

# Problem A. Xiongnu's Land

## Description

Wei Qing (died 106 BC) was a military general of the Western Han dynasty whose campaigns against the Xiongnu earned him great acclaim. He was a relative of Emperor Wu because he was the younger half-brother of Empress Wei Zifu (Emperor Wu's wife) and the husband of Princess Pingyang. He was also the uncle of Huo Qubing, another notable Han general who participated in the campaigns against the Xiongnu and exhibited outstanding military talent even as a teenager.

Defeated by Wei Qing and Huo Qubing, the Xiongnu sang: "Losing my Qilian Mountains, made my cattle unthriving; Losing my Yanzhi Mountains, made my women lacking rouge."

The text above is digested from Wikipedia. Since Wei and Huo's distinguished achievements, Emperor Wu decided to give them some awards --- a piece of land taken by them from Xiongnu. This piece of land was located in a desert, and there were many oases in it. Emperor Wu wanted to draw a straight south-to-north dividing line to divide the land into two parts, and gave the western part to Wei Qing while gave the eastern part to Huo Qubing. There are two rules about the land dividing:

1. The total area of the oases lay in Wei's land must be larger or equal to the total area of the oases lay in Huo's land, and the difference must be as small as possible.
2. Emperor Wu wanted Wei's land to be as large as possible without violating the rule 1.

To simplify the problem, please consider the piece of land given to Wei and Huo as a square on a plane. The coordinate of its left bottom corner was  $(0,0)$  and the coordinate of its right top corner was  $(R,R)$ . Each oasis in this land could also be considered as a rectangle which was parallel to the coordinate axes. The equation of the dividing line was like  $x = n$ , and  $n$  must be an integer. If the dividing line split an oasis, then Wei owned the western part and Huo owned the eastern part. Please help Emperor Wu to find out how to draw the dividing line.

## Input

The first line of the input is an integer  $K$  meaning that there are  $K$  ( $1 \leq K \leq 15$ ) test cases.

For each test case:

The first line is an integer  $R$ , indicating that the land's right top corner was at  $(R,R)$  ( $1 \leq R \leq 1,000,000$ )

Then a line containing an integer  $N$  follows, indicating that there were  $N$  ( $0 < N \leq 10000$ ) oases.

Then  $N$  lines follow, each contains four integers  $L, T, W$  and  $H$ , meaning that there was an oasis whose coordinate of the left top corner was  $(L,T)$ , and its width was  $W$  and height was  $H$ . ( $0 \leq L, T \leq R, 0 < W, H \leq R$ ). No oasis overlaps.

## output

For each test case, print an integer  $n$ , meaning that Emperor Wu should draw a dividing line whose equation is  $x = n$ . Please note that, in order to satisfy the rules, Emperor might let Wei get the whole land by drawing a line of  $x = R$  if he had to.

## Sample Input

```
2
1000
2
1 1 2 1
5 1 2 1
1000
1
1 1 2 1
```

## Sample Output

```
5
2
```

## Problem B. Xiang Hex

### Description

Xiang Hex is a kind of Chinese Chess played on an elongated hexagonal chessboard by black side and red side. The chessboard consists of nine columns with the outer ones having seven cells and the center one having eleven, as shown in figure 1. The "river" is the cells marked with '0'. The "palace" of black side is marked with '1', and the "palace" of red side is marked with '2'. The player's side of the field consists of the cells before the "river".

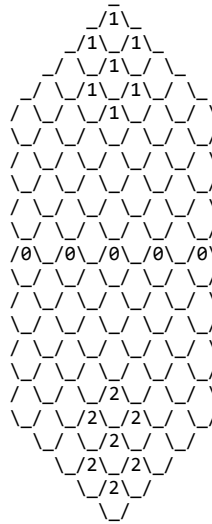


figure 1

The rules of Xiang Hex is familiar to Xiangqi. Each side controls some pieces, moves one piece at each turn, and tries to get the opponent's general piece.

On the chessboard, each column was marked from the left to the right with an uppercase character A, B, ... ,H, I, and the location of a cell can be described by the character of the column and the number of cells under it in the same column (No space between the character and the number).

For example, on a chessboard below, the cell A is marked as E0, the cell B is marked as E0, and the cell C is marked as I6.

