## Grammar Subset from Textbook

*PROGRAM* **->**

**program id (** *IDENTIFIER\_LIST* **) ;**

*DECLARATIONS*

*SUBPROGRAM\_DECLARATIONS*

*COMPOUND\_STATEMENT*

**.**

*IDENTIFIER\_LIST* **->**

**id**

**|** *IDENTIFIER\_LIST* **, id**

*DECLARATIONS* **->**

*DECLARATIONS* **var** *IDENTIFIER\_LIST* **:** *TYPE* **;**

**| e**

*TYPE* **->**

*STANDARD\_TYPE*

**| array [ num .. num ] of** *STANDARD\_TYPE*

*STANDARD\_TYPE* **->**

**integer**

**| real**

*SUBPROGRAM\_DECLARATIONS* **->**

*SUBPROGRAM\_DECLARATIONS**SUBPROGRAM\_DECLARATION* **;**

**| e**

*SUBPROGRAM\_DECLARATION* **->**

*SUBPROGRAM\_HEAD**DECLARATIONS**COMPOUND\_STATEMENT*

*SUBPROGRAM\_HEAD* **->**

**function id** *ARGUMENTS* **:** *STANDARD\_TYPE* **;**

**| procedure id** *ARGUMENTS* **;**

*ARGUMENTS* **->**

**(** *PARAMETER\_LIST* **)**

**| e**

*PARAMETER\_LIST* **->**

*IDENTIFIER\_LIST* **:** *TYPE*

**|** *PARAMETER\_LIST* **;** *IDENTIFIER\_LIST* **:** *TYPE*

*COMPOUND\_STATEMENT* **->**

**begin**

*OPTIONAL\_STATEMENTS*

**end**

*OPTIONAL\_STATEMENTS* **->**

*STATEMENT\_LIST*

**| e**

*STATEMENT\_LIST* **->**

*STATEMENT*

**|** *STATEMENT\_LIST* **;** *STATEMENT*

*STATEMENT* **->**

*VARIABLE* **assignop** *EXPRESSION*

**|** *PROCEDURE\_STATEMENT*

**|** *COMPOUND\_STATEMENT*

**| if** *EXPRESSION* **then** *STATEMENT* **else** *STATEMENT*

**| while** *EXPRESSION* **do** *STATEMENT*

*VARIABLE* **->**

**id**

**| id [** *EXPRESSION* **]**

*PROCEDURE\_STATEMENT* **->**

**id**

**| id (** *EXPRESSION\_LIST* **)**

*EXPRESSION\_LIST* **->**

*EXPRESSION*

**|** *EXPRESSION\_LIST* **,** *EXPRESSION*

*EXPRESSION* **->**

*SIMPLE\_EXPRESSION*

**|** *SIMPLE\_EXPRESSION* **relop** *SIMPLE\_EXPRESSION*

*SIMPLE\_EXPRESSION* **->**

*TERM*

**|** *SIGN**TERM*

**|** *SIMPLE\_EXPRESSION* **addop** *TERM*

*TERM* **->**

*FACTOR*

**|** *TERM* **mulop** *FACTOR*

*FACTOR* **->**

**id**

**| id (** *EXPRESSION\_LIST* **)**

**| num**

**| (** *EXPRESSION* **)**

**| not** *FACTOR*

*SIGN* **->**

**+ | -**

## Grammar modified according to the specifications of this project

*PROGRAM* **->**

**program id (** *IDENTIFIER\_LIST* **) ;**

*DECLARATIONS*

*SUBPROGRAM\_DECLARATIONS*

*COMPOUND\_STATEMENT*

**.**

*IDENTIFIER\_LIST* **->**

**id**

**|** *IDENTIFIER\_LIST* **, id**

*DECLARATIONS* **->**

*DECLARATIONS* **var id :** *TYPE* **;**

**| e**

*TYPE* **->**

*STANDARD\_TYPE*

**| array [ num .. num ] of** *STANDARD\_TYPE*

*STANDARD\_TYPE* **->**

**integer**

**| real**

*SUBPROGRAM\_DECLARATIONS* **->**

*SUBPROGRAM\_DECLARATIONS**SUBPROGRAM\_DECLARATION* **;**

**| e**

*SUBPROGRAM\_DECLARATION* **->**

*SUBPROGRAM\_HEAD**DECLARATIONS**SUBPROGRAM\_DECLARATIONS**COMPOUND\_STATEMENT*

*SUBPROGRAM\_HEAD* **->**

**procedure id** *ARGUMENTS* **;**

*ARGUMENTS* **->**

**(** *PARAMETER\_LIST* **)**

**| e**

*PARAMETER\_LIST* **->**

**id :** *TYPE*

**|** *PARAMETER\_LIST* **; id :** *TYPE*

*COMPOUND\_STATEMENT* **->**

**begin**

*OPTIONAL\_STATEMENTS*

**end**

*OPTIONAL\_STATEMENTS* **->**

*STATEMENT\_LIST*

**| e**

*STATEMENT\_LIST* **->**

*STATEMENT*

**|** *STATEMENT\_LIST* **;** *STATEMENT*

*STATEMENT* **->**

*VARIABLE* **assignop** *EXPRESSION*

**|** *PROCEDURE\_STATEMENT*

**|** *COMPOUND\_STATEMENT*

**| if** *EXPRESSION* **then** *STATEMENT*

**| if** *EXPRESSION* **then** *STATEMENT* **else** *STATEMENT*

**| while** *EXPRESSION* **do** *STATEMENT*

*VARIABLE* **->**

**id**

**| id [** *EXPRESSION* **]**

*PROCEDURE\_STATEMENT* **->**

**call id**

**| call id (** *EXPRESSION\_LIST* **)**

*EXPRESSION\_LIST* **->**

*EXPRESSION*

**|** *EXPRESSION\_LIST* **,** *EXPRESSION*

*EXPRESSION* **->**

*SIMPLE\_EXPRESSION*

**|** *SIMPLE\_EXPRESSION* **relop** *SIMPLE\_EXPRESSION*

*SIMPLE\_EXPRESSION* **->**

*TERM*

**|** *SIGN**TERM*

**|** *SIMPLE\_EXPRESSION* **addop** *TERM*

*TERM* **->**

*FACTOR*

**|** *TERM* **mulop** *FACTOR*

*FACTOR* **->**

**id**

**| num**

**| (** *EXPRESSION* **)**

**| not** *FACTOR*

**| id [** *EXPRESSION* **]**

*SIGN* **->**

**+ | -**

## Grammar with grouping numbering

**1.1** *PROGRAM* **-> program id (** *IDENTIFIER\_LIST* **) ;** *DECLARATIONS**SUBPROGRAM\_DECLARATIONS**COMPOUND\_STATEMENT* **.**

