

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 =*

$$\begin{array}{l} I_0: \quad S' \rightarrow \cdot S \\ \quad \quad S \rightarrow \cdot L = R \\ \quad \quad S \rightarrow \cdot R \\ \quad \quad L \rightarrow \cdot * R \\ \quad \quad L \rightarrow \cdot \text{id} \\ \quad \quad R \rightarrow \cdot L \end{array}$$
$$I_1: \quad S' \rightarrow S \cdot$$
$$\begin{array}{l} I_2: \quad S \rightarrow L \cdot = R \\ \quad \quad R \rightarrow L \cdot \end{array}$$
$$I_3: \quad S \rightarrow R \cdot$$
$$\begin{array}{l} I_4: \quad L \rightarrow * \cdot R \\ \quad \quad R \rightarrow \cdot L \\ \quad \quad L \rightarrow \cdot * R \\ \quad \quad L \rightarrow \cdot \text{id} \end{array}$$
$$I_5: \quad L \rightarrow \text{id} \cdot$$
$$\begin{array}{l} I_6: \quad S \rightarrow L = \cdot R \\ \quad \quad R \rightarrow \cdot L \\ \quad \quad L \rightarrow \cdot * R \\ \quad \quad L \rightarrow \cdot \text{id} \end{array}$$
$$I_7: \quad L \rightarrow * R \cdot$$
$$I_8: \quad R \rightarrow L \cdot$$
$$I_9: \quad S \rightarrow L = R \cdot$$

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  $I$ ;  
}
```

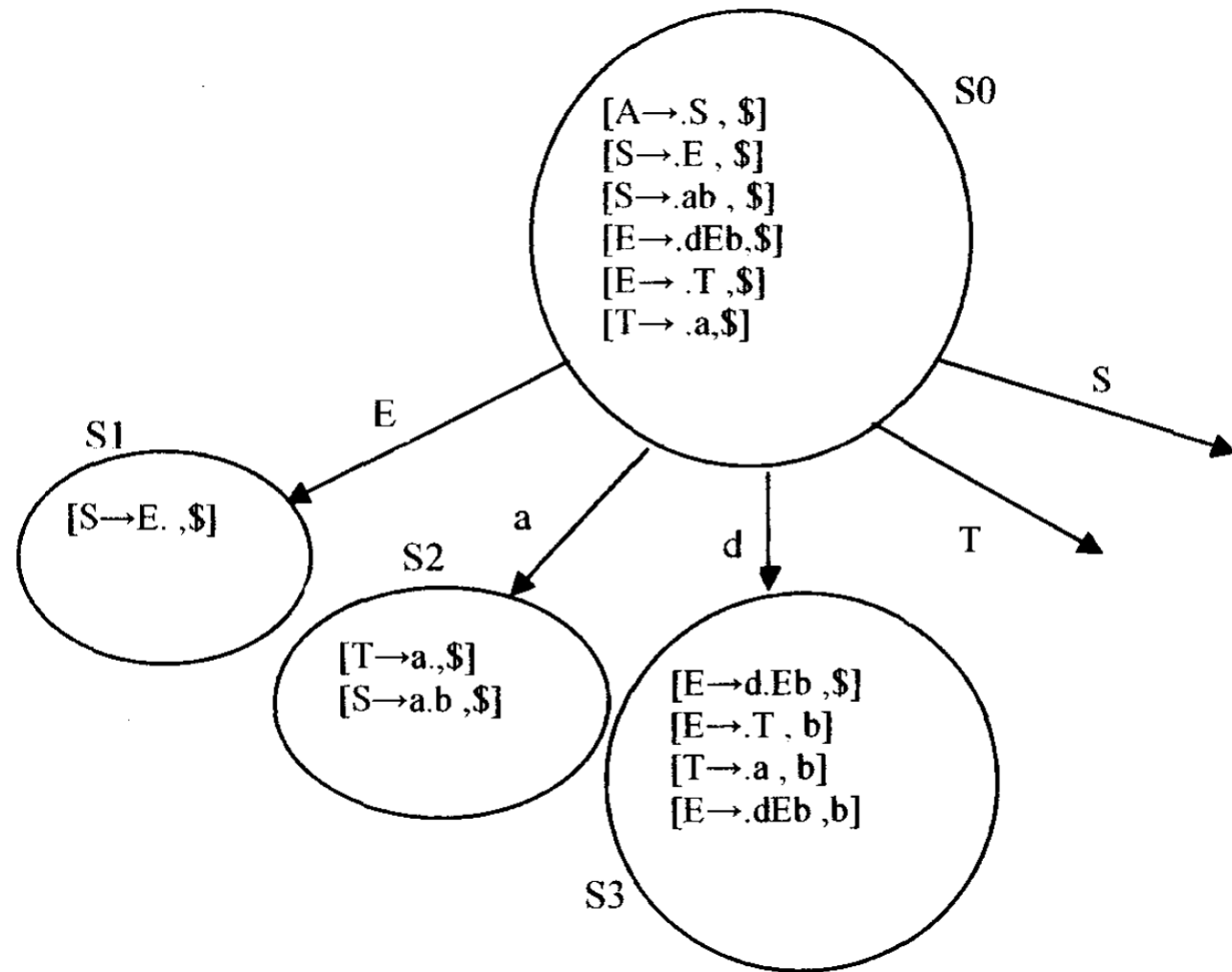
```
SetOfItems GOTO( $I, X$ ) {  
    initialize  $J$  to be the empty set;  
