GenCODE

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Group number 21

Grammar Description

OHAI
BTW welcome to the feature set of GenCode !

GenCode is an *esoteric* , general purpose Turing-complete language built upon the **imperative paradigm.** The **humour-laden keywords** make program readability a delightful experience. It is inspired by Adam Linsay's **LOLCODE** but improves upon the simplicity of use and expression. Even non-programmers who are current with memes on the Internet and general slang language would be able to understand and program in **GenCode.**

Features

- Compiled language
- Block structured
- Lexically scoped
- Statically Typed
- Strongly typed
- Explicitly declaration of data type
- Statically scoped functions
- Function Parameters passed by value,
- Typecasting allowed
- Described in English words - comma is the only special character used
- Separated by newline - no special characters needed
- Follows arithmetic operator precedence (DMAS)
- Mixed-mode assignment coercion
- Supports Conditions, Iterations, I/O, Expressions
- Lazy evaluation of expressions
- Supports Arrays and Strings

Constructs

1. **Keywords**
   Keywords are UPPER-case words deriv
2. ed from Internet slang. For eg. **OHAI**.

3. **Identifiers**

   Variable Identifiers are all valid string sequences which may start with an underscore (_) or an alphabet and may be followed by digits. e.g. _hello, hell_o123, hello, etc.

4. **Function Identifiers**

   Function identifiers follow the same rules as variable identifiers.

5. **Data Types**

   Primitive: NUMBER(integer), TUBE(Floating point), TROOF(Boolean)
   Derived : YARN(String) and TRAIN(Array).

6. **Operations**

   Arithmetic - PLUS(addition), MINUS(Subtract), MULT(Multiply), DIV(Divide)
   String - SMOOSH(concatenate)
   Array/Stack - PICK(get), PUT(insert), DROP(delete)
   I/O - GIMME(input), EXPOSE(output)

7. **Functions**

   Parameters are passed by value and returned by value. Single level functions are supported.

8. **Scope Rules**

   GenCode supports Static / Lexical scoping

9. **Conditions**

   OREILLY? YAREILLY(If-then-else) and WHICH?(switch) statements are supported

10. **Iteration**

    Value terminated loops supported. Break can be used to prematurely exit the loop

11. **Expressions**

    Supports semantically correct compound Arithmetic, String, Boolean expressions with operator precedence and name binding.

12. **Assignment**

    Mixed mode assignment coercion allowed.

13. **Separators**

    Tokens are separated by **spaces** except for keywords containing spaces.

14. **Documentation Support**

    Single-line and Multi-line comments are supported via BTW and OBTW….TLDR keywords.

LEXICAL UNITS TOKENS IN GENCODE

Token	Grammar Identifier	Purpose	Token Type
[\w\s\a\n]*	TK_STRALL	Represents any string	String
,	TK_COMMA	Function parameter assign	Separator
(	TK_LPAREN	Left paranthese	Separator
)	TK_RPAREN	Right paranthese	Separator
\s	TK_WHITESPACE	Whitespace separator	Separator
newline	TK_NEWLINE	Newline character (Carriage Return/Return)	Separator
DIFF	TK_SUB	Operator – Substraction	Operator
DIV	TK_DIV	Operator – Division	Operator
DROP	TK_DROP	REMOVE value from array/stack	Operator
MULT	TK_MUL	Operator – Multiplication	Operator
PICK	TK_PICK	GET value from array/stack	Operator
PLUS	TK_ADD	Operator – Addition	Operator
PUT	TK_PUT	PUT value in array/stack	Operator
SMOOSH	TK_CAT	String Concatenation	Operator
[0-9][0-9]*	TK_INT	Integers	Numeric
[0-9][0-9]*\.[0-9]*	TK_FLOAT	Floating point integers	Numeric
(NUMBER)	TK_convINT	Type Conversion Unary	Keyword
(TUBE)	TK_convFloat	Type Conversion Unary	Keyword
(YARN)	TK_convString	Type Conversion Unary	Keyword
(TROOF)	TK_convBool	Type Conversion Unary	Keyword
BTW	TK_CommentSingle	Single Line Comment	Keyword
DOWNIN	TK_DECR	Decrement Unary	Keyword
EXPOSE	TK_PRINT	Print to an output stream	Keyword
FOUND UR	TK_FuncReturn	Function return value	Keyword
GETOUT	TK_BREAK	break out from the loop	Keyword
GETOUTNOW	TK_SWITCHEND	End marker for switch	Keyword
GIMME	TK_INPUT	Take input from an input stream	Keyword
HMM	TK_DEFAULT	Default case for switch	Keyword
HOWZ	TK_FuncStart	Function start marker	Keyword
I HAS A	TK_DeclarePre	Keyword for Variable Declaration	Keyword
IM IN UR LOOP	TK_LoopStart	Loop Declaration	Keyword
IM OUTTA UR LOO	TK_LoopEnd	Loop End Marker	Keyword
ITZ	TK_Assign	Assignment Operator	Keyword
KTHX	TK_FuncEnd	Function End marker	Keyword
KTHXBYE	TK_EndProgram	End Marker of any GenCode	Keyword
NOWAY	TK_ELSE	Else condition	Keyword
NUMBER	TK_typeINT	Data Type for integers	Keyword
NUMBER BAG	TK_typeINTStack	Data Type for stack integers	Keyword
NUMBER TRAIN	TK_typeINTArray	Data Type for Array integers	Keyword
OBTW	TK_CommentMultiStart	Multi Line Comment Start marker	Keyword
OHAI	TK_StartProgram	Start Marker of any GenCode	Keyword

