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БЕЛОРУССКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ИНФОРМАТИКИ  
И РАДИОЭЛЕКТРОНИКИ

КАФЕДРА ИНФОРМАТИКИ

Отчёт по лабораторной работе № 3

По теме «Синтаксический анализатор»

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## **1. Цель работы**

Освоение работы с существующими синтаксическими анализаторами. Разработать свой собственный синтаксический анализатор, выбранного подмножества языка программирования. Построить синтаксическое дерево. Определить минимум 4 возможных синтаксических ошибки и показать их корректное выявление.

## 2. Результаты

### 2.1 АСД для тестовой программы test.cpp

На рисунках ниже представлен код программы test.cpp, на языке программирования C++. В программу входят простые математические операции (см. рисунок 2.1).

```
int main()
{
    float a, b, c, Y = 0.0;
    int n;
    cout << "Enter a : ";
    cin >> a;
    cout << "Enter b : ";
    cin >> b;
    cout << "Enter c : ";
    cin >> c;
    cout << "Enter N : ";
    cin >> n;
    switch (n)
    {
        case 2:
            Y = (b * c);
            break;
        case 56:
            Y = (b * c);
            break;
        case 7:
            Y = a + c;
            break;
        case 3:
            Y = a - (b * c);
            break;
        default:
            Y = a + (b * 3);
            break;
    }
    cout << "Y is : " << Y << endl;
    return 0;
}
```

Рисунок 2.1 - Код программы test.cpp

Результат выполнения программы синтаксического анализатора, а именно построенное абстрактное синтаксическое дерево изображено ниже (см. рисунок 2.2, рисунок 2.3, рисунок 2.4, рисунок 2.5)

```
main
    double a
    double b
    double c
    double Y
    double = 0.0
    cout << "Enter a : "
    cin >> a
    cout << "Enter b : "
    cin >> b
    cout << "Enter c : "
```

Рисунок 2.2 - Первая часть АСД для test.cpp

```

cin
    c

cout
    "Enter N : "

cin
    n

switch
n
    case
    2
        Y
        =
        b
        *
        c

        break
    case
    56
        Y
        =
        b
        *
        c

```

Рисунок 2.3 - Вторая часть АСД для test.cpp

```

break

case
7
    Y
    =
        a
        +
        c

break

case
3
    Y
    =
        a
        -
        b
        *
        c

break

default
    Y
    =

```

Рисунок 2.4 - Третья часть АСД для test.cpp

```

                                a
                                +
                                b
                                *
                                3

                                break

                                cout
                                "Y is : "
                                Y
                                endl

```

Рисунок 2.5 - Четвертая часть АСД для test.cpp

## 2.2 Примеры синтаксических ошибок

1) Пример с пропущенной запятой в объявлении переменных (см. рисунок 2.6, рисунок 2.7).

```

int main()
{
    float a b, c, Y = 0.0;
    int n;
}

```

Рисунок 2.6 - Пример кода с синтаксической ошибкой

```

"/Users/lnxd/Desktop/BSUIR/SIXTH TERM/MTran/LABS/DONE/LAB3/SyntaxAnalyzer/bin/Debug/net6.0/SyntaxAnalyzer"
Unhandled exception. System.Exception: after token 'a' needs token ','
   at SyntaxAnalyzer.Parser.Require(List`1 tokenTypes) in /Users/lnxd/Desktop/BSUIR/SIXTH TERM/MTran/LABS/DONE/LAB3/SyntaxAnalyzer/Parser.cs:line 41
   at SyntaxAnalyzer.Parser.ParseExpression() in /Users/lnxd/Desktop/BSUIR/SIXTH TERM/MTran/LABS/DONE/LAB3/SyntaxAnalyzer/Parser.cs:line 412
   at SyntaxAnalyzer.Parser.ParseCode() in /Users/lnxd/Desktop/BSUIR/SIXTH TERM/MTran/LABS/DONE/LAB3/SyntaxAnalyzer/Parser.cs:line 588
   at SyntaxAnalyzer.Parser.ParseExpression() in /Users/lnxd/Desktop/BSUIR/SIXTH TERM/MTran/LABS/DONE/LAB3/SyntaxAnalyzer/Parser.cs:line 348
   at SyntaxAnalyzer.Parser.ParseCode() in /Users/lnxd/Desktop/BSUIR/SIXTH TERM/MTran/LABS/DONE/LAB3/SyntaxAnalyzer/Parser.cs:line 588
   at SyntaxAnalyzer.Program.Main() in /Users/lnxd/Desktop/BSUIR/SIXTH TERM/MTran/LABS/DONE/LAB3/SyntaxAnalyzer/Program.cs:line 188
Process finished with exit code 134.

