

# ANÁLISIS SINTÁCTICO LALR(1)

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## • GRAMÁTICA

P = {

- (1) program  $\rightarrow$  statements
- (2) statements  $\rightarrow \epsilon$
- (3) statements  $\rightarrow$  statements statement
- (4) statement  $\rightarrow$  **SEMICOLON**
- (5) statement  $\rightarrow$  type **ID LPAREN** list **RPAREN SEMICOLON**
- (6) type  $\rightarrow$  type **POINTER**
- (7) type  $\rightarrow$  **INT**
- (8) list  $\rightarrow$  list **COMMA** type
- (9) list  $\rightarrow$  type

}

program  $\Rightarrow$ (1) statements

$\Rightarrow$ (3) statements statement

$\Rightarrow$ (5) statements type ID LPAREN list RPAREN SEMICOLON

$\Rightarrow$ (8) statements type **ID LPAREN** list **COMMA** type **RPAREN SEMICOLON**

$\Rightarrow$ (7) statements type **ID LPAREN** list **COMMA** INT **RPAREN SEMICOLON**

$\Rightarrow$ (9) statements type **ID LPAREN** type **COMMA INT RPAREN SEMICOLON**

$\Rightarrow$ (6) statements type **ID LPAREN** type POINTER **COMMA INT RPAREN SEMICOLON**

$\Rightarrow$ (7) statements type **ID LPAREN INT POINTER COMMA INT RPAREN SEMICOLON**

$\Rightarrow$ (7) statements INT **ID LPAREN INT POINTER COMMA INT RPAREN SEMICOLON**

$\Rightarrow$ (2) **INT ID LPAREN INT POINTER COMMA INT RPAREN SEMICOLON**

## • AMPLIACIÓN DE LA GRAMÁTICA

P' = {

- (1') program'  $\rightarrow$  program
- (1) program  $\rightarrow$  statements
- (2) statements  $\rightarrow \epsilon$
- (3) statements  $\rightarrow$  statements statement
- (4) statement  $\rightarrow$  **SEMICOLON**
- (5) statement  $\rightarrow$  type **ID LPAREN** list **RPAREN SEMICOLON**
- (6) type  $\rightarrow$  type **POINTER**
- (7) type  $\rightarrow$  **INT**
- (8) list  $\rightarrow$  list **COMMA** type
- (9) list  $\rightarrow$  type

}

- CONSTRUCCIÓN DE LA COLECCIÓN DE ELEMENTOS-LR(1)

$I_0 = \text{clausura}\{\text{program}' \rightarrow \cdot \text{program}, \$\}$   
 $= \{$   
      $[\text{program}' \rightarrow \cdot \text{program}, \$],$   
      $[\text{program} \rightarrow \cdot \text{statements}, \$],$   
      $[\text{statements} \rightarrow \cdot, \$, \text{SEMICOLON}, \text{INT}]$   
      $[\text{statements} \rightarrow \cdot \text{statements statement}, \$, \text{SEMICOLON}, \text{INT}]$   
 $\}$

**Transiciones de I0**

$Ir_a(I_0, \text{program}) = \text{clausura}\{[\text{program}' \rightarrow \text{program} \cdot, \$]\}$   
 $= \{[\text{program}' \rightarrow \text{program} \cdot, \$]\} = I_1$

$Ir_a(I_0, \text{statements}) = \text{clausura}\{[\text{program} \rightarrow \text{statements} \cdot, \$],$   
      $[\text{statements} \rightarrow \text{statements} \cdot \text{statement}, \$, \text{SEMICOLON}, \text{INT}]\}$   
 $= \{$   
      $[\text{program} \rightarrow \text{statements} \cdot, \$],$   
      $[\text{statements} \rightarrow \text{statements} \cdot \text{statement}, \$, \text{SEMICOLON}, \text{INT}],$   
      $[\text{statement} \rightarrow \cdot \text{SEMICOLON}, \$, \text{SEMICOLON}, \text{INT}],$   
      $[\text{statement} \rightarrow \cdot \text{type ID LPAREN list RPAREN SEMICOLON}, \$, \text{SEMICOLON}, \text{INT}],$   
      $[\text{type} \rightarrow \cdot \text{type POINTER, ID, POINTER}],$   
      $[\text{type} \rightarrow \cdot \text{INT, ID, POINTER}]$   
 $\} = I_2$

**Transiciones de I1** =  $\{[\text{program}' \rightarrow \text{program} \cdot, \$]\}$   
 No tiene

**Transiciones de I2**

$Ir_a(I_2, \text{statement}) = \text{clausura}\{[\text{statements} \rightarrow \text{statements statement} \cdot, \$, \text{SEMICOLON}, \text{INT}]\}$   
 $= \{[\text{statements} \rightarrow \text{statements statement} \cdot, \$, \text{SEMICOLON}, \text{INT}]\}$   
 $= I_3$