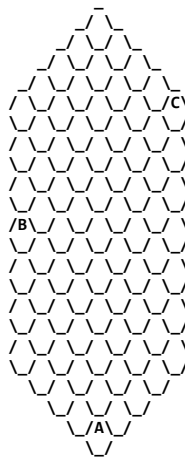


figure 2

As shown in figure 3 below, suppose a piece is on the cell with '0'. If it moves to cells with '1', we say this kind of move is "orthogonal" because the destination cells share an edge with the original cell. If the piece moves from cell with '0' to cells with '2', we say this kind of move is "diagonal".

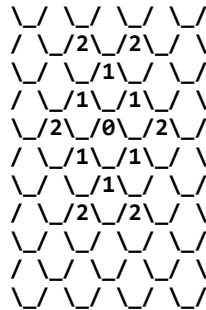


figure 3

There are seven kinds of pieces in Xiang Hex, and figure 4 shows the layout before game begins: (Lowercase pieces above the river belong to black side and uppercase pieces below the river belong to red side):

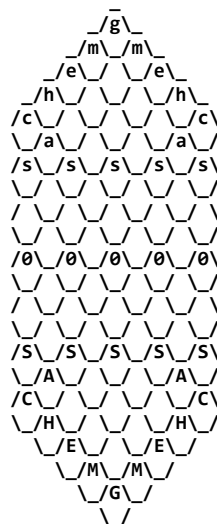


figure 4

1. SOLDIER(S, s): Figure 5 explains the moving rule of a soldier of red side: it can only step into cell with 1 (one forward) before crossing the river. If it stands in the river or has already cross the river, it can step into cell with 1 (one forward), or cells with 2 (one right forward or left forward). Note that for black side, "forward" means "downward", which is opposite to red side.

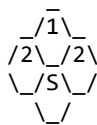


figure 5

2. HORSE(H, h) : in one move, it can step into one vacant cell orthogonally and then step into another cell diagonally in the same direction. As shown in figure 6, a horse can step into the vacant cell with 1 first, then jump to one of the cells with 2. If there is a piece on the cell with 1, the horse cannot move to any one of the cells with 2. The horse can also move to cells with 3 if the corresponding orthogonal cell is vacant.

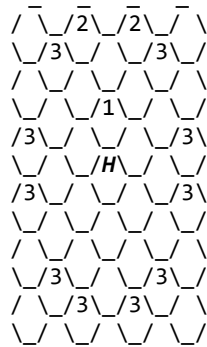


figure 6

3. CHARIOT(C, c) can slide any steps orthogonally (forward, right forward, left forward, backward, right backward or left backward), without leaping any pieces (May capture the first piece it meets and stay where the enemy piece is).

4. CANNON(A, a) can slide any steps orthogonally through vacant cells. It also can leap exactly one piece to capture an enemy piece and stay where the enemy piece is. But it can't leap without capturing.

5. ELEPHANT(E, e) moves two steps diagonally and never cross the "river". When taking the move, the first diagonal cell should be vacant. As shown in figure 7, an elephant steps into the vacant cell with 1 first, then jumps to the cell with 2. If there is a piece on the cell with 1, the elephant cannot move to the cell with 2. The elephant can also move to cells with 3 if the corresponding diagonal cell is vacant. Five cells with 2, 3 or E are the only places can a red side's elephant step into.

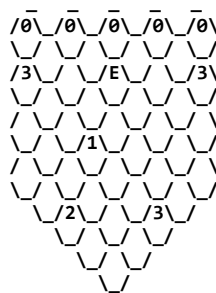


figure 7

6. MANDARIN(M, m) : moves one step diagonally and never leave the "palace". Figure 8 represents the red side's "palace", and the cells with 1 are the only places can a red side's mandarin step into.

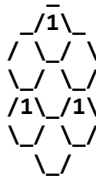


Figure 8

7. GENERAL(G, g) moves one step orthogonally and never leave the “palace”. **Facing the enemy GENERAL in the same column with no intervening pieces is not permitted.**

A piece can never move to a cell containing another piece from the same side. If a piece moves to a cell containing a piece from the enemy, the enemy’s piece is captured and will be removed from the board.

**You can’t take such a move that after this move, your enemy can capture your GENERAL just by one move.**

Now you are controlling the red side and it is your turn. How many different moves can you take?

## Input

The first line contains an integer T ( $1 \leq T \leq 20$ ) -- the number of test cases.

For each case:

The first line contains an integer N ( $2 \leq N \leq 32$ ) -- the number of pieces on the current situation.

