

Compiler Design

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SLR(1) Grammar

- Every SLR(1) grammar is unambiguous, but there are many unambiguous grammars that are not SLR(1)

$$\begin{array}{lcl} S & \rightarrow & L = R \mid R \\ L & \rightarrow & *R \mid \text{id} \\ R & \rightarrow & L \end{array}$$

- Shift/Reduce conflict on input symbol =

$$\begin{array}{l} I_0: \quad S' \rightarrow \cdot S \\ \quad S \rightarrow \cdot L = R \\ \quad S \rightarrow \cdot R \\ \quad L \rightarrow \cdot * R \\ \quad L \rightarrow \cdot \text{id} \\ \quad R \rightarrow \cdot L \end{array}$$

$$I_1: \quad S' \rightarrow S \cdot$$

$$\boxed{\begin{array}{l} I_2: \quad S \rightarrow L \cdot = R \\ \quad R \rightarrow L \cdot \end{array}}$$

$$I_3: \quad S \rightarrow R \cdot$$

$$\begin{array}{l} I_4: \quad L \rightarrow * \cdot R \\ \quad R \rightarrow \cdot L \\ \quad L \rightarrow \cdot * R \\ \quad L \rightarrow \cdot \text{id} \end{array}$$

$$I_5: \quad L \rightarrow \text{id} \cdot$$

$$\begin{array}{l} I_6: \quad S \rightarrow L = \cdot R \\ \quad R \rightarrow \cdot L \\ \quad L \rightarrow \cdot * R \\ \quad L \rightarrow \cdot \text{id} \end{array}$$

$$I_7: \quad L \rightarrow * R \cdot$$

$$I_8: \quad R \rightarrow L \cdot$$

$$I_9: \quad S \rightarrow L = R \cdot$$

Constructing LR(1) Sets of Items

```
SetOfItems CLOSURE( $I$ ){
    repeat
        for ( each item  $[A \rightarrow \alpha \cdot B\beta, a]$  in  $I$  )
            for ( each production  $B \rightarrow \gamma$  in  $G'$  )
                for ( each terminal  $b$  in FIRST( $\beta a$ ) )
                    add  $[B \rightarrow \cdot \gamma, b]$  to set  $I$ ;
    until no more items are added to  $I$ ;
```

return I ;

