Problem A. Cake

Input file: `standard input`
Output file: `standard output`

Grammy and Oscar bought a big cake. They like it very much, so dividing the cake becomes difficult. In order to divide the cake in a relatively fair way, they decided to play a game to earn more part of the cake for themselves.

The game consists of two phases.

For phase 1, Grammy and Oscar will play on a tree rooted at vertex 1. Each edge of the tree has a number 0 or 1. Initially, there is a horse on the root. They take turns moving the horse, with Grammy moving first. At each turn, suppose the horse is at vertex p, the player must select some child of p and move the horse to that child of p. Phase 1 ends when p has no children. As a result of phase 1, we will get a string S formed by concatenating the numbers on edges the horse has passed by. Note that S consists of only 0 and 1.

For phase 2, Grammy and Oscar will play on the string S they obtained in phase 1. Let m be the length of S. Firstly, Oscar will divide the cake into m parts (some parts can be empty). Then m steps follow. At the i-th step, if the i-th character of S is 1, Grammy will choose one part and get it; otherwise, Oscar will choose one part and get it.

Both of them hope to maximize the cake they get, and they both play optimally. Please calculate the fraction of cake Grammy gets.

Input

There are multiple test cases. The first line of the input contains an integer T ($1 \le T \le 100\,000$) indicating the number of test cases. For each test case:

The first line contains one integer n ($2 \le n \le 200\,000$), indicating the size of the rooted tree in phase 1.

For the following $n-1$ lines, the i-th line contains three integers x, y, k ($1 \le x, y \le n, 0 \le k \le 1$) describing an edge connecting x and y with number k.

It is guaranteed that the sum of n over all test cases will not exceed $500\,000$.

Output

For each test case:

Output one line containing one real number indicating the fraction of cake Grammy gets in the game, assuming both players play optimally.

Your answer is considered correct if its absolute or relative error does not exceed 10^{-9}.

Formally, let your answer be a, and the jury's answer be b. Your answer is accepted if and only if $\frac{|a-b|}{max(1,|b|)} \le 10^{-9}$.

Example

standard input	standard output
3 3 1 2 1 1 3 0 4 1 2 0 1 3 1 3 4 0 5 1 2 0 1 3 0 3 4 1 4 5 1	1.000000000000 0.500000000000 0.000000000000

Problem B. Cake 2

Input file: `standard input`
Output file: `standard output`

Grammy bought a big cake. The shape of the cake is a regular polygon. That is, a convex polygon whose all interior angles are equal and all edges are equal.

Grammy wants to cut the cake into a pretty pattern and share the cake with her friends. She indexed the vertices 0 through $n-1$ in counterclockwise order and chooses an integer k. After that, she cuts the cake through n straight lines connecting vertex i and vertex $(i+k) \bmod n$ for each i.

Grammy wants to know the number of pieces after cutting the cake. Please calculate it for her.

Input

The only line contains 2 integers n, k ($4 \le n \le 10^6, 2 \le k \le n-2$), denoting the number of sides of the regular polygon and the integer chosen by Grammy.

Output

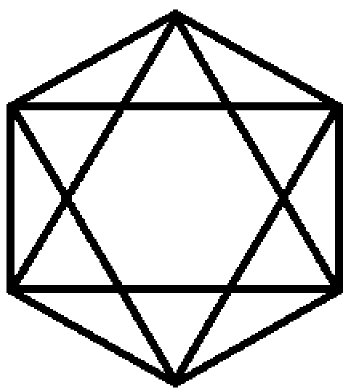
Output a single integer in a line, denoting the number of pieces after cutting the cake.

Example

standard input	standard output
6 2	13

Note

For the sample test case, the final cake is shown below:



Problem C. Cake 3

Input file: `standard input`
Output file: `standard output`

Grammy bought a big cake. She wants to put n candles on the cake to form a pretty pattern and share the cake with her friends. Each candle can be viewed as a point on the plane. The distance between two candles is considered as the Euclidean distance on the plane. Two candles cannot be placed at the same point.

For each (unordered) pair of candles (u, v), if u is one of the nearest candles of v, and v is one of the nearest candles of u, then (u, v) is called a good pair.

