A - Yet Another AB Problem

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score: 400 points

Problem Statement

You are given two strings S and T of length N consisting of `A` and `B`. Let S_i denote the i-th character from the left of S.

You can repeat the following operation any number of times, possibly zero:

- Choose integers i and j such that $1 \leq i < j \leq N$. Replace S_i with `A` and S_j with `B`.

Determine if it is possible to make S equal T. If it is possible, find the minimum number of operations required.

Constraints

- $2 \leq N \leq 2 \times 10^5$
- Each of S and T is a string of length N consisting of `A` and `B`.
- All input numbers are integers.

Input

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

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

Output

If it is impossible to make S equal T, print `-1`.

Otherwise, print the minimum number of operations required to do so.

Sample Input 1

```
5
BAABA
AABAB
```

Sample Output 1

```
2
```

Performing the operation with $i = 1$ and $j = 3$ changes S to AABBA.

Performing the operation with $i = 4$ and $j = 5$ changes S to AABAB.

Thus, you can make S equal T with two operations. It can be proved that this is the minimum number of operations required, so the answer is 2.

Sample Input 2

```
2
AB
BA
```

Sample Output 2

```
-1
```

It can be proved that no matter how many operations you perform, you cannot make S equal T.

B - Arithmetic Progression Subsequence

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score: 500 points

Problem Statement

You are given a sequence A of length N consisting of integers between 1 and $\mathbf{10}$, inclusive.

A pair of integers (l, r) satisfying $1 \leq l \leq r \leq N$ is called a good pair if it satisfies the following condition:

- The sequence $(A_l, A_{l+1}, \ldots, A_r)$ contains a (possibly non-contiguous) arithmetic subsequence of length 3. More precisely, there is a triple of integers (i, j, k) with $l \leq i < j < k \leq r$ such that $A_j - A_i = A_k - A_j$.

Find the number of good pairs.

Constraints

- $3 \leq N \leq 10^5$
- $1 \leq A_i \leq 10$
- All input numbers are integers.

Input

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

$$
\begin{array}{l}
N \\
A_1 \ \ \ldots \ \ A_N
\end{array}
$$

Output

Print the answer.

Sample Input 1

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

Sample Output 1

```
3
```

There are three good pairs: $(l, r) = (1, 4), (1, 5), (2, 5)$.

For example, the sequence (A_1, A_2, A_3, A_4) contains an arithmetic subsequence of length 3, which is $(5, 3, 1)$, so $(1, 4)$ is a good pair.

Sample Input 2

```
3
1 2 1
```

Sample Output 2

```
0
```

There may be cases where no good pairs exist.

Sample Input 3

```
9
10 10 1 3 3 7 2 2 5
```

Sample Output 3

```
3
```

C - Prefix Mex Sequence

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score: 600 points

Problem Statement

For a sequence X composed of a finite number of non-negative integers, we define $\mathrm{mex}(X)$ as the smallest non-negative integer not in X. For example, $\mathrm{mex}((0,0,1,3)) = 2, \mathrm{mex}((1)) = 0, \mathrm{mex}(()) = 0$.

You are given a sequence $S = (S_1, \ldots, S_N)$ of length N where each element is 0 or 1.

Find the number, modulo 998244353, of sequences $A = (A_1, A_2, \ldots, A_N)$ of length N consisting of integers between 0 and M, inclusive, that satisfy the following condition:

- For each $i (1 \le i \le N)$, $A_i = \mathrm{mex}((A_1, A_2, \ldots, A_{i-1}))$ if $S_i = 1$, and $A_i \neq \mathrm{mex}((A_1, A_2, \ldots, A_{i-1}))$ if $S_i = 0$.

Constraints

- $1 \le N \le 5000$
- $0 \le M \le 10^9$
- S_i is 0 or 1.
- All input numbers are integers.

Input

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

$$
\begin{array}{l}
N \quad M \\
S_1 \quad \ldots \quad S_N
\end{array}
$$

Output

Print the answer.

Sample Input 1

```
4 2
1 0 0 1
```

Sample Output 1

```
4
```

The following four sequences satisfy the conditions:

- $(0, 0, 0, 1)$
- $(0, 0, 2, 1)$
- $(0, 2, 0, 1)$
- $(0, 2, 2, 1)$

Sample Input 2

```
10 1000000000
0 0 1 0 0 0 1 0 1 0
```

Sample Output 2

```
587954969
```

Be sure to find the count modulo 998244353.

