Problem A. Necklace Constructions

Input file:	`standard input`
Output file:	`standard output`
Time limit:	1 second
Memory limit:	256 megabytes

Hephaestus has n straight metal rods of various lengths not necessarily distinct, and he's trying to use them to construct the largest necklace possible, for some notions of "large." He makes a necklace by taking some of the rods and attaching every end of every rod to exactly one other end of another rod until the rods "loop around" to form a single, connected polygon. Although the rods are infinitely thin, they cannot occupy the same space, i.e. the polygon must be non-degenerate.

Let the length of a necklace be the sum of the lengths of its constituent rods. Let S be the set of necklaces that he can construct. Help Hephaestus find the answer to the following two problems:

1. Find the maximum length of any necklace in S (output -1 if S is empty).
2. Find the maximum number of rods of any necklace in S (output -1 if S is empty).

Input

The first line contains a single integer n ($3 \leq n \leq 5 \times 10^5$), the number of rods.

For $1 \leq i \leq n$, the $i+1$-th line contains a single integer s_i ($1 \leq s_i \leq 10^9$), the length of the i-th rod.

Output

Two space-separated integers, where the first one is the maximum necklace length and the second one is the maximum number of rods in a necklace.

Examples

standard input	standard output
3 3 4 5	12 3
3 1 1 3	-1 -1

Problem B. Shrine

Input file:	`standard input`
Output file:	`standard output`
Time limit:	1 second
Memory limit:	256 megabytes

Within the ProColosseum, there is a shrine shaped like a $n \times n \times n$ lattice cube. An ant can walk on the surface of the cube only from one lattice point to an adjacent lattice point in one step (we do not allow diagonal movements).

Given two points on the surface of the cube, compute the minimum number of steps the ant needs to take in order to walk from one point to the other.

Input

The first line contains a single integer n ($1 \leq n \leq 5 \cdot 10^8$), the size of the cube.

The second line contains three space-separated integers x_1, y_1, z_1 ($0 \leq x_1, y_1, z_1 \leq n$). These are the coordinates of the starting point.

The third line contains three space-separated integers x_2, y_2, z_2 ($0 \leq x_2, y_2, z_2 \leq n$). These are the coordinates of the destination point.

Output

Print a single integer, the minimum number of steps for the ant to walk from the starting point to the destination point.

Examples

standard input	standard output
3 0 0 1 3 3 3	8
4 2 2 0 2 0 2	4

Problem C. Gladiators' Language

Input file:	`standard input`
Output file:	`standard output`
Time limit:	1 second
Memory limit:	256 megabytes

Gladiators have a specialized language that is simple, having an alphabet consisting only of $\{a, b, c\}$, yet offers the opportunity to communicate emphasis through word transformations that preserve meaning. Given an initial string, determine whether it has the same meaning as a target string under the two phrase sets $A = \{a, bb, caababc\}$ and $B = \{bbbbbbbb, ab, bc, ca\}$.

Under a phrase set P, one transforms a string s to another string s' with the same meaning through a series of steps. Each step is either an insertion of a string $p \in P$ at a single location in s or a deletion of an appearance of $p \in P$ in s (this must be a deletion of contiguous letters). At any point in the process, the string may have length at most L.

As an example, with $L = 10$, "babc" has the same meaning as "c" under phrase set A, since we can delete the "a" and then the "bb", and it has the same meaning as "bbbbbbbb" under phrase set B, since we can delete the "ab" and then the "bc" and then add the "bbbbbbbb".

Input

The first line contains an integer L ($1 \leq L \leq 5 \times 10^5$) indicating the maximum string length that one may have at any time.

The second line contains the input string over the alphabet $\{a, b, c\}$. Its length is at most L.

The third line contains the target string over the same alphabet with length at most L.

Output

The first line should be a 1 or a 0 indicating whether the target string has the same meaning as the initial string under phrase set A.

The second line is the same as the first, except that it corresponds to using phrase set B instead.

