PLU February 2018 Programming Contest

Advanced Division

I. General Notes

1. Do the problems in any order you like. They do not have to be done in order from 1 to 12.

2. Problems will have either no input or will read input from a specified file. All output should be to standard output (the monitor).

3. All input is as specified in the problem. Unless specified by the problem, integer inputs will not have leading zeros.

4. Your program should not print extraneous output. Follow the form exactly as given in the problem.

II. Names of Problems

Number	Name
Problem 1	Zero
Problem 2	Mathematics
Problem 3	Reverse
Problem 4	Square
Problem 5	Quadratics
Problem 6	Holes
Problem 7	Ornaments
Problem 8	Family
Problem 9	Checkpoint
Problem 10	Bags
Problem 11	Bomb
Problem 12	Draw

1. Zero

Input File: zero.dat

You're writing the positive integers in increasing order starting from one. But you've never learned the digit zero, and thus omit any number that contains a zero in any position. The first ten integers you write are: 1, 2, 3, 4, 5, 6, 7, 8, 9, and 11. You have just written down the integer `k` (which is guaranteed to not contain the digit zero). What will be the next integer that you write down?

Input

The first line will contain a single integer `n` that indicates the number of data sets that follow. Each data set will consist of a single line containing the integer `k` (`1 ≤ k ≤ 999,999`). It is guaranteed that `k` does not contain the digit zero.

Output

For each data set print, on a single line, the next integer you will be writing down.

Example Input File

```
2
99
1234
```

Example Output to Screen

```
111
1235
```

2. Mathematics

Input File: mathematics.dat

A mathematician has stolen your calculator! Luckily, you know how to code and can write a program that adds together numbers. Write a program that adds together a list of integers.

Input

The first line will contain a single integer `n` that indicates the number of integers to add together. The next `n` lines will each contain one integer. Your task is to write a program that adds all of the integers together.

Output

Output the resulting integer. The output should be one line containing one integer value.

Example Input File

```
3
1
2
3
```

Example Output to Screen

```
6
```

3. Reverse

Input File: reverse.dat

In the String class, there exists a function called `substring`. Your task is to do the opposite of the `substring` function. Rather than returning a specified substring within the String, you will output the String with the substring taken out.

Input

The first line will contain a single integer `n` that indicates the number of data sets that follow. Each data set will be one line with a string and two integers `i` and `j`, separated by spaces. The first int, `i`, is the start index of the substring to be taken out, and the substring removed extends to index `j-1`. Thus the length of the substring removed is `j-i`. You may assume that $0 \leq i \leq j \leq length(string)$.

Output

Output the given string, with the substring taken out specified by the given integers. The output will be `n` lines, with no leading or trailing white space.

Example Input File

```
3
COMPUTER 1 3
SCIENCE 3 7
RULES 3 4
```

Example Output to Screen

```
CPUTER
SCI
RULS
```

4. Square

Input File: square.dat

Your mother has asked you to create a template for the squares of a quilt she is making. Her quilt will be based on words! Print out a square of the given word, in the style shown in the example output.

Input
The first line will contain a single integer `n` that indicates the number of data sets that follow. Each data set will consist of a single line with one word of length `k` (`0 < k < 100`).

Output
Output the square in the format shown in the example output. There are no spaces between data sets. The final square should be both as wide and as tall as the length of the word.

Example Input File
```
3
one
three
fifteen
```

Example Output to Screen
```
one
n n
eno
three
h   e
r   r
e   h
eerht
fifteen
i     e
f     e
t     t
e     f
e     i
neetfif
```

5. Quadratics

Input File: quadratics.dat

After hearing that the quadratic formula is used constantly in calculus, you decide that it would be more efficient to just write a program for it! Write a program that solves the equation shown below:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

The $\pm$ sign represents two different equations, one with $+$ and one with $-$. Your answer will be both answers, separated by a comma and a space.

