This is the **problem set for the final contest**.
This problem set has **13 problems**. The items in the problem list below are links to each problem. You can click a problem name to jump to its page in the PDF file.
Problems are not in order of difficulty.

Verdict Information

Yes/Accepted: Your program passed all the judge's test cases.

Runtime Error: Your program produced an error while running.

Wrong Answer: Your program's output did not match the judge's output file.

Time-limit Exceeded: Your program was not able to process all input and terminate in the time limit set for the problem. You may have infinite loops, or your solution may not be efficient enough.
The time limit for all problems is **3 seconds**.

Output Format Error: Output is correct, but the spacing is wrong.

Please Send to Correct Problem: Your program appears to be a solution for another problem that you intended to submit to.

Problem A: AM-GM Inequality

The AM-GM inequality states that for any set $\{a_1, a_2, \cdots, a_n\}$, the arithmetic mean is always greater than or equal to the geometric mean. You've been told to prove this, but you'd rather just write a program to prove it to yourself via brute force.

For a set of numbers $\{a_1, a_2, \cdots, a_n\}$ containing n elements:
The arithmetic mean is:

$$\frac{a_1 + a_2 + \cdots + a_n}{n}$$

The geometric mean is:

$$\sqrt[n]{a_1 \times a_2 \times \cdots \times a_n}$$

Input
The first line of input contains an integer N $(1 \leq N \leq 10)$, the number of elements in the set. N real numbers follow, which are the elements of the set $(0.00 \leq a_i \leq 5.00)$. The elements of the set will be expressed to 2 decimal places.

Output
The output consists of two lines: first the arithmetic mean, then the geometric mean.
All values must be rounded to two decimal places.

Sample Input #1	**Sample Output #1**
3 1.00 2.00 3.00	2.00 1.82
Sample Input #2	**Sample Output #2**
2 3.14 5.00	4.07 3.96

Hint: $\sqrt[n]{x} = x^{1/n}$

Problem B: A Certain Magical Index

A certain monster trainer loves the letter 'A'. No one knows why. She has asked you to make a program that will print out the locations of all the A's (**uppercase and lowercase**) in any sentence she feeds into the program.

Input
Input consists of a single line, which is at most 1000 characters. The line may contain English letters, spaces and punctuation marks.
There will be at least one letter A (or a) in the input.

Output
Output should be the index/position of each `'a'` or `'A'` in the line.

For each 'a' in the input, output:
`a found at index X`
where X is the index where the `'a'` character is found.

For each 'A' in the input, output:
`A found at index X`
where X is the index where the `'A'` character is found.

The index of the first character of a string is zero. Output the lines in increasing index order.

Sample Input #1
```
Once, I went to ASPC. And it was awesome.
```

Sample Output #1
```
A found at index 16
A found at index 22
a found at index 30
a found at index 33
```

Sample Input #2
```
Another day. Another activity. Aha!
```

Sample Output #2
```
A found at index 0
a found at index 9
A found at index 13
a found at index 21
A found at index 31
a found at index 33
```

Problem C: Field of Numbers

Do you know Sudoku? To solve a Sudoku puzzle, you need to fill in the grid such that:

1. Each row contains the digits 1-9, with no repetitions.
2. Each column contains the digits 1-9, with no repetitions.
3. Each 3 x 3 box contains the digits 1-9, with no repetitions.

For example, here is a Sudoku puzzle and its solution.

			2	6		7		1
6	8			7			9	
1	9				4	5		
8	2		1				4	
		4	6		2	9		
	5				3		2	8
		9	3				7	4
	4			5			3	6
7		3		1	8			

4	3	5	2	6	9	7	8	1
6	8	2	5	7	1	4	9	3
1	9	7	8	3	4	5	6	2
8	2	6	1	9	5	3	4	7
3	7	4	6	8	2	9	1	5
9	5	1	7	4	3	6	2	8
5	1	9	3	2	6	8	7	4
2	4	8	9	5	7	1	3	6
7	6	3	4	1	8	2	5	9

Taken from http://dingo.sbs.arizona.edu/~sandiway/sudoku/examples.html

For this problem, you **do not need to solve a Sudoku puzzle**.
You just need to check if a 9 by 9 grid of numbers is a **valid Sudoku solution**.

