VISHWAKARMA UNIVERSITY
Maximising Human Potential

T. Y. B. Tech Computer Engineering

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Assignment - 6

QUE 1 :

Design Lexical analyzer for the subset of "C" Language. Accept input from file.

Output : Line No, Lexeme , Token , Token_Value.

Also implement any one error checking. Submit single .pdf file with input C program , Token listing and source code in sequence.

Output 1 :

Input.c :

input.c > main()

```c
int main()
{
    int p = 15;
    int n = 22;
    // ignore this line.
    int sum = p + n; // Add p & n
    int sum_ = 0;
    for(int i=1; i< 10; i= i+ 1){
        sum_ = sum_ + i;
    }
    return 0;
}
```

Tokens table :

Tokens Table:

Line_No	Lexeme	Token	Token Value
1	int	Keyword	17
1	main	Identifier	1
1	(	Delimiter	1
1	)	Delimiter	2
2	{	Delimiter	3
3	int	Keyword	17
3	p	Identifier	2
3	=	Operator	23
3	15	Constant	15
3	;	Delimiter	8
4	int	Keyword	17
4	n	Identifier	3
4	=	Operator	23
4	22	Constant	22
4	;	Delimiter	8
5	int	Keyword	17
5	sum	Identifier	4
5	=	Operator	23
5	p	Identifier	2
5	+	Operator	1
5	n	Identifier	3
5	;	Delimiter	8
6	int	Keyword	17
6	sum_	Identifier	5
6	=	Operator	23
6	0	Constant	0
6	;	Delimiter	8

```
7           for             Keyword         14
7           (               Delimiter       1
7           int             Keyword         17
7           i               Identifier      6
7           =               Operator        23
7           1               Constant        1
7           ;               Delimiter       8
7           i               Identifier      6
7           <               Operator        11
7           10              Constant        10
7           ;               Delimiter       8
7           i               Identifier      6
7           =               Operator        23
7           i               Identifier      6
7           +               Operator        1
7           1               Constant        1
7           )               Delimiter       2
7           {               Delimiter       3
8           sum_            Identifier      5
8           =               Operator        23
8           sum_            Identifier      5
8           +               Operator        1
8           i               Identifier      6
8           ;               Delimiter       8
9           }               Delimiter       4
10          return          Keyword         20
10          0               Constant        0
10          ;               Delimiter       8
11          }               Delimiter       4
PS E:\TY-LAB\SP - Lab\Assignment-6>
```

Symbol Table :

```
Symbol Table:
Index  Symbol
1      main
2      p
3      n
4      sum
5      sum_
6      i
```

Output 2 : Error handling :

Input.c :

input.c 1 ×

input.c > main()

```c
int main()
{
    int p = 15;
    int n = 22;
    // ignore this line.
    int sum = p + n; // Add p & n
    int sum_ = 0; [
    for(int i=1; i< 10; i= i+ 1){
        sum_ = sum_ + i;
    }
    return 0;
}
```

PROBLEMS OUTPUT DEBUG CONSOLE PORTS

TERMINAL

```
PS E:\TY-LAB\SP - Lab\Assignment-6> cd "e:\TY-LAB\SP
t_6 }


Error : Missing parentheses : ]

PS E:\TY-LAB\SP - Lab\Assignment-6>
```

Output 3 : Error handling :

input.c 2 ×

input.c > main()

```c
int main()
{
    int p = 15;
    int n = 22;
    // ignore this line.
    int 10sum = p + n;
    int sum_ = 0;
    for(int i=1; i< 10; i= i+ 1){
        sum_ = sum_ + i;
    }
    return 0;
}
```

