

Chaga Programming Language

BNF grammar

Version: 1.2 (work-in-progress)

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```
<CHARACTER> ::= | ! | # | $ | % | & | ( | ) | * | + | , | - | . | / | 0 | 1 | 2 | 3 | 4  
| 5 | 6 | 7 | 8 | 9 | : | ; | < | = | > | ? | @ | A | B | C | D | E | F | G | H | I | J  
| K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z | [ | ] | ^ | _ | ` | a  
| b | c | d | e | f | g | h | i | j | k | l | m | n | o | p | q | r | s | t | u | v | w  
| x | y | z | { | | | } | ~
```

```
<ESCAPED_CHARACTER> ::= \a | \b | \f | \n | \r | \t | \v | \\ | \? | \' | \" | \  
x<HEX_DIGIT> | \x<HEX_DIGIT><HEX_DIGIT>
```

```
<LETTER> ::= A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T  
| U | V | W | X | Y | Z | a | b | c | d | e | f | g | h | i | j | k | l | m | n | o | p  
| q | r | s | t | u | v | w | x | y | z
```

```
<DIGIT> ::= 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9
```

```
<NON_ZERO_DIGIT> ::= 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9
```

```
<HEX_DIGIT> ::= 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F | a | b | c  
| d | e | f
```

```
<L_PAREN> ::= (
```

```
<R_PAREN> ::= )
```

```
<L_BRACKET> ::= [
```

```
<R_BRACKET> ::= ]
```

```
<L_BRACE> ::= {
```

```
<R_BRACE> ::= }
```

```
<DOUBLE_QUOTE> ::= "
```

```
<SINGLE_QUOTE> ::= '
```

```
<SEMICOLON> ::= ;
```

```
<COMMA> ::= ,
```

```
<PERIOD> ::= .
```

```
<ASSIGNMENT_OPERATOR> ::= =
```

```
<PLUS> ::= +
```

```
<MINUS> ::= -
```

```

<ASTERISK> ::= *

<DIVIDE> ::= /

<MODULO> ::= %

<CARET> ::= ^

<LT> ::= <

<GT> ::= >

<LT_EQUAL> ::= <=

<GT_EQUAL> ::= >=

<BOOLEAN_AND> ::= &&

<BOOLEAN_OR> ::= ||

<BOOLEAN_NOT> ::= !

<BOOLEAN_EQUAL> ::= ==

<BOOLEAN_NOT_EQUAL> ::= !=

<BOOLEAN_TRUE> ::= TRUE

<BOOLEAN_FALSE> ::= FALSE

<STRING> ::= <CHARACTER> | <ESCAPED_CHARACTER> | <CHARACTER> <STRING> |
    <ESCAPED_CHARACTER> <STRING>

<DOUBLE_QUOTED_STRING> ::= <DOUBLE_QUOTE> <STRING> <DOUBLE_QUOTE>

<SINGLE_QUOTED_STRING> ::= <SINGLE_QUOTE> <STRING> <SINGLE_QUOTE>

<QUOTED_STRING> ::= <DOUBLE_QUOTED_STRING> | <SINGLE_QUOTED_STRING>

<UNDERSCORE> ::= _

<LETTER_UNDERSCORE> ::= <LETTER> | <UNDERSCORE>

<LETTER_DIGIT_UNDERSCORE> ::= <LETTER> | <DIGIT> | <UNDERSCORE>

<POSITIVE_INTEGER_EXPONENT_TAIL> ::= <DIGIT> | <DIGIT> <POSITIVE_INTEGER_EXPONENT_TAIL>

<POSITIVE_INTEGER_WITH_EXPONENT_LOWERCASE_E> ::=
    <POSITIVE_INTEGER_NO_EXPONENT>e<POSITIVE_INTEGER_EXPONENT_TAIL>

<POSITIVE_INTEGER_WITH_EXPONENT_UPPERCASE_E> ::=
    <POSITIVE_INTEGER_NO_EXPONENT>E<POSITIVE_INTEGER_EXPONENT_TAIL>

<POSITIVE_INTEGER_WITH_EXPONENT> ::= <POSITIVE_INTEGER_WITH_EXPONENT_LOWERCASE_E> |
    <POSITIVE_INTEGER_WITH_EXPONENT_UPPERCASE_E>

