APAC Semifinal 2008

A. What are Birds?

B. Apocalypse Soon

C. Millionaire

D. Modern Art Plagiarism

Contest Analysis

Questions asked 2

Problem A. What are Birds?

This contest is open for practice. You can try every problem as many times as you like, though we won't keep track of which problems you solve. Read the Quick-Start Guide to get started.

Small input 5 points	Solve A-small
Large input 12 points	Solve A-large

Problem

You are studying animals in a forest, and are trying to determine which animals are birds and which are not.

You do this by taking two measurements of each animal – their height and their weight. For an animal to be a bird, its height needs to be within some range, and its weight needs to be within another range, but you're not sure what the height and weight ranges are. You also know that *every* animal that satisfies these ranges is a bird.

You have taken some of the animals you have measured and shown them to biologists, and they have told you which are birds and which are not. This has given you some information on what the height and weight ranges for a bird must be. For the remaining animals, your program should determine if they are definitely birds, definitely not birds, or if you don't know from the information you have.

Input

One line containing an integer **C**, the number of test cases in the input.

Then for each of the **C** test cases:

- One line containing an integer **N**, the number of animals you have shown to the biologists.
- **N** lines, one for each of these animals, each of the format "**H W X**", where **H** is the height of the animal, **W** is the weight of the animal, and **X** is either the string "BIRD" or "NOT BIRD". All numbers are positive integers.
- One line containing an integer **M**, the number of animals you have not shown to the biologists.
- **M** lines, one for each of these animals, each of the format "**H W**", where **H** is the height of the animal and **W** is the weight of the animal. All numbers are positive integers.

Output

For each of the **C** test cases:

- One line containing the string "Case #**X**:" where **X** is the number of the test case, starting from 1.
- M lines, each containing one of "BIRD", "NOT BIRD", or "UNKNOWN" (quotes are just for clarity and should not be part of the output).

Limits

$1 \le \mathbf{C} \le 10$
1 ≤ all heights and weights ≤ 1000000

Small dataset

$1 \le \mathbf{N} \le 10$
$1 \le \mathbf{M} \le 10$

Large dataset

$1 \le \mathbf{N} \le 1000$
$1 \le \mathbf{M} \le 1000$

Sample

Input	Output
3 5 1000 1000 BIRD 2000 1000 BIRD 2000 2000 BIRD 1000 2000 BIRD 1500 2010 NOT BIRD 3	Case #1: BIRD UNKNOWN NOT BIRD Case #2: UNKNOWN NOT BIRD Case #3:

```
1500 1500            UNKNOWN
900 900              UNKNOWN
1400 2020            UNKNOWN
3
500 700 NOT BIRD
501 700 BIRD
502 700 NOT BIRD
2
501 600
502 501
1
100 100 NOT BIRD
3
107 93
86 70
110 115
```

Case 1:

The animal "1500 1500" must be within the ranges for birds, since we know that the ranges for height and weight each include 1000 and 2000.

The animal "900 900" may or may not be a bird; we don't know if the ranges for height and weight include 900.

The animal "1400 2020" is within the height range for birds, but if 2020 was in the weight range, then the animal "1500 2010", which we know is not a bird, would also have to be within the weight range.

Case 2:

In this case we know that birds must have a height of 501. But we don't know what the weight range for a bird is, other than that it includes weight 700.

Case 3:

In this case, we know that anything with height 100 and weight 100 is not a bird, but we just don't know what birds are.

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Problem B. Apocalypse Soon

Small input 8 points	Solve B-small
Large input 14 points	Solve B-large

Problem

Oh no! The delicate political balance of the world has finally collapsed, and everybody has declared war on everybody else. You warned whoever would listen that this would happen, but did they pay attention? Ha! Now the only thing you can hope for is to survive as long as possible.

Fortunately (sort of), everyone's industrial centers have already been nuked, so the only method of attack available to each nation is to hurl wave after wave of conscripted soldiers at each other. This limits each nation to attacking only its immediate neighbors. The world is a R-by-C grid with R rows, numbered from 1 in the far North to R in the far South, and C columns, numbered from 1 in the far West to C in the far East. Each nation occupies one square of the grid, which means that each nation can reach at most 4 other adjacent nations.

Every nation starts with a specific strength value, known to everyone. They have no concept of advanced strategy, so at the beginning of each day, they will simply choose their strongest neighbor (breaking ties first by Northernmost nation, then by Westernmost) and attack them with an army. The army will have a power equal to the current strength S of the nation; by the end of the day, it will have depleted that neighbor's strength by S. A nation whose strength reaches 0 is destroyed. Note that all nations attack at the same time; an army's power is the same regardless of whether its nation is attacked that day.

Your nation is located at (c, r), in row r and column c. Fortunately, your nation is listening to your advice, so you don't have to follow this crazy strategy. You may choose to attack any of your neighbors on a given day (or do nothing at all). You can't attack multiple neighbors, however, or attack with an army of less than full power.

Determine the maximum number days you can survive.

Input

The first line of input gives the number of cases, **T**. **T** test cases follow. The first line of each test case contains four integers, **C**, **R**, **c**, and **r**. The next **R** lines each contain **C** integers, giving the starting strength $\mathbf{S_{ci,ri}}$ of the nation in column **ci** and row **ri**. It may be 0, indicating that the nation has already been destroyed. Your nation's starting strength will not be 0.