PROBLEMS OUTPUT DEBUG CONSOLE PORTS

TERMINAL

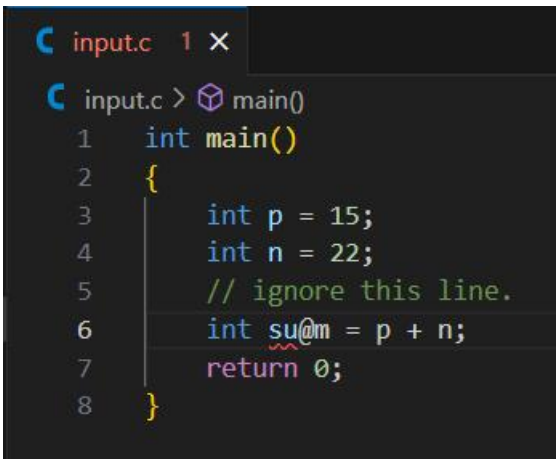
```
PS E:\TY-LAB\SP - Lab\Assignment-6> cd "e:\TY-LAB\SP - Lab
t_6 }


Error :Wrong declaration of variable: start with number

PS E:\TY-LAB\SP - Lab\Assignment-6>
```

Output : 4 Error handling :

Input.c :



CODE :

```
import java.util.*;
import java.io.*;

class CustomException extends Exception {
    String exception = null;
    public CustomException(String str) {
        exception = str;
    }
    @Override
    public String toString() {
        return exception;
    }
}

class LexicalAnalyzer {

    ArrayList<String> keywords = new ArrayList<>(List.of(
            "auto", "break", "case", "char", "const", "continue", "default", "do",
            "double", "else", "enum", "extern", "float", "for", "goto", "if", "int",
            "long", "register", "return", "short", "signed", "sizeof", "static",
            "struct", "switch", "typedef", "union", "unsigned", "void", "volatile", "while"));
```

```
    ArrayList<String> delimiters = new ArrayList<>(List.of(
            "(", ")", "{", "}", "[", "]", ",", ";", ":", "\"", "'", ".", "#"));

    ArrayList<String> operators = new ArrayList<>(List.of(
            "+", "-", "*", "/", "%", ">", "<", "!",
            "&", "|", "^", "~", "=", "?", ":", ".", "&", "*"));

    private Stack<String> stack = new Stack<>();
    private ArrayList<String> symbolTable = new ArrayList<>();
    private List<Object[]> tokensTable = new ArrayList<>();

    private int lineNumber = 0;

    private Integer getIndex_addSymbol(String token) {
        if (!symbolTable.contains(token)) {
            symbolTable.add(token);
        }
        return (symbolTable.indexOf(token) + 1);
    }

    private boolean isIdentifier(String preLexeme, String nextLexeme) {
        return (!preLexeme.equals("\"") && !nextLexeme.equals("\""));
    }

    private boolean isConstantString(String preLexeme, String curToken, String nextLexeme) {
        return preLexeme.equals("\"") && nextLexeme.equals("\"") && curToken.matches("[a-zA-Z0-
9]+");
    }

    private boolean checkParentheses(String closed) {
        if (closed.equals(")") && stack.peek().trim().equals("(")) {
            return true;
        } else if (closed.equals("}") && stack.peek().trim().equals("{")) {
            return true;
        } else if (closed.equals("]") && stack.peek().trim().equals("[")) {
            return true;
        }
        return false;
    }

    private void isValidVariable(String var) throws CustomException {
        char ch = var.charAt(0);
        if (Character.isDigit(ch)) {
            throw new CustomException("Wrong declaration of variable: start with number");
        }

        for (int i = 0; i < var.length(); i++) {
            ch = var.charAt(i);
            if (Character.isWhitespace(ch)) {
                throw new CustomException("Wrong declaration of variable: it contains a whitespace
character.");
            }
            if (!Character.isLetterOrDigit(ch) && ch != '_') {
```

```
                throw new CustomException("Wrong declaration of variable: it contains a special
character.");
            }
        }
    }

    private void handleDelimiter(String lexeme) throws CustomException {
        String token = "Delimiter";
        Integer tokenValue = delimiters.indexOf(lexeme) + 1;

        if (lexeme.trim().equals("(") || lexeme.trim().equals("{") || lexeme.trim().equals("[")) {
            stack.push(lexeme);
        }

        if (lexeme.trim().equals(")") || lexeme.trim().equals("}") || lexeme.trim().equals("]")) {
            if (!stack.isEmpty() && checkParentheses(lexeme.trim())) {
                stack.pop();
            } else if (stack.isEmpty()) {
                throw new CustomException("Extra closing parentheses: " + lexeme);
            } else {
                String expectedParen = stack.peek().equals("(") ? ")"
                        : stack.peek().trim().equals("{") ? "}" : "]";
                throw new CustomException("Invalid use of parentheses : " + expectedParen);
