Compilers Principals - Chapter3

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Problems：3.6，3.9，3.13，3.14.

1 Problem 3.6

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a. Calculate nullable, FIRST, and FOLLOW for this grammar:

$$S \to uBDz$$
$$B \to Bv$$
$$B \to w$$
$$D \to EF$$
$$E \to y$$
$$E \to$$
$$F \to x$$
$$F \to$$

b. Construct the LL(1) parsing table.

c. Give evidence that this grammar is not LL(1).

d. Modify the grammar **as little as possible** to make an LL(1) grammar that accepts the same language.

解:

a.

	nullable	FIRST	FOLLOW
S	no	u	
B	no	w	x, y, z
D	yes	x, y	z
E	yes	y	x, z
F	yes	x	z

表 1　nullable, FIRST and FOLLOW

b.

	u	v	w	x	y	z
S	$S \to uBDz$					
B			$B \to w, B \to Bv$			
D				$D \to EF$	$D \to EF$	$D \to EF$
E				$E \to$	$E \to y$	$E \to$
F				$F \to x$		$F \to$

表 2　LL(1) parsing table

c. No, according to the parsing table, we get two possible production when the top of stack of non-terminal is B and the input token is w, $B \to w, B \to Bv$.

d. I modify the grammar as follows:

$$S \rightarrow uBEFz$$
$$B \rightarrow wB'$$
$$B' \rightarrow vB'$$
$$B' \rightarrow$$
$$E \rightarrow y$$
$$E \rightarrow$$
$$F \rightarrow x$$
$$F \rightarrow$$

□

2 Problem 3.9

Diagram the LR(0) states for Grammar 3.26, build the SLR parsing table, and identify the conflicts.
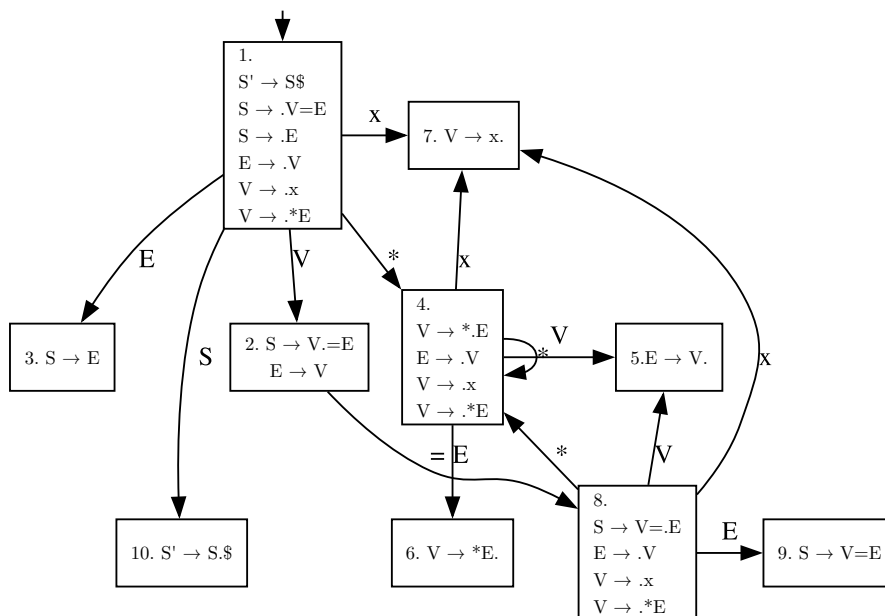
解:

图 1   LR(0) state diagram

	x	*	$	=	E	V	S
1	s7	s4			g3	g2	g10
2			r3	s8, r3			
3	r10	r10	r10	r10			
4	s7	s4			g6	g5	
5			r6	r6			
6			r5	r5			
7			r2	r2			
8	s7	s4			g9	g5	
9			r10				
10			a				

表 3   SLR parsing table

□

3 Problem 3.13

Show that this grammar is LALR(1) but not SLR:

$$
\begin{array}{llll}
{}_0 & S \to X\ \$ & {}_3 & X \to d\ c \\
{}_1 & X \to M\ a & {}_4 & X \to b\ d\ a \\
{}_2 & X \to b\ M\ c & {}_5 & M \to d
\end{array}
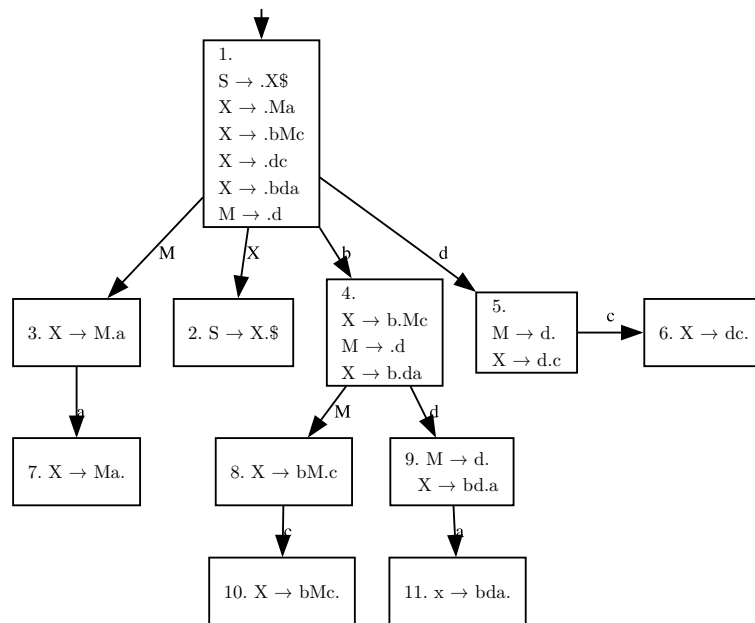$$

