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https://github.com/ComanacDragos/ToyLanguageCompiler

Statement: Implement a parser algorithm

1. One of the following parsing methods will be chosen (assigned by teaching staff):

1.a. recursive descendent

~~1.b. ll(1)~~

~~1.c. lr(0)~~

2. The representation of the parsing tree (output) will be (decided by the team):

2.a. productions string (max grade = 8.5)

2.b. derivations string (max grade = 9)

2.c. **table (using father and sibling relation)** (max grade = 10)

PART 1: Deliverables

1. *Class Grammar* (required operations: read a grammar from file, print set of nonterminals, set of terminals, set of productions, productions for a given nonterminal, CFG check)
2. Input files: *g1.txt* (simple grammar from course/seminar), *g2.txt* (grammar of the minilanguage - syntax rules from Lab 1b)

PART 2: Deliverables

Functions corresponding to the assigned parsing strategy + appropriate tests, as detailed below:

Recursive Descendent - functions corresponding to moves (*expand*, *advance*, *momentary insuccess*, *back*, *another try*, *success*)

Statement: Implement a parser algorithm (final tests)

Input: 1) g1.txt + seq.txt

2) g2.txt + PIF.out (result of Lab 3)

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Output: out1.txt, out2.txt

Run the program and generate:

- out1.txt (result of parsing if the input was g1.txt);

- out2.txt (result of parsing if the input was g2.txt)

-messages (if conflict exists/if syntax error exists - specify location if possible)

PART 3: Deliverables

1. Algorithms corresponding to *parsing table* (if needed) and *parsing strategy*

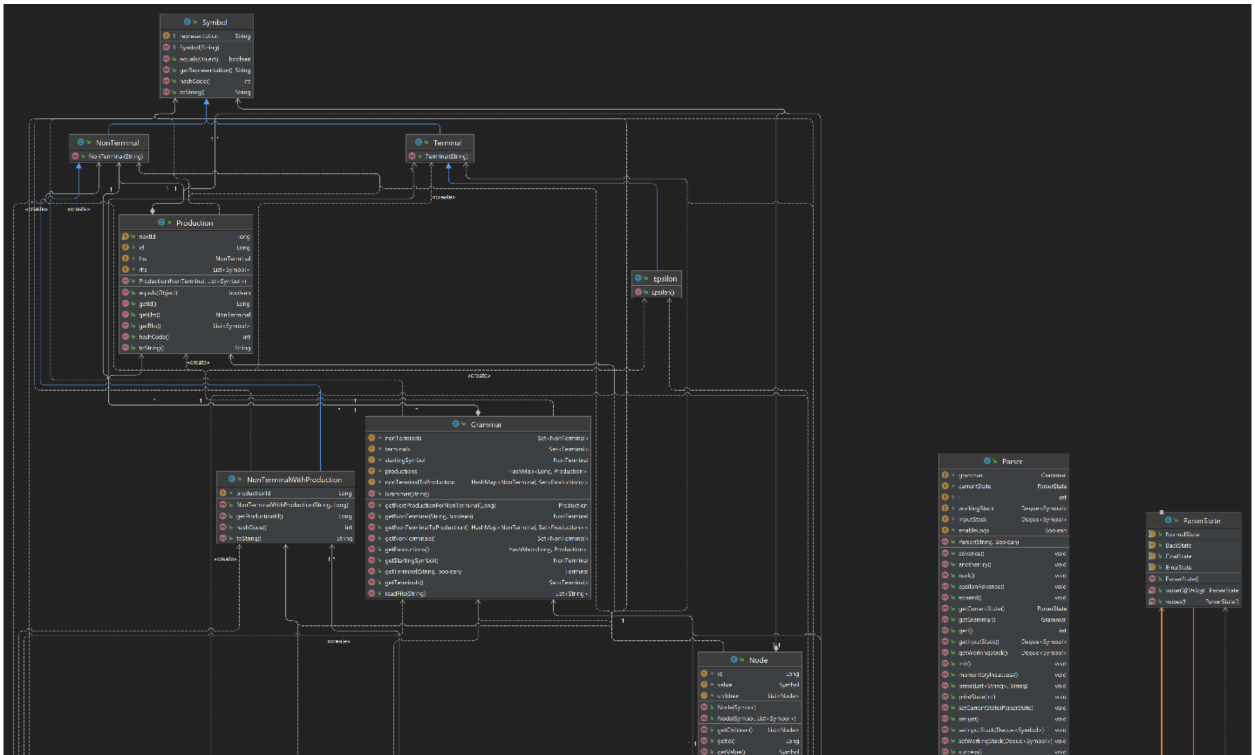
2. Class *ParserOutput* - DS and operations corresponding to choice 2.a/2.b/2.c (Lab 5) (required operations: transform parsing tree into representation; print DS to screen and to file)

