

# BNF for the Gryph Programming Language

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## 1 General structure

### 1.1 Program

$$\begin{aligned}\langle \text{program} \rangle &\models \langle \text{program-unit} \rangle \mid \langle \text{program-unit} \rangle \langle \text{program} \rangle \\ \langle \text{program-unit} \rangle &\models \langle \text{stmt} \rangle ; \mid \langle \text{subprog-decl} \rangle\end{aligned}$$

### 1.2 Statements

$$\begin{aligned}\langle \text{stmt-list} \rangle &\models \langle \text{stmt} \rangle ; \mid \langle \text{stmt} \rangle ; \langle \text{stmt-list} \rangle \\ \langle \text{stmt} \rangle &\models \langle \text{read-stmt} \rangle \mid \langle \text{print-stmt} \rangle \mid \langle \text{var-decl-stmt} \rangle\end{aligned}$$

#### 1.2.1 IO

$$\begin{aligned}\langle \text{read-stmt} \rangle &\models \text{read } \langle \text{ident} \rangle \\ \langle \text{write-stmt} \rangle &\models \text{print } \langle \text{ident} \rangle \mid \text{print } \langle \text{string-lit} \rangle\end{aligned}$$

### 1.2.2 Variables

$$\begin{aligned}\langle \text{ident-begin-stmt} \rangle & \models \langle \text{ident-list} \rangle \langle \text{ident-list-post} \rangle \\ \langle \text{ident-list-post} \rangle & \models : \langle \text{type} \rangle \langle \text{var-decl-stmt} \rangle \mid \langle \text{var-attr-stmt} \rangle \\ \langle \text{var-decl-stmt} \rangle & \models \lambda \mid \langle \text{var-attr-stmt} \rangle \\ \langle \text{var-attr-stmt} \rangle & \models = \langle \text{expr-list} \rangle\end{aligned}$$

## 1.3 Subprograms

### 1.3.1 Declaration

### 1.3.2 Call

$$\langle \text{subprog-call} \rangle \models \langle \text{ident} \rangle (\langle \text{expr-list} \rangle)$$

## 2 Control Structures

### 2.1 Ifelse statements

$$\langle \text{if-stmt} \rangle \models (\langle \text{b-expr} \rangle) \langle \text{block-or-stmt} \rangle$$

## 3 Types

$$\begin{aligned}\langle \text{type-list} \rangle & \models \langle \text{type} \rangle, \langle \text{type-list} \rangle \mid \langle \text{type} \rangle \\ \langle \text{type} \rangle & \models \langle \text{native-type} \rangle \mid \langle \text{user-type} \rangle \\ \langle \text{native-type} \rangle & \models \langle \text{primitive-type} \rangle \mid \langle \text{composite-type} \rangle \\ \langle \text{primitive-type} \rangle & \models \text{int} \mid \text{float} \mid \text{char} \mid \text{string} \\ \langle \text{composite-type} \rangle & \models [\langle \text{type} \rangle] \mid |\langle \text{type} \rangle| \mid (\langle \text{type} \rangle, \langle \text{type-list} \rangle) \mid \langle \text{graph-type} \rangle \\ \langle \text{graph-type} \rangle & \models < \langle \text{type} \rangle > \mid < \langle \text{type} \rangle, \langle \text{type} \rangle > \\ \langle \text{user-type} \rangle & \models \langle \text{upper-letter} \rangle \langle \text{alpha-num-list} \rangle\end{aligned}$$

### Observations

- The maximum size of tuples depends on the language implementation, though, in the BNF description above, it may assume any value.

