

Mint Programming Language

SER 502-Team 25

Spring 2025



Contributors:

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Overview

1. Introduction
2. Grammar & Tokens
3. Evaluator & Interpreter Design
4. Sample Code Execution
5. Future Scope

1.



INTRODUCTION

1. **Mint** is a beginner-friendly, imperative programming language designed to provide a smooth learning curve for new programmers while offering a robust foundation for structured programming.
2. **Cross-platform compatibility:** Mint is implemented in Java, enabling it to run seamlessly on Windows, macOS, and Linux systems. Its runtime behavior is consistent across platforms, making it a reliable tool for developers regardless of their OS.
3. **Full interpretation pipeline:** Mint supports the complete interpretation process—from **lexical analysis** (tokenizing source code) to **parsing** (syntax validation) and **runtime execution** (evaluating code through a visitor-based interpreter).
4. **ANTLR4-based architecture:** The language's grammar is defined using **ANTLR 4.13.2**, a powerful parser generator. This enables us to convert source code into parse trees efficiently, facilitating both syntax checking and semantic processing.
5. **Readable, modern syntax:** Inspired by modern C-style imperative languages, Mint provides familiar constructs such as loops, conditionals, arithmetic expressions, and more. Keywords are chosen for clarity (e.g., `mint_if`, `mint_for`, `sayln`) to enhance readability and reduce the cognitive load on beginners.
5. **Educational and extensible:** Mint is designed with educational goals in mind. It offers strong type checking and clearly defined semantics, making it suitable for teaching compiler and interpreter design. Additionally, its modular structure allows for future extensions, such as support for functions, data structures, and concurrency.

2.



GRAMMAR & TOKENS

GRAMMAR – Mint.g4

```
1 // File: Mint.g4
2 // Author: Kiran Venkatachalam, Monisha Krishnamurthy, Rahul Ravindra Reddy, Vishnu Kumar Adhilakshmi Kalidas
3 // Purpose: Grammar definition for Mint language parser using ANTLR4
4 // Version: 5.0
5
6 grammar Mint;
7
8 @header {
9 package gen;
10 }
11
12 // =====
13 // Lexer Rules
14 // =====
15
16 MINT_IF      : 'mint_if';
17 MINT_ELSE    : 'mint_else';
18 MINT_ELSEIF  : 'mint_elseif';
19 MINT_FOR     : 'mint_for';
20 MINT_WHILE   : 'mint_while';
21 MINT_BREAK   : 'mint_break';
22 MINT_CONTINUE : 'mint_continue';
23 SAY         : 'say';
24 SAYLN       : 'sayln';
25 T_IF        : '?';
26 T_ELSE      : ':';
27
28 AND         : 'and';
29 OR          : 'or';
30 NOT         : 'not';
31
32 ADD         : '+';
33 SUB         : '-';
34 MUL         : '*';
35 DIV         : '/';
36 MOD         : '%';
37
38 EQ          : '=';
39 NEQ         : '!=';
40 LT          : '<';
41 LTE         : '<=';
42 GT          : '>';
43 GTE         : '>=';
44
45 ASSIGN      : '=';
46 SEMI        : ';';
47 COMMA       : ',';
48 LPAREN      : '(';
49 RPAREN      : ')';
50 LBRACE      : '{';
51 RBRACE      : '}';
```

```
53 INT_TYPE    : 'mint_int';
54 FLOAT_TYPE  : 'mint_float';
55 STRING_TYPE : 'mint_string';
56 BOOL_TYPE   : 'mint_bool';
57
58 NUMBER      : [0-9]+'.'[0-9]+?;
59 BOOL        : 'true' | 'false';
60 STRING      : '"' .*? '"';
61 IDENTIFIER   : [a-zA-Z_][a-zA-Z_0-9]*;
62
63 WS          : [ \t\r\n]+ -> skip;
64 LINE_COMMENT : '//' ~[\r\n]* -> skip;
65
66 // =====
67 // Parser Rules
68 // =====
69
70 program
71 : statement* EOF
72 ;
73
74 statement
75 : declaration
76 | assignment
77 | printStatement
78 | ifStatement
79 | whileLoop
80 | forLoop
81 | breakStatement
82 | continueStatement
83 | expressionStatement
84 ;
85
86 declaration
87 : type IDENTIFIER (ASSIGN expression)? SEMI
88 ;
89
90 assignment
91 : IDENTIFIER ASSIGN expression SEMI
92 ;
93
94 printStatement
95 : SAY LPAREN expression RPAREN SEMI
96 | SAYLN LPAREN expression RPAREN SEMI
97 ;
98
99 ifStatement
100 : MINT_IF LPAREN expression RPAREN block
101 | (MINT_ELSEIF LPAREN expression RPAREN block)*
102 | (MINT_ELSE block)?
103 ;
104
```

```

Mint.g4 x
Mint.g4
105 whileLoop
106     : MINT_WHILE LPAREN expression RPAREN block
107     ;
108
109 simpleAssignment
110     : IDENTIFIER ASSIGN expression
111     ;
112
113 forLoop
114     : MINT_FOR LPAREN simpleAssignment SEMI expression SEMI simpleAssignment RPAREN block
115     ;
116
117 breakStatement
118     : MINT_BREAK SEMI
119     ;
120
121 continueStatement
122     : MINT_CONTINUE SEMI
123     ;
124
125 expressionStatement
126     : expression SEMI
127     ;
128
129 block
130     : LBRACE statement* RBRACE
131     ;
132
133 type
134     : INT_TYPE
135     | FLOAT_TYPE
136     | STRING_TYPE
137     | BOOL_TYPE
138     ;
139
140 // =====
141 // Expression Parsing by Precedence
142 // =====
143
144 expression
145     : ternaryExpression
146     ;
147
148 ternaryExpression
149     : logicalExpression (T_IF expression T_ELSE expression)?
150     ;
151