**2.1** *IDENTIFIER\_LIST* **-> id**

**2.2** *IDENTIFIER\_LIST* **->** *IDENTIFIER\_LIST* **, id**

**3.1** *DECLARATIONS* **->** *DECLARATIONS* **var id :** *TYPE* **;**

**3.2** *DECLARATIONS* **-> e**

**4.1** *TYPE* **->** *STANDARD\_TYPE*

**4.2** *TYPE* **-> array [ num .. num ] of** *STANDARD\_TYPE*

**5.1** *STANDARD\_TYPE* **-> integer**

**5.2** *STANDARD\_TYPE* **-> real**

**6.1** *SUBPROGRAM\_DECLARATIONS* **->** *SUBPROGRAM\_DECLARATIONS**SUBPROGRAM\_DECLARATION* **;**

**6.2** *SUBPROGRAM\_DECLARATIONS* **-> e**

**7.1** *SUBPROGRAM\_DECLARATION* **->** *SUBPROGRAM\_HEAD**DECLARATIONS**SUBPROGRAM\_DECLARATIONS**COMPOUND\_STATEMENT*

**8.1** *SUBPROGRAM\_HEAD* **-> procedure id** *ARGUMENTS* **;**

**9.1** *ARGUMENTS* **-> (** *PARAMETER\_LIST* **)**

**9.2** *ARGUMENTS* **-> e**

**10.1** *PARAMETER\_LIST* **-> id :** *TYPE*

**10.2** *PARAMETER\_LIST* **->** *PARAMETER\_LIST* **; id :** *TYPE*

**11.1** *COMPOUND\_STATEMENT* **-> begin** *OPTIONAL\_STATEMENTS* **end**

**12.1** *OPTIONAL\_STATEMENTS* **->** *STATEMENT\_LIST*

**12.2** *OPTIONAL\_STATEMENTS* **-> e**

**13.1** *STATEMENT\_LIST* **->** *STATEMENT*

**13.2** *STATEMENT\_LIST* **->** *STATEMENT\_LIST* **;** *STATEMENT*

**14.1** *STATEMENT* **->** *VARIABLE* **assignop** *EXPRESSION*

**14.2** *STATEMENT* **->** *PROCEDURE\_STATEMENT*

**14.3** *STATEMENT* **->** *COMPOUND\_STATEMENT*

**14.4** *STATEMENT* **-> if** *EXPRESSION* **then** *STATEMENT*

**14.5** *STATEMENT* **-> if** *EXPRESSION* **then** *STATEMENT* **else** *STATEMENT*

**14.6** *STATEMENT* **-> while** *EXPRESSION* **do** *STATEMENT*

**15.1** *VARIABLE* **-> id**

**15.2** *VARIABLE* **-> id [** *EXPRESSION* **]**

**16.1** *PROCEDURE\_STATEMENT* **-> call id**

**16.2** *PROCEDURE\_STATEMENT* **-> call id (** *EXPRESSION\_LIST* **)**

**17.1** *EXPRESSION\_LIST* **->** *EXPRESSION*

**17.2** *EXPRESSION\_LIST* **->** *EXPRESSION\_LIST* **,** *EXPRESSION*

**18.1** *EXPRESSION* **->** *SIMPLE\_EXPRESSION*

**18.2** *EXPRESSION* **->** *SIMPLE\_EXPRESSION* **relop** *SIMPLE\_EXPRESSION*

**19.1** *SIMPLE\_EXPRESSION* **->** *TERM*

**19.2** *SIMPLE\_EXPRESSION* **->** *SIGN**TERM*

**19.3** *SIMPLE\_EXPRESSION* **->** *SIMPLE\_EXPRESSION* **addop** *TERM*

**20.1** *TERM* **->** *FACTOR*

**20.2** *TERM* **->** *TERM* **mulop** *FACTOR*

**21.1** *FACTOR* **-> id**

**21.2** *FACTOR* **-> num**

**21.3** *FACTOR* **-> (** *EXPRESSION* **)**

**21.4** *FACTOR* **-> not** *FACTOR*

**21.5** *FACTOR* **-> id [** *EXPRESSION* **]**

**22.1** *SIGN* **-> +**

**22.2** *SIGN* **-> -**

## Grammar with null productions removed

**1.1.1** *PROGRAM* **-> program id (** *IDENTIFIER\_LIST* **) ;** *DECLARATIONS**SUBPROGRAM\_DECLARATIONS**COMPOUND\_STATEMENT* **.**

**1.1.2** *PROGRAM* **-> program id (** *IDENTIFIER\_LIST* **) ;** *SUBPROGRAM\_DECLARATIONS**COMPOUND\_STATEMENT* **.**

**1.1.3** *PROGRAM* **-> program id (** *IDENTIFIER\_LIST* **) ;** *DECLARATIONS**COMPOUND\_STATEMENT* **.**

**1.1.4** *PROGRAM* **-> program id (** *IDENTIFIER\_LIST* **) ;** *COMPOUND\_STATEMENT* **.**

**2.1.1** *IDENTIFIER\_LIST* **-> id**

**2.2.1** *IDENTIFIER\_LIST* **->** *IDENTIFIER\_LIST* **, id**

**3.1.1** *DECLARATIONS* **->** *DECLARATIONS* **var id :** *TYPE* **;**

**3.1.2** *DECLARATIONS* **-> var id :** *TYPE* **;**

**4.1.1** *TYPE* **->** *STANDARD\_TYPE*

**4.2.1** *TYPE* **-> array [ num .. num ] of** *STANDARD\_TYPE*

**5.1.1** *STANDARD\_TYPE* **-> integer**

**5.2.1** *STANDARD\_TYPE* **-> real**

**6.1.1** *SUBPROGRAM\_DECLARATIONS* **->** *SUBPROGRAM\_DECLARATIONS**SUBPROGRAM\_DECLARATION* **;**

**6.1.2** *SUBPROGRAM\_DECLARATIONS* **->** *SUBPROGRAM\_DECLARATION* **;**

**7.1.1** *SUBPROGRAM\_DECLARATION* **->** *SUBPROGRAM\_HEAD**DECLARATIONS**SUBPROGRAM\_DECLARATIONS**COMPOUND\_STATEMENT*

