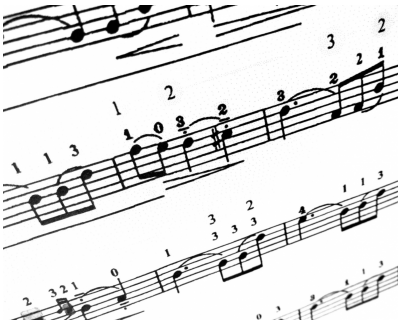
Problem A. Alto Singing

Source file name:	Alto.c, Alto.cpp, Alto.java, Alto.py
Input:	`Standard`
Output:	`Standard`



Sheet music, public domain

Anton is a famous choir singer in the *Kongliga Teknologkören*, the KTH choir. After years of careful political maneuvering, he managed to become the chairman of the choir. As such he has absolute power of what the choir does – including what pieces to rehearse.

Anton has chosen a particular song he likes very much that he wants the choir to sing. There is only a slight problem – the song is not at all suited for his particular vocal range. Anton has the *alto* vocal range, and wants to make sure that the most important part of the piece is perfect for his voice.

The piece is currently written down using the 12 standard tones, in ascending order C, C#, D, D#, E, F, F#, G, G#, A, A#, B, each followed by an integer denoting the octave the tone appears in. The lowest octave is 1. Immediately after the B tone of octave i, the C tone of octave $i + 1$ follows.

Now, Anton wants to *transpose* the piece so that all tones in the part are within his vocal range, which is given by the lowest and highest tone he can sing. Transposing means that all tones are shifted either up or down by some fixed number of tones. For example, C#4 (C# in the fourth octave) transposed 5 tones down would be G#3. Furthermore, Anton is not very good at reading sheet music. Among all valid transpositions, he is only interested in the ones that minimize the number of tones with accidentals (that is, those with a # sign)[1].

Given the piece and Anton's vocal range, can you determine how many such transpositions there are?

Input

The first line of input contains the number of tones n ($1 \leq n \leq 1000$) in the piece. Then follows a line containing two tones, the lowest and the highest tone that Anton can sing (in that order).

The third and final line contains the tones that Anton's piece consists of. The same tone may appear multiple times in the piece. It is guaranteed that Anton can sing at least one transposition of the piece.

Each tone is written as one of the 12 tones C, C#, D, D#, E, F, F#, G, G#, A, A#, B followed immediately by its octave without any space in between. Only octaves between 1 and 10^9 are used[2].

Output

Output a single line with two integers – the minimum number of accidentals (notes with #) among all transpositions, and the number of transpositions that keeps the piece in Anton's vocal range and has the minimum number of accidentals. If the piece is already in Anton's vocal range, the transposition of 0 tones should be counted as well (if that minimizes accidentals).

[1] For those of you who know music, Anton finds writing down a key for the piece other than C major even more confusing, since he must then remember what tones should be raised or lowered throughout the piece.

[2] Possibly only after centuries of vocal exercises.

Example

Input
14 F3 F5 C4 C4 G4 G4 A4 A4 G4 F4 F4 E4 E4 D4 D4 C4
Output
0 3

Input
1 C#1 A#1 C1000000000
Output
0 5

Input
3 F3 F5 F3 F#3 F5
Output
1 1

Problem B. Black Friday

Source file name:	Black.c, Black.cpp, Black.java, Black.py
Input:	`Standard`
Output:	`Standard`

Black friday by Powhusku

Black Friday is the Friday following Thanksgiving Day in the United States (the fourth Thursday of November). Since the early 2000s, it has been regarded as the beginning of the Christmas shopping season in the US, and most major retailers open very early and offer promotional sales. (Source: Wikipedia)

You work in the IT support division of an electronics store. This year, in an attempt to prevent overcrowding, the management has decided to limit the number of people entering the store. They divide the people at the entrance into groups of size n and process them as follows: all n participants roll a die, and report the outcomes $a_1, a_2, \ldots, a_n$. To prevent cheating, instead of selecting the one with the highest outcome, the rule is to select the participant with the highest unique outcome. Everybody not selected has to move to the back of the queue. If there is no winner, the experiment is repeated.