Then N lines follow. Each line contains a character P and a cell mark M, separated by a single space, indicating that there is a piece P in the cell marked M. Uppercase pieces belong to red side and lowercase ones belong to black side.

It’s guaranteed that in all given cases, you can’t capture the black GENERAL just by one move.

## Output

For each test case, output an integer on a single line -- the number of different moves you can take now.

## Sample Input

```
2
2
g E9
G D0
11
g E10
e C8
m E8
C B6
s I5
a H5
h D5
```

S C4

S A1

G E1

A H1

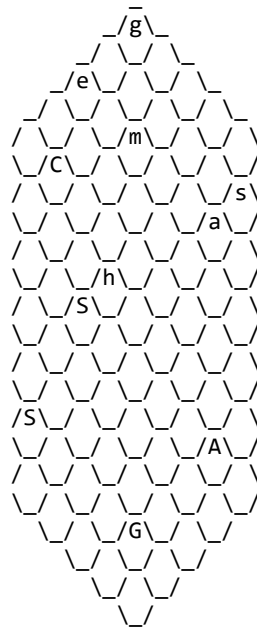
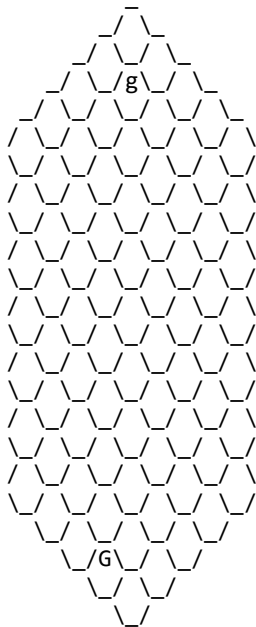
## Sample Output

1

42

## Hint

Two chessboards in the sample are shown below. For the first chessboard, the only legal move for red side is to step the GENERAL one forward.



## Problem C. Today Is a Rainy Day

### Description

Today is a rainy day. The temperature is apparently lower than yesterday. Winter is coming. It always leaves people feeling fatigued and tired.

Lee hasn't prepared for winter yet. As he wakes up this morning, he looks out of the window. Yesterday's shining sunlight can no longer be seen. It is dark outside. The sky looks so heavy that it may collapse down at any moment. Lee gets out of his bed, shakes his head slightly to make himself more awake. But it's of no use for him. Then he goes to the restroom and washes up.

Lee has a class in fifteen minutes. If he sets out immediately, he may get to the classroom on time. But he is not in the mood to do so. He decides to skip class and does something more interesting to train his mind.

He takes out a draft paper and writes a list of digits using a dice. It is obvious that the digits are all between 1 and 6. And then he applies two kinds of modifications to the digits. The first kind is to modify one digit into another. The second kind is to modify one kind of digit into another. For example, he can modify "12123" to "12121" using the first kind of modification, or modify "12123" to "13133" using the second kind of modification. In the process of modification, all digits should be in {1, 2, 3, 4, 5, 6};

After a few modifications, he feels tired but pleased. He's got a list of digits which is very different from the original one. Thinking of the next thing to do, Lee becomes a little excited. He is going to figure out the least number of modifications to transform the final list back to the original one using the same rules.

Lee made it in a very short time. Can you do this like him?

### Input

There are up to 100 test cases.

For each test case, there are two lines containing two lists of digits, representing the original list and the final list in order. The digits are all between 1 and 6. It is guaranteed that two lists are of the same length. The length will not be greater than 110.

### Output

For each test case, output one integer, the answer.

### Sample Input

```
22345611
12345611
2234562221
1234561221
2234562211
1234561111
22345622112
12345611111
```



654321654321654321654321  
123456123456123456123456

## **Sample Output**

1  
2  
3  
3  
11

## Problem D. Kejin Game

### Description

Nowadays a lot of Kejin games (the games which are free to get and play, but some items or characters are unavailable unless you pay for it) appeared. For example, Love Live, Kankore, Puzzle & Dragon, Touken Ranbu and Kakusansei Million Arthur (names are not listed in particular order) are very typical among them. Their unbelievably tremendous popularity has become a hot topic, and makes considerable profit every day.

