

HW 6 Solutions

3.11

0. $S \rightarrow B \$$
1. $B \rightarrow id P$
2. $B \rightarrow id (E)$
3. $P \rightarrow$
4. $P \rightarrow (E)$
5. $E \rightarrow B$
6. $E \rightarrow B, E$

	Follow
B	], comma,), \$
P	], comma,), \$
E],)

YES, G is an SLR grammar

States of DFA:

<p>I₀ $S \rightarrow .B\\$ ----- $B \rightarrow .id P$ $B \rightarrow .id (E)$</p>	<p>I₄ $B \rightarrow id (.E)$ $P \rightarrow (.E)$ ----- $E \rightarrow .B$ $E \rightarrow .B, E$ $B \rightarrow .id P$ $B \rightarrow .id (E)$</p>	<p>I₇ $B \rightarrow id(E).$ ----- I₈ $P \rightarrow (E).$</p>
<p>I₁₁ : $S \rightarrow B. \\$ -----</p>	<p>I₅ $E \rightarrow B.$ $E \rightarrow B., E$ -----</p>	<p>I₉ $E \rightarrow B, .E$ ----- $E \rightarrow .B$ $E \rightarrow .B, E$</p>
<p>I₂ $B \rightarrow id.P$ $B \rightarrow id.(E)$ ----- $P \rightarrow .$ $P \rightarrow .(E)$</p>	<p>I₆ $B \rightarrow id (E.)$ $P \rightarrow (E.)$ -----</p>	<p>I₁₀ $E \rightarrow B, E.$</p>
<p>I₃ $B \rightarrow id P.$</p>		

Transitions

delta (I0, B, I1)

delta (I0, id, I2)

delta (I2, P, I3)

delta (I2, C, I4)

delta (I4, B, I5)

delta (I4, E, I6)

delta (I4, id, I2)

delta (I5, comma, I9)

delta (I6,], I7)

delta (I6,), I8)

delta (I9, E, I10)

delta (I9, B, I5)

SLR Parsing Table

		Id	(	]	)	Comma	\$		B	P	E
0		S2							1		
1							Acc				
2			S4	R3	R3	R3	R3			3	
3				R1	R1	R1	R1				
4		S2							5		6
5				R5	R5	S9					
6				S7	S8						
7				R2	R2	R2	R2				
8				R4	R4	R4	R4				
9									5		10
10				R6	R6						

3.12

- 0. $S \rightarrow E \$$
- 1. $E \rightarrow id$
- 2. $E \rightarrow id (E)$
- 3. $E \rightarrow E + id$

	Follow
E), +, \$

I₀
 $S \rightarrow .E\$$

 $E \rightarrow .id$
 $E \rightarrow .id (E)$
 $E \rightarrow .E + id$
 I₁ : $E \rightarrow E. + id$

I₄
 $E \rightarrow id (.E)$

 $E \rightarrow .id$
 $E \rightarrow .id (E)$
 $E \rightarrow .E + id$

I₇
 $E \rightarrow id(E).$

I₂
 $E \rightarrow id.$
 $E \rightarrow id.(E)$

I₅
 $E \rightarrow E + id.$

I₆
 $E \rightarrow id (E.)$
 $E \rightarrow E. + id$

I₃
 $S \rightarrow E.$$
 $E \rightarrow E + .id$

Transitions

delta (I0, E, I1)

delta (I0, id, I2)

delta (I1, +, I3)

delta (I2, (, I4)

delta (I3, id, I5)

delta (I4, id, I2)

delta (I4, E, I6)

delta (I6, +, I3)

delta (I6,), I7)

LR(0) Parsing Table

		Id	(	)	+	\$	E
0		S2					1
1					S3	Acc	
2		R1	S4, R1	R1	R1	R1	
3		S5					
4		S2					6
5		R3	R3	R3	R3	R3	
6				S7	S3		
7		R2	R2	R2	R2	R2	

SLR Parsing Table

		Id	(	)	+	\$	E
0		S2					1
1					S3	Acc	
2			S4	R1	R1	R1	
3		S5					
4		S2					6
5				R3	R3	R3	
6				S7	S3		
7				R2	R2	R2	

G is NOT LR(0); G is SLR

3.13 Grammar G:

0. $S \rightarrow X \$$
1. $X \rightarrow Ma$
2. $X \rightarrow bMc$
3. $X \rightarrow dc$
4. $X \rightarrow bda$
5. $M \rightarrow d$

SYMBOL	FOLLOW
M	a, c
X	\$

Step I: Produce LR(0) sets of Items and DFA

I0:

- $S \rightarrow .X\$$
- $X \rightarrow .Ma$
- $X \rightarrow .b Mc$
- $X \rightarrow .dc$
- $X \rightarrow .bda$
- $M \rightarrow .d$

I1:

- $S \rightarrow X.\$$

I2:

- $X \rightarrow M.a$

I3:

- $X \rightarrow b.Mc$
- $X \rightarrow b.da$
- $M \rightarrow .d$

I4:

- $X \rightarrow d.c$
- $M \rightarrow d.$

I5:

- $X \rightarrow Ma.$

I6:

- $X \rightarrow bM.C$

I7:
 $X \rightarrow bd.a$
 $M \rightarrow d.$

I8:
 $X \rightarrow dc.$

I9:
 $X \rightarrow bMc.$

I10:
 $X \rightarrow bda.$

Transition Function

FROM	SYMBOL	TO
I0	X	I1
I0	M	I2
I0	b	I3
I0	d	I4
I2	a	I5
I3	M	I6
I3	d	I7
I4	c	I8
I6	c	I9
I7	a	I10

SLR Table

	A	b	c	D	\$	X	M
0		S3		S4		1	2
1					Acc		
2	S5						
3				S7			6
4	R5		S8/R5				
5					R1		
6			S9				
7	S10/R5		R5				
8					R3		
9					R2		
10					R4		

Not SLR – Couple of Conflicts

I0:

$S \rightarrow .X, \#$

$X \rightarrow .Ma, \#$

$X \rightarrow .bMc, \#$

$X \rightarrow .dc, \#$

$X \rightarrow .bda, \#$

$M \rightarrow .d, a$ SPONTANEOUS

I1:

$S \rightarrow X. , \#$

I2:

$X \rightarrow M.a, \#$

I3:

$X \rightarrow b.Mc, \#$

$M \rightarrow .d, c$ SPONTANEOUS

I3:

$X \rightarrow b.da, \#$

I4:

$X \rightarrow d.c, \#$

I4:

$M \rightarrow d., \#$

I5:

$X \rightarrow Ma., \#$

I6:

$X \rightarrow bM.c, \#$

I7:

$X \rightarrow bd.a, \#$

I7:

$M \rightarrow d., \#$

I8:

$X \rightarrow dc., \#$

I9:

$X \rightarrow bMc., \#$

I10:

$X \rightarrow bda., \#$

Lookahead Propagation Pattern

FROM	TO
I0: S → .X	I1: S → X.
I0: S → .X	I2: X → M.a
I0: S → .X	I3: X → b.Mc
I0: S → .X	I3: X → b.da
I0: S → .X	I4: S → d.c
I2: X → M.a	I5: X → Ma.
I3: X → b.Mc	I6: X → bM.c
I3: X → b.da	I7: X → bd.a
I4: X → d.c	I8: X → dc.
I6: X → bM.c	I9: X → bMc.
I7: X → bd.a	I10: X → bda.

Lookahead Calculation

Item	Init	Pass 1	Pass2	Pass3
I0: S → .X	\$	\$	\$	\$
I1: S → X.		\$	\$	\$
I2: X → M.a		\$	\$	\$
I3: X → b.Mc		\$	\$	\$
I3: X → b.da		\$	\$	\$
I4: X → d.c		\$	\$	\$
I4: M → d.	a	a	a	a
I5: X → Ma.			\$	\$
I6: X → bM.c			\$	\$
I7: X → bd.a			\$	\$
I7: M → d.	c	c	c	c
I8: X → dc.			\$	\$
I9: X → bMc.				\$
I10: X → bda.				\$

Step 4: LALR Table

	A	B	C	D	\$	X	M
0		S3		S4		1	2
1					Acc		
2	S5						
3				S7			6
4	R5		S8				
5					R1		
6			S9				
7	S10		R5				
8					R3		
9					R2		
10					R4		

No Conflicts; Therefore LALR(1)

3.14 Grammar G:

- 0. $S1 \rightarrow S \$$
- 1. $S \rightarrow (X$
- 2. $S \rightarrow E]$
- 3. $S \rightarrow F)$
- 4. $X \rightarrow E)$
- 5. $X \rightarrow F]$
- 6. $E \rightarrow A$
- 7. $F \rightarrow A$
- 8. $A \rightarrow$