$Ir_a(I_2, \text{SEMICOLON}) = \text{clausura}\{[\text{statement} \rightarrow \text{SEMICOLON} \cdot, \$, \text{SEMICOLON}, \text{INT}]\}$   
 $= \{[\text{statement} \rightarrow \text{SEMICOLON} \cdot, \$, \text{SEMICOLON}, \text{INT}]\}$   
 $= I_4$

$Ir_a(I_2, \text{type}) = \text{clausura}\{[\text{statement} \rightarrow \text{type} \cdot \text{ID LPAREN list RPAREN SEMICOLON},$   
      $\$, \text{SEMICOLON}, \text{INT}],$   
      $[\text{type} \rightarrow \text{type} \cdot \text{POINTER, ID, POINTER}]\}$   
 $= \{[\text{statement} \rightarrow \text{type} \cdot \text{ID LPAREN list RPAREN SEMICOLON},$   
      $\$, \text{SEMICOLON}, \text{INT}],$   
      $[\text{type} \rightarrow \text{type} \cdot \text{POINTER, ID, POINTER}]\} = I_5$

$Ir_a(I_2, \text{INT}) = \text{clausura}\{[\text{type} \rightarrow \text{INT} \cdot, \text{ID, POINTER}]\}$   
 $= \{[\text{type} \rightarrow \text{INT} \cdot, \text{ID, POINTER}]\}$   
 $= I_6$

**Transiciones de I3** = {{statements → statements statement ·, \$, SEMICOLON, INT}}

No tiene

**Transiciones de I4** = {{statement → SEMICOLON ·, \$, SEMICOLON, INT}}

No tiene

**Transiciones de I5**

$lr\_a(I5, ID) = \text{clausura}(\{\{statement \rightarrow type\ ID \cdot LPAREN\ list\ RPAREN\ SEMICOLON,\ \$,\ SEMICOLON,\ INT\}\})$   
= {{statement → type ID · LPAREN list RPAREN SEMICOLON, \$, SEMICOLON, INT}}  
= I7

$lr\_a(I5, POINTER) = \text{clausura}(\{\{type \rightarrow type\ POINTER \cdot,\ ID,\ POINTER\}\})$   
= {{type → type POINTER ·, ID, POINTER}}  
= I8

**Transiciones de I6** = {{type → INT ·, ID, POINTER}}

No tiene

**Transiciones de I7**

$lr\_a(I7, LPAREN) = \text{clausura}(\{\{statement \rightarrow type\ ID\ LPAREN \cdot\ list\ RPAREN\ SEMICOLON,\ \$,\ SEMICOLON,\ INT\}\})$   
= {{statement → type ID LPAREN · list RPAREN SEMICOLON, \$, SEMICOLON, INT},  
[list → · list COMMA type, RPAREN, COMMA],  
[list → · type, RPAREN, COMMA],  
[type → · type POINTER, RPAREN, COMMA, POINTER],  
[type → · INT, RPAREN, COMMA, POINTER]}  
= I9

**Transiciones de I8** = {{type → type POINTER ·, ID, POINTER}}

No tiene

**Transiciones de I9**

$lr\_a(I9, list) = \text{clausura}(\{\{statement \rightarrow type\ ID\ LPAREN\ list \cdot\ RPAREN\ SEMICOLON,\ \$,\ SEMICOLON,\ INT\},$   
[list → list · COMMA type, RPAREN, COMMA]})  
= {{statement → type ID LPAREN list · RPAREN SEMICOLON, \$, SEMICOLON, INT},  
[list → list · COMMA type, RPAREN, COMMA]}  
= I10

$lr\_a(I9, type) = \text{clausura}(\{\{list \rightarrow type \cdot,\ RPAREN,\ COMMA\},$   
[type → type · POINTER, RPAREN, COMMA]})  
= {{list → type ·, RPAREN, COMMA},  
[type → type · POINTER, RPAREN, COMMA, POINTER]}  
= I11

$lr\_a(I9, INT) = \text{clausura}(\{\{type \rightarrow INT \cdot,\ RPAREN,\ COMMA\}\})$   
= {{type → INT ·, RPAREN, COMMA, POINTER}}

= I12

#### Transiciones de I10

$lr\_a(I10, RPAREN) = \text{clausura}(\{[statement \rightarrow type \text{ ID LPAREN list RPAREN } \cdot \text{ SEMICOLON}, \\ \$, \text{ SEMICOLON}, \text{ INT}]\})$   
 $= \{[statement \rightarrow type \text{ ID LPAREN list RPAREN } \cdot \text{ SEMICOLON}, \$, \text{ SEMICOLON}, \text{ INT}]\}$   
= I13

$lr\_a(I10, COMMA) = \text{clausura}(\{[list \rightarrow list \text{ COMMA } \cdot \text{ type, RPAREN, COMMA}]\})$   
 $= \{[list \rightarrow list \text{ COMMA } \cdot \text{ type, RPAREN, COMMA}, \\ [type \rightarrow \cdot \text{ type POINTER, RPAREN, COMMA, POINTER}, \\ [type \rightarrow \cdot \text{ INT, RPAREN, COMMA, POINTER}]\}$   
= I14

