

LABORATORY REPORT

Algorithm Laboratory (CS-39001)

B.Tech Program in ECS

Submitted By

Name:- SANNIDHI DEB

Roll No: 2330044



**Kalinga Institute of Industrial Technology
(Deemed to be University) Bhubaneswar, India**

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Experiment Number	9.1
Experiment Title	<p>Write a C program to implement matrix chain multiplication (A1.A2.A3.A4.A5.A6) using a dynamic programming approach.</p> <p>Input (for example): matrix dimensions, $\{d_0, d_1, d_2, d_3, d_4, d_5, d_6\} = \{30, 35, 15, 5, 10, 20, 25\}$</p> <p>Output: Parenthesized product: ((A1.(A2.A3))((A4.A5).A6)) Number of scalar multiplications: 15125</p>
Date of Experiment	16/10/2025
Date of Submission	22/10/2025

1.Algorithm:-

Algorithm:-

```

MATRIX_CHAIN_MULTIPLICATION
n = length(p)-1
let m[1...n][1...n] be a 2-D array
for i=1 to n:
    m[i][i] = 0
for chain-length = 2 to n:
    for i=1 to n-chain-length+1:
        j = i + chain-length - 1
        m[i][j] = infinity
        for k=i to j-1:
            q = m[i][k] + m[k+1][j] + p[i-1] * p[k] * p[j]
            if q < m[i][j]:
                m[i][j] = q
return m[1][n]

```

sannidhi Deb
21112330044

2. Code:-

```
#include <stdio.h>
#include <limits.h>

void printOptimalParens(int i, int j, int n, int bracket[n][n]) {
    if (i == j) {
        printf("A%d", i);
        return;
    }
    printf("(");
    printOptimalParens(i, bracket[i][j], n, bracket);
    printOptimalParens(bracket[i][j] + 1, j, n, bracket);
    printf(")");
}

void matrixChainOrder(int p[], int n) {
    int m[n][n];
    int bracket[n][n];
    int i, j, k, L, q;

    for (i = 1; i < n; i++)
        m[i][i] = 0;

    for (L = 2; L < n; L++) {
        for (i = 1; i < n - L + 1; i++) {
            j = i + L - 1;
            m[i][j] = INT_MAX;
            for (k = i; k <= j - 1; k++) {
                q = m[i][k] + m[k + 1][j] + p[i - 1] * p[k] * p[j];
                if (q < m[i][j]) {
                    m[i][j] = q;
                    bracket[i][j] = k;
                }
            }
        }
    }
    printf("\nSannidhi Deb\n2330044\n\n");
    printf("Optimal Parenthesization: ");
    printOptimalParens(1, n - 1, n, bracket);
    printf("\nMinimum number of scalar multiplications: %d\n", m[1][n - 1]);
}
```

```

}

int main() {
    int p[] = {30, 35, 15, 5, 10, 20, 25};
    int n = sizeof(p) / sizeof(p[0]);

    matrixChainOrder(p, n);

    return 0;
}

```

3. Results/Output:- Entire Screen Shot including Date & Time:-

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS SPELL CHECKER 9

C:\Users\debsa\OneDrive\Desktop\AL_Lab_044>gcc exp9_1.c -o exp9_1

C:\Users\debsa\OneDrive\Desktop\AL_Lab_044>exp9_1

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Optimal Parenthesization: ((A1(A2A3))((A4A5)A6))
Minimum number of scalar multiplications: 15125

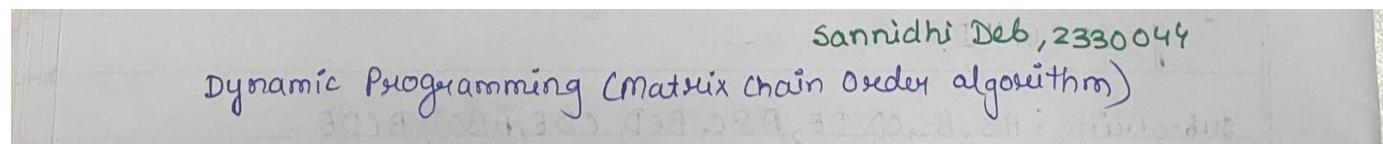
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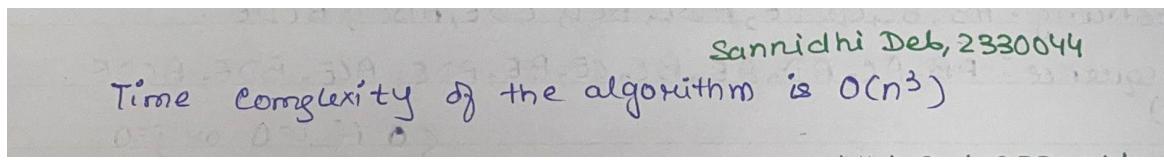
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4. Remarks:-