## 4 Expressions

### 4.1 Any expression

$$\begin{aligned}\langle \text{expression} \rangle & \models \langle \text{logical-xor-expr} \rangle \\ \langle \text{logical-xor-expr} \rangle & \models \langle \text{logical-or-expr} \rangle \mid \langle \text{logical-or-expr} \rangle \langle \text{logical-xor-expr-aux} \rangle \\ \langle \text{logical-or-expr-aux} \rangle & \models \text{xor} \langle \text{logical-or-expr} \rangle \mid \text{xor} \langle \text{logical-or-expr} \rangle \langle \text{logical-xor-expr-aux} \rangle \\ \langle \text{logical-or-expr} \rangle & \models \langle \text{logical-and-expr} \rangle \mid \langle \text{logical-and-expr} \rangle \langle \text{logical-or-expr-aux} \rangle \\ \langle \text{logical-or-expr-aux} \rangle & \models \text{or} \langle \text{logical-and-expr} \rangle \mid \text{or} \langle \text{logical-and-expr} \rangle \langle \text{logical-or-expr-aux} \rangle \\ \langle \text{logical-and-expr} \rangle & \models \langle \text{equality-expr} \rangle \mid \langle \text{equality-expr} \rangle \langle \text{logical-and-expr-aux} \rangle \\ \langle \text{logical-and-expr-aux} \rangle & \models \text{and} \langle \text{equality-expr} \rangle \mid \text{and} \langle \text{equality-expr} \rangle \langle \text{logical-and-expr-aux} \rangle \\ \langle \text{equality-expr} \rangle & \models \langle \text{rel-expr} \rangle \mid \langle \text{rel-expr} \rangle \langle \text{rel-expr-aux} \rangle \\ \langle \text{equality-expr-aux} \rangle & \models \langle \text{equality-op} \rangle \langle \text{rel-expr} \rangle \mid \langle \text{equality-op} \rangle \langle \text{rel-expr} \rangle \langle \text{equality-expr-aux} \rangle \\ \langle \text{rel-expr} \rangle & \models \langle \text{add-expr} \rangle \langle \text{rel-expr-aux} \rangle\end{aligned}$$

$\langle \text{rel-expr-aux} \rangle$	$\models$	$\langle \text{rel-op} \rangle \langle \text{add-expr} \rangle \mid \langle \text{rel-op} \rangle \langle \text{add-expr} \rangle \langle \text{rel-expr-aux} \rangle$
$\langle \text{add-expr} \rangle$	$\models$	$\langle \text{mult-expr} \rangle \mid \langle \text{mult-expr} \rangle \langle \text{add-expr-aux} \rangle$
$\langle \text{add-expr-aux} \rangle$	$\models$	$\langle \text{add-op} \rangle \langle \text{mult-expr} \rangle \mid \langle \text{add-op} \rangle \langle \text{mult-expr} \rangle \langle \text{add-expr-aux} \rangle$
$\langle \text{mult-expr} \rangle$	$\models$	$\langle \text{exp-expr} \rangle \mid \langle \text{exp-expr} \rangle \langle \text{mult-expr-aux} \rangle$
$\langle \text{mult-expr-aux} \rangle$	$\models$	$\langle \text{mult-op} \rangle \langle \text{exp-expr} \rangle \mid \langle \text{mult-op} \rangle \langle \text{exp-expr} \rangle \langle \text{mult-expr-aux} \rangle$
$\langle \text{exp-expr} \rangle$	$\models$	$\langle \text{cast-expr} \rangle \mid \langle \text{cast-expr} \rangle \langle \text{exp-op} \rangle \langle \text{exp-expr} \rangle$
$\langle \text{cast-expr} \rangle$	$\models$	$\langle \text{unary-expr} \rangle \mid \langle \text{unary-expr} \rangle \langle \text{cast-expr-aux} \rangle$
$\langle \text{cast-expr-aux} \rangle$	$\models$	$@\langle \text{type} \rangle \mid @\langle \text{type} \rangle \langle \text{cast-expr-aux} \rangle$
$\langle \text{unary-expr} \rangle$	$\models$	$\langle \text{unary-op} \rangle \langle \text{cast-expr} \rangle \mid \langle \text{postfix-expr} \rangle$
$\langle \text{postfix-expr} \rangle$	$\models$	$\langle \text{primary-expr} \rangle \mid \langle \text{ident} \rangle [\text{expression}] \mid \langle \text{ident} \rangle < \text{expression} > \mid \langle \text{ident} \rangle [\text{expression}] \mid \langle \text{ident} \rangle \{ \langle \text{ident} \rangle \} \mid \langle \text{ident} \rangle . \langle \text{expression} \rangle$
$\langle \text{primary-expr} \rangle$	$\models$	$(\langle \text{expression} \rangle) \mid \langle \text{ident} \rangle \mid \langle \text{subprogcall} \rangle \mid \langle \text{constant} \rangle$
$\langle \text{constant} \rangle$	$\models$	$\langle \text{int-lit} \rangle \mid \langle \text{float-lit} \rangle \mid \langle \text{string-lit} \rangle \mid \langle \text{bool-lit} \rangle \mid \langle \text{list-lit} \rangle \mid \langle \text{graph-lit} \rangle$
$\langle \text{rel-op} \rangle$	$\models$	$> \mid < \mid <= \mid >=$
$\langle \text{equality-op} \rangle$	$\models$	$== \mid !=$
$\langle \text{unary-op} \rangle$	$\models$	$+ \mid -$
$\langle \text{add-op} \rangle$	$\models$	$+ \mid -$
$\langle \text{mult-op} \rangle$	$\models$	$* \mid / \mid \% \mid ++ \mid **$
$\langle \text{exp-op} \rangle$	$\models$	$^$

