EGOI '22 P1 - SubsetMex

Time limit: 1.0s   **Memory limit:** 512M

A multiset is a collection of elements similar to a set, where elements can repeat multiple times. For example, the following is a multiset: $\{0, 0, 1, 2, 2, 5, 5, 5, 8\}$.

Given a multiset S defined on non-negative integers, and a target non-negative integer value n such that n does not belong to S, your goal is to insert n into S by using the following 3-step operation, repeatedly:

- Choose a (possibly empty) subset T of S. Here, T is a set of **distinct** numbers that appear in S.
- Erase elements of T from S. (Remove only one copy of each element.)
- Insert $\text{mex}(T)$ into S, where $\text{mex}(T)$ is the smallest non-negative integer that does not belong to T. The name mex stands for "minimum excluded" value.

Your goal is to find the minimum number of operations to perform so that n becomes part of S. Since the size of S may be large, it will be given in the form of a list $(f_0, \ldots, f_{n-1})$ of size n, where f_i represents the number of times that the number i appears in S. (Recall that n is the integer we are trying to insert into S.)

Input Specification

The first line contains a single integer t $(1 \le t \le 200)$ — the number of test cases. Each two of the following lines describe a test case:

The first line of each test case contains a single integer n $(1 \le n \le 50)$, representing the integer to be inserted into S.

The second line of each test case contains n integers $f_0, f_1, \ldots, f_{n-1}$ $(0 \le f_i \le 10^{16})$, representing the multiset S as mentioned above.

Output Specification

For each test case, print a single line containing the minimum number of operations needed to satisfy the condition.

Sample Input

```
2
4
0 3 0 3
5
4 1 0 2 0
```

Sample Output

```
4
10
```

Explanation

In the first example, initially, $S = \{1, 1, 1, 3, 3, 3\}$ and our goal is to have 4 in S. We can do the following:

- choose $T = \{\}$ then S becomes $\{0, 1, 1, 1, 3, 3, 3\}$.
- choose $T = \{0, 1, 3\}$ then S becomes $\{1, 1, 2, 3, 3\}$.
- choose $T = \{1\}$ then S becomes $\{0, 1, 2, 3, 3\}$.
- choose $T = \{0, 1, 2, 3\}$ then S becomes $\{3, 4\}$.

Constraints

- Subtask 1 (5 points): $n \leq 2$
- Subtask 2 (17 points): $n \leq 20$
- Subtask 3 (7 points): $f_i = 0$
- Subtask 4 (9 points): $f_i \leq 1$
- Subtask 5 (20 points): $f_i \leq 2000$
- Subtask 6 (9 points): $f_0 \leq 10^{16}$ and $f_j = 0$ (for all $j \neq 0$)
- Subtask 7 (10 points): There exists a value i for which $f_i \leq 10^{16}$ and $f_j = 0$ (for all $j \neq i$).
- Subtask 8 (23 points): No additional constraints