A Candle Box

Rita loves her Birthday parties. She is really happy when blowing the candles at the *Happy Birthday*'s clap melody. Every year since the age of four she adds her birthday candles (one for every year of age) to a candle box. Her younger daydreaming brother Theo started doing the same at the age of three. Rita and Theo boxes look the same, and so do the candles.

One day Rita decided to count how many candles she had in her box:

– *No, no, no! I'm younger than that!*

She just realized Theo had thrown some of his birthday candles in her box all these years. Can you help Rita fix the number of candles in her candle box?

Task

Given the difference between the ages of Rita and Theo, the number of candles in Rita's box, and the number of candles in Theo's box, find out how many candles Rita needs to remove from her box such that it contains the right number of candles.

Input

The first line of the input has one integer D, corresponding to the difference between the ages of Rita and Theo.

The second line has one integer R, corresponding to the number of candles in Rita's box.

The third line has one integer T, corresponding to the number of candles in Theo's box.

Constraints

$1 \leq D \leq 20$	Difference between the ages of Rita and Theo
$4 \leq R < 1\,000$	Number of candles in Rita's box
$0 \leq T < 1\,000$	Number of candles in Theo's box

Output

An integer representing the number of candles Rita must remove from her box such that it contains the right number of candles.

Sample Input

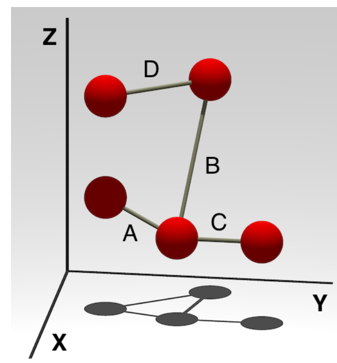
```
2
26
8
```

Sample Output

```
4
```

B Balls and Needles

Joana Vasconcelos is a Portuguese artist who uses everyday objects in her creations, like electric irons or plastic cutlery. She is an inspiration to Ana, who wants to make ceiling hanging sculptures with straight knitting needles and balls of wool. For safety reasons, there will be a ball at each end of each needle. Knitting needles vary in colour, length and thickness (to allow intersections of needles).



Sculptures are to be exhibited in room corners, which provide a 3D Cartesian coordinate system, with many lamps on the ceiling. Sculpture designs are made with the coordinates of the centres of the balls of wool in which knitting needles are stuck. That is, each needle N is represented by a set of two different triples: $N = \{(x, y, z), (x', y', z')\}$.

Ana dislikes *closed chains*. A *true closed chain* is a sequence of k distinct needles, $N_1, N_2, \ldots, N_k$ (for some $k \geq 3$), such that:

- $N_1 = \{(x_1, y_1, z_1), (x_2, y_2, z_2)\}$, $N_2 = \{(x_2, y_2, z_2), (x_3, y_3, z_3)\}$, $\ldots$,
  $N_k = \{(x_k, y_k, z_k), (x_{k+1}, y_{k+1}, z_{k+1})\}$, and $(x_{k+1}, y_{k+1}, z_{k+1}) = (x_1, y_1, z_1)$.

But her dislike of closed chains is so extreme that the shadow of the sculpture on the floor has to be free of "floor closed chains". Given any needle $N = \{(x, y, z), (x', y', z')\}$, let $N^{\downarrow} = \{(x, y), (x', y')\}$ denote the shadow of needle N on the floor. For Ana (who is an artist), a *floor closed chain* is also a sequence of k distinct needles, $N_1, N_2, \ldots, N_k$ (for some $k \geq 3$), such that:

- $N_i^{\downarrow} \neq N_j^{\downarrow}$, for every $1 \leq i < j \leq k$ (the k needle shadows are all distinct);
- $N_1^{\downarrow} = \{(x_1, y_1), (x_2, y_2)\}$, $N_2^{\downarrow} = \{(x_2, y_2), (x_3, y_3)\}$, $\ldots$,
  $N_k^{\downarrow} = \{(x_k, y_k), (x_{k+1}, y_{k+1})\}$, and $(x_{k+1}, y_{k+1}) = (x_1, y_1)$.

