Problem A. Counting Bits

Time Limit 1000 ms
Mem Limit 524288 kB

Your task is to count the number of one bits in the binary representations of integers between 1 and n.

Input

The only input line has an integer n.

Output

Print the number of one bits in the binary representations of integers between 1 and n.

Constraints

- $1 \le n \le 10^{15}$

Example

Input	Output
7	12

Explanation: The binary representations of $1 \ldots 7$ are 1, 10, 11, 100, 101, 110, and 111, so there are a total of 12 one bits.

Problem B. Maximum Xor Subarray

Time Limit 1000 ms
Mem Limit 524288 kB

Given an array of n integers, your task is to find the maximum xor sum of a subarray.

Input

The first line has an integer n: the size of the array.

The next line has n integers $x_1, x_2, \ldots, x_n$: the contents of the array.

Output

Print one integer: the maximum xor sum in a subarray.

Constraints

- $1 \leq n \leq 2 \cdot 10^5$
- $0 \leq x_i \leq 10^9$

Example

Input	Output
4 5 1 5 9	13

Problem C. Maximum Xor Subset

Time Limit 1000 ms
Mem Limit 524288 kB

Given an array of n integers, your task is to find the maximum xor sum of a subset.

Input

The first line has an integer n: the size of the array.

The next line has n integers $x_1, x_2, \ldots, x_n$: the contents of the array.

Output

Print one integer: the maximum xor sum of a subset.

Constraints

- $1 \leq n \leq 2 \cdot 10^5$
- $0 \leq x_i \leq 10^9$

Example

Input	Output
4 1 6 12 6	13

Problem D. Number of Subset Xors

Time Limit 1000 ms
Mem Limit 524288 kB

Given an array of n integers, your task is to find the number of different subset xors.

Input

The first line has an integer n: the size of the array.

The next line has n integers $x_1, x_2, \ldots, x_n$: the contents of the array.

Output

Print one integer: the number of different subset xors.

Constraints

- $1 \le n \le 2 \cdot 10^5$
- $0 \le x_i \le 10^9$

Example

Input	Output
3 3 6 5	4

Explanation: The following values can be the xor of a subset:

- $0 =$ xor of the empty set
- $3 = 3$
- $5 = 3 \oplus 6$
- $6 = 3 \oplus 5$

In this case, no other values can be the xor of a subset.

Problem E. K Subset Xors

Time Limit 1000 ms
Mem Limit 524288 kB

You are given an array of n integers. Consider the xors of all 2^n subsets of the array (including the empty subset with xor equal to zero).

Your task is to find the k smallest subset xors.

Input

The first line has two integers n and k: the size of the array and the number of subset xors k.

The next line has n integers $x_1, x_2, \ldots, x_n$: the contents of the array.

Output

Print k integers: the k smallest subset xors in increasing order.

Constraints

- $1 \le n \le 2 \cdot 10^5$
- $1 \le k \le \min(2^n, 2 \cdot 10^5)$
- $0 \le x_i \le 10^9$

Example

Input	Output
4 9 3 5 14 8	0 0 3 3 5 5 6 6 8

Problem F. All Subarray Xors

Time Limit 1000 ms
Mem Limit 524288 kB

Given an array of n integers, your task is to find all integers that are the xor sum in some subarray.

Input

The first line has an integer n: the size of the array.

The next line has n integers $x_1, x_2, \ldots, x_n$: the contents of the array.

Output

First print an integer k: the number of distinct integers that are the xor sum in some subarray.

After this print k integers: the xor sums in increasing order.

Constraints

- $1 \leq n \leq 2 \cdot 10^5$
- $0 \leq x_i \leq 10^6$

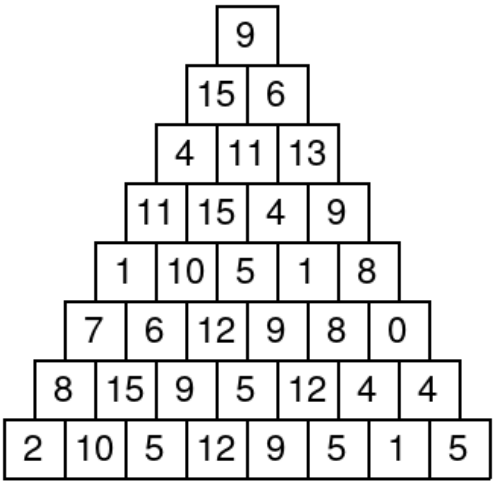
Example

Input	Output
4 5 1 5 9	7 1 4 5 8 9 12 13

Problem G. Xor Pyramid Peak

Time Limit 1000 ms
Mem Limit 524288 kB

Consider a xor pyramid where each number is the xor of lower-left and lower-right numbers. Here is an example pyramid:



Given the bottom row of the pyramid, your task is to find the topmost number.

Input

The first line has an integer n: the size of the pyramid.