```

Рисунок 2.7 - Реакция синтаксического анализатора на ошибку



2) Пример неправильного использования ключевых слов (см. рисунок 2.8, рисунок 2.9).

```
switch if (n)
{
case 2:
    Y = (b * c);
    break;
case 56:
    Y = (b * c);
    break;
case 7:
    Y = a + c;
    break;
case 3:
    Y = a - (b * c);
    break;
default:
    Y = a + (b * 3);
    break;
}
cout << "Y is : " << Y << endl;
```

Рисунок 2.8 - Пример кода с синтаксической ошибкой

```
"/Users/Lnxd/Desktop/BSUIR/SIXTH TERM/MTran/LABS/DONE/LAB3/SyntaxAnalyzer/bin/Debug/net6.0/SyntaxAnalyzer"
Unhandled exception. System.Exception: after token 'switch' needs token '('
   at SyntaxAnalyzer.Parser.Require(List`1 tokenTypes) in /Users/Lnxd/Desktop/BSUIR/SIXTH TERM/MTran/LABS/DONE/LAB3/SyntaxAnalyzer/Parser.cs:line 41
   at SyntaxAnalyzer.Parser.ParseExpression() in /Users/Lnxd/Desktop/BSUIR/SIXTH TERM/MTran/LABS/DONE/LAB3/SyntaxAnalyzer/Parser.cs:line 518
   at SyntaxAnalyzer.Parser.ParseCode() in /Users/Lnxd/Desktop/BSUIR/SIXTH TERM/MTran/LABS/DONE/LAB3/SyntaxAnalyzer/Parser.cs:line 588
   at SyntaxAnalyzer.Parser.ParseExpression() in /Users/Lnxd/Desktop/BSUIR/SIXTH TERM/MTran/LABS/DONE/LAB3/SyntaxAnalyzer/Parser.cs:line 348
   at SyntaxAnalyzer.Parser.ParseCode() in /Users/Lnxd/Desktop/BSUIR/SIXTH TERM/MTran/LABS/DONE/LAB3/SyntaxAnalyzer/Parser.cs:line 588
   at SyntaxAnalyzer.Program.Main() in /Users/Lnxd/Desktop/BSUIR/SIXTH TERM/MTran/LABS/DONE/LAB3/SyntaxAnalyzer/Program.cs:line 188
Process finished with exit code 134.
```

Рисунок 2.9 - Реакция синтаксического анализатора на ошибку

3) Пример неправильного объявления функции (см. рисунок 2.10, рисунок 2.11).

```
int main(123)
{
    float a, b, c, Y = 0.0;
    int n;
    cout << "Enter a : ";
    cin >> a;
    cout << "Enter b : ";
    cin >> b;
    cout << "Enter c : ";
    cin >> c;
    cout << "Enter N : ";
    cin >> n;
```

