

CS315 - Programming Languages

YarLang Language Specification



Team 6

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1. BNF Description

```
<program> ::= begin <stmt_list> end
<stmt_list> ::= <stmt> | <stmt> <stmt_list>
<stmt> ::= <dec_stmt>;
          | <assign_stmt>;
          | <return_stmt>;
          | <while_stmt>
          | <if_stmt>
          | <input_stmt>;
          | <output_stmt>;
          | <func_def>
          | <func_call>;
          | <foreach_stmt>

<assign_stmt> ::= <id> = <expression> | <concat_stmt>
<dec_stmt> ::= <type> <declarators>
<declarators> ::= <declarator> | <declarators>, <declarator>
<declarator> ::= <id> | <id> = <var_init>
<var_init> ::= <expression> | { <value_list> }

<input_stmt> ::= input(<id_list>)
<output_stmt> ::= print(<str_const>)
                  | print(<expression>)
                  | print(<id_list>)

<concat_stmt> ::= <list_id> += <expression>

<relational_exp> ::= <id> | <id> == <id> | <id> != <id>
<del_expr> ::= <list_id>-- //returns the last item in the list and
                        deletes the item from the list

<expression> ::= <value>
                  | <id>
                  | <func_call>
                  | <relational_expr>
                  | <expr>
                  | <del_expr>

<expr> ::= <expr> <dimp_op> <term1> | <term1>
<term1> ::= <term1> <imp_op> <term2> | <term2>
<term2> ::= <term2> <or_op> <term3> | <term3>
<term3> ::= <term3> <and_op> <term4> | <term4>
<term4> ::= <not_op> <term4> | <term5>
<term5> ::= <id> | <value> | (<expr>)
```

```

<if_stmt> ::= <matched> | <unmatched>
<matched> ::= if ( <expression> ) begin <matched> end else begin <matched>
end
                | any non-if statement
<unmatched> ::= if ( <expression> ) begin <stmt_list> end
                | if ( <logic_expr> ) begin <matched> end else begin <unmatched>
end

<while_stmt> ::= while ( <expression> ) begin <stmt_list> end
<foreach_stmt> ::= foreach ( <id> in <list_id> ) begin <stmt_list> end

<func_def> ::= <return_type> <id> ( <param_list> ) begin <stmt_list> end
<param_list> ::= <type> <id> | <param_list>, <type> <id>
<func_call> ::= <id> ( <call_list> )
<call_list> ::= <id> | <value> | <call_list>, <id> | <call_list>, <value>
<return_stmt> ::= return <expression>
<return_type> ::= <type> | <boid>

<type> ::= <bool> | <list>
<bool> ::= bool
<list> ::= bool[]
<boid> ::= boid

<id> ::= <letter> | <id> <digit> | <id> <letter>
<id_list> ::= <id> | <id_list>, <id>
<list_id> ::= <id>
<value_list> ::= <value> | <value_list>, <value>

<not_op> ::= ! | not
<dimp_op> ::= <-> | dimp
<imp_op> ::= -> | imp
<and_op> ::= & | and
<or_op> ::= | | or
<value> ::= true | false | TRUE | FALSE

<digit> ::= 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9
<letter> ::= a | b | ... | z | A | B | ... | Z |
<punctuation> ::= : | ! | ? | , | . | - | _
                | ( | ) | ' | % | & | $
                | # | ; | " | *

<white_spc> ::= \t | \n | \s |
<str_const> ::= "<char_array>"
<char_array> ::= <char> | <char_array>
<char> ::= <letter> | <digit> | <punctuation> | <white_spc>

<comment> ::= /* <str_const> */

```

2. Explanation of Language Constructs

a. Statements

i. Declaration Statement

One or more variables of the same type can be declared simultaneously in a single statement. Types can be the boolean or the boolean data structure boolean list, denoted by “bool” and “bool[]” keywords. Any declaration made in a statement might include initialization of the value or not. Declarations without initializations only take an identifier as the variable name. For initialization, the assignment operator is used with an expression that can be evaluated to have a meaningful result of the declaration type (boolean constant for “bool”, boolean const list for “bool[]”). Declaration statements are ended with a semicolon to indicate the end of the statement.

ii. Assignment Statement

A simple “=” sign or “is” word is used for assigning expressions to variable ids. A statement ends with a semicolon for increased reliability. Using both the “=” sign and the “is” keyword increases the writability and expressibility of our language, but the drawback is that it is slightly less readable. “expression” is divided into four subcategories: An expression can be a boolean value, a variable (designated by a variable identifier), a function call, a relational expression, a list deletion expression and a boolean operation expression. Declaration statements are ended with a semicolon to indicate the end of the statement.

