Problem A. Arrange The Piranhas

Input file:	*standard input*
Output file:	*standard output*
Time limit:	2 seconds
Memory limit:	512 mebibytes

The aquarium at which you work is hoping to expand its meagre selection of aquatic life, but lacks the funds to do so. You have been tasked to help promote the aquarium by taking photos of the two exhibits. Taking the first photo went swimmingly, because the catfish were very cooperative. For the piranhas, you have an arrangement of piranhas in mind that will look great on the photo. However, the only way to get the piranhas to move is by recklessly sticking your finger into the water to lure the piranhas. Your goal is to move the piranhas to the desired positions as quickly as possible without losing your finger in the process.

The piranha exhibit can be divided into positions $1, \ldots, n$ from left to right. The exhibit contains k piranhas and every position is occupied by at most one piranha. You can stick your finger into any unoccupied position. This will lure the nearest piranha to the left of your finger and the nearest piranha to the right of your finger. These piranhas will swim towards your finger, moving forward one position per second. All other piranhas simply stay in place. A piranha will bite your finger if it reaches the same position, so you must pull your finger away before this happens. Pulling your finger away and sticking it into a different position does not take any time.

For example, suppose there are piranhas at positions 2, 7 and 9. If you stick your finger into the water at position 4, the piranhas will be at positions 3, 6 and 9 after one second. You now have to pull your finger away to prevent the piranha at position 3 from biting your finger one second later. If you now stick your finger into the water at position 1, only the piranha at position 3 will move and will end up at position 2 after one second.

Input

- One line containing two integers n ($1 \le n \le 1000$), the number of positions, and k ($1 \le k \le n$), the number of piranhas.
- One line containing k integers $1 \le p_1 < \ldots < p_k \le n$, the current positions of the piranhas.
- One line containing k integers $1 \le d_1 < \ldots < d_k \le n$, the desired positions of the piranhas.

Output

Output the minimum number of seconds needed to get all of the piranhas at the desired positions. If it is impossible to do so, output "`impossible`".

Examples

<table>
<tr><th>standard input</th><th>standard output</th></tr>
<tr><td><pre>9 3
3 7 9
3 5 9</pre></td><td><pre>4</pre></td></tr>
<tr><td><pre>8 3
1 5 8
2 4 7</pre></td><td><pre>impossible</pre></td></tr>
<tr><td><pre>20 6
1 4 7 10 13 20
2 5 8 11 14 17</pre></td><td><pre>17</pre></td></tr>
</table>

Problem B. Big Brother

Input file:	*standard input*
Output file:	*standard output*
Time limit:	2 seconds
Memory limit:	512 mebibytes

You have come up with a new brilliant idea of automatically keeping track of how much (or little) your employees are working in the office: face recognition! By installing some advanced CCTV cameras in the office you will be able to automatically detect when the staff arrives or leaves, are taking breaks etc, thus reducing the need for manual administrative work. No more stamping clocks.

A good CCTV camera is expensive, so ideally you would only use one. It would obviously have to be placed somewhere where the entire office floor can be overlooked, so there are no walls blocking some dark corner of the floor where your workforce might hide.

While looking at the floor map, which can be modelled as a simple polygon, you are not sure if this is possible. Since the task is way above the paygrade of everyone else in the company you will have to write the program figuring this out yourself. If it is possible, you also want to know the area of the surface where the camera could be placed. See Figure 1 for an example.

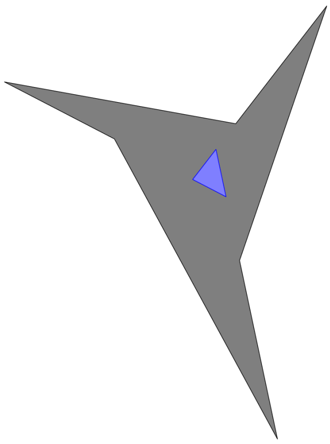

Figure 1: Illustration of Sample Input 3. The blue shaded area in the middle indicates the region where the camera can be placed.

Input

The first line of input contains an integer n ($3 \le n \le 500\,000$), the number of vertices describing the polygon representing the office floor. Then follow n lines containing the integer coordinates x, y of the polygon in clockwise order ($0 \le x, y \le 10^7$).

Output

Output the area of the region of the map where a CCTV camera could be placed so that the rest of the office can be observed. (If it is not possible to put the camera anywhere, this area is 0.)

