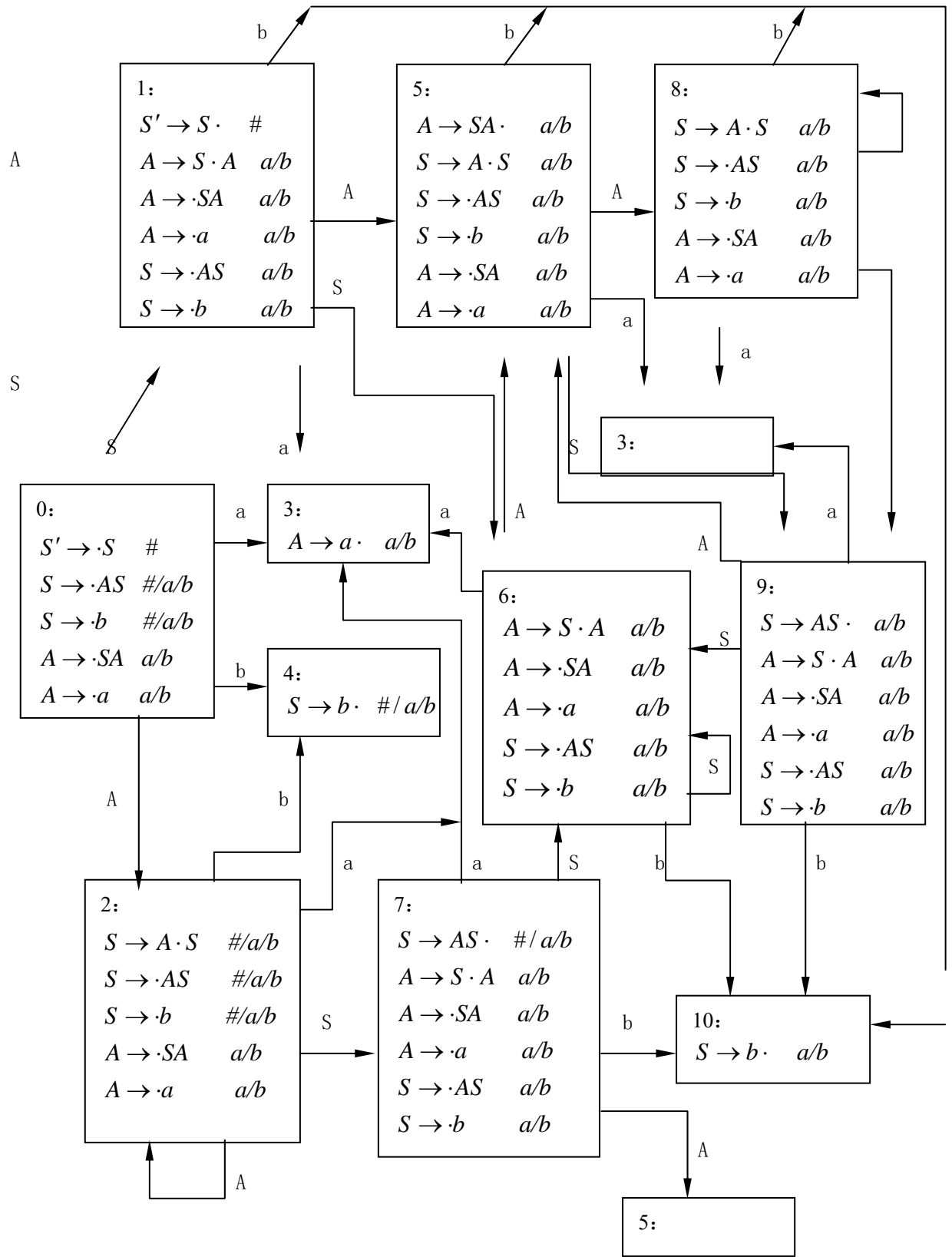
状态 7: FOLLOW(A) = {a, b} 包含 a, b; 移进归约冲突消解

所以不是 SLR 文法。

(4) 构造例如 LR(1) 项目集规范族

见下图:

对于状态 5, 因为包含项目 $[A \rightarrow AS \cdot \quad a/b]$, 所以遇到搜索符号 a 或 b 时, 应该用 $A \rightarrow AS$ 归约。又因为状态 5 包含项目 $[A \rightarrow \cdot a \quad a/b]$, 所以遇到搜索符号 a 时, 应该移进。因此存在“移进-归约”矛盾, 所以这个文法不是 LR(1) 文法。



P135 - 8

答:

因为 $\text{FIRST}(AaAb) = \{a\}, \text{FIRST}(BbBa) = \{b\}$

$\text{FIRST}(AaAb) \cap \text{FIRST}(BbBa) = \emptyset$

所以该文法是 LL(1) 的。

求该文法的 LR(0) 项目集规范族如下:

$I_0 = \{ S \rightarrow \cdot AaAb, S \rightarrow \cdot BbBa, A \rightarrow \cdot, B \rightarrow \cdot \}$

$I_1 = \{ S \rightarrow A \cdot aAb \}$

$I_2 = \{ S \rightarrow B \cdot bBa \}$

$I_3 = \{ S \rightarrow Aa \cdot Ab, A \rightarrow \cdot \}$

$I_4 = \{ S \rightarrow Bb \cdot Ba, B \rightarrow \cdot \}$

$I_5 = \{ S \rightarrow AaA \cdot b \}$

$I_6 = \{ S \rightarrow BbB \cdot a \}$

$I_7 = \{ S \rightarrow AaAb \cdot \}$

$I_8 = \{ S \rightarrow BbBa \cdot \}$

考虑 I_0 :

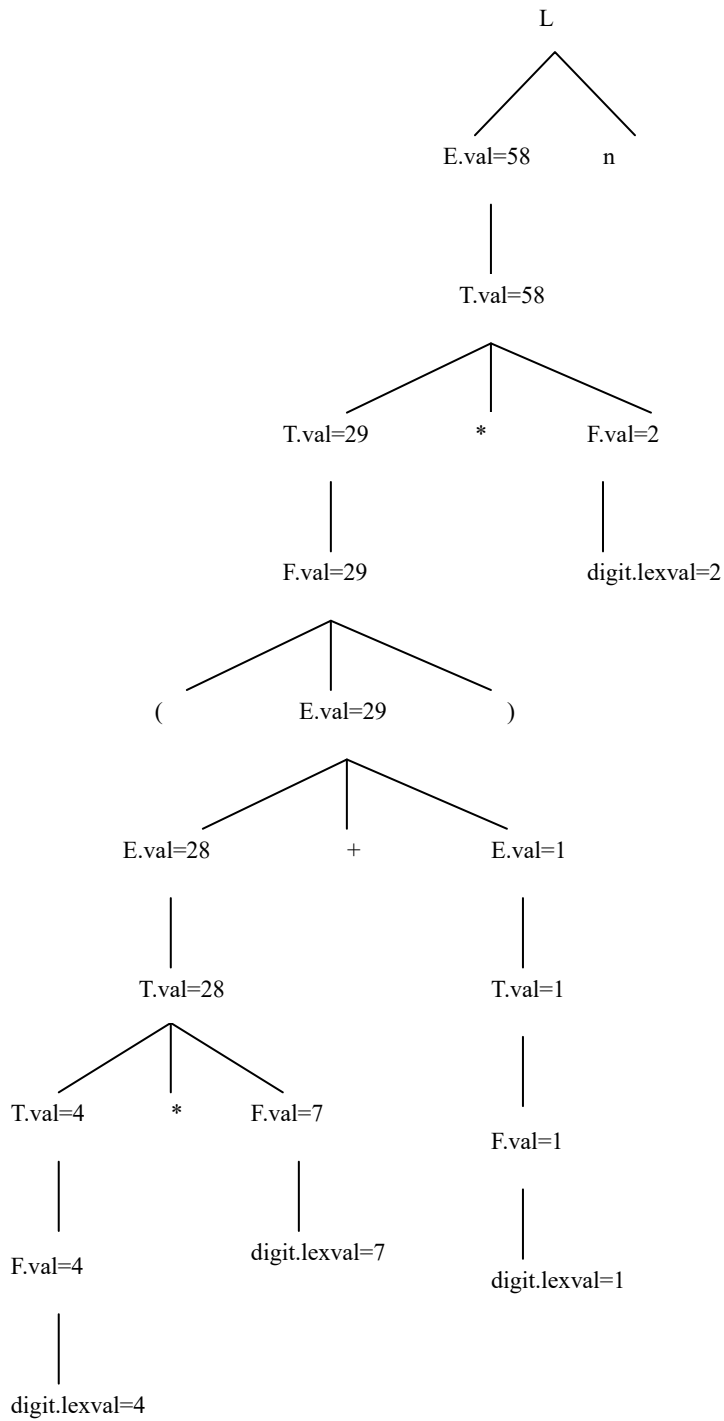
$\text{FOLLOW}(A) = \text{FOLLOW}(B) = \{a, b\}$