SYMBOL	FIRST	FOLLOW
A	ϵ],)
E	ϵ],)
F	ϵ],)
S	(,],)	\$
S1	(,],)	
X),]	\$

LL(1) Parsing Table

SYMBOL	([)]	\$
S1	$S1 \rightarrow S \$$		$S1 \rightarrow S \$$	$S1 \rightarrow S \$$	
S	$S \rightarrow (X$		$S \rightarrow F)$	$S \rightarrow E]$	
X			$X \rightarrow E)$	$X \rightarrow F]$	
E			$E \rightarrow A$	$E \rightarrow A$	
F			$F \rightarrow A$	$F \rightarrow A$	
A			$A \rightarrow$	$A \rightarrow$	

No Conflicts – So, G is LL(1)

Step I: Produce LR(0) sets of Items and DFA

I0:

$S1 \rightarrow .S\$$

$S \rightarrow .(X$

$S \rightarrow .E]$

$S \rightarrow .F)$

$E \rightarrow .A$

$F \rightarrow .A$

$A \rightarrow .$

I1:

$S1 \rightarrow S.S\$$

I2:

$S \rightarrow (.X$

$X \rightarrow .E)$

$X \rightarrow .F]$

$E \rightarrow .A$

$F \rightarrow .A$

$A \rightarrow .$

I3:

$S \rightarrow E.]$

I4:

$S \rightarrow F.)$

I5:

$E \rightarrow A.$

$F \rightarrow A.$

I6:

$S \rightarrow (X.$

I7:

$X \rightarrow E.)$

I8:

$X \rightarrow F.]$

I9:

$S \rightarrow E].$

I10:

$S \rightarrow F).$

I11:

$X \rightarrow E).$

I12:

$X \rightarrow F]$.

LR(0) DFA Transition Function

FROM	SYMBOL	TO
I0	S	I1
I0	(	I2
I0	E	I3
I0	F	I4
I0	A	I5
I2	X	I6
I2	E	I7
I2	F	I8
I2	A	I5
I3	]	I9
I4	)	I10
I7	)	I11
I8	]	I12

Step II: Calculate “spontaneous lookaheads” and “lookahead propagation pattern”

I0:

$S1 \rightarrow .S, \#$

$S \rightarrow .(X, \#$

$S \rightarrow .E], \#$

$S \rightarrow .F), \#$

$E \rightarrow .A,]$ SPONTANEOUS

$F \rightarrow .A,)$ SPONTANEOUS

$A \rightarrow ., \#$

I2:

$S \rightarrow (.X, \#$

$X \rightarrow .E), \#$

$X \rightarrow .F], \#$

$E \rightarrow .A,),$ SPONTANEOUS

$F \rightarrow .A,]$ SPONTANEOUS

$A \rightarrow ., \#$

I3:

$S \rightarrow E.], \#$

I4:

$S \rightarrow F.), \#$

I7:

$X \rightarrow E.), \#$

I8:

$X \rightarrow F.], \#$

Lookahead propagation pattern:

FROM	TO
I0: S1 → .S	I1: S1 → S.
I0: S1 → .S	I2: S → (.X
I0: S1 → .S	I3: S → E.]
I0: S1 → .S	I4: S → F.)
I2: S1 → (.X	I6: S → (X.
I2: S1 → (.X	I7: X → E.)
I2: S1 → (.X	I8: X → F.]
I3: S → E.]	I9: S → E].
I4: S → F.)	I10: S → F).
I7: X → E.)	I11: X → E).
I8: X → F.]	I12: X → F].

Step 3: Lookahead calculation

Item	Init	Pass 1	Pass2	Pass3
I0: S1 → .S	\$	\$	\$	\$
I1: S1 → S.		\$	\$	\$
I2: S → (.X		\$	\$	\$
I3: S → E.]		\$	\$	\$
I4: S → F.)		\$	\$	\$
I5: E → A.] ,)] ,)] ,)] ,)] ,)
I5: F → A.] ,)] ,)] ,)] ,)] ,)
I6: S → (X.			\$	\$
I7: X → E.)			\$	\$
I8: X → F.]			\$	\$
I9: S → E].			\$	\$
I10: S → F).			\$	\$
I11: X → E).				\$
I12: X → F].				\$

Step 4: LALR(1) Parse Table construction

	(	] , )	)	\$	S	X	E	F	A
0	S2			R8	1		3	4	5
1				Acc					
2				R8		6	7	8	5
3		S11							
4			S12						
5		R6/R7	R6/R7						
6				R1					

7			S9							
8		S10								
9				R2						
10				R3						
11				R4						
12				R5						

Not LALR(1) because there are reduce-reduce conflicts in row 5.