#### Transiciones de I11

$lr\_a(I11, POINTER) = \text{clausura}(\{[type \rightarrow type \text{ POINTER } \cdot, \text{ RPAREN, COMMA, POINTER}]\})$   
 $= \{[type \rightarrow type \text{ POINTER } \cdot, \text{ RPAREN, COMMA, POINTER}]\}$   
= I15

**Transiciones de I12** =  $\{[type \rightarrow \text{ INT } \cdot, \text{ RPAREN, COMMA, POINTER}]\}$

No tiene

#### Transiciones de I13

$lr\_a(I13, SEMICOLON) = \text{clausura}(\{[statement \rightarrow type \text{ ID LPAREN list RPAREN SEMICOLON } \cdot, \\ \$, \text{ SEMICOLON}, \text{ INT}]\})$   
 $= \{[statement \rightarrow type \text{ ID LPAREN list RPAREN SEMICOLON } \cdot, \$, \text{ SEMICOLON}, \text{ INT}]\}$   
= I16

#### Transiciones de I14

$lr\_a(I14, type) = \text{clausura}(\{[list \rightarrow list \text{ COMMA type } \cdot, \text{ RPAREN, COMMA}, \\ [type \rightarrow type \cdot \text{ POINTER, RPAREN, COMMA, POINTER}]\})$   
 $= \{[list \rightarrow list \text{ COMMA type } \cdot, \text{ RPAREN, COMMA}, \\ [type \rightarrow type \cdot \text{ POINTER, RPAREN, COMMA, POINTER}]\}$   
= I17

$lr\_a(I14, INT) = \text{clausura}(\{[type \rightarrow \text{ INT } \cdot, \text{ RPAREN, COMMA, POINTER}]\})$   
 $= \{[type \rightarrow \text{ INT } \cdot, \text{ RPAREN, COMMA, POINTER}]\}$   
= I12

**Transiciones de I15** =  $\{[type \rightarrow type \text{ POINTER } \cdot, \text{ RPAREN, COMMA, POINTER}]\}$

No tiene

**Transiciones de I16** =  $\{[statement \rightarrow type \text{ ID LPAREN list RPAREN SEMICOLON } \cdot, \\ \$, \text{ SEMICOLON}, \text{ INT}]\}$

No tiene

#### Transiciones de I17

$lr\_a(I17, POINTER) = \text{clausura}(\{[type \rightarrow type \text{ POINTER } \cdot, \text{ RPAREN, COMMA, POINTER}]\})$   
 $= \{[type \rightarrow type \text{ POINTER } \cdot, \text{ RPAREN, COMMA, POINTER}]\}$   
= I15

- COLECCIÓN DE ELEMENTOS-LR(1)

I0 = clausura{  $\text{program}' \rightarrow \cdot \text{program}, \$$  }

= {  
 $[\text{program}' \rightarrow \cdot \text{program}, \$]$ ,  
 $[\text{program} \rightarrow \cdot \text{statements}, \$]$ ,  
 $[\text{statements} \rightarrow \cdot, \$, \text{SEMICOLON}, \text{INT}]$   
 $[\text{statements} \rightarrow \cdot \text{statements statement}, \$, \text{SEMICOLON}, \text{INT}]$   
 }

I1 = {  $[\text{program}' \rightarrow \text{program} \cdot, \$]$  }

I2 =

{  
 $[\text{program} \rightarrow \text{statements} \cdot, \$]$ ,  
 $[\text{statements} \rightarrow \text{statements} \cdot \text{statement}, \$, \text{SEMICOLON}, \text{INT}]$ ,  
 $[\text{statement} \rightarrow \cdot \text{SEMICOLON}, \$, \text{SEMICOLON}, \text{INT}]$ ,  
 $[\text{statement} \rightarrow \cdot \text{type ID LPAREN list RPAREN SEMICOLON}, \$, \text{SEMICOLON}, \text{INT}]$ ,  
 $[\text{type} \rightarrow \cdot \text{type POINTER}, \text{ID}, \text{POINTER}]$ ,  
 $[\text{type} \rightarrow \cdot \text{INT}, \text{ID}, \text{POINTER}]$   
 }

I3 = {  $[\text{statements} \rightarrow \text{statements statement} \cdot, \$, \text{SEMICOLON}, \text{INT}]$  }

I4 = {  $[\text{statement} \rightarrow \text{SEMICOLON} \cdot, \$, \text{SEMICOLON}, \text{INT}]$  }

I5 = {  $[\text{statement} \rightarrow \text{type} \cdot \text{ID LPAREN list RPAREN SEMICOLON}, \$, \text{SEMICOLON}, \text{INT}]$ ,  
 $[\text{type} \rightarrow \text{type} \cdot \text{POINTER}, \text{ID}, \text{POINTER}]$  }

I6 = {  $[\text{type} \rightarrow \text{INT} \cdot, \text{ID}, \text{POINTER}]$  }