Consider the sculpture depicted in the figure, which has the following four knitting needles:

$$A = \{(12, 12, 8), (10, 5, 11)\}, \quad B = \{(12, 12, 8), (4, 14, 21)\},$$
$$C = \{(12, 12, 8), (12, 20, 8)\}, \quad D = \{(4, 14, 21), (10, 5, 21)\}.$$

This structure is not free of closed chains because, although there is no true closed chain, the sequence of needles A, B, D is a floor closed chain.

Task

Write a program that, given the knitting needles of a sculpture, determines whether there is a true or a floor closed chain in the sculpture.

Input

The first line of the input has one integer, K, which is the number of knitting needles in the sculpture. Each of the following K lines contains six integers, x_1, y_1, z_1, x_2, y_2, and z_2, which indicate that $\{(x_1, y_1, z_1), (x_2, y_2, z_2)\}$ is the set of triples of a needle. Any two distinct needles are represented by different sets of triples.

Constraints

$1 \leq K \leq 50\,000$	Number of knitting needles
$1 \leq x_i, y_i, z_i < 1\,000$	Coordinates of each triple

Output

The output has two lines, each one with a string. The string in the first line is: `True closed chains`, if there is some true closed chain in the sculpture; `No true closed chains`, otherwise. The string in the second line is: `Floor closed chains`, if there is some floor closed chain in the sculpture; `No floor closed chains`, otherwise.

Sample Input 1

```
4
12 12 8 10 5 11
12 12 8 4 14 21
12 12 8 12 20 8
4 14 21 10 5 21
```

Sample Output 1

```
No true closed chains
Floor closed chains
```

Sample Input 2

```
4
1 1 1 2 2 2
2 2 2 1 5 5
9 4 4 9 4 2
9 4 4 9 9 4
```

Sample Output 2

```
No true closed chains
No floor closed chains
```

Sample Input 3

```
3
50 50 50 100 100 100
100 100 100 50 50 90
50 50 90 50 50 50
```

Sample Output 3

```
True closed chains
No floor closed chains
```

Sample Input 4

```
3
1 1 5 1 3 7
1 3 7 4 4 5
4 4 5 1 1 5
```

Sample Output 4

```
True closed chains
Floor closed chains
```

C Coordinates

In this problem, you are an advisor to a galactic empire that tries to locate all the rebel bases on a planet Taboo. The map of the planet Taboo is a grid of size $10^8 \times 10^8$ and a position of a rebel based can be described by coordinate (**x,y**) where $0 \le \mathbf{x}, \mathbf{y} < 10^8$.

The empire captures a number of the rebels that surrender and interrogate them about the locations of the bases. Unfortunately, each surrendered rebel can only tell how far along **X** axis and **Y** axis a pair of bases are. Your job in this problem is to help reconstructing possible coordinates of all the bases that is consistent with all the interrogations.

Input

First line consists of two integers, **N** and **M** where $1 \le \mathbf{N} \le 100\,000$ is the number of bases and $\mathbf{N} \le \mathbf{M} \le 1\,000\,000$ is the number of captured rebels.

The next **M** lines consist of 4 integers, $\mathbf{a_i}$, $\mathbf{b_i}$, $\mathbf{dx_i}$, and $\mathbf{dy_i}$ where $1 \le \mathbf{a_i}, \mathbf{b_i} \le \mathbf{N}$, $-10^8 \le \mathbf{dx_i}, \mathbf{dy_i} \le 10^8$ indicating that the x-coordinate of base $\mathbf{b_i}$ subtracted with the x-coordinate of base $\mathbf{a_i}$ is $\mathbf{dx_i}$ and the y-coordinate of base $\mathbf{b_i}$ subtracted with the y-coordinate of base $\mathbf{a_i}$ is $\mathbf{dy_i}$

It is guaranteed that we can always deduce the positions of the bases from the input.