}

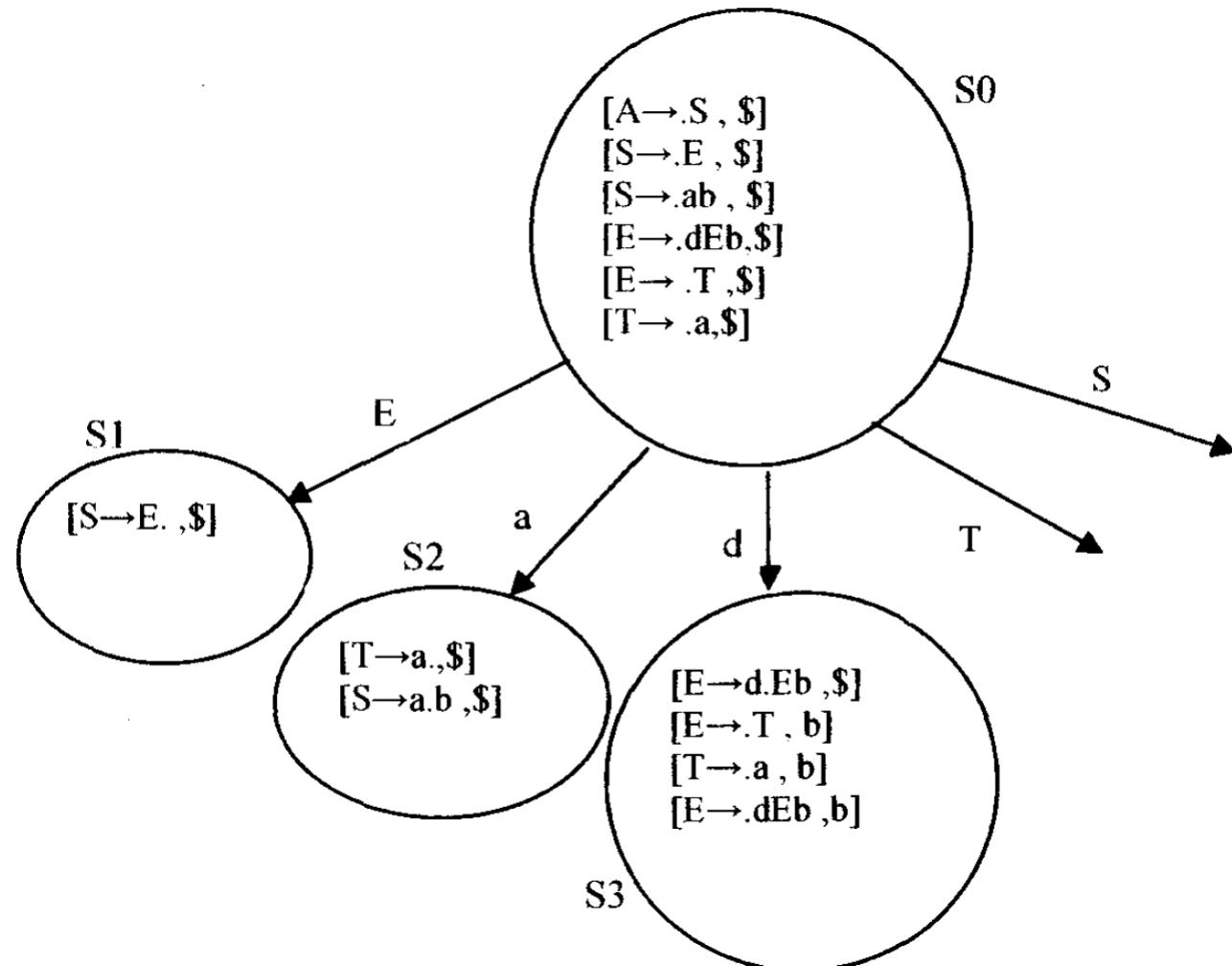
```
SetOfItems GOTO( $I, X$ ){
    initialize  $J$  to be the empty set;
    for ( each item  $[A \rightarrow \alpha \cdot X\beta, a]$  in  $I$  )
        add item  $[A \rightarrow \alpha X \cdot \beta, a]$  to set  $J$ ;
    return CLOSURE( $J$ );
}
```