<NON_NEGATIVE_INTEGER_NO_EXPONENT> ::= <DIGIT> | <DIGIT>
    <NON_NEGATIVE_INTEGER_NO_EXPONENT>

<POSITIVE_INTEGER_NO_EXPONENT> ::= <NON_NEGATIVE_INTEGER_NO_EXPONENT> <NON_ZERO_DIGIT> |
    <NON_ZERO_DIGIT> <NON_NEGATIVE_INTEGER_NO_EXPONENT>

```

<POSITIVE_INTEGER> ::= <POSITIVE_INTEGER_NO_EXPONENT> | <POSITIVE_INTEGER_WITH_EXPONENT>
<INTEGER_EXPONENT> ::= <DIGIT> | <DIGIT><INTEGER_EXPONENT>
<INTEGER_UNSIGNED_WITH_EXPONENT> ::= <INTEGER_UNSIGNED>e<INTEGER_EXPONENT> | <INTEGER_UNSIGNED>E<INTEGER_EXPONENT>
<INTEGER_UNSIGNED> ::= <DIGIT> | <DIGIT><INTEGER_UNSIGNED>
<INTEGER> ::= <INTEGER_UNSIGNED> | <PLUS><INTEGER_UNSIGNED> | <MINUS><INTEGER_UNSIGNED> | <INTEGER_UNSIGNED_WITH_EXPONENT> | <PLUS><INTEGER_UNSIGNED_WITH_EXPONENT> | <MINUS><INTEGER_UNSIGNED_WITH_EXPONENT>
<FLOAT_WITH_EXPONENT_TAIL> ::= <DIGIT> | <DIGIT><FLOAT_DECIMAL_EXPONENT_TAIL>
<FLOAT_WITH_POSITIVE_EXPONENT_LOWERCASE_E> ::= <FLOAT_NO_EXPONENT>e<PLUS><FLOAT_DECIMAL_EXPONENT_TAIL>
<FLOAT_WITH_NEGATIVE_EXPONENT_LOWERCASE_E> ::= <FLOAT_NO_EXPONENT>e<MINUS><FLOAT_DECIMAL_EXPONENT_TAIL>
<FLOAT_WITH_POSITIVE_EXPONENT_UPPERCASE_E> ::= <FLOAT_NO_EXPONENT>E<PLUS><FLOAT_DECIMAL_EXPONENT_TAIL>
<FLOAT_WITH_NEGATIVE_EXPONENT_UPPERCASE_E> ::= <FLOAT_NO_EXPONENT>E<MINUS><FLOAT_DECIMAL_EXPONENT_TAIL>
<FLOAT_DECIMAL_TAIL> ::= <DIGIT> | <DIGIT><FLOAT_DECIMAL_TAIL>
<FLOAT_DECIMAL> ::= <PERIOD> | <PERIOD><FLOAT_DECIMAL_TAIL>
<FLOAT_TAIL> ::= <FLOAT_DECIMAL> | <DIGIT><FLOAT_TAIL>
<FLOAT_NO_EXPONENT> ::= <DIGIT><FLOAT_TAIL> | <PLUS><FLOAT_TAIL> | <MINUS><FLOAT_TAIL>
<FLOAT> ::= <FLOAT_NO_EXPONENT> | <FLOAT_WITH_POSITIVE_EXPONENT_LOWERCASE_E> | <FLOAT_WITH_POSITIVE_EXPONENT_UPPERCASE_E> | <FLOAT_WITH_NEGATIVE_EXPONENT_LOWERCASE_E> | <FLOAT_WITH_NEGATIVE_EXPONENT_UPPERCASE_E>
<IMAGINARY_NUMBER> ::= <FLOAT> * i
<COMPLEX_NUMBER> ::= <FLOAT> + <IMAGINARY_NUMBER> | <FLOAT> - <IMAGINARY_NUMBER>
<NUMBER> ::= <INTEGER> | <FLOAT> | <IMAGINARY_NUMBER> | <COMPLEX_NUMBER>
<IDENTIFIER_TAIL> ::= <LETTER_DIGIT_UNDERSCORE> | <LETTER_DIGIT_UNDERSCORE><IDENTIFIER_TAIL>
<IDENTIFIER> ::= <LETTER_UNDERSCORE> | <LETTER_UNDERSCORE><IDENTIFIER_TAIL>
<IDENTIFIER_LIST> ::= <IDENTIFIER> | <IDENTIFIER><COMMA><IDENTIFIER_LIST>
<IDENTIFIER_ARRAY_LIST> ::= <IDENTIFIER><L_BRACKET><POSITIVE_INTEGER><R_BRACKET> | <IDENTIFIER><L_BRACKET><POSITIVE_INTEGER><R_BRACKET><COMMA><IDENTIFIER_ARRAY_LIST>
<IDENTIFIER_AND_IDENTIFIER_ARRAY_LIST> ::= <IDENTIFIER_LIST> | <IDENTIFIER_ARRAY_LIST> | <IDENTIFIER_LIST><IDENTIFIER_ARRAY_LIST> | <IDENTIFIER_ARRAY_LIST><IDENTIFIER_LIST>
<IDENTIFIER_AND_IDENTIFIER_ARRAY_PARAMETER_LIST> ::= <IDENTIFIER> | <IDENTIFIER><L_BRACKET><IDENTIFIER><R_BRACKET> | <IDENTIFIER><COMMA><IDENTIFIER_AND_IDENTIFIER_ARRAY_PARAMETER_LIST> | <IDENTIFIER><L_BRACKET><IDENTIFIER><R_BRACKET><COMMA><IDENTIFIER_AND_IDENTIFIER_ARRAY_PARAMETER_LIST> |