Output

The output consists of **N** lines each line consists of 2 integers $\mathbf{x_j}$ and $\mathbf{y_j}$ indicating possible position of the $\mathbf{j}^{th}$ base. You can answer any solution that is consistent with all the interrogations. Translation of map is possible to outside of $[0, 10^8]$, however, the output coordinate of each base must be between -10^9 to 10^9

Example

Input	Output	Explanation
3 3 1 2 3 0 2 3 0 3 1 3 3 3	0 0 3 0 3 3	This is one of the possible coordinates, assuming that the first base is at (0,0)

D Sky Tax

New Bangkok is a newly built province of Thailand that is floating in the sky. In order for the province to be able to float, each city is supported by a spaceship. Because all spaceships are moving in same direction and velocity, the structure of the province stays still.

Cities are connected by sky ways. A sky way is a floating road connects two cities of New Bangkok together, so a citizen can commute from a city to another city by sky ways. With well urban planning, it is guaranteed that one can commute from any city to all other cities. Also, from a city to another city, there is only one simple route, i.e., no skyway that is used twice.

Because it is new, the province changes its capital city rapidly. This province also has a strange rule, this is, a city **A** must handle tax from a city **B** if a route from **B** to the capital city must pass through **A**. So it could be that a city have to handle taxes of many cities.

In this problem, we provide that structure of New Bangkok, an initial capital city, and number of queries. For each query, we ask you to either (1) move the capital city of the province to city **R**. or (2) given a city **X**, tell us how many cities that **X** has to handle taxes.

Input

The first line contains an integer **T** ≤ 10, number of test cases. Then for each test case:

The first line of the test case contains three integers 1 ≤ **N** ≤ 100 000, 1 ≤ **Q** ≤ 50 000, 1 ≤ **R** ≤ **N**, denote number of cities, number of queries, and an initial capital city in respective order.

Each of next **N - 1** lines gives an information of a sky way. It contains two integers 1 ≤ **A** ≤ **N** and 1 ≤ **B** ≤ **N**, **A** ≠ **B**, there is a sky way connects **A** and **B.**

Each of next **Q** lines gives an information about query. It contains two integers 0 ≤ **S** ≤ 1 and 1 ≤ **U** ≤ **N.**

If **S** is 0, then it asks you to move the capital city to city **U**. Otherwise, it asks you to compute number of cities that **U** needs to handle taxes.

Output

You must print answer of test cases and queries in the order given in the input.

For test case **I**, you must start with a line containing "`Case #I:`" (without double quotes).

Then, for each query that needs an answer, print the answer in a line.

Example

Input	Output
2 5 5 1 1 5 3 4 3 5 2 1 1 1 1 2 0 5 1 5 1 3 1 5 1 1 1 1 1 0 1 1 1 1 1	Case #1: 5 1 5 2 Case #2: 1 1 1 1

E Pascal's Hyper-Pyramids

We programmers know and love Pascal's triangle: an array of numbers with 1 at the top and whose entries are the sum of the two numbers directly above (except numbers at both ends, which are always 1). For programming this generation rule, the triangle is best represented left-aligned; then the numbers on the left column and on the top row equal 1 and every other is the sum of the numbers immediately above and to its left. The numbers highlighted in bold correspond to the base of Pascal's triangle of height 5:

1	1	1	1	**1**
1	2	3	**4**	
1	3	**6**		
1	**4**			
1				

Pascal's hyper-pyramids generalize the triangle to higher dimensions. In 3 dimensions, the value at position (x, y, z) is the sum of up to three other values:

- $(x, y, z - 1)$, the value immediately below it if we are not on the bottom face ($z = 0$);
- $(x, y - 1, z)$, the value immediately behind if we are not on the back face ($y = 0$);
- $(x - 1, y, z)$, the value immediately to the left if we are not on the leftmost face ($x = 0$).