**7.1.2** *SUBPROGRAM\_DECLARATION* **->** *SUBPROGRAM\_HEAD**SUBPROGRAM\_DECLARATIONS**COMPOUND\_STATEMENT*

**7.1.3** *SUBPROGRAM\_DECLARATION* **->** *SUBPROGRAM\_HEAD**DECLARATIONS**COMPOUND\_STATEMENT*

**7.1.4** *SUBPROGRAM\_DECLARATION* **->** *SUBPROGRAM\_HEAD**COMPOUND\_STATEMENT*

**8.1.1** *SUBPROGRAM\_HEAD* **-> procedure id** *ARGUMENTS* **;**

**8.1.2** *SUBPROGRAM\_HEAD* **-> procedure id ;**

**9.1.1** *ARGUMENTS* **-> (** *PARAMETER\_LIST* **)**

**10.1.1** *PARAMETER\_LIST* **-> id :** *TYPE*

**10.2.1** *PARAMETER\_LIST* **->** *PARAMETER\_LIST* **; id :** *TYPE*

**11.1.1** *COMPOUND\_STATEMENT* **-> begin** *OPTIONAL\_STATEMENTS* **end**

**11.1.2** *COMPOUND\_STATEMENT* **-> begin end**

**12.1.1** *OPTIONAL\_STATEMENTS* **->** *STATEMENT\_LIST*

**13.1.1** *STATEMENT\_LIST* **->** *STATEMENT*

**13.2.1** *STATEMENT\_LIST* **->** *STATEMENT\_LIST* **;** *STATEMENT*

**14.1.1** *STATEMENT* **->** *VARIABLE* **assignop** *EXPRESSION*

**14.2.1** *STATEMENT* **->** *PROCEDURE\_STATEMENT*

**14.3.1** *STATEMENT* **->** *COMPOUND\_STATEMENT*

**14.4.1** *STATEMENT* **-> if** *EXPRESSION* **then** *STATEMENT*

**14.5.1** *STATEMENT* **-> if** *EXPRESSION* **then** *STATEMENT* **else** *STATEMENT*

**14.6.1** *STATEMENT* **-> while** *EXPRESSION* **do** *STATEMENT*

**15.1.1** *VARIABLE* **-> id**

**15.2.1** *VARIABLE* **-> id [** *EXPRESSION* **]**

**16.1.1** *PROCEDURE\_STATEMENT* **-> call id**

**16.2.1** *PROCEDURE\_STATEMENT* **-> call id (** *EXPRESSION\_LIST* **)**

**17.1.1** *EXPRESSION\_LIST* **->** *EXPRESSION*

**17.2.1** *EXPRESSION\_LIST* **->** *EXPRESSION\_LIST* **,** *EXPRESSION*

**18.1.1** *EXPRESSION* **->** *SIMPLE\_EXPRESSION*

**18.2.1** *EXPRESSION* **->** *SIMPLE\_EXPRESSION* **relop** *SIMPLE\_EXPRESSION*

**19.1.1** *SIMPLE\_EXPRESSION* **->** *TERM*

**19.2.1** *SIMPLE\_EXPRESSION* **->** *SIGN**TERM*

**19.3.1** *SIMPLE\_EXPRESSION* **->** *SIMPLE\_EXPRESSION* **addop** *TERM*

**20.1.1** *TERM* **->** *FACTOR*

**20.2.1** *TERM* **->** *TERM* **mulop** *FACTOR*

**21.1.1** *FACTOR* **-> id**

**21.2.1** *FACTOR* **-> num**

**21.3.1** *FACTOR* **-> (** *EXPRESSION* **)**

**21.4.1** *FACTOR* **-> not** *FACTOR*

**21.5.1** *FACTOR* **-> id [** *EXPRESSION* **]**

**22.1.1** *SIGN* **-> +**

**22.2.1** *SIGN* **-> -**

## Grammar with Left Recursion Removed

**1.1.1.1** *PROGRAM* **-> program id (** *IDENTIFIER\_LIST* **) ;** *DECLARATIONS**SUBPROGRAM\_DECLARATIONS**COMPOUND\_STATEMENT* **.**

**1.1.2.1** *PROGRAM* **-> program id (** *IDENTIFIER\_LIST* **) ;** *SUBPROGRAM\_DECLARATIONS**COMPOUND\_STATEMENT* **.**