Grammy wants to choose the positions for all candles such that each candle is in exactly k good pairs. Please help Grammy to find a set of positions for the candles or report if no solutions exist.

Input

The only line contains 2 integers n, k ($2 \leq n \leq 1000, 1 \leq k \leq n-1$), denoting the number of candles and the integer chosen by Grammy.

Output

If the solution does not exist, output "`NO`" on a single line.

Otherwise, output "`YES`" on the first line, then output n lines, each of which contains two real numbers x_i, y_i ($-10^6 \leq x_i, y_i \leq 10^6$), denoting the position of a candle. If there are multiple solutions, output any.

The distance between two candles will be calculated using double-precision floating point numbers with a tolerance of 10^{-6}. That is, if the nearest candle to a candle u has a distance of a, then all candles having a distance less than or equal to $a \cdot (1 + 10^{-6})$ to candle u are considered as nearest candles of u. Additionally, two candles having a distance less than or equal to 10^{-6} are considered as two candles at the same position, which should not appear in your output.

Examples

standard input	standard output
4 1	YES 0.000000000000 0.000000000000 0.000000000000 1.000000000000 2.000000000000 0.000000000000 2.000000000000 1.000000000000
4 2	YES 0.707106781187 0.000000000000 0.000000000000 0.707106781187 -0.707106781187 0.000000000000 -0.000000000000 -0.707106781187
4 3	NO

Problem D. Puzzle: Wagiri

Input file: `standard input`
Output file: `standard output`

If you can't remember which character corresponds to which rule, remember that ""contains a loop, and "切"doesn't!

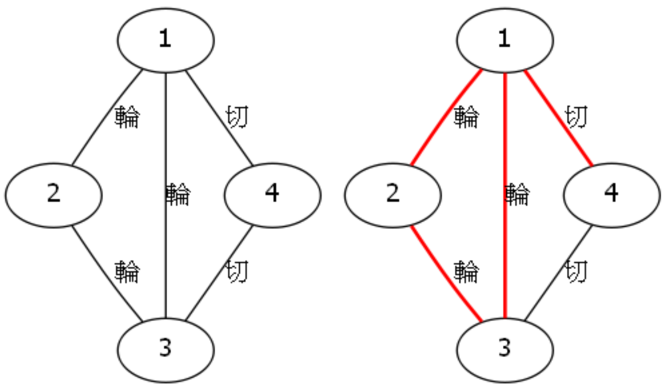
— Lavaloid

Grammy is a puzzle master. Today, she is playing a variant of "Wagiri" puzzle.

The puzzle consists of a simple connected graph with n vertices with some Chinese characters on it. Each edge has a "Lun" or "Qie" symbol on it.

The goal is to delete some of the edges to form a **connected** subgraph (including all of the vertices) such that:

- Each remaining edge with the character "Lun" on it must be on at least one cycle formed by the remaining edges.
- Each remaining edge with the character "Qie" on it must not be on any cycle formed by the remaining edges.



For example, the picture on the left illustrates an unsolved puzzle, and the picture on the right shows a solution to the puzzle, in which the highlighted edges are chosen in the final subgraph.

Grammy wants to find a solution to the puzzle. Please help Grammy find a solution, or report that no solution exists.

Input

The first line contains 2 integers n, m ($1 \le n \le 10^5, n-1 \le m \le 2 \times 10^5$), denoting the number of vertices and the number of edges.

Each of the next m lines contains 2 integers u_i, v_i ($1 \le u_i, v_i \le n$) and a string t_i ($t_i \in \{$"`Lun`", "`Qie`"$\}$), denoting that there is an edge between u_i and v_i, and the type of this edge is t_i.

It is guaranteed that the given graph is a simple connected graph, that is, there are no self-loops or multiple edges, and all vertices are directly or indirectly connected by edges.

Output

If the solution does not exist, output "`NO`" on a single line.

Otherwise, output "YES" on the first line, then output a single integer m' ($0 \le m' \le m$) on the second line, followed by m' lines, each of which contains two integers u_i, v_i, denoting a remaining edge in your solution. If there are multiple solutions, output any.