Рисунок 2.10 - Пример кода с синтаксической ошибкой

```
"/Users/lnxd/Desktop/BSUIR/SIXTH TERM/MTran/LABS/DONE/LAB3/SyntaxAnalyzer/bin/Debug/net6.0/SyntaxAnalyzer"
Unhandled exception. System.Exception: After token '(' need token var type or ')'
   at SyntaxAnalyzer.Parser.ParseFunctionDefinition() in /Users/lnxd/Desktop/BSUIR/SIXTH TERM/MTran/LABS/DONE/LAB3/SyntaxAnalyzer/Parser.cs:line 283
   at SyntaxAnalyzer.Parser.ParseExpression() in /Users/lnxd/Desktop/BSUIR/SIXTH TERM/MTran/LABS/DONE/LAB3/SyntaxAnalyzer/Parser.cs:line 345
   at SyntaxAnalyzer.Parser.ParseCode() in /Users/lnxd/Desktop/BSUIR/SIXTH TERM/MTran/LABS/DONE/LAB3/SyntaxAnalyzer/Parser.cs:line 588
   at SyntaxAnalyzer.Program.Main() in /Users/lnxd/Desktop/BSUIR/SIXTH TERM/MTran/LABS/DONE/LAB3/SyntaxAnalyzer/Program.cs:line 188
Process finished with exit code 134.
```

Рисунок 2.11 - Реакция синтаксического анализатора на ошибку

4) Пример недопустимого присвоения (см. рисунок 2.12, рисунок 2.13).

```
int main()
{
    float a, b, c, Y = float;
    int n;
    cout << "Enter a : ";
    cin >> a;
```

Рисунок 2.12 - Пример кода с синтаксической ошибкой

```
"/Users/lnxd/Desktop/BSUIR/SIXTH TERM/MTran/LABS/DONE/LAB3/SyntaxAnalyzer/bin/Debug/net6.0/SyntaxAnalyzer"
Unhandled exception. System.Exception: After token '=' needs var or literal token
   at SyntaxAnalyzer.Parser.ParseVariableOrLiteral() in /Users/lnxd/Desktop/BSUIR/SIXTH TERM/MTran/LABS/DONE/LAB3/SyntaxAnalyzer/Parser.cs:line 108
   at SyntaxAnalyzer.Parser.ParseParentheses() in /Users/lnxd/Desktop/BSUIR/SIXTH TERM/MTran/LABS/DONE/LAB3/SyntaxAnalyzer/Parser.cs:line 121
   at SyntaxAnalyzer.Parser.ParseFormula() in /Users/lnxd/Desktop/BSUIR/SIXTH TERM/MTran/LABS/DONE/LAB3/SyntaxAnalyzer/Parser.cs:line 127
   at SyntaxAnalyzer.Parser.ParseExpression() in /Users/lnxd/Desktop/BSUIR/SIXTH TERM/MTran/LABS/DONE/LAB3/SyntaxAnalyzer/Parser.cs:line 406
   at SyntaxAnalyzer.Parser.ParseCode() in /Users/lnxd/Desktop/BSUIR/SIXTH TERM/MTran/LABS/DONE/LAB3/SyntaxAnalyzer/Parser.cs:line 588
   at SyntaxAnalyzer.Parser.ParseExpression() in /Users/lnxd/Desktop/BSUIR/SIXTH TERM/MTran/LABS/DONE/LAB3/SyntaxAnalyzer/Parser.cs:line 348
   at SyntaxAnalyzer.Parser.ParseCode() in /Users/lnxd/Desktop/BSUIR/SIXTH TERM/MTran/LABS/DONE/LAB3/SyntaxAnalyzer/Parser.cs:line 588
   at SyntaxAnalyzer.Program.Main() in /Users/lnxd/Desktop/BSUIR/SIXTH TERM/MTran/LABS/DONE/LAB3/SyntaxAnalyzer/Program.cs:line 188
Process finished with exit code 134.
```

