A - Replace Digits

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score : 400 points

Problem Statement

You are given a string S of length N and a string T of length M, both consisting of digits from 1 to 9.

You will perform the following operation for $k = 1, 2, \ldots, M$ in order:

- Choose an integer i such that $1 \leq i \leq N$. Then, replace the i-th character of S with the k-th character of T.

Find the maximum possible value of the resulting string S interpreted as an integer after performing the M operations.

Constraints

- $1 \leq N, M \leq 10^6$
- N and M are integers.
- S is a string of length N consisting of digits from 1 through 9.
- T is a string of length M consisting of digits from 1 through 9.

Input

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

$$
\begin{array}{l}
N \quad M \\
S \\
T
\end{array}
$$

Output

Print the maximum possible value of the resulting string S interpreted as an integer after performing the M operations.

Sample Input 1

```
3 3
191
325
```

Sample Output 1

```
593
```

The following sequence of operations is optimal:

- For $k = 1$: Choose $i = 3$. Then, $S =$ `193`.
- For $k = 2$: Choose $i = 1$. Then, $S =$ `293`.
- For $k = 3$: Choose $i = 1$. Then, $S =$ `593`.

In this case, the value of S interpreted as an integer is 593, which is the maximum.

Sample Input 2

```
3 9
191
998244353
```

Sample Output 2

```
993
```

Sample Input 3

```
11 13
31415926535
2718281828459
```

Sample Output 3

```
98888976555
```

B - XOR = MOD

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score : 500 points

Problem Statement

You are given two positive integers N and K. A positive integer X is called **compatible with** N if it satisfies the following condition:

- The bitwise XOR of X and N is equal to the remainder when X is divided by N.

Determine whether there exist at least K such integers X that are compatible with N. If they do exist, find the K-th smallest such integer.

You are given T test cases; solve each of them.

▶ About XOR

Constraints

- $1 \leq T \leq 2 \times 10^5$
- $1 \leq N, K \leq 10^9$
- All input values are integers.

Input

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

$$
\begin{array}{l}
T \\
\mathrm{case}_1 \\
\mathrm{case}_2 \\
\vdots \\
\mathrm{case}_T
\end{array}
$$

Here, case_i denotes the i-th test case.
Each test case is given in the following format:

$$N \quad K$$

Output

For each test case, if there exist at least K positive integers that are compatible with N, print the K-th smallest such integer. Otherwise, print `-1`.

Sample Input 1

```
4
2 1
2 2
1 7
20250126 191
```

Sample Output 1

```
2
3
-1
20381694
```

Consider the case $N = 2$.

- When $X = 1$, $X \text{ XOR } N = 3$ and the remainder of X when divided by N is 1. Therefore, 1 is not compatible with N.
- When $X = 2$, $X \text{ XOR } N = 0$ and the remainder of X when divided by N is 0. Therefore, 2 is compatible with N.
- When $X = 3$, $X \text{ XOR } N = 1$ and the remainder of X when divided by N is 1. Therefore, 3 is compatible with N.

Hence, among the numbers that are compatible with 2, the smallest is 2 and the second smallest is 3. Therefore, the answer to case_1 is 2 and the answer to case_2 is 3.

C - A^n - 1

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score : 600 points

Problem Statement

You are given a positive integer N between 1 and 10^9, inclusive.

Find one pair of positive integers (A, M) satisfying the following conditions. It can be proved that such a pair of integers always exists under the constraints.

- Both A and M are positive integers between 1 and 10^{18}, inclusive.
- There exists a positive integer n such that $A^n - 1$ is a multiple of M, and the smallest such n is N.

You are given T test cases; solve each of them.

Constraints

- $1 \leq T \leq 10^4$
- $1 \leq N \leq 10^9$
- All input values are integers.

Input

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

$$
\begin{aligned}
&T \\
&\mathrm{case}_1 \\
&\mathrm{case}_2 \\
&\vdots \\
&\mathrm{case}_T
\end{aligned}
$$

Here, case_i denotes the i-th test case.
Each test case is given in the following format:

$$N$$

Output

For each test case, print a pair of positive integers (A, M) in the following format:

$A \quad M$

If there are multiple valid solutions, any one of them is considered correct.

Sample Input 1

```
4
3
16
1
55
```

Sample Output 1

```
2 7
11 68
20250126 1
33 662
```

Consider case_1.

For example, if we choose $(A, M) = (2, 7)$, then:

- When $n = 1$: $2^1 - 1 = 1$ is not a multiple of 7.
- When $n = 2$: $2^2 - 1 = 3$ is not a multiple of 7.
- When $n = 3$: $2^3 - 1 = 7$ is a multiple of 7.

Hence, the smallest n for which $A^n - 1$ is a multiple of M is 3. Therefore, $(A, M) = (2, 7)$ is a correct solution. Other valid solutions include $(A, M) = (100, 777)$.

D - Moving Pieces on Graph

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score : 700 points

Problem Statement

You are given a simple connected undirected graph with N vertices and M edges, where the vertices are numbered 1 to N and the edges are numbered 1 to M. Edge i connects vertex u_i and vertex v_i in both directions.

Initially, there is a piece A on vertex S and a piece B on vertex T. Here, S and T are given as input.

You may perform the following operation any number of times in any order:

- Choose either piece A or piece B, and move it from its current vertex to an adjacent vertex via an edge. However, you cannot make a move that results in both pieces ending up on the same vertex.

Your goal is to reach the state in which piece A is on vertex T and piece B is on vertex S.

Determine whether this is possible, and if it is, find the minimum number of operations required to achieve it.

Constraints

- $2 \leq N \leq 2 \times 10^5$
- $N-1 \leq M \leq \min\left(\frac{N(N-1)}{2},\ 2 \times 10^5\right)$
- $1 \leq u_i < v_i \leq N$
- The given graph is simple and connected.
- $1 \leq S, T \leq N$
- $S \neq T$
- All input values are integers.

Input

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

$$
\begin{array}{l}
N \quad M \quad S \quad T \\
u_1 \quad v_1 \\
u_2 \quad v_2 \\
\vdots \\
u_M \quad v_M
\end{array}
$$

Output

If it is impossible to achieve the goal, print `-1`.

If it is possible, print the minimum number of operations required.

Sample Input 1

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

Sample Output 1

```
3
```

For example, the following sequence of operations completes the goal in three moves:

1. Move piece A to vertex 2.
   - Piece A is on vertex 2, piece B is on vertex 4.
2. Move piece B to vertex 3.
   - Piece A is on vertex 2, piece B is on vertex 3.
3. Move piece A to vertex 4.
   - Piece A is on vertex 4, piece B is on vertex 3.

It is impossible to complete the goal in fewer than three moves, so print 3.

Sample Input 2

```
2 1 1 2
1 2
```

Sample Output 2

```
-1
```

No matter how you move the pieces, you cannot achieve the goal.

Sample Input 3

```
5 6 3 5
1 2
2 3
1 5
2 4
1 3
2 5
```

Sample Output 3

```
4
```

E - Unfair Game

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score : 800 points

Problem Statement

You are given positive integers N, X, and Y, and two length-N sequences of non-negative integers $A = (A_1, A_2, \ldots, A_N)$ and $B = (B_1, B_2, \ldots, B_N)$.

There are N bags, numbered from 1 to N. Initially, bag i contains A_i gold coins and B_i silver coins.

Consider the following game played by Takahashi and Aoki using these N bags. First, Takahashi takes some of these bags (possibly zero), and Aoki takes all remaining bags. Then, starting with Takahashi, the two players alternate performing the following operation.

- Choose one bag held by the player with at least one gold coin or silver coin in it, and do one of the following two actions for that bag.
  - Remove one gold coin and add silver coins; the number of silver coins to be added is X for Takahashi and Y for Aoki. This action can only be done if the chosen bag has at least one gold coin.
  - Remove one silver coin. This action can only be done if the chosen bag has at least one silver coin.
- Then, give the chosen bag to the other player.

The player who cannot perform the operation loses the game.

Find the number, modulo 998244353, of ways Takahashi can initially take bags so that he will win under optimal play by both players.

Constraints

- $1 \leq N \leq 2 \times 10^5$
- $1 \leq X, Y \leq 10^9$
- $0 \leq A_i, B_i \leq 10^9$
- All input values are integers.

Input

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

$$
\begin{array}{l}
N \quad X \quad Y \\
A_1 \quad B_1 \\
A_2 \quad B_2 \\
\vdots \\
A_N \quad B_N
\end{array}
$$

Output

Print the number, modulo 998244353, of ways Takahashi can initially take bags so that he will win under optimal play by both players.

Sample Input 1

```
2 1 1
1 0
1 1
```

Sample Output 1

```
2
```

Consider the case where Takahashi initially takes bags 1 and 2. One possible progression of the game is as follows:

1. Takahashi chooses bag 2, removes 1 gold coin, and adds 1 silver coin. Then, he gives bag 2 to Aoki.
   - Takahashi holds bag 1 with 1 gold coin. Aoki holds bag 2 with 2 silver coins.
2. Aoki chooses bag 2 and removes 1 silver coin. Then, gives bag 2 to Takahashi.
   - Takahashi holds bags 1 with 1 gold coin and bag 2 with 1 silver coin. Aoki holds none.
3. Takahashi chooses bag 1, removes 1 gold coin, and adds 1 silver coin. Then, he gives bag 1 to Aoki.
   - Takahashi holds bag 2 with 1 silver coin. Aoki holds bag 1 with 1 silver coin.
4. Aoki chooses bag 1, removes 1 silver coin. Then, he gives bag 1 to Takahashi.
   - Takahashi holds bag 1 which is empty and bag 2 with 1 silver coin. Aoki holds none.
5. Takahashi chooses bag 2 and removes 1 silver coin. Then, he gives bag 2 to Aoki.
   - Takahashi holds bag 1 which is empty. Aoki holds bag 2 which is empty.
6. Aoki cannot perform the operation, so Aoki loses and Takahashi wins.

Takahashi can win if he initially takes only bag 2, or if he takes both bags 1 and 2. Therefore, the answer is 2.

Sample Input 2

```
2 2 1
1 2
1 2
```

Sample Output 2

```
3
```

Takahashi wins if he initially takes bag 1, bag 2, or both.

Sample Input 3

```
5 8 3
0 0
0 0
0 0
0 0
0 0
```

Sample Output 3

```
0
```

No matter how Takahashi chooses the bags initially, he will lose.

Sample Input 4

```
7 2025 191
1323 9953
2763 3225
2624 5938
6718 2998
3741 7040
9837 1681
8817 4471
```

Sample Output 4

```
40
```