Problem A
Largest Common Ghassan of Two Trees

Time limit: 3 seconds
Memory limit: 1024 megabytes

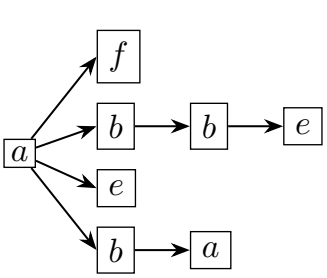
Problem Description

Tree 1 in Figure 1a is encoded as

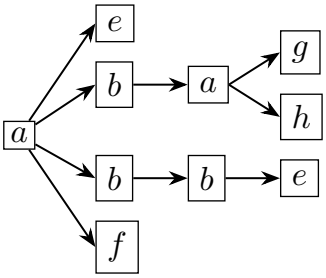
[a [f] [b [b [e]]] [e] [b [a]]]

in the input. Similarly, Tree 2 in Figure 1b is encoded as

[a [e] [b [a [g] [h]]] [b [b [e]]] [f]]



(a) Tree 1.



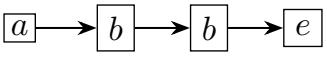
(b) Tree 2.

Figure 1: Two sample trees.

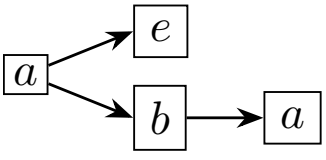
We assume that the label of each node is a single English character, such as a, b, c, etc. Note that the children of a node are ordered. You cannot rearrange the order of siblings.

A *ghassan* of a tree is obtained by removing zero or more subtrees from the tree. Note that if a node is removed, all its descendants are also removed. A ghassan itself is also a tree. The empty tree is trivially a ghassan of every tree. A ghassan of a tree must contain the root of the original tree unless it is an empty tree.

A tree that is a ghassan of two trees is called a *common ghasson* of them. We want to find the *largest common ghassan* of the two trees. "largest" means the most number of nodes. The largest common ghassan of the two trees may not be unique. For example, both trees in Figure 2 are the largest common ghassans of the two trees is shown in Figure 1. Their sizes are 4.



(a) Tree 3.



(b) Tree 4.

Figure 2: the largest common ghassans of the two trees in Figure 1

Input Format

There are two parts. The first part is the encoding of the first tree. The second part is the encoding of the second tree. Spaces and blank lines may be added to the input. They can be simply skipped. You may assume that input is always correct. It is unnecessary to check the input for validly encoding trees.

Output Format

The number of nodes in the largest common ghassan.

Technical Specification

The sum of the sizes of the trees in a single input file is at most 150.

Sample Input 1

```
[a [f] [b [b [e] ] ]
   [e] [b [a] ] ]
[a [e] [b [a [g] [h] ] ]
   [b [b [e] ] ] [f] ]
```

Sample Output 1

```
4
```

Sample Input 2

```
[a [f] [b [b [e] ] ]
   [e] [b [a] ] ]
[b [e] [b [a [g] [h] ] ]
   [b [b [e] ] ] [f] ]
```

Sample Output 2

```
0
```

Problem B
One-way Traveler

Time limit: 3 seconds
Memory limit: 1024 megabytes

Problem Description

There are n planets numbered from 1 to n in New Yellow Cloud Universe (NYCU). In order to promote tourism industry, the government decides to offer free one-way tickets for travelers. A traveler can receive up to n free one-way tickets, and these tickets allow from one planet to another planet in NYCU. However, such tickets have some limitation. For each planet, there is only one destination for departuring from that planet when free one-way ticket is used. That is, travelers can only go from planet i to planet d_i when they use the free one-way ticket.

Paul loves NYCU so much, but Paul is so poor. Paul may only buy a one-way ticket from the Earth to some planet in NYCU. Please assist Paul to calculate how many planets in NYCU Paul can visit by using the free one-way tickets. Paul can choose any planet in NYCU to start his visit.

Input Format

The first line contains an integer n, the number of planet in NYCU. The second line contains n integers $d_1, \ldots, d_n$ indicating the destinations of the free one-way tickets departuring from planets $1, \ldots, n$, respectively.