PART 4: Deliverables

Source code for the parser + in/out files + documentation

Code review

Implementation



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Picture also available at
https://github.com/ComanacDragos/ToyLanguageCompiler/tree/main/documentation/lab11

public class Grammar Used to represent the grammar
Set<NonTerminal> nonTerminals = new HashSet<>(); // set of non-terminals
Set<Terminal> terminals = new HashSet<>(); // set of terminals
NonTerminal startingSymbol; // starting symbol
HashMap<Long, Production> productions = new HashMap<>(); // maps the id of a production to the respective production
HashMap<NonTerminal, Set<Production>> nonTerminalToProduction = new HashMap<>(); // maps a non-terminal to all it's productions

/*
The file containing a grammar is processed
First line: the non-terminals separated by space
Second line: terminals separated by space
Third line: starting symbol
Remaining lines: productions: lhs is separated by rhs by ::= and | is used to separate rhs. List of symbols is separated by space
*/
public Grammar(String file)

/*
Returns the non-terminal with the given representation from the list of non-terminals
If the non-terminal does not exist and throwException is true, an exception is thrown
If the non-terminal does not exist and throwException is false null is returned
*/
public NonTerminal getNonTerminal(String representation, boolean throwException)

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/*
Returns the terminal with the given representation from the list of terminals
If the terminal does not exist and throwException is true, an exception is thrown
If the terminal does not exist and throwException is false null is returned
*/
public Terminal getTerminal(String representation, boolean throwException)

For a given production id returns the next production of the left-hand side if it exists

Otherwise return null
public Production getNextProductionForNonTerminal(Long previousId)

The following classes are used to represent the symbols and productions

```
public class Symbol {
    protected String representation;

    protected Symbol(String representation)



public class Terminal extends Symbol
    public Terminal(String representation)


public class NonTerminal extends Symbol
    public NonTerminal(String representation)


public class Epsilon extends Symbol
    public Epsilon()


public class Production

public static long nextId = 0; // global id
Long id; // local id
NonTerminal lhs; // left-hand side of the production
List<Symbol> rhs; // right-hand side of the production

public Production(NonTerminal lhs, List<Symbol> rhs)


public class NonTerminalWithProduction extends NonTerminal
    Long productionId;
```

public enum ParserState
  NormalState,
  BackState,
  FinalState,
  ErrorState

public class Parser
  Grammar grammar;
  ParserState currentState = ParserState.NormalState; // current state of the parser
  int i = 0; // position of the current symbol in input sequence
  Deque<Symbol> workingStack = new ArrayDeque<>();
  Deque<Symbol> inputStack = new ArrayDeque<>();

// performs Recursive descendent algorithm on the given sequence
public void parse(List<String> sequence)

The parse function uses the following functions corresponding to the Descendent Recursive algorithm's actions:

// initializes the parser state
public void init()

public void expand()

public void advance()

public void epsilonAdvance()

public void momentaryInsuccess()

public void back()

public void anotherTry()

public void success()