OIC	TK_FuncEndMarker	Function end marker	Keyword
OREILLY?	TK_IF	If condition	Keyword
TILL	TK_LoopCondition	Loop Condition	Keyword
TLDR	TK_CommentMultiEnd	Multi-Line comment end marker	Keyword
TROOF	TK_typeBool	Data Type for Boolean Values	Keyword
TROOF BAG	TK_typeBoolStack	Data Type for Stack of Boolean Values	Keyword
TROOF TRAIN	TK_typeBoolArray	Data Type for Array of Boolean Values	Keyword
TUBE	TK_typeFloat	Data Type for Float type	Keyword
TUBE BAG	TK_typeFloatStack	Data Type for Stack Float type	Keyword
TUBE TRAIN	TK_typeFloatArray	Data Type for Array Float type	Keyword
UMM	TK_CASE	Case for Switch	Keyword
UPPIN	TK_INCR	Increment Unary	Keyword
WHICH?	TK_SWITCH	Switch	Keyword
YAREILLY	TK_THEN	Then condition	Keyword
YARN	TK_typeString	Data Type for String	Keyword
YARN BAG	TK_typeStringStack	Data Type for Stack type String	Keyword
YARN TRAIN	TK_typeStringArray	Data Type for Array type String	Keyword
FALSE	TK_BOOL_FALSE	Boolean False Value	Keyword
TRUE	TK_BOOL_TRUE	Boolean True	Keyword
[_a-zA-Z][_a-zA-Z0-	TK_ID	Identifier	Identifier
[\w\s\a]*	TK_STR	Strings	Identifier
LESSEQUALTO	TK_LTEQ	Condition – Less than equal to	Condition
LESSTHAN	TK_LT	Condition – Less than	Condition
MOREEQUALTO	TK_GTEQ	Condition – Greater than equal to	Condition
MORETHAN	TK_GT	Condition – Greater than	Condition
NOTEQUAL	TK_NEQ	Condition - Not equal to	Condition
SAMEAS	TK_EQ	Condition – Equality	Condition

GenCODE

Grammar

OHAI
BTW welcome to the LL(1) grammar set of GenCode.

This is the LL(1) grammar for *GenCode* language :-

The Non-Terminal <program> is the start symbol of the given grammar.

<program> → <TK_StartProgram><stmts&funcsDefs><TK_EndProgram>

<stmts&funcsDefs> → <stmtDef><TK_NEWLINE><stmts&funcsDefs> | <funcDef><TK_NEWLINE><stmts&FuncsDefs> | eps

<funcDef> → <TK_FuncStart><TK_ID><parameters><TK_NEWLINE><stmtDefs> <return_value><TK_FuncEnd>

<return_value> → <TK_FuncEndMarker><parameters>

<parameters> → <value><parameters> | <TK_COMMA><value><parameters> | eps

<stmtDef> → <TK_ID><func_case_assign> | <declaration_group> | <conditionalStmt> | <i_oStmt> | <cmmntStmt> | <loopStmt>

<func_case_assign> → <assignmentStmt> | <caseStmt> | <funcCallStmt>

<assignmentStmt> → <TK_Assign><value>
<type> → <TK_typeINT> | <TK_typeFloat> | <TK_typeString> | <TK_typeBool> | <TK_typeINTStack> | <TK_typeFloatStack> | <TK_typeStringStack> | <TK_typeBoolStack> | <TK_typeINTArray> | <TK_typeFloatArray> | <TK_typeStringArray> | <TK_typeBoolArray>

