

Name	DARSHIT BHAGTANI
UID	2021700006
Experiment No.	5

AIM:	Matrix Chain Multiplication
PROBLEM STATEMENT :	Apply the concept of dynamic programming to solve the problem of finding the minimum cost i.e. multiplications required to perform Matrix Chain Multiplications
ALGORITHM/ THEORY:	<p>Matrix Chain Multiplication can be solved using dynamic programming. We can define the minimum number of scalar multiplications needed to iteratively compute the product of a chain of matrices. We start with sub chains of length 1 and then compute the minimum cost for sub chains of increasing length until we have the minimum cost for the entire chain. The time complexity of this algorithm is $O(n^3)$, where n is the number of matrices in the chain.</p> <p><u>Algorithm:</u></p> <ol style="list-style-type: none"> 1. Define the subproblem: Find the minimum number of scalar multiplications needed to compute the product of a chain of matrices. 2. Find the recurrence relation: Let $M[i,j]$ be the minimum number of scalar multiplications needed to compute the product of the chain of matrices from matrix i to matrix j. We can define $M[i,j]$ recursively as follows: $M[i,j] = \min(M[i,k] + M[k+1,j] + a[i-1] \times a[k] \times a[j])$ for $i \leq k < j$ 3. Initialize the base case: $M[i,i] = 0$ for $1 \leq i \leq n$, where n is the number of matrices in the chain. 4. Solve the subproblems: Compute the minimum cost for subchains of increasing length until we have the minimum cost for the entire chain. 5. Return the final answer: The minimum cost for the entire chain is <ol style="list-style-type: none"> 1. stored in $M[1,n]$, where n is the number of matrices in the chain.

PROGRAM:

```
#include<stdio.h>
#include<conio.h>
void optimal(int s[10][10],int i,int j);
void mcm(int n, int p[10])
{
    int k,i,j,m[10][10],temp,s[10][10];
    for(j=1;j<=n;j++)
    {
        for(i=n;i>=1;i--)
        {
            if(i==j)
            {
                m[i][j]=0;
            }
            else if(i<j)
            {
                m[i][j]=9999;
                for(k=i;k<=j-1;k++)
                {
                    temp=m[i][k]+m[k+1][j]+(p[i-1]*p[j]*p[k]);
                    if(temp<m[i][j])
                    {
                        m[i][j]=temp;
                        s[i][j]=k;
                    }
                }
            }
        }
    }
    printf("\n M-Table \n");
    for(i=1;i<n;i++)
    {
        for(j=1;j<n;j++)
        {
            if(i>j)
            {
                printf("\t");
            }
            else
            {
                printf("%d\t",m[i][j]);
            }
        }
        printf("\n");
    }
    printf("\n S-Table \n");
    for(i=1;i<n;i++)
    {
        for(j=2;j<n;j++)
        {
            if(i>=j)
            {
                printf("\t");
            }
        }
    }
}
```

```

else
{
printf("%d\t",s[i][j]);
}
}
printf("\n");
}
printf("\n Answer \n");
optimal(s,l,n-1);
}
void optimal(int s[10][10],int i,int j)
{
if(i==j)
{
printf("A%d ",i);
}
else
{
printf(" ( ");
optimal(s,i,s[i][j]);
optimal(s,s[i][j]+1,j);
printf(" ) ");
}
}
void main()
{
int n,p[10],i;

printf("Enter the number of elements");
scanf("%d",&n);
printf("Enter value of elements\n");
for(i=0;i<n;i++)
{
printf("Enter value of element[%d]:",i);
scanf("%d",&p[i]);
}
mcm(n,p);
getch();
}

```

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main.c

36 }
37 }
38 printf("\n M-Table \n");

input

Enter the number of elements6
Enter value of elements
Enter value of element[0]:4
Enter value of element[1]:10
Enter value of element[2]:3
Enter value of element[3]:12
Enter value of element[4]:20
Enter value of element[5]:7

M-Table
0 120 264 1080 1344
 0 360 1320 1350
 0 720 1140
 0 1680
 0

S-Table
1 2 2 2
 2 2 2
 3 4
 4

Answer
((A1 A2) ((A3 A4) A5))

...Program finished with exit code 0
Press ENTER to exit console.[]

RESULT:

CONCLUSION:

Successfully carried out matrix chain multiplication and displayed the parenthesizing as well

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