Guangdong Collegiate Programming Contest

Problem Set

May 6th, 2018

Problem A: Chika's Math Homework

Time Limit: 1s Memory Limit: 256M

Description

Chika is a popular school idol from Numazu. However, her math is really poor. Today, she meets a hard math problem which she could not solve.

The problem is here: Given a positive integer n, please calculate

$$\sum_{i=0}^{n} i^2 \binom{n}{i}$$

Please help her!

Note: $\binom{n}{i}$ equals the number of ways of choosing i items from n different items (ignoring the order).

Input

The first line of the input is a integer T ($1 \leq T \leq 10^5$), which means the number of test cases.

Then T lines follow. Each line contains one positive integer n ($1 \leq n \leq 10^{18}$).

Output

For each test case, the output should contain one integer in one line, which is the answer $\mod 1000000007$.

Sample Input

```
3
1
4
100
```

Sample Output

```
1
80
337477370
```

Problem B: Letter Kingdom

Time Limit: 2s Memory Limit: 256M

Description

One day, you had a dream. In the dream, you got trapped in the Letter Kingdom. Two soldiers caught you, and brought you to the front of the king.

The king asked you: "Are you a programmer?"

You answered: "Yes."

The king said: Our Letter Kingdom is going to hold the 233rd National Day ceremony, now we need to check our traffic network, and I appoint you to be the commander of this event. Our country has n cities, numbered by the first n uppercase letters, for example the first city named `A`, the second city named `B`, and so on. Due to the lack of money, every city only has one directed road to another city. The army will arrange m soldiers walk between these cities. The soldiers are numbered from 1 to m. I will tell you the initial position of each soldier, and then issue three types of orders:

1. **Interval Move**: Given two integers l and r, the soldiers numbered between $[l,\ r]$ walk along the only directed road to from the current city to another city (we'll call it **Moving Operation**).
2. **Multiple Move**: Given an integer x, the soldiers whose number is a multiple of x ($id \mod x = 0$) do **Moving Operation**.
3. **Commander Report**: Given an integer p, please tell me which city the soldier numbered p located in.

Since you are a smart person, can you complete this task?

Input

The first line consists of two integers n and m, which represent the amounts of city and soldier.

The second line is a n-length string. The i^{th} letter in the string represents the directed road's leading city from the i^{th} city. It's guaranteed that the i^{th} letter in the string differs from the i^{th} letter in the alphabet, and the string only consists of uppercase letters.

The third line is a m-length string. The i^{th} letter in the string represents the i^{th} soldier's initial city. The string also only consists of uppercase letters.

The fourth line consist of an integer q, which represent the number of king's orders.

Following q lines, the first part of the line is an integer op.

- If $op = 1$, then input two integers l and r, which represent the soldiers numbered between $[l,\ r]$ do **Moving Operation**.
- If $op = 2$, then input an integer x, which represents the soldiers whose number is a multiple of x do **Moving Operation**.
- If $op = 3$, then input an integer p, you should output where the soldier numbered p located in.

Its guaranteed there is at least one order that $op = 3$.

Output

For each order that $op = 3$, output the position of the soldier.

Sample Input

```
5 6
DAEEA
AEDCBA
7
1 1 4
2 2
3 4
2 3
1 3 6
2 1
3 6
```

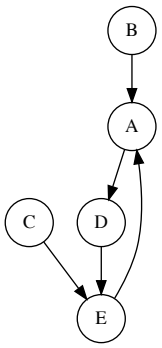
Sample Output

```
A
D
```

Constraints

- $2 \leq N \leq 26$
- $1 \leq M \leq 200000$
- $1 \leq Q \leq 200000$

Hint



Problem C: Xortree

Time Limit: 3s Memory Limit: 256M

Description

There is a tree which has n nodes. Node `1` is the root. Every node has a positive integer value. The value of node u is a_u. And there are m queries. Each of them includes 3 integers x, u, v, which means you should answer such a question:

What's $\max\{a_w \text{ xor } x\}$ (w is on the shortest path from u to v)? `xor` here means bitwise exclusive-OR.

Input

The first line of the input file is an integer T, which means the number of test cases.

For each case, the first line contains 2 integers n and m (the sum of n of all test cases is not greater than 200000, and the sum of m of all test cases is not greater than 200000), representing the number of nodes of the tree and the number of queries.

The following line contains n positive integers $a_1,\ a_2, \cdots,\ a_n$, $1 \le a_i \le 10^9$.

The following line contains $n-1$ positive integers, representing the father of node `2` to node `n`.

The following m lines are the queries. Each line contains 3 integers x ($1 \le x \le 10^9$), u ($1 \le u \le n$), v ($1 \le v \le n$), whose meanings are defined in the description.