<IDENTIFIER> <L_BRACKET> <NUMERICAL_EXPRESSION> <R_BRACKET> | <IDENTIFIER> <L_BRACKET>
<NUMERICAL_EXPRESSION> <R_BRACKET> <COMMA>
<IDENTIFIER_AND_IDENTIFIER_ARRAY_PARAMETER_LIST>

<IDENTIFIER_AND_IDENTIFIER_ARRAY_PARAMETER_LIST_DECLARATION> ::= <IDENTIFIER> |
<IDENTIFIER> <L_BRACKET> <POSITIVE_INTEGER> <R_BRACKET> | <IDENTIFIER> <COMMA>
<IDENTIFIER_AND_IDENTIFIER_ARRAY_PARAMETER_LIST_DECLARATION> | <IDENTIFIER> <L_BRACKET>
<POSITIVE_INTEGER> <R_BRACKET> <COMMA>
<IDENTIFIER_AND_IDENTIFIER_ARRAY_PARAMETER_LIST_DECLARATION> | <IDENTIFIER> <L_BRACKET>
<POSITIVE_INTEGER> <R_BRACKET> | <IDENTIFIER> <L_BRACKET> <POSITIVE_INTEGER>
<R_BRACKET> <COMMA> <IDENTIFIER_AND_IDENTIFIER_ARRAY_PARAMETER_LIST_DECLARATION>

<DATATYPE_SPECIFIER> ::= bool | char | string | date | time | datetime | int | float |
complex | imaginary | file | pointer | enum <IDENTIFIER_AND_IDENTIFIER_ARRAY> | struct
<IDENTIFIER_AND_IDENTIFIER_ARRAY>

<NUMERICAL_OPERAND> ::= <IDENTIFIER> | <NUMBER> | <IDENTIFIER> <L_BRACKET> <NUMERICAL
EXPRESSION> <R_BRACKET> | <GETCHAR_FUNCTION> | <USER_DEFINED_FUNCTION> | <SINGLE_QUOTE>
<CHARACTER> <SINGLE_QUOTE> | <SINGLE_QUOTE> <ESCAPED_CHARACTER> <SINGLE_QUOTE> |
<DOUBLE_QUOTE> <CHARACTER> <DOUBLE_QUOTE> | <DOUBLE_QUOTE> <ESCAPED_CHARACTER>
<DOUBLE_QUOTE>

<NUMERICAL_OPERATOR> ::= <PLUS> | <MINUS> | <ASTERISK> | <DIVIDE> | <MODULO> | <CARET>

<BOOLEAN_OPERATOR> ::= <BOOLEAN_AND> | <BOOLEAN_OR>

<RELATIONAL_OPERATOR> ::= <LT> | <LT_EQUAL> | <GT> | <GT_EQUAL> | <BOOLEAN_EQUAL> |
<BOOLEAN_NOT_EQUAL>

<NUMERICAL_OPERAND_WITH_UNARY_MINUS> ::= <MINUS> <NUMERICAL_OPERAND>

<NUMERICAL_OPERAND_WITH_UNARY_PLUS> ::= <PLUS> <NUMERICAL_OPERAND>

<NUMERICAL_OPERAND_WITH_UNARY_PLUS_OR_MINUS> ::= <NUMERICAL_OPERAND_WITH_UNARY_MINUS> |
<NUMERICAL_OPERAND_WITH_UNARY_PLUS>

<NUMERICAL_OPERAND_WITH_UNARY_OPERATOR_INSIDE_PARENTHESIS_TAIL> ::= <L_PAREN>
<NUMERICAL_OPERAND_WITH_UNARY_PLUS_OR_MINUS> <R_PAREN>

<NUMERICAL_OPERAND_WITH_UNARY_OPERATOR_INSIDE_PARENTHESIS> ::=
<NUMERICAL_OPERAND_WITH_UNARY_OPERATOR_INSIDE_PARENTHESIS_TAIL> | <L_PAREN>
<NUMERICAL_OPERAND_WITH_UNARY_OPERATOR_INSIDE_PARENTHESIS> <R_PAREN>

<NUMERICAL_OPERAND_INSIDE_PARENTHESIS_TAIL> ::= <L_PAREN>
<NUMERICAL_OPERAND_WITH_UNARY_PLUS_OR_MINUS> <R_PAREN>

<NUMERICAL_OPERAND_INSIDE_PARENTHESIS> ::= <NUMERICAL_OPERAND_INSIDE_PARENTHESIS_TAIL> |
<L_PAREN> <NUMERICAL_OPERAND_INSIDE_PARENTHESIS> <R_PAREN>

<NUMERICAL_OPERAND_ALL> ::= <NUMERICAL_OPERAND> | <NUMERICAL_OPERAND_INSIDE_PARENTHESIS> |
<NUMERICAL_OPERAND_WITH_UNARY_PLUS_OR_MINUS> |
<NUMERICAL_OPERAND_WITH_UNARY_OPERATOR_INSIDE_PARENTHESIS>

<NUMERICAL_EXPRESSION_SINGLE_TERM> ::= <NUMERICAL_OPERAND_ALL>

<NUMERICAL_EXPRESSION_MULTI_TERM> ::= <NUMERICAL_OPERAND_ALL> <NUMERICAL_OPERATOR>
<NUMERICAL_EXPRESSION>

<NUMERICAL_EXPRESSION_MULTI_TERM_INSIDE_PARENTHESIS_TAIL> ::= <L_PAREN>
<NUMERICAL_EXPRESSION_MULTI_TERM> <R_PAREN>

