A. And-y

1 s., 256 MB

Andy has a favorite number x. He recently learned about the bitwise AND operator — he knows that x & $(x - 1)$ & $(x - 2)$ & ... 0 = 0.

However, he later realised that it is possible to find an integer y ($0 \le y \le x - 1$), such that x & $(x - 1)$ & $(x - 2)$ & ... (y) = 0.

Help him find the maximum possible value of y.

Input

The first line has a single integer T $(1 \le T \le 10^5)$ — the number of testcases.

The T lines that follow describe the testcases. Each testcase contains a single integer x $(1 \le x \le 10^9)$.

Output

For each testcase, print a single integer — the maximum possible value of y.

input
```
5
1
8
18
35
39
```
output
```
0
7
15
31
31
```

In testcase three, no value greater than 15 will give the result as 0:

- $18 \,\&\, 17 \neq 0$,
- $18 \,\&\, 17 \,\&\, 16 \neq 0$,
- $18 \,\&\, 17 \,\&\, 16 \,\&\, 15 = 0$

B. Mitosis

1 s., 256 MB

You are a scientist studying about mitosis by raising some amoebae in a box.

Initially, the box is empty. Each morning, you can put any number of amoebae into the box. And each night, each amoeba in the box will split into two amoebae.

You want to get exactly n amoebae in the box at some moment. What is the minimum number of amoebae you need to put into the box across those days?

Input

A single integer $n(1 \le n \le 10^9)$.

Output

A single integer.

input
```
5
```
output
```
2
```

input
```
8
```
output
```
1
```

input
```
6
```
output
```
2
```

In the first example, you can **put** 1 amoeba into the box on day 1. On day 3, the box will have 4 amoebae in the morning. Now, you can **put** 1 more amoeba to get 5.

In the second example, you can **put** 1 amoeba into the box on day 1. On day 4, the box will contain 8 amoebae in the morning.

In the third example, you can **put** 1 amoeba into the box on day 1. On day 2, the box will have 2 amoebae in the morning. You can then **put** 1 more amoeba in the box on day 2. Now, on day 3 the box will have 6 amoebae in the morning.

C. Prime is Fine

2 s., 64 MB

Ashwin is interested in prime numbers. Once he came across a very interesting problem. It stated that any number more than 2 can be written as sum of two primes. This caught Ashwin's attention and he decided to make a problem of his own. It stated that at least t prime numbers from 2 to m (inclusive) can be expressed as a sum of three integer numbers: Two neighbouring prime numbers and 1, such as $13 = 7 + 5 + 1$.

You are to help Ashwin, and find out if he is right or wrong.

Input

The input is two integers $m(2 \le m \le 1000)$ and $t(0 \le t \le 1000)$.

Output

Output YES if at least t prime numbers from 2 to m (inclusive) can be expressed as described above. Else output `NO`.

input
```
34 5
```
output
```
NO
```

input
```
38 4
```
output
```
YES
```

In the second example, $13(5+7+1), 19(7+11+1), 31(13+17+1)$ and $37(17+19+1)$ are 4 numbers that satisfy the given conditions, so the answer is YES.

D. Perfect Sequence

1 s., 256 MB

Emily got a question on primes as homework. She is given a sequence $nums$ containing l elements.

Her question states that a sequence is perfect if all the pairs of neighboring elements of the sequence are relatively prime (two integers are said to be relatively prime if 1 is the only common divisor).

In order to make a given sequence perfect, she is allowed to perform the following operation — insert a positive integer (whose value is $\leq 10^9$) at any location in the sequence.

Help her find the minimum number of operations required to make the given sequence perfect. Also, output the perfect sequence you obtained.

If multiple answers are possible, you can output any valid answer.

Input

The first line has a single integer l ($1 \leq l \leq 1000$) which represents the number of elements in the given sequence.

The second line contains l integers $nums_i$ ($1 \leq nums_i \leq 10^9$) — the elements of the sequence $nums$.

Output

On the first line print one integer c — the minimum number of elements that have to be inserted into $nums$ to make it perfect.

The second line must contain $l + c$ integers — the elements of $nums$ after inserting c elements into it.

If multiple answers are possible, you can output any valid answer.

input

```
8
4 9 6 11 84 49 24 46
```

output

```
3
4 9 25 6 11 84 13 49 24 13 46
```

9 and 6 are not relatively prime so we can insert 25 between them (since both pairs $(9, 25)$ and $(25, 6)$ are relatively prime). Similarly, we can insert 13 between 84 and 49, and also between 24 and 46.

It can be shown that the original sequence cannot be made perfect in less than 3 operations. So, any other perfect sequence obtained by performing 3 operations on the original sequence is also a valid answer.

E. Number Game

2 s., 256 MB

Alice and Bob decide to play a game. Alice chooses an integer x and Bob chooses an integer y. They tell you their choices and you have to decide who wins.

Alice wins if it's possible to represent x as a sum of y **odd** integers (these y **odd** integers must be **distinct** and **positive**). Otherwise Bob wins.

Output YES if Alice wins and NO otherwise.

Input

The first line of the input has a single integer T ($1 \leq T \leq 10^5$) which represents the number of test cases.

The T lines that follow describe the testcases. Each testcase has a single line containing two integers x and y ($1 \leq x, y \leq 10^7$).

Output

For each testcase, print YES if Alice wins and NO otherwise.

input

```
5
25 5
68 8
21 6
52 7
17 3
```

output

```
YES
YES
NO
NO
YES
```

In testcase two, one way to represent 68 is $3+5+11+13+15+21$.

In testcase three, it is not possible to represent 21 as a sum of 6 **odd** integers that are **distinct** and **positive**.

F. Arjun's Array

1 s., 256 MB

Arjun has an array of m (m is even) integers $x_1, x_2, \ldots, x_m$. Arjun conceived of a positive integer n. After that, Arjun began performing an operations on the array: take an index $j(1 \leq j \leq m)$ and reduce the number x_j by n.

After Arjun performed some (possibly zero) number of such operations, it turned out that **all** numbers in the array became the same. Find the maximum n at which such a situation is possible, or print -1 if such a number can be arbitrarily large.

Input

The first line has a single integer $t (1 \leq t \leq 10)$ — the number of test cases. Then t test cases follow.

Each test case consists of two lines. The first line has a single even integer $m (4 \leq m \leq 40)$. The second line has m integers $a_1, a_2, \ldots a_m (-10^6 \leq a_i \leq 10^6)$.

The sum of all m specified in the given test cases does not exceed 100.

Output

For each test case output an integer $n(n \geq 1)$ — the maximum possible number that Arjun used in operations on the array, or -1, if such a number can be arbitrarily large.

input

```
2
6
1 5 3 1 1 5
8
-1 0 1 -1 0 1 -1 0
```

output

```
2
1
```