$A \rightarrow \cdot$ 和 $B \rightarrow \cdot$ 的冲突无法消解, 所以该文法不是 SLR(1) 的。

第六章

P164 - 1

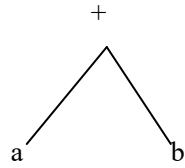
答：表达式 $(4*7+1)*2$ 的附注语法树如下图：



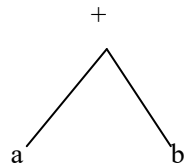
P164 - 2

答:

(1)



(2)



P164 - 5

(1)

```

E → E1 + T {if (E1.type = int) and (T.type = int )
               then E.type := int
               else E.type := real}
  
```

```

E → T {E.type := T.type}
  
```

```

T → num.num {T.type := real}
  
```

```

T → num {T.type := int}
  
```

(2)

```

E → E1 + T {if (E1.type = int) and (T.type = int )
               then begin
                   E.type := int
                   E.code := E1.code || T.code || +
               end
               else if (E1.type = real) and (T.type = real)
               then begin
                   E.type := real;
                   E.code := E1.code || T.code || +
               end
               End
               Else if (E1.type = int)
               then begin
                   E.type := real;
                   E.code := E1.code || intto real || T.code || +
               end
               End
               Else begin
  
```

```

        E.type := real;
        E.code:=E1.code || T.code || inttoreal || +
    end
}
E→T      {E.type := T.type;
           E.code:= T.code
          }
T→num.num {T.type := real
           E.code:= num.num
          }
T→num     {T.type := int
           E.code:= num
          }

```

P164 - 7

```

S→L1|L2  {S.val:=L1.val+(L2.val/2L2.length)}
S→L       {S.val:=L.val}
L→L1B     {L.val:=2*L1.val + B.val;
           L.length:=L1.length+1}
L→B       {L.val:=B.c;
           L.length :=1}
B→0       {B.c:=0}
B→1       {B.c:=1}

```

P165 - 11

答：(1)

```

D→id L      {D.type:= L.type; addtype(id.type,L.type)}
L→, id L1   {L.type:= L1.type; addtype(id.type,L1.type)}
L→ : T      {L.type:= T.type}
T→integer   { T.type := integer}
T→ real     { T.type := real}

```

(2) 假设 Ttype 为已定义的表示“类型”的数据结构，预测翻译器如下：

```

procedure D;
  var l_type:Ttype
begin
  if sym=“id” then
    begin
      advance;

```

```

        l_type:=L;
        addtype(id.entry, l_type)
    end
    else error
end;
procedure L;
    var l_type:Ttype;
begin
    if sym= “,” then
        begin
            advance;
            if sym= “id” then
                begin
                    advance;
                    l_type:=L;
                    addtype(id.entry, l_type)
                end
            else error;
        end
    else if sym= “:” then
        begin
            advance;
            l_type:=T;
        end
    else error;
    return(l_type);
end;
procedure T;
    var t_type:Ttype
begin
    if sym= “integer” then
        begin
            advance;
            t_type:=integer;
        end
    else if sym= “real” then
        begin
            advance;
            t_type:=real;
        end
    else error;
    return(t_type);
end;