```

<NUMERICAL_EXPRESSION_MULTI_TERM_INSIDE_PARENTHESIS> ::=
    <NUMERICAL_EXPRESSION_MULTI_TERM_INSIDE_PARENTHESIS_TAIL> | <L_PAREN>
    <NUMERICAL_EXPRESSION_MULTI_TERM_INSIDE_PARENTHESIS> <R_PAREN>

<NUMERICAL_EXPRESSION_MULTI_TERM_INSIDE_PARENTHESIS_AND_TERM_OUTSIDE_PARENTHESIS> ::=
    <NUMERICAL_EXPRESSION_MULTI_TERM_INSIDE_PARENTHESIS> <NUMERICAL_OPERATOR>
    <NUMERICAL_EXPRESSION>

<NUMERICAL_EXPRESSION> ::= <NUMERICAL_EXPRESSION_SINGLE_TERM> |
    <NUMERICAL_EXPRESSION_MULTI_TERM> |
    <NUMERICAL_EXPRESSION_MULTI_TERM_INSIDE_PARENTHESIS> |
    <NUMERICAL_EXPRESSION_MULTI_TERM_INSIDE_PARENTHESIS_AND_TERM_OUTSIDE_PARENTHESIS>

<BOOLEAN_OPERAND> ::= <BOOLEAN_TRUE> | <BOOLEAN_FALSE> | <NUMERICAL_OPERAND>

<BOOLEAN_OPERAND_INSIDE_PARENTHESIS_TAIL> ::= <L_PAREN> <BOOLEAN_OPERAND> <R_PAREN>

<BOOLEAN_OPERAND_INSIDE_PARENTHESIS> ::= <BOOLEAN_OPERAND_INSIDE_PARENTHESIS_TAIL> |
    <L_PAREN> <BOOLEAN_OPERAND_INSIDE_PARENTHESIS> <R_PAREN>