Рисунок 2.13 - Реакция синтаксического анализатора на ошибку

## Примечание. Код программы

```
using LexicalAnalyzer.Functional;
using SyntaxAnalyzer.Nodes;

namespace SyntaxAnalyzer;

internal class Parser
{
    public Lexer Lexer { get; set; }
    public List<Token> Tokens { get; set; }
    public int Position { get; set; } = 0;
    public bool Switch { get; set; } = false; // to check
default in code

    public Parser(Lexer lexer, List<Token> tokens)
    {
        Lexer = lexer;
        Tokens = tokens;
    }

    public Token? Match(List<string> tokenTypes) // FIND
TOKEN
    {
        if (Position < Tokens.Count)
        {
            var token = Tokens[Position];

            if (tokenTypes.Contains(token.Identifier))
            {
                Position++;
                return token;
            }
        }

        return null;
    }

    public Token Require(List<string> tokenTypes) // REQUIRE
END-POINT OF BLOCK ETC.( ], }, ;, .....)
    {
        var token = Match(tokenTypes);
```

```

        if (token == null)
        {
            throw new Exception($"after token
'{Tokens[Position - 1].Identifier}' needs token
'{tokenTypes[0]}'");
        }

        return token;
    }

    public List<string> GetVariables()
    {
        var variables = new List<string>();

        foreach (var elem in Lexer.VariablesTables.Values)
        {
            foreach (var elem2 in elem.Keys)
            {
                variables.Add(elem2);
            }
        }

        return variables;
    }

    AbstractNode ParseVariableType()
    {
        var type = Match(Lexer.VariablesTypes);

        if (type != null)
        {
            return new VariableTypeNode(type);
        }

        throw new Exception($"After token '{Tokens[Position -
1].Identifier}' need var token");
    }

    AbstractNode ParseVariableOrLiteral()
    {
        var number = Match(Lexer.Literals.Keys.ToList());
    }

```

```

        if (number != null)
        {
            return new LiteralNode(number);
        }

        var variable = Match(GetVariables());

        if (variable != null)
        {
            var leftNode = new VariableNode(variable) as
AbstractNode;
            var @operator = Match(new List<string> { "[" });

            while (@operator != null)
            {
                @operator.Identifier = "[";
                var rightNode = ParseFormula();
                leftNode = new BinaryOperationNode(@operator,
leftNode, rightNode);
                Require(new List<string> { "]" });
                @operator = Match(new List<string> { "[" });
            }

            return leftNode;
        }

        if (Tokens[Position].Identifier == "false" ||
Tokens[Position].Identifier == "true")
        {
            return new LiteralNode(new Token(Tokens[Position+
+].Identifier, "bool literal"));
        }

        throw new Exception($"After token '{Tokens[Position -
1].Identifier}' needs var or literal token");
    }

    public AbstractNode ParseParentheses()
    {
        if (Match(new List<string> { "(" }) != null)
        {
            var node = ParseFormula();
            Require(new List<string> { ")" });
        }
    }

```

```

        return node;
    }
    else
    {
        return ParseVariableOrLiteral();
    }
}

public AbstractNode ParseFormula()
{
    var leftNode = ParseParentheses();
    var @operator =
Match(Lexer.CurrentOperations.Keys.ToList());
    @operator ??= Match(new List<string> { "[" });

    while (@operator != null)
    {
        if (@operator.Identifier == "[")
        {
            @operator.Identifier = "[";
            var rightNode = ParseFormula();
            leftNode = new BinaryOperationNode(@operator,
leftNode, rightNode);
            Require(new List<string> { "]" });
            @operator =
Match(Lexer.Operations.Keys.ToList());
        }
        else if (@operator.Identifier == "++" ||
@operator.Identifier == "--")
        {
            leftNode = new UnaryOperationNode(@operator,
leftNode);
            @operator =
Match(Lexer.Operations.Keys.ToList());
            @operator ??= Match(new List<string>
{ "[" });
        }
        else if (@operator.Identifier == "?")
        {
            var ifBody = ParseFormula();
            Require(new List<string> { ":" });
            var elseBody = ParseFormula();