<caseStmt> → <TK_COMMA><WHICH><TK_NEWLINE><cases>

<cases> → <TK_CASE><value><TK_NEWLINE><stmts&funcsDefs><cases> | <TK_DEFAULT><TK_NEWLINE><stmts&funcsDefs><TK_SWITCHEND>

<funcCallStmt> → <TK_LPAREN><parameters><TK_RPAREN>

<parameters> → <value><parameters> | <TK_COMMA><value><parameters> | eps

```
<declaration_group> → <TK_DeclarePre><type><TK_ID><assign_hua>

<assign_hua>          → <TK_Assign><value> | eps

<conditionalStmt>     → <TK_IF><expression><true><false>

<true>                → <TK_THEN><stmts&funcsDefs>

<false>               → <TK_ELSE><stmts&funcsDefs>

<i_oStmt>             → <inputStmt> | <outputStmt>

<inputStmt>           → <TK_INPUT> <value>

<outputStmt>          → <TK_PRINT> <value>

<cmmntStmt>           → <singleLine> | <multiLine>

<singleLine>          → <TK_CommentSingle> <TK_STR>

<multiLine>           → <TK_CommentMultiStart><TK_STR><TK_NEWLINE><TK_CommentMulti>

<loopStmt>            → <TK_LOOPSTART><expression><TK_LoopCondition><expression>
                      <TK_NEWLINE><stmts&funcsDefs><TK_LoopEnd>

<value>               → <value_output> | <expression>

<value_output>        →  <TK_ID><id_func> | <TK_INT> | <TK_FLOAT> | <TK_STR> | <booleanValue>

<id_func>             → <funcCallStmt> | eps

<booleanValue>        → <TK_BOOL_TRUE> | <TK_BOOL_FALSE>

<expression>          →  <unaryExpression> | <value_output><expression1> | <StringExpression> |
                      <DerivedDataTypeExpression>

 <expression1>        →  <booleanExpression> | <arithmeticExpressions>

<unaryExpression>     → <unaryOp><value>

<unaryOp>             → <TK_INCR> | <TK_DECR> | <TK_convINT> | <TK_convFloat> |
                      <TK_convString> | <TK_convBool>
```

```
<booleanExpression>→ <logicalOp><value>

<logicalOp>          → <TK_EQ> | <TK_NEQ>

<arithmeticExpression>→ <TK_MUL><value_output><arithmeticExpression> |
                     <TK_DIV><value_output><arithmeticExpression> |
                     <TK_ADD><value_output><arithmeticExpression> |
                     <TK_SUB><value_output><arithmeticExpression> | eps

<StringExpression>   → <TK_CAT><parameters>

<DerivedDataTypeExpression>→ <TK_PUT><parameters> | <TK_PICK><parameters> |
                     <TK_DROP><parameters>
```

Test cases

HELLO WORLD

```
OHAI
        EXPOSE "HELLO WORLD!"
KTHXBYE
```

SWAPPING

```
OHAI
        I HAS A NUMBER FOO ITZ 1000
        I HAS A NUMBER BAR ITZ 9999
        I HAS A NUMBER VAR

        VAR ITZ FOO
        FOO ITZ BAR
        BAR ITZ VAR

        BTW “FOO IS 9999 BAR IS 1000”

        EXPOSE FOO
        EXPOSE BAR
KTHXBYE
```

LOOPS

```
OHAI
I HAS A var ITZ 1024
IM IN UR LOOP UPPIN var TILL var != 0
  EXPOSE var
  var ITZ var DIV 2
IM OUTTA UR LOOP
KTHXBYE
```

FUNCTIONS

```
OHAI
 HOWZ MYCUBE FOO,BAR
   I HAS A NUMBER SUM
   I HAS A NUMBER CUBE

   SUM ITZ FOO PLUS BAR
   CUBE ITZ SUM MULT SUM MULT SUM

   OIC CUBE
 KTHX

 I HAS A XX, YY
 GIMME XX
 GIMME YY

 EXPOSE MYCUBE XX,YY

KTHXBYE
```

Complex Data Type - String

```
OHAI

I HAS A YARN SWEATER ITZ “SO FULL OF WOOL!!!”

I HAS A NUMBER  HOURS ITZ 3

I HAS A YARN DAY

DAY ITZ SMOOSH SWEATER,HOURS,”minutes”

EXPOSE DAY

KTHXBYE
```

Derivations of test cases

Five test cases

Hello World	Shows how I/O works
Swapping	How comments work and variables work
1024/2^x	How conditions, loops and arithmetic operations work
Functions	How functions work
String operations	How string expressions work