LR(1) Grammar

$S \rightarrow E \mid ab$
 $E \rightarrow dEb \mid T$
 $T \rightarrow a$



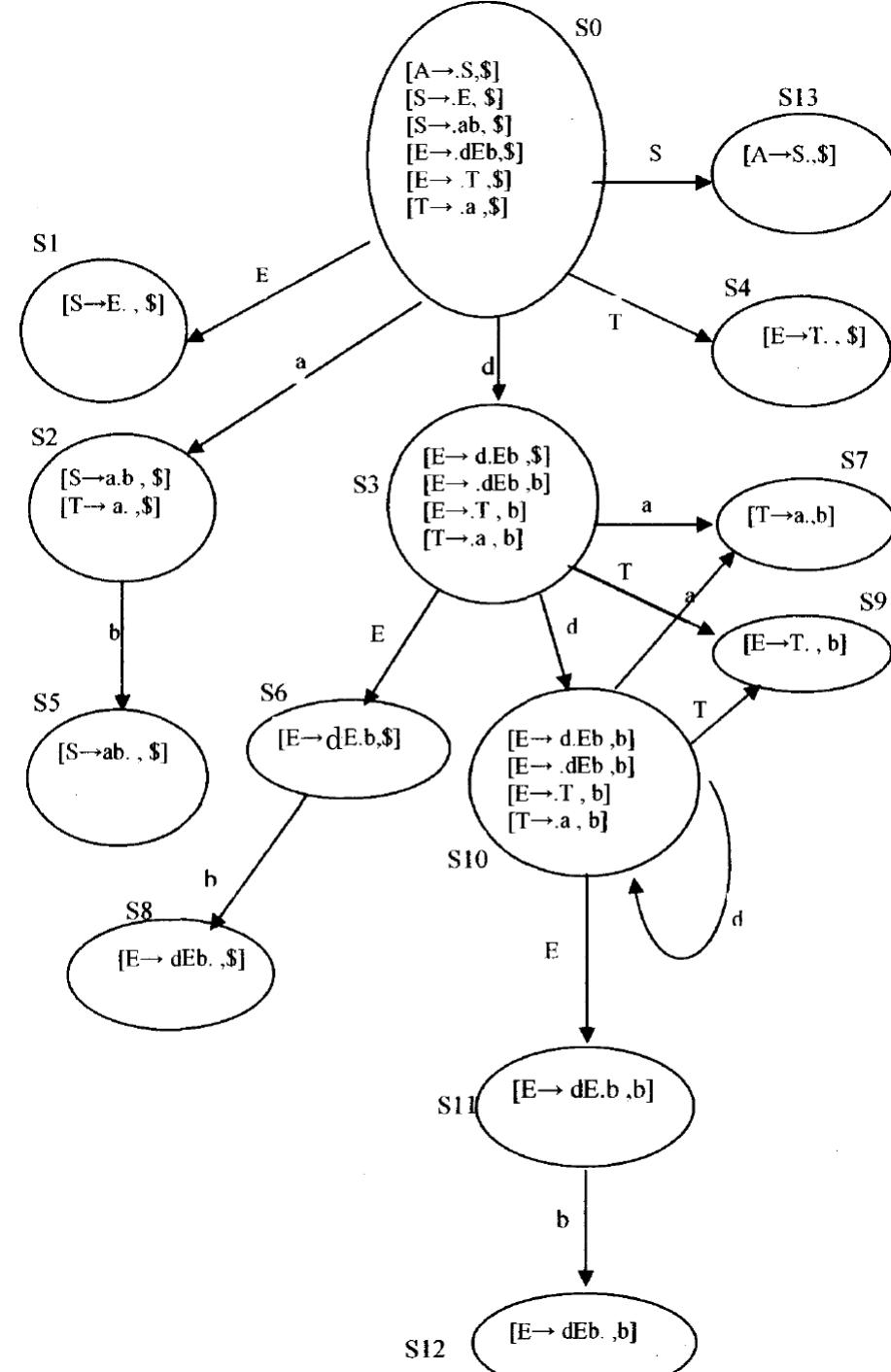
- 1- $A \rightarrow S$
- 2- $S \rightarrow E$
- 3- $S \rightarrow ab$
- 4- $E \rightarrow dEb$
- 5- $E \rightarrow T$
- 6- $T \rightarrow a$



