LABORATORY REPORT

Algorithm Laboratory (CS-39001)

B.Tech Program in ECSc

Submitted By

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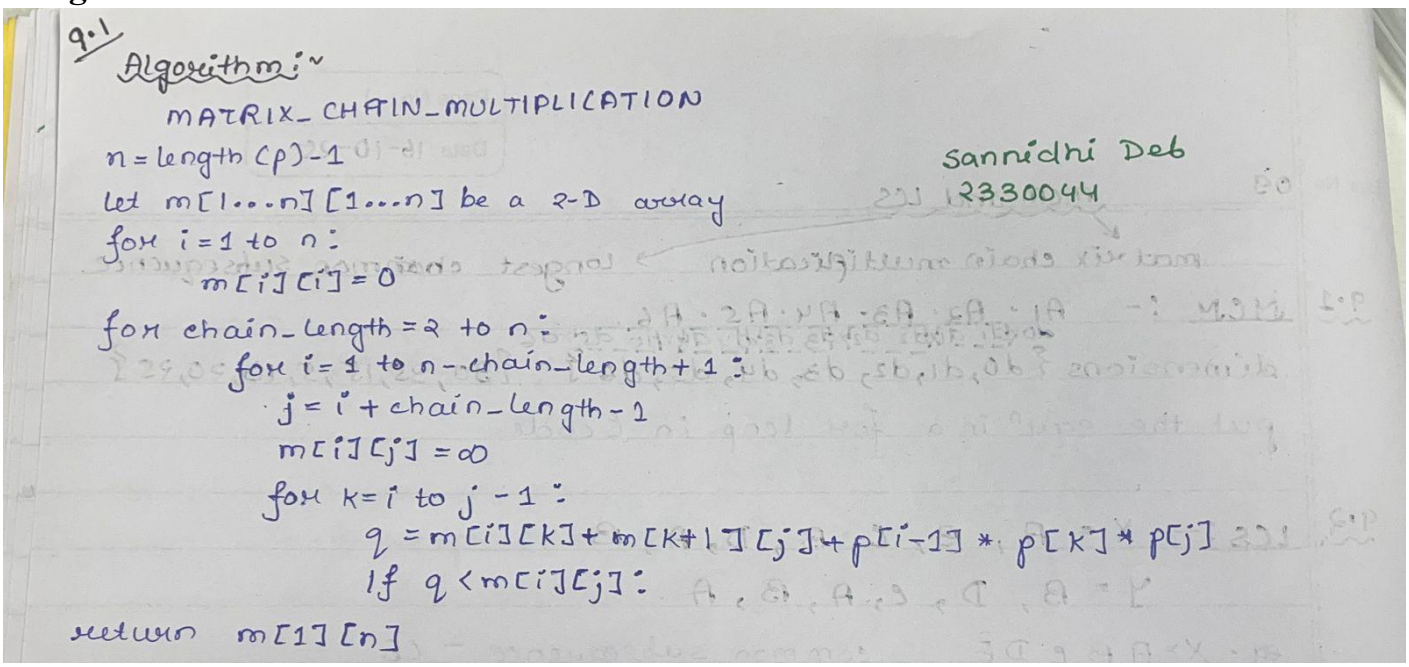
Experiment Number	9.1
Experiment Title	Write a C program to implement matrix chain multiplication (A1.A2.A3.A4.A5.A6) using a dynamic programming approach. Input (for example): matrix dimensions, {d0, d1, d2, d3, d4, d5, d6} = {30, 35, 15, 5, 10, 20, 25} Output: Parenthesized product: ((A1.(A2.A3))((A4.A5).A6)) Number of scalar multiplications: 15125
Date of Experiment	16/10/2025
Date of Submission	22/10/2025