The answer must be correct with a relative of at most 10^{-6}, or an absolute error of at most 0.1.

Examples

standard input	standard output
8 0 0 0 1 1 1 1 2 2 2 2 1 3 1 3 0	1.0
8 0 0 0 2 1 2 1 1 2 1 2 2 3 2 3 0	0.0
6 140 62 97 141 68 156 129 145 153 176 130 109	48.80349500

Problem C. Company At Danger

Input file:	*standard input*
Output file:	*standard output*
Time limit:	2 seconds
Memory limit:	512 mebibytes

Your company has a policy that every employee should be refunded an amount of money proportional to the shortest distance between their home and office. This causes the loophole that many employees intentionally move very far away to claim the maximum possible reimbursement.

One employee has taken this policy way too far and is in danger of bankrupting you. You must find a way to stop this before cancelling the policy next year. However, the rules are strict: as long as the employee keeps track of the distances they have travelled, you are forced to reimburse them.

Suddenly you have a flash of inspiration: nowhere does it say that you have to use the *Euclidean* distances! You start working on more subtle distance functions and now you have a first prototype: XOR distance. The length of a path is defined as the XOR of the lengths of the edges on the path (as opposed to the sum). The distance between two locations is defined as the length of the shortest path between them.

You will need to test this principle on the transport network with the locations of each of your employees in turn.

Input

- One line containing three integers n ($2 \le n \le 10^4$), m ($n-1 \le m \le 10^5$), and q ($1 \le q \le 10^5$), the number of nodes, edges, and questions respectively.
- m lines describing an edge. Each line consists of three integers x, y, w ($1 \le x, y \le n$, $x \ne y$ and $0 \le w \le 10^{18}$), indicating that there is an undirected edge of length w between nodes x and y.
- q lines describing a question. Each line consists of two integers a, b ($1 \le a, b \le n$) asking for the shortest distance between nodes a and b.

Between every pair of distinct nodes, there is at most one edge, and every node can be reached from any other node.

Output

For every question, output one line containing the shortest distance between nodes a and b.

Examples

standard input	standard output
3 3 3 1 2 2 1 3 2 2 3 3 1 2 1 3 2 3	1 1 0
7 10 5 1 2 45 2 3 11 2 4 46 3 4 28 3 5 59 3 6 12 3 7 3 4 5 11 5 6 23 6 7 20 1 4 2 6 3 5 1 7 5 5	1 5 0 5 0

Problem D. Dams in Distress

Input file: *standard input*
Output file: *standard output*
Time limit: 2 seconds
Memory limit: 512 mebibytes

Freyr, the god of prosperity, rain and the harvest, is having a lot of trouble these days. The giants are once again trying to invade Midgard, and have built a war camp at the bottom of the many valleys leading to Midgard. Now Freyr needs to wash that camp away, so a great victory feast can be held. Being at the bottom of the valley, any rain in the region can make its way through rivers and streams to the bottom of the valley and contribute to the glorious flooding of the giants. However, beavers and industrious humans have built dams throughout the river system, and these act as buffers that can hold some amount of water. But, on the flip side, once a dam is filled up to its capacity, it will break and all of the water stored there (as well as any further water added) will be released downstream.

Freyr, being the god of rain, knows exactly how much water is needed to wash the war camp away, and for each dam knows its exact capacity and how much water is currently stored there. Freyr, also being the god of prosperity and harvest, has better things to do than making it rain everywhere all day, so Freyr decides to only make it rain at a single place (either a dam, or the war camp), and to make it rain as little as possible in that place. What is the minimum amount of rain that Freyr needs to make to wash away the giants war camp, provided he carefully chooses the best location for the rain?

The network of dams and the war camp form a rooted tree, where the war camp is the root and the parent of a dam is the location (either another dam, or the war camp) immediately downstream of the dam. See Figure 2 for an example.