```

```

        leftNode = new IfNode(leftNode, ifBody,
elseBody);

                                @operator =
Match(Lexer.Operations.Keys.ToList());
                                @operator ??= Match(new List<string>
{ "[" });
    }
        else if (@operator.Identifier == "<<" ||
@operator.Identifier == ">>")
    {
        Position--;
        break;
    }
        else if (@operator.Identifier == "==" ||
@operator.Identifier == "!=" || @operator.Identifier == "<"
|| @operator.Identifier == ">")
    {
        var rightNode = ParseFormula();
        leftNode = new BinaryOperationNode(@operator,
leftNode, rightNode);

                                @operator =
Match(Lexer.Operations.Keys.ToList());
                                @operator ??= Match(new List<string>
{ "[" });
    }
    else
    {
        var rightNode = ParseParentheses();

        if (leftNode is BinaryOperationNode binary)
        {
                                binary.RightNode = new
BinaryOperationNode(@operator, binary.RightNode, rightNode);
            leftNode = binary;
        }
        else
        {
                                leftNode = new
BinaryOperationNode(@operator, leftNode, rightNode);
        }

                                @operator =
Match(Lexer.Operations.Keys.ToList());

```



```

                                @operator ??= Match(new List<string>
{ "[" });
                                }
                                }

                                return leftNode;
                                }

public List<Token> ParseFunctionDefinition()
{
    var parameters = new List<Token>();

    if (Match(Lexer.VariablesTypes) == null)
    {
        if (Match(new List<string> { ")" }) != null)
        {
            Position--;
            return parameters;
        }

        throw new Exception(
            $"After token '{Tokens[Position -
1].Identifier}' need token var type or ')'");
    }

    var parameter = Match(GetVariables());

    if (parameter == null)
    {
        throw new Exception($"After token
'{Tokens[Position - 1].Identifier}' need token var");
    }

    parameters.Add(parameter);

    var keySymbol = Match(new List<string> { ",", " " });

    while (keySymbol != null)
    {
        if (Match(Lexer.VariablesTypes) == null)
        {
            throw new Exception(

```

```

                                $"After token '{Tokens[Position -
1].Identifier}' need token var type");
        }

        parameter = Match(GetVariables());
        parameters.Add(parameter!);
        keySymbol = Match(new List<string> { ",", " " });
    }

    return parameters;
}

public List<AbstractNode> ParseCout()
{
    var parameters = new List<AbstractNode>();

    var @operator = Match(new List<string> { "<<" });

    while (@operator != null)
    {
        if (Match(new List<string> { "endl" }) != null)
        {
            Position--;
            var temp = new KeywordNode(Match(new
List<string> { "endl" }));
            parameters.Add(temp);
            @operator = Match(new List<string> { "<<" });
            continue;
        }

        var parameter = ParseFormula();
        parameters.Add(parameter);
        @operator = Match(new List<string> { "<<" });
    }

    if (parameters.Count == 0)
    {
        throw new Exception($"After token
'{Tokens[Position - 1].Identifier}' need token '<<'");
    }

    return parameters;
}

```

```

public List<AbstractNode> ParseCin()
{
    var parameters = new List<AbstractNode>();

    var @operator = Match(new List<string> { ">>" });

    while (@operator != null)
    {
        var parameter = ParseFormula();
        parameters.Add(parameter);
        @operator = Match(new List<string> { ">>" });
    }

    if (parameters.Count == 0)
    {
        throw new Exception($"After token
'{Tokens[Position - 1].Identifier}' need token '>>'");
    }

    return parameters;
}

public List<AbstractNode> ParseFunctionParameters()
{
    var parameters = new List<AbstractNode>();

    var parameter = ParseFormula();
    parameters.Add(parameter);
    var @operator = Match(new List<string> { ",", " " });

    while (@operator != null)
    {
        parameter = ParseFormula();
        parameters.Add(parameter);
        @operator = Match(new List<string> { ",", " " });
    }

    return parameters;
}

public AbstractNode ParseIfElse()
{

