Comsats University Islamabad Attock campus

Lab MID

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Submitted to:

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Course title:

CC LAB

Deadline:

April 11, 2025

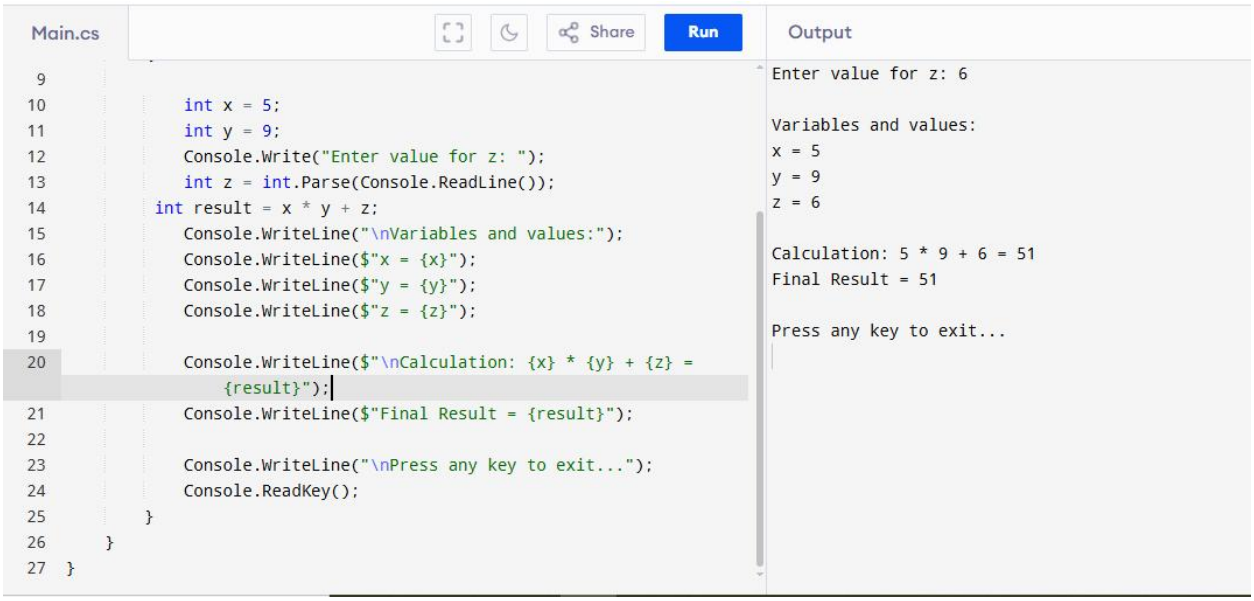
Department of computer sciences

Question1:

```
using System;
namespace ModifiedVariableProgram
{
   class Program
    {
        static void Main()
        {

            int x = 5;
            int y = 9;
            Console.Write("Enter value for z: ");
            int z = int.Parse(Console.ReadLine());
         int result = x * y + z;
            Console.WriteLine("\nVariables and values:");
            Console.WriteLine($"x = {x}");
            Console.WriteLine($"y = {y}");
            Console.WriteLine($"z = {z}");

            Console.WriteLine($"\nCalculation: {x} * {y} + {z} = {result}");
            Console.WriteLine($"Final Result = {result}");

            Console.WriteLine("\nPress any key to exit...");
            Console.ReadKey();
        }
```

```
    }
}
```

Output:



Question2:

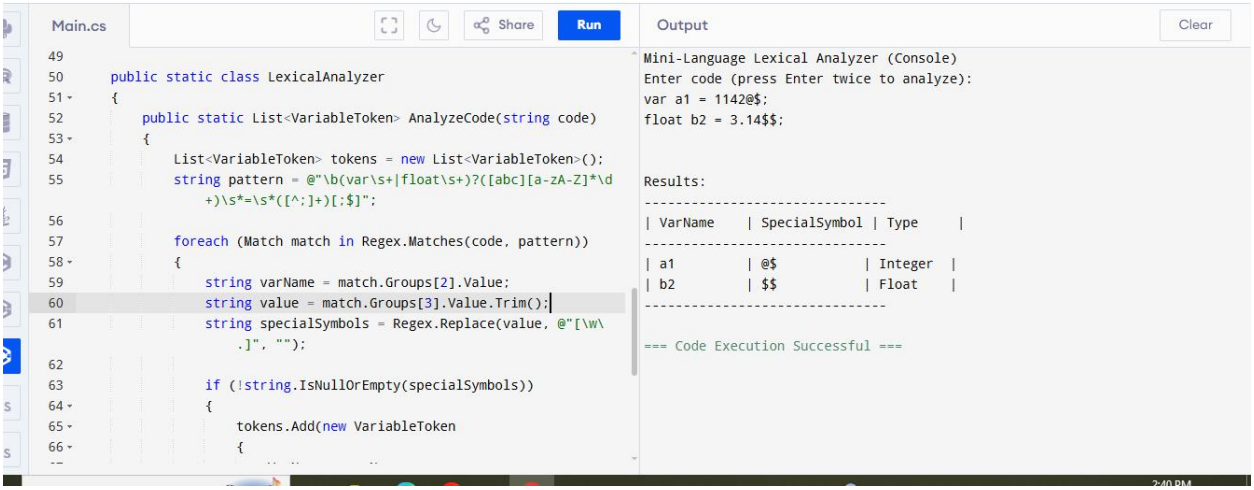
```
using System;
using System.Collections.Generic;
using System.Text.RegularExpressions;

namespace MiniLanguageLexerConsole
{
    class Program
    {
        static void Main(string[] args)
        {
            Console.WriteLine("Mini-Language Lexical Analyzer (Console)");
            Console.WriteLine("Enter code (press Enter twice to analyze):");
```

```
    // Read multi-line input until double Enter
    string inputCode = ReadMultiLineInput();

    // Analyze and display results
    List<VariableToken> tokens = LexicalAnalyzer.AnalyzeCode(inputCode);
    DisplayResults(tokens);
}

static string ReadMultiLineInput()
{
    string input = "";
    string line;
    while (!string.IsNullOrWhiteSpace(line = Console.ReadLine()))
    {
        input += line + Environment.NewLine;
    }
    return input;
}

static void DisplayResults(List<VariableToken> tokens)
{
    Console.WriteLine("\nResults:");
    Console.WriteLine("-------------------------------");
    Console.WriteLine("| {0,-10} | {1,-12} | {2,-8} |",
                      "VarName", "SpecialSymbol", "Type");
```

```
        Console.WriteLine("-------------------------------");

        foreach (var token in tokens)
        {
            Console.WriteLine("| {0,-10} | {1,-12} | {2,-8} |",
                              token.VarName, token.SpecialSymbol, token.TokenType);
        }
        Console.WriteLine("-------------------------------");
    }
}

public static class LexicalAnalyzer
{
    public static List<VariableToken> AnalyzeCode(string code)
    {
        List<VariableToken> tokens = new List<VariableToken>();
        string pattern = @"\b(var\s+|float\s+)?([abc][a-zA-Z]*\d+)\s*=\s*([^;]+)[;$]";

        foreach (Match match in Regex.Matches(code, pattern))
        {
            string varName = match.Groups[2].Value;
            string value = match.Groups[3].Value.Trim();
            string specialSymbols = Regex.Replace(value, @"[\w\.]", "");

            if (!string.IsNullOrEmpty(specialSymbols))
            {
```

```
                tokens.Add(new VariableToken
                {
                    VarName = varName,
                    SpecialSymbol = specialSymbols,
                    TokenType = match.Groups[1].Value.Contains("float") ? "Float" : "Integer"
                });
            }
        }
        return tokens;
    }
}

public class VariableToken
{
    public string VarName { get; set; }
    public string SpecialSymbol { get; set; }
    public string TokenType { get; set; }
}
}
```

Output:



Question3:

Question3:

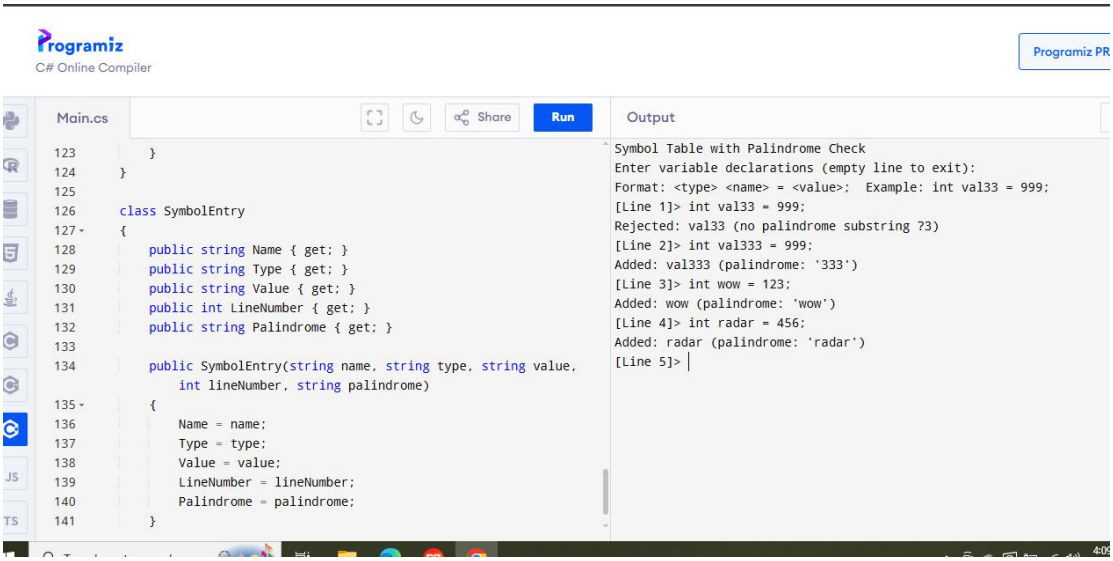
```
using System;
using System.Collections.Generic;

namespace SymbolTableWithPalindromeCheck
{
    class Program
    {
        static void Main(string[] args)
        {
            SymbolTable symbolTable = new SymbolTable();
            int lineNumber = 1;

            Console.WriteLine("Symbol Table with Palindrome Check");
            Console.WriteLine("Enter variable declarations (empty line to exit):");
            Console.WriteLine("Format: <type> <name> = <value>;  Example: int val33 = 999;");

            while (true)
            {
                Console.Write($"[Line {lineNumber}]> ");
                string input = Console.ReadLine().Trim();

                if (string.IsNullOrEmpty(input))
                    break;

                try
                {
                    // Parse the input
```

```
            string[] parts = input.Split(new[] { ' ', '=', ';' }, StringSplitOptions.RemoveEmptyEntries);

            if (parts.Length != 3)
            {
                Console.WriteLine("Invalid format. Use: <type> <name> = <value>;");
                continue;
            }

            string type = parts[0];
            string name = parts[1];
            string value = parts[2];

            // Add to symbol table if valid palindrome substring exists
            var result = symbolTable.AddVariable(name, type, value, lineNumber);
            if (result.success)
            {
                Console.WriteLine($"Added: {name} (palindrome: '{result.palindrome}')");
            }
            else
            {
                Console.WriteLine($"Rejected: {name} (no palindrome substring ≥3)");
            }
        }
        catch (Exception ex)
        {
            Console.WriteLine($"Error: {ex.Message}");
        }

        lineNumber++;
    }

    // Display symbol table
    Console.WriteLine("\nSymbol Table Contents:");
    Console.WriteLine("-----------------------------------------------");
    Console.WriteLine("| Line # | Variable Name | Type    | Value     | Palindrome  |");
    Console.WriteLine("-----------------------------------------------");
    symbolTable.Display();
    Console.WriteLine("-----------------------------------------------");
  }
}

class SymbolTable
{
  private readonly List<SymbolEntry> _entries = new List<SymbolEntry>();

  public (bool success, string palindrome) AddVariable(string name, string type, string value, int
lineNumber)
  {
    string palindrome = FindPalindromeSubstring(name, 3);
    if (palindrome != null)
    {
```

```
            _entries.Add(new SymbolEntry(name, type, value, lineNumber, palindrome));
            return (true, palindrome);
        }
        return (false, null);
    }

    public void Display()
    {
        foreach (var entry in _entries)
        {
            Console.WriteLine($"| {entry.LineNumber,-6} | {entry.Name,-13} | {entry.Type,-6} |
{entry.Value,-9} | {entry.Palindrome,-10} |");
        }
    }

    private string FindPalindromeSubstring(string s, int minLength)
    {
        for (int len = s.Length; len >= minLength; len--)
        {
            for (int i = 0; i <= s.Length - len; i++)
            {
                string substring = s.Substring(i, len);
                if (IsPalindrome(substring))
                {
                    return substring;
                }
            }
        }
        return null;
    }

    private bool IsPalindrome(string s)
    {
        int left = 0;
        int right = s.Length - 1;

        while (left < right)
        {
            if (s[left] != s[right])
            {
                return false;
            }
            left++;
            right--;
        }
        return true;
    }
}

class SymbolEntry
{
```

```
        public string Name { get; }
        public string Type { get; }
        public string Value { get; }
        public int LineNumber { get; }
        public string Palindrome { get; }

        public SymbolEntry(string name, string type, string value, int lineNumber, string palindrome)
        {
            Name = name;
            Type = type;
            Value = value;
            LineNumber = lineNumber;
            Palindrome = palindrome;
        }
    }
}
```

Output:



Question4:

```
using System;
using System.Collections.Generic;
using System.Linq;

class Program
{
    static void Main()
    {
        // Step 1: Take input from user
        Console.Write("Enter number of non-terminals: ");
        int n = int.Parse(Console.ReadLine());
```

```
        var grammar = new Dictionary<string, List<List<string>>>();

        for (int i = 0; i < n; i++)
        {
            Console.Write($"Enter production for non-terminal {i + 1}: ");
            string input = Console.ReadLine();
            var parts = input.Split(new[] { "->" }, StringSplitOptions.RemoveEmptyEntries);
            string lhs = parts[0].Trim();
            string[] rhsOptions = parts[1].Split('|');

            var productions = new List<List<string>>();
            foreach (string option in rhsOptions)
            {
                List<string> symbols = option.Trim().Split(' ').ToList();
                productions.Add(symbols);
            }

            grammar[lhs] = productions;
        }

        var firstSets = ComputeFirstSets(grammar);
        var followSets = ComputeFollowSets(grammar, firstSets);

        Console.WriteLine("\nFIRST Sets:");
        foreach (var kvp in firstSets)
        {
            Console.WriteLine($"FIRST({kvp.Key}) = {{ {string.Join(", ", kvp.Value)} }}");
        }

        Console.WriteLine("\nFOLLOW Sets:");
        foreach (var kvp in followSets)
        {
            Console.WriteLine($"FOLLOW({kvp.Key}) = {{ {string.Join(", ", kvp.Value)} }}");
        }
    }

    static Dictionary<string, HashSet<string>> ComputeFirstSets(Dictionary<string, List<List<string>>>
grammar)
    {
        var first = new Dictionary<string, HashSet<string>>();

        foreach (var nt in grammar.Keys)
            first[nt] = new HashSet<string>();

        bool changed;

        do
        {
            changed = false;
```

```
            foreach (var nt in grammar.Keys)
            {
                foreach (var production in grammar[nt])
                {
                    for (int i = 0; i < production.Count; i++)
                    {
                        string symbol = production[i];

                        if (!grammar.ContainsKey(symbol)) // Terminal
                        {
                            if (first[nt].Add(symbol))
                                changed = true;
                            break;
                        }

                        foreach (var f in first[symbol])
                        {
                            if (f != "ε" && first[nt].Add(f))
                                changed = true;
                        }

                        if (!first[symbol].Contains("ε"))
                            break;

                        if (i == production.Count - 1 && first[nt].Add("ε"))
                            changed = true;
                    }
                }
            }
        } while (changed);

        return first;
    }

    static Dictionary<string, HashSet<string>> ComputeFollowSets(Dictionary<string,
List<List<string>>> grammar, Dictionary<string, HashSet<string>> firstSets)
    {
        var follow = new Dictionary<string, HashSet<string>>();

        foreach (var nt in grammar.Keys)
            follow[nt] = new HashSet<string>();

        string startSymbol = grammar.Keys.First();
        follow[startSymbol].Add("$");

        bool changed;

        do
        {
            changed = false;
```

```
    foreach (var lhs in grammar.Keys)
    {
        foreach (var production in grammar[lhs])
        {
            for (int i = 0; i < production.Count; i++)
            {
                string symbol = production[i];
                if (!grammar.ContainsKey(symbol))
                    continue;

                bool epsilonInAll = true;

                for (int j = i + 1; j < production.Count; j++)
                {
                    string next = production[j];
                    if (!grammar.ContainsKey(next))
                    {
                        if (follow[symbol].Add(next))
                            changed = true;
                        epsilonInAll = false;
                        break;
                    }

                    foreach (var f in firstSets[next])
                    {
                        if (f != "ε" && follow[symbol].Add(f))
                            changed = true;
                    }

                    if (!firstSets[next].Contains("ε"))
                    {
                        epsilonInAll = false;
                        break;
                    }
                }

                if (epsilonInAll)
                {
                    foreach (var f in follow[lhs])
                    {
                        if (follow[symbol].Add(f))
                            changed = true;
                    }
                }
            }
        }
    }

} while (changed);

return follow;
```

```
    }
}
```

Output:

Programiz
C# Online Compiler

Programiz PRO

Main.cs

Share Run

```
                    epsilonInAll = false;
                    break;
                }
            }

            if (epsilonInAll)
            {
                foreach (var f in follow[lhs])
                {
                    if (follow[symbol].Add(f))
                        changed = true;
                }
            }
        }
    }
}

} while (changed);

return follow;
```

Output

```
Enter number of non-terminals: 3
Enter production for non-terminal 1: E -> T X
Enter production for non-terminal 2: X -> + T X | ??
Enter production for non-terminal 3: T -> int | ( E )

FIRST Sets:
FIRST(E) = { int, ( }
FIRST(X) = { +, ?? }
FIRST(T) = { int, ( }

FOLLOW Sets:
FOLLOW(E) = { $, ) }
FOLLOW(X) = { $, ) }
FOLLOW(T) = { +, ?? }

=== Code Execution Successful ===
```