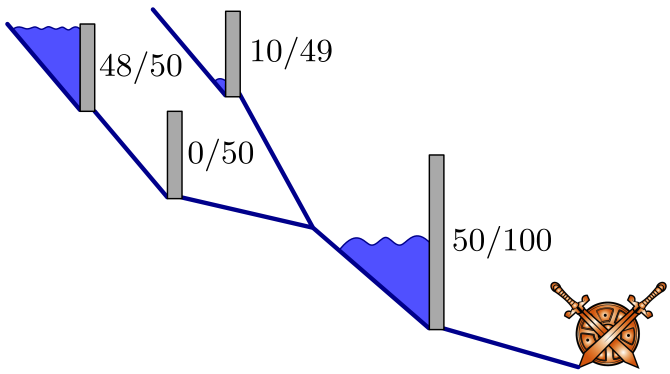

Figure 2: Illustration of Sample Input 1. In this case Freyr only has to make 2 units of rain at the left-most dam in order to make it break and send 50 units of water downstream, which then ultimately results in 100 units of rain reaching the war camp, well exceeding the 75 units of water needed to flood the camp.

Input

The first line of input consists of two integers n and w ($1 \le n \le 2 \cdot 10^5$, $1 \le w \le 10^9$), the number of dams and the amount of water needed to wash away the war camp, respectively. Then follow n lines, describing the n dams. The dams are numbered from 1 to n.

The ith line contains three integers d_i, c_i and u_i ($0 \le d_i < i$, $1 \le c_i \le 10^9$, $0 \le u_i < c_i$), where d_i is the number of the dam immediately downstream of dam i (or 0 if the war camp is immediately downstream of dam i), c_i is the maximum capacity of dam i, and u_i is the current amount of water in dam i.

Output

Output the minimum amount of rain Freyr needs to make at one location, which will result in at least w water reaching the war camp.

Examples

standard input	standard output
4 75 0 100 50 1 49 10 1 50 0 3 50 48	2
4 13 0 12 1 1 6 1 2 4 1 3 10 0	10
4 1 0 100 50 1 49 10 1 50 0 3 50 48	1

Problem E. Exhaustive Experiment

Input file: *standard input*
Output file: *standard output*
Time limit: 2 seconds
Memory limit: 512 mebibytes

You have been assigned to a new top-secret program involving a strange vacuum system. The physicists working on the system have been trying to find out where it is leaking but now they are confused by all the measurement results and want your help to figure out what is going on.

The vacuum system contains a wall with possibly leaking components. The physicists have performed vacuum leak tests on some of these components by flushing them with helium gas and then noting down whether their mass spectrometer detected any spike in helium in the vacuum system directly following this release of gas. If the component has even the tiniest leak they will detect it this way but there are some complications as well. The helium will rise up and spread out from where they released it and if it passes by any other leaking component, that will also trigger a positive reading. For each unit distance the helium has risen it will also have expanded by one unit. Thus the leak test will produce a positive result if the tested component is leaking or if there is a leaking component above it for which the x coordinates differs by at most half of the difference in the y coordinate. See Figure 3 for an example.

You start out with a positive mindset thinking that there are probably just a few leaking components responsible for all the positive measurements. To determine if this is indeed possible you set out to determine the minimum number of leaking components that could give rise to the observed leak test results.

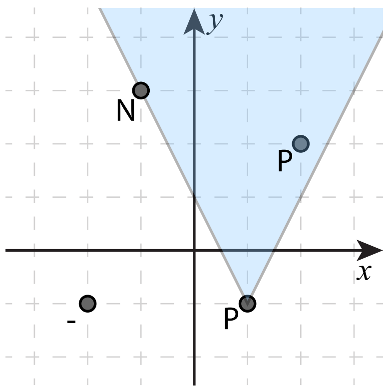

Figure 3: Illustration of Sample Input 1. Circles indicate components and the blue triangle indicates where helium will spread when the first component is tested. This test being positive means that at least one of the the three components covered by the triangle is leaking. The correct answer in this case is 1 since the measurement results can all be explained with only the rightmost component leaking.

Input

The first line of input contains an integer n ($1 \le n \le 2 \cdot 10^5$), the number of components involved. The following n lines each contain two integers x and y and a character c ($-10^8 \le x, y \le 10^8$, $c \in \{$`-, P, N`$\}$), where (x, y) are the coordinates of a component and c describes a possible leak test result, with the following meanings:

- '`-`' – No leak test has been performed on this component
- '`N`' – Leak test gave negative response on this component
- '`P`' – Leak test gave positive response on this component

No two components have the same position.

Output

Output a single integer, the minimum number of leaking components that could give rise to the observed leak test results. If no set of leaking components could give rise to the observed results, instead output the single word "`impossible`".