Output Format

Output the maximum number of planets that Paul can visit by using free one-way tickets.

Technical Specification

- $1 \leq n \leq 10^6$
- $d_i \in \{1, \ldots, n\}$ for $i \in \{1, \ldots, n\}$.

Sample Input 1

```
6
2 3 4 1 2 3
```

Sample Output 1

```
5
```

Sample Input 2

```
6
1 2 3 4 5 6
```

Sample Output 2

```
1
```

Problem C
Spiral of Numbers

Time limit: 3 seconds
Memory limit: 1024 megabytes

Problem Description

Fill in an $N \times M$ matrix with integers between 0 and $NM - 1$ in clockwise order.

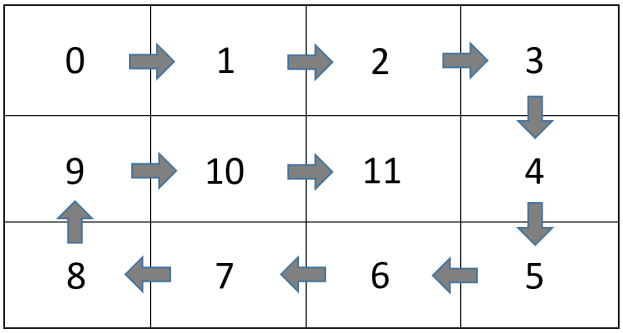


Figure 3: Filling an 3×4 matrix with integers between 0 and 11

Input Format

The input consists of two integers N and M, separated by a space, indicating the size of the matrix.

Output Format

Print the resulting matrix in N lines, each containing M integers separated by a space.

Technical Specification

$0 \leq N \leq 100$ and $0 \leq M \leq 100$.

Sample Input 1

```
3 4
```

Sample Output 1

```
0 1 2 3
9 10 11 4
8 7 6 5
```

Problem D
Large Number Multiply

Time limit: 3 seconds
Memory limit: 1024 megabytes

Problem Description

Given two large numbers A and B, and calculate the multiplication result of A and B.

Input Format

The first line gives how many sets of data, N. N sets of data are given starting from the second line. Each set contains two lines of data.

Output Format

N numbers separated with the new line.

Technical Specification

- The lengths of the numbers in the input are between 1 and 20.
- The lengths of the numbers in the output are between 1 and 41.
- The multiplier and the multiplicand are positive.

Sample Input 1

```
3
12345
12345
98765
98765
12345678999
12345678999
```

Sample Output 1

```
152399025
9754525225
152415789946349642001
```

Problem E
Total Number of Segments in All Permutations

Time limit: 3 seconds
Memory limit: 1024 megabytes

Problem Description

Consider a permutation of $1, 2, \ldots, n$. Define a *segment* in a permutation as a longest, increasing, consecutive sequence of elements. For example, in the permutation 1-4-5-2-3-8-7-6, there are four segments: 1-4-5; 2-3-8; 7; and 6. For another example, the permutation 1-2-3-4-5-6-7-8 contains exactly 1 segment 1-2-3-4-5-6-7-8. For a third example, the permutation 8-7-6-5-4-3-2-1 contains eight segment; Each element is segment by itself.

Input Format

The input contains a positive number n.

Output Format

Output the total number of segments in all permutations of of $1, 2, \ldots, n$.

Technical Specification

$n < 12$

Sample Input 1	Sample Output 1
7	20160

Sample Input 2	Sample Output 2
8	181440

Problem F
Fulcrum

Time limit: 3 seconds
Memory limit: 1024 megabytes

Problem Description

Archimedes said, "Give me a lever and a place to stand and I will move the earth." We call such place to stand a fulcrum. In this problem, torque is defined as the the products of the magnitude of the force applied to the lever and the distance between the fulcrum and where the force applied.