```

```

        Require(new List<string> { "(" });
        var ifCondition = ParseFormula();
        Require(new List<string> { ")" });
        Require(new List<string> { "{" });
        var ifBody = ParseCode();
        Position--;
        Require(new List<string> { "}" });

        AbstractNode? elseBody = null;

        if (Match(new List<string> { "else" }) != null)
        {
            if (Match(new List<string> { "if" }) != null)
            {
                elseBody = ParseIfElse();
            }
            else
            {
                Require(new List<string> { "{" });
                elseBody = ParseCode();
                Position--;
                Require(new List<string> { "}" });
                return new IfNode(ifCondition, ifBody,
elseBody);
            }
        }

        return new IfNode(ifCondition, ifBody, elseBody);
    }

    public AbstractNode? ParseExpression()
    {
        if (Match(Lexer.VariablesTypes) != null)
        {
            var functionToken =
Match(Lexer.CurrentKeyWords.Keys.ToList());

            if (functionToken != null)
            {
                if (functionToken.Type == "function")
                {
                    Require(new List<string> { "(" });

```

```

var parameters =
ParseFunctionDefinition();
    Require(new List<string> { ")" });
    Require(new List<string> { "{" });
    var body = ParseCode();
    Position--;
    Require(new List<string> { "}" });
    return new FunctionNode(functionToken,
parameters, body);
    }
    else
    {
        throw new Exception(
            $"After token '{Tokens[Position -
1].Identifier}' need token var or token function");
    }
}

var variableToken = Match(GetVariables());

if (variableToken != null)
{
    var leftNode = new
VariableNode(variableToken) as AbstractNode;
    var @operator = Match(new List<string>
{ ",", " " });

    while (@operator != null)
    {
        variableToken = Match(GetVariables());

        if (variableToken == null)
        {
            throw new Exception(
                $"After token '{Tokens[Position -
1].Identifier}' need token var");
        }

        var rightNode = new
VariableNode(variableToken);
        leftNode = new BinaryOperationNode(new
Token("=", "operation"), leftNode, rightNode);
    }
}

```

```

        @operator = Match(new List<string>
{ " ," }));
    }

    @operator = Match(new List<string> { "=" });

    if (@operator != null)
    {
        if (Match(new List<string> { "new" }) !=
null)
        {
            var type =
Match(Lexer.VariablesTypes);

            if (type != null)
            {
                Position--;
                var typeNode =
ParseVariableType();
                Require(new List<string>
{ "[" });
                var index = ParseFormula();
                Require(new List<string>
{ "]" });
                Require(new List<string>
{ ";" });
                var rightNode = new
BinaryOperationNode(new Token("new", "key word"), typeNode,
index);
                return new
BinaryOperationNode(@operator, leftNode, rightNode);
            }

            throw new Exception(
                $"After token '{Tokens[Position -
1].Identifier}' need token var type");
        }

        var value = ParseFormula();
        Require(new List<string> { ";" });
        return new BinaryOperationNode(new
Token("=", "operation"), leftNode, value);
    }

```

```

        else
        {
            Require(new List<string> { ";" });
            return null;
        }
    }

    if (Match(GetVariables()) != null)
    {
        Position--;
        var variableNode = ParseVariableOrLiteral();
        var list = Lexer.CurrentOperations.Keys.ToList();
        list.Add("[");
        var @operator = Match(list);

        if (@operator != null)
        {
            if (@operator.Identifier == "++" ||
@operator.Identifier == "--")
            {
                var unaryNode = new
UnaryOperationNode(@operator, variableNode);
                Require(new List<string> { ";" });
                return unaryNode;
            }

            if (@operator.Identifier == "[")
            {
                @operator.Identifier = "[";
                var rightNode = ParseFormula();
                variableNode = new
BinaryOperationNode(@operator, variableNode, rightNode);
                Require(new List<string> { "]" });
                @operator =
Match(Lexer.Operations.Keys.ToList());
            }

            if (Match(new List<string> { "new" }) !=
null)
            {
                var type = Match(Lexer.VariablesTypes);

