Compilers Project 2020: Mini-pl interpreter documentation

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1 General view of the application

1.1 Architecture

The architecture of my implementation of Mini-pl interpreter follows closely the pipeline pattern presented on the lectures. The interpreter uses a multi-pass construction, as all of the parsing is done before semantical analysis, and all semantical analysis is done before the interpreting. The scanning is driven by the parser, like in single pass compilers.

At the lowest level we have the class Source, that is responsible for reading a source file and giving characters from it one by one.

This is given as a constructor parameter to the class Scanner following the dependency injection pattern. Scanner does the lexical analysis of the characters, and forms tokens out of them. The Scanner consists of a collection of routines that try to form a token by iterating the source. When a next token is asked from the scanner it screens out whitespace and comments and then it iterates through these routines until one of them returns a valid token. If no valid token is produced the scanner returns an error token.

When the source reaches the end-of-file the scanner produces end of file token.

The parser is a recursive descent parser that asks for the tokens one by one from the scanner. Every construct in the language has a own method for parsing it. These methods produce abstract syntax tree nodes. The overall architecture can be observed in figure 1.1.

The abstract syntax tree produced by the parser is first decorated by the TypeCheckVisitor, that checks for semantical errors and creates a symbol table based on variable declarations.

The table created by TypeCheckVisitor is then used by InterpretingVisitor that interprets the source file.

1.2 Testing

The classes Source, Scanner and Parser have quite comprehensive unit tests written to test their core functionality. Those can be found in the '/tests' folder. I have taken care in designing these test cases and at least the tests for the InterpretingVisitor and TypeCheckVisitor are worth to take look at. Also the 'tests/test.minipl' includes all the examples given in the language specification.

1.3 Shortcomings

The interpreter is mostly fully featured. The scanner supports only a limited set of escape characters that are tabs, newlines, escape character and the quotation mark. The parser is bit lacking in the error handling part, as in most of the statements, if a necessary token is missing the parsing of that statement will fail, and the exception handler will try to parse a new statement all together.

1.4 Running the program

On Linux-machines running this program should be very straight forward. Open the directory where the archive was unzipped in a terminal. Then running 'python3 main.py ./tests/test.minipl' There is no additional external dependencies in runnign the program, everything should be included in the python standard library.

2 Specifying the interpretation

2.1 Mini-PL token patterns

The token patterns can be observed in figure 2.1

2.2 Context-free grammar

The modified context-free grammar for Mini-pl can be seen in figure 2.2

2.3 Abstract syntax tree

The abstract syntax tree used in the interpreter, uses the composite pattern and visitor pattern is used to manipulate the tree. The base class Node and its descendants are defined in the file './interpreter/ast.py'