解:

Follow(x) = {$}, Follow(M) = {a, c}

图 2   SLR state diagram

At state 5 and the input is c, we have two possible ways, either to reduce to state 3 or to shift to state 6. So it is not SLR.
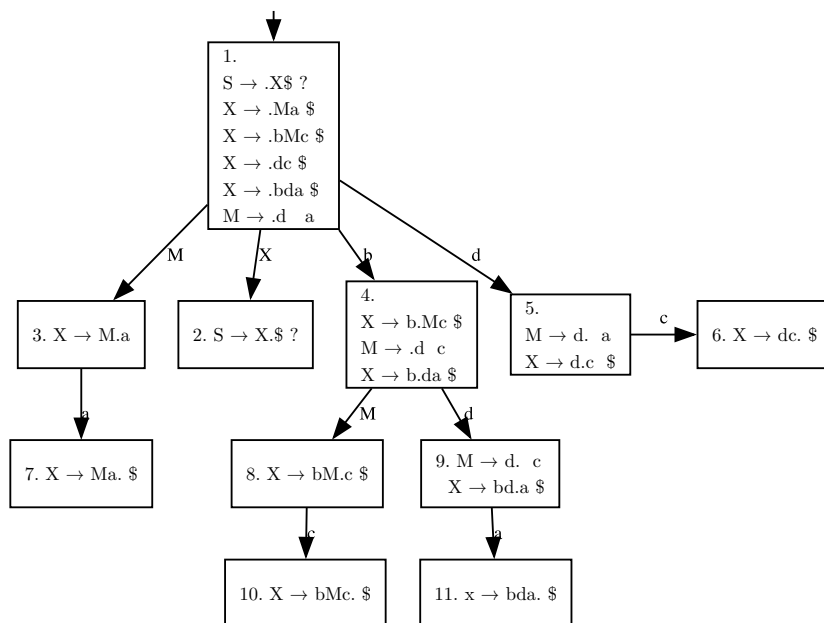
图 3   LR(1) state diagram

The language is LALR(1).

	a	b	c	d	$	X	M
1		s4		s5		g2	g3
2					a		
3	s6						
4				s8			g7
5	r3			s9			
6					r2		
7			s10				
8	s11		r7				
9					r2		
10					r2		
11					r2		

表 4   LALR(1) parsing table

4 Problem 3.14

Show that this grammar is LL(1) but not LALR(1):

$$_1 \quad S \rightarrow (\ X \qquad _5 \quad X \rightarrow F\ ]$$
$$_2 \quad S \rightarrow E\ ] \qquad _6 \quad E \rightarrow A$$
$$_3 \quad S \rightarrow F\ ) \qquad _7 \quad F \rightarrow A$$
$$_4 \quad X \rightarrow E\ ) \qquad _8 \quad A \rightarrow$$

解: The language is LL(1).

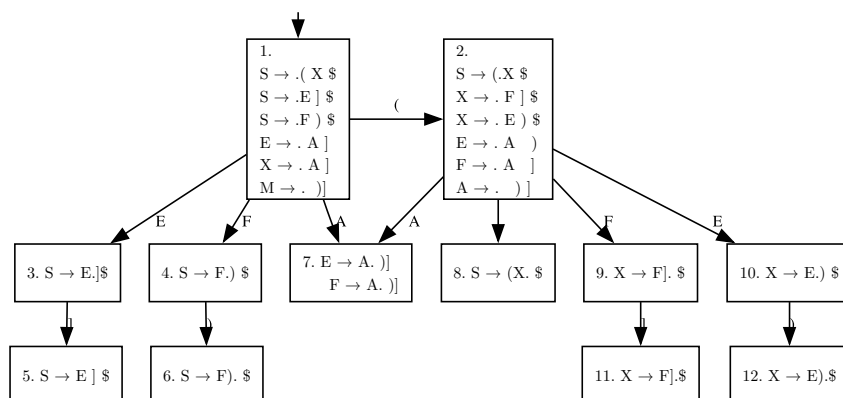|	(	)	[ ]
X		$X \rightarrow E)$	$X \rightarrow F]$
S	$S \rightarrow (X$	$S \rightarrow F)$	$S \rightarrow E]$
E		$E \rightarrow A$	$E \rightarrow A$
F		$F \rightarrow A$	$F \rightarrow A$
A		$A \rightarrow$	$A \rightarrow$

图 4   LL(1) Parsing table

In state 7, there is a reduce-reduce conflict, so it is not LALR(1).

图 5   LALR(1) state diagram