**1.1.3.1** *PROGRAM* **-> program id (** *IDENTIFIER\_LIST* **) ;** *DECLARATIONS**COMPOUND\_STATEMENT* **.**

**1.1.4.1** *PROGRAM* **-> program id (** *IDENTIFIER\_LIST* **) ;** *COMPOUND\_STATEMENT* **.**

**2.1.1.1** *IDENTIFIER\_LIST* **-> id** *IDENTIFIER\_LIST***`**

**2.2.1.1** *IDENTIFIER\_LIST***` -> , id** *IDENTIFIER\_LIST***`**

**2.2.1.2** *IDENTIFIER\_LIST***` -> e**

**3.1.1.1** *DECLARATIONS* **-> var id :** *TYPE* **;** *DECLARATIONS***`**

**3.1.2.1** *DECLARATIONS***` -> var id :** *TYPE* **;** *DECLARATIONS***`**

**3.1.2.2** *DECLARATIONS***` -> e**

**4.1.1.1** *TYPE* **->** *STANDARD\_TYPE*

**4.2.1.1** *TYPE* **-> array [ num .. num ] of** *STANDARD\_TYPE*

**5.1.1.1** *STANDARD\_TYPE* **-> integer**

**5.2.1.1** *STANDARD\_TYPE* **-> real**

**6.1.1.1** *SUBPROGRAM\_DECLARATIONS* **->** *SUBPROGRAM\_DECLARATION* **;** *SUBPROGRAM\_DECLARATIONS***`**

**6.1.2.1** *SUBPROGRAM\_DECLARATIONS***` ->** *SUBPROGRAM\_DECLARATION* **;** *SUBPROGRAM\_DECLARATIONS***`**

**6.1.2.2** *SUBPROGRAM\_DECLARATIONS***` -> e**

**7.1.1.1** *SUBPROGRAM\_DECLARATION* **->** *SUBPROGRAM\_HEAD**DECLARATIONS**SUBPROGRAM\_DECLARATIONS**COMPOUND\_STATEMENT*

