Processor Scheduling (INOI 2019 Problem 1)

There are $N + M$ jobs waiting to be run on a processor. N of these are **classified** jobs: $C_1, C_2, \ldots, C_N$, and the other M are **public** jobs: $P_1, P_2, \ldots, P_M$. There can only be one job running on the processor at any given millisecond (ms). Once the processor starts running a job, it has to finish it completely before starting any other job.

C_i takes time q_i milliseconds (ms) to finish. Also, for $1 \leq i \leq N$, C_i can be started **only after** $C_1, C_2, \cdots, C_{i-1}$ have finished.

P_j takes p_j ms to finish. These jobs can be run in any order. The classified and public jobs can also be interleaved in any order. However, sources have reported that for all $1 \leq j \leq M$, there may be an interrupt signal sent to the processor by an alien spaceship at time t_j. In order to remain on good terms with the aliens, the processor is required to be running the public job P_j at time t_j. In other words, each of the M public jobs need to be scheduled such that for $1 \leq j \leq M$, if P_j starts at the s_j-th millisecond, then $s_j \leq t_j < s_j + p_j$.

You want to finish all the jobs as soon as possible. You can start assigning jobs from time 1. Please find the minimum time (in ms) by which all the $N + M$ jobs can be finished. If it is not possible to finish all the jobs while satisfying the rules, output -1 instead.

Input:

- First line will contain T, the number of testcases. Then the testcases follow.
- The first line of each test case contains two integers N and M, the number of classified and public jobs respectively.
- The second line contains N space separated integers $q_1 \cdots q_N$.
- The third line contains M space separated integers, $p_1\ p_2 \cdots p_M$.
- The fourth line contains M space separated integers, $t_1\ t_2 \cdots t_M$.

Output:

For each testcase, output in a single line the minimum time in ms needed to finish all the jobs. If it is not possible to finish all the jobs output -1 instead.

Constraints

- $1 \leq T \leq 10$
- $0 \leq N \leq 5000$
- $0 \leq M \leq 5000$
- $1 \leq N + M$
- $1 \leq q_i, p_i, t_i \leq 10^9$

Subtasks

- **Subtask 1**: 10 points : $N \leq 10$, $M \leq 10$
- **Subtask 2**: 16 points : $N = 0$
- **Subtask 3**: 13 points: $p_i = 1$ for each of the M public jobs.
- **Subtask 4**: 61 points: No further constraints

Sample Input:

```
2
4 2
3 4 1 2
3 2
4 9
4 2
3 4 1 1
3 2
4 9
```

Sample Output:

```
16
15
```

Explanation:

Testcase 1: We can start C_1 at t = 1. Because its duration is 3ms, it will take up the times 1, 2 and 3. Then at t=4, we can start P_1. It will take up t=4, 5, and 6. Then we leave t=7 free, and at t=8, we start P_2, which will end at t=9. Then at t=10, we start C_2 which will end at t=13. Then at t=14, we start C_3 which finishes at that very second. And finally, at t=15, we start C_4, which ends at t=16. Note that at t_1 (ie. t = 4), P_1 was being executed, and at t_2 (ie. t = 9), P_2 was being executed.

This is the best we can do, and hence the answer is 16.

Interesting Sequences (INOI 2019 Problem 2)

You are given N integers in an array: $A[1], A[2], \ldots, A[N]$. You also have another integer L.

Consider a sequence of indices $(i_1, i_2, \ldots, i_k)$. Note that a particular index can occur multiple times in the sequence, and there is no order in which these indices have to occur. $(i_1, i_2, \ldots, i_k)$ is a sequence of size k. It is said to be an *Interesting* sequence, if $A[i_1] \geq A[i_2] \geq \ldots \geq A[i_k]$.

The *Cost* of an Interesting sequence $(i_1, i_2, \ldots, i_k)$, is defined to be the minimum absolute difference between any two adjacent indices. In other words, the Cost is $min\{|i_2 - i_1|, |i_3 - i_2|, \ldots, |i_k - i_{k-1}|\}$.

Your job is to consider the Costs of all the Interesting sequences of size L associated with the given array, and output the maximum Cost. Note that you can show that there is always at least one Interesting sequence for the given constraints.

Input

- The first line contains a single integer, T, which is the number of testcases. The description of each testcase follows.
- The first line of each testcase contains two space separated integers: N and L.
- The second line of each testcase contains N space separated integers: $A[1], A[2], \ldots, A[N]$.

Output

- For each testcase, output the answer in a new line.

Constraints

- $1 \leq T \leq 3$
- $1 \leq A[i] \leq 10^9$
- $2 \leq L \leq 10^9$

Subtasks

- **Subtask 1**: 7 points
  - It is guaranteed that $A[1] > A[2] > \ldots > A[N]$
  - Note that the above condition implies that all elements are distinct.
  - $1 \leq N \leq 500$
- **Subtask 2**: 7 points
  - It is guaranteed that $A[1] \geq A[2] \geq \ldots \geq A[N]$
  - $1 \leq N \leq 500$
- **Subtask 3**: 14 points
  - It is guaranteed that all elements are distinct.
  - $1 \leq N \leq 500$
- **Subtask 4**: 14 points
  - $1 \leq N \leq 500$
- **Subtask 5**: 25 points
  - It is guaranteed that all elements are distinct.
  - $1 \leq N \leq 3000$
- **Subtask 6**: 33 points
  - $1 \leq N \leq 3000$

Sample Input

```
1
6 3
2 4 1 12 3 5
```

Sample Output

```
3
```

Explanation

We are looking for Interesting sequences of length 3. Some of them are: - (4, 2, 3): This is Interesting because $A[4] \geq A[2] \geq A[3]$. Its cost is $min\{|2-4|, |3-2|\} = 1$. - (5, 1, 1): Cost is 0. - (2, 2, 2): Cost is 0. - (6, 1, 3): Cost is 2. - (6, 2, 5): Cost is 3.

There are other Interesting Sequences of length 3 as well. But if you list them all out, you'll see that the maximum Cost is 3. Hence the answer is 3.

INOI 2019 Cutoffs

- Class 12: 39/200
- Class 11: 33/200
- Class 10: 29/200
- Class 9 and below: 26/200