```

```

        if (type != null)
        {
            Position--;
            var typeNode = ParseVariableType();
            Require(new List<string> { "[" });
            var value = ParseFormula();
            Require(new List<string> { "]" });
            Require(new List<string> { ";" });
            return new BinaryOperationNode(new
Token("new", "key word"), typeNode, value);
        }

        throw new Exception(
            $"After token '{Tokens[Position -
1].Identifier}' need token var type");
    }

    var rightFormulaNode = ParseFormula();
    var binaryNode = new
BinaryOperationNode(@operator, variableNode, rightFormulaNode);
    Require(new List<string> { ";" });
    return binaryNode;
}
else
{
    Require(new List<string> { ";" });
    return null;
}

    throw new Exception($"After token
'{Tokens[Position - 1].Identifier}' need token operator");
}

    if (Match(Lexer.CurrentKeyWords.Keys.ToList()) !=
null)
    {
        Position--;

        var token =
Match(Lexer.CurrentKeyWords.Keys.ToList());

        switch (token!.Identifier)
        {
            case "while":

```



```

        Require(new List<string> { "(" });
        var condition = ParseFormula();
        Require(new List<string> { ")" });
        Require(new List<string> { "{" });
        var body = ParseCode();
        Position--;
        Require(new List<string> { "}" });
        return new WhileNode(condition, body);
    case "cout":
        var parameters = ParseCout();
        Require(new List<string> { ";" });
        return new CoutNode(parameters);
    case "cin":
        var cin_parameters = ParseCin();
        Require(new List<string> { ";" });
        return new CinNode(cin_parameters);
    case "for":
        Require(new List<string> { "(" });
        Match(Lexer.VariablesTypes);
        var first = ParseFormula();
        Require(new List<string> { ";" });
        var second = ParseFormula();
        Require(new List<string> { ";" });
        var third = ParseFormula();
        Require(new List<string> { ")" });
        Require(new List<string> { "{" });
        var forBody = ParseCode();
        Position--;
        Require(new List<string> { "}" });
        return new ForNode(first, second, third,
forBody);

    case "if":
        return ParseIfElse();
    case "switch":
        Require(new List<string> { "(" });
        var variable = Match(GetVariables());

        if (variable == null)
        {
            throw new Exception(
                $"After token '{Tokens[Position -
1].Identifier}' need token var");
        }

```

```

        Require(new List<string> { ")" }));
        Require(new List<string> { "{" }));
        Switch = true;
        var switchBody = ParseCode();
        Switch = false;
        Position--;
        Require(new List<string> { "}" }));
        return new SwitchNode(variable,
switchBody);

    case "case":
        if (Switch)
        {
            var literalNode =
ParseVariableOrLiteral() as LiteralNode;

            if (literalNode == null)
            {
                throw new Exception(
                    $"After token
{Tokens[Position - 1].Identifier} need token literal");
            }

            Require(new List<string> { ":" }));
            return new
CaseNode(literalNode.Literal);
        }

        throw new Exception("Unexpected token:
'case' without 'switch'");
    case "default":
        if (Switch)
        {
            Require(new List<string> { ":" }));
            return new KeywordNode(token);
        }

        throw new Exception("Unexpected token:
'default' without 'switch'");
    case "break":
        Require(new List<string> { ";" }));
        return new KeywordNode(token);
    case "continue":

```

```

        Require(new List<string> { ";" });
        return new KeyWordNode(token);
    default:
        Require(new List<string> { "(" });
        var functionParameters =
ParseFunctionParameters();
        Require(new List<string> { ")" });
        Require(new List<string> { ";" });
        return new FunctionExecutionNode(token,
functionParameters);
    }
}

        throw new Exception($"Need var type, var, literal
{Position}");
    }

public AbstractNode ParseCode()
{
    var root = new StatementsNode();

    while (Position < Tokens.Count)
    {
        if (Match(new List<string> { "}" }) != null)
        {
            return root;
        }

        var statementNode = ParseExpression();

        if (statementNode != null)
        {
            root.AddNode(statementNode);
        }
    }

    return root;
}
}

```