Problem Cheerleader

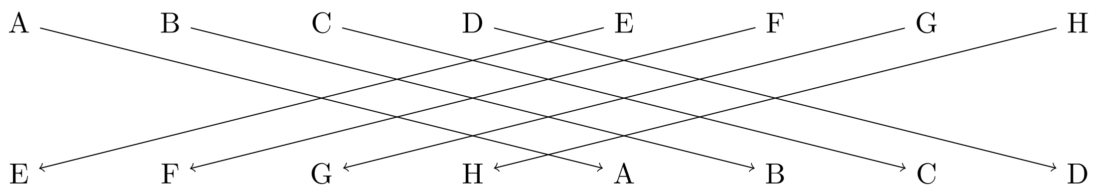
Input file: *standard input*
Output file: *standard output*

In preparation for the Fo(1)otball cup, the cheerleaders from Little Square's school are trying to create a new routine. There are 2^N cheerleaders with **distinct** heights between 0 and $2^N - 1$. The cheerleaders stand in a row. The height of the cheerleader that is initially at position i is $h[i]$ for $1 \leq i \leq 2^N$.

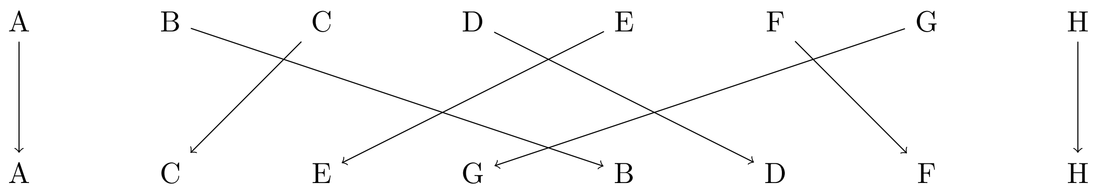
The cheerleaders know two coordinate dance moves:

- The *big swap*. In this move, the first 2^{N-1} cheerleaders swap places with the last 2^{N-1} cheerleaders.
- The *big split*. In this move, the cheerleaders at odd positions go to the beginning of the row, and the cheerleaders at even positions go to the end of the row.

For instance, a *big swap* on 8 elements has the following effect:



And a *big split* on 8 elements has the following effect:



Now, define the number of inversions of a row of cheerleaders with heights $h'[1], \ldots, h'[2^N]$ as the number of pairs $(i, j), 1 \leq i < j \leq 2^N$ where $h'[i] > h'[j]$. The cheerleaders want to know a sequence of dance moves that minimises the number of inversions in the resulting row.

Input

On the first line of the input you will find N. On the second line of the input you will find 2^N integers, that represent $h[1], \ldots, h[2^N]$.

Output

On the first line of the output, print the minimum number of inversions that can be achieved. On the second line of the output, write a string that represents a sequence of dance moves that leads to that minimum number of inversions. In this string, a `1` represents a *big swap*, and a `2` represents a *big split*. Any sequence of moves that leads to the minimum number of inversions will be accepted.

Constraints

- $0 \leq N \leq 17$.
- **N can be 0**.
- If you output the correct minimum number of inversions, but the string of moves is incorrect, you will receive X points. The value of X varies from subtask to subtask.

- The length of the string of moves must be at most 500.000 characters long.

Subtask 1 (points: 16)

- $N \leq 4$
- $X = 8$

Subtask 2 (points: 10)

- $N \leq 7$
- $X = 5$

Subtask 3 (points: 25)

- $N \leq 11$
- $X = 20$

Subtask 4 (points: 21)

- $N \leq 16$
- It is guaranteed that the minimum number of inversions that can be achieved is 0.
- $X = 0$

Subtask 5 (points: 28)

- No additional restrictions.
- $X = 21$

Examples

standard input	standard output
2 0 3 1 2	1 2212
3 2 3 7 6 1 4 5 0	8 21221
4 1 4 8 5 3 6 12 13 10 11 2 9 14 0 15 7	43 2222

Problem Football

Input file: *standard input*
Output file: *standard output*

Little Square's school is organising the annual football match. The two team captains are Little Square and Little Triangle. They will select their teams from the N classes in the school. The team selection works in the following way:

- Little Square and Little Triangle alternate picking people in turns. Little Square goes first.
- In a turn, only students from a single class can be chosen.
- In a turn, at least one and at most K students can be chosen.
- In a turn, one must select at most as many students as were selected in the previous turn.
- The captain who selects the last student(s) gets the "Fo(1)otball" prize.

