

LR(0) parser

Ex. $G = (\{S', S, A\}, \{a, b, c\}, P, S')$

P: $S' \rightarrow S$

(1) $S \rightarrow aA$

(2) $A \rightarrow bA$

(3) $A \rightarrow c$

$w = abbc$

Obs.: LR(0) item $[A \rightarrow \alpha.\beta]$

1. Compute the canonical collection of states @B Razvan Neta

$s_0 = \text{closure}(\{[S' \rightarrow .S]\}) = \{[S' \rightarrow .S], [S \rightarrow .aA]\}$

$s_1 = \text{goto}(s_0, S) = \text{closure}(\{[S' \rightarrow S.]\}) = \{[S' \rightarrow S.]\}$

$s_2 = \text{goto}(s_0, a) = \text{closure}(\{[S \rightarrow a.A]\}) = \{[S \rightarrow a.A], [A \rightarrow .bA], [A \rightarrow .c]\}$

$s_3 = \text{goto}(s_2, A) = \text{closure}(\{[S \rightarrow aA.]\}) = \{[S \rightarrow aA.]\}$

$s_4 = \text{goto}(s_2, b) = \text{closure}(\{[A \rightarrow b.A]\}) = \{[A \rightarrow b.A], [A \rightarrow .bA], [A \rightarrow .c]\}$

$s_5 = \text{goto}(s_2, c) = \text{closure}(\{[A \rightarrow c.]\}) = \{[A \rightarrow c.]\}$

$s_6 = \text{goto}(s_4, A) = \text{closure}(\{[A \rightarrow bA.]\}) = \{[A \rightarrow bA.]\}$

$\text{goto}(s_4, b) = \text{closure}(\{[A \rightarrow b.A]\}) = s_4$

$\text{goto}(s_4, c) = \text{closure}(\{[A \rightarrow c.]\}) = s_5$

2. Fill in LR(0) parsing table @B Iuliana Pascotescu

	ACTION	GOTO				
		a	b	c	S	A
0	shift	2			1	
1	acc					
2	shift		4	5		3

3	reduce 1					
4	shift		4	5		6
5	reduce 3					
6	reduce 2					

3. Parse the input sequence @B Nenisca Maria

work stack	input stack	output band
\$0	abbc\$	ϵ
\$0a2	bbc\$	ϵ
\$0a2b4	bc\$	ϵ
\$0a2b4b4	c\$	ϵ
\$0a2b4b4c5	\$	ϵ
\$0a2b4b4A6	\$	3
\$0a2b4A6	\$	2,3
\$0a2A3	\$	2,2,3
\$0S1	\$	1,2,2,3
acc	\$	1,2,2,3

SLR parser

Ex. $G = (\{S', E, T\}, \{+, id, const, (,)\}, P, S')$

P: $S' \rightarrow E$

(1) $E \rightarrow T$

(2) $E \rightarrow E + T$

(3) $T \rightarrow (E)$

(4) $T \rightarrow id$

(5) $T \rightarrow const$

$w = id + const$

$FOLLOW(E) = \{\epsilon, +,)\}$

$FOLLOW(T) = \{\epsilon, +,)\}$

1. Canonical collection Onita Andrei @B: Bogdan Diaconu

$s_0 = closure(\{[S' \rightarrow .E]\}) = \{[S' \rightarrow .E], [E \rightarrow .T], [E \rightarrow .E + T], [T \rightarrow .(E)], [T \rightarrow .id], [T \rightarrow .const]\}$

$s_1 = goto(s_0, E) = closure(\{[S' \rightarrow E.], [E \rightarrow E. + T]\}) = \{[S' \rightarrow E.], [E \rightarrow E. + T]\}$

$s_2 = goto(s_0, T) = closure(\{[E \rightarrow T.]\}) = \{[E \rightarrow T.]\}$

$s_3 = goto(s_0, () = closure(\{[T \rightarrow .(E)]\}) = \{[T \rightarrow .(E)], [E \rightarrow .T], [E \rightarrow .E + T], [T \rightarrow .(E)], [T \rightarrow .id], [T \rightarrow .const]\}$

$s_4 = goto(s_0, id) = closure(\{[T \rightarrow id.]\}) = \{[T \rightarrow id.]\}$

$s_5 = goto(s_0, const) = closure(\{[T \rightarrow const.]\}) = \{[T \rightarrow const.]\}$

$s_6 = goto(s_1, +) = closure(\{[E \rightarrow E + .T]\}) = \{[E \rightarrow E + .T], [T \rightarrow .(E)], [T \rightarrow .id], [T \rightarrow .const]\}$

$s_7 = goto(s_3, E) = closure(\{[T \rightarrow (E.)], [E \rightarrow E. + T]\}) = \{[T \rightarrow (E.)], [E \rightarrow E. + T]\}$

$goto(s_3, T) = closure(\{[E \rightarrow T.]\}) = \{[E \rightarrow T.]\} = s_2$

$goto(s_3, () = closure(\{[T \rightarrow .(E)]\}) = s_3$

$goto(s_3, id) = closure(\{[T \rightarrow id.]\}) = s_4$

$goto(s_3, const) = closure(\{[T \rightarrow const.]\}) = s_5$

$$s_8 = goto(s_6, T) = closure(\{[E \rightarrow E + T.]\}) = \{[E \rightarrow E + T.]\}$$

$$goto(s_6, () = closure(\{[T \rightarrow (.E)]\}) = s_3$$

$$goto(s_6, id) = closure(\{[T \rightarrow id.]\}) = s_4$$

$$goto(s_6, const) = closure(\{[T \rightarrow const.]\}) = s_5$$

$$s_9 = goto(s_7,) = closure(\{[T \rightarrow (E).]\}) = \{[T \rightarrow (E).]\}$$

$$goto(s_7, +) = closure(\{[E \rightarrow E + .T]\}) = s_6$$

2. SLR table @B: Iuliana Pascotescu

	ACTION						GOTO	
	+	()	id	const	\$	E	T
0		Shift 3		Shift 4	Shift 5		1	2
1	Shift 6					acc		
2	Reduce 1		Reduce 1			Reduce 1		
3		Shift 3		Shift 4	Shift 5		7	2
4	Reduce 4		Reduce 4			Reduce 4		
5	Reduce 5		Reduce 5			Reduce 5		
6		Shift 3		Shift 4	Shift 5			8
7	Shift 6		Shift 9					
8	Reduce 2		Reduce 2			Reduce 2		
9	Reduce 3		Reduce 3			Reduce 3		

3. Parse the sequence @B: Petcu Dragos

Work stack	Input stack	Output band
\$0	id+const\$	ϵ
\$0id4	+const\$	
\$0T2	+const\$	4
\$0E1	+const\$	1,4
\$0E1+6	const\$	1,4
\$0E1+6const5	\$	1,4
\$0E1+6T8	\$	5,1,4
\$0E1	\$	2,5,1,4
acc		

$E \Rightarrow E + T \Rightarrow E + const \Rightarrow T + const \Rightarrow id + const$
 2 5 1 4

LR(1) parser

Ex. $G = (\{S', S, A\}, \{a, b\}, P, S')$

P: $S' \rightarrow S$

(1) $S \rightarrow AA$

(2) $A \rightarrow aA$

(3) $A \rightarrow b$

w = abab

LR(1) item $[A \rightarrow \alpha.\beta, a]$

FIRST(A) = {a,b}

FIRST(S) = {a,b}

1. Canonical collection

//Onita Andrei

//Nourescu Oana

$$s_0 = \text{closure}(\{[S' \rightarrow .S, \$]\}) = \{[S' \rightarrow .S, \$], [S \rightarrow .AA, \$], [A \rightarrow .aA, a], [A \rightarrow .aA, b], [A \rightarrow .b, a], [A \rightarrow .b, b]\}$$

$$s_1 = \text{goto}(s_0, S) = \text{closure}(\{[S' \rightarrow S., \$]\}) = \{[S' \rightarrow S., \$]\}$$

$$s_2 = \text{goto}(s_0, A) = \text{closure}(\{[S \rightarrow AA., \$]\}) = \{[S \rightarrow AA., \$], [A \rightarrow .aA, \$], [A \rightarrow .b, \$]\}$$

$$s_3 = \text{goto}(s_0, a) = \text{closure}(\{[A \rightarrow a.A, a], [A \rightarrow a.A, b]\}) = \{[A \rightarrow a.A, a], [A \rightarrow a.A, b], [A \rightarrow .aA, a], [A \rightarrow .b, a], [A \rightarrow .aA, b], [A \rightarrow .b, b]\}$$

$$s_4 = \text{goto}(s_0, b) = \text{closure}(\{[A \rightarrow b., a], [A \rightarrow b., b]\}) = \{[A \rightarrow b., a], [A \rightarrow b., b]\}$$

$$s_5 = \text{goto}(s_2, A) = \text{closure}(\{[S \rightarrow AA., \$]\}) = \{[S \rightarrow AA., \$]\}$$

$$s_6 = \text{goto}(s_2, a) = \text{closure}(\{[A \rightarrow a.A, \$]\}) = \{[A \rightarrow a.A, \$], [A \rightarrow .aA, \$], [A \rightarrow .b, \$]\}$$