```


第七章

P217 - 1

$a*(-b+c)$

$a+b*(c+d/e)$

$-a+b*(-c+d)$

A (C or not D)

(A and B) or (not C or D)

(A or B) and (C or not D and E)

if $(x+y)*z=0$ then $(a+b) \uparrow c$

$ab@c+*$

abcde/+*+

$a@bc@d+*+$

A not C D not or not or

A B and C not D or or

A B or C D not E and or and

else $a \uparrow b \uparrow c$

$xy+z*0= ab+c \uparrow abc \uparrow \uparrow \forall$

或 $xy+z*0= P1 \text{ jez } ab+c \uparrow P2 \text{ jump } abc \uparrow \uparrow$



P217 - 3

$-(a+b)*(c+d)-(a+b+c)$ 的

三元式序列:

- (1) +, a, b
- (2) @, (1), -
- (3) +, c, d
- (4) *, (2), (3)
- (5) +, a, b
- (6) +, (5), c
- (7) -, (4), (6)

间接三元式序列:

三元式表:

- (1) +, a, b
- (2) @, (1), -
- (3) +, c, d
- (4) *, (2), (3)
- (5) +, (1), c
- (6) -, (4), (5)

间接码表:

- (1)
- (2)
- (3)
- (4)
- (1)

(5)

(6)

四元式序列:

(1) +, a, b, T_1

(2) @, T_1 , -, T_2

(3) +, c, d, T_3

(4) *, T_2 , T_3 , T_4

(5) +, a, b, T_5

(6) +, T_5 , c, T_6

(7) -, T_4 , T_6 , T_7

P218 - 4

自下而上分析过程中把赋值句翻译成四元式的步骤: $A := B * (-C + D)$

步骤	输入串	栈	PLACE	四元式
(1)	$A := B * (-C + D)$			
(2)	$:= B * (-C + D)$	i	A	
(3)	$B * (-C + D)$	i :=	A-	
(4)	$* (-C + D)$	i := i	A-B	
(5)	$* (-C + D)$	i := E	A-B	
(6)	$* (-C + D)$	i := E	A-B	
(7)	$(-C + D)$	i := E*	A-B-	
(8)	$-C + D)$	i := E*(	A-B--	
(9)	$C + D)$	i := E*(-	A-B---	
(10)	$+D)$	i := E*(-i	A-B---C	
(11)	$+D)$	i := E*(-E	A-B---C	(@, C, -, T_1)
(12)	$+D)$	i := E*(E	A-B-- T_1	
(13)	$D)$	i := E*(E+	A-B-- T_1 -	
(14)	$)$	i := E*(E+I	A-B-- T_1 -D	
(15)	$)$	i := E*(E+E	A-B-- T_1 -D	(+, T_1 , D, T_2)
(16)	$)$	i := E(E	A-B-- T_2	
(17)		i := E*(E)	A-B-- T_2 -	
(18)		i := E+E	A-B- T_2	(*, B, T_2 , T_3)
(19)		i := E	A- T_3	(:=, T_3 , -, A)
(20)		A		

产生的四元式:

(@, C, -, T_1)

(+, T_1 , D, T_2)

(*, B, T_2 , T_3)

(:=, T_3 , -, A)

P218 - 5

答：不妨设 A : 10×20 , B、C、D: 20 , 宽度为 “w” 则

$T1 := i * 20$

$T1 := T1 + j$

$T2 := A - C1$

$T3 := w * T1$

$T4 := i + j$

$T5 := B - C2$

$T6 := w * T4$

$T7 := T5[T6]$

$T8 := i * 20$

$T8 := T8 + j$

$T9 := A - C1$

$T10 := w * T8$

$T11 := T9[T10]$

$T12 := i + j$

$T13 := D - C4$

$T14 := w * T12$

$T15 := T13[T14]$

$T16 := T11 + T15$

$T17 := C - C3$

$T18 := w * T16$

$T19 := T17[T18]$

$T20 := T7 + T19$

$T2[T3] := T20$

其中 $C1 = 21 * w$; $C2 = C3 = C4 = w$ 。

P218 - 6

100. (jnz, A, -, 0)