1. Concatenation Assignment

This is a list concatenation (adding a value to the list structure) expression. We decided to write it out as an assignment statement rather than an expression since it is constructed as an assignment statement, different from all other expression types, increasing reliability. The Syntax is here simple with a “+=” sign only, which increases readability.

iii. Conditional Statements

1. **If Statement:** If statements use “begin” and “end” keywords to indicate the body of the statement inside, like functions and loops. Using “begin” and “end” keywords instead of matching brackets is simply a stylistic choice which aligns with the simple and easy-to-read nature of our language if statements use <matched> <unmatched> constructs to ensure unambiguous if-else grammar, increasing reliability.

iv. Iteration Statements

1. **While Statement:** While statement use “begin” and “end” keywords to indicate the statement body. A while statement takes a single expression as the loop condition. Since the language only supports boolean type, a while loop can only be terminated when the value of the condition expression changes. The condition must be updated inside the loop, or the while loop loses its functionality, which decreases reliability.
2. **Foreach Statement:** Foreach statement is a powerful tool in this limited language, giving the user an easy way to iterate through the list data structure, which is impossible to do with a for loop. Foreach statements also use “begin” and “end” keywords for the body. The foreach statement uses the “in” keyword to specify which list is used for the loop. There must be a variable identifier before the “in” keyword, which will hold the value gathered from the list and a list variable identifier after the “in” keyword. The “in” keyword and the foreach statement are similar to C-type languages, with high readability, writability and reliability.

v. IO Statements

I/O statements are ended with a semicolon to indicate the end of the statement.

1. **Input Statement:** Input statements use the keyword “input” followed by the parameter list inside parentheses. The parameter list is a list of variable identifiers. The variables in the parameter list will store the input values entered by the user. These variables must be declared before in the code, the input statement does not create temporary variables, like the foreach statement.
2. **Output Statement:** Output statements use the keyword “print” followed by the output message or value inside the parentheses. The output can be a string constant, an expression (which will be evaluated to a boolean value), and a variable identifier list. The print statement will always print a string constant or a boolean value, so an identifier will be evaluated to its value and will be printed accordingly. Output messages must be wrapped around quotation marks for them to be considered string constants; everything else will be evaluated as an expression or identifier. Boolean lists will be printed with brackets and values inside, separated by commas.

vi. Function Definitions, Function Calls and Return Statement

Function definition follows the C-type language rules, with return type (boolean, boolean list or void) identifier and parameter list structure. Again, “begin”, and “end” keywords are used for the function body. The parameter list consists of variable identifiers coupled with their respective types (boolean and boolean list). Function calls are made with a function identifier followed by a list of variables inside the parentheses. Function call lists can include variable identifiers and boolean values. The return statement is a one-line statement with the “return” keyword followed by the expression to return. Function calls are ended with a semicolon to indicate the end of the statement.

b. Types

- i. **Bool:** Stores true or false values

c. Data Structures

- i. **List:** Stores Bool literals, the list data structure is implemented in a queue fashion

d. Expressions

- i. **Operators:** In YarLang, programmers are allowed to use both the operator symbol (&, | etc.) and their equivalent verbal versions (and, or etc.). This increases the writability criteria while decreasing the readability criteria.

1. Unary Operators

- a. **not:** Returns inverse of the bool value

2. Logical Binary Operators

- a. **and:** Returns true if both operands are true
- b. **or:** Returns true if at least one of the operators are true
- c. **imp:** Returns the result of logical implication operation with two operands
- d. **dimp:** Returns the result of logical double implication operation with two operands

3. Relational Binary Operators

- a. **==:** Returns true if the value of two variables is equal
 - b. **!:=:** Returns true if the value of two variables are equal
- ii. **Delete Expression:** Returns and deletes the last item in the list, analogous to the dequeue operation for queues.

3. Description of Nontrivial Tokens

a. Identifiers

Identifiers are unique names that can be assigned to variables or functions. Identifiers are alphanumeric character strings. They must start with an alphabetic character and must differ from reserved words. Multiple identifiers can be used together as a comma-separated list to represent an “identifier list”.

b. Literals

String constant literals are used for input and output operations to communicate with the user. Output prompt can show messages to the user that are specified in the program, while input functionality can get constant boolean values from user input strings. String constant literals are always between “ “ (quotation) signs. A single and simple way of string literal representation increases readability and reliability.

c. Comments

Comments are information the programmer supplies to the readers and do not affect the functionality. The beginning and ending of the comments are indicated by “/*” and “*/” symbols, respectively, to increase reliability by ensuring nothing is written between these symbols and readability by increasing the simplicity of the code by having only one set way of writing comments.

d. Reserved Words

- i. true (TRUE)
- ii. false (FALSE)
- iii. begin
- iv. end
- v. print
- vi. input
- vii. if
- viii. else
- ix. return
- x. while
- xi. foreach
- xii. in
- xiii. bool
- xiv. boid
- xv. or
- xvi. and
- xvii. imp
- xviii. dimp
- xix. not