National Taiwan University

2012 Preliminary - Team Qualification

Every problem, is just like a piece of pizza.

A	Pizza Agents	3s
B	Pizza Boxes	5s
C	Pizza Cards	2s
D	Pizza Dreams	5s
E	Pizza Maze	5s
F	Pizza Maze II	15s
G	Pizza Ordering	5s
H	Pizza Packages	10s
I	Pizza Quiz	5s
J	Pizza Separator	12s
K	Pizza Testing	1s
L	Pizza Universe	1s

August 5, 2012

(This page was intentionally left blank.)

A. Pizza Agents

time limit: 3 seconds

There are n agents in International Creative Pizza Company (ICPC) selling pizza. Each agent contributes some number of profit a_i to the company. But, the actual total profit that the company gets is

$$P = a_1 \oplus a_2 \oplus \cdots \oplus a_n,$$

where the binary operator $\oplus$ denotes the exclusive-or operation.

Now it's time to share the profit P to all the agents in the company. The boss wants to distribute them with just and honest. So he decides that an agent i should earn his/her own marginal contribution. For any permutation σ of agents $\sigma(1), \sigma(2), \cdots, \sigma(n)$, the marginal contribution of a single agent $v_{i,\sigma}$ is defined as follows.

$$v_{i,\sigma} = \left(\bigoplus_{\sigma^{-1}(j) \le \sigma^{-1}(i)} a_j \right) - \left(\bigoplus_{\sigma^{-1}(j) < \sigma^{-1}(i)} a_j \right)$$

Here σ^{-1} denotes the inverse function of σ. Furthermore, the marginal contribution of the single agent i is the average marginal contribution on all permutations. That is,

$$v_i = \frac{1}{n!} \sum_{\sigma} v_{i,\sigma}.$$

Please write a program that calculate the marginal contribution of every agent, and find out the top three most contributive agents.

Input Format

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

For each test case, first line contains an integer n ($3 \le n \le 10^5$). Then n non-negative integers $a_1, a_2, \cdots, a_n$ follows ($0 \le a_i \le 10^{12}$).

Output Format

For each test case, please output three agents' ID whose marginal contribution is largest ordered by their own marginal contribution. If two or more agents get same marginal contribution, smaller ID goes first.

Sample Input

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

Sample Output

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

B. Pizza Boxes

time limit: 5 seconds

You are a manager of a pizza box factory which produces boxes for delicious pizza. But, as a stingy guy, you wish to minimize the number of producing machines. Each machine will produce 1 pizza box per minute. There are n trucks waiting for pizza boxes. For i-th truck it will arrive at t_i-th minute and require a_i pizza boxes. The trucks cannot wait too long, since there are only k parking spaces. If a truck does not get enough pizza boxes by the time it arrives, this truck must require a parking slot. (You need to serve some coffee to these drivers.) Conversely, if a truck can get enough pizza boxes by the time it arrives, this truck does not need any parking slot.

Please find the minimum number of machines that you will need to fulfill all the requests.

Input Format

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

For each test case, first line contains two integers n, k ($1 \leq n, k \leq 10^5$). Each of the next n lines contains two integers t_i, a_i ($1 \leq t_i, a_i \leq 10^9$.) Moreover, a truck can successfully parked in the parking space if and only if there are less than k trucks parking or at least one truck can leave instantly. You may neglect the transporting time between machines and trucks. If more than two trucks arrive at the same time, you may let them come in any order.

Output Format

For each test case, output the minimum machines that can fulfill all the requests.

Sample Input

```
1
5 1
1 10
2 10
3 10
4 10
5 10
```

Sample Output

```
8
```

C. Pizza Cards

time limit: 2 seconds

Dreamoon and Doraemon like to play Pizza Card games. There are $2n+k$ pizza cards. $2n$ of them are numbered with 1, 1, 2, 2, ..., n, n and k special cards "Pika". The game goes as follows: initially all the $2n+k$ cards are distributed to both players. Then starting from Dreamoon, they randomly pick one card from the other player alternatively. During the game, if any one got two cards with the same number, he must drop that two cards immediately. A player is declared as a winner if he has no card in hand. If it is impossible for a player to drop all his card out, no player wins.

Given all cards at Dreamoon's hand, please find out the probability that he will win, if for every move each card in opponent's hand can be drawn with same probability.

Input Format

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

For each test case, the first line contains four integers n, k, m, p ($0 \leq m \leq n \leq 10^5$; $0 \leq p \leq k \leq 2$; $k > 0$). Then m integers follow, indicating the number cards in Dreamoon's hand. Moreover, Dreamoon has p "Pika" cards.

Output Format

For each test case, please output the winning probability for Dreamoon.

Sample Input

```
1
1 2 1 1
1
```

Sample Output

```
0.750000000
```

D. Pizza Dream

time limit: 5 seconds

Little Tomato eats pizza everyday. He eats pizza of type a_i on the $(kn + i)$-th day, whenever k is an integer and n is a fixed positive integer. Now he dreamed that he have eaten pizza of types $b_1, b_2, \cdots, b_m$ on some consecutive days. What is the probability that his dream come true if he pick the starting day randomly with uniform probability?