Examples

standard input	standard output
4 1 -1 P 2 2 P -1 3 N -2 -1 -	1
2 0 0 N 1 2 P	impossible

Problem F. Film Critics

Input file:	*standard input*
Output file:	*standard output*
Time limit:	2 seconds
Memory limit:	512 mebibytes

The premier of the anticipated action film *No Thyme to Fry* is right around the corner, and it is time to give early screenings to film critics so that they can review it. A small cinema has been selected to show these early screenings.

There are n critics numbered from 1 to n scheduled to watch the movie early, and each of them will watch it separately. After watching it, they will immediately give it a score from 0 to m. Susan, the cinema owner, has carefully looked at every critic's social media and already knows that the ith critic thinks the movie is worth a score of a_i. However, the ith critic will not simply give the movie a score of a_i like you would expect, because they also take into account the scores that the other critics gave. Here is how they behave:

1. The first critic to arrive will be so happy that they are the first to review the movie that they will give it a score of m regardless of their initial opinion.
2. Every subsequent critic will look at the average score given by the previous critics. If this number is smaller than or equal to the initial opinion a_i then the critic will give it a score of m, otherwise they will give it a 0.

Susan thinks the critics' behaviour is ridiculous. She has watched the movie, and it is clearly worth a score of exactly k/n and nothing else! But Susan is the owner of the cinema, so she gets to decide in what order to invite the critics. Your task is to find a permutation of $1, 2, \ldots, n$ so that if the critics arrive in this order the average score will be exactly k/n.

Input

The first line of input contains three integers n, m and k ($1 \le n \le 2 \cdot 10^5$, $1 \le m \le 10^4$, $0 \le k \le n \cdot m$). The second line contains the n integers $a_1, a_2, \ldots, a_n$ ($0 \le a_i \le m$ for each i), the n critic scores as described above.

Output

If the critics can be ordered in such a way that the resulting average score is exactly k/n, then output n integers $p_1, \ldots, p_n$ ($1 \le p_i \le n$), where p_i indicates that the ith critic to visit the cinema is the critic numbered p_i. This list of integers should be a permutation such that the average score given by the critics is k/n. If there are multiple solutions any one will be accepted.

Otherwise, if there is no such way to order the critics, output "`impossible`".

Examples

standard input	standard output
5 10 30 10 5 3 1 3	3 5 2 1 4
5 5 20 5 3 3 3 3	impossible

Problem G. Gig Combinatorics

Input file:	*standard input*
Output file:	*standard output*
Time limit:	2 seconds
Memory limit:	512 mebibytes

Your friend Tóti is an aspiring musician. He has written n songs, each of which has a *hype rating* of either 1, 2, or 3. A higher hype rating means the song has more energy. Tóti is planning his first live performance and needs your help. He wants to know how many *setlists* he can make. A setlist consist of at least three songs, the first song must have hype rating 1, the last song must have hype rating 3, and all other songs must have hype rating 2. Tóti also wants to play the songs in the same order he wrote them.

Given the hype rating of each of Tóti's songs in the order he wrote them, how many setlists can he make?

Input

The first line of input consists of an integer n ($1 \le n \le 10^6$), the number of songs Tóti has written. The second line consists of n integers, each in $\{1, 2, 3\}$, giving the hype ratings of the n songs in the order they were written.

Output

Output the number of setlists Tóti can make. Since this number can be large, print it modulo $10^9 + 7$.

Examples

standard input	standard output
9 1 1 1 2 2 2 3 3 3	63
8 1 2 1 2 3 1 2 3	15

Problem H. Hiring and Firing

Input file:	*standard input*
Output file:	*standard output*
Time limit:	2 seconds
Memory limit:	512 mebibytes

Amazin' Inc, an up-and-coming company in e-commerce, has recently optimized its operations to make the most out of its workers. Thanks to state-of-the-art prediction methods, Amazin' now knows in advance how many workers will be needed each day for the foreseeable future. Using this information they can adjust the size of their workforce on a day-to-day basis by firing and/or hiring workers so that they always have exactly as many as are needed each day. In order to prevent the workers from getting too comfortable and organizing themselves, they will also regularly fire workers and replace them with new ones. For instance, if on some day four more workers are needed than yesterday, Amazin' might fire 10 people and then hire 14 new ones on that day.

