Good Bye 2013

A. New Year Candles

time limit per test: 1 second
memory limit per test: 256 megabytes
input: standard input
output: standard output

Vasily the Programmer loves romance, so this year he decided to illuminate his room with candles.

Vasily has a candles.When Vasily lights up a new candle, it first burns for an hour and then it goes out. Vasily is smart, so he can make b went out candles into a new candle. As a result, this new candle can be used like any other new candle.

Now Vasily wonders: for how many hours can his candles light up the room if he acts optimally well? Help him find this number.

Input
The single line contains two integers, a and b ($1 \le a \le 1000$; $2 \le b \le 1000$).

Output
Print a single integer — the number of hours Vasily can light up the room for.

Examples

input
4 2
output
7

input
6 3
output
8

Note
Consider the first sample. For the first four hours Vasily lights up new candles, then he uses four burned out candles to make two new ones and lights them up. When these candles go out (stop burning), Vasily can make another candle. Overall, Vasily can light up the room for 7 hours.

B. New Year Present

time limit per test: 1 second
memory limit per test: 256 megabytes
input: standard input
output: standard output

The New Year is coming! That's why many people today are busy preparing New Year presents. Vasily the Programmer is no exception.

Vasily knows that the best present is (no, it's not a contest) money. He's put n empty wallets from left to right in a row and decided how much money to put in what wallet. Vasily decided to put a_i coins to the i-th wallet from the left.

Vasily is a very busy man, so the money are sorted into the bags by his robot. Initially, the robot stands by the leftmost wallet in the row. The robot can follow instructions of three types: go to the wallet that is to the left of the current one (if such wallet exists), go to the wallet that is to the right of the current one (if such wallet exists), put a coin to the current wallet. Due to some technical malfunctions the robot cannot follow two "put a coin" instructions in a row.

Vasily doesn't want to wait for long, so he wants to write a program for the robot that contains at most 10^6 operations (not necessarily minimum in length) the robot can use to put coins into the wallets. Help him.

Input

The first line contains integer n ($2 \le n \le 300$) — the number of wallets. The next line contains n integers $a_1, a_2, \ldots, a_n$ ($0 \le a_i \le 300$).

It is guaranteed that at least one a_i is positive.

Output

Print the sequence that consists of k ($1 \le k \le 10^6$) characters, each of them equals: "L", "R" or "P". Each character of the sequence is an instruction to the robot. Character "L" orders to move to the left, character "R" orders to move to the right, character "P" orders the robot to put a coin in the wallet. The robot is not allowed to go beyond the wallet line. In other words, you cannot give instructions "L" if the robot is at wallet 1, or "R" at wallet n.

As a result of the performed operations, the i-th wallet from the left must contain exactly a_i coins. If there are multiple answers, you can print any of them.

Examples

input
2 1 2
output
PRPLRP

input
4 0 2 0 2
output
RPRRPLLPLRRRP

C. New Year Ratings Change

time limit per test: 1 second
memory limit per test: 256 megabytes
input: standard input
output: standard output

One very well-known internet resource site (let's call it X) has come up with a New Year adventure. Specifically, they decided to give ratings to all visitors.

There are n users on the site, for each user we know the rating value he wants to get as a New Year Present. We know that user i wants to get at least a_i rating units as a present.

The X site is administered by very creative and thrifty people. On the one hand, they want to give distinct ratings and on the other hand, the total sum of the ratings in the present must be as small as possible.

Help site X cope with the challenging task of rating distribution. Find the optimal distribution.

Input

The first line contains integer n ($1 \le n \le 3 \cdot 10^5$) — the number of users on the site. The next line contains integer sequence $a_1, a_2, \ldots, a_n$ ($1 \le a_i \le 10^9$).

Output

Print a sequence of integers $b_1, b_2, \ldots, b_n$. Number b_i means that user i gets b_i of rating as a present. The printed sequence must meet the problem conditions.

If there are multiple optimal solutions, print any of them.

Examples

input
3 5 1 1

output
5 1 2

input
1 1000000000

output
1000000000

D. New Year Letter

time limit per test: 1 second
memory limit per test: 256 megabytes
input: standard input
output: standard output

Many countries have such a New Year or Christmas tradition as writing a letter to Santa including a wish list for presents. Vasya is an ordinary programmer boy. Like all ordinary boys, he is going to write the letter to Santa on the New Year Eve (we Russians actually expect Santa for the New Year, not for Christmas).

Vasya has come up with an algorithm he will follow while writing a letter. First he chooses two strings, s_1 anf s_2, consisting of uppercase English letters. Then the boy makes string s_k, using a recurrent equation $s_n = s_{n-2} + s_{n-1}$, operation '+' means a concatenation (that is, the sequential record) of strings in the given order. Then Vasya writes down string s_k on a piece of paper, puts it in the envelope and sends in to Santa.

Vasya is absolutely sure that Santa will bring him the best present if the resulting string s_k has exactly x occurrences of substring AC (the short-cut reminds him of accepted problems). Besides, Vasya decided that string s_1 should have length n, and string s_2 should have length m. Vasya hasn't decided anything else.

At the moment Vasya's got urgent New Year business, so he asks you to choose two strings for him, s_1 and s_2 in the required manner. Help Vasya.

Input

The first line contains four integers k, x, n, m ($3 \le k \le 50$; $0 \le x \le 10^9$; $1 \le n, m \le 100$).

Output

In the first line print string s_1, consisting of n uppercase English letters. In the second line print string s_2, consisting of m uppercase English letters. If there are multiple valid strings, print any of them.

If the required pair of strings doesn't exist, print "`Happy new year!`" without the quotes.