I7 = {  $[\text{statement} \rightarrow \text{type ID} \cdot \text{LPAREN list RPAREN SEMICOLON}, \$, \text{SEMICOLON}, \text{INT}]$  }

I8 = {  $[\text{type} \rightarrow \text{type POINTER} \cdot, \text{ID}, \text{POINTER}]$  }

I9 = {  $[\text{statement} \rightarrow \text{type ID LPAREN} \cdot \text{list RPAREN SEMICOLON}, \$, \text{SEMICOLON}, \text{INT}]$ ,  
 $[\text{list} \rightarrow \cdot \text{list COMMA type}, \text{RPAREN}, \text{COMMA}]$ ,  
 $[\text{list} \rightarrow \cdot \text{type}, \text{RPAREN}, \text{COMMA}]$ ,  
 $[\text{type} \rightarrow \cdot \text{type POINTER}, \text{RPAREN}, \text{COMMA}, \text{POINTER}]$ ,  
 $[\text{type} \rightarrow \cdot \text{INT}, \text{RPAREN}, \text{COMMA}, \text{POINTER}]$  }

I10 = {  $[\text{statement} \rightarrow \text{type ID LPAREN list} \cdot \text{RPAREN SEMICOLON}, \$, \text{SEMICOLON}, \text{INT}]$ ,  
 $[\text{list} \rightarrow \text{list} \cdot \text{COMMA type}, \text{RPAREN}, \text{COMMA}]$  }

I11 = {  $[\text{list} \rightarrow \text{type} \cdot, \text{RPAREN}, \text{COMMA}]$ ,  
 $[\text{type} \rightarrow \text{type} \cdot \text{POINTER}, \text{RPAREN}, \text{COMMA}, \text{POINTER}]$  }

I12 = {  $[\text{type} \rightarrow \text{INT} \cdot, \text{RPAREN}, \text{COMMA}, \text{POINTER}]$  }

I13 = {[statement → type ID LPAREN list RPAREN · SEMICOLON, \$, SEMICOLON, INT]}

I14 = {[list → list COMMA · type, RPAREN, COMMA],  
 [type → · type POINTER, RPAREN, COMMA, POINTER],  
 [type → · INT, RPAREN, COMMA, POINTER]}

I15 = {[type → type POINTER ·, RPAREN, COMMA, POINTER]}

I16 = {[statement → type ID LPAREN list RPAREN SEMICOLON ·, \$, SEMICOLON, INT]}

I17 = {[list → list COMMA type ·, RPAREN, COMMA],  
 [type → type · POINTER, RPAREN, COMMA, POINTER]}

- AUTÓMATA QUE RECONOCE LOS PREFIJOS VIABLES PARA LOS ELEMENTOS LR(1) VÁLIDOS

	SEMICOLON	ID	LPAREN	RPAREN	POINTER	INT	COMMA	P	Ss	S	type	list
0								1	2			
1												
2	4					6				3	5	
3												
4												
5		7			8							
6												
7			9									
8												
9						12					11	10
10				13			14					
11					15							
12												
13	16											
14						12					17	
15												
16												
17					15							

P = program

Ss: statements

S: statement

- TABLA DE ANÁLISIS SINTÁCTICO ASCENDENTE LR(1)

	ACCIÓN								IR A				
	SEMICOLON	ID	LPAREN	RPAREN	POINTER	INT	COMMA	\$	P	Ss	S	type	list
0	r 2					r 2		r 2	1	2			
1								Aceptar					
2	d 4					d 6		r 1			3	5	
3	r 3					r 3		r 3					
4	r 4					r 4		r 4					
5		d 7			d 8								
6		r 7			r 7								
7			d 9										
8		r 6			r 6								
9						d 12						11	10
10				d 13			d 14						
11				r 9	d 15		r 9						
12				r 7	r 7		r 7						
13	d 16												
14						d 12						17	
15				r 6	r 6		r 6						
16	r 5					r 5		r 5					
17				r 8	d 15		r 8						

P = program  
 Ss: statements  
 S: statement

P' = {

- (1') program' → program
- (1) program → statements
- (2) statements → ε
- (3) statements → statements statement
- (4) statement → **SEMICOLON**
- (5) statement → type **ID LPAREN** list **RPAREN SEMICOLON**
- (6) type → type **POINTER**
- (7) type → **INT**
- (8) list → list **COMMA** type
- (9) list → type

