DAA Lab-10

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Q-10.1) Write a program to solve the matrix chain multiplication problem following dynamic programming approach.

Program:

```
/*
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Idea of the solution:
        Matrix chain multiplication is an optimization problem concerning the most efficient way to
        multiply a given sequence of matrices. The problem is not actually to perform the
        multiplications, but merely to decide the sequence of the matrix multiplications involved. The
        problem is solved using dynamic programming as it can be divided into shared sub problems.
*/
#include <bits/stdc++.h>
using namespace std;
int dp[100][100],a[100][100];

void optimalParents(int i,int j)                              //Prints optimal parents
{
        if(i==j)
                cout<<"A"<<i;
        else
                {
                        cout<<"(";
                        optimalParents(i,a[i][j]);
                        optimalParents(a[i][j]+1,j);
                        cout<<")";
                }
}

int matrixChain(int* p, int i, int j)                         //Calculates matrix chain multiplication
{
        int q;
        if(i==j)
                return 0;

        if (dp[i][j] != -1)
                return dp[i][j];

        dp[i][j]=INT_MAX;
        for (int k=i;k<j;k++)
        {
                q=matrixChain(p,i,k)+matrixChain(p,k+1,j)+p[i-1]*p[k]*p[j];
                if(q<dp[i][j])
                {
                        dp[i][j]=q;
                        a[i][j]=k;
                }
        }
        cout<<dp[i][j]<<endl;
        return dp[i][j];
}
int MatrixChainOrder(int* p, int n)                             //calls matricChain()
{
        int i=1,j=n-1;
        return matrixChain(p,i,j);
}


int main()                                                      //Driver code
{
        int n,i;
        cin>>n;
        int arr[n];
        for(i=0;i<n;i++)
                cin>>arr[i];
        memset(dp, -1, sizeof dp);
        memset(a, -1, sizeof a);
        int s=MatrixChainOrder(arr, n);
        cout<<endl;
        optimalParents(1,n-1);
        cout<<endl;
        cout << "Minimum number of multiplications is "<< s<<endl;
}
```
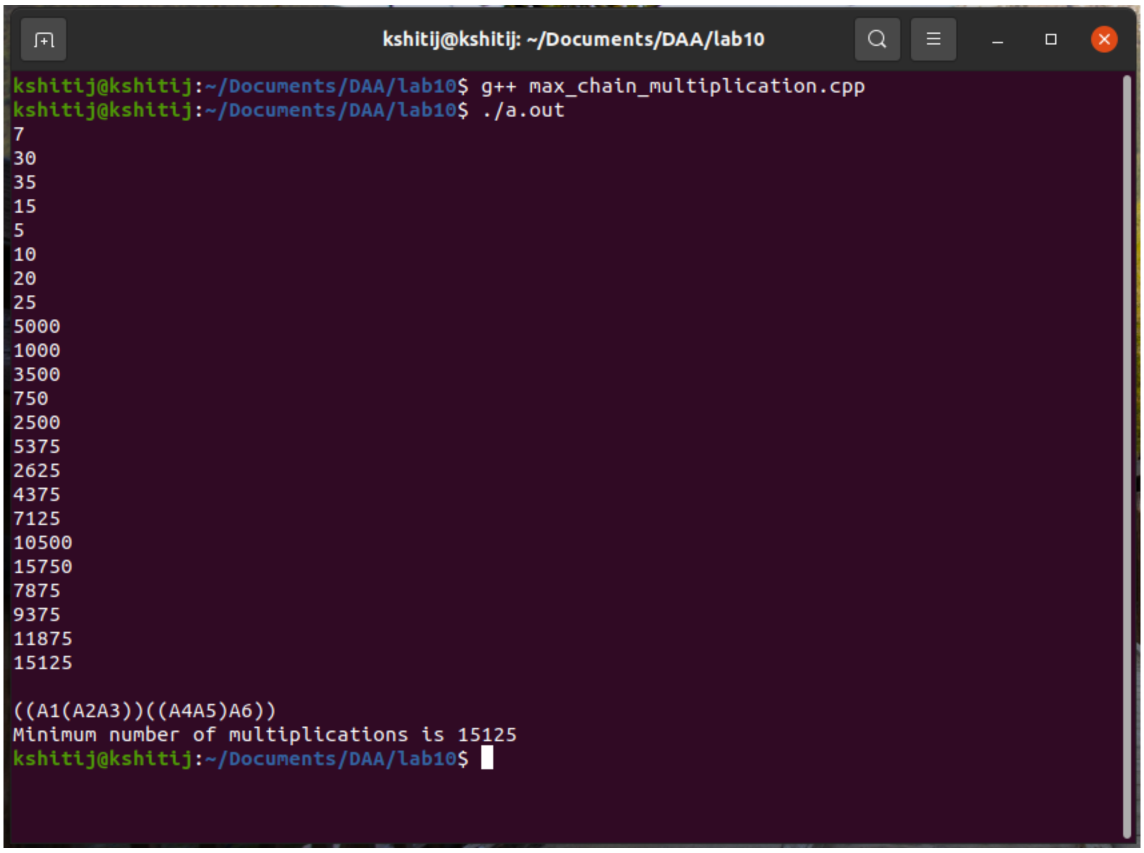

Output:



```
kshitij@kshitij:~/Documents/DAA/lab10$ g++ max_chain_multiplication.cpp
kshitij@kshitij:~/Documents/DAA/lab10$ ./a.out
7
30
35
15
5
10
20
25
5000
1000
3500
750
2500
5375
2625
4375
7125
10500
15750
7875
9375
11875
15125

((A1(A2A3))((A4A5)A6))
Minimum number of multiplications is 15125
kshitij@kshitij:~/Documents/DAA/lab10$
```