1.Algorithm:-

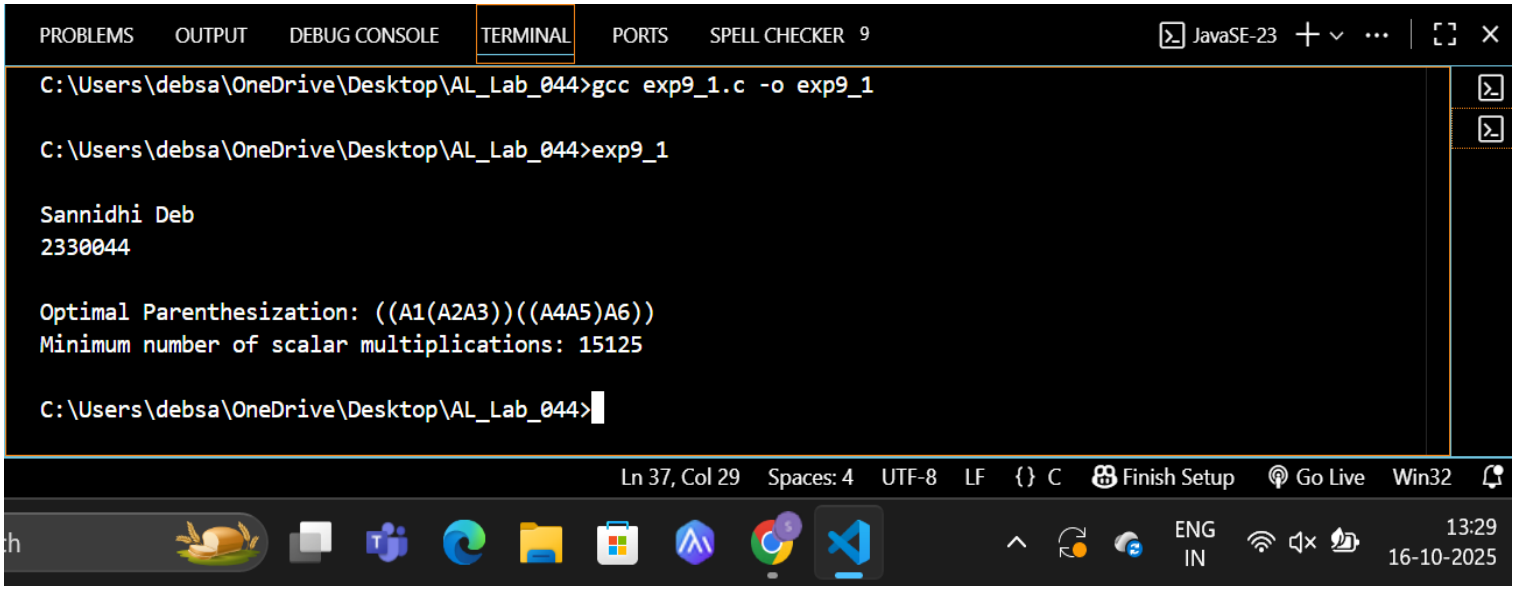


2. Code:-

```
#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]);
```

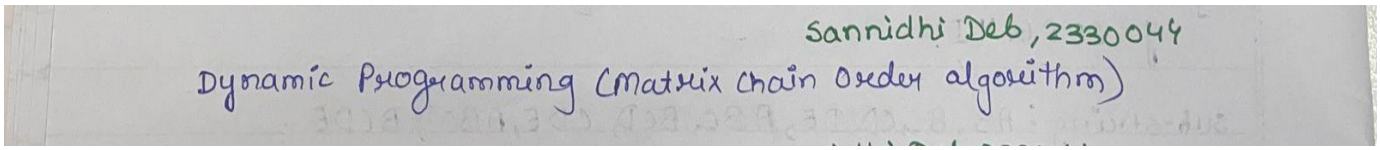
```
}

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:-



4. Remarks:-

1. What type of algorithm is used?



2. Analyze the complexity of your algorithm.

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Time complexity of the algorithm is $O(n^3)$

3.Any other observations?

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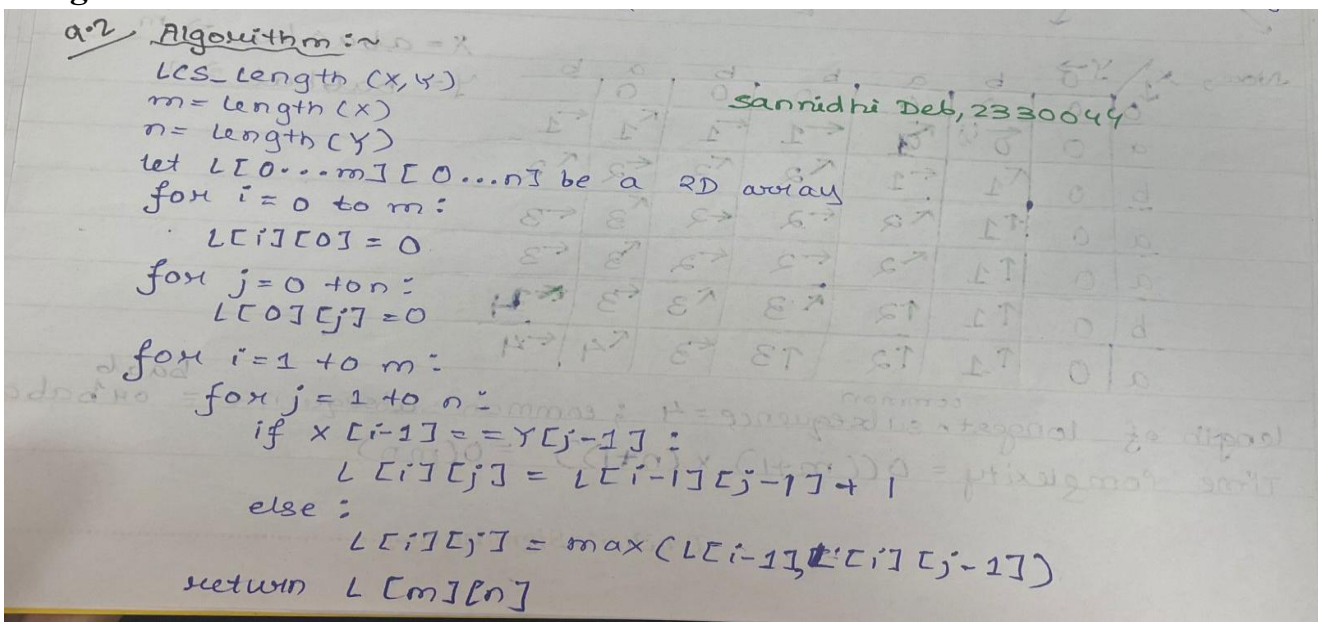
i) The algorithm minimizes total scalar multiplications by finding an optimal order of matrix multiplication.

ii) The diagonal elements of cost matrix are zero since a single matrix requires no multiplication.

