A - Neq Number

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score: 400 points

Problem Statement

A positive integer X is called a **"Neq Number"** if it satisfies the following condition:

- When X is written in decimal notation, no two adjacent characters are the same.

For example, $1, 173$, and 9090 are Neq Numbers, while 22 and 6335 are not.

You are given a positive integer K. Find the K-th smallest Neq Number.

You have T test cases to solve.

Constraints

- $1 \leq T \leq 100$
- $1 \leq K \leq 10^{12}$
- All input values are integers.

Input

The input is given from Standard Input in the following format:

$$
\begin{array}{l}
T \\
\mathrm{case}_1 \\
\vdots \\
\mathrm{case}_T
\end{array}
$$

Each case is given in the following format:

$$K$$

Output

Print T lines. The i-th line should contain the answer for the i-th test case.

Sample Input 1

```
3
25
148
998244353
```

Sample Output 1

```
27
173
2506230721
```

For the first test case, here are the smallest 25 Neq Numbers in ascending order:

- The nine integers from 1 to 9
- The nine integers from 10 to 19, excluding 11
- The seven integers from 20 to 27, excluding 22

Thus, the 25-th smallest Neq Number is 27.

B - Make Many Triangles

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score: 500 points

Problem Statement

There are N distinct points on a two-dimensional plane. The coordinates of the i-th point are (x_i, y_i).

We want to create as many (non-degenerate) triangles as possible using these points as the vertices. Here, the same point cannot be used as a vertex of multiple triangles.

Find the maximum number of triangles that can be created.

▶ What is a non-degenerate triangle?

Constraints

- $3 \leq N \leq 300$
- $-10^9 \leq x_i, y_i \leq 10^9$
- If $i \neq j$, then $(x_i, y_i) \neq (x_j, y_j)$
- All input values are integers.

Input

The input is given from Standard Input in the following format:

$$
\begin{array}{l}
N \\
x_1 \quad y_1 \\
x_2 \quad y_2 \\
\vdots \\
x_N \quad y_N
\end{array}
$$

Output

Print the answer.

Sample Input 1

```
7
0 0
1 1
0 3
5 2
3 4
2 0
2 2
```

Sample Output 1

```
2
```

For example, if we create a triangle from the first, third, and sixth points and another from the second, fourth, and fifth points, we can create two triangles.

The same point cannot be used as a vertex for multiple triangles, but the triangles may have overlapping areas.

Sample Input 2

```
3
0 0
0 1000000000
0 -1000000000
```

Sample Output 2

```
0
```

C - Not Median

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score: 600 points

Problem Statement

You are given a permutation $P = (P_1, P_2, \ldots, P_N)$ of integers from 1 to N.

For each $i = 1, 2, \ldots, N$, print the minimum value of $r - l + 1$ for a pair of integers (l, r) that satisfies all of the following conditions. If no such (l, r) exists, print `-1`.

- $1 \leq l \leq i \leq r \leq N$
- $r - l + 1$ is odd.
- The median of the contiguous subsequence $(P_l, P_{l+1}, \ldots, P_r)$ of P is **not** P_i.

Here, the median of A for an integer sequence A of length L (odd) is defined as the $\frac{L+1}{2}$-th value of the sequence A' obtained by sorting A in ascending order.

Constraints

- $3 \leq N \leq 3 \times 10^5$
- $(P_1, P_2, \ldots, P_N)$ is a permutation of integers from 1 to N.
- All input values are integers.

Input

The input is given from Standard Input in the following format:

$$
\begin{array}{l}
N \\
P_1 \quad P_2 \quad \ldots \quad P_N
\end{array}
$$

Output

Print the answers for $i = 1, 2, \ldots, N$ in this order, separated by spaces.

Sample Input 1

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

Sample Output 1

```
3 3 3 5 3
```

For example, when $i = 2$, if we set $(l, r) = (2, 4)$, then $r - l + 1 = 3$ is odd, and the median of $(P_2, P_3, P_4) = (3, 5, 4)$ is 4, which is not P_2, so the conditions are satisfied. Thus, the answer is 3.