Examples

standard input	standard output
4 5 1 2 Lun 1 3 Lun 1 4 Qie 2 3 Lun 3 4 Qie	YES 4 1 2 1 3 2 3 1 4
4 5 1 2 Lun 1 3 Qie 1 4 Qie 2 3 Lun 3 4 Qie	NO

Problem E. Palindrome Counter

Input file: `standard input`
Output file: `standard output`

Define the palindrome value of a string s as the number of non-empty strings t such that:

- t is a palindrome, that is, it reads the same forwards and backwards.
- t is a contiguous substring of s.

For example, if s is "`aba`", then string t can be "`a`", "`b`", or "`aba`", so the palindrome value of s is 3.

Find the sum of palindrome values of all strings with length n and character set size k. Since the answer may be too large, output it modulo 998 244 353.

Input

The first line contains two integers n, k ($1 \le n \le 128, 1 \le k \le 10^5$), denoting the length of the string and the character set size.

Output

Output a single integer, representing the answer, modulo 998 244 353.

Examples

standard input	standard output
4 2	64
5 3	1167

Problem F. Challenge NPC 2

Input file:	`standard input`
Output file:	`standard output`

You are given a forest. Find a Hamiltonian path for its complement graph or determine if it does not contain any Hamiltonian path.

A forest is a graph with no cycles.

A Hamiltonian path is a path that visits every vertex exactly once.

A graph G's complement graph is a graph H on the same vertices such that two distinct vertices of H are adjacent if and only if they are not adjacent in G.

Input

The first line contains one integer T ($1 \le T \le 10^5$), representing the number of test cases.

For each test case, the first line contains two integers n, m ($2 \le n \le 5 \cdot 10^5$, $0 \le m \le n-1$), representing the number of vertices and the number of edges.

The following m lines each contain two integers u, v ($1 \le u, v \le n$, $u \ne v$), representing an edge.

It is guaranteed that the given graph is a forest, and $\sum n \le 10^6$.

Output

For each test case, if it is impossible to find a Hamiltonian path on the graph's complement, output -1 in a single line.

Otherwise, output n distinct integers $p_1, p_2 \dots p_n$ ($1 \le p_i \le n$) in a line, where edge (p_i, p_{i+1}) ($1 \le i < n$) is in G's complement graph. If there are multiple answers, output any.

Example

standard input	standard output
5 3 2 1 2 2 3 2 0 4 3 1 2 2 3 2 4 5 2 1 5 2 3 5 4 1 2 1 3 2 4 2 5	-1 1 2 -1 2 1 4 3 5 1 5 4 3 2

Problem G. Easy Brackets Problem

Input file: `standard input`
Output file: `standard output`

For a number sequence a of length $2n$ and a bracket sequence s of $2n$, denote that

$$f(a, s) = \sum_{i=1}^{2n} a_i[s_i],$$

where $[s_i] = \begin{cases} 1, & s_i = \text{‘(’}, \\ 0, & s_i = \text{‘)’} \end{cases}.$

Randias is facing a **too easy problem**:

- Given a number sequence a of length $2n$, find the value of $F(a) = \max\{f(a, s) : \text{where } s \text{ is a regular bracket sequence of } 2n\}$.

For example, $F(\{1,2,1,2\}) = f(\{1,2,1,2\},\text{“(())”}) = 3$ and $F(\{1,2,3,4\}) = f(\{1,2,3,4\},\text{“()()”}) = 4$,

Since this problem is too easy for Randias, so he's thinking of another **easy problem**:

- For each $i = 1, 2, \ldots, 2n$, a_i is a uniformly random **real number** picked from $[L_i, R_i]$, find the expected value of $F(a)$.

He wants you to find the answer of the easy problem and output it modulo $10^9 + 7$.

A bracket sequence is called regular if it is possible to obtain a correct arithmetic expression by inserting characters ‘+’ and ‘1’ into it. For example, sequences “(())()”, “()”, and “(()(()))” are regular, while “)(”, “(()”, and “(()))(” are not.