Node
  Long id = nextId++;
  Symbol value;
  List<Node> children;

public Node(Symbol value, List<Symbol> symbols) // creates recursively the tree

public class TreeGenerator
  Node root; // root of the tree
  Long nextId = 0L; // id generator for nodes
  Deque<NonTerminalWithProduction> productionStack;
  Grammar grammar;

public TreeGenerator(Deque<Symbol> workingStack, Grammar grammar) // instantiate the productionStack from a given workingStack so that it contains only the NonTerminalWithProduction classes

public void generateTree() // begins the generation of the tree

public void toFile(String outputDir) // writes to an output directory the table

private List<String> constructTableRecursive(Node currentNode, Node fatherNode, Integer positionRelativeToFather) // constructs the string representation of the table recursively

Testing

simple_grammar.in

```
S A
a b c d e
S
S ::= a S | b S c | d A
A ::= d c | e | e
A ::= d | e
```

TestParser is a class that tests the Parser functions

simple_grammar

```
S A B
a b
S
S ::= a B | b A
A ::= a | a S | b A A
B ::= epsilon | b | b S | a B B
```

```
int[256] a;
int i=0;
int n;
<<n;
if (i<n){
  <<a[i];
  i=i+1;
}
n=0;
```

program statement_list statement simple_statement compound_statement simple_type array_type type expression binary_operator unary_operator declaration_statement iostatement assignment_statement if_statement else_branch while_statement expression' expression_simple
id constant int char bool string float >> << while if else and or ! + - * / % > < >= <= != == = ; [ ] { } ( ) , ^
program
program ::= statement_list
statement_list ::= statement | statement statement_list
statement ::= simple_statement | compound_statement

simple_statement ::= assignment_statement ; | iostatement ; | declaration_statement ;

compound_statement ::= if_statement | while_statement

simple_type ::= bool | char | int | string | float

array_type ::= simple_type [constant]

type ::= simple_type | array_type

expression_simple ::= constant | id | id [constant] | id [id] | unary_operator expression | (expression)

expression' ::= binary_operator expression expression' | epsilon

expression ::= expression_simple expression'

declaration_statement ::= type id | type id = expression

iostatement ::= << id | << id [constant] | << id [id] | >> expression

assignment_statement ::= id = expression

if_statement ::= if (expression) { statement_list } else_branch
else_branch ::= epsilon | else { statement_list }

while_statement ::= while (expression) { statement_list }

unary_operator ::= !
binary_operator ::= + | - | * | / | ^ | % | and | or | > | < | >= | <=| != | ==

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unary_operator ::= !
binary_operator ::= + | - | * | / | ^ | % | and | or | > | < | >= | <=| != | ==

Output for simple_grammar

id	value	father	right-sibling
0	S	-1	-1
1	b	0	2
2	A	0	-1
3	a	2	4
4	S	2	-1
5	a	4	6
6	B	4	-1
7	b	6	8
8	S	6	-1
9	a	8	10
10	B	8	-1
11	a	10	12
12	B	10	14
13	epsilon	12	-1
14	B	10	-1
15	b	14	-1

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Output for syntax grammar

id	value	father	right-sibling
0	program	-1	-1
1	statement_list	0	-1
2	statement	1	14
3	simple_statement	2	-1
4	declaration_statement	3	13
5	type	4	12
6	array_type	5	-1
7	simple_type	6	9
8	int	7	-1
9	[	6	10
10	constant	6	11
11	]	6	-1
12	id	4	-1
13	;	3	-1
14	statement_list	1	-1
15	statement	14	-1
16	simple_statement	15	-1
17	declaration_statement	16	28
18	type	17	21
19	simple_type	18	-1
20	int	19	-1
21	id	17	22
22	=	17	23
23	expression	17	-1
24	expression_simple	23	26
25	constant	24	-1
26	expression'	23	-1
27	epsilon	26	-1
28	;	16	-1