<BOOLEAN_OPERAND_WITH_UNARY_NOT> ::= <BOOLEAN_NOT> <BOOLEAN_OPERAND>

<BOOLEAN_OPERAND_WITH_UNARY_NOT_INSIDE_PARENTHESIS_TAIL> ::= <L_PAREN> <BOOLEAN_NOT>
    <BOOLEAN_OPERAND> <R_PAREN>

<BOOLEAN_OPERAND_WITH_UNARY_NOT_INSIDE_PARENTHESIS> ::=
    <BOOLEAN_OPERAND_WITH_UNARY_NOT_INSIDE_PARENTHESIS_TAIL> | <L_PAREN>
    <BOOLEAN_OPERAND_WITH_UNARY_NOT_INSIDE_PARENTHESIS> <R_PAREN>

<BOOLEAN_OPERAND_ALL> ::= <BOOLEAN_OPERAND> | <BOOLEAN_OPERAND_INSIDE_PARENTHESIS> |
    <BOOLEAN_OPERAND_WITH_UNARY_NOT> | <BOOLEAN_OPERAND_WITH_UNARY_NOT_INSIDE_PARENTHESIS>

<BOOLEAN_EXPRESSION_SINGLE_TERM> ::= <BOOLEAN_OPERAND_ALL>

<BOOLEAN_EXPRESSION_MULTI_TERM> ::= <BOOLEAN_OPERAND_ALL> <BOOLEAN_OPERATOR>
    <BOOLEAN_EXPRESSION> | <NUMERICAL_EXPRESSION> <RELATIONAL_OPERATOR>
    <NUMERICAL_EXPRESSION>

<BOOLEAN_EXPRESSION_MULTI_TERM_INSIDE_PARENTHESIS_TAIL> ::= <L_PAREN>
    <BOOLEAN_EXPRESSION_MULTI_TERM> <R_PAREN>

<BOOLEAN_EXPRESSION_MULTI_TERM_INSIDE_PARENTHESIS> ::=
    <BOOLEAN_EXPRESSION_MULTI_TERM_INSIDE_PARENTHESIS_TAIL> | <L_PAREN>
    <BOOLEAN_EXPRESSION_MULTI_TERM_INSIDE_PARENTHESIS> <R_PAREN>

<BOOLEAN_EXPRESSION_MULTI_TERM_INSIDE_PARENTHESIS_AND_TERM_OUTSIDE_PARENTHESIS> ::=
    <BOOLEAN_EXPRESSION_MULTI_TERM_INSIDE_PARENTHESIS> <BOOLEAN_OPERATOR>
    <BOOLEAN_EXPRESSION> | <NUMERICAL_EXPRESSION_MULTI_TERM_INSIDE_PARENTHESIS>
    <RELATIONAL_OPERATOR> <NUMERICAL_EXPRESSION>

<BOOLEAN_EXPRESSION> ::= <BOOLEAN_EXPRESSION_SINGLE_TERM> |
    <BOOLEAN_EXPRESSION_MULTI_TERM> | <BOOLEAN_EXPRESSION_MULTI_TERM_INSIDE_PARENTHESIS> |
    <BOOLEAN_EXPRESSION_MULTI_TERM_INSIDE_PARENTHESIS_AND_TERM_OUTSIDE_PARENTHESIS>

<EXPRESSION> ::= <BOOLEAN_EXPRESSION> | <NUMERICAL_EXPRESSION>

<ASSIGNMENT_EXPRESSION> ::= <BOOLEAN_EXPRESSION> | <NUMERICAL_EXPRESSION> |
    <FUNCTION_CALL>

<CASE_CHARACTER_CONSTANT> ::= <CHARACTER> | <ESCAPED_CHARACTER>

<CASE_CONSTANT> ::= <SINGLE_QUOTE> <CASE_CHARACTER_CONSTANT> <SINGLE_QUOTE> |
    <DOUBLE_QUOTE> <CASE_CHARACTER_CONSTANT> <DOUBLE_QUOTE> | <NUMBER>

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```

<BREAK_STATEMENT> ::= break;

<STATEMENT_BLOCK_WITHOUT_BRACES_LAST_STATEMENT_BREAK> ::=
    <STATEMENT_BLOCK_WITHOUT_BRACES> <BREAK_STATEMENT> <SEMICOLON>