For example, if there are three players and the outcomes are 6, 6 and 5, then the third player wins, because the first and second player lose even though their outcomes are higher, since they both have the same outcome. If instead the third player also rolls 6, then nobody wins.

They asked you to write a program for selecting the winner.

Input

The first line of the input contains one integer n, $1 \leq n \leq 100$, the group size. The second line contains n integers $a_1, a_2, \ldots, a_n$ ($1 \leq a_i \leq 6$ for all $1 \leq i \leq n$): the outcome of each participant's die roll.

Output

Output the index of the participant that has the highest unique outcome, or "`none`" (without the quotes) if nobody has a unique outcome.

Example

Input	Output
8 1 1 1 5 3 4 6 6	4
3 4 4 4	none

Problem C. Costly Contest

Source file name:	Contest.c, Contest.cpp, Contest.java, Contest.py
Input:	`Standard`
Output:	`Standard`

The company Mindsight is holding a programming contest for n contestants of varying ages. It has been decided that the contest will be separated into k age divisions. The duration of the contest will be t minutes, the same for all divisions. Mindsight has created a pool of m available problems for use in the contest, and since all divisions will compete at the same time, the same problems can be used in multiple divisions without any issues.

In each division, the participant that solves the largest number of problems gets a prize, and in case of a tie (same number of problems solved) everyone tied for first place gets a prize. In particular, if no one in a division solves any problems, then everyone in that division gets a prize.

Mindsight has now come to the horrible realization that with these rules it is possible that all participants win a prize. This could bankrupt the company! So the company has enlisted a team of experts to help resolve the situation.

The expert group analyzed the data in depth. For each of the n participants, their skill level was quantified: for the i'th participant, a *slowness factor* s_i was determined. Then, for each of the m problems available, its difficulty was quantified: for the j'th problem, a *difficulty rating* d_j was assigned. The experts predict that the time it takes for participant i to solve problem j is $s_i \cdot d_j$ minutes. Furthermore participants cannot work on multiple problems in parallel so the time it takes to solve multiple problem is the sum of times of solving the individual problems. It is also well-established that participants always solve problems in increasing order of difficulty, starting with the easiest problem.

Now it is up to you, the underpaid intern, to configure the divisions so as to minimize the number of awarded prizes. Your task is to partition the n participants into k non-empty age divisions, and for each age division choose a non-empty subset of the m available problems to use in that division. Each division must correspond to a *contiguous* age range of participants (e.g. a division *cannot* be "20-25 or 30-35 years old"). Recall that the same problem may be used in multiple divisions.

Input

The first line of input contains four integers n, m, k, t ($1 \leq n \leq 10^5$, $1 \leq m \leq 100$, $1 \leq k \leq n$, $1 \leq t \leq 10^5$) – the number of participants n, the number of available problems m, the number of age divisions k, and the duration of the contest t. The second line contains n integers $s_1, \ldots, s_n$ the slowness factors of the participants ($1 \leq s_i \leq 10^5$). The participants are ordered by age, and you can assume no two participants have the same exact age. The third line contains m integers $d_1, \ldots, d_m$ the difficulty ratings of the problems ($1 \leq d_j \leq 10^5$).

Output

Output a single integer, the minimum number of prize winners.

Example

Input	Output
4 3 2 10 2 4 3 4 11 3 6	2
4 3 1 10 4 2 2 6 2 4 4	2

Problem D. DEX Save

Source file name:	DEXSave.c, DEXSave.cpp, DEXSave.java, DEXSave.py
Input:	`Standard`
Output:	`Standard`

Oh no! After months of playing a campaign in the table-top role-playing game Bungalows & Banshees, your character accidentally triggered a trap and was squished under a gigantic rolling boulder. If you had only succeeded in that dexterity saving throw to dodge out of the way of the incoming boulder of doom...

Purple d20, public domain

Always one to dwell on the past, you begin to wonder what your chances actually were of succeeding with the saving throw, and discover that it is not immediately obvious – you had that bardic inspiration giving you a d6 bonus, but then you had disadvantage on the roll due to being intoxicated, but on the other hand your dexterity save modifier was pretty high...