Output

For each query of each test case, you should print one integer in one line, which means the max value of a_w xor x, where w can be all of the nodes on the shortest path from u to v.

Sample Input

```
2
5 2
3 2 7 1 8
1 1 2 2
3 1 4
4 1 5
3 1
1 5 10
1 2
8 1 3
```

Sample Output

```
2
12
13
```

Problem D: Bipartite Coloring

Time Limit: 1s Memory Limit: 256M

Description

In graph theory, a bipartite graph is a simple undirected graph that does not contain any odd-length cycles.

Now, you are given a bipartite graph $G = (V, E)$ and two sets $B_1, B_2 \subseteq V$. A proper 2-coloring that agrees with B_1 and B_2 is a function $f : V \to 1, 2$ such that $f(u) \neq f(v)$ for each edge $(u, v) \in E$ and $f(v) = i$ whenever $v \in B_i$ for $i = 1, 2$.

You realize that there is may no proper 2-coloring that agrees with B_1 and B_2 for G. In order to get a valid coloring, you can delete some vertices from G. For each vertex $v \in V$, there is a weight $w(v)$ assigned to it. You need to find a vertex set X with the minimum weight $\sum_{v \in X} w(v)$ such that graph $G - X$ admits a proper 2-coloring that agrees with $B_1 \setminus X$ and $B_2 \setminus X$.

Input

The first line contains two integers N and M denote the number of vertices and the number of edges in G. The vertices in G are numbered from 1 to N.

The next line contains N integers $w(i)$ denote the weight for each vertex.

For the next M lines, each line contains two integers u and v, denote an edge $(u, v) \in E$. It is guaranteed that G is a bipartite graph.

The next line contains two integers $|B_1|$ and $|B_2|$, denote the size of sets B_1 and B_2.

The next line contains $|B_1|$ integers denote the vertices in B_1.

The last line contains $|B_2|$ integers denote the vertices in B_2.

$1 \leq |N| \leq 3000$, $0 \leq |M| \leq 50000$, $0 \leq |B_1|, |B_2| \leq N$, $0 \leq w(i) \leq 100000$.

Output

The minimum weight $\sum_{v \in X} w(v)$.

Sample Input

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

Sample Output

```
2
```

Problem E: Lottery

Time Limit: 2s Memory Limit: 256M

Description

One day, CC walked into a shop and a game attracted her attention. There are n balls in the box and m balls are blue and the others are red. The boss told her that there were at least P balls in the box. She wanted to take two blue balls out consecutively first to win the game. (She did't need to put the ball back after taking it out). Obviously, the probability was $\frac{m}{n} \cdot \frac{m-1}{n-1}$. To be fair, she wants to know how many balls and blue balls in the box at least so that the probability is $\frac{1}{2}$. However, her math was bad so she asked you for help.

Input

Only one integer P, which means there are at least P balls in the box. $(2 \leq P \leq 10^{14})$

Output

Two integers n and m. At least n balls in the box and m blue balls so that the probability is $\frac{1}{2}$. $(n \geq P,\ 2 \leq m \leq n)$

Sample Input

```
20
```

Sample Output

```
21 15
```

Hint

The probability is $\frac{15}{21} \cdot \frac{14}{20} = \frac{1}{2}$.

Problem F: Find the Number

Time Limit: 1s Memory Limit: 128M

Description

Alice, Bob and Chris are playing a boring game. Chris first chooses an integer from 1 to n as his lucky number. Alice and Bob don't know the number, but they gonna find it out, and both of them want to find it first.

So Alice and Bob take turns to guess the lucky number and Alice will take first. In each turn, the player can either speak out the number to win the first if she or he knows it for sure, or just choose an integer x from 1 to $n-1$ and ask Chris "Is the lucky number greater than x?", then Chris will give the answer.

It should be noted that both Alice and Bob can't ask Chris a question whose answer can be inferred from the information they get before, or it will make she or he feel stupid.

For example, if the lucky number is 3 ($n = 5$), and Alice asks "Is the lucky number greater than 3?" in her first turn, then Bob can only choose $x = 1$ or $x = 2$ to ask Chris the question.

Alice is too eager to be the first to find out the lucky number, so she asks you the probability of her winning the first if both of them play optimally.

Input

The first line consists of one integer T ($1 \leq T \leq 10^5$), the number of test cases.

Then T lines follow, each line consists of one integer n ($1 \leq n \leq 10^9$).

Output

Output should consist of T lines, and each line consists of the corresponding answer.

If the answer is an integer (0 or 1), then print the integer. Otherwise print a fraction in the form of `p/q`. Both p and q are integers, and $\gcd(p, q) = 1$.