LR(1) Grammar

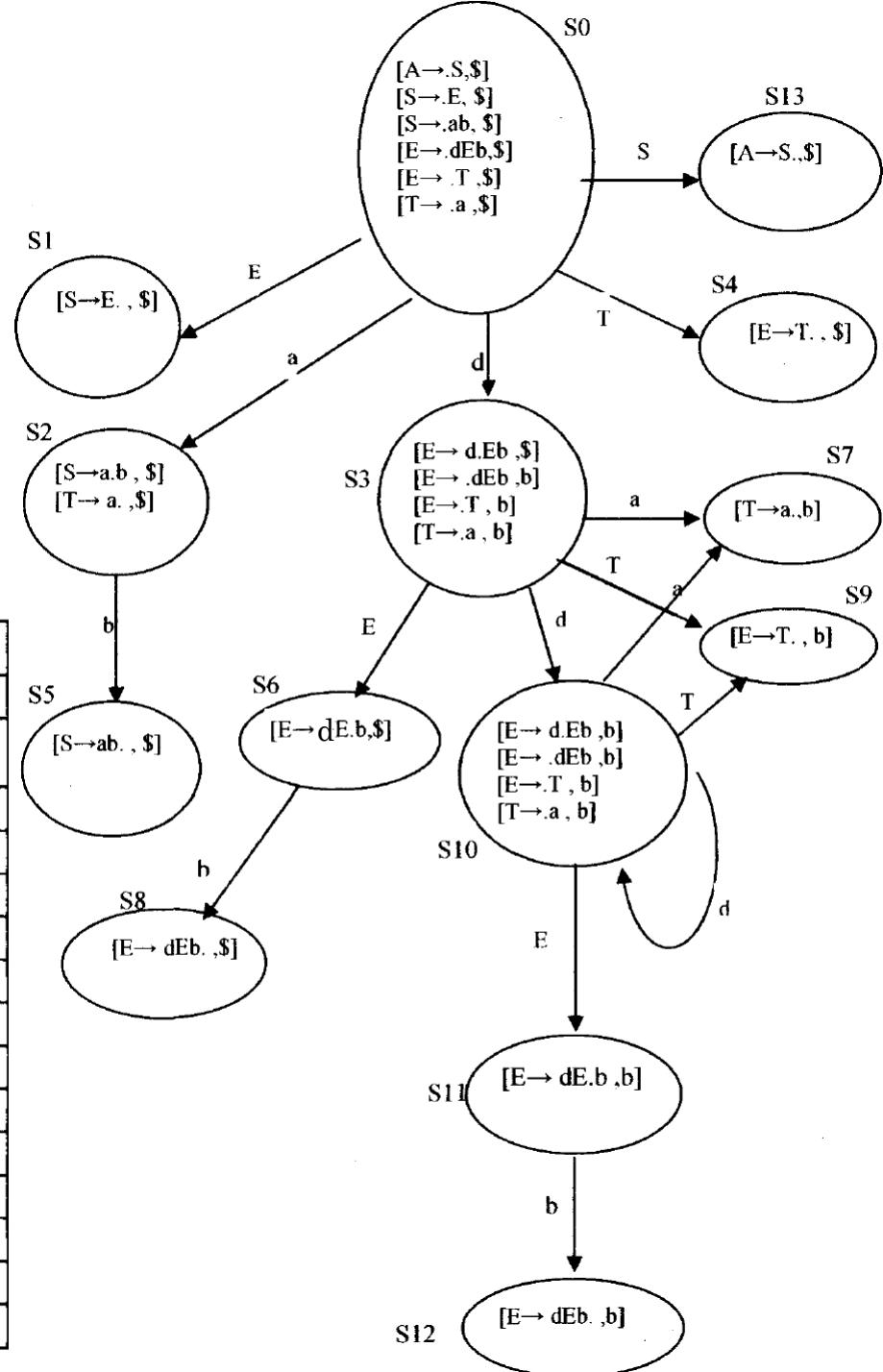
$S \rightarrow E \mid ab$
 $E \rightarrow dEb \mid T$
 $T \rightarrow a$

- ↓
- 1- $A \rightarrow S$
 - 2- $S \rightarrow E$
 - 3- $S \rightarrow ab$
 - 4- $E \rightarrow dEb$
 - 5- $E \rightarrow T$
 - 6- $T \rightarrow a$