Input Format

First line contains an integer T $(1 \leq T \leq 100)$ indicating the number of test cases.

For each test case, the first line contains two integers n, m $(1 \leq n, m \leq 10^5)$. The second line contains n integers $a_1, a_2, \cdots, a_n$ $(1 \leq a_i \leq 10^5)$. The third line contains m integers $b_1, b_2, \cdots, b_m$ $(1 \leq b_i \leq 10^5)$.

Output Format

For each test case, please output the probability with at least six digits after the decimal point.

Sample Input

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

Sample Output

```
0.200000000
```

E. Pizza Maze

time limit: 5 seconds

Haha, it is time for escaping from the room! You are at some point $S(S_x+0.5, S_y+0.5)$ in a maze. The room is divided into $m \times n$ unit square-shaped cells, and is blocked from outside. In each of the cells, either a big square rock blocked in whole cell or an empty space that you can pass. Your goal is simple enough, it is a point of pizza at $E(E_x+0.5, E_y+0.5)$. You don't want to eat a cold pizza, so please find the minimum length path from your starting point to the end point. Note that you may regard yourself as a circle with a very small positive radius near zero.

Input Format

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

For each test case, first line contains 6 integers n, m, S_x, S_y, E_x, E_y ($1 \leq n, m \leq 30$; $0 \leq S_x, E_x < n$; $0 \leq S_y, E_y < m$). Each of the next n lines contains a string of length m. A huge square rock is denoted by "#" and a space is denoted by ".". The left-topmost point in the left-topmost cell has coordinates $(0, 0)$ and the right-bottommost point in the right-bottommost cell has coordinates (n, m).

Output Format

For each test case, if it is impossible to walk from S to E, output "Impossible". Otherwise output the minimum distance.

Sample Input

```
4
3 3 0 0 2 2
...
...
...
3 3 0 0 2 2
...
.#.
...
3 4 0 0 1 3
....
.##.
....
2 2 0 0 1 1
.#
#.
```

Sample Output

```
2.828427125
3.162277660
3.256616538
Impossible
```

F. Pizza Maze II

time limit: 15 seconds

Haha, it is another time for escaping from the room!

At time 0, you are standing on one corner of a $m \times n$ grid, with each cell marked by a single non-zero digit ('1' to '9'). Your job is quite simple: Escape from the left-topmost corner $(0, 0)$ to right-bottommost corner $(m-1, n-1)$. Each time you may move up, down, left, right or stay. The only condition is that at time t, after you did your move (or stay), the number a_{ij} marked on the cell which you are standing on should divide t.

It is guaranteed that the number marked on the cell $(0, 0)$ and $(m-1, n-1)$ is always 1. Please find the minimum time that you can arrive the cell $(m-1, n-1)$.

Input Format

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

For each test case, the first line contains two integers m, n ($1 \leq m, n \leq 500$). Each of the next m lines contains n integers in the range 1 to 9.

Output Format

For each test case, please output the minimum time. If it is impossible, output "-1".

Sample Input

```
2
3 3
1 9 7
5 7 1
9 3 1
3 3
1 2 6
4 8 2
6 4 1
```

Sample Output

```
23
-1
```

G. Pizza Ordering

time limit: 5 seconds

You need to build a table of contents for your new pizza menu. There are $m \times n$ types of new pizzas, numbered from 1 to mn as you like. Now it's time for you to fill all the type of pizzas into each of the $m \times n$ table cells.

But, as a tradition for the pizza company, there are some rules when you place these pizzas into the cells. Each row, as well as each column, is marked by a certain number. After you place all pizzas into the cells, the number of these pizzas determines whether the placing is good or bad.

This year, the rules are based on longest increasing subsequences and longest decreasing subsequences. The manager told you that you need to place all the pizzas into the cells, such that for each row (from left to right) and each column (from top to bottom), the length of one of its LIS or LDS must correspond to the number marked in that row or that column.

Can you accomplish this task?

Input Format

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

For each test case, the first line consists of two even integers m, n ($1 \leq m, n \leq 100$; $4|m^2 + n^2$) representing number of rows and columns respectively. The second line contains m integers $r_1, r_2, \cdots, r_m$ ($1 \leq r_i \leq n$) denoting the marked number on each row. The third line contains n integers $c_1, c_2, \cdots, c_n$ ($1 \leq c_i \leq m$) denoting the marked number on each column.

Output Format

For each test case, output a table of $m \times n$ distinct integers from 1 to mn. If it is impossible to finish the task, output "Impossible" instead. If there are more than one solutions, you may print any of them.

Sample Input

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

Sample Output

```
10 1 16 15
7 6 5 4
3 8 13 14
2 9 12 11
1 2 3 4
5 6 7 8
```

H. Pizza Packages

time limit: 10 seconds

You have made n pizzas with radius $a_1, a_2, \cdots, a_n$. Now you want to buy some pizza boxes to put these pizzas in. Since it is raining heavily outside, you want to order pizza boxes through the Internet.

