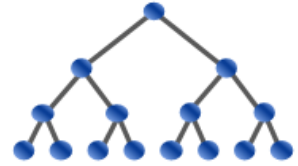


# USA Computing Olympiad



OVERVIEW

DETAILS / FAQ

TRAINING

HISTORY

RESOURCES

## USACO 2025 JANUARY CONTEST, GOLD PROBLEM 1. MEDIAN HEAP

[Return to Problem List](#)

Contest has ended.

[Log in to allow submissions in analysis mode](#)

English (en)

**\*\*Note: The time limit for this problem is 4s, twice the default.\*\***

Farmer John has a binary tree with  $N$  nodes where the nodes are numbered from 1 to  $N$  ( $1 \leq N < 2 \cdot 10^5$  and  $N$  is odd). For  $i > 1$ , the parent of node  $i$  is  $\lfloor i/2 \rfloor$ . Each node has an initial integer value  $a_i$ , and a cost  $c_i$  to change the initial value to any other integer value ( $0 \leq a_i, c_i \leq 10^9$ ).

He has been tasked by the Federal Bovine Intermediary (FBI) with finding an approximate median value within this tree, and has devised a clever algorithm to do so.

He starts at the last node  $N$  and works his way backward. At every step of the algorithm, if a node would not be the median of it and its two children, he swaps the values of the current node and the child value that would be the median. At the end of this algorithm, the value at node 1 (the root) is the median approximation.

The FBI has also given Farmer John a list of  $Q$  ( $1 \leq Q \leq 2 \cdot 10^5$ ) independent queries each specified by a target value  $m$  ( $0 \leq m \leq 10^9$ ). For each query, FJ will first change some of the node's initial values, and then execute the median approximation algorithm. For each query, determine the minimum possible total cost for FJ to make the output of the algorithm equal to  $m$ .

### INPUT FORMAT (input arrives from the terminal / stdin):

The first line of input contains  $N$ .

The next  $N$  lines each contain two integers  $a_i$  and  $c_i$ .

The next line contains  $Q$ .

The next  $Q$  lines each contain a target value  $m$ .

### OUTPUT FORMAT (print output to the terminal / stdout):

Output  $Q$  lines, the minimum possible total cost for each target value  $m$ .

### SAMPLE INPUT:

```
5
10 10000
30 1000
20 100
50 10
40 1
11
55
50
45
40
35
30
25
20
15
10
5
```

### SAMPLE OUTPUT:

```
111
101
101
100
100
100
100
100
0
```

11  
11  
111

To make the median approximation equal 40, FJ can change the value at node 3 to 60. This costs  $c_3 = 100$ .

To make the median approximation equal 45, FJ can change the value at node 3 to 60 and the value at node 5 to 45. This costs  $c_3 + c_5 = 100 + 1 = 101$ .

**SCORING:**

- Inputs 2-4:  $N, Q \leq 50$
- Inputs 5-7:  $N, Q \leq 1000$
- Inputs 8-16: No additional constraints

Problem credits: Suhas Nagar and Benjamin Qi

Contest has ended. No further submissions allowed.