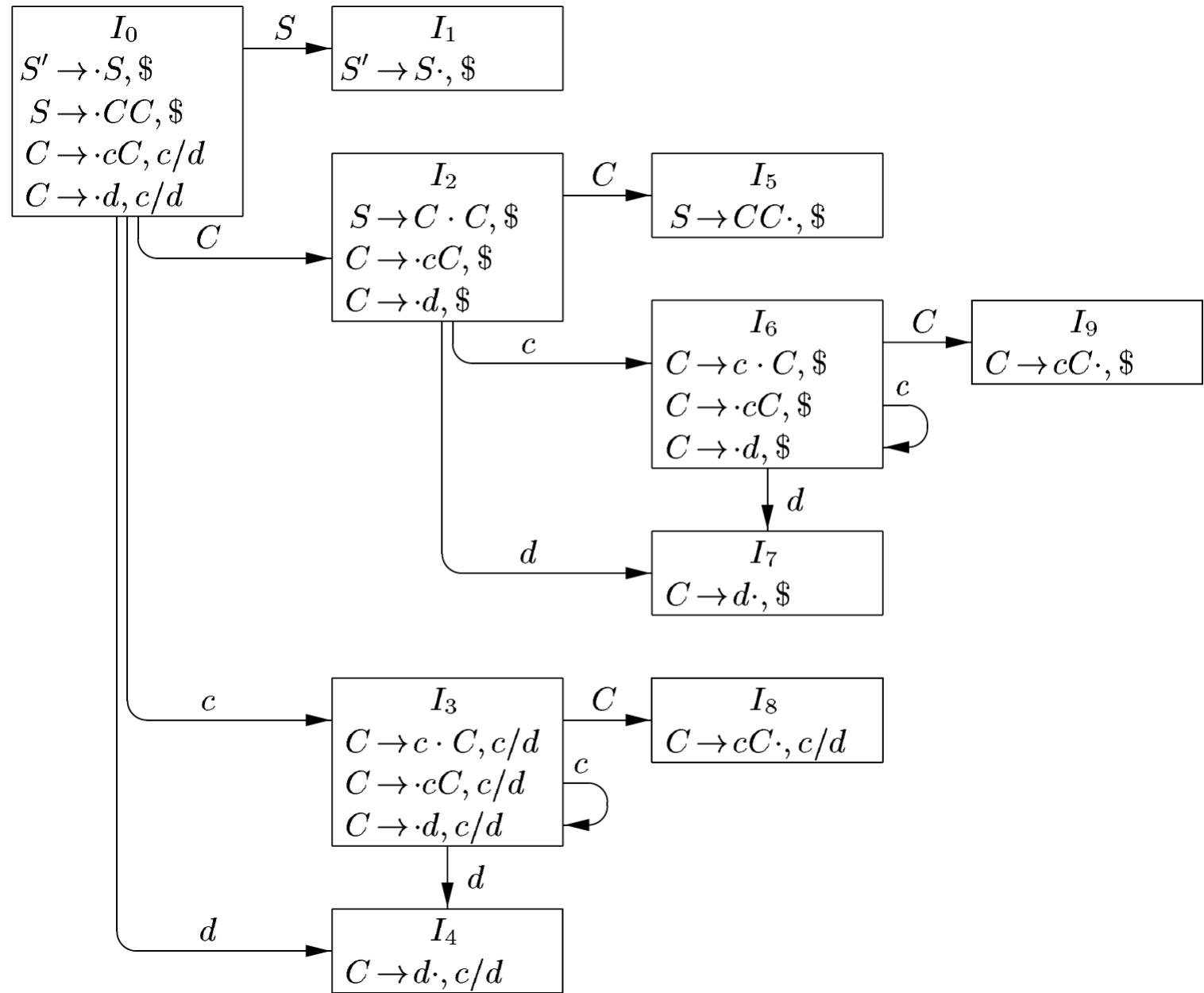
LR(1) Grammar

حالات	action				goto			
	a	b	d	\$	E	T	S	
0	s2			s3		1	4	13
1					r2			
2			s5		r6			
3	s7			s10		6	9	
4					r5			
5					r3			
6			s8					
7			r6					
8					r4			
9			r5					
10	s7			s10		11	9	
11			s12					
12			r4					
13				accept				