101. (j, -, -, 102)

102. (jnz, B, -, 104)

103. (j, -, -, 0)

104. (jnz, C, -, 103)

105. (j, -, -, 106)

106. (jnz, D, -, 104) --假链链首

107. (j, -, -, 100) --真链链首

P218 - 7

100. (j<, A, C, 102)

101. (j, -, -, 0)
102. (j<, B, D, 104)
103. (j, -, -, 101)
104. (j=, A, '1' , 106)
105. (j, -, -, 109)
106. (+, C, '1' , T1)
107. (:=, T1, -, C)
108. (j, -, -, 100)
109. (j≤, A, D, 111)
110. (j, -, -, 100)
111. (+, A, '2' , T2)
112. (:=, T2, -, A)
113. (j, -, -, 109)
114. (j, -, - 100)

P219 - 12

/*****

(1)

MAXINT - 5

MAXINT - 4

MAXINT - 3

MAXINT - 2

MAXINT - 1

MAXINT

(2) $S \rightarrow$ for id:=E₁ to E₂ do S₁

改造成:

$S \rightarrow F S_1$

$F \rightarrow$ for id:=E₁ to E₂ do

翻译模式:

$S \rightarrow F S_1$

{

backpatch(S₁.nextlist, nextquad)

p:=nextquad+2;

emit('j≠,' F.place', ' F.final ', ' p);

S.nextlist := merge(F.nextlist, makelist(nextquad));

emit('j, -, -, -');

emit('succ, ' F.place ', - , ' F.place);

emit('j, -, -, ' F.quad);

}

$F \rightarrow$ for id:=E₁ to E₂ do

{

```

INITIAL=NEWTEMP;
emit(':=, 'E1.PLACE', -, 'INITIAL);
FINAL=NEWTEMP;
emit(':=, 'E2.PLACE', -, 'FINAL);
p:= nextquad+2;
emit('j≤,' INITIAL ', ' FINAL ', p);
F.nextlist:=makelist(nextquad);
emit('j,—,—,—');

F.place:=lookup(id.name);
if F.place≠nil then
emit(F.place ':= ' INITIAL)

F.quad:=nextquad;
F.final:=FINAL;
}

```

第九章

P270 - 9

- (1) 9
- (2) 8
- (3) 7
- (4) 2

第十章

P 306-1:

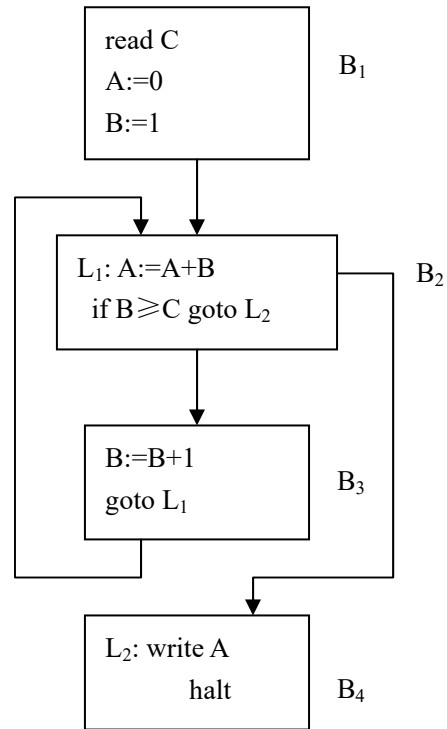
read C	
A:=0	B ₁
B:=1	

L ₁ : A:=A+B	
if B ≥ C goto L ₂	B ₂

B:=B+1	
goto L ₁	B ₃

L ₂ : write A	
halt	B ₄

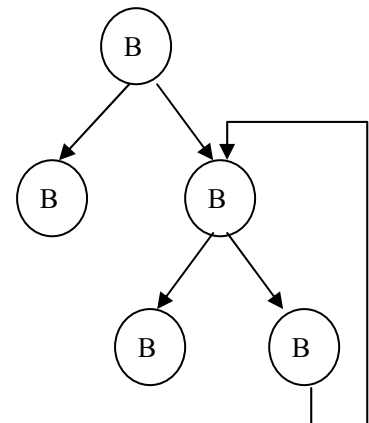
基本块为 B₁ 、 B₂ 、 B₃ 、 B₄
程序流图如右：



P 306-2:

read A,B	
F:=1	
C:=A*A	B ₁
D:=B*B	
if C<D goto L ₁	

E:=A*A	
F:=F+1	
E:=E+F	B ₂
write E	
halt	



```

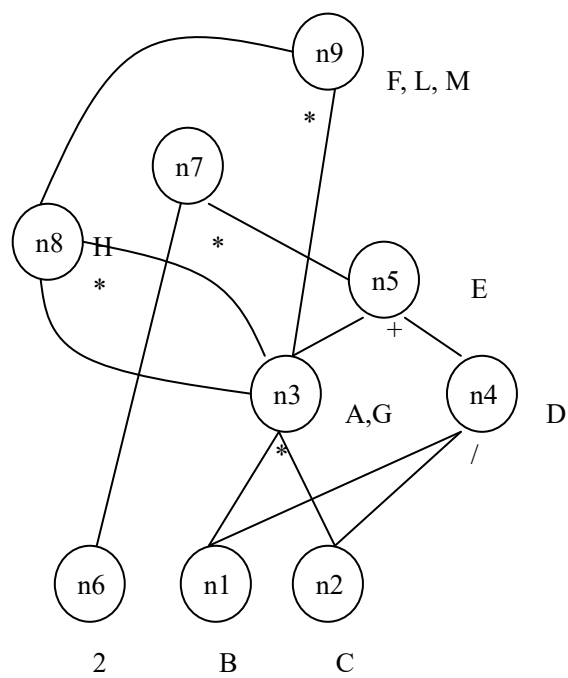
-----
L1:  E:=B*B
      F:=F+2
      E:=E+F          B3
      write E
      if E>100 goto L2
-----
      halt          B4
-----
L2:  F:=F-1
      goto L1      B5
-----

```

基本块为 B₁、B₂、B₃、B₄、B₅
 程序流图如右：

P306-3

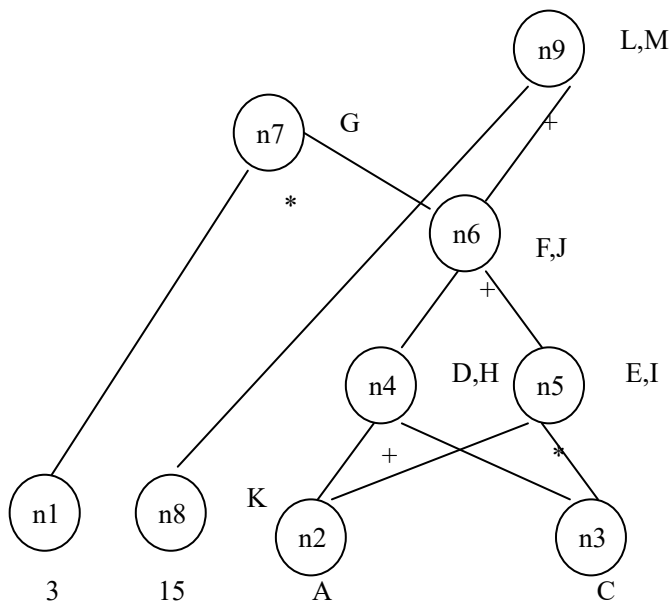
(1)
 B1:



若只有 G,L,M 在基本块后面还要被引用, 优化后的四元式序列是:
 $G := B * C$
 $S1 := G * G$
 $L := S1 * G$
 $M := L$
 (S1 为临时变量)

若只有 L 在基本块后面还要被引用, 优化后的四元式序列是:
 $S1 := B * C$
 $S2 := S1 * S1$
 $L := S2 * S1$
 (S1, S2 为临时变量)

B2:



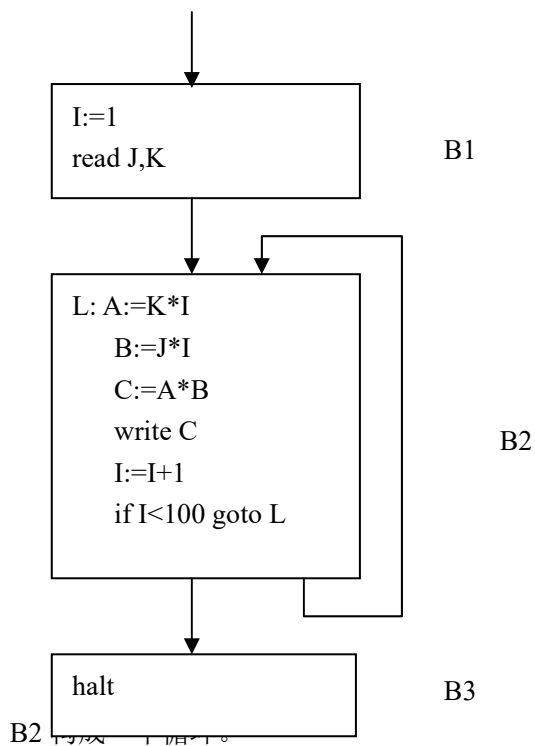
若只有 G,L,M 在基本块后面还要被引用, 优化后的四元式序列是:

$S1:=A+C$
 $S2:=A*C$
 $S3:=S1+S2$
 $G:=3*S3$
 $L:=15+S3$
 $M:=L$
 (S1,S2,S3 为临时变量)

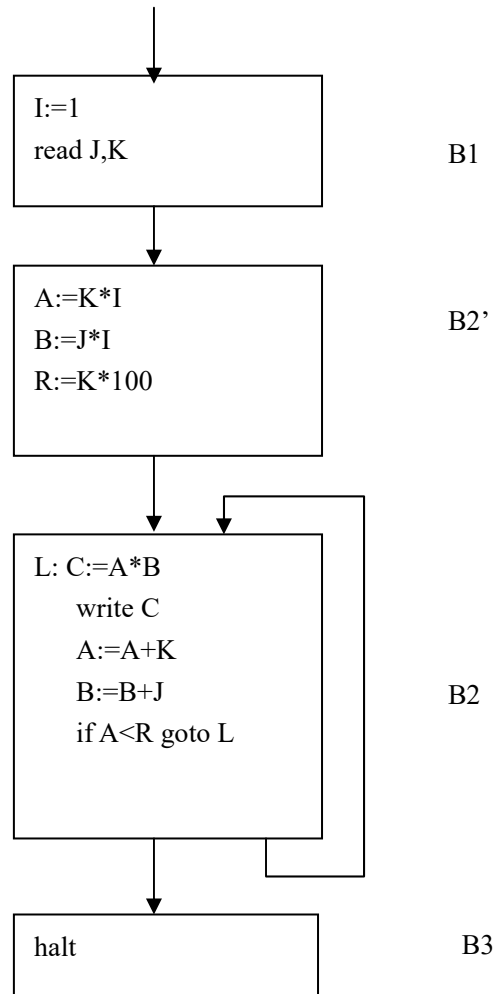
若只有 L 在基本块后面还要被引用, 优化后的四元式序列是:

$S1:=A+C$
 $S2:=A*C$
 $S3:=S1+S2$
 $L:=15+S3$
 (S1,S2,S3 为临时变量)