    for ( each item  $[A \rightarrow \alpha \cdot X \beta, a]$  in  $I$  )  
        add item  $[A \rightarrow \alpha X \cdot \beta, a]$  to set  $J$ ;  
    return CLOSURE( $J$ );  
}
```

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- $T \rightarrow a$

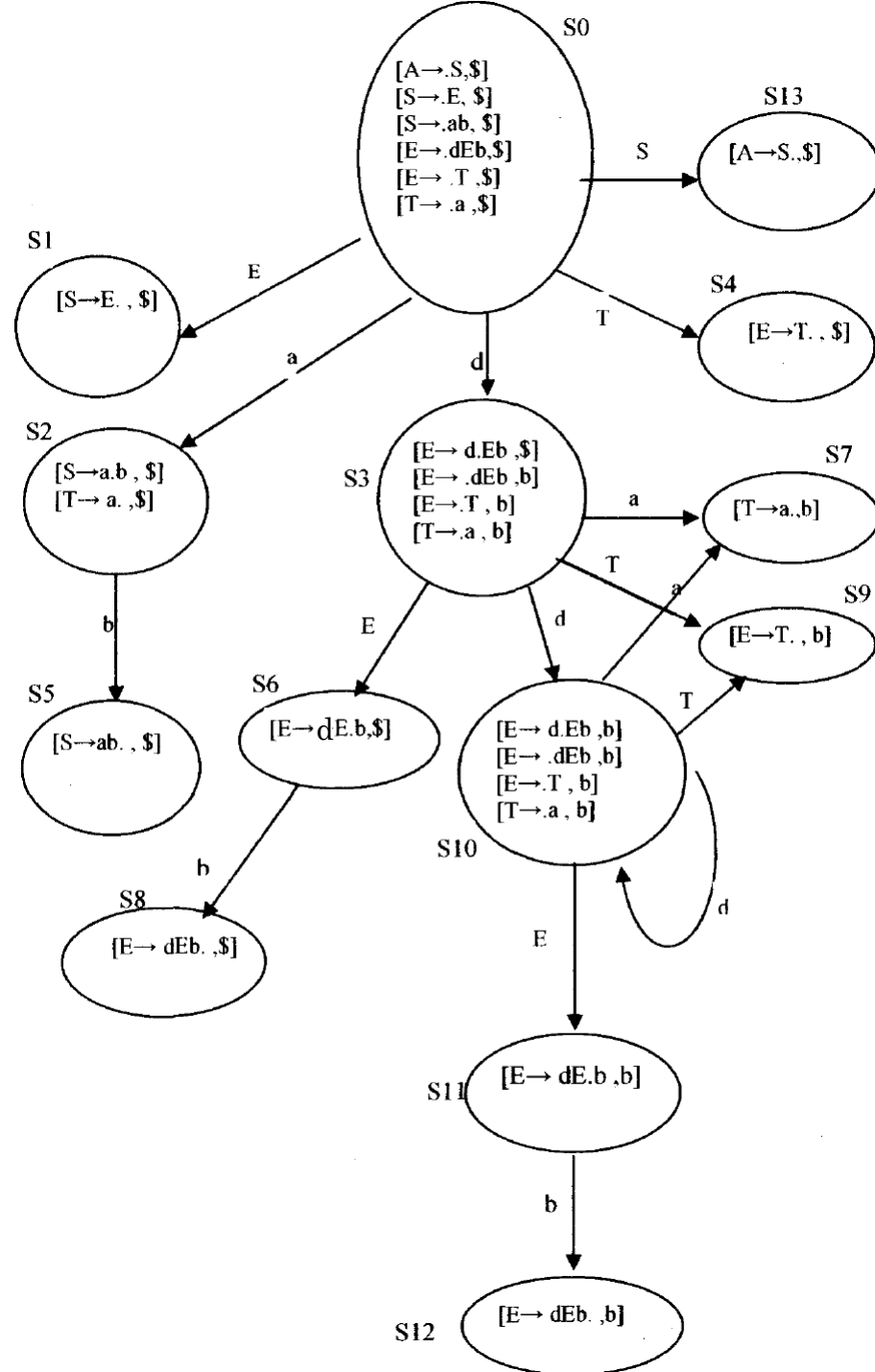


LR(1) Grammar

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

