



Bharatiya Vidya Bhavan's Sardar Patel Institute of Technology

Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058-India
(Autonomous College Affiliated to University of Mumbai)

SE - COMP (SE-A/08)

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Subject	Design And Analysis Of Algorithm
Class	Comps A
Experiment No.	5
AIM	To implement Matrix Chain Multiplication

Theory -

Matrix Chain Multiplication is an optimization problem that involves finding the most efficient way to multiply a sequence of matrices. The problem is to determine the order in which the matrices should be multiplied to minimize the number of scalar multiplications.

The idea is to consider all possible ways of splitting the matrix sequence into two sub-sequences, compute the minimum cost of multiplying each sub-sequence recursively, and add the cost of multiplying the resulting matrices. We then take the minimum of all possible ways of splitting the matrix sequence.

The overall time complexity of this algorithm is $O(n^3)$, where n is the number of matrices in the sequence. This makes it much more efficient than simply trying all possible orders of matrix multiplication, which would take $O(n!)$ time.

Algorithm -

1. $n = \text{length}[p] - 1$
2. for $i \leftarrow 1$ to n
3. do $m[i, i] \leftarrow 0$



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4. for $l \leftarrow 2$ to n // l is the chain length
5. do for $i \leftarrow 1$ to $n-l+1$
6. do $j \leftarrow i+l-1$
7. $m[i,j] \leftarrow \infty$
8. for $k \leftarrow i$ to $j-1$
9. do $q \leftarrow m[i,k] + m[k+1,j] + p_{i-1} p_k p_j$
10. If $q < m[i,j]$
11. then $m[i,j] \leftarrow q$
12. $s[i,j] \leftarrow k$
13. return m and s .

Program -

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

int matrixChainOrder(int p[], int n){
    int m[n][n];
    for (int i = 1; i < n; i++){
        m[i][i] = 0;
    }
    for (int L = 2; L < n; L++){
        for (int i = 1; i < n - L + 1; i++){
            int j = i + L - 1;
            m[i][j] = INT_MAX;
            for (int k = i; k < j; k++){
                int 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(){
```



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```
int num;
printf("Enter the number of dimensions : ");
scanf("%d", &num);
int p[num];
printf("Enter the dimensions : ");
for(int i=0; i<num; i++){
    scanf("%d", &p[i]);
}
int n = sizeof(p) / sizeof(p[0]);
printf("Minimum number of multiplications is %d ", matrixChainOrder(p, n));
return 0;
}
```

Result Analysis -

A screenshot of a Windows Command Prompt window. The title bar shows 'PROBLEMS', 'OUTPUT', 'DEBUG CONSOLE', and 'TERMINAL', with 'TERMINAL' being the active tab. The command prompt shows the user's current directory as 'C:\Users\ashok\Desktop\Sem IV' and the command 'cd "c:\Users\ashok\Desktop\Sem IV"' being executed. The program's output is displayed below the command: 'Enter the number of dimensions : 5', 'Enter the dimensions : 15', followed by five lines of input dimensions: '20', '32', '12', '18', and '18'. The final output is 'Minimum number of multiplications is 14520'. The prompt 'PS C:\Users\ashok\Desktop\Sem IV>' is shown at the bottom with a cursor.