}



- ANÁLISIS LR(1)-canónico

PILA	ENTRADA	ACCIÓN
0	INT ID LPAREN INT POINTER COMMA INT RPAREN SEMICOLON \$	r 2 statements $\rightarrow \epsilon$
0 Ss 2	INT ID LPAREN INT POINTER COMMA INT RPAREN SEMICOLON \$	Desplazar 6
0 Ss 2 INT 6	ID LPAREN INT POINTER COMMA INT RPAREN SEMICOLON \$	r 7: type $\rightarrow$ INT
0 Ss 2 type 5	ID LPAREN INT POINTER COMMA INT RPAREN SEMICOLON \$	Desplazar 7
0 Ss 2 type 5 ID 7	LPAREN INT POINTER COMMA INT RPAREN SEMICOLON \$	Desplazar 9
0 Ss 2 type 5 ID 7 LPAREN 9	INT POINTER COMMA INT RPAREN SEMICOLON \$	Desplazar 12
0 Ss 2 type 5 ID 7 LPAREN 9 INT 12	POINTER COMMA INT RPAREN SEMICOLON \$	r 7: type $\rightarrow$ INT
0 Ss 2 type 5 ID 7 LPAREN 9 type 11	POINTER COMMA INT RPAREN SEMICOLON \$	Desplazar 15
0 Ss 2 type 5 ID 7 LPAREN 9 type 11 POINTER 15	COMMA INT RPAREN SEMICOLON \$	r 6: type $\rightarrow$ type POINTER
0 Ss 2 type 5 ID 7 LPAREN 9 type 11	COMMA INT RPAREN SEMICOLON \$	r 9: list $\rightarrow$ type
0 Ss 2 type 5 ID 7 LPAREN 9 list 10	COMMA INT RPAREN SEMICOLON \$	Desplazar 14
0 Ss 2 type 5 ID 7 LPAREN 9 list 10 COMMA 14	INT RPAREN SEMICOLON \$	Desplazar 12
0 Ss 2 type 5 ID 7 LPAREN 9 list 10 COMMA 14 INT 12	RPAREN SEMICOLON \$	r 7: type $\rightarrow$ INT
0 Ss 2 type 5 ID 7 LPAREN 9 list 10 COMMA 14 type 17	RPAREN SEMICOLON \$	r 8: list $\rightarrow$ list COMMA type
0 Ss 2 type 5 ID 7 LPAREN 9 list 10	RPAREN SEMICOLON \$	Desplazar 13
0 Ss 2 type 5 ID 7 LPAREN 9 list 10 RPAREN 13	SEMICOLON \$	Desplazar 16
0 Ss 2 type 5 ID 7 LPAREN 9 list 10 RPAREN 13 SEMICOLON 16	\$	r 5: statement $\rightarrow$ type ID LPAREN list RPAREN SEMICOLON
0 Ss 2 statement 3	\$	r 3: statements $\rightarrow$ statements statement
0 Ss 2	\$	r 1: program $\rightarrow$ statements
0 P 1	\$	

P = program

Ss: statements

S: statement

- COLECCIÓN DE ELEMENTOS-LALR(1)

I0 = clausura{ **program'** → · program, \$}}

= {  
 [program' → · program, \$],  
 [program → · statements, \$],  
 [statements → ·, \$, SEMICOLON, INT]  
 [statements → · statements statement, \$, SEMICOLON, INT]  
 }

I1 = {[program' → program ·, \$]}

I2 =

{  
 [program → statements ·, \$],  
 [statements → statements · statement, \$, SEMICOLON, INT],  
 [statement → · SEMICOLON, \$, SEMICOLON, INT],  
 [statement → · type ID LPAREN list RPAREN SEMICOLON, \$, SEMICOLON, INT],  
 [type → · type POINTER, ID, POINTER],  
 [type → · INT, ID, POINTER]  
 }

I3 = {[statements → statements statement ·, \$, SEMICOLON, INT]}

I4 = {[statement → SEMICOLON ·, \$, SEMICOLON, INT]}

I5 = {[statement → type · ID LPAREN list RPAREN SEMICOLON, \$, SEMICOLON, INT],  
 [type → type · POINTER, ID, POINTER]}

I6-12 = {[type → INT ·, ID, POINTER, RPAREN, COMMA]}

I7 = {[statement → type ID · LPAREN list RPAREN SEMICOLON, \$, SEMICOLON, INT]}

I8-15 = {[type → type POINTER ·, ID, POINTER, RPAREN, COMMA]}

I9 = {[statement → type ID LPAREN · list RPAREN SEMICOLON, \$, SEMICOLON, INT],  
 [list → · list COMMA type, RPAREN, COMMA],  
 [list → · type, RPAREN, COMMA],  
 [type → · type POINTER, RPAREN, COMMA, POINTER],  
 [type → · INT, RPAREN, COMMA, POINTER]}

I10 = {[statement → type ID LPAREN list · RPAREN SEMICOLON, \$, SEMICOLON, INT],  
 [list → list · COMMA type, RPAREN, COMMA]}

I11 = {[list → type ·, RPAREN, COMMA],  
 [type → type · POINTER, RPAREN, COMMA, POINTER]}

I13 = {[statement → type ID LPAREN list RPAREN · SEMICOLON, \$, SEMICOLON, INT]}

I14 = {[list → list COMMA · type, RPAREN, COMMA],  
[type → · type POINTER, RPAREN, COMMA, POINTER],  
[type → · INT, RPAREN, COMMA, POINTER]}

I16 = {[statement → type ID LPAREN list RPAREN SEMICOLON · , \$, SEMICOLON, INT]}

