

Assignment Seven

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1 Question One

1.1 Removal of Left Recursion

$A \rightarrow BbA'$
 $A' \rightarrow aA' \mid \epsilon$
 $B \rightarrow aB \mid b$

1.2 Left Factoring

No need to left factor this grammar

1.3 Parse Table

1.3.1 Calculation of first and follow

$\text{first}(A) = \text{first}(B) = \{a, b\}$
 $\text{first}(A') = \text{first}(a) \cup \text{first}(\epsilon) = \{a, \epsilon\}$
 $\text{first}(B) = \text{first}(a) \cup \text{first}(b) = \{a, b\}$

$\text{follow}(A) = \{\$ \}$
 $\text{follow}(A') = \text{follow}(A) = \{\$ \}$
 $\text{follow}(B) = \{b\}$

1.3.2 Predictive Parse Table

Nonterminal	a	b	\$
A	$A \rightarrow BbA'$	$A \rightarrow BbA'$	
A'	$A' \rightarrow aA'$		$A' \rightarrow \epsilon$
B	$B \rightarrow aB$	$B \rightarrow b$	

1.4 Parse of "abba"

Stack	Input	Action	Matched
A\$	abba\$	$A \rightarrow BbA'$	
BbA'\$	abba\$	$B \rightarrow aB$	
aBbA'\$	bba\$	Match a	a
BbA'\$	bba\$	$B \rightarrow b$	a
bbA'\$	bba\$	Match b	ab
bA'\$	ba\$	Match b	abb
A'\$	a\$	$A \rightarrow aA'$	abb
aA'\$	a\$	Match a	abba
A'\$	\$	$A' \rightarrow$	abba
\$	\$	Match	abba
\$	\$	Match \$	
		Accept	

2 Question Two

Stack	Input	Action
\$	(id)*id\$	shift
\$(	id)*id\$	shift
\$(id	)*id\$	reduce $F \rightarrow id$
\$(F	)*id\$	reduce $F \rightarrow E$
\$(E)	*id\$	shift
\$F	*id\$	reduce $F \rightarrow (E)$
\$T	*id\$	reduce $T \rightarrow F$
\$T*	id\$	shift
\$T*id	\$	shift
\$T*F	\$	reduce $F \rightarrow id$
\$T	\$	reduce $T \rightarrow T * F$
\$E	\$	reduce $E \rightarrow T$
\$E	\$	accept

3 Question Three

Stack	Input	Action
\$	()(())\$	Shift
\$(	)((())\$	Shift
\$()	((())\$	Shift
\$Pair	((())\$	Reduce R5
\$List	((())\$	Reduce R3
\$List(	((())\$	Shift
\$List((	((())\$	Shift
\$List((	)\$	Shift
\$List(Pair	)\$	Reduce R5
\$List(Pair)	\$	Shift
\$List Pair	\$	Reduce R4
\$Goal	\$	Reduce R1
\$Goal	\$	Accept

4 Question Four

4.1 a

$\{[N \rightarrow \cdot N + N], [N \rightarrow \cdot NN], [N \rightarrow \cdot (N)], [N \rightarrow \cdot N^*], [N \rightarrow \cdot a]\}$

4.2 b

$\{[N \rightarrow (\cdot N)], [N \rightarrow \cdot NN], [N \rightarrow \cdot (N)], [N \rightarrow \cdot N^*], [N \rightarrow \cdot a]\}$

4.3 c

$\{[N \rightarrow (N \cdot)]\}$

5 Question Five

5.1 a

$\{[A \rightarrow \cdot C B], [C \rightarrow \cdot E D], [E \rightarrow \cdot x A y], [E \rightarrow \cdot x]\}$

5.2 b

$\{[B \rightarrow a \cdot C B], [C \rightarrow \cdot E D], [E \rightarrow \cdot x A y], [E \rightarrow \cdot x]\}$