Input

The first line contains one integer n ($1 \le n \le 100$), representing the half of the length of the sequence.

The following $2n$ lines, each of them contain two integers L_i, R_i ($0 \le L_i \le R_i \le 10^9$), representing the interval where a_i is picked from.

Output

One single integer, representing the answer, modulo $10^9 + 7$.

More precisely, assume the reduced fraction of the answer is $\frac{p}{q}$, you should output the minimum non-negative integer r such that $q \cdot r \equiv p \pmod{10^9 + 7}$. You may safely assume that such r always exists in all test cases.

Examples

standard input	standard output
1 2 4 3 6	3
2 0 1 1 3 1 3 2 2	833333342
3 1 5 2 9 4 5 5 10 1 7 0 8	96825414

Note

For the first example, note that the only regular bracket is "()", so the answer is the expected value of a_1, which is 3.

For the second example, we can choose from "(())" or "()()", which means the answer is the expected value of $\max(a_1 + a_2, a_1 + a_3)$, one can prove that it equals to $\frac{17}{6}$.

Problem H. Genshin Impact's Fault

Input file: `standard input`
Output file: `standard output`

In Genshin Impact, making wishes is an action trying to obtain some specific character.

In this problem, there are four possible results for making wishes: 3-star weapon, 4-star weapon/character, 5-star non-promotional weapon/character, 5-star promotional weapon/character. Here, we do not distinguish between weapon and character, and we use 3, 4, 5, and U to represent each result, respectively.

There are some rules for making wishes.

- For every consecutive 10 wishes, it will not only contain 3-star weapons.
- For every consecutive 90 wishes, it must contain at least one 5-star weapon/character, no matter whether it is promotional.
- For every two neighboring 5-star weapons/characters, there must be at least one which is promotional. Here, two 5-star weapons/characters are called neighboring if and only if all wishes between them are not 5-star weapons/characters.

Now you're given a list of wishes. Determine if it fits in the above rules.

Input

The first line contains one integer T ($1 \le T \le 10^5$), representing the number of test cases.

For each test case, one single line contains a string S ($1 \le |S| \le 10^6$), which only contains 3, 4, 5, and U.

It is guaranteed that $\sum |S| \le 10^6$.

Output

For each test case, if it fits in the above rules, output "`valid`", otherwise output "`invalid`".

Example

standard input	standard output
5 433333333334 34343453434 333335333335 UUUUUUUUUU 5U5U5U5U5U4	invalid valid invalid valid valid

Problem I. Intersecting Intervals

Input file:	`standard input`
Output file:	`standard output`

You are given a matrix A of n rows and m columns, containing only integers.

For each row i, choose a non-empty interval l_i, r_i, such that the adjacent row's interval intersects, and maximize the sum of all integers over all intervals.

Formally, choose l_i, r_i such that $1 \le l_i \le r_i \le m$, $\max(l_i, l_{i+1}) \le \min(r_i, r_{i+1})$ for all $i \in \mathbb{Z} \cap [1, n)$, and maximize $\sum_{i=1}^{n} \sum_{j=l_i}^{r_i} A_{i,j}$

Input

The first line contains one integer T $(1 \le T \le 10^5)$, representing the number of test cases.

For each test case, the first line contains two integers n, m $(1 \le n, m, n \cdot m \le 10^6)$, representing the size of the matrix.

The following n lines, each contain m integers $A_{i,j}$ $(-10^9 \le A_{i,j} \le 10^9)$, representing each element of the matrix.

It is guaranteed that $\sum n \cdot m \le 10^6$.

Output

For each test case, output one line containing a single integer, representing the answer.

Example

standard input	standard output
5 4 4 -1 1 1 -1 1 1 -1 -1 -1 1 1 -1 -1 -1 1 1 3 4 2 -3 4 -1 1 2 -4 -7 1 1 -7 2 4 3 1 -1 1 -2 4 5 2 -3 2 6 -5 7 1 1 1 2 2 -1 -1 -1 -2	8 8 20 1 -2

Problem J. Stone Merging

Input file: `standard input`
Output file: `standard output`

Randias has n stones, the i-th stone has number a_i written on it. Initially, n stones are piled up separately (which means they form n piles, and each pile contains one stone).

