The 44th International Collegiate Programming Contest

Asia Shenyang Regional Contest

東北大學 NORTHEASTERN UNIVERSITY

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Problems

A | Leftbest
B | First Date
C | Sequence
D | Quickpow
E | Capture Stars
F | Crossroads
G | Triangulation
H | Points
I | Parallel Network Analysis
J | Graph
K | Rooted Tree
L | Flowers
M | Interesting Strings

DO NOT TOUCH ANYTHING BEFORE CONTEST START

November 17, 2019

Problem A. Leftbest

Input file:	`standard input`
Output file:	`standard output`
Memory limit:	256 mebibytes

Jack is worried about being single for his whole life, so he begins to use a famous dating app. In this app, the user is shown single men/women's photos one by one, and the user may choose between "yes" and "no". Choosing "yes" means an invitation while choosing "no" means nothing. The photos would be shown one by one until the number of rest photos to be shown reaches zero. Of course, efficient and single Jack would always choose "yes".

When viewing photos, Jack would have a "fake impression point" on every photo, which is not accurate. To calculate the "true impression point" of one photo, Jack would recall the "fake impression point" of every previous photo whose "fake impression point" is larger than this photo, and regard the smallest "fake impression point" of them as the "true impression point" of this photo. Jack would like to sum the "true impression point" of all photos as the outcome of his effort.

Note that if such a larger "fake impression point" does not exist, the "true impression point" of this photo is zero.

Input

The first line contains an integer n ($1 \le n \le 100\,000$) — the number of photos.

The second line contains n integers $a_1, a_2, \ldots, a_n$ where a_i ($0 \le a_i \le 10^8$) is the "fake impression point" of the i-th photo.

Output

Output a single integer — the sum of the "true impression point" of all photos.

Examples

standard input	standard output
4 2 1 4 3	6

Problem B. First Date

Input file:	standard input
Output file:	standard output
Memory limit:	256 mebibytes

Jack finally meets a girl, and today is their first date. The city they live in consists of n vertices and m bidirectional roads. Each road has a standard time x_i to pass through and an influence factor y_i. Every day there is a congestion factor a, which is a uniformly distributed random variable between $[0, 1]$. The time needed to pass the i-th road is $x_i + a \cdot y_i$. Note that $x_i + y_i$ is always not less than 0.

Jack wants to calculate the **expected value** of minimum time between his home S and their date place T.

Input

The first line contains four integers n, m, S, T ($1 \le n \le 200$, $1 \le m \le 400$, $1 \le S, T \le n$) — the number of vertices, the number of roads, Jack's home, and Jack's date place, respectively.

The following m lines describe roads. Each line contains four integers u_i, v_i, x_i, y_i ($1 \le u_i, v_i \le n$, $1 \le x_i \le 10^7$, $-10^7 \le y_i \le 10^7$) — denotes that there is a road between u_i and v_i, whose factors are x_i and y_i.

Output

Output a real number — the expected value of minimum time between S and T.

The output is considered correct if it has an absolute error of at most 10^{-4}.

Examples

standard input	standard output
2 1 1 2 1 2 2 1	2.5

Problem C. Sequence

Input file:	`standard input`
Output file:	`standard output`
Memory limit:	256 mebibytes

Jack feels good with Rose, as Rose is a master of math. However, Rose sets a higher standard on Jack, to improve Jack's ability of math. So today Rose as usual sets a math question to Jack.

Given an integer k and a sequence $A : a_1, a_2, \ldots, a_n$, one position is *Good* if and only if there exists $i_1 < i_2 < \ldots < i_k < i$ where $a_{i_j} < a_i$, and the weight of this sequence $F_k(A)$ is defined as the number of *Good* positions in this sequence.

Given n and lim, for every k between 1 and n (1 and n included), calculate $\sum_{A \in S_{lim}} F_k(A)$.

Note that S_{lim} is the set of sequences satisfying $1 \le a_i \le lim$.

Each output should module 998244353.

Input

The only line contains two integers n, lim ($1 \le n \le 100\,000$, $1 \le lim \le 10^9$).

Output

Output n integers in one line, as the description above indicated.

Examples

standard input	standard output
`3 3`	`22 5 0`

Problem D. Quickpow

Input file:	standard input
Output file:	standard output
Memory limit:	256 mebibytes

With more and more communication with each other, Jack and Rose fall in love. One day they go to a shopping hall to play doll machine. There are n doll machines, and the i-th machine has a difficulty level of a_i.

However, Jack is a grandmaster at catching dolls, and the difficulty level can be a bit different. As to Jack, the difficulty level of the i-th machine is $b_i = e^{a_i} / \sum_{j=1}^{n} e^{a_j}$. Here e is the mathematical constant which is the base of the natural logarithm. Now Rose asks you to calculate the difficulty level of every doll machine to Jack.

Please remind that to balance the difficulty level of doll machines, this shopping hall guarantees that the difference between the maximum difficulty level and the minimum difficulty level would not exceed 10.

Input

The first line contains an integer n ($1 \le n \le 100\,000$) — the number of doll machines.

The second line contains n integers $a_1, a_2, \ldots, a_n$ where a_i ($0 \le a_i \le 1\,000\,000$) is the difficulty level of the i-th doll machine.

It is guaranteed that $argmax(a_i) - argmin(a_i) \le 10$.

Output

Output n real numbers $b_1, b_2, \ldots, b_n$ in one line, where b_i is the difficulty level of the i-th machine to Jack.

The output is considered correct if when the correct output is p, the output q satisfies $\min\left\{|p-q|, \left|\frac{p-q}{p}\right|\right\} \le 10^{-4}$.

Examples

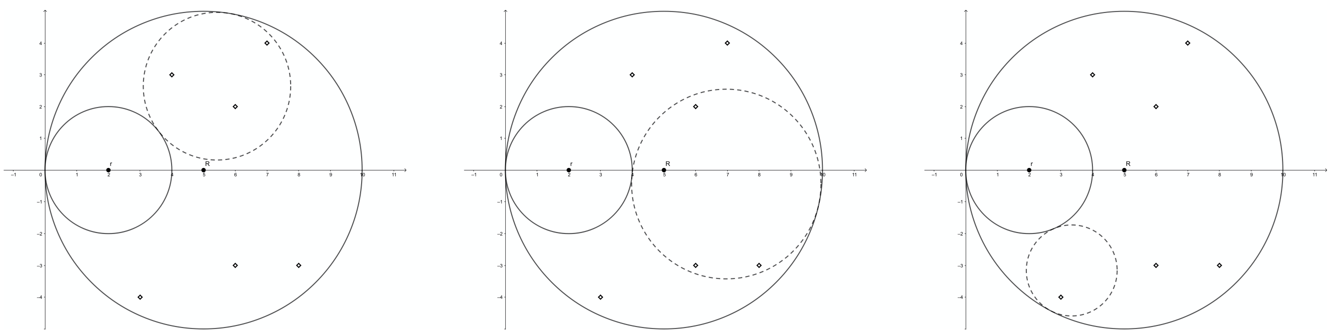
standard input	standard output
2 1 1	0.50000000 0.50000000

Problem E. Capture Stars

Input file:	`standard input`
Output file:	`standard output`
Memory limit:	256 mebibytes

It is necessary to watch stars with the partner in passionate love. So Jack and Rose decide to watch stars this night.

In the sky, there are n stars in a rectangular Cartesian coordinate system and they have a special camera fixed in one position. This camera contains two different circles which are internally tangent. And it has a magic viewfinder which can be treated as a circle with dynamic size between the two circles (externally tangent to the small one and internally tangent to the large one) as shown in figure below. The stars in the range of the viewfinder (not on the edge) would be photographed. The problem is, what is the maximum number of stars could be photographed in one photograph?



To simplify this problem, the center of either small or large circle is on the positive side of the x-axis and they are internally tangent at the origin of the coordinate system, and the stars are distinct points with integer coordinates which are guaranteed between the two circles (and not on both circles).

Input

The first line contains an integer T ($1 \le T \le 100$) — the number of test cases.

The first line of each test case contains three integers n, R and r ($1 \le n \le 10\,000$, $1 \le r < R \le 1\,000$) — the number of stars, the radius of the large circle and the radius of the small circle.

The next n lines contain the coordinates of the stars, where the i-th line contains two integers x_i, y_i ($-2\,000 \le x_i, y_i \le 2\,000$) — the coordinates of the i-th star.

It's guaranteed that $(x_i - R)^2 + y_i^2 < R^2$ and $(x_i - r)^2 + y_i^2 > r^2$, and all (x_i, y_i) are pairwise different.

Output

Output one integer in one line for each test case — the maximum number of stars in one photograph.

Examples

standard input	standard output

`1`
`6 5 2`
`4 3`
`6 2`
`6 -3`
`3 -4`
`7 4`
`8 -3`
	`3`

Problem F. Crossroads

Input file:	`standard input`
Output file:	`standard output`
Memory limit:	256 mebibytes

Jack and Rose are citizens sparing no effort to make their city better. Therefore when they see crowds waiting for a traffic light in their city, they start to seek ways shortening the time of waiting.

To simplify the problem, the problem can be regarded as there are N different roads from $LocA$ to $LocB$, and K citizens will walk from $LocA$ to $LocB$.

For the i-th road, it takes a_i minutes to finish the journey, and the distance is b_i. At the end of each road, there is a traffic light, which turns green every P minutes from the time 0, and pedestrians can cross the traffic light in a flash (taking 0 minutes), and then the traffic light also turns red in another flash (taking 0 minutes).

These K citizens decide to start their journey from $LocA$ at the same integer moment (in minute), each of them chooses a road and no two citizens choose the same road. The problem is finding the best start time, to make the ratio of the sum of citizens' waiting time at the traffic light to the sum of citizens' distance of journey as small as possible. And you only need to output this ratio.

Input

The first line contains three integers N, K, P ($1 \le K \le N \le 200\,000$, $1 \le P \le 10^9$) — the number of roads and the number of citizens indicated above, and the change time-circle of each road.

The following N lines describe roads. Each line contains two integers a_i and b_i ($1 \le a_i, b_i \le 10^9$) — the time needed to walk to the end and the distance of the i-th road.

Output

Output one real number r in one line — the minimum ratio mentioned above.

The output is considered correct if when the correct output is r_0, the output r satisfies $\min\left\{|r - r_0|, \left|\frac{r-r_0}{r_0}\right|\right\} \le 10^{-9}$.

Examples

standard input	standard output
3 2 3 1 2 2 2 3 1	0.250000000000

Problem G. Triangulation

Input file: `standard input`
Output file: `standard output`
Memory limit: 256 mebibytes

Rose is no longer satisfied by math, so she lets Jack start to learn geometry.

Today they work on such a problem: Given a simple polygon of n vertices on a plane, how many different triangulations of this polygon are there? The answer needs to module 998244353.

Simple polygon: A polygon that does not intersect itself and has no holes.

Triangulation: An edge set contains $n-3$ diagonal lines, and these lines only intersect at polygon vertices. These lines separate a simple polygon into $n-2$ triangles.

Input

The first line contains one integer n ($3 \le n \le 200$) — the number of vertices.

The next n lines contain the coordinates of the polygon vertices, where the i-th line contains two integers x_i, y_i ($|x_i|, |y_i| \le 10^6$) — the coordinates of the polygon's i-th vertex. The vertices are given clockwise or counterclockwise.

It is guaranteed that no three vertices are collinear.

Output

Output one integer in one line — the number of different triangulations module 998244353.

Examples

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

Problem H. Points

Input file:	`standard input`
Output file:	`standard output`
Memory limit:	256 mebibytes

Jack and Rose are playing games after working out so many difficult problems. They together drew a "Haizi" tree to show their collaboration. "Haizi" tree is the same as the tree defined in graph theory.

Now Jack would like to count the number of vertices whose degree is one in this tree. You need to help him with this calculation.

Degree: The degree of a vertex of a graph is the number of edges that are connected with the vertex.

Input

The first line contains an integer n ($2 \le n \le 10^5$) — the number of vertices.

The next $n-1$ lines describe the edges of the tree, where the i-th line contains two integers x_i, y_i ($1 \le x_i, y_i \le n$) — the two vertices that is connected by the i-th edge.

Output

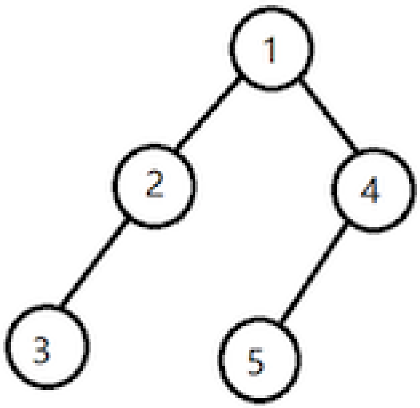
Output one integers in one line — the number of vertices whose degree is one.

Examples

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

Explanations

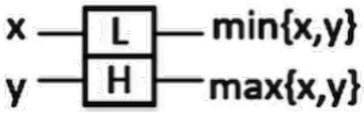
As shown in figure below, only the vertex 3 and vertex 5 are connected with only one edge. So there are 2 vertices whose degree is one.



Problem I. Parallel Network Analysis

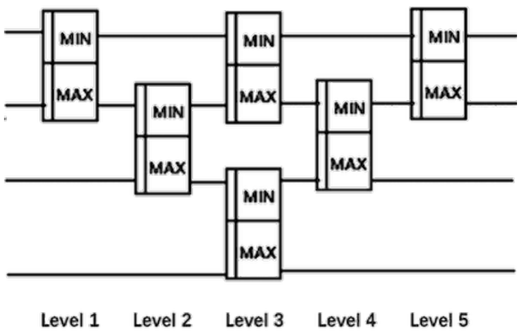
Input file: `standard input`
Output file: `standard output`
Memory limit: 256 mebibytes

As an engineering student, Jack starts to consider a network problem. Jack designs a comparator circuit as the birthday present to Rose, which works by inputting two integers and outputting min, the minimum of the two integers and max, the maximum of the two integers.



Now Jack would like to build a comparator network which can sort **any** integer permutation of size N. This comparator network is divided into D levels, where the i-th level consists of n_i comparators and many wires. For the j-th comparator of the i-th level, you may choose two locations a_j, b_j, and this comparator will compare the two numbers from same locations of $(i-1)$-th level and send the minimum of them to the location a_j and the maximum to the location b_j of the i-th level. And in the last level the integers should be well sorted in ascending order from location 0 to $N-1$. Note that no two comparators in the same level can share the input from the same location.

When N is very small, Jack easily constructs a comparator network based on bubbling sort, which is illustrated below.



But now he only has $100N$ comparators, and he asks you to help him design a better parallel network meeting the requirements.

Input

Only one integer N ($N \le 15\,000$) — the size of permutation.

Output

Output one integer D in the first line — the number of levels in this parallel network.

Then describe each level in order with the following format:

For each level, output one integer n_i in the first line — the number of your comparator(s) in the i-th level.

The following n_i lines describe comparators of this level, each contains two integers a, b satisfying $0 \le a, b < N$, denoting that the a-th and the b-th number from the previous level are compared and the minimum is outputted to the a-th number of this level and the maximum the b-th number.

It is required that any number should at most occurs once at the same level, and $\sum n_i \le 100N$.

If there are multiple answers, output any of them.

If your answer does not meet the requirement or not solve the problem, you would receive a "Wrong Answer".

Examples

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

Explanations

For the first test case, the figure is shown in the description above.

Problem J. Graph

Input file: `standard input`
Output file: `standard output`
Memory limit: 256 mebibytes

Rose would like to find whether they truly love each other.

Rose lets Jack draw a graph of N vertices, and Rose herself writes a set of vertex pair (u_i, v_i), named S.

Initially the graph has no edge and S is empty.

There are Q operations of 5 kinds, which are listed below:

1.Jack adds edge (u, v) into the graph. It is guaranteed that u and v are unreachable before adding.

2.Jack deletes edge (u, v) from the graph. It is guaranteed that this edge exists before deleting.

3.Rose adds vertex pair (u, v) into S. It is guaranteed that (u, v) is not in S before adding.

4.Rose deletes vertex pair (u, v) from S. It is guaranteed that (u, v) exists before deleting.

5.Ask if they love each other, that is, whether every vertex pair in S is reachable in the graph. In other words, whether for every vertex pair (u, v) in S, u and v are reachable in the graph.

Input

The first line contains an integer T $(1 \leq T \leq 100)$ — the number of test cases.

The first line of each test case contains two integers N $(3 \leq N \leq 100\,000)$, Q $(3 \leq Q \leq 300\,000)$ — the number of vertices, the number of operations.

The next Q lines describe the operations, where the i-th line contains three integers $Type$, u, v $(u < v)$ for the first four operations and one integer $Type$ for the last (fifth) kind of operation.

It is guaranteed that $\sum N \leq 300\,000$ and $\sum Q \leq 500\,000$.

Output

For each operation of the fifth kind, output "YES" or "NO" in one line to indicate the answer, with the same order as the input.

Examples

standard input	standard output
1 5 10 5 3 2 5 4 2 5 1 4 5 2 4 5 5 1 1 2 3 1 5 4 1 5 2 1 2	YES YES

Problem K. Rooted Tree

Input file:	`standard input`
Output file:	`standard output`
Memory limit:	256 mebibytes

Already been college students, Jack and Rose start to work out problems of discrete mathematics.

Jack emerges great interest in rooted tree, which is a kind of directed tree that has a root vertex.

In a rooted tree, define the depth of vertex u $depth(u)$ as the number of edges between root vertex and u. And the depth of a rooted tree is the maximum depth among all vertices of this tree.

The problem is to count the number of rooted trees that have n vertices, whose depth are not more than two, and are not isomorphism with each other. The answer should module 998244353.

Isomorphism: Rooted tree $T1 = \langle V1, E1 \rangle$ and $T2 = \langle V2, E2 \rangle$ are isomorphism if and only if there exists such a bijection $f : V1 \to V2$ that satisfying to any $u, v \in V1$, $\langle u, v \rangle \in E1$ when and only when $\langle f(u), f(v) \rangle \in E2$.

Bijection (bijective function): A kind of function between the elements of two set, where each element of one set is paired with exactly one element of the other set, and each element of the other set is paired with exactly one element of the first set.

Input

The only line contains one integer n $(1 \le n \le 500\,000)$ — the number of vertices.

Output

Output a single integer — the answer of the problem described above.

Examples

standard input	standard output
5	5

Problem L. Flowers

Input file:	`standard input`
Output file:	`standard output`
Memory limit:	256 mebibytes

Recently Jack becomes much more romantic. He would like to prepare several bunches of flowers.

Each bunch of flowers must have exactly M flowers. As Jack does not want to be boring, he hopes that flowers in the same bunch are all different species. Now there are N species of flowers in the flower shop, and the number of the i-th species of flower is a_i. Now Jack would like to know how many bunches of flowers he can prepare at most.

(Flowers are used to propose.)

Input

The first line contains an integer T $(1 \le T \le 10)$ — the number of test cases.

In the first line of each test case, there are two integers N, M $(1 \le N, M \le 300\,000)$ — the number of flowers' species and the number of flowers in a bunch.

In the second line of each test case, there are N integers — the i-th integer indicates a_i $(1 \le a_i \le 10^9)$, the number of i-th species' flowers.

Output

For each test case, output one integer in one line — the answer of the corresponding test case.

Examples

standard input	standard output
1 5 3 1 1 1 2 1	2

Problem M. Interesting Strings

Input file:	`standard input`
Output file:	`standard output`
Memory limit:	256 mebibytes

Jack and Rose are entering into the marriage hall, and here comes the final experiment on them.

Define string T satisfying this format: $T = a + b + c + d + e$, where a, c, e are palindrome strings chosen by Jack and b, d are any strings chosen by Rose, the intimacy value $Value(T)$ of Jack and Rose is defined as $Value(T) = length(a) + length(c) + length(e)$.

Given string S which consists of only lowercase letters, please calculate the maximum intimacy value of every substring of S.

Note that $length(a), length(b), length(c), length(d), length(e) \geq 0$.

Palindrome: A sequence of characters which reads the same backward as forward.

Input

The first line contains an integer T ($1 \leq T \leq 10$) — the number of test cases.

The next T lines each describes the string S ($5 \leq length(S) \leq 200\,000$) of the corresponding test case.

Output

For each test case, output one integer in one line — the maximum intimacy value.

Examples

standard input	standard output
`1` `saicpcilicpcqici`	`13`

Explanations

In the sample input, a="*cpcilicpc*", c="*q*", e="*ici*"