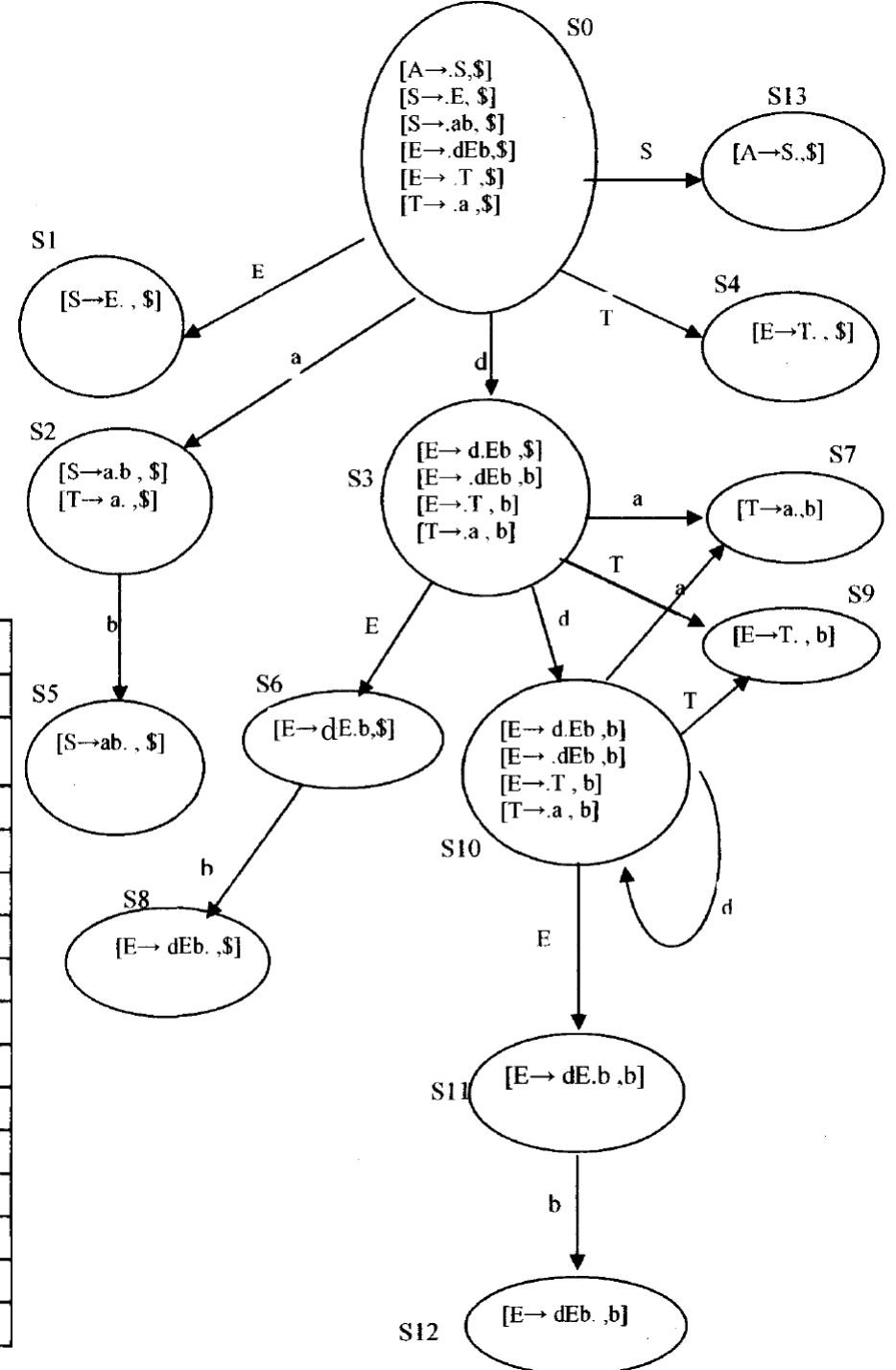


- 1- $A \rightarrow S$
- 2- $S \rightarrow E$
- 3- $S \rightarrow ab$
- 4- $E \rightarrow dEb$
- 5- $E \rightarrow T$
- 6- $T \rightarrow a$



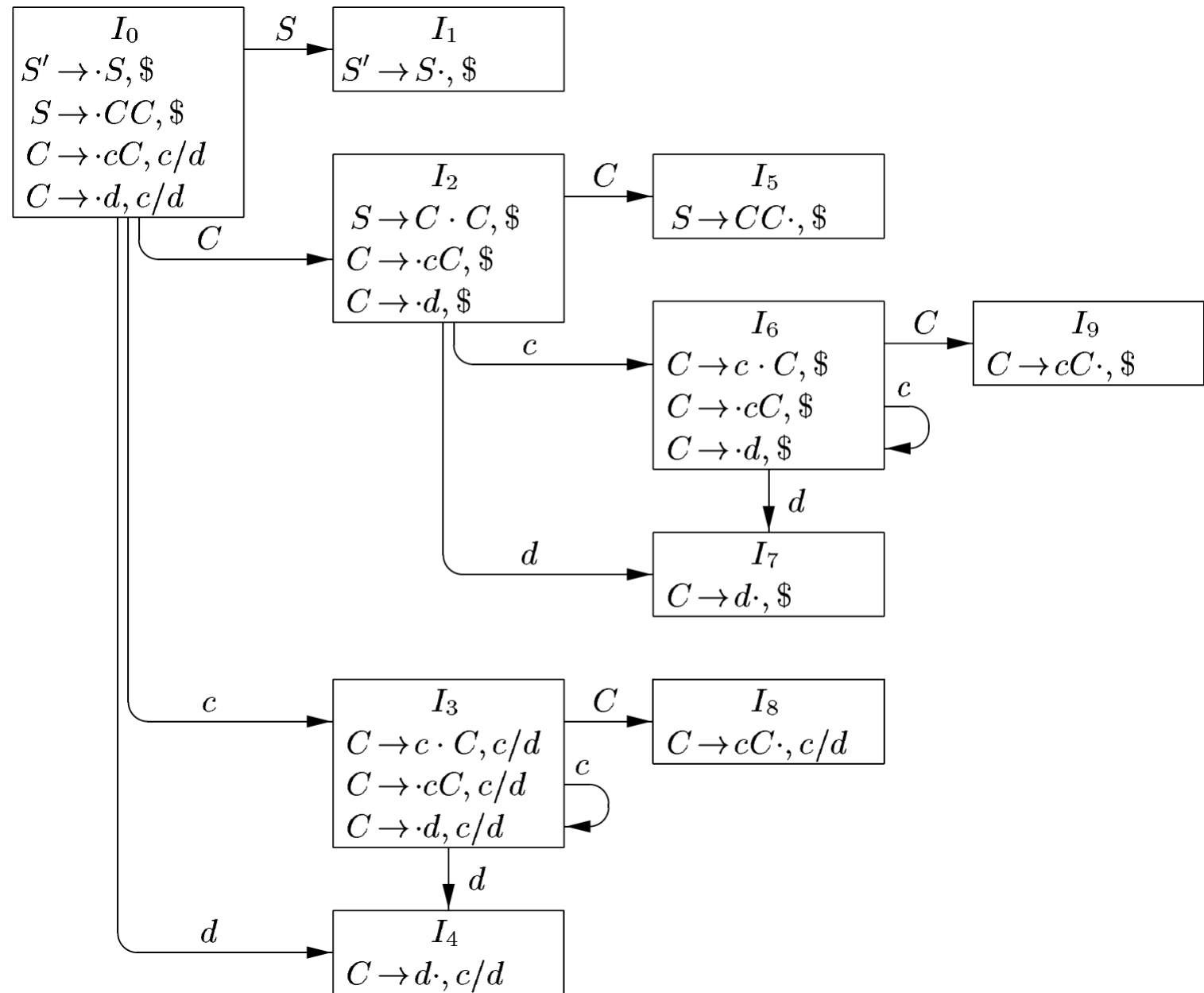
LR(1) Grammar

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			



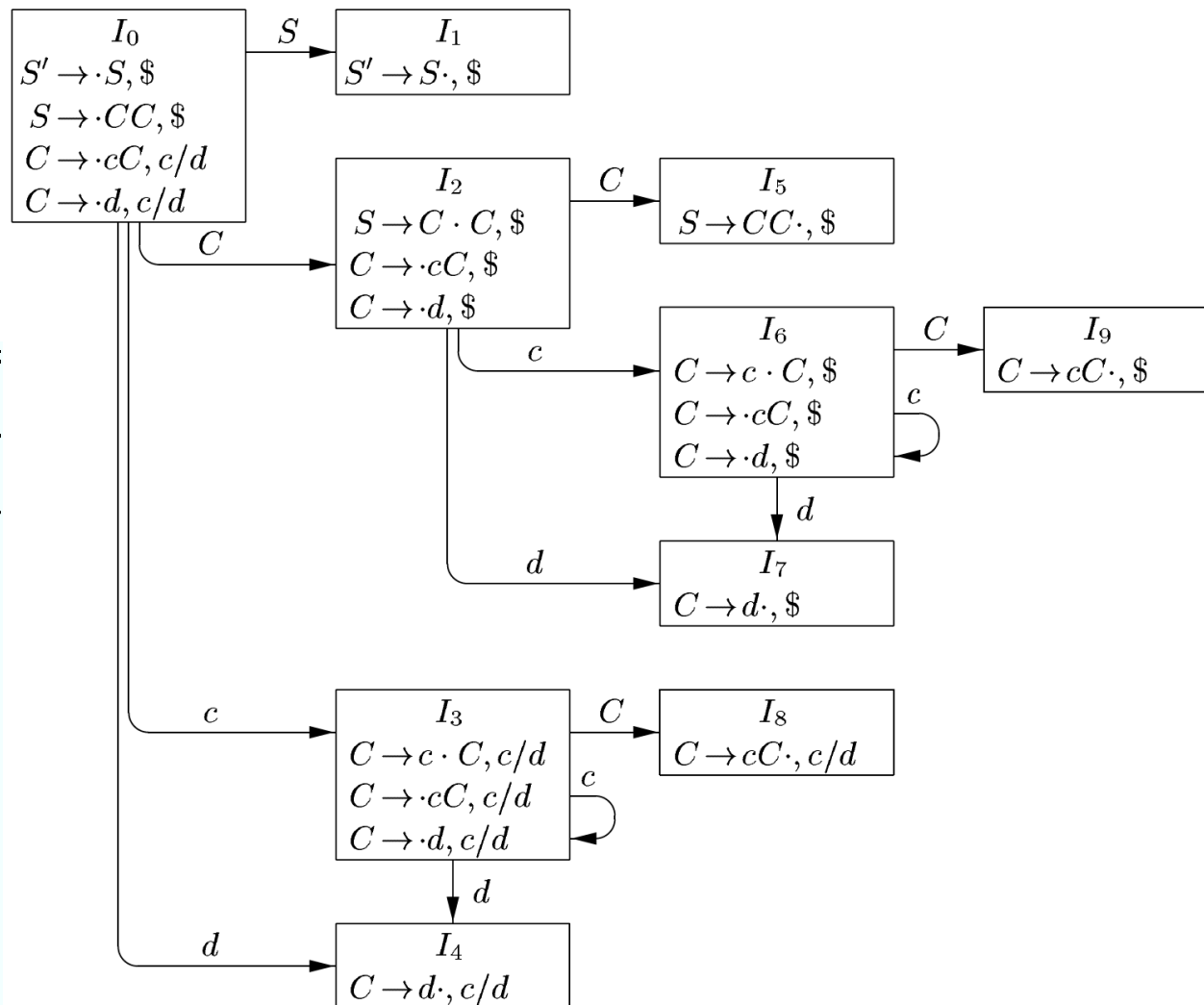
LR(1) Grammar

$S' \rightarrow S$
 $S \rightarrow CC$
 $C \rightarrow cC \mid d$



