



Winter Camp Contest 2023

## Problem A

### ATCG

Time limit: 1 second

Memory limit: 2048 megabytes

### Problem Description

DNA is a polymer found in many organisms' cells, including humans. It is composed of two strands, which coil together to form a double helix.

The structure of each DNA strand can be seen as an array of nucleotides. According to the type of nucleobases each nucleotide contains, we can classify the nucleotides into four categories: **A**, **T**, **C**, and **G**. Thus, each strand of the DNA can be simplified as a sequence containing characters **ATCG**. The beginning and the end of any DNA strand are called the 5'-end and the 3'-end, respectively.

The nucleotides on the two strands bind together, which is why the two strands won't separate. According to base pairing rules, **A** is always paired with **T** while **C** is always paired with **G**. The direction of the nucleotides in one strand is opposite to the direction in the other strand; that is, one strand's 5'-end matches the other strand's 3'-end. Hence, to find the sequence for the other strand, one just needs to reverse the sequence and do the substitution ( $A \rightarrow T$ ,  $T \rightarrow A$ ,  $C \rightarrow G$ ,  $G \rightarrow C$ ). See the figure below for a better understanding.

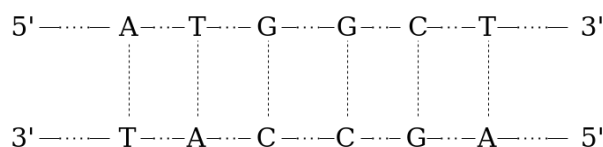


Figure 1: The DNA structure.

Alan is a biologist conducting experiments with DNA. He is playing with a special kind of DNA, just finding the sequence for one strand from the 5'-end to the 3'-end is  $s$ . Can you help him find the sequence for the other strand from the 5'-end to the 3'-end?

### Input Format

The first line contains the number of test cases  $T$ .

Each test case contains two lines. The first line contains an integer  $n$  denoting the length of  $s$ . The second line contains the string  $s$ .



## Output Format

For each testcase, print the sequence for the other strand from the 5'-end to the 3'-end in one line.

## Technical Specification

- $1 \leq T \leq 2000$
- $1 \leq n \leq 100$
- $n = |s|$
- Each character in  $s$  is one of ATCG.

## Sample Input 1

```
3
4
ATCG
4
ACGT
6
ATGGCT
```

## Sample Output 1

```
CGAT
ACGT
AGCCAT
```



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## Problem B

### Buying Mascots

Time limit: 1 second

Memory limit: 2048 megabytes

#### Problem Description

Brian is a fan of the double-sided octopus mascots. He visits a fair with  $n$  stands providing numerous octopus double-sided mascots to collect as many mascots as possible.

The stands in the fair are numbered from 1 to  $n$ , and Brian will also visit the stands in this order. When visiting the  $i$ -th stand, he can do exactly one of the following (but not both):

1. Pay  $a_i$  dollars to obtain  $a_i$  tokens. Brian can hold at most  $m$  tokens at a time. If Brian earns more than  $m$  at any time, the rest of the tokens must be returned to the stand.
2. Pay  $b_i$  tokens to obtain  $b_i$  double-sided octopus mascots.

At this moment, Brian has no tokens. What is the maximum number of double-sided octopus mascots he can receive after visiting the  $n$  stands? You may assume that Brian always has enough money to pay for the tokens.

#### Input Format

The first line of the input contains two integers  $n, m$ . The second line of the input contains  $n$  integers  $a_1, a_2, \dots, a_n$ . The third line of the input contains  $n$  integers  $b_1, b_2, \dots, b_n$ .

#### Output Format

Print the the maximum number of double-sided octopus mascots Brian can receive.

#### Technical Specification

- $1 \leq n \leq 10^5$
- $1 \leq m \leq 100$
- $0 \leq a_i, b_i \leq m$  for  $i = 1, 2, \dots, n$



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### Sample Input 1

```
5 10
5 6 0 10 2
2 3 10 0 3
```

### Sample Output 1

```
13
```

### Sample Input 2

```
7 100
21 15 0 32 21 23 14
8 23 20 67 31 72 15
```

### Sample Output 2

```
87
```



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## Problem C

### Colorful Pictures

Time limit: 8 seconds

Memory limit: 2048 megabytes

#### Problem Description

Carol is a prestigious painter in the PCCA Kingdom. Unfortunately, she has to spend time in quarantine during the pandemic, so she comes up with the game described below.