The following figure depicts Pascal's 3D-pyramid of height 5 as a series of plane cuts obtained by fixing the value of the z coordinate.

$z = 0$

1	1	1	1	**1**
1	2	3	**4**	
1	3	**6**		
1	**4**			
1				

$z = 1$

1	2	3	**4**
2	6	**12**	
3	**12**		
4			

$z = 2$

1	3	**6**
3	**12**	
6		

$z = 3$

1	**4**
4	

$z = 4$

1

For example, the number at position $x = 1$, $y = 2$, $z = 1$ is the sum of the values at $(0, 2, 1)$, $(1, 1, 1)$ and $(1, 2, 0)$, namely, $6 + 3 + 3 = 12$. The base of the pyramid corresponds to a plane of positions such that $x + y + z = 4$ (highlighted in bold above).

The size of each layer grows quadratically with the height of the pyramid, but there are many repeated values due to symmetries: numbers at positions that are permutations of one another must be equal. For example, the numbers at positions $(0, 1, 2)$, $(1, 2, 0)$ and $(2, 1, 0)$ above are all equal to 3.

Task

Write a program that, given the number of dimensions D of the hyper-space and the height H of a hyper-pyramid, computes the set of numbers at the base.

Input

A single line with two positive integers: the number of dimensions, D, and the height of the hyper-pyramid, H.

Constraints

$2 \leq D < 32$	Number of dimensions
$1 \leq H < 32$	Height

D and H are such that all numbers in the hyper-pyramid are less than 2^{63}.

Output

The set of numbers at the base of the hyper-pyramid, with no repetitions, one number per line, and in ascending order.

Sample Input 1

```
2 5
```

Sample Output 1

```
1
4
6
```

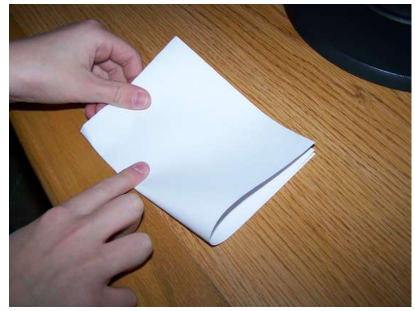
Sample Input 2

```
3 5
```

Sample Output 2

```
1
4
6
12
```

F Risky Lottery



Prof. Peter decided to surprise his class by organizing a new lottery with a very peculiar system.

He starts by announcing a small positive number M. Afterwards, each student is going to secretly write an integer from the set $\{1, ..., M\}$ on a slip of paper that is then folded. After everyone has selected a number, they reveal all choices and whoever wrote down the lowest unique number is the winner! For instance, if there are only three students in the class, two of them select number 2 and the other selects number 5, then the student who chose number 5 is the winner.

The lottery was a success, but Prof. Peter is now wondering what strategy his students should have used. If everyone follows the same optimal randomized strategy, with which probability should each number be chosen so that they maximize their chances of winning? A strategy is optimal if, when everyone is following it, then no individual student can improve his winning probability by selecting a different strategy. Can you help Prof. Peter?

Task

Given N, the number of students in the class, and M, the largest number they can write down, determine the optimal randomized strategy (followed by all students). That is, determine the probability of selecting each number between 1 and M.

Input

There is one line with two integers: N, which is the number of students in the class, and M, which is the largest integer each student can choose.

Constraints

$3 \leq N \leq 7$	Number of students in the class
$1 \leq M \leq N + 1$	Maximum number that can be selected

Output

The output consists of M lines. Line k should have the probability of selecting number k.

The result will be considered correct as long as the absolute error does not exceed 10^{-3}.

Sample Input 1

```
3 3
```

Sample Output 1

```
0.46410
0.26795
0.26795
```

Sample Input 2

```
7 1
```

Sample Output 2

```
1.00000
```

Sample Input 3

```
5 6
```

Sample Output 3

```
0.35785
0.31502
0.19107
0.09512
0.03515
0.00580
```