CodeNection 2024 Preliminary Round Problems

Competition Team of CodeNection 2024

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Codey and CodeNection

Problem Statement

Codey loves creating patterns with letters! Codey wants to print a right-aligned pattern consisting of n rows using the letters from the word `CODENECTION`. Help Codey to build this unique pattern.

Input Format

The first line contains an integer n, which represents the number of rows of the pattern.

Constraints

$1 \leq n \leq 11$

Output Format

Output the right-aligned pattern.

Sample Test Case 1

`6`	<pre> C
	    CO
	   COD
	  CODE
	 CODEN
	CODENE</pre>

When $n = 6$, the first 6 letters of the word `CODENECTION` is printed in a right-aligned pattern with 6 rows.

Codey and Pebbles

Problem Statement

Codey and its n friends have gathered in CodeNection Town. Each one of them brings a handful of pebbles they collected by the river. Everyone brings an even or odd number of pebbles, but one friend, by mistake, **brings a number that doesn't match the rest.**

The friends line up in a row, each showing the number of pebbles they've brought. Help Codey identify the one friend whose pile has a different number type (odd or even) than all the others.

Input Format

The first line contains an integer n, which represents the number of Codey's friends.

The second line contains n space-separated integers, where each integer represents the number of pebbles brought by Codey's friend.

Constraints

$3 \leq n \leq 100$

Output Format

Output a single integer representing the index of the number that differs in evenness, assuming index starts from 1.

Sample Test Case 1

6 2 4 10 17 8 20	4

All numbers are even except 17. The position of 17 is 4, so the output is 4.

Codey and Spam

Problem Statement

Codey is too excited for CodeNection 2024! It wanted to spam a series of lines arranged in a triangle on the Discord server. The height (vertex) of the triangle is n, and it contains $2n-1$ lines.

Example of $n=3$ containing 5 lines:

CODENECTION
CODENECTION CODENECTION
CODENECTION CODENECTION CODENECTION
CODENECTION CODENECTION
CODENECTION

However, Zoey will kick Codey out immediately if it **spam at least** x `CODENECTION` **word consecutively**. How many lines can Codey spam before Zoey kicks it out of the server?

Input Format

The first line contains two integers, n and x, where n represents the height of the triangle and x represents the maximum number of consecutive `CODENECTION` allowed before Zoey kicks Codey out.

Constraints

$1 \leq n, x \leq 10^5$

Output Format

Output an integer representing the maximum number of lines Codey can spam before getting kicked out.

Sample Test Case 1

`5 16`	`6`

Codey can spam a maximum of 6 lines, and since $1 + 2 + 3 + 4 + 5 + 4 \geq 16$, Codey will get kicked out by Zoey after that.

Codey and Coins

Problem Statement

Codey is hanging around a bustling market when it spots n money bags scattered along a straight path. This market can be visualized as a one-dimensional axis, with **Codey starting at position** $x = 0$. Codey wants to gather these coins without drawing too much attention, so it follows a specific pattern to avoid being noticed.

Each money bag i is located at position at x_i and contains c_i coins. At the start, Codey can choose to walk either to the right or to the left. Each time Codey collects the coins from the money bag at a specific position, it must **reverse its direction** and continue its search for money bags in the opposite direction.

Codey will keep switching directions and collect coins until there are no more money bags available in the direction it is facing that it hasn't already collected.

What is the maximum number of coins Codey can gather?

Input Format

The first line contains an integer n, where n represents the number of money bags in the market.

The following n lines contains two integers, x_i and c_i, where x_i represents the position of the i-th money bag and c_i represents the number of coins in it.

Constraints

- $1 \leq n \leq 100$
- $-10^5 \leq x_i \leq 10^5, x_i \neq 0$
- $1 \leq c_i \leq 10^5$
- It's guaranteed that there's at most one money bag at each x-coordinate.
- It's guaranteed that there's no money bag at $x = 0$.

Output Format

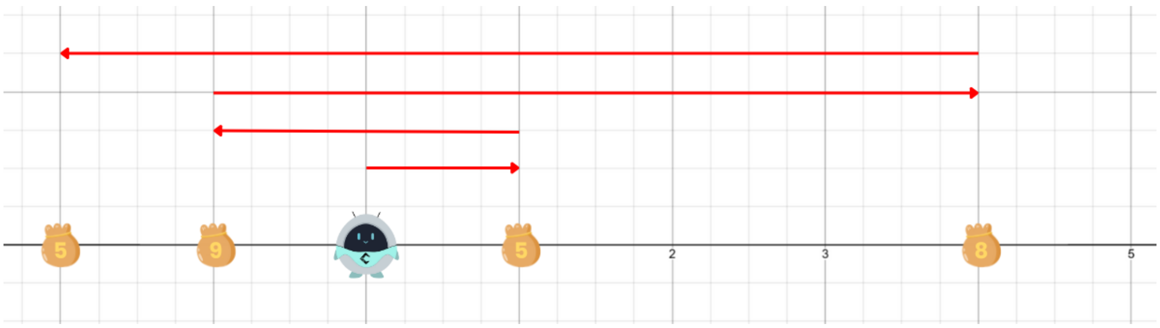
Output the maximum number of coins Codey can collect.