There are m pizza box sellers that you can choose. But each of them only provide one package of b_j pizza boxes, all with radius r_j and cost you only c_j dollars! You can buy at most one package from a seller.

In order to put all pizzas in, you need to buy enough boxes. For a pizza with radius x and a pizza box with radius y, this pizza can be put into the pizza box if and only if $x \leq y$.

At most one pizza can be put into a pizza box.

Please find the minimum cost.

Input Format

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

For each test case, first line contains two integers n, m $(1 \leq n \leq 10^5; 1 \leq m \leq 1000)$. The second line contains n integers $a_1, a_2, \cdots, a_n$ $(1 \leq a_i \leq 10^5)$. Each of the next m lines contains three integers b_j, r_j, c_j. $(1 \leq b_j, r_j, c_j \leq 10^5)$.

Output Format

For each test case, if it is impossible to complete the task please output `-1`, otherwise output the minimum cost.

Sample Input

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

Sample Output

```
5
```

I. Pizza Quiz

time limit: 5 seconds

Win pizza from daily quiz! Imagine that you have a pizza machine. The machine has three states, which are A, B and C. On each of the states it can produce corresponding type of pizzas.

After a serious flood some machines got weird behavior. Now you restart this machine and try to adjust the state from A to B, then to C. After recording the states showed on the machine every second, you get a sequence of A, B and C. Originally the sequence should be something like A...AB...BC...C, but it was somehow scrambled.

Then you decided to test it twice, and got two sequences S_1, S_2. Now you must decide the reliability for this machine. That is, to find a common subsequence on both sequences such that this subsequence is of the form A...AB...BC...C (The number of As, Bs, Cs can be zero.) Please find the maximum possible length of this subsequence.

Input Format

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

For each test case, there are two sequences S_1 and S_2 in two lines. The length of any string will be no more than 10^5.

Output Format

For each test case please output the maximum possible length.

Sample Input

```
3
AABCABCB
AABCABCB
ABC
AAAAA
ABABC
ABBCCA
```

Sample Output

```
5
1
4
```

J. Pizza Separator

time limit: 12 seconds

There are n houses in the pizza kingdom. Now the Pizza Company wants to open two new stores in the pizza kingdom, so they decide to divide these houses into two parts. For each part, the delivering difficulty is measured by two most distant houses (Here we mean Euclidean distance.) Your job is to minimize the maximum difficulty on both part, among all possible ways.

Input Format

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

For each test case, the first line contains an integer n ($1 \leq n \leq 3000$.) Each of the next n lines contains two integers x_i, y_i denoting the coordinates of the i-th house ($-10^4 \leq x_i, y_i \leq 10^4$.)

Output Format

For each test case, please output the minimum value of most distant houses in same part.

Sample Input

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

Sample Output

```
2.000000000
1.414213562
```

K. Pizza Testing

time limit: 1 second

The Pizza Company not only sells pizza, but also sells cokes that is most suitable for pizza. Recently, the company produced n special limited-edition bottles marked with different sizes.

As a tester, you need to make sure each bottle is marked with correct size. The only thing you can do is to pick one bottle among all n bottles, then (1) fill it with water. (2) pour it. (3) pour any amount of water to another bottle, with some (or none) water remain in the bottle. At any time you can only distinguish a bottle whether it is (a) full, (b) empty or (c) neither full nor empty.

You trust the company's products, so you assume there is at most one bottle that have small error. That is, if some bottle is the error one, it may contain 0.5L more water, or 0.5L less water as the bottle marked.

Given all marks on the n bottles, can you surely find out the error one if there is any, using only these bottles?

Input Format

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

For each test case, first line contains an integer n ($1 \leq n \leq 50$.) Then n integers follows $a_1, a_2, \cdots, a_n$ ($1 \leq a_i \leq 500$.)

Output Format

For each test case, output "Yes" if it is possible to distinguish the error bottle, "No" otherwise.

Sample Input

```
3
1
100
3
1 1 1
3
2 8 16
```

Sample Output

```
No
Yes
Yes
```

L. Pizza Universe

time limit: 1 second

There are a lot of particles flying in the universe. Now we are interested in a special kind of particle, called "pizza particles." Two particles may collide. After collision, their mass may be changed.

2000 years passed, scientists finally discovered the rules when particles collide. If a particle with mass a and a particle with mass b collide, their mass could be changed into $X = a + b$ and $Y = a \times b$.

Your job is to write a program that, given a and b, calculates the corresponding mass X and Y after collision.

Input Format

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

For each test case, there are two integers a, b ($0 \leq a, b \leq 10^{12}$).

Output Format

For each test case, please output the corresponding integer values X and Y in a single line.

Sample Input

```
3
1 2
3 4
5 6
```

Sample Output

```
3 2
7 12
11 30
```