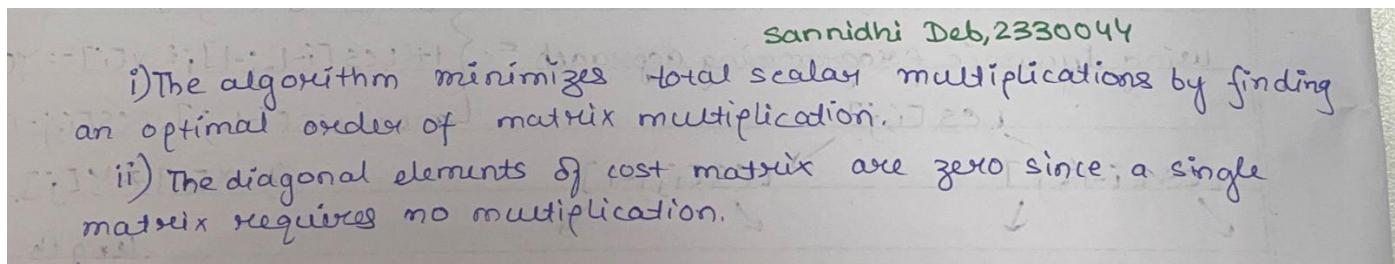
1. What type of algorithm is used?



2. Analyze the complexity of your algorithm.



3. Any other observations?



Experiment Number	9.2
Experiment Title	<p>Write a C program to find the longest common subsequence in a given two sequences using a dynamic programming approach.</p> <p>Input (for example): Sequence X = A, B, C, B, D, A, B Sequence Y = B, D, C, A, B, A</p> <p>Output: Longest common subsequence: B,C,B,A Length of longest common subsequence: 4</p>
Date of Experiment	16/10/2025
Date of Submission	22/10/2025

1.Algorithm:-

a.2 Algorithm :-

```

LCS_length (X, Y)
m = length (X)
n = length (Y)
let L [0...m] [0...n] be a RD array
for i = 0 to m:
    L[i][0] = 0
for j = 0 to n:
    L[0][j] = 0
for i = 1 to m:
    for j = 1 to n:
        if X[i-1] == Y[j-1]:
            L[i][j] = L[i-1][j-1] + 1
        else:
            L[i][j] = max(L[i-1][j], L[i][j-1])
return L[m][n]

```

sanridhi Deb, 2330044

2. Code:-

```
#include <stdio.h>
#include <string.h>
int max(int a, int b) {
    return (a > b) ? a : b;
}

void LCS(char X[], char Y[], int m, int n) {
    int L[m + 1][n + 1];
    for (int i = 0; i <= m; i++) {
        for (int j = 0; j <= n; j++) {
            if (i == 0 || j == 0)
                L[i][j] = 0;
            else if (X[i - 1] == Y[j - 1])
                L[i][j] = L[i - 1][j - 1] + 1;
            else
                L[i][j] = max(L[i - 1][j], L[i][j - 1]);
        }
    }
    int index = L[m][n];
    char lcs[index + 1];
    lcs[index] = '\0';
    int i = m, j = n;
    while (i > 0 && j > 0) {
```

```

if (X[i - 1] == Y[j - 1]) {
    lcs[index - 1] = X[i - 1];
    i--;
    j--;
    index--;
} else if (L[i - 1][j] > L[i][j - 1])
    i--;
else
    j--;
}
printf("\nSannidhi Deb\n2330044\n\n");
printf("Longest Common Subsequence: ");
for (int k = 0; lcs[k] != '\0'; k++) {
    printf("%c", lcs[k]);
    if (lcs[k + 1] != '\0')
        printf(",");
}
printf("\nLength of Longest Common Subsequence: %d\n", L[m][n]);
}

int main() {
    char X[] = {'A', 'B', 'C', 'B', 'D', 'A', 'B'};
    char Y[] = {'B', 'D', 'C', 'A', 'B', 'A'};

    int m = sizeof(X) / sizeof(X[0]);

```

```

int n = sizeof(Y) / sizeof(Y[0]);

LCS(X, Y, m, n);

return 0;

}

```

3. Results/Output:- Entire Screen Shot including Date & Time:-

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS SPELL CHECKER 10 JavaSE-23 + v ... | [] X

```

C:\Users\debsa\OneDrive\Desktop\AL_Lab_044>gcc exp9_2.c -o exp9_2
C:\Users\debsa\OneDrive\Desktop\AL_Lab_044>exp9_2
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2330044

Longest Common Subsequence: B,D,A,B
Length of Longest Common Subsequence: 4

C:\Users\debsa\OneDrive\Desktop\AL_Lab_044>

```

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4. Remarks:-

1. What type of algorithm is used?

The algorithm used is Dynamic Programming (Bottom-up approach).
 Sannidhi Deb
 2330044

2. Analyze the complexity of your algorithm.

The time complexity is $O(mn)$ where,

m is length of first sequence, and

n is length of the other sequence.

Sannidhi Deb
2330044

3. Any other observations?

i) The algorithm builds a 2D table storing subproblem results to avoid recomputation.

ii) This approach is used to find both the LCS and its length

Sannidhi Deb 2330044

5. Conclusion:- Both the Matrix Chain Multiplication (MCM) and Longest Common Subsequence (LCS) problems were efficiently solved using dynamic programming, demonstrating its power in optimizing recursive problems by storing intermediate results. These experiments highlight how dynamic programming minimizes computation time and provides optimal solutions for complex problems involving overlapping subproblems and optimal substructure.

Sannidhi Deb

(2330044)

Signature of the FIC

Sannidhi Deb

(Name of the FIC)