```

```

Mint.g4 x
Mint.g4
152 logicalExpression
153     : logicalExpression AND equalityExpression
154     | logicalExpression OR equalityExpression
155     | NOT logicalExpression
156     | equalityExpression
157     ;
158
159 equalityExpression
160     : comparisonExpression ((EQ | NEQ) comparisonExpression)*
161     ;
162
163 comparisonExpression
164     : additiveExpression ((LT | LTE | GT | GTE) additiveExpression)*
165     ;
166
167 additiveExpression
168     : additiveExpression (ADD | SUB) multiplicativeExpression
169     | multiplicativeExpression
170     ;
171
172 multiplicativeExpression
173     : multiplicativeExpression (MUL | DIV | MOD) primaryExpression
174     | primaryExpression
175     ;
176
177 primaryExpression
178     : LPAREN expression RPAREN
179     | IDENTIFIER
180     | NUMBER
181     | STRING
182     | BOOL
183     ;
184

```

Mint Evaluator Methods Implemented

```
J MintEvaluator.java 9+ x
src > runtime > J MintEvaluator.java > MintEvaluator > visitProgram(ProgramContext)
1 package runtime;
2
3 > import gen.MintBaseVisitor;-
4
5 public class MintEvaluator extends MintBaseVisitor<Object> {
6
7     private final Map<String, Object> variables = new HashMap<>();
8     private final Map<String, String> types = new HashMap<>();
9     private boolean breakFlag = false;
10    private boolean continueFlag = false;
11
12    @Override
13    public Object visitProgram(MintParser.ProgramContext ctx) {-
14
15    @Override
16    public Object visitDeclaration(MintParser.DeclarationContext ctx) {-
17
18    @Override
19    public Object visitAssignment(MintParser.AssignmentContext ctx) {-
20
21    @Override
22    public Object visitPrintStatement(MintParser.PrintStatementContext ctx) {-
23
24    @Override
25    public Object visitIfStatement(MintParser.IfStatementContext ctx) {-
26
27    @Override
28    public Object visitWhileLoop(MintParser.WhileLoopContext ctx) {-
29
30    @Override
31    public Object visitSimpleAssignment(MintParser.SimpleAssignmentContext ctx) {-
32
33    @Override
34    public Object visitForLoop(MintParser.ForLoopContext ctx) {-
35
36    @Override
37    public Object visitBreakStatement(MintParser.BreakStatementContext ctx) {-
38
39    @Override
40    public Object visitContinueStatement(MintParser.ContinueStatementContext ctx) {-
41
42    @Override
43    public Object visitExpression(MintParser.ExpressionContext ctx) {-
44
45    @Override
46    public Object visitExpressionStatement(MintParser.ExpressionStatementContext ctx) {-
47
48    @Override