Examples

standard input	standard output
3 abb a	1 1
10 aab cabcabb	0 1

Problem D. Zeus's Trap

Input file:	`standard input`
Output file:	`standard output`
Time limit:	1 second
Memory limit:	256 megabytes

Zeus is standing at the origin in the plane, continuously firing a perfectly straight, infinitely thin, and lethal lightning bolt in the direction of the lattice point (m, n) (which is not the origin). After initially aiming at (m, n), Zeus has turned the plane into a torus: The rectangle $(0, 0), (a, 0), (0, b), (a, b)$ has its opposite sides identified with matching orientation so that a point (x, y) is equivalent to another point (x', y') if $x - x'$ is a multiple of a and $y - y'$ is a multiple of b.

Our hero Odysseus is trapped in this plane and can only stand at lattice points. Zeus's lightning bolt will loop around the toroidal world infinitely, and it passes through Zeus without any change to Zeus or the lightning bolt. However, Odysseus will die if he's zapped by the lightning bolt. On how many distinct lattice points in this toroidal world (including the origin) would Odysseus die?

Input

The first line describes the size of the toroidal world: two space-separated integers a and b ($1 \le a, b \le 10^9$).

The second line has the direction in which Zeus aims: two space-separated integers m and n ($0 \le m, n \le 10^9$, $(m, n) \ne (0, 0)$). Notice that it is possible that $m \ge a$ and/or $n \ge b$.

Output

A single integer describing the number of deadly lattice points for Odysseus.

Examples

standard input	standard output
3 4 1 1	12
3 4 3 2	2
3 4 0 2	4

Problem E. Thefts

Input file:	`standard input`
Output file:	`standard output`
Time limit:	1 second
Memory limit:	256 megabytes

Autolycus, true to his wolfish nature, likes to steal. Today, he has taken notice of N people standing in a line, and has decided to steal all of their wallets.

Autolycus has the ability to steal anything without being caught. Hence, when he steals a wallet from someone, that person doesn't notice at first, and neither does anyone looking at him. When the victim eventually reaches for his wallet, he believes he has left it at home and leaves to retrieve it. Autolycus sneakily waits for his victim to leave the line before attempting his next theft. However, those who have seen Autolycus standing next to the victim will start to get suspicious of him, even if they have no concrete proof.

Not everyone in the line is paying attention to their surroundings. You are given N integers $a_1, \ldots, a_N$. Person i is either not paying attention at all ($a_i = 0$), looking to the left ($a_i = 1$), looking to the right ($a_i = 2$), or vigilantly paying attention both to the left and the right ($a_i = 3$).

Everyone begins with no distrust for Autolycus. However, each person i will witness Autolycus standing next to the victim if he or she is looking in Autolycus's direction when he steals the wallet. When that happens, person i's distrust of Autolycus increases by 1. This happens each time person i witnesses Autolycus standing next to someone who later leaves to retrieve his wallet. Note that everyone will see Autolycus if they are looking in his direction, even if there are people in between.

Autolycus may be good at stealing, but he can only steal one wallet at a time, and wishes to minimize the sum of everyone's distrust for him. Find the lowest total distrust that he can achieve.

Input

The first line contains one integer, N, representing the total number of people. $1 \leq N \leq 5 \times 10^5$. The next line contains N integers, $a_1, \ldots, a_N$. For all i, $0 \leq a_i \leq 3$ describes the direction(s) in which person i is looking, as explained above.

Output

Output a single line containing a single integer, the minimum total distrust Autolycus can achieve.

Examples

standard input	standard output
5 3 2 1 1 0	4
3 0 0 0	0

Problem F. Twisting Words

Input file:	`standard input`
Output file:	`standard output`
Time limit:	2 seconds
Memory limit:	256 megabytes

Hermes is very adept at twisting the words of others. The rest of the pantheon are annoyed about this, and are trying their best to prevent him from doing this. Help them figure out if Hermes will be able to twist their statements into something else, and if so, how he might do it.

As Hermes listens to people speak, he is constantly thinking of ways to twist each of their sentences. A sentence contains at most $1 \leq N \leq 25$ words, $s_1, \ldots, s_N$. For each word, Hermes can either keep it, omit it, or repeat it (have two copies of the word). Then, Hermes can rearrange all the letters in the words he chose in any order he likes. Note that Hermes cannot add new letters from words he has not chosen, nor can he omit letters from a word he has chosen.

Given such a sentence, determine if Hermes can twist it to arrive at a different statement T. Each word $s_1, \ldots, s_N$ and the entire target statement T contains only lowercase letters (a-z). If Hermes can, also find out whether he might keep, omit or repeat each original word.