You are now playing another Kejin game. In this game, your character has a skill graph which decides how can you gain skills. Particularly speaking, skill graph is an oriented graph, vertices represent skills, and arcs show their relationship - if an arc from A to B exists in the graph (i.e. B has a dependency on A), you need to get skill A before you are ready to gain skill B. If a skill S has more than one dependencies, they all need to be got firstly in order to gain S. Note that there is no cycles in the skill graph, and no two same arcs.

Getting a skill takes time and energy, especially for those advanced skills appear very deep in the skill graph. However, as an RMB player, you know that in the game world money could distort even basic principles. For each arc in skill graph, you can "Ke" (which means to pay) some money to erase it. Further, for each skill, you could even "Ke" a sum of money to gain it directly in defiance of any dependencies!

As you have neither so much leisure time to get skills nor sufficient money, you decide to balance them. All costs, including time, energy or money, can be counted in the unit "TA". You calculate costs for all moves (gaining a skill in normal way, erasing an arc and gaining a skill directly). Note that all costs are non-negative integers. Then, you want to know the minimum cost to gain a particular skill S if you haven't get any skills initially. Solve this problem to make your game life more joyful and ... economical.

### Input

The input consists of no more than 10 test cases, and it starts with a single integer indicating the number of them.

The first line of each test case contains 3 positive integers N ( $1 \leq N \leq 500$ ), M ( $1 \leq M \leq 10000$ ) and S, representing the number of vertices and arcs in the skill graph, and the index of the skill you'd like to get. Vertices are indexed from 1 to N, each representing a skill. Then M lines follow, and each line consists of 3 integers A,B and C, indicating that there is an arc from skill A to skill B, and C ( $1 \leq C \leq 1000000$ ) TAs are needed to erase this arc.

The next line contains N integers representing the cost to get N skills in normal way. That means ,the  $i^{\text{th}}$  integer representing the cost to get the  $i^{\text{th}}$  skill after all its dependencies are handled. The last line also contains N integers representing the cost to get N skills directly by "Ke". These 2N integers are no more than 1000000.

### Output

For each test case, output your answer, the minimum total cost to gain skill S, in a single line.

## Sample Input

2  
5 5 5  
1 2 5  
1 3 5  
2 4 8  
4 5 10  
3 5 15  
3 5 7 9 11  
100 100 100 200 200  
5 5 5  
1 2 5  
1 3 5  
2 4 8  
4 5 10  
3 5 15  
3 5 7 9 11  
5 5 5 50 50

## Sample Output

31  
26

## Problem E. Stamps

### Description

Bob sells stamps. There are  $n$  kinds of stamps. The amount of each kind of stamps is infinite.

Each time Alice buys a stamp from Bob, she gets a random kind of stamp. The probability for her to get any kind of stamp is  $1/n$ .

Alice wants to collect all kinds of stamps. However, Bob gets bored when he sells stamps to Alice. So for the  $i^{\text{th}}$  stamp he sells to Alice, Bob will ask for  $H(i, k)$  money from Alice ( $k$  is a constant integer).

The function  $H(i, k)$  is defined as follow:

$$H(i, 0) = 1, \text{ for } i = 1, 2, \dots$$

$$H(i, k) = H(1, k-1) + H(2, k-1) + \dots + H(i, k-1), \text{ when } k > 0 \text{ and } i > 0.$$

Even Alice is rich, she notices that it will cost her a huge amount of money. So she wants to know the expected cost when she collects all kinds of stamps.

### Input

Up to 100000 test cases. Each test case is one line containing a pair of integers:

$n$   $k$

For all test cases,  $1 \leq n \leq 100000$ ,  $0 \leq k \leq 9$

Input ends with  $n = 0$  and  $k = 0$

### Output:

One line for each test cases. If the expected cost is MONEY, output  $(\text{MONEY} \times (n!)^{10}) \% 1000003$  instead.

It is guaranteed that  $(\text{MONEY} \times (n!)^{10})$  is always an integer.

1000003 is a prime number.

### Sample Input

```
1 0
3 0
4 1
100 9
0 0
```

### Sample Output

```
1
562972
739841
816538
```

## Problem F. You Are Under Arrest

### Description

The police is now hunting a wanted suspect. He was spotted  $T$  ( $1 \leq T \leq 100$ ) minutes ago at  $(x_0, y_0)$ , which is on a highway. However, the suspect began to escape at the same time, and as he was driving a car, he could cover  $V_1$  miles per minute on highways.