**7.1.2.1** *SUBPROGRAM\_DECLARATION* **->** *SUBPROGRAM\_HEAD**SUBPROGRAM\_DECLARATIONS**COMPOUND\_STATEMENT*

**7.1.3.1** *SUBPROGRAM\_DECLARATION* **->** *SUBPROGRAM\_HEAD**DECLARATIONS**COMPOUND\_STATEMENT*

**7.1.4.1** *SUBPROGRAM\_DECLARATION* **->** *SUBPROGRAM\_HEAD**COMPOUND\_STATEMENT*

**8.1.1.1** *SUBPROGRAM\_HEAD* **-> procedure id** *ARGUMENTS* **;**

**8.1.2.1** *SUBPROGRAM\_HEAD* **-> procedure id ;**

**9.1.1.1** *ARGUMENTS* **-> (** *PARAMETER\_LIST* **)**

**10.1.1.1** *PARAMETER\_LIST* **-> id :** *TYPE**PARAMETER\_LIST***`**

**10.2.1.1** *PARAMETER\_LIST***` -> ; id :** *TYPE**PARAMETER\_LIST***`**

**10.2.1.2** *PARAMETER\_LIST***` -> e**

**11.1.1.1** *COMPOUND\_STATEMENT* **-> begin** *OPTIONAL\_STATEMENTS* **end**

**11.1.2.1** *COMPOUND\_STATEMENT* **-> begin end**

**12.1.1.1** *OPTIONAL\_STATEMENTS* **->** *STATEMENT\_LIST*

**13.1.1.1** *STATEMENT\_LIST* **->** *STATEMENT**STATEMENT\_LIST***`**

**13.2.1.1** *STATEMENT\_LIST***` -> ;** *STATEMENT**STATEMENT\_LIST***`**

**13.2.1.2** *STATEMENT\_LIST***` -> e**

**14.1.1.1** *STATEMENT* **->** *VARIABLE* **assignop** *EXPRESSION*

**14.2.1.1** *STATEMENT* **->** *PROCEDURE\_STATEMENT*

**14.3.1.1** *STATEMENT* **->** *COMPOUND\_STATEMENT*

**14.4.1.1** *STATEMENT* **-> if** *EXPRESSION* **then** *STATEMENT*

**14.5.1.1** *STATEMENT* **-> if** *EXPRESSION* **then** *STATEMENT* **else** *STATEMENT*

**14.6.1.1** *STATEMENT* **-> while** *EXPRESSION* **do** *STATEMENT*

**15.1.1.1** *VARIABLE* **-> id**

**15.2.1.1** *VARIABLE* **-> id [** *EXPRESSION* **]**

**16.1.1.1** *PROCEDURE\_STATEMENT* **-> call id**

**16.2.1.1** *PROCEDURE\_STATEMENT* **-> call id (** *EXPRESSION\_LIST* **)**

**17.1.1.1** *EXPRESSION\_LIST* **->** *EXPRESSION**EXPRESSION\_LIST***`**

**17.2.1.1** *EXPRESSION\_LIST***` -> ,** *EXPRESSION**EXPRESSION\_LIST***`**

**17.2.1.2** *EXPRESSION\_LIST***` -> e**

**18.1.1.1** *EXPRESSION* **->** *SIMPLE\_EXPRESSION*

**18.2.1.1** *EXPRESSION* **->** *SIMPLE\_EXPRESSION* **relop** *SIMPLE\_EXPRESSION*

**19.1.1.1** *SIMPLE\_EXPRESSION* **->** *TERM**SIMPLE\_EXPRESSION***`**

**19.2.1.1** *SIMPLE\_EXPRESSION* **->** *SIGN**TERM**SIMPLE\_EXPRESSION***`**

**19.3.1.1** *SIMPLE\_EXPRESSION***' -> addop** *TERM**SIMPLE\_EXPRESSION***`**

