Experiment Title - 2.1

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1. Aim/Overview of the practical:

Code and analyze to find an optimal solution to matrix chain multiplication using dynamic programming.

2. Task to be done/which logistics used:

Find an optimal solution to matrix chain multiplication using dynamic programming.

3. Algorithm/Flowchart:

1) Start Execution.
2) Iterate from l = 2 to N-1 which denotes the length of the range:
3) Iterate from i = 0 to N-1:
4) Find the right end of the range (j) having l matrices.
5) Iterate from k = i+1 to j which denotes the point of partition.
6) Multiply the matrices in range (i, k) and (k, j).
7) This will create two matrices with dimensions arr[i-1]*arr[k] and arr[k]*arr[j].
8) The number of multiplications to be performed to multiply these two matrices (say X)are arr[i-1]*arr[k]*arr[j].
9) The total number of multiplications is dp[i][k]+ dp[k+1][j] + X.
10) The value stored at dp[1][N-1] is the required answer.
11) End Execution.

4. Steps for experiment/practical/Code:

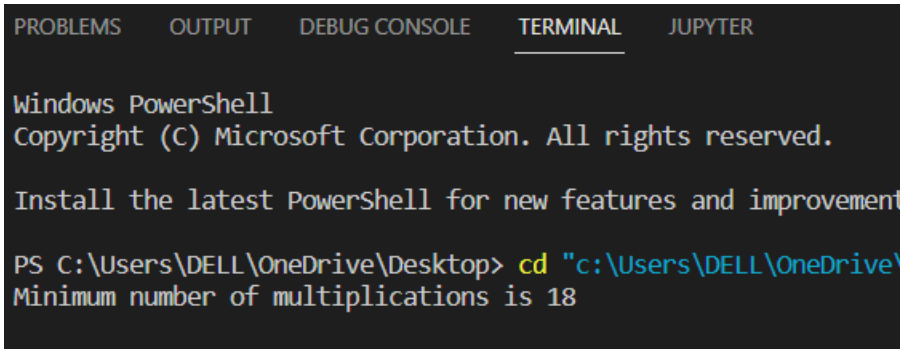
```
#include <bits/stdc++.h>
using namespace std;
 int MatrixChainOrder(int p[], int n)
{
   int m[n][n];
 int i, j, k, L, q;
 for (i = 1; i < n; i++)
  m[i][i] = 0;
 for (L = 2; L < n; L++)
{
  for (i = 1; i < n - L + 1; i++)
  {
   j = i + L - 1;
   m[i][j] = INT_MAX;
   for (k = i; k <= j - 1; k++)
   {
    q = m[i][k] + m[k + 1][j]
     + p[i - 1] * p[k] * p[j];
    if (q < m[i][j])
     m[i][j] = q;
```

```
    }
   }
}
return m[1][n - 1];
}
 int main(){
int arr[] = { 1, 2, 3, 4 };
int size = sizeof(arr) / sizeof(arr[0]);

cout << "Minimum number of multiplications is "
  << MatrixChainOrder(arr, size);

getchar();
return 0;
}
```

5. Observations/Discussions/ Complexity Analysis:

Time Complexity: $O(N^3)$
Auxiliary Space: $O(N^2)$

6. Output:


PROBLEMS
OUTPUT
DEBUG CONSOLE
TERMINAL
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Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.
Install the latest PowerShell for new features and improvement
PS C:\Users\DELL\OneDrive\Desktop> cd "c:\Users\DELL\OneDrive
Minimum number of multiplications is 18