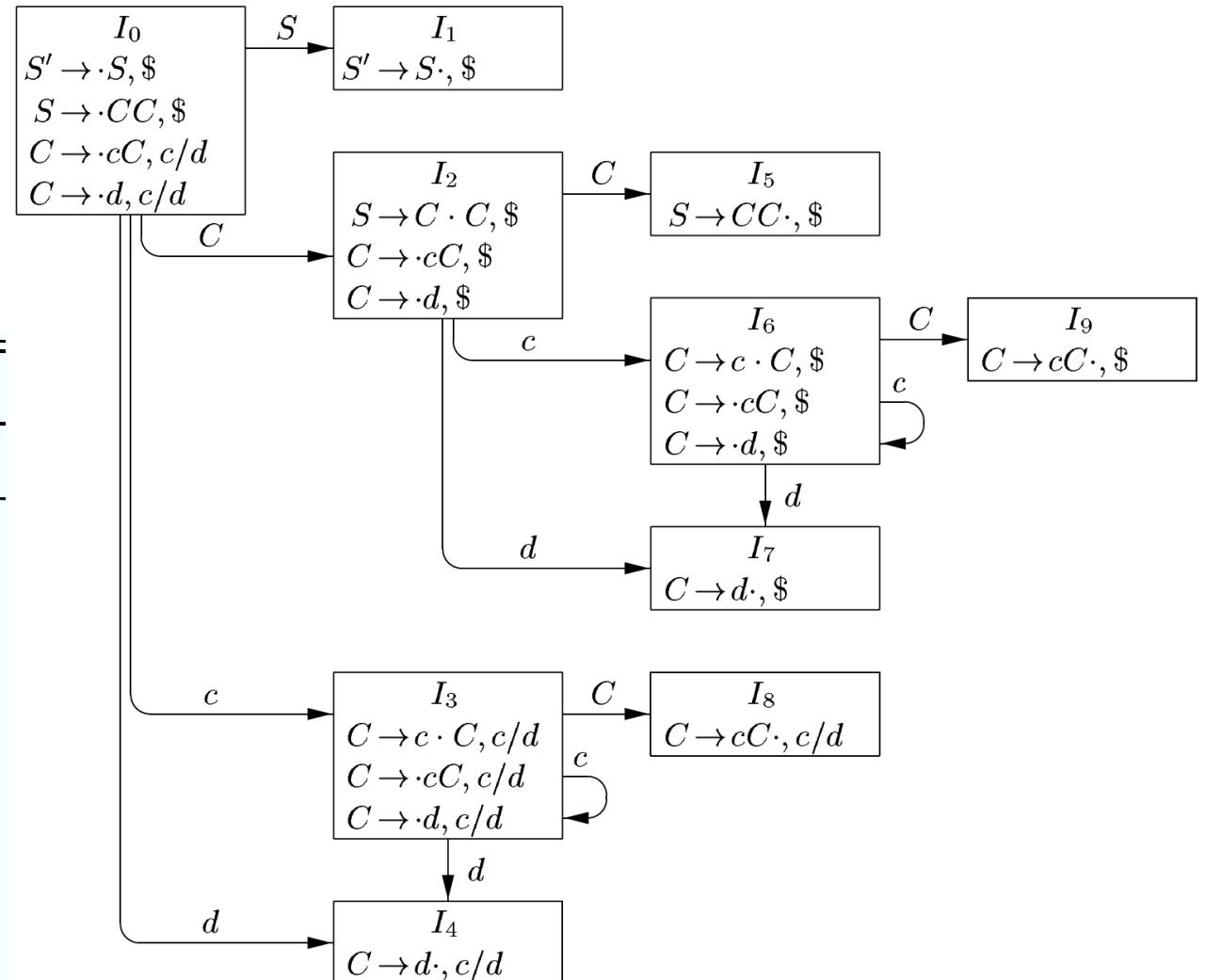
LR(1) Grammar

$$\begin{array}{lcl}
 S' & \rightarrow & S \\
 S & \rightarrow & C \ C \\
 C & \rightarrow & c \ C \mid d
 \end{array}$$



LR(1) Grammar

STATE	ACTION			GOTO	
	c	d	\$	S	C
0	s3	s4		1	2
1			acc		
2	s6	s7		5	
3	s3	s4		8	
4	r3	r3			
5			r1		
6	s6	s7		9	
7			r3		
8	r2	r2			
9			r2		