            }
        }
        tokensTable.add(new Object[] { lineNumber, lexeme, token, tokenValue });
    }

    private void handleToken(String preLexeme, String lexeme, String nextLexeme) throws
CustomException {
        Integer tokenValue = 0;
        String token = "";
        if (keywords.contains(lexeme)) {
            token = "Keyword";
            tokenValue = keywords.indexOf(lexeme) + 1;
        } else if (operators.contains(lexeme)) {
            token = "Operator";
            tokenValue = operators.indexOf(lexeme) + 1;
        } else if (delimiters.contains(lexeme)) {
            handleDelimiter(lexeme);
            return;
        } else if (lexeme.matches("\\d+\\.\\d+|\\d+")) {
            token = "Constant";
            tokenValue = Integer.parseInt(lexeme);
        } else if (isConstantString(preLexeme, lexeme, nextLexeme)) {
            token = "Constant";
            tokenValue = -1;
            tokensTable.add(new Object[] { lineNumber, lexeme, token, lexeme });
            return;
        } else if (isIdentifier(preLexeme, nextLexeme)) {
            isValidVariable(lexeme);
            token = "Identifier";
            tokenValue = getIndex_addSymbol(lexeme);
```

```
        }
        tokensTable.add(new Object[] { lineNumber, lexeme, token, tokenValue });
    }

    private void processTokens(String[] tokens) throws CustomException {
        for (int i = 0; i < tokens.length; i++) {
            int preIndex = (i != 0) ? (i - 1) : 0;
            int nextIndex = (i < tokens.length - 1) ? (i + 1) : i;

            if (tokens.length > 1 && tokens[0].trim().equals("/") && tokens[1].trim().equals("/")) {
                lineNumber--;
                break;
            } else if (i < tokens.length - 1 && tokens[i].trim().equals("/") &&
tokens[nextIndex].trim().equals("/")) {
                break;
            }
            handleToken(tokens[preIndex].trim(), tokens[i].trim(), tokens[nextIndex].trim());
        }
    }

    private void scanProgram() throws CustomException {
        String regex = "(?<=\\W)(?<![+\\-*/%])|(?=\\W)";
        try (BufferedReader fileReader = new BufferedReader(new FileReader("input.c"))) {
            String line;
            while ((line = fileReader.readLine()) != null) {
                if (!line.isEmpty()) {
                    lineNumber++;
                    String[] tokenArr = line.split(regex);
                    String tokenList = "";
                    for (int k = 0; k < tokenArr.length; k++) {
                        if (tokenArr[k] != null && !tokenArr[k].trim().isEmpty()) {
                            tokenList += tokenArr[k].trim() + "\t";
                        }
                    }
                    String[] tokens = tokenList.split("\t");
                    processTokens(tokens);
                }
            }
        } catch (IOException e) {
            e.printStackTrace();
        }
    }

    private void printTables() {
        System.out.println("\nSymbol Table:");
        System.out.println(String.format("%-6s %-10s", "Index", "Symbol"));
        for (int i = 0; i < symbolTable.size(); i++) {
            System.out.println(String.format("%-6d %-10s", (i + 1), symbolTable.get(i)));
        }

        System.out.println("\nTokens Table:");
        System.out.println(String.format("%-10s %-15s %-15s %-10s", "Line_No", "Lexeme", "Token",
"Token Value"));
```

```
        for (Object[] entry : tokensTable) {
            System.out.println(String.format("%-10d %-15s %-15s %-10s", entry[0], entry[1], entry[2],
entry[3]));
        }
    }

    public void lexicalAnalysis() throws CustomException{
        scanProgram();
        printTables();
    }
}

public class Assignment_6 extends LexicalAnalyzer {
    public static void main(String[] args) {
        Assignment_6 analyzer = new Assignment_6();
        try {
            analyzer.lexicalAnalysis();
        } catch (CustomException e) {
            System.out.println("Error encountered: " + e);
        } catch (Exception e) {
            e.printStackTrace();
        }
    }
}
```