<DEFAULT_CASE_STATEMENT_TAIL> ::= <STATEMENT_BLOCK_WITHOUT_BRACES> |
    <STATEMENT_BLOCK_WITHOUT_BRACES_LAST_STATEMENT_BREAK>

<DEFAULT_CASE_STATEMENT> ::= default: <DEFAULT_CASE_STATEMENT_TAIL>

<CASE_STATEMENT_PRECEDES_DEFAULT_CASE_STATEMENT> ::= case <CASE_CONSTANT>:
    <CASE_STATEMENT_TAIL> <DEFAULT_CASE_STATEMENT>

<CASE_STATEMENT_FOLLOWS_DEFAULT_CASE_STATEMENT> ::= <DEFAULT_CASE_STATEMENT> case
    <CASE_CONSTANT>: <CASE_STATEMENT_TAIL>

<CASE_STATEMENT> ::= <CASE_STATEMENT_PRECEDES_DEFAULT_CASE_STATEMENT> |
    <CASE_STATEMENT_FOLLOWS_DEFAULT_CASE_STATEMENT> | <DEFAULT_CASE_STATEMENT>

<SWITCH_SELECTION_STATEMENT> ::= switch { <CASE_STATEMENT> }

<THEN_STATEMENT_BLOCK> ::= then <BLOCK_STATEMENT>

<THEN_ELSE_STATEMENT_BLOCK> ::= then <BLOCK_STATEMENT> else <BLOCK_STATEMENT>

<IF_SELECTION_STATEMENT_TAIL> ::= <THEN_STATEMENT_BLOCK> | <THEN_ELSE_STATEMENT_BLOCK>

<IF_SELECTION_STATEMENT> ::= if <L_PAREN> <BOOLEAN_EXPRESSION> <R_PAREN>
    <IF_SELECTION_STATEMENT_TAIL>

<SELECTION_STATEMENT> ::= <IF_SELECTION_STATEMENT> | <SWITCH_SELECTION_STATEMENT>

<DO_BLOCK_STATEMENT> ::= do <BLOCK_STATEMENT>

<FOR_STATEMENT_TAIL> ::= <R_PAREN> <DO_BLOCK_STATEMENT> | step <INTEGER_OR_FLOAT>
    <R_PAREN> <DO_BLOCK_STATEMENT>

<FOR_STATEMENT> ::= for <L_PAREN> <IDENTIFIER> = <INTEGER_OR_FLOAT> to <INTEGER_OR_FLOAT>
    <FOR_STATEMENT_TAIL>

<UNTIL_STATEMENT> ::= <DO_BLOCK_STATEMENT> until <L_PAREN> <BOOLEAN_EXPRESSION> <R_PAREN>
    <SEMICOLON>

<WHILE_STATEMENT> ::= while <L_PAREN> <BOOLEAN_EXPRESSION> <R_PAREN> <DO_BLOCK_STATEMENT>

<ITERATION_STATEMENT> ::= <FOR_STATEMENT> | <WHILE_STATEMENT> | <UNTIL_STATEMENT>

<ASSIGNMENT_STATEMENT_ATTRIBUTE_READONLY_UPPERCASE> ::= set <IDENTIFIER><PERIOD>protect
    <ASSIGNMENT_OPERATOR> <DOUBLE_QUOTE>r<DOUBLE_QUOTE> <SEMICOLON>

<ASSIGNMENT_STATEMENT_ATTRIBUTE_READONLY_LOWERCASE> ::= set <IDENTIFIER><PERIOD>protect
    <ASSIGNMENT_OPERATOR> <DOUBLE_QUOTE>r<DOUBLE_QUOTE> <SEMICOLON>

<ASSIGNMENT_STATEMENT_ATTRIBUTE_WRITEONLY_UPPERCASE> ::= set <IDENTIFIER><PERIOD>protect
    <ASSIGNMENT_OPERATOR> <DOUBLE_QUOTE>w<DOUBLE_QUOTE> <SEMICOLON>

<ASSIGNMENT_STATEMENT_ATTRIBUTE_WRITEONLY_LOWERCASE> ::= set <IDENTIFIER><PERIOD>protect
    <ASSIGNMENT_OPERATOR> <DOUBLE_QUOTE>w<DOUBLE_QUOTE> <SEMICOLON>

