CS323 · Compilers

Assignment4

胡玉斌 / 11712121

November 11, 2020

1 (Simple LR): Consider the following grammar G:

$$S \to aB$$

$$B \to S + B \mid \epsilon$$

1.1 Construct the $SLR(1)$ parsing table for G. Please put down the detailed steps, including the calculation of $LR(0)$ item sets. [20 points]

$S' \Rightarrow S,\ S \to aB,\ B \to S + B \mid \epsilon$

$FIRST(S) = \{a\},\ FIRST(B) = \{a, \epsilon\}$

$FOLLOW(S) = \{+, \$\},\ FOLLOW(B) = \{\$, +\}$

LR(0) sets:

- $S' \to .S$
- $S' \to S.$
- $S \to .aB$
- $S \to a.B$
- $S \to aB.$
- $B \to .S + B$
- $B \to S. + B$
- $B \to S + .B$
- $B \to S + B.$
- $B \to .$

LR(0) collection:

- $I_0 = \{S' \to .S,\ S \to .aB\}$
- $I_1 = GOTO(I_0, S) = \{S' \to S.\}$
- $I_2 = GOTO(I_0, a) = \{S \to a.B\}$
- $I_3 = GOTO(I_2, S) = \{B \to S. + B\}$
- $I_4 = GOTO(I_2, B) = \{S \to aB.\}$
- $I_5 = GOTO(I_3, +) = \{B \to S + .B,\ B \to .S + b,\ B \to .,\ S \to .aB\}$
- $I_6 = GOTO(I_5, B) = \{B \to S + B.\}$
- $GOTO(I_5, S) = I_3$
- $GOTO(I_5, a) = I_2$

State	a	+	$	S	B
I_0	s2			I_1	
I_1				acc	
I_2	s2	r $B \to \epsilon$	r $B \to \epsilon$	I_3	I_4
I_3		s5			
I_4		r $S \to aB$	r $S \to aB$		
I_5	s2	r $B \to \epsilon$	r $B \to \epsilon$	I_3	I_6
I_6		r $B \to S + B$	r $B \to S + B$		

1.2 Is the grammar $SLR(1)$? [10 points]

YES, because there is no conflicts in the parsing table.

1.3 Can the $SLR(1)$ parser accept the input string $aaaa + ++$? If yes, please list the moves made by the parser; otherwise, state the reason. Before parsing, please resolve conflicts if any. [10 points]

Stack	Symbols	Input	Action
0	$	aaaa+++$	s2
02	$a	aaa+++$	s2
022	$aa	aa+++$	s2
0222	$aaa	a+++$	s2
02222	$aaaa	+++$	r $B \to \epsilon$
022224	$aaaaB	+++$	r $B \to S + B$
02223	$aaaS	+++$	s5
022235	$aaaS+	++$	r $B \to \epsilon$
0222356	$aaaS+B	++$	r $B \to S + B$
02224	$aaaB	++$	r $S \to aB$
0223	$aaS	++$	s5
02235	$aaS+	+$	r $B \to \epsilon$
022356	$aaS+B	+$	r $B \to S + B$
0224	$aaB	+$	r $S \to aB$
023	$aS	+$	s5
0235	$aS+	$	r $B \to \epsilon$
02356	$aS+B	$	r $B \to S + B$
024	$aB	$	r $S \to aB$
01	$S	$	acc

2 (Canonical LR): Consider the grammar G in Exercise 1:

2.1 Construct the $CLR(1)$ parsing table for G. Please put down the detailed steps, including the calculation of $LR(1)$ item sets. [20 points]

LR(0) collection:

- $I_0 = \{[S' \to .S, \$], [S \to .aB, \$]\}$
- $I_1 = GOTO(I_1, S) = \{[S' \to S., \$]\}$
- $I_2 = GOTO(I_0, a) = \{[S \to a.B, \$], [B \to .S + B, \$], [B \to ., \$], [S \to .aB, +]\}$
- $I_3 = GOTO(I_2, S) = \{[B \to S. + B, \$]\}$
- $I_4 = GOTO(I_2, a) = \{[S \to a.B, +], [B \to .S + B, +], [B \to ., +], [S \to .aB, +]\}$