Sample Test Case 1

4 4 8 1 5 -2 5 -1 9	27

There's 4 money bags, each positioned at -2, -1, 1 and 4. Codey starts at 0 and collects coins by moving as follows:

1. Moves right to 1
2. Reverses direction and moves left to -1,
3. Reverses direction and moves right to 4,
4. Reverses direction and moves left to -2.



Hence, the maximum number of coins collected is $5 + 9 + 8 + 5 = 27$.

Codey and Rectangles

Problem Statement

Codey has a rectangular sheet of paper with dimensions x and y. It wants to draw a rectangle that is parallel to the edges of the paper with a **specified area** k.

The rectangle drawn must satisfy the following conditions:

- Both the width and height of the rectangle drawn must be positive integers.
- The rectangle drawn must be exactly k square units and completely contained within the boundaries of the paper.
- The corners of the rectangle drawn must lie on integer coordinates.

Out of all possible rectangle dimensions with an area k, help Codey determine the maximum number of unique positions where it can draw the rectangle of area k on the paper.

Input Format

The first line contains three integers x, y, and k, where x and y represents the dimensions of the rectangle sheet of paper, and k represents the area of the rectangle drawn.

Constraints

- $1 \leq x, y \leq 2000$
- $1 \leq k \leq x \cdot y$

Output Format

Output the maximum number of unique positions where the rectangle of area k can be drawn on the paper. If there is no way the rectangle drawn will fit in paper, output 0.

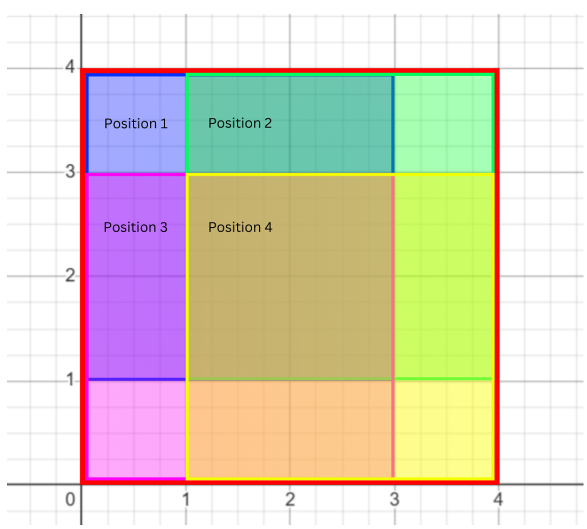
Sample Test Case 1

`4 4 9`	`4`

For area $k = 9$, the only possible integer dimensions are:

- $1 \cdot 9$
- $3 \cdot 3$

The first dimensions $(1 \cdot 9)$ would extend beyond the paper dimensions $(4 \cdot 4)$, so it does not fit. Hence, it's optimal to have the rectangle drawn with side lengths 3 and 3. It can be shown that there's 4 ways to draw a $(3 \cdot 3)$ rectangle in the paper:



Codey and Manuscript

Problem Statement

Codey, a scholar from the kingdom of CodeNection, has been given an important mission by Queen Zoey. Queen Zoey recently uncovered an ancient manuscript that holds a string s, believed to contain a hidden message about the future king of the kingdom. However, parts of the manuscript are missing, with these gaps **marked by `*`** where letters once were.

To help restore the message, Queen Zoey gives Codey another string v, which is known to be part of the hidden message. Codey's task is to determine whether it is possible to fill the gaps in s with lowercase English letters such that v appears as a **subsequence** of the s.

Codey must report back to Queen Zoey about his progress.

A string b is subsequence of string a if it's possible to remove some character in a to get b (without changing the order).

Input Format

The first line contains a single integer t, where t represents the number of test cases.

The first line of each test case contains a single string s, where s represents the damaged manuscript. It contains lowercase English letters and `*`.

The second line of each test case contains a single string v, where v represents the hidden message that must appear as a subsequence in the completed manuscript.

Constraints

- $1 \le t \le 100$
- $1 \le |s| \le 10^5$
- $1 \le |t| \le |s|$
- It's guaranteed that the sum of $|s|$ across all test cases doesn't exceed $2 \cdot 10^5$.

Output Format

For each test case, if it's possible to fulfill the conditions, `YES`. Otherwise, output `NO`.

Sample Test Case 1

3 co**y codey ma**a leo z**y o	YES NO YES

In the first test case, the missing characters `*` can be replaced with `d` and `e` to form `codey`.

In the second test case, it's impossible to fill in the gaps to form `leo`.

In the third test case, one of the missing character `*` can be replaced with `o`.

Codey and Recipe

Problem Statement

Codey wants to impress Zoey by recreating some of Zoey's secret recipes using the ingredients in his kitchen.

Codey lined up all its n ingredients from left to right in its kitchen. The kitchen can be represented as an array a of length n, where a_i represents the type of ingredient at i-th position. Zoey's secret recipe is array t of length m, where t_i represent the type of ingredient needed for its special dish.