5.3 c

$\{[B \rightarrow a C \cdot B], [B \rightarrow \cdot a C B]\}$

5.4 d

$\{[C \rightarrow E D \cdot]\}$

5.5 e

$\{[D \rightarrow b \cdot E D], [E \rightarrow \cdot x A y], [E \rightarrow \cdot z]\}$

5.6 f

$\{\}$

6 Question Six

GOTO	state	items
	0	closure($A' \rightarrow \cdot A$) $A' \rightarrow \cdot A$ $A \rightarrow \cdot a A$ $A \rightarrow \cdot B$ $B \rightarrow \cdot b$
(0, A)	1	closure($A' \rightarrow A \cdot$) $A' \rightarrow A \cdot$
(0, B)	2	closure($A \rightarrow B \cdot$) $A \rightarrow B \cdot$
(0, a)	3	closure($A \rightarrow a \cdot A b B$) $A \rightarrow a \cdot A$ $A \rightarrow \cdot a A$ $A \rightarrow \cdot B$ $B \rightarrow \cdot b$
(0, b)	4	closure($B \rightarrow b \cdot$) $B \rightarrow b \cdot$
(3, A)	5	closure($A \rightarrow a A \cdot b B$) $A \rightarrow a A \cdot$
(3, B)	2	$A \rightarrow B \cdot$
(3, a)	3	$A \rightarrow a \cdot A$ $A \rightarrow \cdot a A$ $A \rightarrow \cdot B$ $B \rightarrow \cdot b$
(3, b)	4	$B \rightarrow b \cdot$
(5, b)	6	closure($A \rightarrow a A b \cdot B$) $A \rightarrow a A b \cdot B$ $B \rightarrow \cdot b$
(6, B)	7	closure($A \rightarrow a A b B \cdot$) $A \rightarrow a A b B \cdot$
(6, b)	4	$B \rightarrow b \cdot$

7 Question Seven

7.1 First, Follow

$\text{first}(A') = \text{first}(A) = \{a\}$
 $\text{first}(A) = \text{first}(B) = \{a\}$
 $\text{first}(B) = \text{first}(a) = \{a\}$

$\text{follow}(A') = \{\$ \}$
 $\text{follow}(A) = \text{first}(b) \cup \text{follow}(A') = \{b, \$ \}$
 $\text{follow}(B) = \text{first}(a) \cup \text{follow}(A) = \{a, b, \$ \}$

7.2 Items

GOTO	state	items
	0	closure($A' \rightarrow \cdot A$) $A' \rightarrow \cdot A$ $A \rightarrow \cdot A b B$ $A \rightarrow \cdot B a$ $B \rightarrow \cdot a$
(0, A)	1	closure($\{A \rightarrow A \cdot b B, A' \rightarrow A \cdot\}$) $A \rightarrow A \cdot b B$ $A' \rightarrow A \cdot$
(0, B)	2	closure($A \rightarrow B \cdot a$) $A \rightarrow B \cdot a$
(0, a)	3	closure($B \rightarrow a \cdot$) $B \rightarrow a \cdot$
(1, b)	4	closure($A \rightarrow A b \cdot B$) $A \rightarrow A b \cdot B$ $B \rightarrow \cdot a$
(2, a)	5	closure($A \rightarrow B a \cdot$) $A \rightarrow B a \cdot$
(4, B)	6	closure($A \rightarrow A b B \cdot$) $A \rightarrow A b B \cdot$
(4, a)	3	closure($B \rightarrow a \cdot$) $B \rightarrow a \cdot$

7.3 SLR Parse Table

state	a	b	\$	A	B
0	s3			1	2
1		s4	acc		
2	s5				
3	r4	r4	r4		
4	s3				6
5		r3	r3		
6		r2	r2		

7.4 Parse of "aaba"

stack	symbols	input	action
0		aaba\$	shift 3
0 3	a	aba\$	reduce 4
0 2	B	aba\$	shift 5
0 2 5	Ba	ba\$	reduce 3
0 1	A	ba\$	shift 4
0 1 4	Ab	a\$	shift 3
0 1 4 3	Aba	\$	reduce 4
0 1 4 6	AbB	\$	reduce 2
0 1	A	\$	accept