Input

Input consists of 9 lines each containing 9 numbers.
All numbers in the input will range from 1 to 9.
Numbers will be separated by single spaces.

Output

Output consists of a single line. Print “Sudoku!” (without the quotes) if the input is a valid solution to a Sudoku puzzle. If the given input is not a solution, print “`Sad aku.`” (without the quotes.)

Sample Input #1

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

Sample Output #1

```
Sudoku!
```

Sample Input #2

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

Sample Output #2

```
Sad aku.
```

Problem D: Diy Latin

Sir Diy came up with a totally new language called Diy Latin! To translate a word to Diy Latin, use the following rules:

Words that **begin with a vowel (a, e, i , o, u)** should have the string "ay" (not including the quotes) added after it.

For example, "apple" becomes "appleay".

Words that **begin with a consonant** should have the first consonant moved to the end of the word, and then adding "ay" after the word.

For example, "hello" becomes "ellohay".

Can you translate words to Diy Latin?

Input

The input consists of a single word, consisting only of lowercase English letters. The word will be at least 3 and at most 10 characters long.

Output

Output a single line containing the Diy Latin translation of that word.

Sample Input #1	Sample Output #1
tomato	omatotay
Sample Input #2	**Sample Output #2**
umbrella	umbrellaay
Sample Input #3	**Sample Output #3**
oregano	oreganoay
Sample Input #4	**Sample Output #4**
yellow	ellowyay

Problem E: Hacking to the Gate

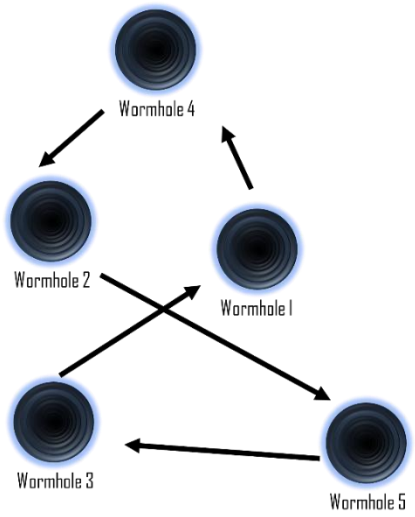
Our sources indicate that someone has discovered how to time travel using black holes. We have acquired data about their movements. Track them down.
Create a simulation which simulates travel through a network of connected wormholes. According to our research, wormholes are known to be unpredictable; you sometimes aren't able to come back the way you came.

Input
The first line of input contains three integers N, S, and K $(1 \leq N, K \leq 100;\ 1 \leq S \leq N)$.
N is the number of wormholes. The wormholes will be numbered from 1 to N.
S is the number of wormhole where you start at, and K is the number of jumps you make.
To make one jump is to travel through one wormhole and end up at its destination.
The second line of input contains N integers D_i $(1 \leq D_i \leq N)$, the immediate destinations of each wormhole from wormhole 1 to wormhole N.

Output
Output `"Location: x"` (without the quotes), where x is a single integer: your location after making K jumps.

Sample Input #1
```
5 2 3
4 5 1 2 3
```
Sample Output #1
```
Location: 1
```
Sample Input #2
```
3 3 10
1 1 2
```
Sample Output 2:
```
Location: 1
```

Explanation for sample case 1:
In the first sample case, there are $N = 5$ wormholes.
Wormhole number 1 takes you to wormhole 4.
Wormhole number 2 takes you to wormhole 5.
Wormhole number 3 takes you to wormhole 1.
Wormhole number 4 takes you to wormhole 2.
Wormhole number 5 takes you to wormhole 3.
You begin at wormhole $S = 2$, and make $K = 3$ jumps:
Your first jump through wormhole 2 and get taken to wormhole 5.
You then jump through wormhole 5 and make it to wormhole 3.
Lastly, you jump through wormhole 3 and make it to wormhole 1. **Thus, your final location is at wormhole 1.**



Problem F: Cake

Sir Diy loves eating cake! Cake! Cake! Cake!

His favorite ASPC students were kind enough to give him wonderful cakes, and he wants to start digging in! Unfortunately, he can't eat them in the lab (that's just how the rules are, even for the teachers!) so he has to find a refrigerator to place them in so they won't go bad!

Help him by determining the circumference of the cakes, so he can better fit them into the fridge!