As a beginner cook, Codey struggles to recognize the different ingredients. It decides to **select a subarray of m consecutive ingredients from its kitchen** (from array a). To replicate the flavor of Zoey's dish, Codey must ensure that **at least p ingredients** from this selected subarray is contained in t.

For example, if the target recipe $t = [7, 2, 8, 1]$ and $p = 2$, then:

- the subarray $[2, 1, 8, 7]$ will impress Zoey because it contains at least 2 ingredients from t.
- the subarray $[2, 6, 3, 9]$ will not impress Zoey.

Help Codey count how many subarrays of m ingredients it can find in its kitchen that meet Zoey's criteria.

Input Format

The first line contains three integers n, m, and p, where n represents the number of ingredients in Codey's kitchen, m represents the number of ingredients in Zoey's recipe, and p represents the minimum number of ingredients in the selected subarray that must also appear in Zoey's recipe.

The second line contains n integers $a_1, a_2, \ldots, a_n$, each representing the type of ingredients in Codey's kitchen.

The third line contains m integers $t_1, t_2, \ldots, t_m$, each representing the type of ingredients needed for the recipe.

Constraints

- $1 \leq p \leq m \leq n \leq 2 \cdot 10^5$
- $1 \leq a_i \leq 10^5$
- $1 \leq t_i \leq 10^5$
- Elements of the array a and t are not necessarily unique.

Output Format

Output the number of subarrays of m ingredients Codey can find in its kitchen that meet Zoey's criteria.

Sample Test Case 1

6 3 2 1 3 5 6 2 1 3 1 2	2

Subarray $[1, 3, 5]$ at position 1, and subarray $[6, 2, 1]$ at position 4 will meet Zoey's criteria.

Codey and Toy Kingdom

Problem Statement

Codey bought a new set of toys, which includes islands and bridges, and wanted to build a dream toy kingdom using them.

First, Codey arranged $2 \cdot n$ islands in a circle, numbered from 1 to $2 \cdot n$ in a clockwise direction, and connected each pair of adjacent islands with a bridge. Although this version of the toy kingdom allows travel between any two islands using a series of bridges, it is inefficient. To improve travel between distant islands, Codey decided to build bridges between islands that are not adjacent.

Codey used the n remaining bridges to connect different pairs of islands. Each island will have exactly one extra bridge connected to it. For each pair of bridges that intersect, the complexity of the toy kingdom increases by 1.

Help Codey determine the total complexity of the toy kingdom.

Input Format

The first line contains an integer, n, where there are $2 \cdot n$ islands.

The next n lines contain two space-separated integers, a_i and b_i, representing the i-th bridge between island a_i and b_i.

Constraints

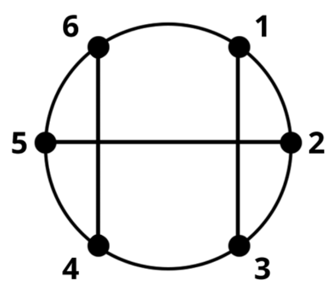
- $1 \leq n \leq 2 \cdot 10^5$
- $1 \leq a_i, b_i \leq 2 \cdot n$

Output Format

Output the total complexity of the toy kingdom.

Sample Test Case 1

3 1 3 2 5 4 6	2



The total complexity is 2 because the following pairs of bridges overlap:

- $(4, 6)$ and $(2, 5)$
- $(1, 3)$ and $(2, 5)$

Codey and Peaks

Problem Statement

Codey is about to explore the legendary Code Mountain, a famous destination for touching grass.

Code Mountain is a one-dimensional mountain made up of n units, which can be represented by an array a of length n, where a_i is the height of the i-th unit. What's special about this mountain is that it is known to have **only two peaks**. Formally, there are only two values of a_i (where $1 < i < n$) such that $a_{i-1} < a_i > a_{i+1}$.

Unfortunately, Codey only knows the heights of the two peaks, while the heights of the remaining units are denoted by -1. Help Codey figure out how many possible combinations of the array a exist modulo 10^9+7, so that he can better prepare for the exploration.

You can assume the max height for each unit is 10^5.

Input Format

The first line contains an integer, n, where n represents the number of units in the Code Mountain.

The second line contains n integers, $a_1, a_2, ..., a_n$ each representing the height of the i-th unit.

Constraints

- $5 \leq n \leq 10^5$
- $2 \leq a_i \leq 10^5$ or $a_i = -1$
- Only two $a_i \neq -1$ where $1 < i < n$

Output Format

Output the total number of combinations of the array a that fulfill the conditions modulo $10^9 + 7$.

Sample Test Case 1

5 -1 2 -1 2 -1	1

The only combination is $[1, 2, 1, 2, 1]$

Sample Test Case 2

8 -1 -1 3 -1 -1 -1 3 -1	2800000

Some of the possible combinations for this test case include:

- $[10^5, 2, 3, 2, 1, 1, 3, 1]$
- $[1, 2, 3, 1, 1, 1, 3, 2]$
- $[2, 2, 3, 2, 2, 2, 3, 2]$