49    public Object visitTernaryExpression(MintParser.TernaryExpressionContext ctx) {-
50
51    @Override
52    public Object visitLogicalExpression(MintParser.LogicalExpressionContext ctx) {-
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```


Features

1. Control Structures:

- `mint_if`, `mint_else`, `mint_elseif` – for conditional branching
- `mint_while`, `mint_for` – for iteration
- `mint_break`, `mint_continue` – for flow control inside loops

2. Print Statements:

- `say()` – prints output without a newline
- `sayln()` – prints output followed by a newline

3. Arithmetic Operations:

- Addition: `add_color`
- Subtraction: `subtract_color`
- Multiplication: `multiply_color`
- Division: `divide_color`
- Modulus: `modulo_color`

4. Data Types:

- `mint_int`: Integer values
- `mint_float`: Floating-point values
- `mint_bool`: Boolean values (`true`, `false`)
- `mint_string`: String values (double-quoted)

5. Ternary Operator:

- `? : –` Used for inline conditional expressions

6. Variable Naming Rules :

- Must begin with a letter or underscore
- Can include letters, digits, and underscores
- Examples: `var1`, `_count`, `temp_val`

Lexer Rules:

- Defined using regular expressions
- Reserved keywords: `mint_if`, `mint_else`, `say`, `sayln`, etc.
- Operators: `+`, `-`, `*`, `/`, `%`, `==`, `!=`, `<`, `<=`, `>`
- Data types: `mint_int`, `mint_float`, `mint_string`, `mint_bool`
- Tokens for: identifiers, numbers, booleans, strings, whitespace, comments

Sample Lexer Snippet:

```
MINT_IF      : 'mint_if';
MINT_ELSE    : 'mint_else';
MINT_FOR     : 'mint_for';
ADD          : '+';
SUB          : '-';
NUMBER       : [0-9]+('.'[0-9]+)?;
IDENTIFIER   : [a-zA-Z_][a-zA-Z_0-9]*;
WS           : [
]+ -> skip;
```

Parser Rules Overview:

- program rule accepts multiple statements
- Supported statements: declarations, assignments, print, if, for, while, break, continue
- Operator precedence is respected in expressions: ternary → logical → equality → comparison → additive → multiplicative → primary

Sample Parser Snippet:

```
program  
: statement* EOF;
```

```
statement  
: declaration  
| assignment  
| printStatement  
| ifStatement  
| forLoop  
| whileLoop  
| breakStatement  
| continueStatement  
| expressionStatement;
```

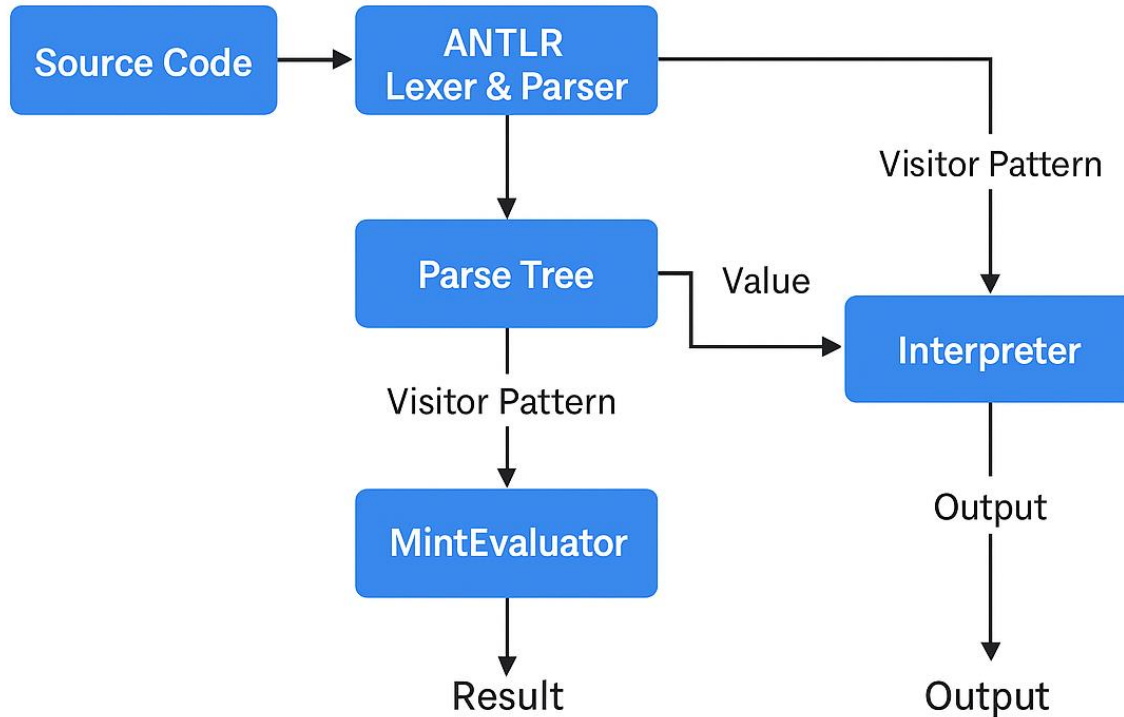
```
declaration  
: type IDENTIFIER (ASSIGN expression)? SEMI;
```

3.



EVALUATOR & INTERPRETER DESIGN

Evaluator & Interpreter Workflow



4.



SAMPLE CODE EXECUTION

sample1.mint

≡ sample1.mint M ×

data > ≡ sample1.mint