## 4.2 Relational expressions

$\langle \text{rel-expr} \rangle$	$\models$	$\langle \text{rel-term} \rangle \langle \text{rel-expr-aux} \rangle$
$\langle \text{rel-expr-aux} \rangle$	$\models$	$\langle \text{rel-op} \rangle \langle \text{rel-term} \rangle \mid \langle \text{rel-op} \rangle \langle \text{rel-term} \rangle \langle \text{rel-expr-aux} \rangle$
$\langle \text{rel-op} \rangle$	$\models$	$> \mid < \mid <= \mid >= \mid == \mid !=$
$\langle \text{rel-term} \rangle$	$\models$	$(\langle \text{rel-expr} \rangle) \mid \langle \text{bool-expr} \rangle \mid \langle \text{expr} \rangle$

## 4.3 Boolean expressions

$\langle \text{b-expr} \rangle$	$\models$	$\langle \text{b-term} \rangle \mid \langle \text{b-term} \rangle \langle \text{b-expr-aux} \rangle$
$\langle \text{b-expr-aux} \rangle$	$\models$	$\langle \text{b-bin-op-p0} \rangle \langle \text{b-term} \rangle \mid \langle \text{b-bin-op-p0} \rangle \langle \text{b-term} \rangle \langle \text{b-expr-aux} \rangle$
$\langle \text{b-term} \rangle$	$\models$	$\langle \text{b-literal} \rangle \mid \langle \text{b-literal} \rangle \langle \text{b-term-aux} \rangle$
$\langle \text{b-term-aux} \rangle$	$\models$	$\langle \text{b-bin-op-p1} \rangle \langle \text{b-literal} \rangle \mid \langle \text{b-bin-op-p1} \rangle \langle \text{b-literal} \rangle \langle \text{b-term-aux} \rangle$
$\langle \text{b-literal} \rangle$	$\models$	$\langle \text{b-base} \rangle \mid \langle \text{b-un-op} \rangle \langle \text{b-base} \rangle$
$\langle \text{b-base} \rangle$	$\models$	$(\langle \text{b-expr} \rangle) \mid \text{true} \mid \text{false} \mid \langle \text{rel-expr} \rangle \mid \langle \text{ident} \rangle \mid \langle \text{subprog-call} \rangle$
$\langle \text{b-un-op} \rangle$	$\models$	$\text{not}$
$\langle \text{b-bin-op-p0} \rangle$	$\models$	$\text{or} \mid \text{xor}$
$\langle \text{b-bin-op-p1} \rangle$	$\models$	$\text{and}$

## 4.4 Expressions with numbers, lists and strings

$\langle \text{expr} \rangle$	$\models$	$\langle \text{term} \rangle \mid \langle \text{term} \rangle \langle \text{expr-aux} \rangle$
$\langle \text{expr-aux} \rangle$	$\models$	$\langle \text{bin-op-p0} \rangle \langle \text{term} \rangle \mid \langle \text{bin-op-p0} \rangle \langle \text{term} \rangle \langle \text{expr-aux} \rangle$
$\langle \text{term} \rangle$	$\models$	$\langle \text{factor} \rangle \mid \langle \text{factor} \rangle \langle \text{term-aux} \rangle$
$\langle \text{term-aux} \rangle$	$\models$	$\langle \text{bin-op-p1} \rangle \langle \text{factor} \rangle \mid \langle \text{bin-op-p1} \rangle \langle \text{factor} \rangle \langle \text{term-aux} \rangle$
$\langle \text{factor} \rangle$	$\models$	$\langle \text{literal} \rangle ^ \langle \text{factor} \rangle \mid \langle \text{literal} \rangle$
$\langle \text{literal} \rangle$	$\models$	$\langle \text{basis} \rangle \mid + \langle \text{basis} \rangle \mid - \langle \text{basis} \rangle$
$\langle \text{basis} \rangle$	$\models$	$(\langle \text{expr} \rangle) \mid \langle \text{ident} \rangle \mid \langle \text{int-lit} \rangle \mid \langle \text{float-lit} \rangle \mid \langle \text{list-lit} \rangle \mid \langle \text{subprog-call} \rangle \mid \langle \text{string-lit} \rangle$

$\langle \text{un-op} \rangle$	$\models$	$+$	$ $	$-$						
$\langle \text{bin-op-p0} \rangle$	$\models$	$+$	$ $	$-$						
$\langle \text{bin-op-p1} \rangle$	$\models$	$*$	$ $	$/$	$ $	$\%$	$ $	$++$	$ $	$**$