A basic dexterity saving throw with difficulty d is performed in the following way: first, a d20 (i.e., a 20-sided die) is rolled. If the result of the roll is 1 the result is immediate failure, and if the result is 20 the result is immediate success. Otherwise, the character's DEX save modifier m is added to the die result. If the sum is at least the difficulty d, the result is a success, otherwise it is a failure.

There are two extensions to this. First, a roll may be made with either advantage or disadvantage. In these cases, two d20s are rolled instead of one, but then only the highest (for advantage) or lowest (for disadvantage) is kept and the result is then computed as in the basic case. Second, the roll may have additional bonuses or penalty in the form of additional dice that are rolled and then added to or subtracted from the d20 result before comparing it to d (but these bonuses/penalties are only rolled once regardless of advantage or disadvantage).

Write a program which, given the data of a saving throw (its difficulty, the DEX save modifier, advantage/disadvantage status, and additional bonus dice) computes the probability that the saving throw will succeed.

Input

The input consists of three lines. The first line contains two integers d and m ($0 \leq d \leq 30$, $-10 \leq m \leq 10$), the difficulty of the roll and the DEX save modifier of the character. The second line contains one word indicating if the roll has advantage or disadvantage. This word is either "`straight`" (for a straight roll with neither advantage or disadvantage), "`advantage`", or "`disadvantage`". Finally, the third line starts with an integer k ($0 \leq k \leq 5$) indicating the number of additional bonus/penalty dice. This is followed by k dice descriptions, each of the form "`[+-]d`x" ($3 \leq x \leq 10$ is an integer) indicating that we add (if '`+`') or subtract (if '`-`') the outcome of an x-sided die to the result.

Output

Output a single number, the probability that a dexterity saving throw with the given parameters will succeed. This number should be given with an absolute error of at most 10^{-6}.

Example

Input	Output
12 4 straight 0	0.65
10 3 advantage 0	0.91
20 7 disadvantage 2 +d6 -d4	0.212916667

Problem E. Even Electricity

Source file name:	Electricity.c, Electricity.cpp, Electricity.java, Electricity.py
Input:	`Standard`
Output:	`Standard`

A town gets all its electricity from solar power and a dam that provides hydroelectric power. These sources of energy are not always the most reliable, since the amount of sun and water can vary a lot from day to day. Luckily, the dam has a large reservoir that can store water in order to even out the supply of electricity from day to day.

You will be given information about the n coming days. On the i'th day, the solar power station generates s_i units of electricity. At the same time, w_i units of water will flow into the reservoir. Each unit of water can be converted into one unit of electricity, and you can decide how much you want to convert and how much should be left in the reservoir. However, the reservoir can only hold r units of water, so at the end of the day the amount of water in the reservoir cannot be larger than r. In the beginning of the first day the reservoir is empty.

On the first day, there is no water currently stored in the reservoir. At the end of the last day, the dam will undergo maintenance and *must be empty*. In other words, all the water that flows into the dam during the n days must at some point be converted to electricity.

Let e_i be the amount of electricity produced on the i'th day. Note that $e_i = s_i + r_i$ where r_i is how much water from the reservoir you converted on the i'th day. Your task is to find the minimum possible value of $\max_i(e_i) - \min_i(e_i)$.

Input

The first line contains two integers n and r ($1 \leq n \leq 10^5$, $1 \leq r \leq 10^9$), the number of days and the amount of water the reservoir can hold.

The following n lines each contain two integers s_i and w_i ($0 \leq s_i, w_i \leq 10^9$), the amount of electricity generated by the solar power station, and the amount of water that flowed into the reservoir on the i'th day.

Output

Output the minimum possible value of $\max_i(e_i) - \min_i(e_i)$.

Example

Input	Output
3 1 4 2 2 0 5 1	3

Problem F. Forgotten Homework

Source file name:	Forgotten.c, Forgotten.cpp, Forgotten.java, Forgotten.py
Input:	`Standard`
Output:	`Standard`

Yesterday was a fun first day of University for Alice. She met so many new people, and there were so many activities to do! But her new teacher was super strict. It was her first day of university, and the teacher still gave them a lecture on linear algebra and matrix multiplication. And not only that, in order to test the new students, the teacher also gave them the following homework due to the next day.