The captains do not care how many students they select overall, and all students are identical when it comes to football skill. They only care about the "Fo(1)otball" prize. Assuming both have perfect strategy, who wins it ?

Input

Each test file will contain multiple test cases, describing different scenarios. On the first line you will find T, the number of testcases. Their descriptions follow. On the first line of a testcase you will find N and K. On the second line of a testcase you will find N positive integers, which represent the sizes of the classes in Little Square's school.

Output

Output the answers for the T testcases, each on the same line, not separated by spaces. If Little Square wins the prize in a testcase, output `1`; output `0` otherwise.

Constraints

- $T \leq 100.000$
- Let $\sum N$ be the sum of the values of N for all testcases in a testfile. Then $\sum N \leq 100.000$
- $K, size\ of\ any\ class \leq 1.000.000.000$

Subtask 1 (points: 26)

- $K = 1$

Subtask 2 (points: 8)

- $N \leq 10$
- $\sum N \leq 100$
- $size\ of\ any\ class \leq 3$.

Subtask 3 (points: 11)

- $N \leq 10$
- $size\ of\ any\ class \leq 5$.

Subtask 4 (points: 8)

- $N = 1$
- $K, size\ of\ any\ class \leq 100$.

Subtask 5 (points: 16)

- $N = 1$

Subtask 6 (points: 16)

- $K = 2$

Subtask 7 (points: 7)

- K is a power of 2

Subtask 8 (points: 8)

- No additional constraints

Examples

standard input	standard output
3 3 1 3 1 1 5 2 2 1 1 1 1 1 2 3	111

Explanation

In the first test, there are 5 students in total, and exactly one student must be selected on each turn (as $K = 1$). Thus, selection will last exactly 5 turns, and the last student will be selected on Little Square's turn, and Little Square wins.

In the second test, Little Square can first select two students from the first class. Then, after four further turns in which each captain selects one student (since all the classes have only one student at this point), Little Square wins.

In the third test, one winning strategy has Little square first selecting one student.

Problem Table Tennis

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

In Little Square's class everyone is obsessed with table tennis. Each person has a distinct non-negative integer score that represents their table tennis skill. His class has N people, and is *perfectly balanced* with respect to table tennis skill. This means that we can form $\frac{N}{2}$ teams of two such that the total table tennis skill of each team is equal. Note that this means that N is even.

Unfortunately, K people from Little Triangle's class have snuck into Little Square's classroom. Now there are $N + K$ people in the classroom, each of which has a distinct, non-negative, integer table tennis skill score. Choose N people from among these such that the resulting group is *perfectly balanced* with respect to table tennis skill.

Input

On the first line of the input you will find N and K. On the next line of the input you will find $N + K$ non-negative, distinct integers, in increasing order. These represent the table tennis skill scores of the people in the classroom, after those Little Triangle's class snuck in.

Output

Output one line, containing N non-negative, distinct integers, in increasing order. The outputs should be a subset of the table tennis skill scores of the people in the classroom, and should be *perfectly balanced*. If there are multiple solutions, any one is accepted.

Constraints

- $1 \leq N \leq 150.000$
- $1 \leq K \leq 400$
- $1 \leq$ *table tennis skill score* $\leq 1.000.000.000$

Subtask 1 (points: 11)

- $1 \leq N \leq 2.000$
- $K = 1$

Subtask 2 (points: 9)

- $1 \leq N \leq 150.000$
- $K = 1$

Subtask 3 (points: 14)

- $1 \leq N \leq 150.000$
- $K = 2$

Subtask 4 (points: 15)

- $1 \leq N \leq 100$
- $1 \leq K \leq 100$

Subtask 5 (points: 9)

- $N + K \leq 18$

Subtask 6 (points: 14)

- $1 \leq N \leq 2.000$
- $1 \leq K \leq 20$

Subtask 7 (points: 15)

- $1 \leq N \leq 150.000$
- $1 \leq K \leq 20$

Subtask 8 (points: 13)

- No additional constraints.

Examples

standard input	standard output
4 3 1 2 3 4 8 10 20	1 2 3 4
4 2 1 2 3 4 5 6	1 2 3 4

Explanation

In both examples, the output is correct since it has 4 elements, is a subset of the input, and since we can form teams of two of equal table tennis skill (one team with skills 1 and 4, and one team with skills 2 and 3).