The next line has n integers $a_1, a_2, \ldots, a_n$: the bottom row of the pyramid.

Output

Print one integer: the topmost number.

Constraints

- $1 \le n \le 2 \cdot 10^5$
- $1 \le a_i \le 10^9$

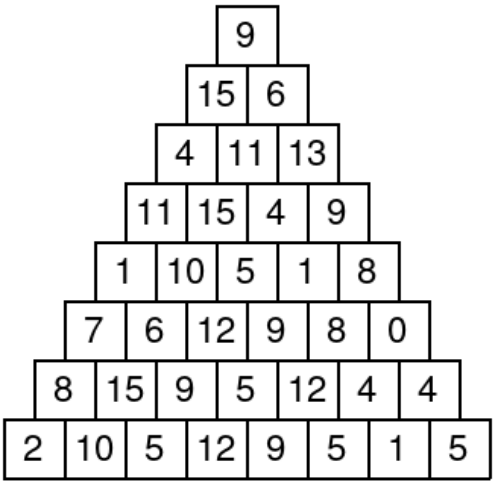
Example

Input	Output
8 2 10 5 12 9 5 1 5	9

Problem H. Xor Pyramid Diagonal

Time Limit 1000 ms
Mem Limit 524288 kB

Consider a xor pyramid where each number is the xor of lower-left and lower-right numbers. Here is an example pyramid:



Given the bottom row of the pyramid, your task is to find the leftmost number of each row.

Input

The first line has an integer n: the size of the pyramid.

The next line has n integers $a_1, a_2, \ldots, a_n$: the bottom row of the pyramid.

Output

Print n integers: the leftmost numbers of the rows from bottom to top.

Constraints

- $1 \le n \le 2 \cdot 10^5$
- $1 \le a_i \le 10^9$

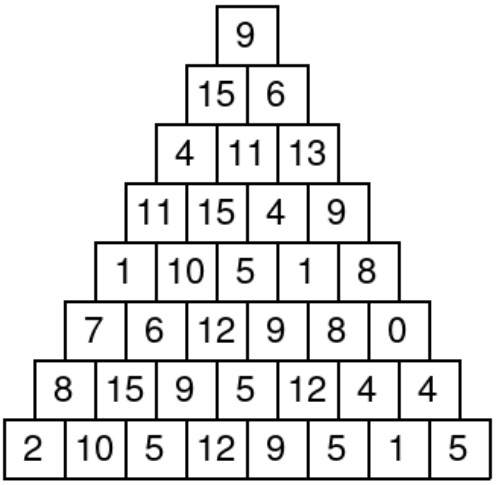
Example

Input	Output
8 2 10 5 12 9 5 1 5	2 8 7 1 11 4 15 9

Problem I. Xor Pyramid Row

Time Limit 1000 ms
Mem Limit 524288 kB

Consider a xor pyramid where each number is the xor of lower-left and lower-right numbers. Here is an example pyramid:



Given the bottom row of the pyramid, your task is to find the numbers on the k-th row from the top.

Input

The first line has two integers n and k: the size of the pyramid and the given row.

The next line has n integers $a_1, a_2, \ldots, a_n$: the bottom row of the pyramid.

Output

Print k integers: the numbers on the k-th row from the top.

Constraints

- $1 \le k \le n \le 2 \cdot 10^5$
- $1 \le a_i \le 10^9$

Example

Input	Output
8 5 2 10 5 12 9 5 1 5	1 10 5 1 8

Problem J. SOS Bit Problem

Time Limit 1000 ms
Mem Limit 524288 kB

Given a list of n integers, your task is to calculate for each element x:

1. the number of elements y such that $x \mid y = x$
2. the number of elements y such that $x \,\&\, y = x$
3. the number of elements y such that $x \,\&\, y \neq 0$

Input

The first line has an integer n: the size of the list.

The next line has n integers $x_1, x_2, \ldots, x_n$: the elements of the list.

Output

Print n lines: for each element the required values.

Constraints

- $1 \leq n \leq 2 \cdot 10^5$
- $1 \leq x_i \leq 10^6$

Example

Input	Output
5 3 7 2 9 2	3 2 5 4 1 5 2 4 4 1 1 3 2 4 4

Problem K. And Subset Count

Time Limit 1000 ms
Mem Limit 524288 kB

You are given an array of n integers. Your task is to calculate the number of non-empty subsets whose elements' *bitwise and* is equal to k for each $k = 0, 1, \ldots, n$.

Input

The first line has an integer n: the size of the array.

The next line has n integers $a_1, a_2, \ldots, a_n$: the contents of the array.

Output

Print $n + 1$ integers as specified above modulo $10^9 + 7$.

Constraints

- $1 \leq n \leq 2 \cdot 10^5$
- $0 \leq a_i \leq n$

Example

Input	Output
4 3 1 3 4	7 4 0 3 1