$N$  ( $1 \leq N \leq 10$ ) highways were constructed in this city. Each of them can be considered as a straight, infinitely extending line, and you can drive can be driven on bidirectionally. Highways may intersect with each other, and it's able to transfer to any highways (and both direction) in each intersections without spending time and decreasing the speed.

The suspect may leave the highways. Once he is not on the highways, he will never enter any highway again (nevertheless, he can drive across highways without entering it), and he can drive  $V_0$  ( $0.01 \leq V_0, V_1 \leq 10, 1.2 \leq V_1 / V_0 \leq 100$ ) miles per minute outside highways.

As the police needs to search the suspect in any possible place, they want to calculate the area that the suspect can cover. Please help them to solve this problem as a responsible citizen.

### Input

The input consists of no more than 10 test cases, and it starts with a single integer indicating the number of them.

The first line of each test case contains 2 real numbers  $x_0$  and  $y_0$ , and the following line consists of 3 real numbers  $V_0, V_1$  and  $T$ . Then, a line containing  $N$ , and  $N$  lines describing highways. Each highway is specified as 4 real numbers  $x_1, y_1, x_2, y_2$ , representing a straight line passes  $(x_1, y_1)$  and  $(x_2, y_2)$ .  $(x_1, y_1)$  and  $(x_2, y_2)$  will not be the same point.

Every coordinates  $(x, y)$  given in the input satisfies  $-10 \leq x, y \leq 10$ , and metered in mile.

It's guaranteed that  $(x_0, y_0)$  lies on at least one highway. Highways don't coincide with each other, even two parallel highways will be apart for more than 0.01 miles. Further, two intersecting highways will have a separation angle for more than  $\pi/40$ . And, there are no more than 2 highways cross at the same point.

### Output

For each test case, output your answer in a single line. Its unit should be square mile.

Your answer will be considered correct if its relative error is no more than  $1e-03$ .

## Sample Input

2  
2 0  
3 5 1  
2  
1 0 3 0  
0 0 1 1  
3 1  
1 3 7  
3  
0 2 3 9  
3 1 7 7  
5 0 6 1

## Sample Output

36.64253903  
318.22573819

## Problem G. Mysterious Antiques in Sackler Museum

### Description

Sackler Museum of Art and Archaeology at Peking University is located on a beautiful site near the West Gate of Peking University campus, and its architecture takes the inspiration from buildings that already exist on campus.

The collection of Chinese art and artifacts currently housed in this new museum contains more than 10,000 objects and spans a period of 280,000 years, from Paleolithic hominids and stone tool remains to costumes, ceramics and paintings of the present era. The collection, which is used for teaching and research purposes, has been acquired during the past seventy years from diverse sources.

The use of some objects in the museum remains unknown. For example, there are four pieces of rectangular bones which can be dated back to 200,000 years ago, and no one knows what they were made for. A former NOier and present ACMer ,Mr. Liang in the School of Archaeology and Museology is very interested in those bones, and his tutor told him to use his wildest imagination to guess the usage of them. So , one day, a crazy idea came up to him: were those bones some kind of IQ test tools used by ancient people? Maybe the one who could pick exactly three pieces of those bones to form a larger rectangle was considered smart at that time. So Mr. Liang wanted to write a program to find out how to pass this IQ test imagined by him. Can you also do this?

### Input

There are several test cases. The first line of input is an integer  $T$  ( $1 \leq T \leq 20$ ), indicating the number of test cases. Each test case is in one line and contains 8 integers describing 4 rectangular bones. Each bone is described by 2 integers indicating its width and height.

All integers in the input are between  $[1,1000]$ .

### Output

For each test case, if Mr. Liang can form a rectangle using those bones in the way he imagined, please print "Yes". If he can't, print "No" instead. Please note that the area of the new rectangle he forms must be equal to the total area of the bones he picks.

### Sample Input

```
2
1 1 1 1 1 2 2 2
1 1 2 2 10 10 20 20
```

### Sample Output

```
Yes
No
```

## Problem H. Archipelago Tour

### Description

Recently, Yudachi has got a map of an archipelago. The archipelago consists of one big land and many small lands. There's a village on each small land and several villages on the big land. The government of the archipelago built some roads around the big land. Each road connects two different villages. These roads and villages on the big land form a "circle". That means you can start from a village and return to it by visiting each road and each of other villages exactly once. Some other roads were also built between two villages on different lands. All the lands, including big and small ones, together with the roads between different lands form a "tree" ("tree" is a conception in graph theory). Due to the environmental condition of the roads, Yudachi find some roads safe and the others dangerous. Each road on the big land is safe, as well as some well-designed roads between different lands.