Unfortunately, due to labor laws, the firing of workers must follow a last-in-first-out order: the people who have been employed the shortest time must be fired first. Furthermore, a fired person cannot be re-hired within the foreseeable future so it is not possible to circumvent the law by firing some people and then immediately re-hiring some of them.

But this story is actually about HR, not workers! Every day, one employee from the HR department is assigned to be responsible for giving the fired workers the bad news that they are fired, and for then giving the newly hired workers the good news that they are hired. In order to minimize work environment problems in the form of social awkwardness for the HR staff, a policy has been established requiring that the HR person firing an employee must always be a different HR person than the one welcoming them when they were hired.

Now the time has come for the HR department to also optimize itself, by making itself as small as possible. Unlike workers, new HR staff cannot be hired with short notice, so the HR personnel must be permanent employees. What is the smallest number of HR people needed in order to manage all the planned hirings and firings?

Input

The first line of input contains an integer n ($1 \le n \le 10^5$), the length in days of the foreseeable future. Then follow n lines, the ith of which contains two integers f_i and h_i ($0 \le f_i, h_i \le 10^6$) where f_i is the number of workers fired on day i and h_i the number of people hired.

The number of workers fired on a day is never larger than the number of currently employed workers (in other words, $f_i \le \sum_{j=0}^{i-1} h_j - f_j$ for all $1 \le i \le n$).

Output

Output a line with an integer k, the smallest number of HR people needed. The HR people are arbitrarily given IDs from 1 to k. Then output a line with n integers, the ith of which contains the ID of the HR person in charge of the firing and hiring on day i. If there is more than one solution, any one will be accepted.

Examples

standard input	standard output
4 0 3 1 1 2 1 2 0	3 1 2 3 2
6 0 10 0 5 2 0 0 0 0 100 50 100	2 1 2 1 2 1 2

Problem I. Infection Estimation

Input file:	*standard input*
Output file:	*standard output*
Time limit:	2 seconds
Memory limit:	512 mebibytes

A new virus has appeared in country X, with a population of 10 million people. This time the country is prepared, and wants to start tracking its spread as quickly as possible. It is currently only known that at least 100 and at most 5 000 000 people are infected, and your job is to provide a more accurate estimate on the number of infected people.

While it will take some time until tests get into mass production, one of the research labs is able to perform up to 50 tests per day. To improve test efficiency, the researchers have decided to combine tests from multiple people. Each test takes in tissue samples from any chosen number of people, and gets a positive result if there is virus in at least one of them, otherwise a negative result. The tests are performed sequentially – the result of each test becomes available before the next test can be performed.

Write a program which decides how to perform the tests and provides an estimate of the number of infected people which is within a factor 2 of the actual number of infected people.

Interaction Protocol

Your program can run up to 50 tests, and must then produce an estimate of the number of infected people. To issue a test, output "`test` k" for an integer $1 \leq k \leq 10^7$. The judge will then provide a line which contains either "`1`" if the test for k randomly chosen people came back positive, or "`0`" if it came back negative. The k people will be chosen without replacement, i.e., the same person cannot be chosen twice. However, the tests are independent, so a person may end up being chosen in more than one round.

To provide the estimate, output "`estimate` x", where $0 \leq x \leq 10^7$ is your estimate on the number of infected people. The answer will be treated as correct if it is within a factor 2 of the correct answer y, i.e., if $y/2 \leq x \leq 2y$.

There will be a total of 100 runs of your program. You may assume that each run is deterministic: making the same sequence of tests on the ith run will always result in the same sequence of test results.

Remember to flush your standard output buffer for every line you output!

(Note: the sample interaction below is shown only for the purpose of illustrating the interaction protocol: there is no way the solution could reliably conclude the given estimate of 250 000 infected people based on the four tests performed.)

Examples

standard input	standard output
test 20	
	1
test 20	
	0
test 23	
	0
test 22	
	1
estimate 250000	

Problem J. Joining Treasure Hunt

Input file:	*standard input*
Output file:	*standard output*
Time limit:	12 seconds
Memory limit:	512 mebibytes

An amateur Viking historian needs your help finding the silver left by Egill Skallagrímsson, of Egil's saga. She has found two old treasure maps that are supposed to lead to it. A treasure map is a list of instructions of the form "*direction k*", where *direction* can be "n", "s", "e", or "w". The maps are sadly old, so some of the instructions are missing and we represent them with a simple "?" instead.