On the other hand, when $i = 4$, the median of $(P_l, \dots, P_r)$ for any of $(l, r) = (4, 4), (2, 4), (3, 5)$ is $P_4 = 4$. If we set $(l, r) = (1, 5)$, the median of $(P_1, P_2, P_3, P_4, P_5) = (1, 3, 5, 4, 2)$ is 3, which is not P_4, so the conditions are satisfied. Thus, the answer is 5.

Sample Input 2

```
3
2 1 3
```

Sample Output 2

```
-1 3 3
```

When $i = 1$, no pair of integers (l, r) satisfies the conditions.

Sample Input 3

```
14
7 14 6 8 10 2 9 5 4 12 11 3 13 1
```

Sample Output 3

```
5 3 3 7 3 3 3 5 3 3 5 3 3 3
```

D - Bracket Walk

Time Limit: 3 sec / Memory Limit: 1024 MiB

Score: 700 points

Problem Statement

You are given a directed graph G with N vertices and M edges. The vertices are numbered from 1 to N, and each edge is labeled with `(` or `)`. The i-th edge is directed from vertex u_i to vertex v_i with a label c_i. The graph does not contain multi-edges or self-loops.

In this graph, for any two vertices s and t, there is a path from s to t.

Determine if there is a **walk** on the graph G that satisfies all of the following conditions:

- The start and end vertices of the walk are the same.
- For $i = 1, 2, \dots, M$, the i-th edge is used at least once in the walk.
- The string obtained by arranging the labels of the edges used in the walk in the order of their usage is a regular bracket sequence.

▶ What is a walk?

▶ What is a regular bracket sequence?

Constraints

- $2 \leq N \leq 4000$
- $N \leq M \leq 8000$
- $1 \leq u_i, v_i \leq N$
- c_i is `(` or `)`.
- $u_i \neq v_i$
- If $i \neq j$, then $(u_i, v_i) \neq (u_j, v_j)$.
- All input values are integers.
- In the input graph, for any two vertices s and t, there is a path from s to t.

Input

The input is given from Standard Input in the following format:

$$
\begin{array}{lll}
N & M & \\
u_1 & v_1 & c_1 \\
u_2 & v_2 & c_2 \\
\vdots & & \\
u_M & v_M & c_M
\end{array}
$$

Output

If there is a walk satisfying the conditions, print `Yes`; otherwise, print `No`.

Sample Input 1

```
5 7
1 2 (
2 3 )
3 4 (
4 1 )
2 4 )
4 5 (
5 1 )
```

Sample Output 1

```
Yes
```

The walk that uses edges $1, 2, 3, 4, 1, 5, 6, 7$ in this order uses all the edges at least once, and the string `()()()()` obtained by arranging the labels of the edges in the order of their usage is a regular bracket sequence, so all conditions are satisfied.

The walk may use the same edge multiple times or visit the same vertex multiple times.

Sample Input 2

```
2 2
1 2 )
2 1 )
```

Sample Output 2

```
No
```

Sample Input 3

```
10 20
4 5 (
5 6 (
6 7 )
2 5 )
5 8 (
6 3 )
8 5 )
1 2 (
9 10 (
4 7 (
3 4 )
8 9 (
2 1 )
1 4 )
2 3 )
3 2 (
7 8 (
7 4 )
10 9 )
9 8 )
```

Sample Output 3

```
Yes
```

E - Rearrange and Adjacent XOR

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score: 800 points

Problem Statement

You are given a sequence of N non-negative integers $A = (A_1, A_2, \dots, A_N)$. Consider performing the following operation $N-1$ times on this sequence to obtain a sequence of length 1:

- Let n be the length of A. First, rearrange the elements in A in any order you like. Then, replace A with a sequence of $n-1$ non-negative integers $(A_1 \oplus A_2, A_2 \oplus A_3, \dots, A_{n-1} \oplus A_n)$.

Here, $\oplus$ represents the bitwise XOR operation.

Let X be the value of the term contained in the sequence of length 1 obtained after $N-1$ operations. Find the maximum possible value of X.