Derivation 1:
HELLO WORLD

```
-----------------------------------------------------
OHAI
        EXPOSE "HELLO WORLD!"
KTHXBYE
```

<program> → <TK_StartProgram> <stmts&funcsDefs> <TK_EndProgram>

<program> → <TK_StartProgram> **<stmtDef> <TK_NEWLINE> <stmts&funcsDefs>** <TK_EndProgram>

<program> → <TK_StartProgram> **<i_oStmt>** <TK_NEWLINE> <stmts&funcsDefs> <TK_EndProgram>

<program> → <TK_StartProgram> **<outputStmt>** <TK_NEWLINE> <stmts&funcsDefs> <TK_EndProgram>

<program> → <TK_StartProgram> **<TK_PRINT> <value>** <TK_NEWLINE> <stmts&funcsDefs> <TK_EndProgram>

<program> → <TK_StartProgram> <TK_PRINT> **<value_output>** <TK_NEWLINE> <stmts&funcsDefs> <TK_EndProgram>

<program> → <TK_StartProgram> <TK_PRINT> **<TK_STR>** <TK_NEWLINE> <stmts&funcsDefs> <TK_EndProgram>

<program> → <TK_StartProgram> <TK_PRINT> <TK_STR> <TK_NEWLINE> **eps** <TK_EndProgram>

<program> → <TK_StartProgram> <TK_PRINT> <TK_STR> <TK_NEWLINE> <TK_EndProgram>

Derivation 2:
SWAPPING

```
OHAI
        I HAS A NUMBER FOO ITZ 1000
        I HAS A NUMBER BAR ITZ 9999
        I HAS A NUMBER VAR

        VAR ITZ FOO
        FOO ITZ BAR
        BAR ITZ VAR

        BTW “FOO IS 9999 BAR IS 1000”

        EXPOSE FOO
        EXPOSE BAR
KTHXBYE
```

____

<program> → <TK_StartProgram> <stmts&funcsDefs> <TK_EndProgram>

//start line 1

<program> → <TK_StartProgram> **<stmtDef><TK_NEWLINE><stmts&funcsDefs>** <TK_EndProgram>

<program> → <TK_StartProgram> **<declaration_group>** <TK_NEWLINE> <stmts&funcsDefs> <TK_EndProgram>

<program> → <TK_StartProgram> **<TK_DeclarePre> <type> <TK_ID><assign_hua>** <TK_NEWLINE><stmts&funcsDefs> <TK_EndProgram>

<program> → <TK_StartProgram> <TK_DeclarePre> **<TK_typeINT>** <TK_ID> <assign_hua> <TK_NEWLINE><stmts&funcsDefs> <TK_EndProgram>

<program> → <TK_StartProgram> <TK_DeclarePre> <TK_typeINT> <TK_ID> **<TK_Assign> <value>** <TK_NEWLINE><stmts&funcsDefs> <TK_EndProgram>

<program> → <TK_StartProgram> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> **<value_output>** <TK_NEWLINE><stmts&funcsDefs> <TK_EndProgram>

<program> → <TK_StartProgram> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> **<TK_INT>** <TK_NEWLINE><stmts&funcsDefs> <TK_EndProgram>

//line 2

<program> → <TK_StartProgram> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> **<stmtDef> <TK_NEWLINE> <stmts&funcsDefs>** <TK_EndProgram>

<program> → <TK_StartProgram> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> **<declaration_group>** <TK_NEWLINE> <stmts&funcsDefs> <TK_EndProgram>

<program> → <TK_StartProgram> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> **<TK_DeclarePre> <type> <TK_ID><assign_hua>** <TK_NEWLINE> <stmts&funcsDefs> <TK_EndProgram>

<program> → <TK_StartProgram> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> <TK_DeclarePre> **<TK_typeINT>** <TK_ID><assign_hua> <TK_NEWLINE> <stmts&funcsDefs> <TK_EndProgram>

<program> → <TK_StartProgram> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> <TK_DeclarePre> <TK_typeINT> <TK_ID> **<TK_Assign> <value>** <TK_NEWLINE> <stmts&funcsDefs> <TK_EndProgram>

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<program> → <TK_StartProgram> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> **<TK_INT>** <TK_NEWLINE> <stmts&funcsDefs> <TK_EndProgram>

//line 3

<program> → <TK_StartProgram> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> **<stmtDef> <TK_NEWLINE> <stmts&funcsDefs>** <TK_EndProgram>

<program> → <TK_StartProgram> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign>

