Problem A
Arranging Wine
Problem ID: arrangingwine

The host university is organizing a party for this year ACM/ICPC contestants with a buffet dinner and R boxes of red wine and W boxes of white wine. Wine boxes are to be arranged into non-empty piles, each pile contains only one type of wine, either white or red. After that, those piles are put into a line so that no two piles belonging to the same kind sit next to each other. In addition, for security reasons, each red wine pile should not have more than d boxes of red wine, although piles of white wine can be arbitrarily large.

Your task is to identify K - the number of different ways to arrange the given wine boxes satisfying all of the above conditions.

Input

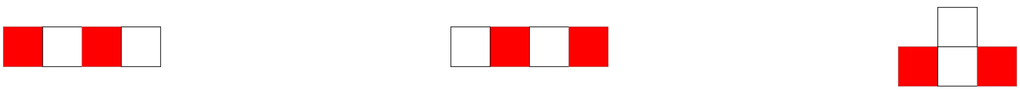
The input contains 3 space separated integers in one line: R, W, d ($1 \leq R, W \leq 10^6, 1 \leq d \leq R$)

Output

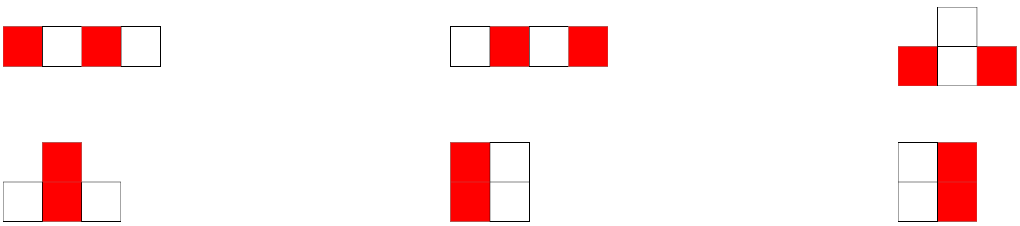
Write in one line the remainder of K divided by $10^9 + 7$.

Sample Clarification

In the first sample below, there are 3 valid arrangements:



In the second sample below, there are 6 valid arrangements:



Sample Input 1	Sample Output 1
`2 2 1`	`3`

Sample Input 2	Sample Output 2
`2 2 2`	`6`

Problem B
Barcode
Problem ID: barcode

To prepare for ACM-ICPC 2017 in Saigon, the host univeriesty - Ho Chi Minh city University of Education (HCMUE) decided to print barcodes in the participants' t-shirts. The barcode requirement needs to be simple to reduce the cost but still shows some scientific styles. HCMUE decided that every barcode consists of red bars and blue bars satisfing at least one of the following conditions:

- The number of blue bars is equal to the number of red bars.
- There is no 2 consecutive blue bars.

Let K denote the number of different ways to create the required barcodes containing N bars. Given two integers N and M, where M is a prime number, your task is to help them identify the remainder of K divided by M.

Input

The input consists of several datasets. The first line of the input contains the number of datasets, which is a positive number and is not greater than 20. Each dataset is described by one line containing two numbers N and M ($1 \leq N \leq 10^6$, $1 < M \leq 10^7$). M is a prime number.

Output

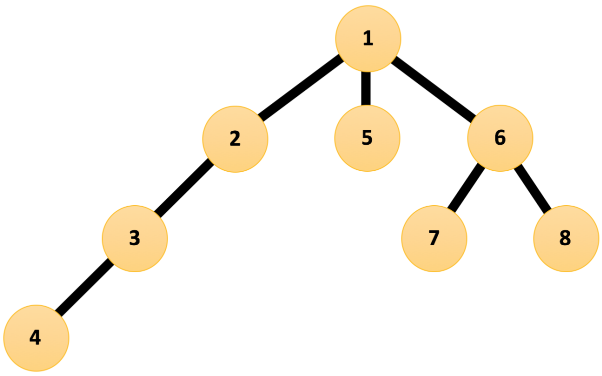
For each dataset, write in one line the remainder of K divided by M.

Sample Input 1	Sample Output 1
6 1 997 2 997 3 997 5 997 7 997 9 997	2 3 5 13 34 89

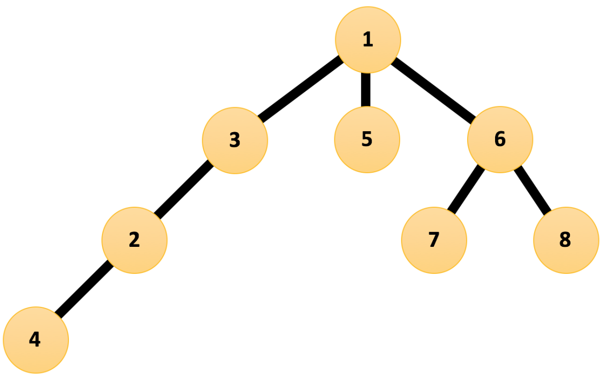
Problem C
Cu Chi Tunnels
Problem ID: cuchitunnels

The tunnels of Cu Chi are an immense network of underground tunnels connecting rooms located in the Cu Chi District of Ho Chi Minh City. The Cu Chi tunnels were the location of several military campaigns in the 1960s. Nowadays, it is a popular tourist destination.

There are documents from trusted sources about a private network of tunnels in this area used by a secret forces unit but it has not been discovered. According to the documents, this private network has N rooms (numbered from 1 to N) connected by $N-1$ bidirectional tunnels. Room 1 is the entry point from the ground surface to this underground network. From room 1, you can follow the tunnels to go to any of the rooms. The rooms are numbered in such a way that, if you follow the shortest path from room 1 to any room X, the sequence of visited rooms' indices will be increasing. The image below shows a valid map of this network.



The network below is invalid, since the path from 1 to 4 is 1 - 3 - 2 - 4, which is not increasing:



There is also an old article from an unknown source mentioning about D_i which is the number of rooms directly connected to room i.

Given an array D of size N, your task is to verify if it is possible to have such a network.

Input

- The first line contains an integer N - the number of rooms in the network ($2 \leq N \leq 1\,000$).
- The second line consists of N integers D_i - the number of rooms that are directly connected to room i ($1 \leq D_i \leq N - 1$).

Output

Print *YES*/*NO* if it is possible/impossible to have such a network, respectively.

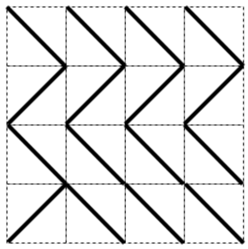
Sample Input 1	Sample Output 1
8 3 2 2 1 1 3 1 1	YES

Sample Input 2	Sample Output 2
4 3 3 3 3	NO

Problem D
Dropping Ball
Problem ID: droppingball

You are given a board with M rows and N columns. The rows are numbered from 1 to M from top to bottom. The columns are numbered from 1 to N from left to right.

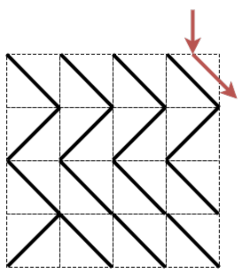
In each cell of the board, there is a diagonal wall. The wall either runs from top-left corner to bottom-right corner, or runs from top-right corner to bottom-left corner.



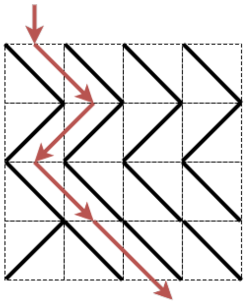
If you drop a ball at some column at the first row, the ball will fall downward due to gravity. Since the ball cannot go through the diagonal walls, it will travel inside the board, and the ball can have one of the following outcomes:

- The ball is stuck inside the board.
- The ball exits the board from the left edge.
- The ball exits the board from the right edge.
- The ball exits the board at the bottom edge.

For example, if we drop a ball at column 4, the ball will exit the board from the right edge:

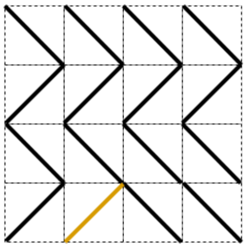


If we drop a ball at column 1, the ball will exit the board at the bottom edge, at column 3.

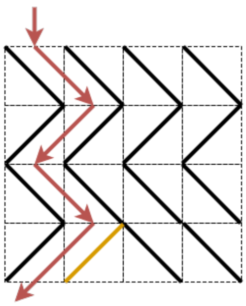


In this problem, we are interested in the question: "If we drop the ball at the top of column x, will the ball exit the board at the bottom edge? If it does, at which column of the bottom edge?".

Those questions look easy but there is also a twist. We can flip the wall to change the direction from direction '\' to direction '/' or vice versa. For example, if we flip the wall at cell $(4, 2)$, the board will look like as below:



After that, if we drop the ball again at column 1, the ball will exit the board at the bottom edge of column 1.



Given Q queries: flip-the-wall or drop-the-ball, your task is to answer all the drop-the-ball questions.

Input

- The input starts with 3 positive integers M, N and Q ($M \times N \leq 100\,000$, $Q \leq 100\,000$).
- The next M lines, each contains a string of length N describes the initial board. The j-th character in the i-th line indicate the wall direction in cell (i, j).

  - '\' indicates top-left to bottom-right direction,
  - '/' indicates top-right to bottom-left diretion.

- The next Q lines describe Q queries. Each query belongs to one of the two types:
  - $1\ x\ y\ (1 \le x \le M,\ 1 \le y \le N)$ - flip the wall at cell (i, j).
  - $2\ y\ (1 \le y \le N)$ - drop the ball at column y.

Output

For each query of type 2:

- Print -1 if the ball can not exit at the bottom edge,
- Otherwise, print the index of the column where the ball exits.

Sample Input 1	Sample Output 1
4 4 7 \\\\ //// \\\\ /\\\ 2 4 2 1 1 4 2 2 1 2 2 1 4 4 2 2	-1 3 1 4 -1

Problem E
Engaging with Loyal Customers
Problem ID: engaging

On the occasion of 10-year anniversary, an e-commerce company is running a campaign to engage with their loyal customers. They has prepared m gifts, numbered from 1 to m, to thank its loyal customers where each customer will receive no more than one gift. The company has n loyal customers, numbered from 1 to n. In order to ensure that customers are satisfied with the gift they receive, the company decided to conduct a customer survey. The customer survey result is recorded by the feedback cards, each of which can be described by a tuple of three positive integers (i, j, p) indicating that customer i has a satisfaction level of p if he or she receives the gift j. Each customer will give his or her level of satisfaction for every gift unless he/she has a satisfaction level of 0. At the end, the company received k feedback cards from their loyal customers.

Based on the result of the customer survey, your task is to determine how to send gifts to loyal customers to bring the greatest sum of satisfaction of all customers receiving the gifts.

Input

- The first line contains three integers m, n, k $(1 \leq m, n \leq 1\,000,\ 1 \leq k \leq m \times n)$;
- The next k lines describe the customer survey results, each of which contains three positive integers i, j, p described above $(1 \leq i \leq n,\ 1 \leq j \leq m,\ 1 \leq p \leq 30\,000)$.

Output

- The first line contains an integer that is the greatest sum of satisfaction of all customers;
- The second line contains the integer s - the number of gifts that must be sent to the customers;
- The next s lines describe how the gifts are sent: each line contains two integers x, y indicating that the customer x receives the gift y.

If there are more than one solutions giving the greatest sum of satisfaction, you can print any of them.

Sample Input 1	Sample Output 1
3 2 4 1 1 2 1 2 3 1 3 5 2 3 8	11 2 1 2 2 3

Problem F
Famous Pagoda
Problem ID: famouspagoda

In order to build a staircase to a famous pagoda on top of a mountain, the local authority has identified N positions along the mountain slope $a_1, a_2, \ldots, a_N$ where a_i is the height of the i-th position and $a_i \le a_{i+1}$ for all $0 < i < N$.

The cost to build a staircase from position i to position j is

$$\min_{v \in \mathbb{Z}} \sum_{s=i}^{j} |a_s - v|^k$$

To speed up the process of building the staircase from position 1 to position N, the local authority has decided to give the job to G builders to build the staircase in parallel. The sequence of N positions will be divided into G segments of consecutive positions where every position belongs to exactly one segment and each segment is managed by exactly one builder.

Given an integer G ($1 \le G \le N$), your task is to identify a way to allocate jobs to G builders to minimize their total building costs.

Input

- The first line contains 3 integers N, G, k ($1 \le N \le 2\,000,\ 1 \le G \le N,\ 1 \le k \le 2$).
- The second line contains N integers $a_1, a_2, \ldots, a_N$ ($1 \le a_i \le 10^6,\ a_i \le a_{i+1}\ \forall\ 0 < i < N$).

Output

Write in one line the minimum building cost required.

Sample Input 1	Sample Output 1
5 1 1 1 2 3 4 5	6

Sample Input 2	Sample Output 2
5 1 2 1 2 3 4 5	10

Sample Input 3	Sample Output 3
5 2 2 1 2 3 4 5	3

Problem G
Game of Divisibility
Problem ID: gameofdivisibility

Viet and Nam are playing a game set up with a list of n positive integers $a_1, a_2, \ldots, a_n$ and a positive integer k. Two players alternatively take turns removing a number from the list until the list is empty. The final score of each player is the sum of all numbers removed by that player. The winner of the game is the only player having the score divisible by k. It is a draw if the scores of both players are divisible by k or not divisible by k.

Your task is to identify the winner of the game assuming that both players play optimally and Viet plays first.

Input

The input consists of several datasets. The first line of the input contains the number of datasets, which is a positive number and is not greater than 50. Each dataset is described by two lines:

- The first line contains two positive integers n ($1 \leq n \leq 1\,024$) and k ($2 \leq k \leq 32$).
- The second line contains n space-separated integers a_i ($0 \leq a_i \leq 2^{31}$).

Output

For each test case, output in one line one word, either *FIRST* if Viet wins, *SECOND* if Nam wins or *DRAW* if the game ends up with a draw.

Sample Input 1	Sample Output 1
3 3 4 4 4 2 3 4 4 4 8 3 4 2 2 2	SECOND DRAW FIRST

Problem H
Height Preservation
Problem ID: heightpreservation

Virtual Reality (VR) is one of the new trends for applications recently. Wearing a VR headset, you will be in an immersive virtual environment for education, collaboration, entertainment, etc.

To enhance user experience, ICPC establishes a VR room for users to walk and explore a virtual environment. The user can see virtual scenes through a VR headset and can feel the slope of the virtual terrain while walking in this VR room.

The floor of this VR room consists of $m \times n$ cells in m rows and n columns. The real height of each cell can be adjusted so that we can simulate a virtual terrain.

The cell at the intersection of the i-th row and the j-th column has the real height level $S_{i,j}$ and corresponds to the virtual height $H_{i,j}$ in the virtual scene. The key idea of virtual terrain simulation is to preserve only the relative order of cell heights in each row and each column:

- In each row i ($1 \leq i \leq m$), $S_{i,j} = S_{i,k}$ if $H_{i,j} = H_{i,k}$, and $S_{i,j} > S_{i,k}$ if $H_{i,j} > H_{i,k}$.
- In each column j ($1 \leq j \leq n$), $S_{i,j} = S_{k,j}$ if $H_{i,j} = H_{k,j}$, and $S_{i,j} > S_{k,j}$ if $H_{i,j} > H_{k,j}$.

Given the virtual height of all cells, your task is to determine the minimum number of different real height levels.

Input

- The first line contains two positive integer numbers: m and n, the number of rows and columns in the floor of the VR room respectively ($m \times n \leq 10^6$).
- The i-th line of the following m rows contains n positive integer numbers $H_{i,j}$ ($H_{i,j} \leq 10^9$, the virtual height of cells in the i-th row).

Output

Display an integer number that is the minimum number of real height levels of cells in the floor of the VR room.

Sample Input 1	Sample Output 1
2 3 8 12 17 17 20 7	3

Problem I
ICPC Awards
Problem ID: icpcawards

The ACM International Collegiate Programming Contest has been held in Vietnam for more than 10 years. The contest is a great chance for the students to meet new friends, broaden their knowledge and of course, win prizes.

Every years, universities can send one or multiple teams to the contest and all universities hope to win prizes. The organizers want to define a rule to award the excellent contestants.

The contest director decided to follow the World Finals policy by having 4 first prizes, 4 second prizes and 4 third prizes. 12 winners out of more than a hundred teams is also a good proportion to recognize the best students.

Since universities can send multiple teams, we don't want one university to swept all the awards. Thus, only the top team from a university can be awarded. It seems harsh for the second best team from one university but do not worry, they will still receive relevant certificates.

The table below is the result of top 10 of Nha Trang Regional Contest 2016. The 4-th (team WINDOWS) and 8-th place (team UBUNTU) did not receive prizes because they were not the top team from University of Engineering and Technology - VNU. Team Metis and team BK.DeepMind are in the same situation.

Place	Institution	Team	Prize
1	Seoul National University	ACGTeam	First Prize
2	University of Engineering and Technology - VNU	LINUX	First Prize
3	Shanghai Jiao Tong University	Mjolnir	First Prize
4	University of Engineering and Technology - VNU	WINDOWS	
5	National Taiwan University	PECaveros	First Prize
6	Hanoi University of Science and Technology	BK.Juniors	Second Prize
7	Ho Chi Minh City University of Science	HCMUS-Serendipity	Second Prize
8	University of Engineering and Technology - VNU	UBUNTU	
9	Shanghai Jiao Tong University	Metis	
10	Hanoi University of Science and Technology	BK.DeepMind	

Given the final scoreboard of the contest, your task is to determine which 12 teams should be awarded prizes.

Input

- The input starts with the number of teams N ($12 \le N \le 200$).
- The i-th line of the next N lines contains information about the team that ranks i: the university name and the team name separated by a single space. Both names consists of digits, lowercase and uppercase English alphabet letters only. Both names does not exceed 20 letters in length.
- It is guaranteed that there are at least 12 different universities.

Output

The output should contains of 12 lines describing 12 winners. In each line, you should print the university name and the team name separated by a single space. The winners should be listed in the same order with the input.

Sample Input 1	Sample Output 1
30 Seoul ACGTeam VNU LINUX SJTU Mjolnir VNU WINDOWS NTU PECaveros HUST BKJuniors HCMUS HCMUSSerendipity VNU UBUNTU SJTU Metis HUST BKDeepMind HUST BKTornado HCMUS HCMUSLattis NUS Tourism VNU DOS HCMUS HCMUSTheCows VNU ANDROID HCMUS HCMUSPacman HCMUS HCMUSGeomecry UIndonesia DioramaBintang VNU SOLARIS UIndonesia UIChan FPT ACceptable HUST BKIT PTIT Miners PSA PSA DaNangUT BDTTNeverGiveUp VNU UNIXBSD CanTho CTUA2LTT Soongsil Team10deung Soongsil BezzerBeater	Seoul ACGTeam VNU LINUX SJTU Mjolnir NTU PECaveros HUST BKJuniors HCMUS HCMUSSerendipity NUS Tourism UIndonesia DioramaBintang FPT ACceptable PTIT Miners PSA PSA DaNangUT BDTTNeverGiveUp

Problem J
Joining Networks
Problem ID: joiningnetwork

A network of size N contains N computers connected by $N - 1$ cables, so that there is exactly 1 path between any pair of computers.

The transmission cost between 2 computers is equal to the square of the number of cables on the path connecting the 2 computers.

The transmission cost of a network is equal to the sum of the transmission cost between all **unordered** pair of computers.

Given network A with N computers and network B with M computers, the administrator wants to create a new network C, by adding exactly one cable connecting one computer in A and one computer in B.

Your task is to minimize the transmission cost of the new network C.

Input

- The first line contains an integer N - the number of computers in the network A ($1 \leq N \leq 50\,000$).
- In the next $N - 1$ lines, each line contains two distinct integers u and v, representing a cable connecting computers u and v in network A ($1 \leq u, v \leq N$).
- The next line contains an integer M - the number of computers in the network B ($1 \leq M \leq 50\,000$).
- In the next $M - 1$ lines, each line contains two distinct integers u and v, representing a cable connecting computers u and v in network B ($1 \leq u, v \leq M$).

It is guaranteed that each network is a tree.

Output

Write in one line the minimum transmission cost of the resulting network C.

Sample clarification

In the first sample below, connecting computer 2 of network A and computer 1 of network B will minimize the transmission cost of the network.

In the second sample below, connecting computer 4 of network A and computer 1 of network B will minimize the transmission cost of the network.

Sample Input 1	Sample Output 1
3 1 2 2 3 4 1 2 1 3 1 4	96

Sample Input 2	Sample Output 2
7 1 2 2 3 2 4 4 5 5 6 5 7 5 1 2 1 3 1 4 1 5	551

Problem K
K-Rotating
Problem ID: krotating

A new school year has started. The high school for gifted students of Ho Chi Minh city has N classes numbered from 1 to N. All N classes will go through M studying weeks. The high school has N teachers numbered from 1 to N. At the beginning teacher i is assigned to class i.

In order to improve the students adaptability to new knowledge or new teaching methods, the principal has plans to reassign the teachers every few weeks. **A reassignment only happens at the beginning of a week** (on Monday before classes start) and **a week has at most** 1 **reassignment**. A reassignment is to rotate K teachers $p_1, p_2, p_3, \ldots, p_K$, described as follows:

- Teacher p_i moves to the current class where teacher p_{i+1} is teaching $(1 \le i < K)$.
- Teacher p_K moves to the current class where teacher p_1 is teaching.

After the reassignment, the teachers will stay at the newly assigned classrom, until he is reassigned again.

The principal continuously add shuffle plans and he also asks questions: "When all the previous reassignment plans comes to effect, which class will teacher d teach on Tuesday of the x-th week?" Your task is to help him answer all those questions.

Input

The first line contains 3 integers: N, M and Q - the number of queries $(1 \le N, M, Q \le 10^5)$. The next Q lines describes Q queries, each will be in either of the 2 forms:

- $0\ K\ x\ p_1\ p_2 \ldots p_K$ - add a plan to rotate K teachers $p_1, p_2, \ldots p_K$ on Monday of the x-th week $(1 \le x \le M, 2 \le K \le 10$, all K values in p are unique).
- $1\ d\ x$ - ask which class is taught by teacher d on Tuesday of the x-th week.

It is guaranteed that there are no two queries of type 0 has the same value x.

Output

For each of the queries type 1, print the answer in a single line.

Clarification for the second sample

Initial assignment

	Class 1	Class 2	Class 3
Week 1	1	2	3
Week 2	1	2	3
Week 3	1	2	3
Week 4	1	2	3

After rotate $(3, 2)$ on Monday of the 2^{nd} week

	Class 1	Class 2	Class 3
Week 1	1	2	3
Week 2	1	3	2
Week 3	1	3	2
Week 4	1	3	2

After rotate $(3, 1, 2)$ on Monday of the 3^{rd} week

	Class 1	Class 2	Class 3
Week 1	1	2	3
Week 2	1	3	2
Week 3	3	2	1
Week 4	3	2	1

Sample Input 1

```
3 4 5
1 3 4
0 2 2 3 2
1 3 2
1 2 4
1 1 4
```

Sample Output 1

```
3
2
3
1
```

Sample Input 2

```
3 4 6
1 3 4
0 2 2 3 2
1 3 2
0 3 3 3 1 2
1 2 4
1 1 4
```

Sample Output 2

```
3
2
2
3
```

Problem L
Land Inheritance
Problem ID: landinheritance

Alob and Bice inherited from their parents a piece of land represented by a simple polygon. There is a canal represented by a straight line. Each brother inherited the lands on one side of the canal. It is possible that the land of each person consists of several disconnected pieces of land. It is also possible that one person does not inherit any land at all.

Alob decided to grow corn fields on his land while Bice decided to grow rice fields. However, they both agree that their fields are symmetrical about the canal.

Your task is to help Alob identify the largest possible area of land to grow corn fields.

Note that a simple polygon is a non-intersecting polygon, and does not have any 3 consecutive vertices that are collinear.

Input

- The first line contains N - the number of vertices representing the simple polygon land ($3 \leq N \leq 100$).
- In the next N lines, the i^{th} one contains two integers x_i, y_i - the coordinate of the i^{th} vertex ($-1\,000 \leq x_i, y_i \leq 1\,000$).
- The last line contains four space-separated integers x_a, y_a, x_b, y_b representing the coordinates of two distinct points in the straight line canal ($-1\,000 \leq x_a, y_a, x_b, y_b \leq 1\,000$).

Output

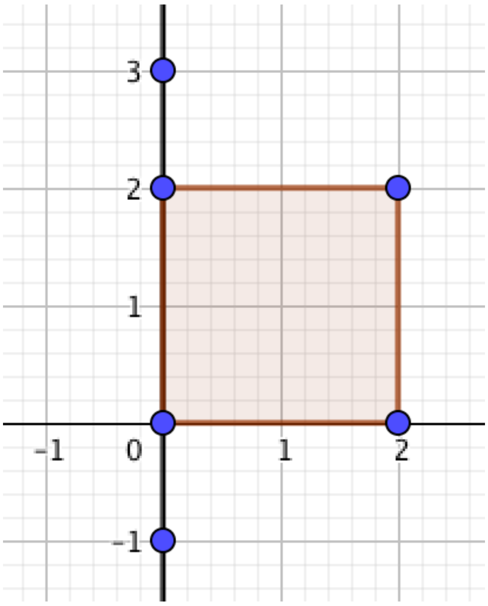
Output a single real number - the largest possible area of land to grow corn fields for Alob. Your answer will be considered correct if its relative or absolute error doesn't exceed 10^{-6}.

Namely: let's assume that your answer is a, and the answer of the jury is b. The checker program will consider your answer correct, if $\frac{|a-b|}{max(1,b)} \leq 10^{-6}$.

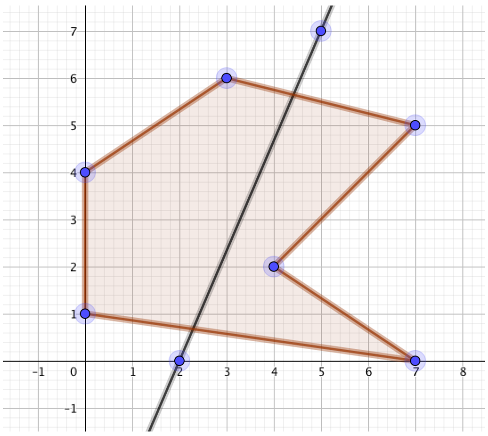
Sample Clarification

These are visualization of the samples below:

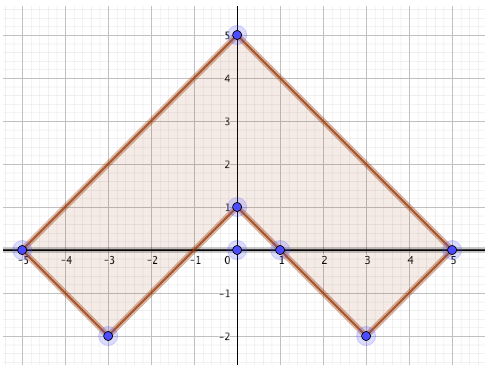
First sample:



Second sample:



Third sample:



Sample Input 1	Sample Output 1
4 0 0 2 0 2 2 0 2 0 -1 0 3	0.0000000000

Sample Input 2	Sample Output 2
6 0 1 0 4 3 6 7 5 4 2 7 0 5 7 2 0	9.476048311178

Sample Input 3	Sample Output 3
6 -5 0 -3 -2 0 1 3 -2 5 0 0 5 0 0 1 0	8.0000000000