Randias has $k-1$ machines, numbered from 2 to k. The machine numbered i can merge exactly i piles into one single pile.

Unfortunately, if the piles put into machine i contain a stone with number i, then the machine will act differently. The machine will output two piles; the first one contains all stones with number i, and the second one contains all remaining stones (the second one may be empty). After that, machine i will be broken, which means that it can not be used again.

Randias can use any machine any number of times before it is broken. He wants to merge all the stones into one pile. Please help him to determine how to merge the stones, or determine if it is impossible.

Input

Each test contains multiple test cases. The first line contains a single integer t ($1 \le t \le 1.2 \cdot 10^4$), denoting the number of test cases.

For each test case, the first line contains two integers n, k ($2 \le k \le n \le 10^5$), denoting the number of stones and the limit of machines. The second line contains n integers $a_1, a_2 \dots a_n$ ($1 \le a_i \le n$), denoting the number written on each stone.

It is guaranteed that the sum of n over all test cases does not exceed 10^5.

Output

For each test case, if it is impossible to merge all stones in one pile, output "-1"(without quotes).

Otherwise, on the first line, output the number of operations L ($0 \le L \le n$).

We assign a unique ID to each pile. The IDs of the initial piles are $1, 2, \dots n$. The two piles possibly created by the i-th operation have the ID $n + 2 \cdot i - 1$ and $n + 2 \cdot i$. Let m_i be the number of piles merged in the i-th operation. The pile with ID $n + 2 \cdot i - 1$ contains all stones with number m_i written on it, and the pile with ID $n + 2 \cdot i$ contains the remaining stones. Note that one of the piles may be empty, but we still assign an ID for it. Also, if the pile with ID $n + 2 \cdot i - 1$ is not empty, which means machine m will be broken after this operation, and you can never use it again.

For each operation, output it in a single line. First output m_i ($2 \le m_i \le k$), the number of piles that need to be merged. Then followed by m_i distinct integers $c_1, c_2 \dots c_{m_i}$, each of them denoting a **non-empty** pile. This represents merging piles with ID $c_1, c_2 \dots c_{m_i}$, and creates two new piles with ID $n + 2 \cdot i - 1$, $n + 2 \cdot i$. After this operation, piles with ID $c_1, c_2 \dots c_{m_i}$ become empty. You should make sure that the machine m_i is not broken before this operation.

After all the operations, you should make sure there is only one non-empty pile, which contains all n stones.

In a single test case, you should make sure that $\sum m_i \le 3 \cdot n$.

Example

standard input	standard output
5 2 2 1 2 3 3 2 2 1 4 3 2 2 2 4 6 4 2 2 3 3 3 5 2 2 2 2	-1 1 3 3 1 2 2 2 1 2 3 3 4 5 2 3 3 4 5 4 1 2 6 7 1 2 1 2

Problem K. The Great Wall 2

Input file: `standard input`
Output file: `standard output`

Beacon towers are built throughout and alongside the Great Wall. There was once a time when there were n beacon towers built from west to east for defending against the invaders. The altitude of the i-th beacon tower, based on historical records, is a_i.

The defenders strategically divide all beacon towers into k parts where each part contains several, but at least one, consecutive beacon towers. The scale of an individual part is given by the difference between the highest and the lowest altitudes of beacon towers, and the most relaxable partition **minimizes** the sum of scales of all parts.

As a historian, you are dying to know the **minimum** sums of scales for every $k = 1, 2, \ldots, n$.

Input

The first line contains an integer n ($1 \leq n \leq 5\,000$), denoting the number of beacon towers alongside the Great Wall.

The second line contains n integers $a_1, a_2, \ldots, a_n$, where the i-th integer a_i ($1 \leq a_i \leq 10^5$) is the altitude of the i-th beacon tower.

Output

Output n lines, the i-th of which contains an integer indicating the **minimum** sum for $k = i$.

Examples

standard input	standard output
5 1 2 3 4 5	4 3 2 1 0
5 1 2 1 2 1	1 1 1 1 0