LR(1) Grammar

STATE	ACTION			GOTO	
	<i>c</i>	<i>d</i>	\$	<i>S</i>	<i>C</i>
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		

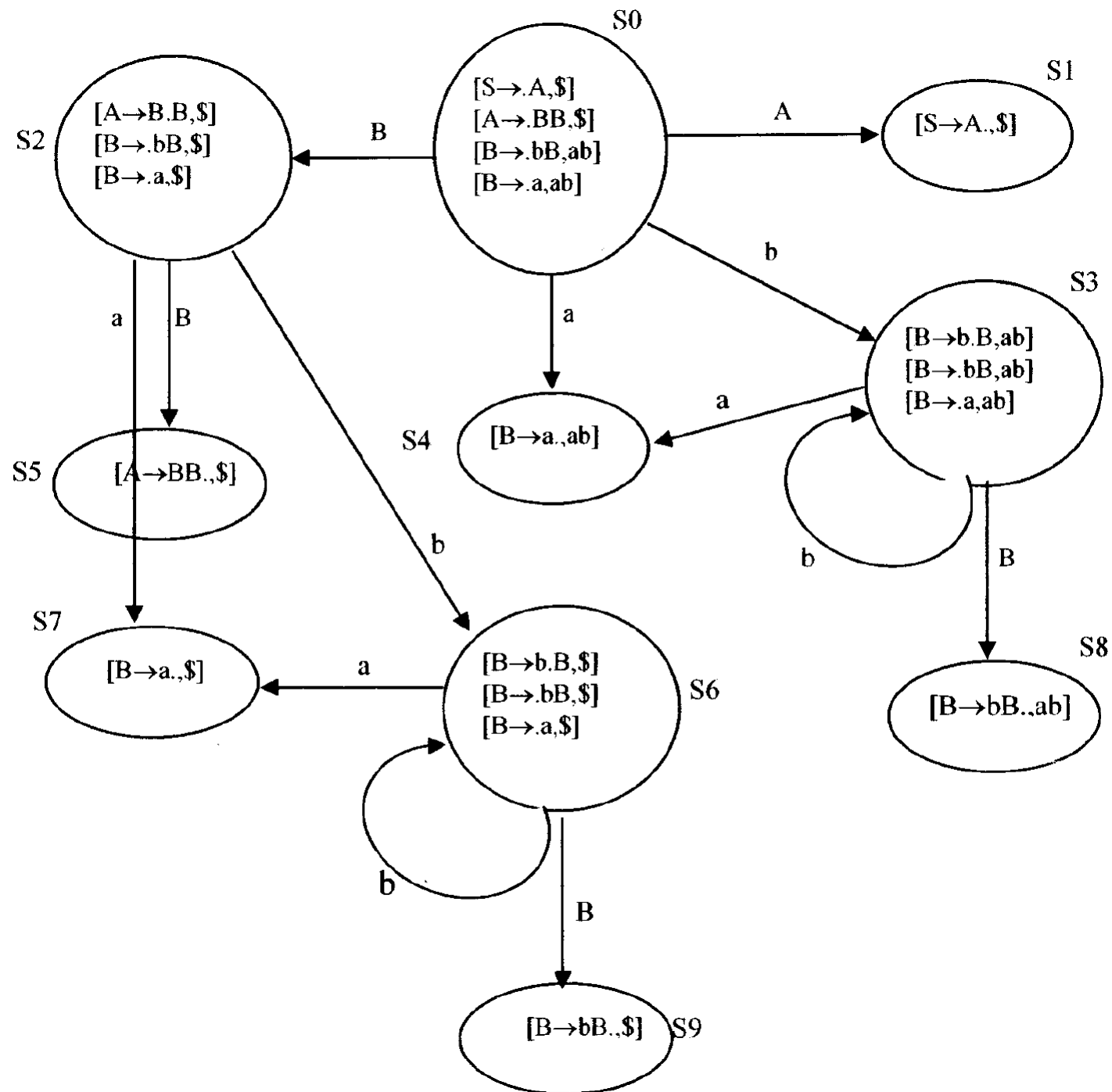


LR(1) Grammar

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



- 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)

$E \rightarrow E+E \mid E-E \mid a$



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