Input

The first line will contain a single integer `n` that indicates the number of data sets that follow. Each data set will contain three numbers (integer or decimal) on a single line, representing `a`, `b`, and `c` respectively.

Output

Output the two answers to the equation, rounded to the thousandths digit and separated by a comma and one space. The + sign will be the first answer, then the − sign will be the second. The solutions will always be real numbers.

Example Input File

```
2
1 6 3
4 10 6.1
```

Example Output to Screen

```
-0.551, -5.449
-1.056, -1.444
```

6. Holes

Input File: holes.dat

After receiving an impenetrable box, you wonder what's inside! Write a program that finds out how many different disconnected sections the box has, and the total area of the space within the box.

Input

The first line will contain a single integer `n` that indicates the number of data sets that follow. Each data set will start with two integers `r` and `c` representing the number of rows and columns of the box, respectively. The next `r` lines will represent the box, with `#` representing walls and `.` representing spaces. The box will be surrounded entirely by walls.

Output

Output the number of discrete (disconnected) sections and the total number of spaces in the box, in the format shown in the example output.

Example Input File

```
2
4 8
########
#...#..#
#.#.#..#
########
3 3
###
#.#
###
```

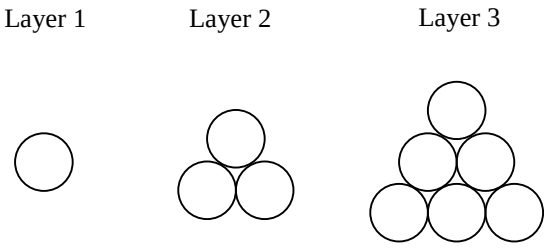
Example Output to Screen

```
2 sections, 9 spaces
1 section, 1 space
```

7. Ornaments

Input File: ornaments.dat

As a worker at the local mall, you have to set out the Christmas ornaments display. The display setup is a triangular pyramid, with the top layer containing one ball, the second from the top containing three, and so on. Each layer's side length will be equal to their layer number. Write a program to determine the total number of ornaments in a pyramid, given the number of layers.



Input
The first line will contain a single integer `n` that indicates the number of data sets that follow. Each data set will consist of a single line containing one integer, denoting the number of layers in the pyramid.

Output
Output the total number of ornaments in the pyramid.

Example Input File
```
2
1
4
```

Example Output to Screen
```
1
10
```

8. Family

Input File: family.dat

You have been given bits and pieces of your family tree. Your task is to determine if two people are related based on several connections.

Input

The first line will contain a single integer `n` that indicates the number of connections. The next `n` lines will consist of a name, a connection, and another name. The connections will be either `mom`, `dad`, `brother`, `sister`, `daughter`, or `son`. The next line will contain a single integer `m` that indicates the number of test cases. The next `m` lines will consist of two names. Your program should determine if the two names are related.

Output

Output either `Related` or `Not Related`, depending on whether they are connected or not. There will be `m` lines of output.

Example Input File

```
3
John brother Susan
Kim mom John
Dave son Jim
2
Jim John
Kim Susan
```

Example Output to Screen

```
Not Related
Related
```

9. Checkpoint

Input File: checkpoint.dat

A drone is being tested by finding the shortest path through a maze, reaching every checkpoint on the way in order. Your task is to write a program that finds the shortest path from the start, through every checkpoint in order, and then to the exit, then prints the length of that path.

Input

The first line will contain a single integer `n` that indicates the number of data sets that follow. Each data set will start with three integers `r`, `c`, and `d` representing the number of rows and columns of the maze and the number of checkpoints, respectively. The next `r` lines will make up the maze, with `S` being the starting point, `E` being the end point, the numbers `1-9` being checkpoints, `#` being a wall, and `.` being an open space. `S` and `E` also count as open spaces.

Output

The output will be the length of the shortest path from the start, through every checkpoint in order, and to the exit. There will be `n` lines of output with no trailing whitespace.