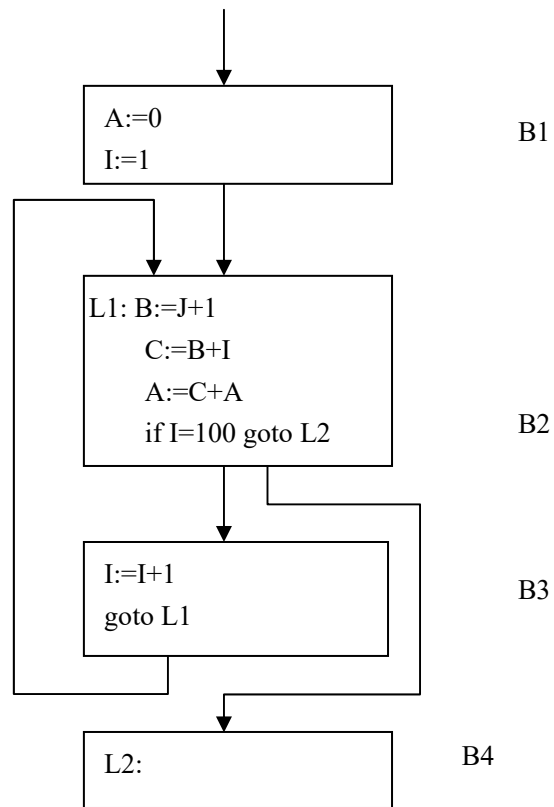
P307-4



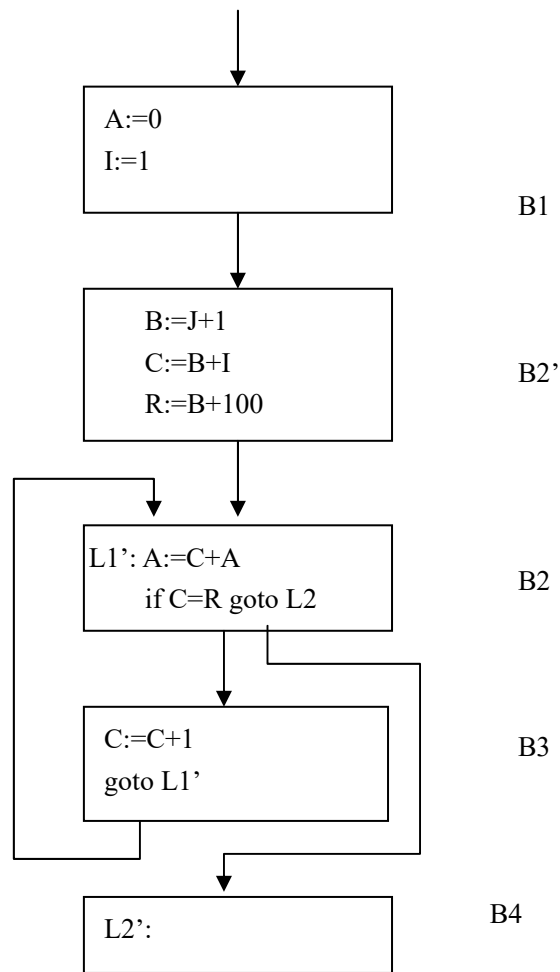
进行循环优化后，得到：



P307-5



B2 和 B3 构成循环，进行循环优化后，得到：



第十一章

P 327-1:

四元式	目标代码	RVALUE	AVALUE
T1:=B-C	LD R_0, B	RVALUE(R_0)={T1}	AVALUE(T1)={ R_0 }
	SUB R_0, C	R_0 含有 T1	T1 在 R_0 中
T2:=A*T1	LD R_1, A	RVALUE(R_0)={T1}	AVALUE(T1)={ R_0 }
	MUL R_1, R_0	RVALUE(R_1)={T2}	AVALUE(T2)={ R_1 }
T3:=D+1	LD R_0, D	RVALUE(R_0)={T3}	AVALUE(T3)={ R_0 }
	ADD $R_0, 1$	RVALUE(R_1)={T2}	AVALUE(T2)={ R_1 }
T4:=E-F	ST $R_1, T2$		AVALUE(T2)={T2}
	LD R_1, E	RVALUE(R_0)={T3}	AVALUE(T3)={ R_0 }
	SUB R_1, F	RVALUE(R_1)={T4}	AVALUE(T4)={ R_1 }
T5:=T3*T4	MUL R_0, R_1	RVALUE(R_0)={T5}	AVALUE(T2)={T2} VALUE(T5)={ R_0 }
		RVALUE(R_1)={T4}	AVALUE(T4)={ R_1 }
W:=T2/T5	LD $R_1, T2$	RVALUE(R_0)={T5}	AVALUE(T2)={T2} AVALUE(T5)={ R_0 }
	DIV R_1, R_0	RVALUE(R_1)={W}	AVALUE(W)={ R_1 }
	ST R_1, W		