```
1 // Demonstrates arithmetic, logical expressions, if-else, and for loop constructs
2 mint_int x = 10;
3 mint_int y = 5;
4
5 // Simple arithmetic
6 sayln(x + y);           // 15
7 sayln(x - y);           // 5
8 sayln(x * y);           // 50
9 sayln(x / y);           // 2
10 sayln(x % y);           // 0
11
12 // Logical expressions
13 mint_bool a = true;
14 mint_bool b = false;
15
16 sayln(a);               // true
17 sayln(b);               // false
18 sayln(a and b);         // false
19 sayln(a or b);          // true
20 sayln(not a);            // false
21
22 // If-else block
23 mint_if (x > y) {
24 |   sayln("x is greater than y");
25 } mint_else {
26 |   sayln("x is not greater");
27 }
28
29 // For loop
30 mint_int i = 0;
31 mint_for (i = 0; i < 3; i = i + 1) {
32 |   say("loop: ");
33 |   sayln(i);            // 0, 1, 2
34 }
```


Output – Tokens

```
PROBLEMS 267 OUTPUT DEBUG CONSOLE TERMINAL PORTS

kiran@Kirans-Laptop ser502-group25 % java -cp "build:antlr-4.13.2-complete.jar" org.antlr.v4.gui.TestRig gen.Mint program -tokens data/sample1.mint
[00,82:89='mint_int',<IDENTIFIER>,2:0]
[01,91:91='x',<IDENTIFIER>,2:9]
[02,93:93='+',<'>,2:11]
[03,95:96='10',<NUMBER>,2:13]
[04,97:97=';',<'>,2:15]
[05,99:106='mint_int',<IDENTIFIER>,3:0]
[06,108:108='y',<IDENTIFIER>,3:9]
[07,110:110='-',<'>,3:11]
[08,112:112='5',<NUMBER>,3:13]
[09,113:113=';',<'>,3:14]
[10,137:141='sayln',<'>,6:0]
[11,142:142='(',<'>,6:5]
[12,143:143='x',<IDENTIFIER>,6:6]
[13,145:145='+',<'>,6:8]
[14,147:147='y',<IDENTIFIER>,6:10]
[15,148:148=')',<'>,6:11]
[16,149:149=';',<'>,6:12]
[17,166:178='sayln',<'>,7:0]
[18,171:171='(',<'>,7:5]
[19,172:172='x',<IDENTIFIER>,7:6]
[20,174:174='-',<'>,7:8]
[21,176:176='y',<IDENTIFIER>,7:10]
[22,177:177=';',<'>,7:11]
[23,178:178=';',<'>,7:12]
[24,194:198='sayln',<'>,8:0]
[25,199:199='(',<'>,8:5]
[26,200:200='x',<IDENTIFIER>,8:6]
[27,202:202='+',<'>,8:8]
[28,204:204='y',<IDENTIFIER>,8:10]
[29,205:205=')',<'>,8:11]
[30,206:206=';',<'>,8:12]
[31,223:227='sayln',<'>,9:0]
[32,228:228='(',<'>,9:5]
[33,229:229='x',<IDENTIFIER>,9:6]
[34,231:231='-',<'>,9:8]
[35,233:233='y',<IDENTIFIER>,9:10]
[36,234:234=';',<'>,9:11]
[37,235:235=';',<'>,9:12]
[38,251:255='sayln',<'>,10:0]
[39,256:256='(',<'>,10:5]
[40,257:257='x',<IDENTIFIER>,10:6]
[41,259:259='+',<'>,10:8]
[42,261:261='y',<IDENTIFIER>,10:10]
[43,262:262=')',<'>,10:11]
[44,263:263=';',<'>,10:12]
[45,303:311='mint_bool',<IDENTIFIER>,13:0]
[46,313:313='a',<IDENTIFIER>,13:10]
[47,315:315='a',<'>,13:12]
[48,317:328='true',<BOOL>,13:14]
[49,321:321=';',<'>,13:18]
[50,323:331='mint_bool',<IDENTIFIER>,14:0]