The first map is larger while the second map is a smaller fragment. She wants to know how she can overlay her maps such that they coincide.

Two maps coincide if the corresponding instructions are either identical or at least one of them is lost to time. All instructions must have a corresponding instruction on the other map when overlaying the maps.

Input

- The first line of the input contains two integers, $1 \le m < n \le 4 \cdot 10^5$.
- The next n lines describe the first map with each containing either "?", or "(n—s—e—w)" followed by the number of steps s ($1 \le s \le 7$).
- The next m lines describe the second map with each containing either "?", or "(n—s—e—w)" followed by the number of steps s ($1 \le s \le 7$).

Output

Output the number of indices such that if the second map was overlaid at this index on the first map then they would coincide.

Examples

standard input	standard output
4 3 n 4 e 1 ? s 5 ? e 1 ?	2
4 3 n 4 e 1 w 3 s 5 ? e 1 ?	1

Problem K. Keep Calm And Carry Off

Input file:	*standard input*
Output file:	*standard output*
Time limit:	2 seconds
Memory limit:	512 mebibytes

Petra is learning how to add two positive integers in school, but thinks it is a bit too difficult. They are currently working with the standard algorithm for addition, where you first compute the sum of the two units digits, then the sum of the two tens digits, and so on. Whenever the sum of the digits at the same position in the two numbers exceeds 9, a carry digit is added onto the digit of the next higher magnitude. Petra has trouble with the last step – she often forgets to keep track of the carry digit.

A few weeks ago, she also learnt a simpler method of addition. In this method, you repeatedly add 1 to one of the numbers and subtract 1 from the other, until the second one reaches zero. This can of course take a lot of time for large numbers.

Petra now wants to combine the two methods, for fast and error-free addition. Her plan is to first perform the second method one step at a time, until the two numbers would not produce a carry digit when added using the standard algorithm (for positive integers, this always happens eventually). To evaluate the performance of her new method, she has asked you to help her compute the number of steps she must perform of the second method when adding two given integers. Petra may perform the addition by 1 to either of the two numbers (and subtraction by 1 from the other).

Input

The input consists of two lines, each containing a positive integer with at most 10^6 digits. These are the two integers Petra wants to add.

Output

Output a single integer, the minimum number of times Petra must add 1 to one of her numbers (while subtracting 1 from the other) until they can be added using the standard addition algorithm without any carry digits.

Examples

standard input	standard output
10 99	1
90 10	10
23425 487915	12085

Problem L. Languages

Input file: *standard input*
Output file: *standard output*
Time limit: 2 seconds
Memory limit: 512 mebibytes

In Askinavia, three languages are spoken: Arwegian, Banish, and Cwedish. Askinavia consists of an $n \times m$ grid, where at least one language is spoken in each cell. It is known that each of the three languages is spoken in a non-empty connected subset of grid cells. Connected means that it is possible to get between any pair of cells by moving through adjacent cells, where two cells are said to be adjacent if they share a side.

You have made a survey to find where in Askinavia each language is spoken. The following question was sent to every cell in the region: "Please indicate if one or several of the languages is spoken in your cell". But due to a misprint, there were no choices after the question, so everyone just wrote "one" or "several". So the only thing you know is for each cell whether exactly one, or more than one language is spoken in that cell.

To make the best out of the situation, you should find any division of the three languages that corresponds to the information.

Input

The first line of input contains two integers n and m ($1 \leq n, m \leq 200$).

The following n lines each contain a string of length m, consisting of the characters `1` and `2`. The jth character on the ith line is `1` if exactly one language is spoken in that cell, and `2` if at least two languages are spoken.

Output

If the languages can be divided according to the information, then output three copies of the grid. The first copy should consist of characters "A" and ".", where the "A" indicates that Arwegian is spoken in that cell, and "." indicates that it isn't spoken. The following two grids should consist of characters "B" and ".", and "C" and ".", respectively, with the corresponding information about Banish and Cwedish.

Remember that the three regions have to be connected and non-empty, and every cell must be part of some region. For readability, it is recommended to put empty lines in between the three grids, but it is not necessary to do so. If there are multiple solutions any one will be accepted.

Otherwise, if there is no way to divide the languages, output "`impossible`".

Examples

standard input	standard output
3 4 2211 1112 1112	AAAA ...A .... BB.. BBBB ...B ....C CCCC
1 1 1	impossible