<ASSIGNMENT_STATEMENT_ATTRIBUTE_READWRITE_UPPERCASE> ::= set <IDENTIFIER><PERIOD>protect
    <ASSIGNMENT_OPERATOR> <DOUBLE_QUOTE>rw<DOUBLE_QUOTE> <SEMICOLON>

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<ASSIGNMENT_STATEMENT_ATTRIBUTE_READWRITE_LOWERCASE> ::= set <IDENTIFIER><PERIOD>protect
    <ASSIGNMENT_OPERATOR> <DOUBLE_QUOTE>rw<DOUBLE_QUOTE> <SEMICOLON>

<ASSIGNMENT_STATEMENT_SET_PRIVATE_ATTRIBUTE> ::=
    <ASSIGNMENT_STATEMENT_ATTRIBUTE_READONLY_UPPERCASE> |
    <ASSIGNMENT_STATEMENT_ATTRIBUTE_READONLY_LOWERCASE> |
    <ASSIGNMENT_STATEMENT_ATTRIBUTE_WRITEONLY_UPPERCASE> |
    <ASSIGNMENT_STATEMENT_ATTRIBUTE_WRITEONLY_LOWERCASE> |
    <ASSIGNMENT_STATEMENT_ATTRIBUTE_READWRITE_UPPERCASE> |
    <ASSIGNMENT_STATEMENT_ATTRIBUTE_READWRITE_LOWERCASE>

<ASSIGNMENT_STATEMENT> ::= set <IDENTIFIER> <ASSIGNMENT_OPERATOR> <ASSIGNMENT_EXPRESSION>
    <SEMICOLON>

<PRINT_STATEMENT_TAIL> ::= <QUOTED_STRING> <R_PAREN> <SEMICOLON> | <IDENTIFIER> <R_PAREN>
    <SEMICOLON>

<PRINT_STATEMENT> ::= print <L_PAREN> <PRINT_STATEMENT_TAIL>

<PRINTF_STATEMENT> ::= printf <L_PAREN> <QUOTED_STRING> <R_PAREN> <SEMICOLON> | print
    <L_PAREN> <DOUBLE_QUOTED_STRING> <COMMA>
    <IDENTIFIER_AND_IDENTIFIER_ARRAY_PARAMETER_LIST> <R_PAREN> <SEMICOLON> | print
    <L_PAREN> <SINGLE_QUOTED_STRING> <COMMA>
    <IDENTIFIER_AND_IDENTIFIER_ARRAY_PARAMETER_LIST> <R_PAREN> <SEMICOLON>

<GETCHAR_FUNCTION> ::= getchar <L_PAREN> void <R_PAREN>

<USER_DEFINED_FUNCTION> ::= <IDENTIFIER> <L_PAREN>
    <IDENTIFIER_AND_IDENTIFIER_ARRAY_PARAMETER_LIST> <R_PAREN> | <IDENTIFIER> <L_PAREN>
    <EXPRESSION> <R_PAREN>

<USER_DEFINED_PROCEDURE_CALL_STATEMENT> ::= <IDENTIFIER> <L_PAREN>
    <IDENTIFIER_AND_IDENTIFIER_ARRAY_PARAMETER_LIST> <R_PAREN> <SEMICOLON> | <IDENTIFIER>
    <L_PAREN> <EXPRESSION> <R_PAREN> <SEMICOLON>

<DECLARATION_STATEMENT> ::= declare <DATATYPE_SPECIFIER> <IDENTIFIER> <SEMICOLON> |
    declare <DATATYPE_SPECIFIER> <IDENTIFIER_AND_IDENTIFIER_ARRAY_LIST> <SEMICOLON>

<RETURN_STATEMENT_PARAMETER_VARIABLE_OR_ARRAY> ::= <IDENTIFIER> | <IDENTIFIER> <L_BRACKET>
    <IDENTIFIER> <R_BRACKET>

<RETURN_STATEMENT_PARAMETER> ::= <IDENTIFIER> | <IDENTIFIER> <L_BRACKET> <IDENTIFIER>
    <R_BRACKET> | <IDENTIFIER> <L_BRACKET> <IDENTIFIER> <COMMA> <IDENTIFIER> <R_BRACKET> |
    <IDENTIFIER> <L_BRACKET> <IDENTIFIER> <COMMA> <IDENTIFIER> <COMMA> <IDENTIFIER>
    <R_BRACKET>