Input

The first line contains an integer N, where $1 \leq N \leq 25$. The second line contains the N words in the order $s_1, \ldots, s_N$. Every two adjacent word are separated by a single space. You are guaranteed that each word does not exceed 100 characters in length, namely $1 \leq |s_i| \leq 100$. The last line contains the target string T, which is not more than 5000 characters long, so $1 \leq |T| \leq 5000$.

Output

On the first line, print `possible` or `impossible` depending on whether Hermes can form the target statement T with the given strings $s_1, \ldots, s_N$. If it is possible, print a second line containing N integers $k_1, \ldots, k_N$, representing what you think Hermes will do to arrive at T. $k_i = 0$ indicates Hermes will omit this word, and $k_i = 1$ and $k_i = 2$ represent keeping and repeating the word respectively. If there are multiple ways for Hermes to reach T by twisting the original sentence, print any one of them.

Examples

standard input	standard output
2 ab bek kebab	possible 1 1
2 ab keb kebaba	impossible

Problem G. Game

Input file:	`standard input`
Output file:	`standard output`
Time limit:	2 seconds
Memory limit:	256 megabytes

In order to test your wisdom, Athena challenges you to a two-player game. This game takes place on a 2D grid with N cells on each side, and begins in the starting cell (x, y), where $0 \leq x < N$ and $0 \leq y < N$.

From cell (x, y), there are six possible next cells each player can go to: $(x', y') \in \{(\lfloor x/2 \rfloor, y), (x, \lfloor y/2 \rfloor), (x-3, y-4), (x-4, y-3), (x-2, y-1), (x-1, y-2)\}$. However, no player is allowed to stay in the same cell, or leave the grid.

The first move is yours, and you and Athena take turns making moves. The player with no moves left loses. If Athena loses, she will reward you with $100000/k$ coins, where k is the number of moves it took before you won. If you lose, you must give $100000/k$ coins to charity. Your goal is to maximise the amount of money that you have. Athena's goal is to maximize the number of coins donated to charity. Even if she loses and has to reward you, she will always donate any remaining coins she has left to charity. If both of you play optimally, who wins, and in how many moves?

Input

The first line contains two integers, N, Q, representing the width and height of the grid, and the number of queries. You are guaranteed that $1 \leq N \leq 2000$, and $1 \leq Q \leq 2000$. The next Q lines contain two integers each. the ith line contains x_i, y_i, representing the starting cell of the ith game. You are guaranteed that $0 \leq x_i, y_i < N$.

Output

Print Q lines, each containing two integers. On the ith line, print w_i, k_i. w_i must be 1 if you win the ith game and 0 otherwise. k_i must be the minimum number of moves it takes for either you or Athena to win the game.

Example

standard input	standard output
3 2 2 2 1 2	0 2 1 1

Problem H. Sinkholes

Input file:	`standard input`
Output file:	`standard output`
Time limit:	2 seconds
Memory limit:	256 megabytes

Gaea is angry that a large part of her land has been fouled by pollutants, and has decided to cleanse and rebuild it by opening up several sinkholes on a 2D $R \times C$ grid. Each sinkhole begins as a single cell and grows to devour adjacent cells at a rate of one cell per second. Cells are adjacent if they share an edge. Of course, a cell that has already collapsed does not collapse again.

Unfortunately, you, an innocent soul, are currently on this patch of land! Gaea realizes this at the last moment and stablizes one of the grid cells. You need to get from your starting grid cell to the safe grid cell if you are to survive! Neither the cell which you are on nor the safe grid cell are sinkholes. What's the minimum speed s at which you need to run to be able to reach your target before it too collapses? To move at speed s means that you can move to an adjacent cell every $1/s$ seconds.

There are also some big trees in the land. You cannot run through these, and they also stabilize the ground so sinkholes will not collapse them. You may assume that sinkholes spread gradually: that is, as long as you arrive at a cell and leave it before a sinkhole expands to contain it, you are safe, otherwise you will fall into the hole.

Input

The first line contains two integers, R, C, where $1 \leq R, C \leq 1000$. The next R lines contain C characters each, representing the 2D grid. These characters are one of '`S`', '`T`', '`#`', '`!`', '`.`' denoting your starting location, your target safe location, a tree, a sinkhole and normal ground respectively. You are guaranteed that there is exactly one '`S`' and exactly one '`T`' in the grid.