> *You are given an $n \times n$ matrix A and two indices i and j. Calculate the sequence $A^1(i,j), A^2(i,j), ..., A^{2n}(i,j)$ by hand. In other words, the element on row i and column j in each of the matrices $A^1, A^2, ..., A^{2n}$. Since these numbers can become very large, you should do all calculations modulo $10^9 + 7$.*

Alice, wanting to be a perfect student, definitely did not want to fail this task. So she stayed up all night yesterday doing matrix calculations. But oh no! In the morning, on her way to university, she realizes that she forgot to write down the last number $A^{2n}(i,j)$. And now she has no time left to fix her mistake.

Help Alice calculate the number she is missing!

Input

The first line contains three integers n and i and j ($1 \leq n \leq 3000$, $1 \leq i \leq n$, $1 \leq j \leq n$), given to Alice by her teacher. The second line contains the incomplete sequence of $2n-1$ integers $A^1(i,j), A^2(i,j), ..., A^{2n-1}(i,j)$ calculated by Alice ($0 \leq A^k(i,j) < 10^9 + 7$ for $k = 1, 2, \ldots, 2n-1$). You may assume that Alice made no mistakes calculating the incomplete sequence. The remaining n lines of input each contain n integers, giving the matrix A. The c'th number in the r'th of these lines is the entry $A(r,c)$ in row r column c of A ($0 \leq A(r,c) < 10^9 + 7$).

Output

Output the value of $A^{2n}(i,j)$ modulo $10^9 + 7$.

Example

Input	Output
3 1 1 0 2 0 4 0 0 1 1 1 0 0 1 0 0	8
1 1 1 2 2	4

Problem G. Guessing Circle

Source file name:	Guessing.c, Guessing.cpp, Guessing.java, Guessing.py
Input:	`Standard`
Output:	`Standard`

Alf and Beata were two young adults living together a long, long time ago, before you could spend all your afternoons competing in programming. Their lives were thus much more boring than those of today's young adults. How could you even survive back then, you might ask yourself. The answer is simple: you write down numbers on pieces of paper! Our two cohabitants loved writing integers on papers, and often had huge piles of them each afternoon. To avoid filling their entire living room with integers, Beata challenged her friend to a game every evening to determine who should take the trash out – the Guessing Circle game.

The Guessing Circle game is played by two players (in our case, Alf and Beata) using a large circle of n pieces of papers, each paper labelled with some integer. Alf starts by choosing an integer x that appears on some piece of paper. Beata then tries to figure out what this integer is by asking a series of questions. In each question, Beata picks an integer y that appears on a piece of paper and asks if y is closest to x on the circle when going clockwise or counter-clockwise (measured in the number of pieces of paper between them). If both directions give the same distance, for instance if $y = x$, Alf can choose which one of the two possible answers to provide.

They had initially agreed that no two pieces of paper may have the same integer written on them, but Alf found this hugely unfair – it was quite easy for Beata to figure out x. Instead, he suggested a variant where some integers can appear multiple times in the circle. When providing the answer to a question y from Beata, he is instead allowed to choose *any* pair of papers on which x and y appear, and give his answer for these two papers.

Beata reluctantly agreed to play the new variant, as long as Alf promises to choose an integer in the circle such that Beata can eventually figure it out. Knowing which these integers are turned out to be quite a tricky task for Alf, and he often had to spend hours before the game proving that Beata would be able to deduce which number he had chosen. Write a program to help Alf determine which numbers he can choose.

Input

The first line of integers contains n ($2 \leq n \leq 15\,000$), the number of pieces of paper in the circle. The next line contains n integers, the integers written on the pieces of paper, each between 1 and 15 000. They are given clockwise in the order they appear on the circle, and are not necessarily unique.

Output

Output all integers x that Alf can choose in the game such that given enough guesses, Beata can uniquely determine the value of x. List these values in increasing order. If there is no such integer x, output "`none`".