I17 = {[list → list COMMA type · , RPAREN, COMMA],  
[type → type · POINTER, RPAREN, COMMA, POINTER]}

- COLECCIÓN DE ELEMENTOS-LALR(1): nueva numeración

I0 = clausura{  $\text{program}' \rightarrow \cdot \text{program}, \$$  }

= {  
      $[\text{program}' \rightarrow \cdot \text{program}, \$]$ ,  
      $[\text{program} \rightarrow \cdot \text{statements}, \$]$ ,  
      $[\text{statements} \rightarrow \cdot, \$, \text{SEMICOLON}, \text{INT}]$   
      $[\text{statements} \rightarrow \cdot \text{statements statement}, \$, \text{SEMICOLON}, \text{INT}]$   
 }

I1 = {  $[\text{program}' \rightarrow \text{program} \cdot, \$]$  }

I2 =

{  
      $[\text{program} \rightarrow \text{statements} \cdot, \$]$ ,  
      $[\text{statements} \rightarrow \text{statements} \cdot \text{statement}, \$, \text{SEMICOLON}, \text{INT}]$ ,  
      $[\text{statement} \rightarrow \cdot \text{SEMICOLON}, \$, \text{SEMICOLON}, \text{INT}]$ ,  
      $[\text{statement} \rightarrow \cdot \text{type ID LPAREN list RPAREN SEMICOLON}, \$, \text{SEMICOLON}, \text{INT}]$ ,  
      $[\text{type} \rightarrow \cdot \text{type POINTER}, \text{ID}, \text{POINTER}]$ ,  
      $[\text{type} \rightarrow \cdot \text{INT}, \text{ID}, \text{POINTER}]$   
 }

I3 = {  $[\text{statements} \rightarrow \text{statements statement} \cdot, \$, \text{SEMICOLON}, \text{INT}]$  }

I4 = {  $[\text{statement} \rightarrow \text{SEMICOLON} \cdot, \$, \text{SEMICOLON}, \text{INT}]$  }

I5 = {  $[\text{statement} \rightarrow \text{type} \cdot \text{ID LPAREN list RPAREN SEMICOLON}, \$, \text{SEMICOLON}, \text{INT}]$ ,  
      $[\text{type} \rightarrow \text{type} \cdot \text{POINTER}, \text{ID}, \text{POINTER}]$  }

I6 = {  $[\text{type} \rightarrow \text{INT} \cdot, \text{ID}, \text{POINTER}, \text{RPAREN}, \text{COMMA}]$  }

I7 = {  $[\text{statement} \rightarrow \text{type ID} \cdot \text{LPAREN list RPAREN SEMICOLON}, \$, \text{SEMICOLON}, \text{INT}]$  }

I8 = {  $[\text{type} \rightarrow \text{type POINTER} \cdot, \text{ID}, \text{POINTER}, \text{RPAREN}, \text{COMMA}]$  }

I9 = {  $[\text{statement} \rightarrow \text{type ID LPAREN} \cdot \text{list RPAREN SEMICOLON}, \$, \text{SEMICOLON}, \text{INT}]$ ,  
      $[\text{list} \rightarrow \cdot \text{list COMMA type}, \text{RPAREN}, \text{COMMA}]$ ,  
      $[\text{list} \rightarrow \cdot \text{type}, \text{RPAREN}, \text{COMMA}]$ ,  
      $[\text{type} \rightarrow \cdot \text{type POINTER}, \text{RPAREN}, \text{COMMA}, \text{POINTER}]$ ,  
      $[\text{type} \rightarrow \cdot \text{INT}, \text{RPAREN}, \text{COMMA}, \text{POINTER}]$  }

I10 = {  $[\text{statement} \rightarrow \text{type ID LPAREN list} \cdot \text{RPAREN SEMICOLON}, \$, \text{SEMICOLON}, \text{INT}]$ ,  
      $[\text{list} \rightarrow \text{list} \cdot \text{COMMA type}, \text{RPAREN}, \text{COMMA}]$  }

I11 = {  $[\text{list} \rightarrow \text{type} \cdot, \text{RPAREN}, \text{COMMA}]$ ,  
      $[\text{type} \rightarrow \text{type} \cdot \text{POINTER}, \text{RPAREN}, \text{COMMA}, \text{POINTER}]$  }

I12 = {  $[\text{statement} \rightarrow \text{type ID LPAREN list RPAREN} \cdot \text{SEMICOLON}, \$, \text{SEMICOLON}, \text{INT}]$  }

I13 = {[list → list COMMA · type, RPAREN, COMMA],  
 [type → · type POINTER, RPAREN, COMMA, POINTER],  
 [type → · INT, RPAREN, COMMA, POINTER]}

I14 = {[statement → type ID LPAREN list RPAREN SEMICOLON · , \$, SEMICOLON, INT]}

I15 = {[list → list COMMA type · , RPAREN, COMMA],  
 [type → type · POINTER, RPAREN, COMMA, POINTER]}