▶ What is the bitwise XOR operation?

Constraints

- $2 \leq N \leq 100$
- $0 \leq A_i < 2^{60}$
- All input values are integers.

Input

The input is given from Standard Input in the following format:

$$
\begin{aligned}
&N \\
&A_1 \quad A_2 \quad \dots \quad A_N
\end{aligned}
$$

Output

Print the answer.

Sample Input 1

```
4
1 2 3 4
```

Sample Output 1

```
7
```

The sequence A can be transformed into $A = (7)$ by the following three operations:

- In the first operation, rearrange $A = (1, 2, 3, 4)$ to $(3, 1, 4, 2)$. A is replaced with $(3 \oplus 1, 1 \oplus 4, 4 \oplus 2) = (2, 5, 6)$.
- In the second operation, rearrange $A = (2, 5, 6)$ to $(2, 6, 5)$. A is replaced with $(2 \oplus 6, 6 \oplus 5) = (4, 3)$.
- In the third operation, rearrange $A = (4, 3)$ to $(4, 3)$. A is replaced with $(4 \oplus 3) = (7)$.

Sample Input 2

```
13
451745518671773958 43800508384422957 153019271028231120 577708532586013562 133532134450358663 61975046
3276496276 615201966367277237 943395749975730789 813856754125382728 705285621476908966 912241698686715
427 951219919930656543 124032597374298654
```

Sample Output 2

```
1152905479775702586
```

F - Select and Split

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score: 1200 points

Problem Statement

There is a blackboard with a set of positive integers written on it. Initially, the set $S = \{1, 2, \ldots, A, A+1, A+2, \ldots, A+B\}$ is written on the blackboard.

Takahashi wants to perform the following operation $N-1$ times to have N sets on the blackboard:

- From the sets of integers written on the blackboard, choose a set S_0 that contains at least one element not greater than A and at least one element not less than $A+1$. From the chosen set S_0, choose one element a not greater than A and one element b not less than $A+1$. Erase the set S_0 from the blackboard and write two sets S_1 and S_2 of his choice that satisfy all of the following conditions:
  - The union of S_1 and S_2 is S_0, and they have no common elements.
  - $a \in S_1, b \in S_2$

Find the number of possible ways to perform the series of operations, modulo 998244353.

Here, two series of operations are distinguished when there is an i $(1 \leq i \leq N-1)$ such that S_0, a, b, S_1, or S_2 chosen in the i-th operation of one series is different from that of the other series.

Constraints

- $2 \leq N \leq 2 \times 10^5$
- $1 \leq A, B \leq 2 \times 10^5$
- $N \leq A+B$
- All input values are integers.

Input

The input is given from Standard Input in the following format:

$$N \quad A \quad B$$

Output

Print the answer.

Sample Input 1

```
3 2 4
```

Sample Output 1

```
1728
```

One possible series of operations is as follows:

- Choose $S_0 = \{1, 2, 3, 4, 5, 6\}$, let $a = 2$ and $b = 5$, and let $S_1 = \{1, 2, 3, 6\}$ and $S_2 = \{4, 5\}$. There are now two sets of integers written on the blackboard: $\{1, 2, 3, 6\}$ and $\{4, 5\}$.
- Choose $S_0 = \{1, 2, 3, 6\}$, let $a = 1$ and $b = 3$, and let $S_1 = \{1, 2\}$ and $S_2 = \{3, 6\}$. There are now three sets of integers written on the blackboard: $\{1, 2\}$, $\{3, 6\}$, and $\{4, 5\}$.

Sample Input 2

```
4 1 3
```

Sample Output 2

```
6
```

If we let $a = 1$ and $b = 2$ and let $S_1 = \{1\}$ and $S_2 = \{2, 3, 4\}$ in the first operation, we can no longer perform the second and subsequent operations.

Do not count these cases where we cannot complete $N - 1$ operations.

Sample Input 3

```
5 6 6
```

Sample Output 3

```
84486693
```

Sample Input 4

```
173173 173173 173173
```

Sample Output 4

```
446948086
```