Yudachi is planning to take a tour of the archipelago now. After reading the introductions of each village on the Internet, she defined a "tour index" of each village, which is an integer evaluating the worth of a visit. She will choose a village as her departure point, travel along the roads without visiting a village twice, and finally end in an arbitrary village except the starting one. The end village can't be the starting village. The safety index of her tour will be the number of safe roads minus the number of dangerous roads, while the happiness index of her tour will be the median "tour index" of all the villages visited. E.g. If she visited villages  $V_1, V_2 \dots V_k$ , and the "tour index" of them are  $T_1, T_2 \dots T_k$  respectively, the median would be  $T_{k/2+1}$  after  $T_1, T_2 \dots T_k$  were sorted in ascending order. Help Yudachi to find a maximum happiness index tour route under the condition that the safety index of her tour is no less than  $L$  and no more than  $R$ .

### Input

The input includes several test cases.

For each case, the 1<sup>st</sup> line includes 3 integers  $N$  ( $1 \leq N \leq 20000$ ),  $L$  and  $R$  ( $1 \leq L \leq R \leq N$ ), representing the number of the villages, and the  $L, R$  in the descriptions above.

The 2<sup>nd</sup> line includes  $N$  integers  $T_1, T_2 \dots T_N$  ( $1 \leq T_i \leq 32768$ ), representing the "tour index" of village 1, 2...  $N$ , respectively.

Each of the 3<sup>rd</sup> to  $N+2$ <sup>th</sup> lines includes 3 integers  $X, Y$  ( $1 \leq X, Y \leq N, X \neq Y$ ) and  $Z$  ( $Z=0$  or  $1$ ), representing a road between villages  $X$  and  $Y$ . If  $Z=0$ , the road is safe. Otherwise it's dangerous. There is at most one road between two certain villages.

An integer  $N=0$  represents the end of the input.

The sum of all the  $N$ s in the input is no more than 80000.



## Output

For each test case in the input, output an integer representing the maximum happiness index of a tour Yudachi can take. If she cannot take a tour under given conditions, the happiness will be 0.

## Sample Input

```
5 2 3
1 10 9 7 8
1 4 0
1 2 0
2 3 1
2 4 0
3 5 0
10 2 5
5 3 3 6 3 2 7 5 3 9
4 10 0
1 2 0
2 3 1
3 4 1
2 5 0
2 6 1
4 7 0
6 8 1
7 9 1
7 10 0
0
```

## Sample Output

```
8
7
```

# Problem I. Snake Carpet

## Description

In school of EECS of Peking University, there is a homework for all freshman -- the contest of AI snakes. This contest is ended today. Bacchus has got a very good result, so he decides to make a carpet full of snakes as a souvenir, and lays it over the floor in his room.

As his room is square, a square carpet is needed. A  $H \times W$  carpets is made up of  $H \times W$  units (each unit is  $1 \times 1$ ). Snakes can have different length, but all snakes' width is 1 unit. For some reason, He hopes that  $N$  special snakes are drawn on the carpet: the length of the  $i^{\text{th}}$  snake should be  $i$ , which can be seen as  $i$  connected units (Two units that share an edge are considered connected). Except the first snake, the  $(2k-1)^{\text{th}}$  snake should have positive odd number of turning points; except the second snake, the  $2k^{\text{th}}$  snake should have an positive even number of turning points.  $i$  and  $k$  both start from 1. Each snake should not intersect with itself, nor with other snakes. All units of the carpet must be covered by snakes.

But the question is whether there is a solution.

## Input

Multiple test cases. There will be up to 25 cases.