Remember, the circumference of a circle is obtained by the equation:

$$C = 2\pi r$$

where r is the radius of the circle.

Input
The input will consist of a single real number representing the radius r $(0 < r \leq 200)$ of the cake, expressed to two decimal places.
.
Output
Output should consist of the circumference of the cake, rounded off to three decimal places.

Sample Input #1	**Sample Output #1**
`1.00`	`6.283`
Sample Input #2	**Sample Output #2**
`123.10`	`773.460`

Problem G: Maximino Triples

A professor has N students, with student numbers from 1 to N. Each student in his class already took three exams, and they each have three scores.

The professor wants to know what the highest, or maximum score is for each student among the three exams.

Input
The first line of input contains an integer N $(1 \leq N \leq 100)$, the number of students.
This is followed by N lines, each containing the scores for one student.
The students' data is given from Student 1 to Student N, in that order.
The scores for each student are represented by three integers ranging from 0 to 100.

Output
Output N lines, one for each student.
Each line should in the format "`Student X: Y`" where X is the student's number, and Y is the highest score the student has among their three exams.

Sample Input #1
```
2
75 95 80
68 73 85
```

Sample Output #1
```
Student 1: 95
Student 2: 85
```

Sample Input #2
```
3
32 50 45
23 21 45
32 21 32
```

Sample Output #2
```
Student 1: 50
Student 2: 45
Student 3: 32
```

Problem H: Range Median Query

The **median** of a data set can be obtained by **sorting the set in ascending order**.
If there are an odd number of elements, the median is the element in the middle of the sorted data set. If there are an even number of elements, the median is the average of the two elements in the middle of the data set.

12	23	35	65	78

Median = $\mathbf{35}$

12	23	35	45	65	78

Median = $(35 + 45) \div 2 = \mathbf{40}$

A **range median query** is as follows:
Given a sequence of numbers (which may or may not be sorted), get only the elements from index x to index y**,** and output the median of this subsequence. For this problem, indices start at zero. For example, given the sequence:

A[0]	A[1]	A[2]	A[3]	A[4]	A[5]	A[6]	A[7]	A[8]	A[9]
1	3	5	4	2	4	1	5	6	7

A range median query from index **2** to index **5** would mean that you must output the median of this subsequence from index 2 to index 5.

A[0]	A[1]	**A[2]**	A[3]	A[4]	**A[5]**	A[6]	A[7]	A[8]	A[9]
1	3	5	4	2	4	1	5	6	7

The median of $\{5,4,2,4\}$ is 4, therefore, the result of the range median query is 4.

Input

The first line of input has an integer N $(1 \leq N \leq 100)$, the number of elements in the list.
The second line of input contains N real numbers A_i $(-10 \leq A_i \leq 10)$ separated by spaces, this is the list. The numbers in the list will be expressed to 2 decimal places.
The third line of input contains an integer Q $(1 \leq Q \leq 100)$, the number of range median queries you have to process.
Q lines follow, each containing two integers x and y $(0 \leq x \leq y < N)$, denoting a range median query from index x to index y.

Output

For each range median query, output a single line: the result of the query, printed to four decimal places.

Sample Input #1

```
6
1.00 3.00 5.00 4.00 2.00 4.00
2
2 5
0 2
```

Sample Output #1

```
4.0000
3.0000
```

Sample Input #2

```
3
2.93 -1.34 -5.81
3
0 1
1 1
1 2
```

Sample Output #2

```
0.7950
-1.3400
-3.5750
```

Problem I: 2D Array Problem

ASPC Students love 2D arrays! One particular student is trying to think of a problem which uses 2D arrays, but he knows he can't make the array too big. He knows that if the dimensions of a 2D array are a and b, the size of the 2D array is $a \times b$.

But he's very slow at multiplying two numbers, so he needs your help!

Input
Input consists of two integers: a and b, $(1 \leq a, b \leq 10^9)$ the dimensions of the 2D array.

Output
Output the size of the 2D array, modulo 10007.

Sample Input #1	**Sample Output #1**
`3001 1026`	`6877`

Sample Input #2	**Sample Output #2**
`104652 107529`	`3233`

Sample Input #3	**Sample Output #3**
`100001904 100001638`	`2408`

Reminder: a modulo b is the remainder when a is divided by b.

