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NIRMA
UNIVERSITY

INSTITUTE OF TECHNOLOGY

NAAC ACCREDITED 'A' GRADE

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Branch: - M.tech-CSE**(Data Science)**

Subject: - Complexity Theory & Algorithms

Practical-9

Aim: Given two sequences X and Y, find the longest common subsequence (LCS) of X and Y using dynamic programming.

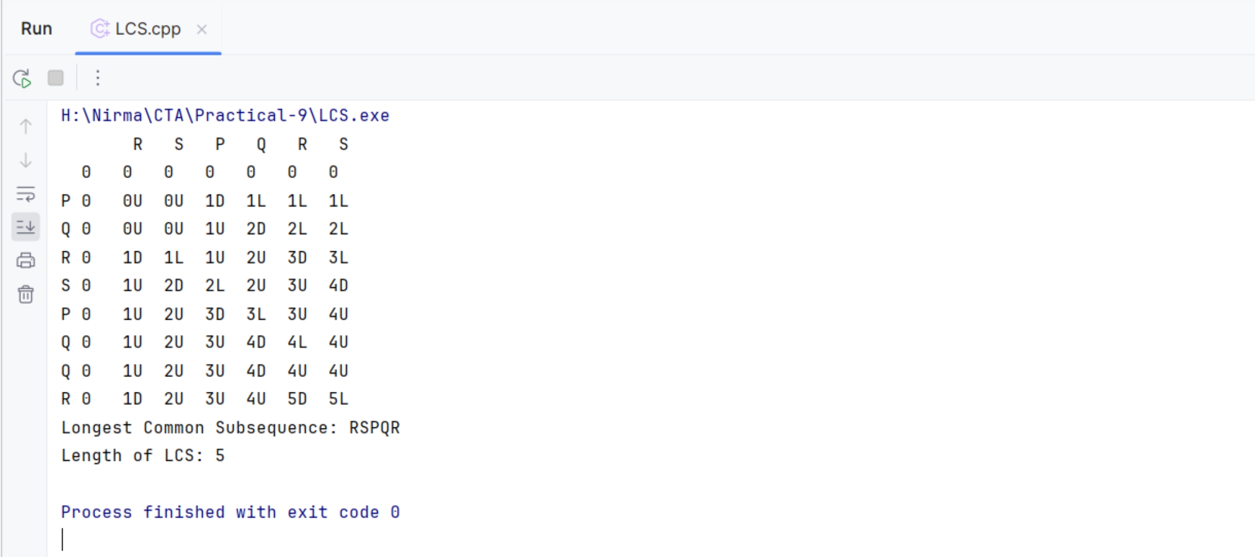
Code for LCS –

```
//
// Created by AKSHAT on 11/4/2023.
//
#include<bits/stdc++.h>
using namespace std;

void PRINT_LCS(vector<vector<char>>& b, const string& X, int i, int j) {
    if (i == 0 || j == 0) {
        return;
    }

    if (b[i][j] == 'D') {
        PRINT_LCS(b, X, i - 1, j - 1);
        cout << X[i - 1];
    } else if (b[i][j] == 'U') {
        PRINT_LCS(b, X, i - 1, j);
    } else {
        PRINT_LCS(b, X, i, j - 1);
    }
}

void PRINT_DP_TABLE(vector<vector<int>>& c, vector<vector<char>>& b, const
string& X, const string& Y) {
    int m = X.length();
    int n = Y.length();

    cout << "       ";
    for (int j = 0; j < n; j++) {
        cout << Y[j] << "   ";
    }
    cout << endl;

    for (int i = 0; i <= m; i++) {
        if (i == 0) {
            cout << "  ";
        } else {
            cout << X[i-1] << " ";
        }
        for (int j = 0; j <= n; j++) {
            cout << c[i][j] << b[i][j] << "  ";
        }
        cout << endl;
    }
}

int LCS(const string& X, const string& Y) {
    int m = X.length();
    int n = Y.length();
    vector<vector<int>> c(m + 1, vector<int>(n + 1, 0)); //for value
    vector<vector<char>> b(m + 1, vector<char>(n + 1, ' ')); //for sign

    for (int i = 1; i <= m; i++) {
        for (int j = 1; j <= n; j++) {
            if (X[i - 1] == Y[j - 1]) {
                c[i][j] = c[i - 1][j - 1] + 1;
                b[i][j] = 'D'; // Diagonal
            } else if (c[i - 1][j] >= c[i][j - 1]) {
                c[i][j] = c[i - 1][j];
                b[i][j] = 'U'; // Up
            } else {
                c[i][j] = c[i][j - 1];
                b[i][j] = 'L'; // Left
            }
        }
    }

    PRINT_DP_TABLE(c, b, X, Y);

    cout << "Longest Common Subsequence: ";
    PRINT_LCS(b, X, m, n);
    cout << endl;

    // Return the length of the LCS
    return c[m][n];
}

int main() {
    string X = "PQRSPQQR";
    string Y = "RSPQRS";

    int length = LCS(X, Y);
    cout << "Length of LCS: " << length << endl;

    return 0;
}
```

Output –

Test Case – 1

For x = PQRSPQQR and y = RSPQRS



```
H:\Nirma\CTA\Practical-9\LCS.exe
        R    S    P    Q    R    S
  0    0    0    0    0    0    0
P 0    0U   0U   1D   1L   1L   1L
Q 0    0U   0U   1U   2D   2L   2L
R 0    1D   1L   1U   2U   3D   3L
S 0    1U   2D   2L   2U   3U   4D
P 0    1U   2U   3D   3L   3U   4U
Q 0    1U   2U   3U   4D   4L   4U
Q 0    1U   2U   3U   4D   4U   4U
R 0    1D   2U   3U   4U   5D   5L
Longest Common Subsequence: RSPQR
Length of LCS: 5

Process finished with exit code 0
```