- $I_5 = GOTO(I_2, B) = \{[S \rightarrow aB., \$]\}$
- $I_6 = GOTO(I_3, +) = \{[B \rightarrow S + .B, \$]\,[B \rightarrow .S + B, \$], [B \rightarrow ., \$], [S \rightarrow .aB, +]\}$
- $I_7 = GOTO(I_4, S) = \{[B \rightarrow S. + B, +]\}$
- $GOTO(I_4, a) = I_4$
- $I_8 = GOTO(I_4, S) = \{[S \rightarrow aB., +]\}$
- $GOTO(I_6, S) = I_4$
- $GOTO(I_6, a) = I_4$
- $I_9 = GOTO(I_6, B) = \{[B \rightarrow S + B., \$]\}$
- $I_10 = GOTO(I_7, +) = \{[B \rightarrow S + .B, +], [B \rightarrow .S + B, +], [B \rightarrow ., +], [S \rightarrow .aB, +]\}$
- $GOTO(I_10, S) = I_7$
- $GOTO(I_10, a) = I_4$
- $I_11 = GOTO(I_10, B) = \{[B \rightarrow S + B., +]\}$

State	a	+	$	S	B
I_0	s2			I_1	
I_1			acc		
I_2	s4		r $B \rightarrow \epsilon$	I_3	I_5
I_3		s6			
I_4	s4	r $B \rightarrow \epsilon$		I_7	I_8
I_5			r $S \rightarrow aB$		
I_6	s4		r $S \rightarrow aB$	I_3	I_9
I_7		s10			
I_8		r $S \rightarrow aB$			
I_9			r $B \rightarrow S + B$		
I_10	s4	r $S \rightarrow aB$		I_7	I_11
I_11		r $B \rightarrow S + B$			

2.2 Can the $CLR(1)$ parser accept the input string $aaaa + ++$? If yes, please list the moves made by the parser; otherwise, state the reason. Before parsing, please resolve conflicts if any. [10 points]

State	a	+	$	S	B
I_0	s2			I_1	
I_1			acc		
I_2	s4		r $B \rightarrow \epsilon$	I_3	I_5
I_3		s6			
I_4	s4	r $B \rightarrow \epsilon$		I_7	I_8
I_5			r $S \rightarrow aB$		
I_6	s4		r $S \rightarrow aB$	I_3	I_9
I_7		s10			
I_8		r $S \rightarrow aB$			
I_9			r $B \rightarrow S + B$		
I_10	s4	r $S \rightarrow aB$		I_7	I_11
I_11		r $B \rightarrow S + B$			

State	a	+	$	S	B
I_0	s24			I_1	
I_1			acc		
$I_2$4	s24	r $B \to \epsilon$	r $B \to \epsilon$	$I_3$7	$I_5$8
$I_3$7		s610			
$I_5$8		r $S \to aB$	r $S \to aB$		
$I_6$10	s24	r $B \to \epsilon$	r $B \to \epsilon$	$I_3$7	$I_9$11
$I_9$11		r $B \to \epsilon$	r $B \to \epsilon$		

3 (Lookahead LR): Consider the grammar G in Exercise 1:

3.1 Construct the $LALR(1)$ parsing table for G. Please put down the detailed steps, including the merging of $LR(1)$ item sets. [20 points]

From exercise 2m, we can get the LR(1) item sets. But we should merge.

merge 2&4, 3&7, 5&8, 6&10, 9&10

3.2 Can the $LALR(1)$ parser accept the input string $aaaa + ++$? If yes, please list the moves made by the parser; otherwise, state the reason. Before parsing, please resolve conflicts if any. [10 points]

Stack	Symbols	Input	Action
0	$	aaaa+++$	s24
024	$a	aaa+++$	s24
02424	$aa	aa+++$	s24
0242424	$aaa	a+++$	s24
024242424	$aaaa	+++$	r $B \to \epsilon$
02424242458	$aaaaB	+++$	$B \to S + B$
024242437	$aaaS	+++$	s610
024242437610	$aaaS+	++$	r $B \to \epsilon$
024242437610911	$aaaS+B	++$	$B \to S + B$
024242458	$aaaB	++$	r $S \to aB$
0242437	$aaS	++$	s610
0242437610	$aaS+	+$	r $B \to \epsilon$
0242437610911	$aaS+B	+$	$B \to S + B$
0242458	$aaB	+$	r $S \to aB$
02437	$aS	+$	s10
02437610	$aS+	$	r $B \to \epsilon$
02437610911	$aS+B	$	$B \to S + B$
058	$aB	$	r $S \to aB$
01	$S	$	acc