<RETURN_STATEMENT_PARAMETER_LIST_TAIL> ::= <RETURN_STATEMENT_PARAMETER> |
    <RETURN_STATEMENT_PARAMETER_LIST>

<RETURN_STATEMENT_PARAMETER_LIST> ::= <RETURN_STATEMENT_PARAMETER> <COMMA>
    <RETURN_STATEMENT_PARAMETER_LIST_TAIL>

<RETURN_STATEMENT_TAIL> ::= <RETURN_STATEMENT_PARAMETER> <SEMICOLON> | <L_PAREN>
    <RETURN_STATEMENT_PARAMETER_LIST> <R_PAREN> <SEMICOLON>

<RETURN_STATEMENT> ::= return <RETURN_STATEMENT_TAIL>

<STATEMENT> ::= <DECLARATION_STATEMENT> | <ASSIGNMENT_STATEMENT> |
    <ASSIGNMENT_STATEMENT_SET_PRIVATE_ATTRIBUTE> | <ITERATION_STATEMENT> |
    <SELECTION_STATEMENT> | <PRINT_STATEMENT> | <RETURN_STATEMENT_SINGLE_ELEMENT> |
    <RETURN_STATEMENT_MULTI_ELEMENT> | <USER_DEFINED_PROCEDURE_CALL_STATEMENT>

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<COMPOUND_STATEMENT> ::= <STATEMENT> | <STATEMENT> <COMPOUND_STATEMENT>

<BLOCK_STATEMENT> ::= <L_BRACE> <COMPOUND_STATEMENT> <R_BRACE> | <L_BRACE> <R_BRACE>

<MAIN_PARAMETER_LIST> ::= void | pointer argv, int argc

<FUNCTION_RETURN_PARAMETER_LIST_TAIL> ::= <DATATYPE_SPECIFIER>

<FUNCTION_RETURN_PARAMETER_LIST> ::= <FUNCTION_RETURN_PARAMETER_LIST_TAIL> |
    <DATATYPE_SPECIFIER> <COMMA> <FUNCTION_RETURN_PARAMETER_LIST>

<PARAMETER_LIST_TAIL> ::= <DATATYPE_SPECIFIER> <IDENTIFIER> | <DATATYPE_SPECIFIER>
    <IDENTIFIER_AND_IDENTIFIER_ARRAY_PARAMETER_LIST_DECLARATION> | <DATATYPE_SPECIFIER>
    <IDENTIFIER> <PARAMETER_LIST_TAIL> | <DATATYPE_SPECIFIER>
    <IDENTIFIER_AND_IDENTIFIER_ARRAY_PARAMETER_LIST_DECLARATION> <PARAMETER_LIST_TAIL>

<PARAMETER_LIST> ::= void | <PARAMETER_LIST_TAIL>

<FUNCTION_DEFINITION> ::= define function <IDENTIFIER> <L_PAREN> <PARAMETER_LIST>
    <R_PAREN> return <L_PAREN> <PARAMETER_LIST_TAIL> <R_PAREN>

<PROCEDURE_DEFINITION> ::= define procedure <IDENTIFIER> <L_PAREN> <PARAMETER_LIST>
    <R_PAREN> <L_BRACE> <COMPOUND_STATEMENT> <R_BRACE>

<MAIN_PROCEDURE_DEFINITION> ::= define procedure main <L_PAREN> <MAIN_PARAMETER_LIST>
    <R_PAREN> <BLOCK_STATEMENT>

<PROGRAM_TAIL> ::= <FUNCTION_DEFINITION> | <PROCEDURE_DEFINITION> |
    <DECLARATION_STATEMENT> | <FUNCTION_DECLARATION> <PROGRAM_TAIL> |
    <PROCEDURE_DEFINITION> <PROGRAM_TAIL> | <DECLARATION_STATEMENT> <PROGRAM_TAIL>

<PROGRAM> ::= <MAIN_PROCEDURE_DEFINITION> | <MAIN_PROCEDURE_DEFINITION> <PROGRAM_TAIL> |
    <FUNCTION_DEFINITION> <PROGRAM> | <PROCEDURE_DEFINITION> <PROGRAM> |
    <DECLARATION_STATEMENT> <PROGRAM>

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