Problem J: Drawn Onward

Have you heard of palindromes?
Palindromes are words or phrases that are the same when spelled backwards, ignoring spaces and punctuation.
For example:
"Racecar"
"Kayak"
or the name of this problem: "Drawn Onward"

Your task is to determine if a sequence of numbers is the same when read backwards.

Input
A test case begins with a single line, an integer N $(1 \leq N \leq 300)$ denoting the number of elements in the test case.
The second line of a test case contains N integers, separated by spaces. This is the test case.

Output
For each test case, output a single line.
If the set of numbers in the test case is the same when read backwards, output "Yes" without the quotes.
Otherwise, output "No" without the quotes.

Sample Input #1
```
4
1 2 2 1
```

Sample Output #1
```
Yes
```

Sample Input #2
```
7
90 50 55 43 55 50 90
```

Sample Output #2
```
Yes
```

Sample Input #3
```
5
1 2 3 4 5
```

Sample Output #3
```
No
```

Problem K: Migeee's String Game

Migeee loves the letter E! He decides to play a game with his friend, Hadee.
First, they ask their other friend, Kylee, to give them two strings, S_1 and S_2, containing only vowels (not including the letter Y). Then, Migeee picks a letter in S_1 and Hadee picks a letter in S_2.

How many ways are there for Migeee and Hadee to both pick a letter E?
Two ways of picking a letter are different if Migeee or Hadee pick a letter in a different position of S_1 or S_2, respectively.

Input
Input consists of two lines.
The first line contains the string S_1, and the second line contains the string S_2.
Both S_1 and S_2 contain only lowercase vowels (not including Y). Each string is at least 1 character long and at most 25000 characters long.

Output
Output the number of ways both Migeee and Hadee can get a letter E.

Sample Input #1	**Sample Output #1**
aeeue aieioo	3

Sample Input #2	**Sample Output #2**
aiuoouoai aieeee	0

Sample Input #3	**Sample Output #3**
eee eeee	12

Explanation for sample inputs 1 and 2:

Sample Input 1:

There are three ways Migeee and Hadee can both pick the letter E from their respective strings.

a**e**eue ai**e**ioo	ae**e**ue ai**e**ioo	aeeu**e** ai**e**ioo

Sample Input 2:

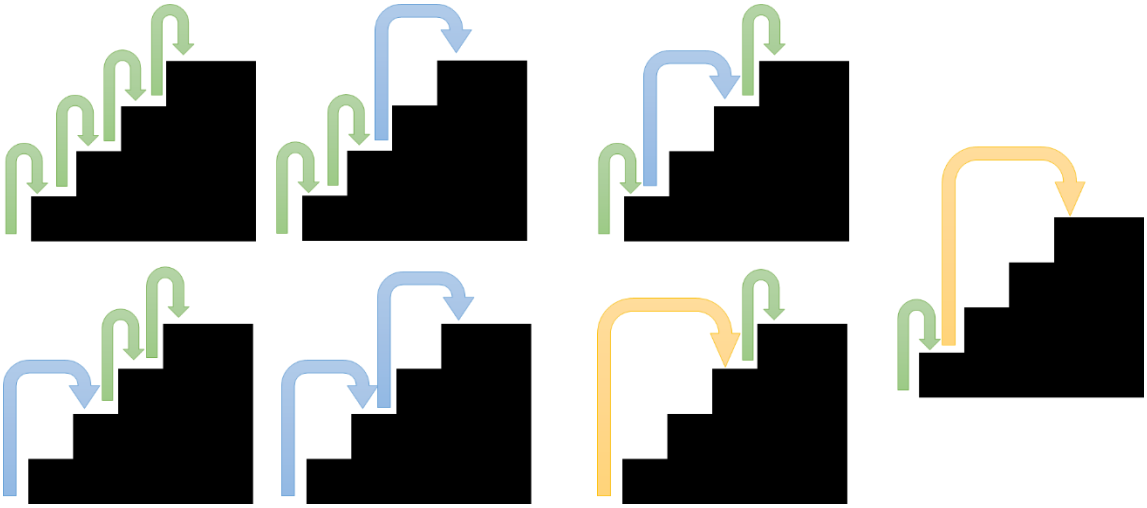
There are no E's in S_1, so there is no way for Migeee to pick a letter E.