Example

Input	Output
3 1 2 3	1 2 3
3 1 1 2	none
4 1 2 1 3	none
5 1 2 3 4 1	1

Problem H. A1 Paper

Source file name:	A1paper.c, A1paper.cpp, A1paper.java, A1paper.py
Input:	`Standard`
Output:	`Standard`

Björn likes the square root of two, $\sqrt{2} = 1.41421356\ldots$ very much. He likes it so much that he has decided to write down the first 10 000 digits of it on a single paper. He started doing this on an A4 paper, but ran out of space after writing down only 1250 digits. Being pretty good at math, he quickly figured out that he needs an A1 paper to fit all the digits. Björn doesn't have an A1 paper, but he has smaller papers which he can tape together.

Taping two A2 papers together along their long side turns them into an A1 paper, two A3 papers give an A2 paper, and so on. Given the number of papers of different sizes that Björn has, can you figure out how much tape he needs to make an A1 paper? Assume that the length of tape needed to join together two sheets of papers is equal to their long side. An A2 paper is $2^{-5/4}$ meters by $2^{-3/4}$ meters and each consecutive paper size (A3, A4, ...) have the same shape but half the area of the previous one.

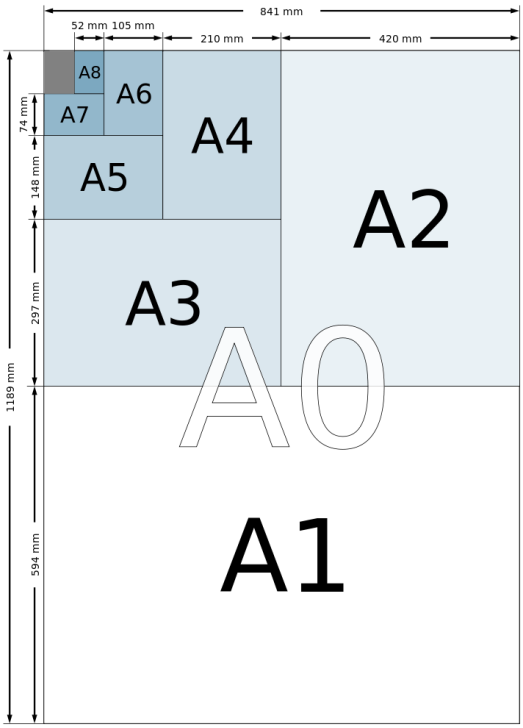


Illustration of the A series paper sizes by Bromskloss

Input

The first line of input contains a single integer $2 \leq n \leq 30$, the A-size of the smallest papers Björn has. The second line contains $n - 1$ integers giving the number of sheets he has of each paper size starting with A2 and ending with An. Björn doesn't have more than 10^9 sheets of any paper size.

Output

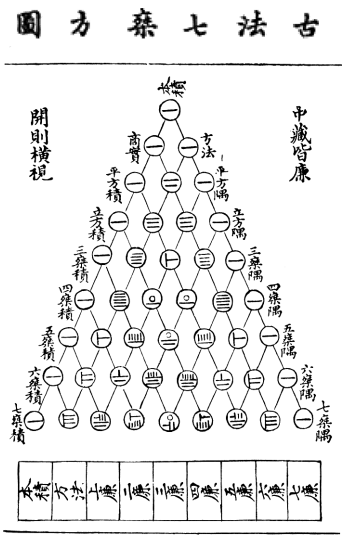
If Björn has enough paper to make an A1 paper, output a single floating point number, the smallest total length of tape needed in meters. Otherwise output "`impossible`". The output number should have an absolute error of at most 10^{-5}.

Example

Input	Output
4 1 0 5	1.60965532263
3 0 3	impossible

Problem I. Odd Binomial Coefficients

Source file name:	Coefficients.c, Coefficients.cpp, Coefficients.java, Coefficients.py
Input:	`Standard`
Output:	`Standard`



You might be familiar with the binomial coefficient $\binom{m}{k}$ defined as $\binom{m}{k} = \frac{m!}{k!(m-k)!}$, where m and k are non-negative integers and $k \leq m$. Let $T_2(n)$ be the number of odd binomial coefficients such that $0 \leq k \leq m < n$. The most useful mathematical inequality you will learn during this competition is

$$0.812556n^{\log_2 3} \leq T_2(n) \leq n^{\log_2 3}.$$

Emma doesn't like such imprecise inequalities and would like to calculate $T_2(n)$ exactly. Can you help her?

Input

The input contains one line with one integer n ($1 \leq n \leq 10^{11}$).

Output

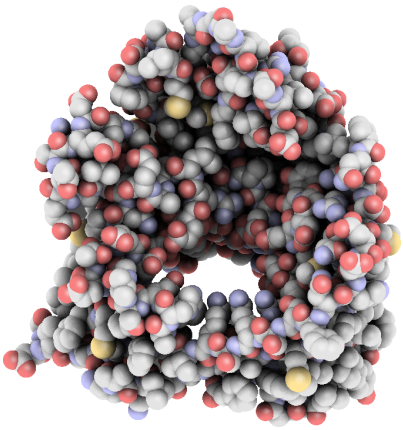
Output one line with the value of $T_2(n)$.

Example

Input	Output
4	9
6	15

Problem J. Proteins

Source file name:	Proteins.c, Proteins.cpp, Proteins.java, Proteins.py
Input:	`Standard`
Output:	`Standard`

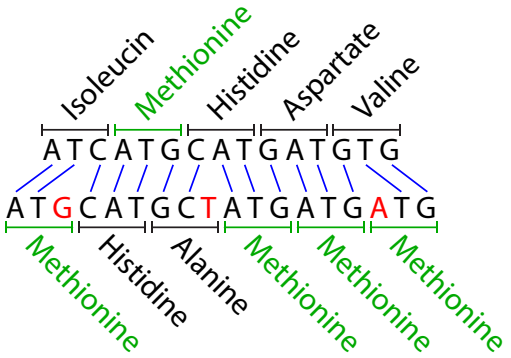


Protein molecule by ALoopingIcon

Magnus is a biologist. He is playing with proteins all day long and now he wants to know what these molecules look like. He has heard that X-ray crystallography can be used to get images of proteins that contain a lot of sulfur atoms. Magnus does not think his proteins contain enough sulfur, but he is willing to change them to get this to work. Magnus has bacteria producing his proteins for him, and he is planning to mutate these bacteria to change the proteins.

Magnus knows the DNA strings coding his proteins and how the DNA is translated into the amino-acid sequence making up the protein. The first three letters in the code determine the first amino acid, the following three letters determine the second, and so on. Whenever those three letters are ATG (in that order) the amino acid methionine will be incorporated into the protein. Methionine contains a sulfur atom, so Magnus wants to have many methionines in his proteins. Magnus can only change the DNA code by inserting letters. This, however, takes a lot of time for each letter he wants to insert. Knowing that you are good at computer stuff, he asks you for help. Can you figure out the smallest number of letters that need to be inserted into the DNA code to make it code for n methionines?

For example, the DNA string TGATGC codes for no methionines, but adding an A in the beginning turns it into ATGATGC which has two ATG blocks and thus codes for two methionines. This is the first sample input and a solution to the second sample input is shown in the figure below.



Input

The first line of input contains a single positive integer $n \leq 10^6$, the number of methionines to be included in the protein. The second line contains a non-empty DNA string of at most 1000 letters, each either A, T, G, or C.

Output

Output a single integer, the smallest number of letters that can be inserted into the DNA string to make at least n of its three-letter blocks be ATG.

Example

Input	Output
2 TGATGC	1
4 ATCATGCATGATGTG	3

Problem K. Shibuya Crossing

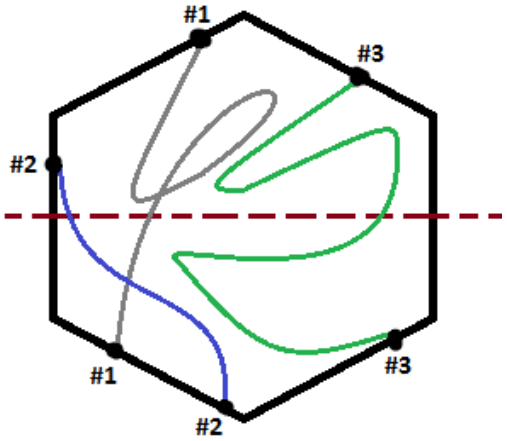
Source file name:	Shibuya.c, Shibuya.cpp, Shibuya.java, Shibuya.py
Input:	`Standard`
Output:	`Standard`

The Shibuya scramble crossing in Tokyo is infamous for being heavily used, resulting in people bumping into each other. The crossing can be modeled as a convex polygon, where the n people about to cross initially stand at a point that is on the perimeter of the polygon and in its lower half. When the traffic lights change, each person starts to walk towards a unique point on the perimeter in the upper half of the polygon. The path each person takes may look like spaghetti (it may even cross itself), but it will never leave the polygon and no two paths will cross more than once.

Shibuya Crossing by Guwashi

Oskar who is a badass geek observes the crossing from the Starbucks nearby. He has numbered the people in the crossing consecutively 1 through n in counter-clockwise order (starting with the person at the very left). Sadly he doesn't know the intended paths of the people at the crossing, but he has gathered some intelligence telling him exactly which persons' paths will cross one another (and this information is consistent with the physical reality).

Being a nerd he obviously knows about Murphy's Law saying "Anything that can go wrong, will go wrong!". So all people who could possibly bump into each other, i.e., all people whose paths cross, will actually bump into each other! He now asks himself, "After all the n people have crossed, what is the size of the largest group of people where everyone has bumped into each other?". Now that is a geeky and tough question, can you help him?



A beautiful illustration of a possible interpretation of the first example test case.

Input

The first line contains an integer $1 \leq n \leq 800$, the number of people at the crossing, and an integer $0 \leq m \leq 10\,000$, the number of paths that will cross, i.e., intersect one another. The next m lines each contain two integers a and b, $1 \leq a < b \leq n$, meaning that the path taken by person a will cross the path taken by person b. (No pair will occur twice in the input.)

Output

Output a single integer giving the size of the largest group of people where everyone has bumped into one

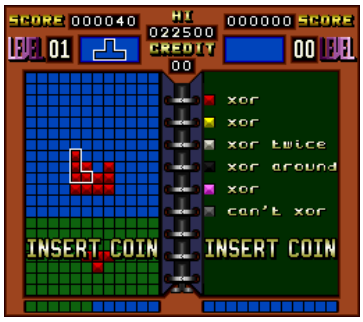
another.

Example

Input	Output
3 1 1 2	2
5 7 1 3 1 5 1 4 2 4 3 4 2 5 2 3	3

Problem L. Xortris

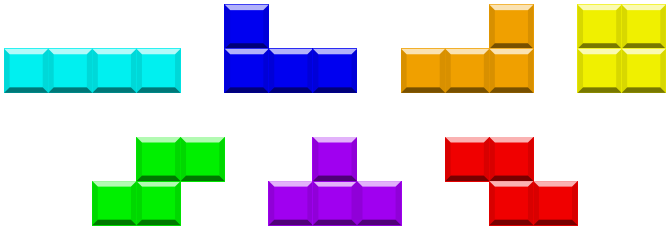
Source file name:	Xortris.c, Xortris.cpp, Xortris.java, Xortris.py
Input:	`Standard`
Output:	`Standard`



Screenshot of World of Xor

It is 1990 and you are in the development team of a video game that is going to revolutionize the future of arcades. The player is given a rectangular board with some white and black squares. The goal is to turn the whole board white. At each turn, the player may choose a tetromino from an infinite supply, move and rotate it within the limits of the board, and toggle the colour of the four squares covered by the tetromino. A tetromino is a connected set of 4 squares (see Figure 2).

Unfortunately, the testing team has been complaining about some levels being impossible to solve. You know that testers are skilled enough to place a piece in any position and rotation needed, so the problem may be somewhere else. Your next debugging step is to write a program that checks whether a level is solvable.



All tetrominoes. From Wikimedia

Input

The first line contains two integers m and n ($1 \leq m, n \leq 100$), the dimensions of the board. m lines with n characters each follow. The character '`.`' represents a white square, and the character '`X`' represents a black square.

Output

One line with the word "`possible`" if the level is solvable and "`impossible`" if it is not.

Example

Input	Output
3 3	possible
3 3 XXX XXX XXX	impossible