For each test case: one line contains one integer  $N$ , indicating the number of snakes. ( $1 \leq N \leq 500$ )

## Output

For each test case:

If the solution does not exist, output one line "0 0", otherwise output  $N+1$  lines: The first line contains two integers  $H$  and  $W$ , indicating the height and the width of the carpet. You should guarantee that  $H \times W = 1 + 2 + \dots + N$ . For the next  $N$  lines, the  $i^{\text{th}}$  line contain  $2i$  integers, indicating the coordinates of the  $i^{\text{th}}$  snake in order. The coordinate of top-left corner unit is  $(1,1)$  and the coordinate of bottom-right corner unit is  $(H,W)$

## Sample Input

3  
4  
5

## Sample Output

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

## Hint

This problem is special judged, and the solutions for the sample input are:

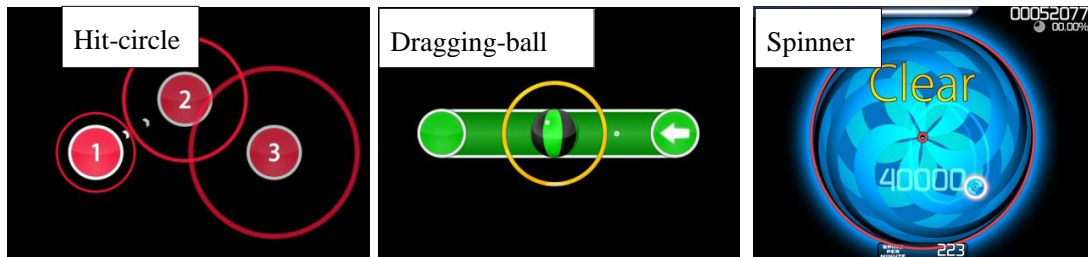
```
3 1 2
3 3 2
3 4 4 1 2
3 3 4 4 2
5 5 5 2 2
5 4 4 3 3
5 4 4 1 3
```

# Problem J. Osu! Master

## Description

“Osu!” is a unique PC rhythm game, which is very popular over the world. The player should follow the rhythm of a song to finish the game.

The game has three kind of elements: hitting circles on the touchscreen, dragging a ball across a fixed path and rotating a spinner very fast, as shown below:



A song is divided into many patterns. There are two kinds of patterns. The first kind is made up of a list of “Hit-circle” elements and “Dragging-ball” elements. The elements are labeled with increasing numbers starting from 1. The player should finish the elements according to the order of the numbers. The second kind of pattern is made up of only one “Spinner” element with no label.

When a player hits a circle, drags a ball or rotates a spinner, he may get 0pt, 100pts or 300pts according to his performance. If he finishes an element perfectly, he will get 300pts. If a player finishes a pattern perfectly, which means that he gets 300pts for all elements in this pattern, he will get a “Shock” mark.

Now, give you the number of elements and the kinds of the elements (together with their label) in order, please calculate that how many “Shock” marks a Osu! master can get at most.

## Input

Multiply test cases. There are up to 100 test cases.

In every test case:

The first line contains a integer  $n$  ( $0 \leq n \leq 10000$ ), representing the number of elements.

Then  $n$  lines follow. Each line describes one element in one of the 3 kinds of format shown below :

1. C x “Hit-circle” with label x
2. B x “Dragging-ball” with label x
3. S “Spinner”

It is guaranteed that the input is always valid.

## Output

For each test case, output one line, an integer, representing the answer.

## Sample Input

10  
C 1  
C 2  
B 3  
C 1  
B 2  
B 1  
S  
C 1  
S  
B 1  
1  
S  
0  
2  
S  
B 1

## Sample Output

7  
1  
0  
2

## Problem K. A Math Problem

### Description

Stan is crazy about math. One day, he was confronted with an interesting integer function defined on positive integers, which satisfies  $f(1) = 1$  and for every positive integer  $n$ ,  $3 \times f(n) \times f(2n+1) = f(2n) \times (1 + 3f(n))$ ,  $f(2n) < 6 \times f(n)$ .

He wanted to know, in the range of 1 to  $n$ , for a given  $k$ , what are  $f(i) \bmod k$  like. For simplicity, you could just calculate the number of  $i$  which satisfies  $f(i) \bmod k = t$  for every  $t$  in range of 0 to  $k - 1$  as  $g(t)$ , and tell Stan what is all  $g(x)$  xor up is.

### Input

There are no more than 40 test cases.

The first line of the input contains an integer  $T$  which means the number of test cases.

Each test case contains two integer,  $n, k$ , just as mentioned earlier. Please note that  $n \leq 10^{18}$ , and  $k$  is a known Fermat prime -- that is to say,  $k$  is among  $\{3, 5, 17, 257, 65537\}$ .

### Output

For each test case, output the result of all  $g(x)$  xor up.

### Sample Input

```
2
1 3
5 5
```

### Sample Output

```
1
3
```