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

1.Algorithm:-



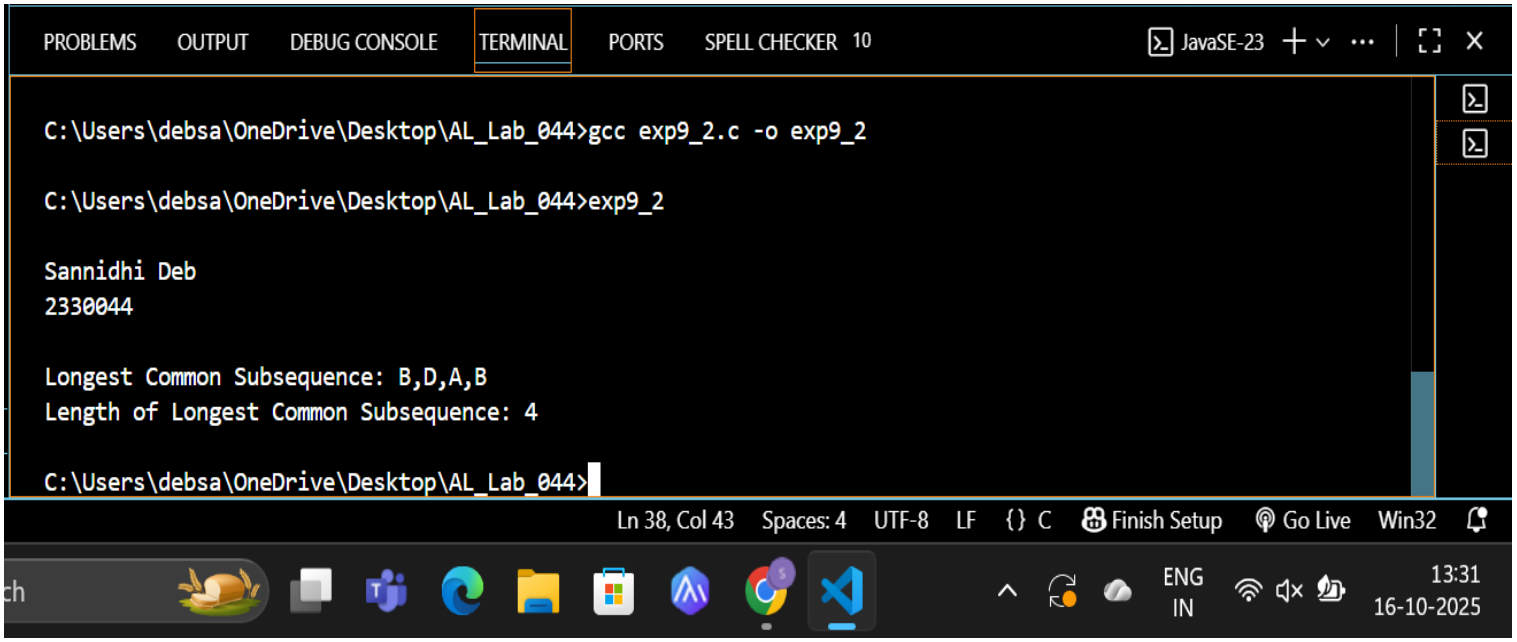
2. Code:-

```
#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]);
```

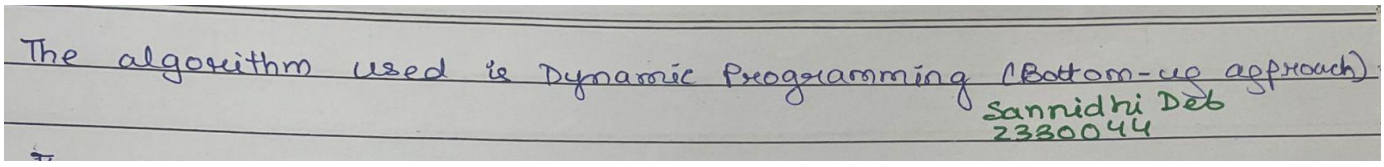
```
    int n = sizeof(Y) / sizeof(Y[0]);

    LCS(X, Y, m, n);

    return 0;

}
```

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



4. Remarks:-

1. What type of algorithm is used?



2. Analyze the complexity of your algorithm.

The time complexity is O(mxn) 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
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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.

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Signature of the FIC

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