Output

For each test case, output one line containing "Case #**A**: " followed by:

- "**B** day(s)", where **B** is the most days you can hope to survive.
- "forever", if you can outlast all your neighbors.

Limits

$1 \le T \le 100$
$1 \le c \le C$
$1 \le r \le R$

Small dataset

$1 \le C \le 5$
$1 \le R \le 5$
$0 \le S_{ci,ri} \le 10$

Large dataset

$1 \le C \le 50$
$1 \le R \le 50$
$0 \le S_{ci,ri} \le 1000$

Sample

Input	Output
2 3 3 2 2 2 3 2	Case #1: forever Case #2: 3 day(s)

```
1 7 1
2 1 2
4 3 2 1
1 2 2 0
10 8 5 10
10 2 9 10
```

Problem C. Millionaire

Small input
13 points
Solve C-small

Large input
16 points
Solve C-large

Problem

You have been invited to the popular TV show "Would you like to be a millionaire?". Of course you would!

The rules of the show are simple:

- Before the game starts, the host spins a wheel of fortune to determine **P**, the probability of winning each bet.
- You start out with some money: **X** dollars.
- There are **M** rounds of betting. In each round, you can bet any part of your current money, including none of it or all of it. The amount is not limited to whole dollars or whole cents.

  If you win the bet, your total amount of money increases by the amount you bet. Otherwise, your amount of money decreases by the amount you bet.

- After all the rounds of betting are done, you get to keep your winnings (this time the amount is rounded down to whole dollars) only if you have accumulated $1000000 or more. Otherwise you get nothing.

Given **M**, **P** and **X**, determine your probability of winning at least $1000000 if you play optimally (i.e. you play so that you maximize your chances of becoming a millionaire).

Input

The first line of input gives the number of cases, **N**.

Each of the following **N** lines has the format "**M P X**", where:

- **M** is an integer, the number of rounds of betting.
- **P** is a real number, the probability of winning each round.
- **X** is an integer, the starting number of dollars.

Output

For each test case, output one line containing "Case #**X**: **Y**", where:

- **X** is the test case number, beginning at 1.
- **Y** is the probability of becoming a millionaire, between 0 and 1.

Answers with a relative or absolute error of at most 10^{-6} will be considered correct.

Limits

$1 \le \mathbf{N} \le 100$
$0 \le \mathbf{P} \le 1.0$, there will be at most 6 digits after the decimal point.
$1 \le \mathbf{X} \le 1000000$

Small dataset

$1 \le \mathbf{M} \le 5$

Large dataset

$1 \le \mathbf{M} \le 15$

Sample

```
Input            Output
2                Case #1: 0.500000
1 0.5 500000     Case #2: 0.843750
3 0.75 600000
```

In the first case, the only way to reach $1000000 is to bet everything in the single round.

In the second case, you can play so that you can still reach $1000000 even if you lose a bet. Here's one way to do it:

- You have $600000 on the first round. Bet $150000.
- If you lose the first round, you have $450000 left. Bet $100000.
- If you lose the first round and win the second round, you have $550000 left. Bet $450000.
- If you win the first round, you have $750000 left. Bet $250000.
- If you win the first round and lose the second round, you have $500000 left. Bet $500000.

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Problem D. Modern Art Plagiarism

Small input 7 points	Solve D-small
Large input 25 points	Solve D-large

Problem

You have pictures of two sculptures. The sculptures consist of several solid metal spheres, and some rubber pipes connecting pairs of spheres. The pipes in each sculpture are connected in such a way that for any pair of spheres, there is exactly one path following a series of pipes (without repeating any) between those two spheres. All the spheres have the same radius, and all the pipes have the same length.

You suspect that the smaller of the two sculptures was actually created by simply removing some spheres and pipes from the larger one. You want to write a program to test if this is possible.

The input will contain several test cases. One sculpture is described by numbering the spheres consecutively from 1, and listing the pairs of spheres which are connected by pipes. The numbering is chosen independently for each sculpture.

Input

- One line containing an integer **C**, the number of test cases in the input file.

For each test case, there will be:

- One line containing the integer **N**, the number of spheres in the large sculpture.
- **N**−1 lines, each containing a pair of space-separated integers, indicating that the two spheres with those numbers in the large sculpture are connected by a pipe.
- One line containing the integer **M**, the number of spheres in the small sculpture.
- **M**−1 lines, each containing a pair of space-separated integers, indicating that the two spheres with those numbers in the small sculpture are connected by a pipe.

Output

- **C** lines, one for each test case in the order they occur in the input file, containing "Case #**X**: YES" if the small sculpture in case **X** could have been created from the large sculpture in case **X**, or "Case #**X**: NO" if it could not. (**X** is the number of the test case, between 1 and **C**.)

Limits

Small dataset

$1 \le \mathbf{C} \le 100$
$2 \le \mathbf{N} \le 8$
$1 \le \mathbf{M} < N$

Large dataset

$1 \le \mathbf{C} \le 50$
$2 \le \mathbf{N} \le 100$
$1 \le \mathbf{M} < N$

Sample

Input	Output
2 5 1 2 2 3 3 4 4 5 4 1 2 1 3 1 4 5	Case #1: NO Case #2: YES

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

In the first case, the large sculpture has five spheres connected in a line, and the small sculpture has one sphere that has three other spheres connected to it. There's no way the smaller sculpture could have been made by removing things from the larger one.

In the second case, the small sculpture is four spheres connected in a line. These can match the larger sculpture's spheres in the order 2-1-4-5.