Example Input File

```
2
5 8 2
S....1..
.######.
..2.#...
.######.
......E.
1 11 2
S...1...E.2
```

Example Output to Screen

```
24
12
```

10. Bags

Input File: bags.dat

When creating a gift bag, you are trying to create a bag that weighs as much as possible with as few items as possible. This is to make it feel like the guests are receiving a lot without having to use as many items in each gift bag. Instead of finding how much to put in each gift bag, write a program that finds the fewest number of items you can put into a gift bag to reach the recommended value.

Input

The first line will contain a single integer `n` that indicates the number of data sets that follow. Each data set will be three lines, and will start with a single integer `x` denoting the number of items. The next line will contain `x` integers, indicating the weight of each item. The next line will be a single integer indicating the total weight you are trying to reach.

Output

Output the smallest number of items that will add up to the weight to be returned. If it is not possible to add up exactly to the weight to be returned, print `Not possible`.

Example Input File

```
3
10
1 3 3 3 5 7 7 5 5 10
39
10
1 2 3 4 5 6 7 8 9 10
27
1
100
50
```

Example Output to Screen

```
6
3
Not possible
```

11.Bomb

Input File: bomb.dat

You decide to create a game involving a 3D maze with destructible walls, where all the character has to work with is bombs. In order to determine the number of bombs to provide for each level, you need to know the minimum amount necessary to reach the exit and base it off of that. Your task is to write a program that will find the smallest number of bombs necessary to reach the exit. Each bomb can destroy one wall, leaving a blank space in its place.

Input

The first line will contain a single integer `n` that indicates the number of data sets that follow. Each data set will start with three integers `f`, `r`, and `c`, representing the number of layers, rows, and columns, respectively. The next `f` sets of `r` lines will be the maze, with every set of `r` lines being one layer of the maze.

The `#` represents a destructible wall, `.` represents an open space, `S` is the start location, and `E` is the exit location. You can only move up, down, left, and right (i.e., you cannot move diagonally). You can move freely between layers, but a move between layers stays in the same relative grid location.

Output

Output the smallest number of bombs necessary to escape the maze. There will be no trailing white space.

Example Input File

```
2
2 3 3
S##
##E
###
#.#
#..
###
1 2 10
S#.####.#E
..##..###.
```

Example Output to Screen

```
1
5
```

12. Draw

Input File: draw.dat

You're bored during class one day. Instead of drawing shapes all over your paper, you decide to write a program that will do it for you! Write a program that, when given the type of shape and the dimensions, will draw the specified shape. The program will also be able to either leave the shape empty or fill it in. The shape names and examples are shown below.

rectangle	## ##	### # # ###	### ### ###
left triangle	# ## ###	# ## # # ####	# ## ### ####
right triangle	# ## ###	# ## # # ####	# ## ### ####
diamond	# # # #	# # # # # # # #	# ### ##### ### #

The rectangle can be any number of rows and columns. The left triangle, the right triangle, and the diamond will always have the same number of rows and columns. For the diamond, the number of rows and columns will always be odd.

Input

The first line will contain a single integer `n` that indicates the number of data sets that follow. Each data set will be one line that starts with the shape name. If the shape is a rectangle, the name will be followed by two integers, `r` and `c`, representing the number of rows and columns respectively. If not, then the shape name will be followed by one integer, denoting the number of both rows and columns. The line will end with either `y` or `n`, `y` meaning that the shape is filled in and `n` meaning that the shape is empty.

Output

You will print the specified shape of the specified size, either filled or empty as denoted by the letter at the end of the line. There are examples of the shapes in the table above. There are no lines of whitespace between data sets.

Example Input File

```
3
rectangle 3 5 n
right triangle 4 n
diamond 7 y
```

Example Output to Screen

```
#####
#    #
#####
    #
   ##
  # #
####
    #
   ###
  #####
#######
  #####
   ###
    #
```