Output

If you cannot reach safety before it collapses no matter how fast you run, print a single line with the word '`impossible`'. If you can walk as slow as you like and still reach your target, print a single line with the word '`stroll`'. Otherwise, print the minimum speed in decimal. Your answer must be accurate to 6 decimal places.

Examples

standard input	standard output
5 4 S#.. ..#. #.#! ..#. T#..	stroll
5 4 S#.. ..#. #..! ..#. T#..	1.5
5 4 ...S .!!! .... ###. T...	8.0
2 3 S#. #.T	impossible

Problem I. Pair Bombs

Input file:	`standard input`
Output file:	`standard output`
Time limit:	1 second
Memory limit:	256 megabytes

Hephaestus has invented a new weapon, called a pair-bomb. Unfortunately, N of these were stolen by Ares to be used against Aphrodite. This is the last thing that Hephaestus wants, and he is trying to help her get to safety.

Ares has placed these pair-bombs on a 2D $R \times C$ grid, where the top-left cell is $(1, 1)$ and the bottom-right cell is (R, C).

Each pair-bomb consists of two separate devices placed in distinct cells (r_a, c_a) and (r_b, c_b) of the grid. When one device is triggered, it explodes and sends a shockwave outwards. At t seconds after the explosion, all cells at Manhattan distance t are affected. That is, when the device at (r_a, c_a) explodes, cell (r, c) is affected $|r - r_a| + |c - c_a|$ seconds later. This explosion can also affect the other device. The other device in the pair-bomb also begins exploding once the shockwave reaches it. There is no delay between the shockwave's arrival and the device's explosion.

Thankfully, Ares doesn't really know how to operate the pair-bombs. He can only prime one of the pair-bombs. Unprimed pair-bombs never explode even if shockwaves reach them. Furthermore, after priming the pair-bomb, he can only trigger one of the devices.

Hephaestus realizes that if he provides Aphrodite with one of his other inventions, she has a better chance of staying safe. He gives her a blast shield that can guard against one shockwave without incurring any damage. However, it will shatter if two shockwaves arrive at the same time, leaving Aphrodite to experience the blast in full force.

Find the total number of cells in which Aphrodite would be safe from Ares' pair-bombs.

Input

The first line contains three integers N, R, C, where $0 \le N \le 10^5$, $2 \le R, C \le 10^6$. The next N lines contains four integers each. The i-th line contains $r_{i,a}, c_{i,a}, r_{i,b}, c_{i,b}$, describing the i-th pair-bomb, where $1 \le r_{i,a}, r_{i,b} \le R$ and $1 \le c_{i,a}, c_{i,b} \le C$. You are also guaranteed that $(r_{i,a}, c_{i,a}) \ne (r_{i,b}, c_{i,b})$ for all i.

Output

Print a single integer on one line, representing the total number of cells in which Aphrodite will be safe from Ares' actions.

Examples

standard input	standard output
1 8 8 1 1 1 2	0
2 8 8 3 3 3 5 4 7 6 7	1

Problem J. Columns

Input file:	`standard input`
Output file:	`standard output`
Time limit:	2 seconds
Memory limit:	256 megabytes

The grand entrance to the ProColosseum needs to be built and you have been hired as the chief architect. The entrance is to be constructed with several columns. Due to some mistakes in the construction of these columns, it turns out that the columns are not all identical.

The emperor still wants the entrance to look good - more specifically, he wants the series of columns to be arranged in a line such that adjacent columns differ in height by at most 1.

You wonder, how many distinct entrances can you build that satisfy the emperor's requirement using all the columns. Two entrances are considered distinct if and only if there exists an i such that the i-th column in one entrance differs *in height* from the i-th column in the other entrance. You are to output the number of distinct entrances modulo $10^9 + 7$.

Input

The first line contains a single integer n ($1 \leq n \leq 10^5$) - the number of different types of columns there are.

The second line contains n space separated integers $a_1, a_2, \cdots, a_n$, ($1 \leq a_i \leq 20$), where a_i represents the number of columns that have height i.

Output

Output a single integer - the number of distinct entrances modulo $10^9 + 7$.

Examples

standard input	standard output
2 3 2	10
3 1 2 1	6