In the first example, it would also be correct to output 1, 3, 8, 10 or 2, 4, 8, 10.

In the the second example, it would also be correct to output 2, 3, 4, 5 or 3, 4, 5, 6.

Problem Trampoline

Input file: *standard input*
Output file: *standard output*

Little Square has started jumping on trampolines from his school's gym. In the gym there are $R \times C$ trampolines arranged in a rectangular grid with R rows and C columns. Each trampoline is either green or blue. There are exactly N green trampolines. Let (i, j) denote the trampoline in the i^{th} row and j^{th} column. We index the rows from 1 to R and the columns from 1 to C.

Little Square's teacher has asked him to practice T gymnastics routines. The i^{th} routine has the following rules:

- The routine starts at trampoline $(x_i^{start}, y_i^{start})$.
- The routine ends at trampoline (x_i^{stop}, y_i^{stop}).
- If Little Square jumps on a green trampoline at position (i, j) then he may go to trampolines $(i + 1, j)$ or $(i, j + 1)$, as long as these are not outside the grid.
- If Little Square jumps on a blue trampoline at position (i, j) then he may go to trampoline $(i, j+1)$, as long as it is not outside the grid.

Little Square wants to know, for each routine, if it is possible to accomplish his teacher's request.

Input

On the first line of the input you will find R, C and N. On the next N lines you will find the positions of the green trampolines. If a line contains integers `a b` then there is a green trampoline at position (a, b). On the next line you will find T. On the next T lines you will find the descriptions of the gymnastics routines. On the i^{th} of these lines you will find x_i^{start}, y_i^{start}, x_i^{stop}, y_i^{stop}.

Output

Output T lines. The i^{th} line should contain `Yes` if it possible to accomplish the i^{th} routine, and `No` if it is not.

Constraints

- $1 \leq R, C \leq 1.000.000.000$
- $1 \leq N, T \leq 200.000$
- $1 \leq x_i^{start}, x_i^{stop} \leq R$,
- $1 \leq y_i^{start}, y_i^{stop} \leq C$,
- The coordinates of green trampolines are pairwise distinct.

Subtask 1 (points: 23)

- $1 \leq R, C, T \leq 200$

Subtask 2 (points: 20)

- $1 \leq R, C \leq 2.500$

- $1 \le T \le 4.000$

Subtask 3 (points: 11)

- $x^i_{stop} - x^i_{start} = 1$

Subtask 4 (points: 19)

- $1 \le T, N \le 5.000$

Subtask 5 (points: 27)

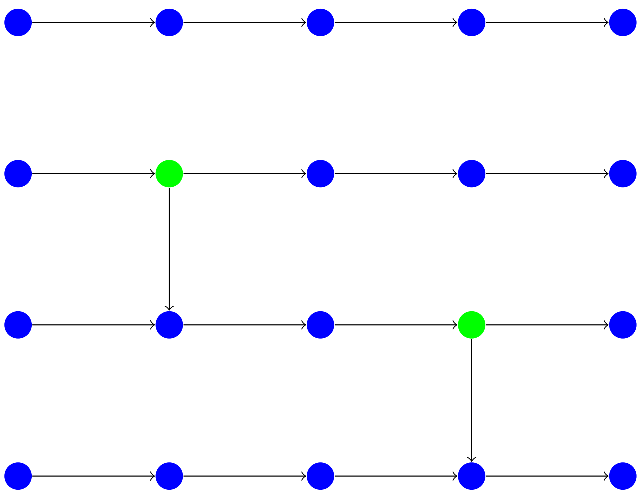
- No additional constraints.

Examples

standard input	standard output
4 5 2 2 2 3 4 3 2 1 4 5 1 2 1 4 2 3 4 4	Yes Yes No

Explanation

The trampolines are placed like so:



In the first routine Little Square can go on the following route: $(2, 1) \to (2, 2) \to (3, 2) \to (3, 3) \to (3, 4) \to (4, 4) \to (4, 5)$.

In the second routine Little Square can go on the following route: $(1, 2) \to (1, 3) \to (1, 4)$.

The third routine cannot be accomplished. No route exists from $(2, 3)$ to $(4, 4)$ that respects Little Square's teacher's rules.