Problem L: Hop, Step, Jump!

Rico likes climbing stairs! He wants to climb up s steps in the coolest way possible.
He can do one of three different moves:

1. He can **step**, going up exactly one step.
2. He can **jump**, going up exactly two steps.
3. He can **hop**, going up exactly three steps.

How many ways can Rico climb up s steps using a combination of the three different moves?
For example, if $s = 4$, there are 7 ways Rico can climb up 4 steps.



In the diagrams, green arrows represent **steps**, blue arrows represent **jumps**, and yellow arrows represent **hops**.

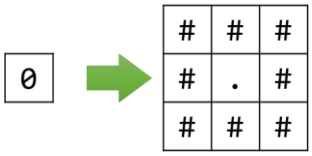
Input
Input consists of a single integer s $(1 \leq s \leq 20)$.

Output
Output the number of ways Rico can go up s steps using some combination of steps, jumps and hops.

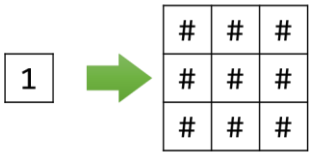
Sample Input #1	Sample Output #1
1	1
Sample Input #2	**Sample Output #2**
2	2
Sample Input #3	**Sample Output #3**
3	4
Sample Input #4	**Sample Output #4**
5	13

Problem M: Dungeon Building

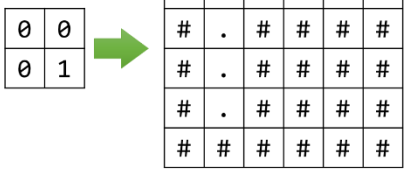
You're working on a game with a friend. Your friend is able to create simple room maps, but he needs your help in order to display these maps as levels on the console window.
A room map is composed of an N by N array of numbers, each cell containing either a zero or a one. A level map is generated from a room map by representing each of the rooms with a 3 by 3 grid.



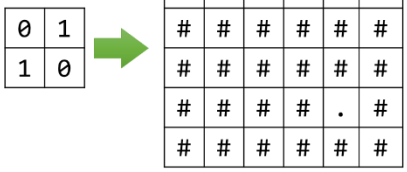
A zero on the level map corresponds to an **open room**: a room with an empty space in the center (denoted by a period), and walls on all four sides and corners (denoted by an octothorpe (#)).



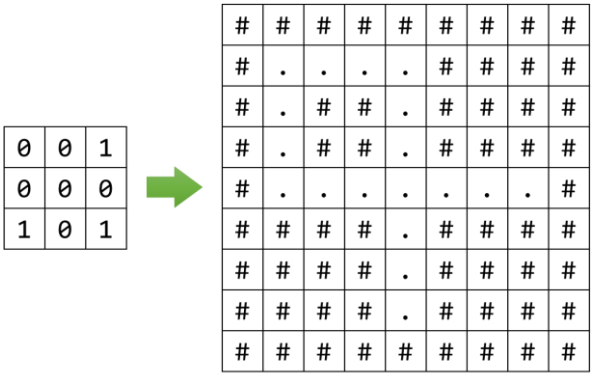
A one on the level map corresponds to a **walled area**, an area filled with walls.



Additionally, if two open rooms are adjacent to each other, the rooms are connected. To connect two rooms, the walls between the centers of the two rooms are turned into open spaces.



Rooms **do not connect diagonally**. In other words, a room is only connected to a room immediately above, below, to the left, or to the right of it.



Input

The first line of input contains a single integer N $(1 \leq N \leq 50)$, the size of the room map. Each of the succeeding N lines contain N integers, each integer either being a `0` or a `1`, the room map to be processed. There will be a single space in between integers.

Output

The output consists of $3N$ lines, each containing $3N$ characters: the level map.

Sample Input #1:

```
2
0 0
0 1
```

Sample Output #1

```
######
#....#
#.####
#.####
#.####
######
```

Sample Input #2

```
3
0 1 0
0 1 0
0 0 0
```

Sample Output #2

```
#########
#.#####.#
#.#####.#
#.#####.#
#.#####.#
#.#####.#
#.#####.#
#.......#
#########
```

Sample Input #3

```
2
0 0
0 0
```

Sample Output #3

```
######
#....#
#.##.#
#.##.#
#....#
######
```