Problem 5: Better Call McKirby
3+5 Points

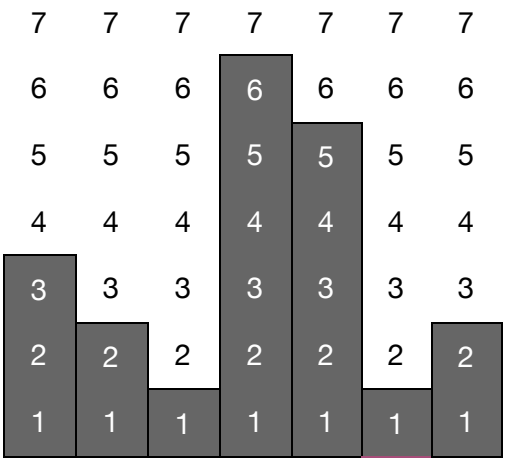
Problem ID: `bridge`
Rank: `2+2`

Introduction

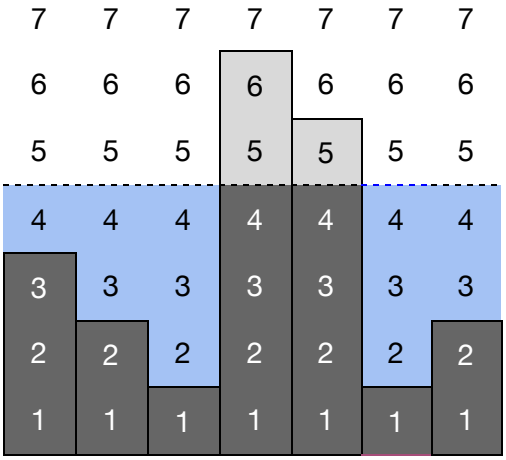
Super Smash Bros is coming to Saffron City! Waluigi Group Global Holding Company has been contracted by Saffron City Sports Authority to construct a city skyline for the fights. He gets off to a blazing start, the first two buildings are up with only a few unimportant casualties, but after a crackdown from OSHA, Waluigi is forced to implement basic safety standards for all his "workers." "Waaaaah"! They've legislated that he must place a safety net that will catch any "workers" falling from a dangerous height. In order to minimize costs and maximize profits, Waluigi has called upon McKirby consulting, who have sent you to help.

Problem Statement

Given a row of adjacent buildings with heights $\mathbf{S_1}$, $\mathbf{S_2}$, ... $\mathbf{S_N}$, choose an integer height to construct a bridge across them that minimizes *danger* without exceeding a total construction *cost* of $\mathbf{B}$. *Danger* is defined as the cumulative difference in heights between the bridge and the top of each building below it. The *cost* to build the bridge is defined as the cumulative difference in heights between the bridge and the top of each building above it. For example, if $\mathbf{N}$ = 7 and $\mathbf{S}$ = [3, 2, 1, 6, 5, 1, 2], the buildings look like this:



Building the bridge at a height of 4 incurs 11 *danger* at 3 *cost*, as pictured by the blue and light gray, respectively.



If there are multiple bridge heights that minimize danger without exceeding a cost of $\mathbf{B}$, output the one that minimizes the cost.

*Note: Templates are available for this problem—and **all other problems in this contest**—in Python, Java, and C++! Find them in the contest.zip provided at the start of the contest. Templates handle input and output for you, so you can just fill out a single function!*

Input Format

The first line of the input contains a single integer $\mathbf{T}$ denoting the number of test cases that follow. For each test case:

- The first line contains two space-separated integers $\mathbf{B}$ $\mathbf{N}$ denoting the maximum cost allowed to build the bridge and the number of buildings, respectively.
- The second line contains $\mathbf{N}$ space-separated integers $\mathbf{S_1}$ $\mathbf{S_2}$ ... $\mathbf{S_N}$ denoting the height of each building.

Output Format

For each test case, output a single integer corresponding to the height you choose to build the bridge.

Constraints

Time limit: **1 second**
Memory limit: **256 MB**

Main Test Set

$1 \le \mathbf{T} \le 10$
$1 \le \mathbf{B} \le 10^4$
$1 \le \mathbf{N} \le 100$
$0 \le \mathbf{S_i} \le 100$ for all $1 \le i \le \mathbf{N}$

Bonus Test Set 1

$1 \le \mathbf{T} \le 10$
$1 \le \mathbf{B} \le 10^{18}$
$1 \le \mathbf{N} \le 10^5$
$0 \le \mathbf{S_i} \le 10^{13}$ for all $1 \le i \le \mathbf{N}$

Sample Test Case

Sample Input Download

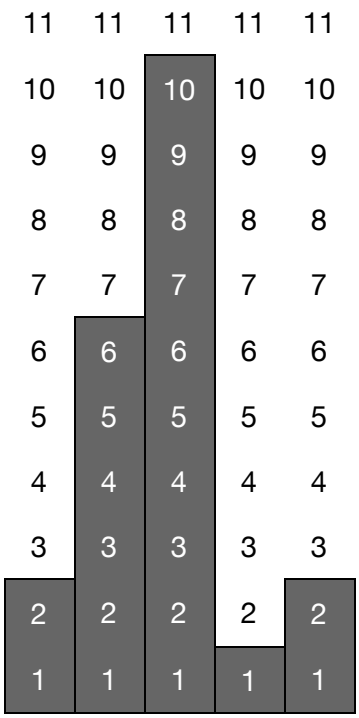
```
3
8 5
2 6 10 1 2
13 10
5 8 9 8 9 8 7 4 1 7
44 12
9 21 4 31 10 20 31 28 16 29 9 11
```

Sample Output Download

```
4
7
20
```

Sample Explanations

For test case #1, the buildings look like this:



The cost to build the bridge cannot exceed $\mathbf{B}$ = 8. Under this constraint, the lowest danger can be incurred by building the bridge at height 4 (7 danger with 8 cost).

Some possible bridge heights with their associated dangers and costs are outlined below:

$\mathbf{H}$	Danger	Cost
0	0	21
1	0	16
2	1	12
3	4	10
4	7	8
5	10	6
6	13	4
7	17	3
8	21	2
9	25	1
10	29	0
11	34	0

For test case #2, building a bridge at height 7 yields the minimum danger of 11 at 7 cost. No other bridge with cost less than $\mathbf{B}$ = 13 incurs less danger.