[51,333:333='b',<IDENTIFIER>,14:10]
[52,335:335='a',<'>,14:12]
[53,337:341='false',<BOOL>,14:14]
[54,342:342=';',<'>,14:18]
[55,345:349='sayln',<'>,16:0]
[56,350:350='(',<'>,16:5]
[57,351:351='a',<IDENTIFIER>,16:6]
[58,352:352=';',<'>,16:7]
[59,353:353=';',<'>,16:8]
[60,376:380='sayln',<'>,17:0]
[61,381:381='(',<'>,17:5]
[62,382:382='b',<IDENTIFIER>,17:6]
[63,383:383=';',<'>,17:7]
[64,384:384=';',<'>,17:8]
[65,408:412='sayln',<'>,18:0]
[66,413:413='(',<'>,18:5]
```

```
PROBLEMS 267 OUTPUT DEBUG CONSOLE TERMINAL PORTS

[066,413:413='(',<'>,18:5]
[067,414:414='a',<IDENTIFIER>,18:6]
[068,416:418='and',<'>,18:8]
[069,420:420='b',<IDENTIFIER>,18:12]
[070,421:421=';',<'>,18:13]
[071,422:422=';',<'>,18:14]
[072,440:444='sayln',<'>,19:0]
[073,445:445='(',<'>,19:5]
[074,446:446='a',<IDENTIFIER>,19:6]
[075,448:449='or',<'>,19:8]
[076,451:451='b',<IDENTIFIER>,19:11]
[077,452:452=';',<'>,19:12]
[078,453:453=';',<'>,19:13]
[079,471:475='sayln',<'>,20:0]
[080,476:476='(',<'>,20:5]
[081,477:479='not',<'>,20:6]
[082,481:481='a',<IDENTIFIER>,20:10]
[083,482:482=';',<'>,20:11]
[084,483:483=';',<'>,20:12]
[085,521:527='mint_if',<IDENTIFIER>,23:0]
[086,529:529='(',<'>,23:8]
[087,530:530='x',<IDENTIFIER>,23:9]
[088,532:532=';',<'>,23:11]
[089,534:534='y',<IDENTIFIER>,23:13]
[090,535:535=';',<'>,23:14]
[091,537:537=';',<'>,23:16]
[092,543:547='sayln',<'>,24:4]
[093,548:548='(',<'>,24:9]
[094,549:569='x is greater than y',<STRING>,24:10]
[095,570:570=';',<'>,24:31]
[096,571:571=';',<'>,24:32]
[097,573:573=';',<'>,25:0]
[098,575:583='mint_else',<IDENTIFIER>,25:2]
[099,585:585='(',<'>,25:12]
[100,591:595='sayln',<'>,26:4]
[101,596:596=';',<'>,26:9]
[102,597:616='x is not greater',<STRING>,26:10]
[103,615:615=';',<'>,26:28]
[104,616:616=';',<'>,26:29]
[105,618:618=';',<'>,27:0]
[106,633:640='mint_int',<IDENTIFIER>,30:0]
[107,642:642=';',<'>,30:9]
[108,644:644=';',<'>,30:11]
[109,646:646='0',<NUMBER>,30:13]
[110,647:647=';',<'>,30:14]
[111,649:650='mint_for',<IDENTIFIER>,31:0]
[112,650:650=';',<'>,31:0]
[113,650:650=';',<'>,31:10]
[114,661:661=';',<'>,31:12]
[115,663:663='0',<NUMBER>,31:14]
[116,664:664=';',<'>,31:15]
[117,666:666=';',<'>,31:17]
[118,668:668=';',<'>,31:19]
[119,670:670='3',<NUMBER>,31:21]
[120,671:671=';',<'>,31:22]
[121,673:673=';',<'>,31:24]
[122,675:675=';',<'>,31:26]
[123,677:677=';',<'>,31:28]
[124,679:679='+',<'>,31:30]
[125,681:681=';',<'>,31:32]
[126,682:682=';',<'>,31:33]
[127,684:684=';',<'>,31:35]
[128,690:692='say',<'>,32:4]
[129,693:693=';',<'>,32:7]
[130,694:703='long',<STRING>,32:8]
[131,702:702=';',<'>,32:16]
[132,703:703=';',<'>,32:17]
[133,709:713='sayln',<'>,33:4]
```