Sample Input

```
3
1
2
3
```

Sample Output

```
1
0
2/3
```

Hint

In the first case, Alice knows that the lucky number is 1 at the beginning because it's the only number. She will absolutely win.

In the second case, Alice can only ask Chris "Is the lucky number greater than 1?" in her first turn. And then Bob will know the lucky number according to Chris's answer, so Bob will no doubt win.

Problem G: Commemorate

Time Limit: 3s Memory Limit: 512M

Description

Edward's transportation system is very prosperous. This is inseparable from the hard work of their ancestors. Now, Edward's transportation system consists of n cities and m undirected roads connecting two cities.

Edward's ancestors began working in the first year of Edward's calendar. They would build a road every year. It has been m years since then. Although it took a long time, Edward experienced famine, riots, and war. The construction of roads is still an annual task.

Now, the m^{th} year of the Edward's calendar, Edward's current king, Albert, wonders how many different connected blocks Edward will be divided into if he only retains the road built in $[l_i,\ r_i]$ years.

Albert will ask you k questions, and you need to output the answer to each question.

Input

The first line of the input contains numbers n, m, and k ($1 \leq n,\ m,\ k \leq 200000$).

Next m lines, the i^{th} line includes two numbers u, v. This means that the road built in year i is from u to v.

Next k lines, the i^{th} line includes two numbers l, r. This means the i^{th} query is $[l,\ r]$.

Output

For each query, print the number of connected block.

Sample Input

```
10 10 10
9 3
6 4
8 8
10 4
10 7
9 10
1 9
2 3
1 6
6 1
5 8
3 6
7 8
7 7
7 9
5 5
2 5
```

```
2 9
2 10
1 6
```

Sample Output

```
6
7
8
9
7
9
7
4
4
5
```

Problem H: Number String

Time Limit: 1s Memory Limit: 128M

Description

Give you an array $a(0 \leq a_i \leq 9)$, now you can do the following two operations at any time.

1. Delete a certain number.
2. If two adjacent numbers equal or less than 9, replace them with their sum.

Find the largest array in lexicographical order[1] and output the least number of operations. It's guaranteed that $\text{Length}(a) \leq 5 \times 10^6$.

Input

The first line of the input contains one integer, the size of array.
The second line input contains a string containing n characters.

Output

The output line contains a string and an integer, denoting the largest array in lexicographical order and the least number of operations.

Sample Input

```
6
182736
```

Sample Output

```
999 3
```

[1]The **lexicographical order** is a generalization of the way words are alphabetically ordered based on the alphabetical order of their component letters.

Problem I: Convex Hull

Time Limit: 1s Memory Limit: 128M

Description

Master Fang has a convex hull of n points. These points are $A_0,\ A_1, \cdots,\ A_{n-1}$ in counterclockwise order.

A point P is great if $\sum_{i=0}^{n-1} S_{\triangle PA_iA_{(i+1)\%n}} = w$. ($S_{\triangle PA_iA_{(i+1)\%n}}$ is the area of the triangle $PA_iA_{(i+1)\%n}$.)

Now, Master Fang want you to calculate the area of graphics surrounded by all great points.

Input

The first line is the number of test cases $T(1 \leq T \leq 10)$.

For each test case, the first line contains two integers $n, w(3 \leq n \leq 1000$. If the area of the convex hull is $S, 1.1S \leq w \leq 1.2S$.).

In the following n lines, each line contains two integers x_i and y_i, mean the coordinate of the point A_i.$(0 \leq x_i, y_i \leq 10000)$

Output

For each test case, output `Case #x: y` in one line, where x indicates the case number starting from 1 and y denotes the answer of corresponding case. Keep 2 decimal places.

Sample Input

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

Sample Output

```
Case #1: 11.00
```

Problem J: Maximum × Minimum

Time Limit: 1s Memory Limit: 128M

Description

There is a sequence $a_1,\ a_2, \cdots,\ a_n$, and your task is to calculate

$$\sum_{l=1}^{n}\sum_{r=1}^{n} \max\{a_l,\ a_{l+1}, \cdots,\ a_r\} \times \min\{a_l,\ a_{l+1}, \cdots,\ a_r\}$$

Input

The first line consists of one integer n ($1 \leq n \leq 10^5$), the size of the sequence.

The second line consists of n integers $a_1,\ a_2, \cdots,\ a_n$ ($1 \leq a_i \leq n$), and each two of them are different.

Output

Output should consist of only one integer, the answer $\mod 10^9 + 7$.

Sample Input #1

```
4
1 2 3 4
```

Sample Output #1

```
65
```

Sample Input #2

```
4
1 3 2 4
```

Sample Output #2

```
62
```