8 Question Eight

8.1 First, Follow

$\text{first}(A') = \text{first}(A) = \{a, b, f\}$

$\text{first}(A) = \text{first}(a) \cup \text{first}(B) = \{a, b, f\}$
 $\text{first}(B) = \text{first}(b) \cup \text{first}(f) = \{b, f\}$

$\text{follow}(A') = \{\$ \}$
 $\text{follow}(A) = \text{follow}(A') = \{\$ \}$
 $\text{follow}(B) = \text{first}(a) = \{a\}$

8.2 Items

GOTO	state	items
	0	closure($A' \rightarrow \cdot A, \backslash$) $A' \rightarrow \cdot A, \$$ $A \rightarrow \cdot B a, \$$ $A \rightarrow \cdot a A, \$$ $B \rightarrow \cdot b B, a$ $B \rightarrow \cdot f, a$
(0, A)	1	closure($A' \rightarrow A \cdot, \$$) $A' \rightarrow A \cdot, \$$
(0, B)	2	closure($A \rightarrow B \cdot a, \$$) $A \rightarrow B \cdot a, \$$
(0, a)	3	closure($A \rightarrow a \cdot A, \$$) $A \rightarrow a \cdot A, \$$ $A \rightarrow \cdot B a, \$$ $A \rightarrow \cdot a A, \$$ $B \rightarrow \cdot b B, a$ $B \rightarrow \cdot f, a$
(0, b)	4	closure($B \rightarrow b \cdot B, a$) $B \rightarrow b \cdot B, a$ $B \rightarrow \cdot b B, a$ $B \rightarrow \cdot f, a$
(0, f)	5	closure($B \rightarrow f \cdot, a$) $B \rightarrow f \cdot, a$
(2, a)	6	closure($A \rightarrow B a \cdot, \$$) $A \rightarrow B a \cdot, \$$
(3, A)	7	closure($A \rightarrow a A \cdot, \$$) $A \rightarrow a A \cdot, \backslash$
(3, B)	2	closure($A \rightarrow B \cdot a, \$$) $A \rightarrow B \cdot a, \$$
(3, a)	3	closure($A \rightarrow a \cdot A, \$$) $A \rightarrow a \cdot A, \$$ $A \rightarrow \cdot B a, \$$ $A \rightarrow \cdot a A, \$$ $B \rightarrow \cdot b B, a$ $B \rightarrow \cdot f, a$
(3, b)	4	closure($B \rightarrow b \cdot B, a$) $B \rightarrow b \cdot B, a$ $B \rightarrow \cdot b B, a$ $B \rightarrow \cdot f, a$
(3, f)	5	closure($B \rightarrow f \cdot, a$) $B \rightarrow f \cdot, a$
(4, B)	8	closure($B \rightarrow b B \cdot, a$) $B \rightarrow b B \cdot, a$
(4, b)	4	closure($B \rightarrow b \cdot B, a$) $B \rightarrow b \cdot B, a$ $B \rightarrow \cdot b B, a$ $B \rightarrow \cdot f, a$
(4, f)	5	closure($B \rightarrow f \cdot, a$) $B \rightarrow f \cdot, a$

8.3 LR Parse Table

state	a	b	f	\$	A	B
0	s3	s4	s5		1	2
1				acc		
2	s6					
3	s3	s4	s5		7	2
4		s4	s5			8
5	r5					
6				r2		
7				r3		
8	r4					

8.4 Parse of "abfa"

stack	symbols	input	action
0		abfa\$	shift 3
0 3	a	bfa\$	shift 4
0 3 4	ab	fa\$	shift 5
0 3 4 5	abf	a\$	reduce 5
0 3 4 8	abB	a\$	reduce 4
0 3 2	aB	a\$	shift 6
0 3 2 6	aBa	\$	reduce 2
0 3 7	aBa	\$	reduce 3
0 1	aA	\$	accept