```
[133,709:713='sayln',<'>,33:4]
[134,714:714='(',<'>,33:9]
[135,715:715='i',<IDENTIFIER>,33:10]
[136,716:716=';',<'>,33:11]
[137,717:717=';',<'>,33:12]
[138,739:739=';',<'>,34:0]
[139,740:739='<EOF>',<EOF>,34:1]
```

Output - Parse Tree

PROBLEMS 267 OUTPUT DEBUG CONSOLE TERMINAL PORTS

zsh + v [] [] ... ^ x

```
kiran@Kirans-Laptop ser502-group25 % java -cp "build:antlr-4.13.2-complete.jar" org.antlr.v4.gui.TestRig gen.Mint program -tree data/sample1.mint
(program (statement (declaration (type mint_int) x = (expression (ternaryExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression 10))))))))))
;)) (statement (declaration (type mint_int) y = (expression (ternaryExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression 5)))))))))) ;)) (s
tatement (printStatement sayLn ( (expression (ternaryExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExpression (additiveExpression (multiplicativeExpression (primaryExpression x))) + (mul
tiplicativeExpression (primaryExpression y)))))))))) ;)) (statement (printStatement sayLn ( (expression (ternaryExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExpressi
on (multiplicativeExpression (primaryExpression x))) - (multiplicativeExpression (primaryExpression y)))))))))) ;)) (statement (printStatement sayLn ( (expression (ternaryExpression (logicalExpression (equalityExpression
(comparisonExpression (additiveExpression (multiplicativeExpression (multiplicativeExpression (primaryExpression x)) * (primaryExpression y)))))))))) ;)) (statement (printStatement sayLn ( (expression (ternaryExpression (
logicalExpression (equalityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (multiplicativeExpression (primaryExpression x)) / (primaryExpression y)))))))))) ;)) (statement (printStatement sa
yLn ( (expression (ternaryExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (multiplicativeExpression (primaryExpression x)) % (primaryExpression y))))))
)) ;)) ;)) (statement (declaration (type mint_bool) a = (expression (ternaryExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression true))))))
)) ;)) (statement (declaration (type mint_bool) b = (expression (ternaryExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression false))))))
)) ;)) (statement (printStatement sayLn ( (expression (ternaryExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression a)))))))))) ;)) (statem
ent (printStatement sayLn ( (expression (ternaryExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression b)))))))))) ;)) (statement (printSta
tement sayLn ( (expression (ternaryExpression (logicalExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression a)))))) and (equalityExpressio