• TABLA DE ANÁLISIS SINTÁCTICO ASCENDENTE LAR(1)

	ACCIÓN							IR A					
	SEMICOLON	ID	LPAREN	RPAREN	POINTER	INT	COMMA	\$	P	Ss	S	type	list
0	r 2					r 2		r 2	1	2			
1								Aceptar					
2	d 4					d 6		r 1			3	5	
3	r 3					r 3		r 3					
4	r 4					r 4		r 4					
5		d 7			d 8								
6		r 7		r 7	r 7		r 7						
7			d 9										
8		r 6		r 6	r 6		r 6						
9						d 6						11	10
10				d 12			d 13						
11				r 9	d 8		r 9						
12	d 14												
13						d 6						15	
14	r 5					r 5		r 5					
15				r 8	d 8		r 8						

P = program  
 Ss: statements  
 S: statement

- ANÁLISIS LALR(1)

PILA	ENTRADA	ACCIÓN
0	INT ID LPAREN INT POINTER COMMA INT RPAREN SEMICOLON \$	r 2 statements $\rightarrow \epsilon$
0 Ss 2	INT ID LPAREN INT POINTER COMMA INT RPAREN SEMICOLON \$	Desplazar 6
0 Ss 2 INT 6	ID LPAREN INT POINTER COMMA INT RPAREN SEMICOLON \$	r 7: type $\rightarrow$ INT
0 Ss 2 type 5	ID LPAREN INT POINTER COMMA INT RPAREN SEMICOLON \$	Desplazar 7
0 Ss 2 type 5 ID 7	LPAREN INT POINTER COMMA INT RPAREN SEMICOLON \$	Desplazar 9
0 Ss 2 type 5 ID 7 LPAREN 9	INT POINTER COMMA INT RPAREN SEMICOLON \$	Desplazar 6
0 Ss 2 type 5 ID 7 LPAREN 9 INT 6	POINTER COMMA INT RPAREN SEMICOLON \$	r 7: type $\rightarrow$ INT
0 Ss 2 type 5 ID 7 LPAREN 9 type 11	POINTER COMMA INT RPAREN SEMICOLON \$	Desplazar 8
0 Ss 2 type 5 ID 7 LPAREN 9 type 11 POINTER 8	COMMA INT RPAREN SEMICOLON \$	r 6: type $\rightarrow$ type POINTER
0 Ss 2 type 5 ID 7 LPAREN 9 type 11	COMMA INT RPAREN SEMICOLON \$	r 9: list $\rightarrow$ type
0 Ss 2 type 5 ID 7 LPAREN 9 list 10	COMMA INT RPAREN SEMICOLON \$	Desplazar 13
0 Ss 2 type 5 ID 7 LPAREN 9 list 10 COMMA 13	INT RPAREN SEMICOLON \$	Desplazar 6
0 Ss 2 type 5 ID 7 LPAREN 9 list 10 COMMA 13 INT 6	RPAREN SEMICOLON \$	r 7: type $\rightarrow$ INT
0 Ss 2 type 5 ID 7 LPAREN 9 list 10 COMMA 13 type 15	RPAREN SEMICOLON \$	r 8: list $\rightarrow$ list COMMA type
0 Ss 2 type 5 ID 7 LPAREN 9 list 10	RPAREN SEMICOLON \$	Desplazar 12
0 Ss 2 type 5 ID 7 LPAREN 9 list 10 RPAREN 12	SEMICOLON \$	Desplazar 14
0 Ss 2 type 5 ID 7 LPAREN 9 list 10 RPAREN 12 SEMICOLON 14	\$	r 5: statement $\rightarrow$ type ID LPAREN list RPAREN SEMICOLON
0 Ss 2 statement 3	\$	r 3: statements $\rightarrow$ statements statement
0 Ss 2	\$	r 1: program $\rightarrow$ statements
0 P 1	\$	Aceptar

P = program

Ss: statements

S: statement

- TABLA DE ANÁLISIS SINTÁCTICO ASCENDENTE LAR(1) CON EL MÉTODO DE NIVEL DE FRASE PARA LA RECUPERACIÓN DE ERORES

	ACCIÓN									IR A				
	SEMICOLON	ID	LPAREN	RPAREN	POINTER	INT	COMMA	\$	P	Ss	S	type	list	
0	r 2	E1	E2	E2	E2	r 2	E2	r 2	1	2				
1	E2	E2	E2	E2	E2	E2	E2	Aceptar						
2	d 4	E1	E2	E2	E2	d 6	E1	r 1			3	5		
3	r 3	E3	E2	E2	E2	r 3	E2	r 3						
4	r 4	E3	E2	E2	E2	r 4	E2	r 4						
5	E2	d 7	E4	E5	d 8	E2	E5	E6						
6	E7	r 7	E4	r 7	r 7	E2	r 7	E6						
7	E2	E2	d 9	E2	E2	E8	E2	E6						
8	E7	r 6	E4	r 6	r 6	E10	r 6	E6						
9	E2	E9	E2	E9	E9	d 6	E9	E6			11	10		
10	E7	E2	E2	d 12	E2	E10	d 13	E6						
11	E7	E2	E2	r 9	d 8	E10	r 9	E6						
12	d 14	E2	E2	E2	E2	E11	E2	E11						
13	E2	E9	E2	E9	E9	d 6	E9	E6			15			
14	r 5	E1	E2	E2	E2	r 5	E2	r 5						
15	E2	E2	E2	r 8	d 8	E10	r 8	E6						

