Optimal Matrix Multiplication P11455_en

Examen parcial d'Algorísmia, FME (2012-11-13)

Given two matrices with dimensions $n_1 \times n_2$ and $n_2 \times n_3$, the cost of the usual multiplication algorithm is $\Theta(n_1 n_2 n_3)$. For simplicity, let us consider that the cost is exactly $n_1 n_2 n_3$.

Suppose that we must compute $M_1 \times \cdots \times M_m$, where every M_i is an $n_i \times n_{i+1}$ matrix. Since the product of matrices is associative, we can choose the multiplication order. For example, to compute $M_1 \times M_2 \times M_3 \times M_4$, we could either choose $(M_1 \times M_2) \times (M_3 \times M_4)$, with cost $n_1 n_2 n_3 + n_3 n_4 n_5 + n_1 n_3 n_5$, or either choose $M_1 \times ((M_2 \times M_3) \times M_4)$, with cost $n_2 n_3 n_4 + n_2 n_4 n_5 + n_1 n_2 n_5$, or three other possible orders.

Write a program to find the minimum cost of computing $M_1 \times \cdots \times M_m$.

Input

Input consists of several cases, each one with m followed by the $m + 1$ dimensions. Assume $2 \leq m \leq 100$ and $1 \leq n_i \leq 10^4$.

Output

For every case, print the minimum cost to compute the product of the m matrices.

Sample input

```
2   1 2 3
3   10 20 30 40
10  9000 4000 3500 8000 2000 7500 6000 1000 8500 5500 7000
```

Sample output

```
6
18000
302250000000
```

Problem information

Author : Salvador Roura
Translator : Salvador Roura
Generation : 2014-08-29 16:07:08