The torque of an array $A = (A_1, \ldots, A_n)$ is defined as the sum of torque generated by the force of A_i units applied at the position of i units far from the fulcrum for $i \in \{1, \ldots, n\}$. For example, the torque of the array $A = 1, 3, 5$ is $1 \times 1 + 3 \times 2 + 5 \times 3 = 22$, because there are a force of 1 unit applied at the position of 1 unit far from the fulcrum, a force of 3 units applied at the position of 2 unit far from the fulcrum, and a force of 5 units applied at the position of 3 units far from the fulcrum.

An array B is a subarray of an array A if B can be obtained from A by deleting several (possibly, zero or all) elements from the beginning and several (possibly, zero or all) elements from the end. In particular, an array is a subarray of itself. Now, we have an array A of n elements. We are interesting in how many nonempty subarrays of torque less than or equal to k. Note that a nonemptry subarray must have at least one element.

Input Format

The first line of input contains two integers n and k. The following line contains n integers $A_1, A_2, \ldots, A_n$.

Output Format

Output an integer, the number of nonempty subarrays of torque less than or equal to k.

Technical Specification

- $1 \leq n \leq 200000$
- $0 \leq a_i \leq 1000000000$
- $0 \leq k \leq 10^{18}$

Sample Input 1

```
3 6
1 2 3
```

Sample Output 1

```
4
```

Sample Input 2

```
3 6
1 3 2
```

Sample Output 2

```
3
```

Sample Input 3

```
3 10
1 3 5
```

Sample Output 3

```
4
```

Problem G
Gambling

Time limit: 3 seconds
Memory limit: 1024 megabytes

Problem Description

As a gambler, you join the International King of Gambler Contest. The contest contains 10^{100} rounds. At the beginning, there are n cards. The i-th card contains a number a_i. And the first card has a joker on it.

When each round starts, we *uniformly randomly* shuffle the cards to a pile. In other word, we randomly choose a permutation p of $\{1, 2, 3...n\}$, and each permutation has the same probability to be chosen. The top of the pile is the p_1-th card, the second one is the p_2-th card and so on. You have to draw the card from the top one by one until you draw a card with a joker. Once the joker is drawn, you can choose to finish the round or keep drawing the cards until the pile is empty. Note that you have to decide the strategy in each round.

After the contest ends, let T be the sum of the numbers on the card drawn by you and C be the number of cards drawn by you in these 10^{100} rounds. Your score will be $\frac{T}{C}$. You want to become the champion, so you want to find the best strategy to maximize the expected value of the score.

Please help to find the expected value of the score if you choose the best strategy.

Input Format

The first line of input contains one integer n, the number of cards. The following line contains n integers $a_1, a_2, \ldots, a_n$, the numbers on the cards. Note that the first card has a joker on it.

Output Format

Output a real number, the expected value of the score if you choose the best strategy. The answer is considered correct if the precision error is less than 10^{-6}.

Technical Specification

$1 \leq n \leq 20$ and $0 \leq a_i \leq 1000000$.

Sample Input 1

```
2
0 1
```

Sample Output 1

```
0.500000000000
```

Sample Input 2

```
2
1 0
```

Sample Output 2

```
0.666666666667
```

Sample Input 3

```
3
1 3 0
```

Sample Output 3

```
1.411764705882353
```

Problem H
An Astronomer's Task

Time limit: 1 second
Memory limit: 1024 megabytes

Problem Description

Imagine the night sky as a 2-D plane, where there is a star at every point with integer coordinates.

While communicating with Bob in ciphers under this beautiful night sky, Alice is wondering how many stars will she hit, if she connects two stars with a line segment?

Please write a program to help Alice calculate.

Input Format

The first line consists of an integers T, the number of test cases. Each of the following T lines consists of four integers x_0, y_0, x_1, y_1, the coordinates of the two stars (x_0, y_0), (x_1, y_1) on which Alice is drawing a line segment.

Output Format

For each test case, print the number of stars on the line segment in a line.

Technical Specification

$0 \leq T \leq 100$ and $-10^9 \leq x_0, y_0, x_1, y_1 \leq 10^9$.