**19.3.2.1** *SIMPLE\_EXPRESSION***' -> e**

**20.1.1.1** *TERM* **->** *FACTOR**TERM***`**

**20.2.1.1** *TERM***` -> mulop** *FACTOR**TERM***`**

**20.2.2.1** *TERM***` -> e**

**21.1.1.1** *FACTOR* **-> id**

**21.2.1.1** *FACTOR* **-> num**

**21.3.1.1** *FACTOR* **-> (** *EXPRESSION* **)**

**21.4.1.1** *FACTOR* **-> not** *FACTOR*

**21.5.1.1** *FACTOR* **-> id [** *EXPRESSION* **]**

**22.1.1.1** *SIGN* **-> +**

**22.2.1.1** *SIGN* **-> -**

## Grammar Left Factored

**1** *PROGRAM* **-> program id (** *IDENTIFIER\_LIST* **) ;** *PROGRAM***^**

**1** *PROGRAM***^ ->** *DECLARATIONS**PROGRAM***^^**

**1** *PROGRAM***^ ->** *SUBPROGRAM\_DECLARATIONS**COMPOUND\_STATEMENT* **.**

**1** *PROGRAM***^ ->** *COMPOUND\_STATEMENT* **.**

**1** *PROGRAM***^^ ->** *SUBPROGRAM\_DECLARATIONS**COMPOUND\_STATEMENT* **.**

**1** *PROGRAM***^^ ->** *COMPOUND\_STATEMENT* **.**

**2** *IDENTIFIER\_LIST* **-> id** *IDENTIFIER\_LIST***`**

**2** *IDENTIFIER\_LIST***` -> , id** *IDENTIFIER\_LIST***`**

**2** *IDENTIFIER\_LIST***` -> e**

**3** *DECLARATIONS* **-> var id :** *TYPE* **;** *DECLARATIONS***`**

**3** *DECLARATIONS***` -> var id :** *TYPE* **;** *DECLARATIONS***`**

**3** *DECLARATIONS***` -> e**

**4** *TYPE* **->** *STANDARD\_TYPE*

**4** *TYPE* **-> array [ num .. num ] of** *STANDARD\_TYPE*

**5** *STANDARD\_TYPE* **-> integer**

**5** *STANDARD\_TYPE* **-> real**

**6** *SUBPROGRAM\_DECLARATIONS* **->** *SUBPROGRAM\_DECLARATION* **;** *SUBPROGRAM\_DECLARATIONS***`**

**6** *SUBPROGRAM\_DECLARATIONS***` ->** *SUBPROGRAM\_DECLARATION* **;** *SUBPROGRAM\_DECLARATIONS***`**

**6** *SUBPROGRAM\_DECLARATIONS***` -> e**

**7** *SUBPROGRAM\_DECLARATION* **->** *SUBPROGRAM\_HEAD**SUBPROGRAM\_DECLARATION***^**

**7** *SUBPROGRAM\_DECLARATION***^ ->** *DECLARATIONS**SUBPROGRAM\_DECLARATION***^^**

**7** *SUBPROGRAM\_DECLARATION***^ ->** *SUBPROGRAM\_DECLARATIONS**COMPOUND\_STATEMENT*

**7** *SUBPROGRAM\_DECLARATION***^ ->** *COMPOUND\_STATEMENT*

**7** *SUBPROGRAM\_DECLARATION***^^ ->** *SUBPROGRAM\_DECLARATIONS**COMPOUND\_STATEMENT*

**7** *SUBPROGRAM\_DECLARATION***^^ ->** *COMPOUND\_STATEMENT*

**8** *SUBPROGRAM\_HEAD* **-> procedure id** *SUBPROGRAM\_HEAD***^**

**8** *SUBPROGRAM\_HEAD***^ ->** *ARGUMENTS* **;**

**8** *SUBPROGRAM\_HEAD***^ -> ;**

**9** *ARGUMENTS* **-> (** *PARAMETER\_LIST* **)**

**10** *PARAMETER\_LIST* **-> id :** *TYPE**PARAMETER\_LIST***`**

**10** *PARAMETER\_LIST***` -> ; id :** *TYPE**PARAMETER\_LIST***`**

**10** *PARAMETER\_LIST***` -> e**

**11** *COMPOUND\_STATEMENT* **-> begin** *COMPOUND\_STATEMENT***^**

**11** *COMPOUND\_STATEMENT***^ ->** *OPTIONAL\_STATEMENTS* **end**

**11** *COMPOUND\_STATEMENT***^ -> end**

**12** *OPTIONAL\_STATEMENTS* **->** *STATEMENT\_LIST*

**13** *STATEMENT\_LIST* **->** *STATEMENT**STATEMENT\_LIST***`**

**13** *STATEMENT\_LIST***` -> ;** *STATEMENT**STATEMENT\_LIST***`**

**13** *STATEMENT\_LIST***` -> e**

**14** *STATEMENT* **->** *VARIABLE* **assignop** *EXPRESSION*

**14** *STATEMENT* **->** *PROCEDURE\_STATEMENT*

**14** *STATEMENT* **->** *COMPOUND\_STATEMENT*

**14** *STATEMENT* **-> if** *EXPRESSION* **then** *STATEMENT**STATEMENT***^**

**14** *STATEMENT* **-> while** *EXPRESSION* **do** *STATEMENT*

**14** *STATEMENT***^ -> else** *STATEMENT*

**14** *STATEMENT***^ -> e**

**15** *VARIABLE* **-> id** *VARIABLE***^**

**15** *VARIABLE***^ -> [** *EXPRESSION* **]**

**15** *VARIABLE***^ -> e**

**16** *PROCEDURE\_STATEMENT* **-> call id** *PROCEDURE\_STATEMENT***^**

**16** *PROCEDURE\_STATEMENT***^ -> (** *EXPRESSION\_LIST* **)**

**16** *PROCEDURE\_STATEMENT***^ -> e**

**17** *EXPRESSION\_LIST* **->** *EXPRESSION**EXPRESSION\_LIST***`**

**17** *EXPRESSION\_LIST***` -> ,** *EXPRESSION**EXPRESSION\_LIST***`**

**17** *EXPRESSION\_LIST***` -> e**

**18** *EXPRESSION* **->** *SIMPLE\_EXPRESSION**EXPRESSION***^**

**18** *EXPRESSION***^ -> relop** *SIMPLE\_EXPRESSION*

**18** *EXPRESSION***^ -> e**

**19** *SIMPLE\_EXPRESSION* **->** *TERM**SIMPLE\_EXPRESSION***`**

**19** *SIMPLE\_EXPRESSION* **->** *SIGN**TERM**SIMPLE\_EXPRESSION***`**

**19** *SIMPLE\_EXPRESSION***' -> addop** *TERM**SIMPLE\_EXPRESSION***`**

**19** *SIMPLE\_EXPRESSION***' -> e**

**20** *TERM* **->** *FACTOR**TERM***`**

**20** *TERM***` -> mulop** *FACTOR**TERM***`**

**20** *TERM***` -> e**

**21** *FACTOR* **-> id** *FACTOR***^**

**21** *FACTOR* **-> num**

**21** *FACTOR* **-> (** *EXPRESSION* **)**

**21** *FACTOR* **-> not** *FACTOR*

**21** *FACTOR***^ -> [** *EXPRESSION* **]**

**21** *FACTOR***^ -> e**

**22** *SIGN* **-> +**

**22** *SIGN* **-> -**