P = program

Ss: statements

S: statement

- **Ejemplo de sentencia:**
  - **INT ID LPAREN INT POINTER COMMA INT RPAREN SEMICOLON**
- **E1:** falta **INT** o **SEMICOLON**
  - Insertar **INT** en la entrada
- **E2:** símbolo inesperado
  - Eliminar símbolo de la entrada
- **E3:** falta **INT** o **SEMICOLON** o **fin de la sentencia**
  - Insertar **INT** en la entrada
- **E4:** falta **ID**
  - Insertar **ID** en la entrada
- **E5:** falta **POINTER**
  - Insertar **ID** en la entrada
- **E6:** fin de sentencia inesperado
  - Termina el análisis
- **E7:** falta **RPAREN**
  - Insertar **RPAREN** en la entrada
- **E8:** falta **LPAREN**
  - Insertar **LPAREN** en la entrada
- **E9:** falta **INT**
  - Insertar **INT** en la entrada
- **E10:** falta **COMMA**
  - Insertar **COMMA** en la entrada
- **E11:** falta **SEMICOLON**
  - Insertar **SEMICOLON** en la entrada

- ANÁLISIS LALR(1) DE UNA DECLARACIÓN CON ERRORES

PILA	ENTRADA	ACCIÓN
0	ID ID INT POINTER INT RPAREN \$	E1: insertar INT en la entrada
0	INT ID ID INT POINTER INT RPAREN \$	r 2: statements → ε
0 Ss 2	INT ID ID INT POINTER INT RPAREN \$	Desplazar 6
0 Ss 2 INT 6	ID ID INT POINTER INT RPAREN \$	r 7: type → INT
0 Ss 2 type 5	ID ID INT POINTER INT RPAREN \$	Desplazar 7
0 Ss 2 type 5 ID 7	ID INT POINTER INT RPAREN \$	E2: eliminar símbolo de la entrada
0 Ss 2 type 5 ID 7	INT POINTER INT RPAREN \$	E8: insertar LPAREN en la entrada
0 Ss 2 type 5 ID 7	LPAREN INT POINTER INT RPAREN \$	Desplazar 7
0 Ss 2 type 5 ID 7 LPAREN 9	INT POINTER INT RPAREN \$	Desplazar 6
0 Ss 2 type 5 ID 7 LPAREN 9 INT 6	POINTER INT RPAREN \$	r 7: type → INT
0 Ss 2 type 5 ID 7 LPAREN 9 type 11	POINTER INT RPAREN \$	Desplazar 8
0 Ss 2 type 5 ID 7 LPAREN 9 type 11 POINTER 8	INT RPAREN \$	E10: insertar COMMA en la entrada
0 Ss 2 type 5 ID 7 LPAREN 9 type 11 POINTER 8	COMMA INT RPAREN \$	r 6: type → type POINTER
0 Ss 2 type 5 ID 7 LPAREN 9 type 11	COMMA INT RPAREN \$	r 9: list → type
0 Ss 2 type 5 ID 7 LPAREN 9 list 10	COMMA INT RPAREN \$	Desplazar 13
0 Ss 2 type 5 ID 7 LPAREN 9 list 10 COMMA 13	INT RPAREN \$	Desplazar 6
0 Ss 2 type 5 ID 7 LPAREN 9 list 10 COMMA 13 INT 6	RPAREN \$	r 7: type → INT
0 Ss 2 type 5 ID 7 LPAREN 9 list 10 COMMA 13 type 15	RPAREN \$	r 8: list → list COMMA type
0 Ss 2 type 5 ID 7 LPAREN 9 list 10	RPAREN \$	Desplazar 12
0 Ss 2 type 5 ID 7 LPAREN 9 list 10 RPAREN 12	\$	E11: insertar SEMICOLON en la entrada
0 Ss 2 type 5 ID 7 LPAREN 9 list 10 RPAREN 12	SEMICOLON \$	Desplazar 14
0 Ss 2 type 5 ID 7 LPAREN 9 list 10 RPAREN 12 SEMICOLON 14	\$	r 5: statement → type ID LPAREN list RPAREN SEMICOLON
0 Ss 2 statement 3	\$	r 3: statements → statements statement
0 Ss 2	\$	r 1: program → statements
0 P 1	\$	Aceptar

P = program  
 Ss: statements  
 S: statement

- Sentencia de entrada: ID ID INT POINTER INT RPAREN \$
- Sentencia reconocida: INT ID LPAREN INT POINTER COMMA INT RPAREN SEMICOLON \$