$$s_7 = \text{goto}(s_2, b) = \text{closure}(\{[A \rightarrow b., \$]\}) = \{[A \rightarrow b., \$]\}$$

$$s_8 = \text{goto}(s_3, A) = \text{closure}(\{[A \rightarrow aA., a], [A \rightarrow aA., b]\}) = \{[A \rightarrow aA., a], [A \rightarrow aA., b], [A \rightarrow .aA, a], [A \rightarrow .b, a], [A \rightarrow .aA, b], [A \rightarrow .b, b]\}$$

$$\text{goto}(s_3, a) = \text{closure}(\{[A \rightarrow a.A, a], [A \rightarrow a.A, b]\}) = s_3$$

$$\text{goto}(s_3, b) = \text{closure}(\{[A \rightarrow b., a], [A \rightarrow b., b]\}) = s_4$$

$$s_9 = \text{goto}(s_6, A) = \text{closure}(\{[A \rightarrow aA., \$]\}) = \{[A \rightarrow aA., \$]\}$$

$$\text{goto}(s_6, a) = \text{closure}(\{[A \rightarrow a.A, \$]\}) = s_6$$

$$\text{goto}(s_6, b) = \text{closure}(\{[A \rightarrow b., \$]\}) = s_7$$

2. LR(1) table

// Nourescu Oana

	ACTION			GOTO	
	a	b	\$	S	A
0	shift 3	shift 4		1	2
1			accept		
2	Shift 6	Shift 7			5
3	Shift 3	Shift 4			8

4	Reduce 3	Reduce 3			
5			Reduce 1		
6	Shift 6	Shift 7			9
7			Reduce 3		
8	Reduce 2	Reduce 2			
9			Reduce 2		

3. Parse the sequence

// Nourescu Oana

Work stack	Input stack	Output band
\$0	abab\$	
\$0a3	bab\$	
\$0a3b4	ab\$	
\$0a3A8	ab\$	3
\$0A2	ab\$	23
\$0A2a6	b\$	23
\$0A2a6b7	\$	23
\$0A2a6A9	\$	323
\$0A2A5	\$	2323
\$0S1	\$	12323
accept		12323

LALR(1) parser

Ex. $G = (\{S', S, A\}, \{a, b\}, P, S')$

P: $S' \rightarrow S$

(1) $S \rightarrow AA$

(2) $A \rightarrow aA$

(3) $A \rightarrow b$

W = aaab

1. Canonical collection

$s_0 = \{[S' \rightarrow .S, \$], [S \rightarrow .AA, \$], [A \rightarrow .aA, a], [A \rightarrow .aA, b], [A \rightarrow .b, a], [A \rightarrow .b, b]\}$

$s_1 = \{[S' \rightarrow S., \$]\}$

$s_2 = \{[S \rightarrow A.A, \$], [A \rightarrow .aA, \$], [A \rightarrow .b, \$]\}$

$s_{36} = \{[A \rightarrow a.A, a/b/\$], [A \rightarrow .aA, a/b/\$], [A \rightarrow .b, a/b/\$]\}$

$s_{47} = \{[A \rightarrow b., a/b/\$]\}$

$s_5 = \{[S \rightarrow AA., \$]\}$

$s_{89} = \{[A \rightarrow aA., a/b/\$]\}$

2. LALR(1) table

	ACTION			GOTO	
	a	b	\$	S	A
s0	Shift s36	Shift s47		s1	s2
s1			accept		
s2	Shift s36	Shift s47			s5
s36	Shift s36	Shift s47			s89

s47	Reduce 3	Reduce 3	Reduce 3		
s5			Reduce 1		
s89	Reduce 2	Reduce 2	Reduce 2		

3. Parse the sequence

// Nourescu Oana

Work stack	Input stack	Output band
\$ s0	a a a b \$	Eps
\$ s0 a s36	a a b \$	Eps
\$ s0 a s36 a s36	a b \$	Eps
\$ s0 a s36 a s36 a s36	b \$	Eps
\$ s0 a s36 a s36 a s36 b s47	\$	Eps
\$ s0 a s36 a s36 a s36 A s89	\$	3
\$ s0 a s36 a s36 A s89	\$	23
\$ s0 a s36 A s89	\$	223
\$ s0 A s2	\$	2223

The sequence is syntactically incorrect

Quiz

$S' \rightarrow E$

(1) $E \rightarrow E + T$

(2) $E \rightarrow T$

(3) $T \rightarrow (E)$

(4) $T \rightarrow a$

? Compute first 3 states of the LR(1) canonical collection -> add a page Quiz12 in your private Homework space of Class Notebook