D - Triangle Card Game

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score: 700 points

Problem Statement

Alice and Bob will play a game.

Initially, Alice and Bob each have N cards, with the i-th card of Alice having the integer A_i written on it, and the i-th card of Bob having the integer B_i written on it.

The game proceeds as follows:

- Prepare a blackboard with nothing written on it.
- Alice eats one of her cards and writes the integer from the eaten card on the blackboard.
- Next, Bob eats one of his cards and writes the integer from the eaten card on the blackboard.
- Finally, Alice eats one more of her cards and writes the integer from the eaten card on the blackboard.

If it is possible to form a (non-degenerate) triangle with the side lengths of the three integers written on the blackboard, Alice wins; otherwise, Bob wins.

Determine who wins when both players act optimally.

Solve each of the T given test cases.

Constraints

- $1 \leq T \leq 10^5$
- $2 \leq N \leq 2 \times 10^5$
- $1 \leq A_i, B_i \leq 10^9$
- All input values are integers.
- The sum of N over all test cases in a single input is at most 2×10^5.

Input

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

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

Each case is given in the following format:

$$
\begin{array}{l}
N \\
A_1 \ \ldots \ A_N \\
B_1 \ \ldots \ B_N
\end{array}
$$

Output

Print T lines. The i-th line $(1 \leq i \leq T)$ should contain `Alice` if Alice wins for the i-th test case, and `Bob` if Bob wins.

Sample Input 1

```
3
3
1 2 3
4 5 6
4
6 1 5 10
2 2 4 5
10
3 1 4 1 5 9 2 6 5 3
2 7 1 8 2 8 1 8 2 8
```

Sample Output 1

```
Bob
Alice
Alice
```

In the first test case, for example, the game could proceed as follows:

- Alice eats the card with 2 written on it and writes 2 on the blackboard.
- Bob eats the card with 4 written on it and writes 4 on the blackboard.
- Alice eats the card with 1 written on it and writes 1 on the blackboard.
- The numbers written on the blackboard are $2, 4, 1$. There is no triangle with side lengths $2, 4, 1$, so Bob wins.

For this test case, the above process is not necessarily optimal for the players, but it can be shown that Bob will win if both players act optimally.

E - BDFS

Time Limit: 8 sec / Memory Limit: 1024 MiB

Score: 800 points

Problem Statement

You are given integers N and P.

There is a graph with N vertices and N edges, where each vertex is labeled 1 to N. The i-th edge connects vertices i and $i+1$ bidirectionally. Here, vertex $N+1$ refers to vertex 1.

Perform the following algorithm to obtain a sequence $D=(D_1,D_2,\dots,D_N)$ of length N:

- Set an integer sequence D of length N to $D=(D_1,\dots,D_N)=(-1,\dots,-1)$. Also, set a sequence Q of number pairs to $Q=((1,0))$. Repeat the following process while Q is not empty:
  - Let (v,d) be the first element of Q. Remove this element.
  - If $D_v=-1$, then set $D_v:=d$, and for each vertex x adjacent to vertex v such that $D_x=-1$, perform the following process. If there are multiple such x that satisfy the condition, process them in ascending order of vertex number:
    1. With probability $\frac{P}{100}$, add $(x,d+1)$ to the **front** of Q.
    2. If $(x,d+1)$ was not added to the front of Q, add it to the **end** of Q.

Find the expected value of the sum of the elements of the final sequence D obtained, modulo 998244353.

Solve each of the T test cases given.

▶ Definition of expected value $\mathrm{mod}\ 998244353$

Constraints

- $1 \le T \le 10^4$
- $3 \le N \le 10^{18}$
- $1 \le P \le 99$
- All input numbers are integers.

Input

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

$$T$$
$$\text{case}_1$$
$$\vdots$$
$$\text{case}_T$$

Each case is given in the following format:

$$N \quad P$$

Output

Print T lines. The i-th line $(1 \leq i \leq T)$ should contain the answer for the i-th test case.

Sample Input 1

```
3
3 50
4 1
1000000000000000000 70
```

Sample Output 1

```
499122179
595552585
760296751
```

In the first test case, the algorithm may operate as follows:

- Initially, $D = (-1, -1, -1)$ and $Q = ((1, 0))$. Remove the first element $(1, 0)$ from Q.
- $D_1 = -1$, so set $D_1 := 0$. The vertices x adjacent to vertex 1 such that $D_x = -1$ are 2 and 3.
- Add $(2, 1)$ to the front of Q. Add $(3, 1)$ to the end of Q. Now $Q = ((2, 1), (3, 1))$.
- Remove the first element $(2, 1)$ from Q.
- $D_2 = -1$, so set $D_2 := 1$. The vertex x adjacent to vertex 2 such that $D_x = -1$ is 3.
- Add $(3, 2)$ to the front of Q. Now $Q = ((3, 2), (3, 1))$.
- Remove the first element $(3, 2)$ from Q.
- $D_3 = -1$, so set $D_3 := 2$. There are no vertices x adjacent to vertex 3 such that $D_x = -1$, so do nothing.
- Remove the first element $(3, 1)$ from Q.
- $D_3 = 2$, so do nothing.
- Q is now empty, so the process ends.

In this case, the final sequence obtained is $D = (0, 1, 2)$. The probability that the algorithm operates as described above is $\frac{1}{8}$, and the expected sum of the elements of D is $\frac{5}{2}$.

F - Edge Deletion 2

Time Limit: 2 sec / Memory Limit: 1024 MiB

Score: 1000 points

Problem Statement

You are given a tree with N vertices numbered 1 to N. The i-th edge of the tree connects vertices u_i and v_i bidirectionally.

For a permutation $P = (P_1, \ldots, P_N)$ of $(1, 2, \ldots, N)$, we define the sequence $A(P)$ as follows:

- $A(P)$ is initially empty. Write P_i on each vertex i.
- For $i = 1, 2, \ldots, N$ in this order, perform the following:
  - If vertex i is an isolated vertex, append 0 to the end of $A(P)$. Otherwise, select the adjacent vertex with the smallest written integer. Append the integer written on the selected vertex to the end of $A(P)$ and remove the edge connecting vertex i and the selected vertex.

Find the lexicographically smallest sequence among all possible $A(P)$.

Solve each of the T given test cases.

Constraints

- $1 \leq T \leq 10^5$
- $2 \leq N \leq 2 \times 10^5$
- $1 \leq u_i, v_i \leq N$
- The given graph is a tree.
- All input numbers are integers.
- The sum of N over all test cases in a single input is at most 2×10^5.

Input

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

$$T \\ \text{case}_1 \\ \vdots \\ \text{case}_T$$

Each case is given in the following format:

$$N \\ u_1 \quad v_1 \\ u_2 \quad v_2 \\ \vdots \\ u_{N-1} \quad v_{N-1}$$

Output

Print T lines. The i-th line $(1 \leq i \leq T)$ should contain the answer for the i-th test case.

Sample Input 1

```
3
5
1 2
2 3
2 4
4 5
8
8 6
7 2
2 1
3 7
5 6
1 6
4 3
7
7 1
5 2
1 2
6 5
4 1
5 3
```

Sample Output 1

```
1 2 0 1 3
1 2 2 3 1 4 0 0
1 2 2 0 3 0 4
```

In the first test case, for $P = (4, 1, 2, 3, 5)$, one can obtain $A(P) = (1, 2, 0, 1, 3)$ as follows:

- The vertex adjacent to vertex 1 with the smallest written integer is vertex 2. Append $P_2 = 1$ to the end of $A(P)$ and remove the edge connecting vertices 1 and 2.
- The vertex adjacent to vertex 2 with the smallest written integer is vertex 3. Append $P_3 = 2$ to the end of $A(P)$ and remove the edge connecting vertices 2 and 3.
- Vertex 3 is an isolated vertex, so append 0 to the end of $A(P)$.
- The vertex adjacent to vertex 4 with the smallest written integer is vertex 2. Append $P_2 = 1$ to the end of $A(P)$ and remove the edge connecting vertices 4 and 2.
- The vertex adjacent to vertex 5 with the smallest written integer is vertex 4. Append $P_4 = 3$ to the end of $A(P)$ and remove the edge connecting vertices 5 and 4.

It can be proved that this is the lexicographically smallest sequence among all possible $A(P)$.