Examples

input
3 2 2 2
output
AC AC

input
3 3 2 2
output
Happy new year!

input
3 0 2 2
output
AA AA

input
4 3 2 1
output
Happy new year!

input
4 2 2 1
output
Happy new year!

E. New Year Tree Decorations

time limit per test: 1 second
memory limit per test: 256 megabytes
input: standard input
output: standard output

Due to atheistic Soviet past, Christmas wasn't officially celebrated in Russia for most of the twentieth century. As a result, the Russian traditions for Christmas and New Year mixed into one event celebrated on the New Year but including the tree, a Santa-like 'Grandfather Frost', presents and huge family reunions and dinner parties all over the country. Bying a Tree at the New Year and installing it in the house is a tradition. Usually the whole family decorates the tree on the New Year Eve. We hope that Codeforces is a big and loving family, so in this problem we are going to decorate a tree as well.

So, our decoration consists of n pieces, each piece is a piece of colored paper, its border is a closed polyline of a special shape. The pieces go one by one as is shown on the picture. The i-th piece is a polyline that goes through points: $(0, 0)$, $(0, y_0)$, $(1, y_1)$, $(2, y_2)$, ..., (k, y_k), $(k, 0)$. The width of each piece equals k.

The figure to the left shows the decoration, the figure to the right shows the individual pieces it consists of.

The piece number 1 (shown red on the figure) is the outer piece (we see it completely), piece number 2 (shown yellow) follows it (we don't see it completely as it is partially closed by the first piece) and so on. The programmers are quite curious guys, so the moment we hung a decoration on the New Year tree we started to wonder: what area of each piece can people see?

Input

The first line contains two integers, n and k $(1 \le n, k \le 300)$. Each of the following n lines contains $k + 1$ integers — the description of the polyline. If the i-th line contains ontegers $y_{i,0}, y_{i,1}, \ldots, y_{i,k}$, that means that the polyline of the i-th piece goes through points $(0, 0)$, $(0, y_{i,0})$, $(1, y_{i,1})$, $(2, y_{i,2})$, ..., $(k, y_{i,k})$, $(k, 0)$ $(1 \le y_{i,j} \le 1000)$.

Output

Print n real numbers — for each polyline, the area of its visible part.

The answer will be considered correct if its relative or absolute error do not exceed 10^{-4}.

Examples

input
2 2 2 1 2 1 2 1
output
3.000000000000 0.500000000000

input
1 1 1 1
output
1.000000000000

input
4 1 2 7 7 2 5 5 6 4
output
4.500000000000 1.250000000000 0.050000000000 0.016666666667

F. New Year Tree

time limit per test: 2 seconds
memory limit per test: 256 megabytes
input: standard input
output: standard output

You are a programmer and you have a New Year Tree (not the traditional fur tree, though) — a tree of four vertices: one vertex of degree three (has number 1), connected with three leaves (their numbers are from 2 to 4).

On the New Year, programmers usually have fun. You decided to have fun as well by adding vertices to the tree. One adding operation looks as follows:

- First we choose some leaf of the tree with number v.
- Let's mark the number of vertices on the tree at this moment by variable n, then two vertexes are added to the tree, their numbers are $n + 1$ and $n + 2$, also you get new edges, one between vertices v and $n + 1$ and one between vertices v and $n + 2$.

Your task is not just to model the process of adding vertices to the tree, but after each adding operation print the diameter of the current tree. Come on, let's solve the New Year problem!

Input

The first line contains integer q ($1 \le q \le 5 \cdot 10^5$) — the number of operations. Each of the next q lines contains integer v_i ($1 \le v_i \le n$) — the operation of adding leaves to vertex v_i. Variable n represents the number of vertices in the current tree.

It is guaranteed that all given operations are correct.

Output

Print q integers — the diameter of the current tree after each operation.

Examples

input
5 2 3 4 8 5
output
3 4 4 5 6

G. New Year Cactus

time limit per test: 2 seconds
memory limit per test: 256 megabytes
input: standard input
output: standard output

Jack and Jill are tired of the New Year tree, now they've got a New Year cactus at home! A cactus is a connected undirected graph where any two simple cycles have at most one common vertex. In other words, this graph doesn't have any edges that lie on more than one simple cycle.

On the 31st of December they are going to decorate the cactus by hanging toys to its vertices. At most one toy is going to hang on each vertex — it's either the toy Jack hung or the toy Jill hung. It's possible for a vertex to have no toys.

Jack and Jill has been arguing, so they don't want any edge to connect two vertices where one vertex has Jack's toy and the other vertex has Jill's toy.

Jack has decided to hang a toys. What maximum number of toys b can Jill hang if they both cooperate to maximize this value? Your task is to write a program that finds the sought b for all a from 0 to the number of vertices on the New Year Cactus.

Input

The first line contains two integers n and m ($1 \le n \le 2500, n - 1 \le m$) — the number of vertices and the number of edges, correspondingly. The next m lines contain two integers a, b each ($1 \le a, b \le n, a \ne b$) that mean that there is an edge connecting vertices a и b. Any pair of vertices has at most one edge between them.

Output

The first line must contain space-separated b_a (for all $0 \le a \le n$) where b_a equals the maximum number of Jill's toys on the cactus considering that it has a Jack's toys. Numbers b_a go in the order of increasing a.

Examples

input
1 0
output
1 0

input
16 20 1 2 3 4 5 6 6 7 7 8 9 10 10 11 11 12 13 14 15 16 1 5 9 13 14 10 10 6 6 2 15 11 11 7 7 3 16 12 8 4
output
16 13 12 12 10 8 8 7 6 4 4 3 3 1 0 0 0

Note

The cactus from the second example is: