Optimal BST

Input file:	`standard input`
Output file:	`standard output`
Time limit:	2 seconds
Memory limit:	512 megabytes

Bobo recently learnt dynamic programming to solve the "Optimal Binary Search Tree" problem. For a sequence of number $\{a_1, a_2, \dots, a_n\}$, $\mathrm{OPT}(\{a_1, a_2, \dots, a_n\})$ is defined as:

- $\mathrm{OPT}(\{a_1\}) = a_1$ when $n = 1$;
- $\mathrm{OPT}(\{a_1, a_2, \dots, a_n\}) = \min_{1 \le j < n} \mathrm{OPT}(\{a_1, a_2, \dots, a_j\}) + \mathrm{OPT}(\{a_{j+1}, a_{j+2}, \dots, a_n\}) + S$, where $S = a_1 + a_2 + \dots + a_n$ when $n > 1$.

Bobo also had a tree T whose vertices conveniently labeled by $1, 2, \dots, n$. The i-th vertex was associated with number a_i. Let P_i be the sequence of numbers on the path from vertex 1 to vertex i. He would like to work out $\mathrm{OPT}(P_i)$ for all $i = 1, 2, \dots, n$.

Input

The first line contains 1 integer n ($2 \le n \le 4000$).

The second line contains n integers $a_1, a_2, \dots, a_n$ ($1 \le a_i \le 10^9$).

The third line contains $(n - 1)$ integers $p_2, p_3, \dots, p_n$ where p_i denotes an edge between vertices p_i and i ($1 \le p_i < i$).

Output

n integeres denote $\mathrm{OPT}(P_1), \mathrm{OPT}(P_2), \dots, \mathrm{OPT}(P_n)$.

Examples

standard input	standard output
3 1 2 3 1 2	1 6 15
3 1 2 3 1 1	1 6 8