Sample Input 1

```
4
1 1 1 1
1 2 3 6
-1 -1 50 101
-10000 1 1000000000 0
```

Sample Output 1

```
1
3
52
2
```

Problem I
Isomorphism

Time limit: 3 seconds
Memory limit: 1024 megabytes

Problem Description

Following is the defination of isomorphism in wiki. In mathematics, an isomorphism is a structure-preserving mapping between two structures of the same type that can be reversed by an inverse mapping. Two mathematical structures are isomorphic if an isomorphism exists between them.

Now, we want to do the string isomorphic. We have a string s and another string t, lets count how many substrings of s which are isomorphic to t.

A string s is isomorphic to t if the characters in s can be replaced and finally it will equal t. All occurances should be replaced with the another character and keep their order. No two different characters can be mapped to the same character. And the character can be mapped to themself.

For example, the string "aabc" and string "ccab" are isomorphic, since we can replace 'a' with 'c', replace 'b' with 'a', and replace 'c' with 'b'.

Input Format

The input have two lines. The first line contains the string s. The second line contains the string t.

Output Format

Print an integer, the number of substrings of s which are isomorphic to t.

Technical Specification

$1 \leq |s| \leq 10^7$ and $1 \leq |t| \leq |s|$.

Sample Input 1

```
abbaa
abb
```

Sample Output 1

```
2
```

Problem J
Exhibition

Time limit: 3 seconds
Memory limit: 1024 megabytes

Problem Description

You visit an exhibition, which consists of n exhibition halls and m one-way moving lines. The i-th moving line (u_i, v_i) represents that you can go from exhibition hall u_i to exhibition hall v_i.

There is a stamp in each exhibition hall and the exhibition planners provide a stamp card for visitors to collect stamps. You will get a_j happiness value if you collect the stamp in the j-th exhibition hall.

You can start your visit to the exhibition by entering an arbitrary exhibition hall. And you can end your visit by leaving from any exhibition hall. During your visit, you may pass through the same exhibition hall or moving line multiple times if you want. However, you may not enter any exhibition hall after your visit ends. Find the maximum happiness you can get from this exhibition.

Input Format

The first line contains two positive integers n and m representing the numbers of exhibition halls and moving lines, respectively. The next line contains n positive integers, $a_1, \ldots, a_n$, representing the happiness of the stamp in each exhibition hall. Following m lines, the i-th line contains two integers u_i and v_i representing that there is an one-way moving line from exhibition hall u_i to exhibition hall v_i.

Output Format

Output an integer that the maximum happiness you can get from this exhibition.

Technical Specification

- $1 \leq n, m \leq 2 \times 10^5$
- $0 \leq u_i, v_i < n, \forall i \in [0, m)$
- $u_i \neq v_i, \forall i \in [0, m)$
- $1 \leq a_j \leq 10^9, \forall j \in [0, n)$

Sample Input 1

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

Sample Output 1

```
8
```

Sample Input 2

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

Sample Output 2

```
10
```

Problem K
Street Light

Time limit: 10 seconds
Memory limit: 1024 megabytes

Problem Description

There are n street lights on Linong street. The i-th street light is located at the position x_i with a_i luminance coefficient.

The brightness at the position j is $\sum_{i=1}^{n} \left\lfloor \frac{a_i}{|j-x_i|+1} \right\rfloor$. Please find the minimum and maximum brightness among position $1, \ldots, L$.

Input Format

The first line contains two positive integers n and L representing the number of lights and the length of the street, respectively. The next line contains n positive integers, $x_1, \ldots, x_n$, representing the position for each street light. The last line contains n positive integers, $a_1, \ldots, a_n$, representing the luminance coefficient for each street light.

Output Format

Output two integers indicating the minimum and maximum brightness among positions $1, 2, \ldots, L$.

Technical Specification

- $1 \leq n \leq 500$
- $1 \leq L \leq 10^8$
- $1 \leq x_1 \leq x_2 \leq ... \leq x_n \leq L$
- $1 \leq a_i \leq 10^8, \forall i \in [1, n]$

Sample Input 1

```
4 8
3 4 4 6
10 6 13 21
```

Sample Output 1

```
10 31
```

Problem L
Underground Sewer System

Time limit: 3 seconds
Memory limit: 1024 megabytes

Problem Description

Consider an underground sewer system built in a city, represented by grids of $N \times M$. The sewer system consists of pipes of three different types, namely, a horizontal-shaped pipe, a vertical-shaped pipe, and a crossed-shaped pipe, respectively. Refer to the following figure for an illustration.

