Problems – Online Programming Contest, Shaastra 2010

1. Fibonacci Sums

The well known fibonacci sequence is defined as follows:

f[0] = 0
f[1] = 1
f[i] = f[i-1] + f[i-2], i>1

Our task is the following:
Given x <= y, compute the sum ((f[x] + f[x+1] + ... + f[y]) MOD 10009)

Input Format

The first line contains a single integer T, denoting the number of test cases. T test cases follow. Each test case is a single line containing 2 integers x, y, as explained in the problem.

Output Format

For each test case, output one line with one integer giving the sum as described above.

Constraints

T <= 10
0 <= x,y <= 100000

Sample Input

```
2
1 2
3 4
```

Sample Output

```
2
5
```

Time Limit: 1s
Memory Limit: 16MB

2. Painful Prof

Professor PP is probably the most painful and mad prof in IITM. But there is a method to his madness.

He offers his students N exams that they can take. The students have to take K consecutive exams and its not hard to guess that the student's grade will be determined by the minimum in exams that "he" writes (notice the absence of "she"). This minimum is the "deciding score". Mr.Boss is a clever student. He has somehow estimated the marks he will get in each of the N exams. He wants to know the following: Given K, what is the maximum value of the deciding score in any consecutive block of K exams? Let us call such a question, a query. Boss wants to answer Q such queries.

Input Format

The first line of the input contains a single integer T, denoting the number of test cases. T test cases follow.The first line of each test case contains a single integer N, denoting the number of exams.The second line contains N integers, denoting Boss' score in the N exams.The third line contains a single integer Q, the number of queries.Q positive integers follow, each denoting a query.

Output Format

For each test case, output Q lines with a single integer in each line denoting the answers to the Q queries.

Constraints

1 <= T <= 10
1 <= Q <= N <= 100000

Sample Input

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

Sample Output

```
5
2
2
1
```

Time Limit: 10s
Memory Limit: 32MB

3. K4 Counting

Planar graphs have fascinated graph theorists for ages. This problem is related to planar graphs.

Kuratowski planarity condition is one famous result in this area. One of the consequences of this is that K_5 or $K_{3,3}$ cannot occur as induced subgraphs of a planar graph. Hence, we ask you to count the number of occurences of K_4 as an induced subgraph.

Input Format

The first line contains a single integer T, the number of testcases. T testcases follow.
The first line of each test case contains 2 integers N and M denoting the numberof vertices and number of edges in the planar graph given.
M lines follow, each with 2 integers, denoting the edges.

Output Format

For each testcase, output one line with a single nonnegative integer denoting the number of occurences of K_4 as an induced subgraph.

Constraints

N <= 50000
M <= 200000

Sample Input

1
5 7
1 2
2 3
3 4
4 1
1 3
2 4
1 5

Sample Output

1

Time Limit: 5s
Memory Limit: 32MB

4. Giving Chocolates

Mr.Stuart is a teacher. In his classroom, the children are arranged into an X by Y grid. At each co-ordinate (i, j) 1<=i<=X and 1<=j<=Y, there is a child. Also, Stuart is a very partial teacher. In fact, he has seated the students in such a way that, whenever x1<=x2 and y1<=y2 and (x1,y1)!=(x2,y2), he likes the student at (x1, y1) more than the one at (x2,y2).

Stuart got N chocolates to the class and he wants to distribute it to the students according to the following rules:
1. If Stuart likes Alice more than Bob, he would not give Bob a (strictly) greater number of chocolates than what he gives to Alice.
2. Whenever he gives non-zero number of chocolates, want to give out >=A and <=B chocolates. He does not mind giving zero chocolates to any student.

Find out the number of way in which stuart can distribute the chocolates to the students.

Input Format

The first line consists of a single integer T, indicating the number of test cases. T test cases follow. Each test consists of 5 space separated integers, X, Y, N, A, B.

Output Format

A single integer denoting the number of ways to distribute the chocolates.

Constraints

X*Y <= 20
N <= 100
1 <= A,B <= N
The result will fit in a 64-bit integer.

Sample Input

```
2
3 3 5 1 1
3 3 5 1 2
```

Sample Output

```
3
10
```

Time Limit: 5s
Memory Limit: 16MB

5. Longest Constrained Difference Subsequence

Lets keep this task short and sweet.
Given a sequence a1, a2, ... aN, find the length of thelongest subsequence such that the difference between adjacent elements of this subsequence is atmost D.

Input Format

The first line consists of a single integer T, indicating the number of test cases. T test cases follow.
The first line of each test case consits of 2 integers, N and D.
The second line of each test case contains N integers, a1, a2, ... aN.
White space can occur freely in the input.

Output Format

A single integer giving the length of the longest subsequence that obeys the property described above.

Constraints

1 <= T <= 20
1 <= N <= 100000

Sample Input

1
5 2
10 13 11 8 12

Sample Output

3

Explanation

13, 11, 12 is a subsequence where adjacent elements differ by atmost 2. Also, there is no sequence of greater length having this property.

Time Limit: 10s
Memory Input: 32MB

6. Best Managers

Mr.Boss recently started his billion dollar enterprise. Since his company is too big, he wants to appoint a board of Managing Directors (Mds). He has a list of candidates numbered 1 to N. Also, there are bidirectional "like" relationships between these candidates, i.e., you are given pairs (a,b) such that a likes b and b likes a. Mr.Boss is very choosy about his Board of Directors. He wants each person in the board to like exactly one other person within the board. This is because he thinks if one person likes many ppl, he will get into a partying mood all the time and if someone is not liked by anybody, he might go into depression. But, the bidirectional "like" relationships also obey a nice property. There are exactly N-1 "like" relationships that Mr.Boss has listed, and also, given any two managers, it is possible to follow a string of "like" relationships from one to the other.

Given this, what is the size of the largest Board that Boss can construct?

Input Format

The first line consists of a single integer T, indicating the number of test cases. T test cases follow. The first line of each test case contains a single integer N, the number of candidates. N-1 lines with two integers each follow describing the bidirectional like relationships.

Output Format

A single line with a single integer denoting the size of the maximum sized Board of Directors that Mr.Boss can form.

Constraints

T <= 10 and N <= 500000

Sample Input

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

Sample Output

```
4
```

Explanation

A board can be constituted of (1,2,4,5) and (1,2,3,4,5) is not a valid board.

Time Limit: 5s

Memory Limit: 32MB

7. Cheapest Network

There are N computers in a 2-d office. Location of the ith computer is given by (xi, yi), which is fixed. There is one extra computer that can be moved anywhere in the infinite 2d plane.

Stuart has to connect exactly N wires such that any pair of computers are connected. Now, Stuart has this habit of day dreaming about interesting stuff. So, he comes up with this: "What is the smallest value of the maximum wire length that I have to use to connect the N+1 computers, assuming I can move the extra computer wherever I want?"

Unfortunately, Stuart is good only in day dreaming. Its now your task to solve this problem for him.

Input Format

First Line: Single integer T, the number of test cases.
The first line of each testcase contains a single integer N, denoting the number of fixed computers.
N lines follow, each containing 2 real numbers. The ith of such lines (xi yi) denotes the position of the ith fixed computer.

Output Format

For each test case, output a single real number rounded to 2 decimal places, indicating the minimum value of the maximum edge length to be used to connect all the computers.

Constraints

1 <= T <= 10
1 <= N <= 300
-100000 <= x,y <= 100000

Sample Input

1
4
-1 -1
-1 1
1 -1
1 1

Sample Output

1.41

Hint for sample input: The moving computer is placed at (0,0).

Time Limit: 2s
Memory Limit: 32MB