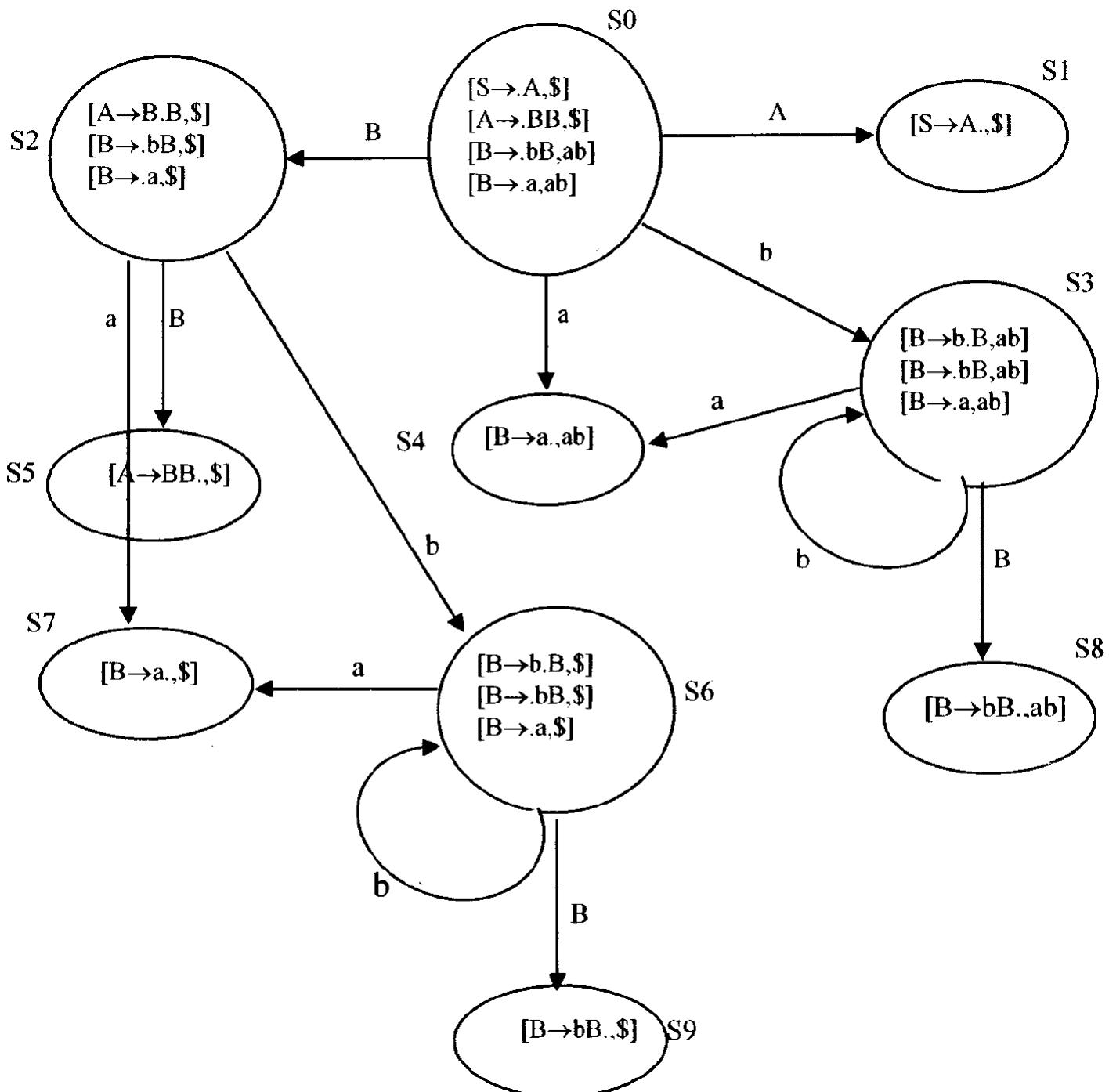


LR(1) Grammar

$A \rightarrow BB$
 $B \rightarrow bB | a$



- 0- $S \rightarrow A$
- 1- $A \rightarrow BB$
- 2- $B \rightarrow bB$
- 3- $B \rightarrow a$



LR(1) Grammar

حالت	action			goto	
	b	a	\$	A	B
0	s3	s4		1	2
1			accept		
2	s6	s7			5
3	s3	s4			8
4	r3	r3			
5			r1		
6	s6	s7			9
7			r3		
8	r2	r2			
9			r2		

LR(1) Grammar

- Example: Shift/Reduce Conflict
 - The grammar is not LR(1)

$E \rightarrow E+E | E-E | a$



- 1- $S \rightarrow E$
- 2- $E \rightarrow E+E$
- 3- $E \rightarrow E-E$
- 4- $E \rightarrow a$