n (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression b)))))))))) ;)) (statement (printStatement sayLn ( (expression (ternaryExpression (logicalExpression (logicalExpression (equalityExp
ression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression a)))))) or (equalityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression b))))))
)) ;)) ;)) (statement (printStatement sayLn ( (expression (ternaryExpression (logicalExpression not (logicalExpression (equalityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpressio
n a)))))))))) ;)) (statement (ifStatement mint_if ( (expression (ternaryExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression x))) > (add
itiveExpression (multiplicativeExpression (primaryExpression y)))))))))) (block { (statement (printStatement sayLn ( (expression (ternaryExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExp
ression (multiplicativeExpression (primaryExpression "x is greater than y")))))))) ;)) ;)) mint_else (block { (statement (printStatement sayLn ( (expression (ternaryExpression (logicalExpression (equalityExpression (comp
arisonExpression (additiveExpression (multiplicativeExpression (primaryExpression "x is not greater")))))))) ;)) ;)) ;)) (statement (declaration (type mint_int) i = (expression (ternaryExpression (logicalExpression (equali
tyExpression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression 0)))))))))) ;)) (statement (forLoop mint_for ( (simpleAssignment i = (expression (ternaryExpression (logicalExpression (equa
lityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression 0)))))))))) ; (expression (ternaryExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExpres
sion (multiplicativeExpression (primaryExpression 1))) < (additiveExpression (multiplicativeExpression (primaryExpression 3)))))) ; (simpleAssignment i = (expression (ternaryExpression (logicalExpression (equalityExpres
sion (comparisonExpression (additiveExpression (additiveExpression (multiplicativeExpression (primaryExpression 1))) + (multiplicativeExpression (primaryExpression 1)))))) ; (block { (statement (printStatement say (
(expression (ternaryExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression "loop: ")")))))))) ;)) ;)) (statement (printStatement sayLn ( (expres
sion (ternaryExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression i)))))))))) ;)) ;)) ;)) <EOF>
```

Output – Execution of sample1.mint

PROBLEMS 267 OUTPUT DEBUG CONSOLE TERMINAL PORTS

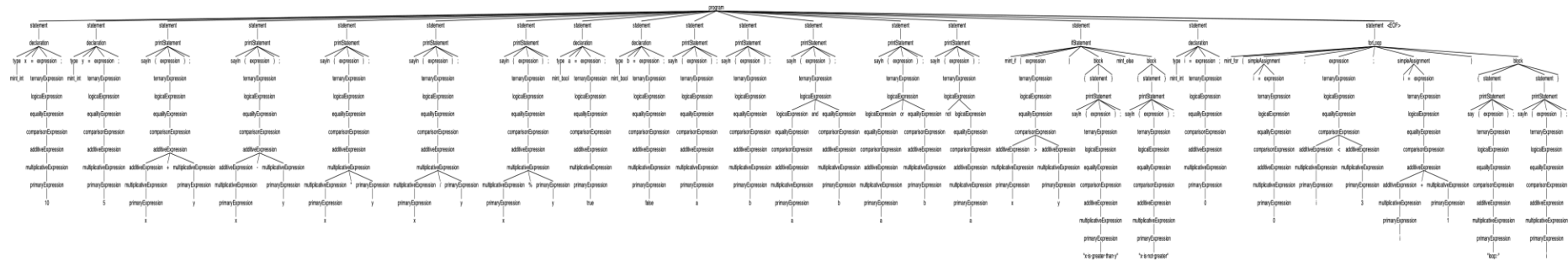

```
kiran@Kirans-Laptop ser502-group25 % java -cp "build:antlr-4.13.2-complete.jar" runtime.MintMain data/sample1.mint
```