<TK_INT> <TK_NEWLINE> **<declaration_group >** <TK_NEWLINE> <stmts&funcsDefs> <TK_EndProgram>

<program> → <TK_StartProgram> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> **<TK_DeclarePre> <type> <TK_ID><assign_hua>** <TK_NEWLINE> <stmts&funcsDefs> <TK_EndProgram>

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<program> → <TK_StartProgram> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> <TK_DeclarePre> <TK_typeINT> <TK_ID> **eps** <TK_NEWLINE> <stmts&funcsDefs> <TK_EndProgram>

//line 4 var itz foo

<program> → <TK_StartProgram> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_NEWLINE> **<stmtDef><TK_NEWLINE><stmts&funcsDefs>** <TK_EndProgram>

<program> → <TK_StartProgram> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_NEWLINE> **<TK_ID> <func_case_assign>**<TK_NEWLINE><stmts&funcsDefs> <TK_EndProgram>

<program> → <TK_StartProgram> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_NEWLINE> <TK_ID> **<assignmentStmt>**<TK_NEWLINE><stmts&funcsDefs> <TK_EndProgram>

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<TK_ID> <TK_Assign> **<value_output>** <TK_NEWLINE> <stmts&funcsDefs> <TK_EndProgram>

<program> → <TK_StartProgram> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_NEWLINE> <TK_ID> <TK_Assign> **<TK_ID> <id_func>** <TK_NEWLINE> <stmts&funcsDefs> <TK_EndProgram>

<program> → <TK_StartProgram> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_NEWLINE> <TK_ID> <TK_Assign> <TK_ID> **eps** <TK_NEWLINE> <stmts&funcsDefs> <TK_EndProgram>

//line 5 foo itz bar

<program> → <TK_StartProgram> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_NEWLINE> <TK_ID> <TK_Assign> <TK_ID> <TK_NEWLINE> **<stmtDef> <TK_NEWLINE> <stmts&funcsDefs>** <TK_EndProgram>

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<program> → <TK_StartProgram> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_NEWLINE> <TK_ID> <TK_Assign> <TK_ID> <TK_NEWLINE> <TK_ID> **<assignmentStmt>** <TK_NEWLINE><stmts&funcsDefs> <TK_EndProgram>

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<program> → <TK_StartProgram> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_NEWLINE> <TK_ID> <TK_Assign> <TK_ID> <TK_NEWLINE> <TK_ID> <TK_Assign> **<value_output>** <TK_NEWLINE><stmts&funcsDefs> <TK_EndProgram>

<program> → <TK_StartProgram> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_Assign> <TK_INT> <TK_NEWLINE> <TK_DeclarePre> <TK_typeINT> <TK_ID> <TK_NEWLINE> <TK_ID> <TK_Assign> <TK_ID> <TK_NEWLINE> <TK_ID> <TK_Assign> **<TK_ID> <id_func>** <TK_NEWLINE><stmts&funcsDefs> <TK_EndProgram>

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//line 6 bar itz var

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//line 6 comment line

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//line 7 expose

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//line 8 expose bar

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DERIVATION 3
MYCUBE

```
OHAI

 HOWZ MYCUBE FOO,BAR
  I HAS A NUMBER SUM
  I HAS A NUMBER CUBE

  SUM ITZ FOO PLUS BAR
  CUBE ITZ SUM MULT SUM MULT SUM

  OIC CUBE
 KTHX

 I HAS A NUMBER XX
 I HAS A NUMBER YY
 GIMME XX
 GIMME YY

 EXPOSE MYCUBE (XX,YY)

KTHXBYE
```

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//line 1

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//line 2 I has a number sum

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//line 3 i has a number cube

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//line 4 sum itz foo plus bar

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KTHXBYE
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<TK_NEWLINE><stmts&funcsDefs><TK_EndProgram>
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<TK_NEWLINE><TK_LoopEnd>
<TK_NEWLINE><TK_EndProgram>

String Manipulation

```
OHAI

I HAS A YARN SWEATER ITZ “SO FULL OF WOOL!!!”

I HAS A NUMBER  HOURS ITZ 3

I HAS A YARN DAY

DAY ITZ SMOOSH SWEATER,HOURS,”minutes”

EXPOSE DAY

KTHXBYE
```

<program> → <TK_StartProgram> **<stmts&funcsDefs>** <TK_EndProgram>

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<program> → <TK_StartProgram> **<declaration_group>** <TK_NEWLINE> <stmts&funcsDefs> <TK_EndProgram>

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<program> →
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<program> →
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KTHXBYE