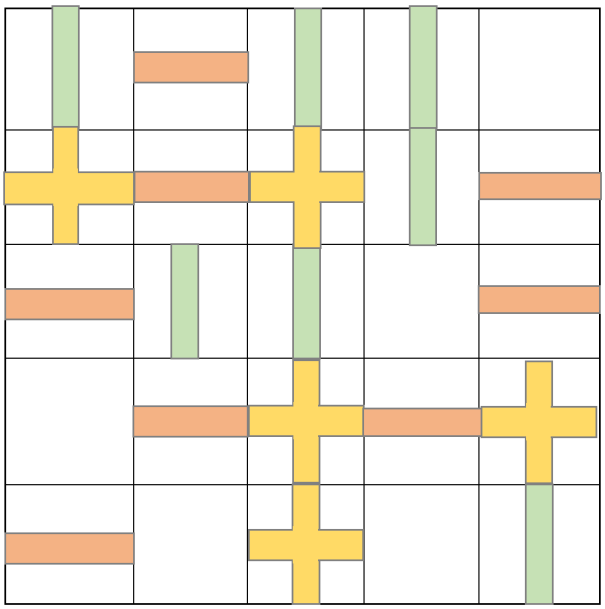


Figure 4: A sewer system

The city is built on the hills, and hence the altitude at which the pipe of each grid is placed may not be the same. As the Laws of Physics suggest, when the water is flowing in the pipes, it cannot flow to pipes that are placed at a higher altitude.

Given the map of the underground sewer system, the altitudes of the pipes, and a pair of grids (x_0, y_0), (x_1, y_1), please determine if the water can flow from (x_0, y_0) to (x_1, y_1).

Note that, the coordinate $(0, 0)$ denotes the top-left grid while $(N - 1, M - 1)$ denotes the bottom-right grid.

Input Format

The first line consists of two integers N and M, indicating the dimension of the grid map.

Then it comes N lines, each containing M characters denoting the types of the pipes.

In particular, '`x`' means that there is no pipe placed at that grid, '`|`' stands for vertical pipes,

'-' stands for horizontal pipes, and '+' stands for crossed pipes, respectively.

Then there are N lines, each containing M integers, representing the altitudes of the pipes.

Note that, larger integer means higher in altitude.

The last line consists of four integers x_0, y_0, x_1, y_1, representing the coordinates of the source and the destination.

Output Format

Print the "YES" if the water can flow from the source to the destination. Otherwise print "NO".

Technical Specification

$0 \leq N, M \leq 100$.

Sample Input 1

```
3 4
-+xx
x|xx
x+--
12 12 10 9
8 7 6 5
4 3 2 1
0 0 2 3
```

Sample Output 1

```
YES
```

Sample Input 2

```
3 4
-+xx
x|xx
x+--
1 2 3 4
5 6 7 8
9 10 11 12
0 0 2 3
```

Sample Output 2

```
NO
```

Problem M
Largest Quadrilateral

Time limit: 3 seconds
Memory limit: 1024 megabytes

Problem Description

A quadrilateral is a four-sided polygon. I.e., a quadrilateral has four edges and four vertices. Given four edge lengths a, b, c, d, please write a program to compute the area of the largest quadrilateral that have edge lengths $\{a, b, c, d\}$.

Input Format

There are four positive integers a, b, c, d in the input file. The numbers are separated by blanks.

Output Format

Print the answer in one line. The answer can be a fractional number. It is acceptable if the absolute error or the relative error is less than 10^{-6}.

Technical Specification

- $a, b, c, d \in [1, 100]$
- You may assume that there exists a quadrilateral having edge lengths $\{a, b, c, d\}$.

Sample Input 1	Sample Output 1
`1 1 1 1`	`1.000000`