Bit Counting Sequence

Input file:	`standard input`
Output file:	`standard output`
Time limit:	2 seconds
Memory limit:	1024 megabytes

For a non-negative integer x, let $p(x)$ be the number of ones in the binary representation of x. For example, $p(26) = 3$ because $26 = (11010)_2$.

You are given a sequence of n integers $(a_1, a_2, \ldots, a_n)$. Your task is to determine whether there exists a non-negative integer x such that $(p(x), p(x+1), ..., p(x+n-1))$ is equal to $(a_1, a_2, \ldots, a_n)$. Furthermore, if it exists, compute the smallest x satisfying the condition.

Input

The first line of input contains one integer t ($1 \le t \le 1000$) representing the number of test cases. After that, t test cases follow. Each of them is presented as follows.

The first line contains one integer n ($1 \le n \le 500\,000$). The second line contains n integers $a_1, a_2, \ldots, a_n$ ($0 \le a_i \le 60$ for all i).

The sum of n across all test cases in one input file does not exceed $500\,000$.

Output

For each test case, output the smallest non-negative integer x satisfying the condition above. If there is no such x, output `-1` instead.

Example

standard input	standard output
4 5 3 3 4 1 2 3 2 1 2 2 60 60 2 8 0	13 3 2305843009213693949 -1

Note

Explanation for the sample input/output #1

For the first test case, $x = 13$ satisfies the condition above since $(p(13), p(14), p(15), p(16), p(17)) = (3, 3, 4, 1, 2)$. It can be shown that there is no non-negative integer smaller than 13 that satisfies the condition above.

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