2.4 Error Handling

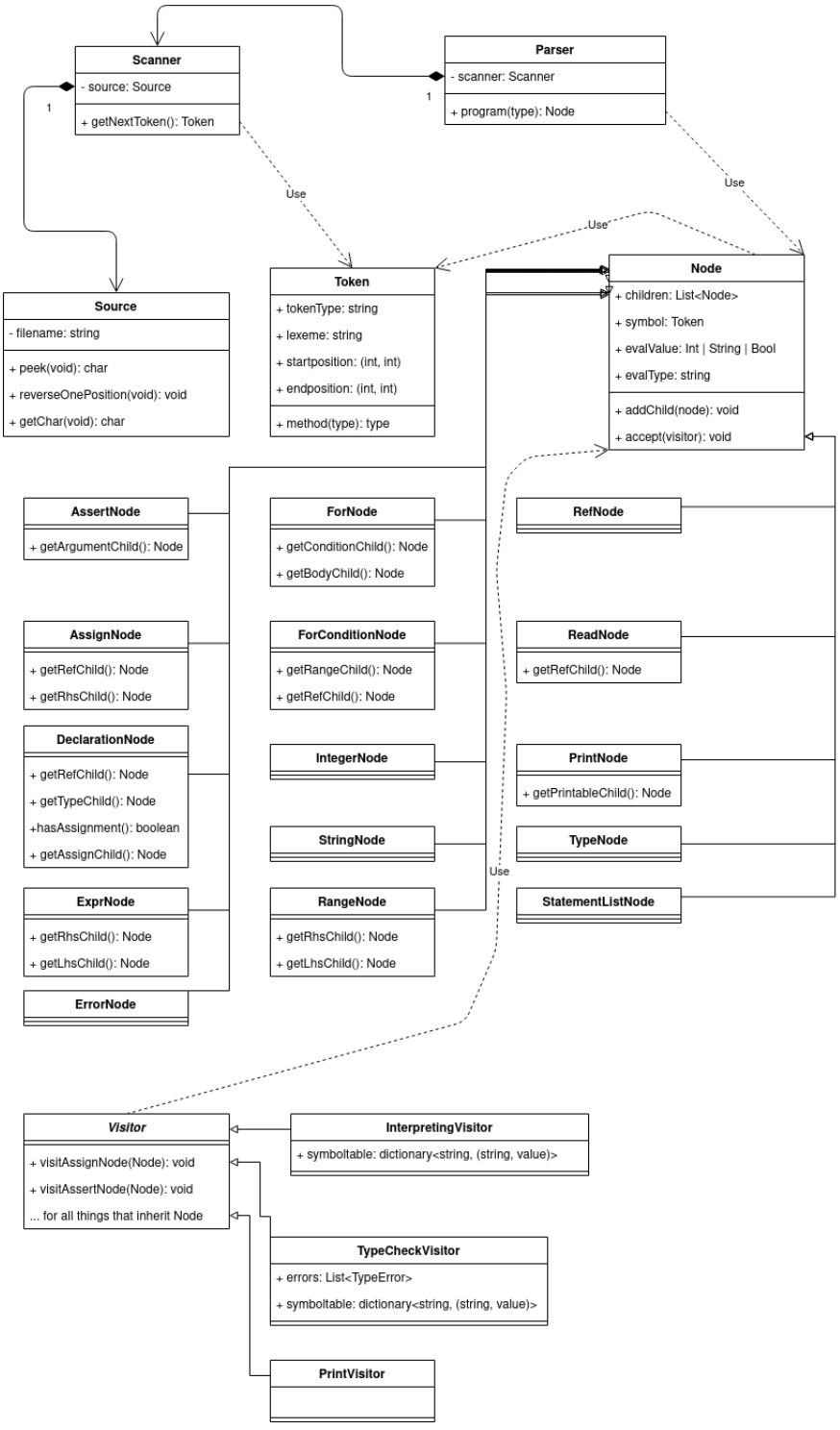
When the scanner encounters an error it sends an error token to the parser.

The parser uses context sensitive lookahead with exception driven error handling to recover from syntax errors. Because of the way how the error handling is written statements that are not able to be parsed will not show up in the AST built by the parser, as the statement routine sees that there is another symbol next, that is in its first set.

Semantic errors are discovered by TypeCheckVisitor. These errors are printed to the user and prevent the interpreting process.

3 Work hour log

Figure 1: UML diagram of the interpreter architecture



coming soon..

Figure 2: Mini-PL token patterns

```
<integer> = <digit>*
<string_literal> = "<alnum>*"
<identifier> = ([a-z] | [A-Z])([a-z] | [A-Z] | _ | [0-9])*
<range> = \.\.
<keyword> = var | for | end | in | do | read
<keyword> =  print | int | string | bool | assert
<operator> = + | - | / | * | & | !
```

Figure 3: Modified LL (1) grammar for Mini-pl

```
<prog> = <stmnts>
<stmts> = <stmnt> ";" <stmnts>
<stmnts> = <epsilon>
<stmnt> = "var" <var_ident> ":" <type> <assign_value>
<stmnt> = <var_ident> ":=" <expr>
<stmnt = "for" <var_ident> "in" <expr> ".." <expr> "do"
              <stmnts> "end" "for"
<stmnt> = "read" <var_ident>
<stmnt> =  "print" <expr>
<stmnt> "assert" "(" <expr> ")"
<assign_value> = ":=" <expr>| <epsilon>
<expr> = <opnd> <op> <opnd>
<opnd> = <int>
<opnd> = <string>
<opnd> = <var_ident>
<opnd> = "(" <expr> ")"
<type> = "int"
<type> = "string''
<type> = "bool"
<var_ident> = <ident>
<reserved_keywords = "var" | "for" | "end" | "in" | "do" | "read" |
                     "print" | "int" | "string" | "bool" | "assert"
```