```

5
0
50
2
0
true
false
false
true
false
x is greater than y
loop: 0
loop: 1
loop: 2
(program (statement (declaration (type mint_int) x = (expression (ternaryExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression 10))))))))))
);)) (statement (declaration (type mint_int) y = (expression (ternaryExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression 5)))))))))) ;)) (s
statement (printStatement sayIn ( (expression (ternaryExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression x)) + (mul
tiplicativeExpression (primaryExpression y)))))))))) ;)) (statement (printStatement sayIn ( (expression (ternaryExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExpressi
on (multiplicativeExpression (primaryExpression x)) - (multiplicativeExpression (primaryExpression y)))))))))) ;)) (statement (printStatement sayIn ( (expression (ternaryExpression (logicalExpression (equalityExpression
(comparisonExpression (additiveExpression (multiplicativeExpression (multiplicativeExpression (primaryExpression x)) * (primaryExpression y)))))))))) ;)) (statement (printStatement sayIn ( (expression (ternaryExpression (
logicalExpression (equalityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (multiplicativeExpression (primaryExpression x)) / (primaryExpression y)))))))))) ;)) (statement (printStatement sa
yIn ( (expression (ternaryExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression x)) % (primaryExpression y))))))))))
);)) ;)) (statement (declaration (type mint_bool) a = (expression (ternaryExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression true))))))))
);)) ;)) (statement (declaration (type mint_bool) b = (expression (ternaryExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression false))))))))
);)) (statement (printStatement sayIn ( (expression (ternaryExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression a)))))))))) ;)) (statement
(printStatement sayIn ( (expression (ternaryExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression b)))))))))) ;)) (statement (printSta
tement sayIn ( (expression (ternaryExpression (logicalExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression a)))))) and (equalityExpressi
on (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression b)))))))))) ;)) (statement (printStatement sayIn ( (expression (ternaryExpression (logicalExpression (logicalExpression (equalityExp
ression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression a)))))) or (equalityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression b))))))
);)) (statement (printStatement sayIn ( (expression (ternaryExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression
n a)))))))))) ;)) (statement (ifStatement mint_if ( (expression (ternaryExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression x)) > (add
itiveExpression (multiplicativeExpression (primaryExpression y)))))))))) (block { (statement (printStatement sayIn ( (expression (ternaryExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExp
ression (multiplicativeExpression (primaryExpression "x is greater than y")))))))) ;)) ;)) mint_else (block { (statement (printStatement sayIn ( (expression (ternaryExpression (logicalExpression (equalityExpression (comp
arisonExpression (additiveExpression (multiplicativeExpression (primaryExpression "x is not greater")))))))) ;)) ;)) (statement (declaration (type mint_int) i = (expression (ternaryExpression (logicalExpression (equalit
yExpression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression 0)))))))))) ;)) (statement (forLoop mint_for ( (simpleAssignment i = (expression (ternaryExpression (logicalExpression (equa
lityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression 0)))))))))) ;)) (expression (ternaryExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExp
ression (multiplicativeExpression (primaryExpression 1))) < (additiveExpression (multiplicativeExpression (primaryExpression 3)))))))))) ;)) (simpleAssignment i = (expression (ternaryExpression (logicalExpression (equalityExp
ression (comparisonExpression (additiveExpression (multiplicativeExpression (multiplicativeExpression (primaryExpression 1))) + (multiplicativeExpression (primaryExpression 1)))))))))) (block { (statement (printStatement sayI
n (expression (ternaryExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression "loop: ")))))))))) ;)) (statement (printStatement sayIn ( (expre
sion (ternaryExpression (logicalExpression (equalityExpression (comparisonExpression (additiveExpression (multiplicativeExpression (primaryExpression 1)))))))))) ;)) ;)) <EOF>
kiran@Kirans-Laptop ser502-group25 %

```

VISUAL TREE



5.



FUTURE SCOPE

FUTURE SCOPE:

- **Enhanced Learning Tools:**

We aim to integrate interactive feedback for syntax errors and semantic issues directly in the console output, helping learners identify and understand mistakes intuitively.

- **Mint Playground (Web IDE):**

A lightweight browser-based IDE for Mint will allow users to write, run, and share Mint programs without local setup. This will make the language more accessible for students and educators.

- **Domain-Specific Extensions:**

Mint will offer optional modules or syntactic sugar tailored for specific domains, such as basic data analysis (e.g., tabular operations) or educational simulations (e.g., logic circuits), expanding Mint's use cases.

- **Standard Library Expansion:**

A minimal standard library will be introduced to support string manipulation, math utilities, and file I/O—making it easier to write real-world programs in Mint.

- **Visual Debugger:**

An optional debug mode with step-by-step execution and variable tracking is planned to help learners visualize program flow and state changes.

THANK YOU