At the beginning of the game, she paints a tree with  $n$  nodes numbered  $1, 2, \dots, n$ . There are  $n - 1$  edges,  $i$ -th of which is  $(u_i, v_i)$ . She also draws a picture with  $n$  squares numbered  $1, 2, \dots, n$ . The  $i$ -th square is colored with color  $a_i = i$ .

Then she can perform the following operation any number of times (possibly zero): Select an existing edge  $(u_i, v_i)$  from the tree, swap the colors in the square  $u_i$  and  $v_i$  (that is, swap  $a_{u_i}$  and  $a_{v_i}$ ) and remove the edge  $(u_i, v_i)$  from the tree.

How many different pictures can be painted after performing any number of operations? Two pictures are considered different if a square  $i$  is painted in different colors in the two pictures.

#### Input Format

The first line of the input contains an integer  $n$ . The  $i$ -th of the following  $n - 1$  lines contain two integers  $u_i, v_i$ .

#### Output Format

Print the number of different pictures can be painted after performing any number of the operations. Output the result modulo 998244353.

#### Technical Specification

- $1 \leq n \leq 1.5 \times 10^5$
- $1 \leq u_i, v_i \leq n$
- It is guaranteed that the  $n - 1$  edges form a tree.



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### Sample Input 1

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

### Sample Output 1

```
16
```

### Sample Input 2

```
2
1 2
```

### Sample Output 2

```
2
```



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### Sample Input 3

```
23
3 13
9 14
8 20
11 4
8 22
6 10
6 2
18 8
19 8
8 9
4 8
4 5
3 8
23 8
15 12
1 14
16 8
2 12
7 6
8 21
8 6
17 8
```

### Sample Output 3

```
616298673
```



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## Problem D

# Duo of Magicians

Time limit: 1 second

Memory limit: 2048 megabytes

### Problem Description

Neko-chan and Laffey are a famous duo of magicians in the PCCA kingdom. Recently they came up with the following new trick for their next show.

In the beginning, Neko-chan will invite an audience to write down a random permutation  $a = [a_1, a_2, \dots, a_n]$  of  $1, 2, \dots, n$  without showing it to Laffey. After seeing the permutation, Neko-chan will hand out a deck of cards (at most  $n$  cards, otherwise, it would be too apparent that they are cheating) to another audience. Neko-chan will ask the new audience to shuffle the cards in any order and hand it to Laffey. Here comes the miracle: Laffey then can read out a sequence of operations to swap the elements in  $a$ , and the array  $a$  will be sorted in increasing order!

If you wonder how this trick works, here is the secret. After the permutation  $a$  is written, Neko-chan secretly writes down a swapping operation on each card. Each operation is denoted as an integer pair  $(x_i, y_i)$  meaning that Laffey has to swap  $a_{x_i}$  and  $a_{y_i}$ . When Laffey receives the deck of cards, she only has to sort the pairs for each operation in ascending order and read out the sorted pairs.

For example, suppose  $a = [1, 3, 5, 2, 4]$  and Neko-chan writes down the pairs  $(4, 5), (2, 3), (2, 4)$ . Then Laffey will read out  $(2, 3), (2, 4), (4, 5)$  one by one. As you can see, swapping the pairs  $(a_2, a_3), (a_2, a_4), (a_4, a_5)$  in this order will sort the array  $a$ .

To make the trick work, Neko-chan requires an efficient algorithm to help decide which operation should be written on each card. This task is too complex for Neko-chan. Can you help him?

### Input Format

The first line of the input contains an integer  $T$ , denoting the number of test cases.

Each test case consists of two lines. The first line contains an integer  $n$ . The second line contains  $n$  integers  $a_1, a_2, \dots, a_n$ .



## Output Format

For each testcase, print an integer  $k$  denoting the number of cards given to Laffey in the first line.

$k$  lines follow. In the  $i$ -th line, print two integers  $x_i, y_i$  denoting the  $i$ -th operation given to Laffey.

Your solution will be considered correct if it satisfies all the following conditions:

- $0 \leq k \leq n$
- $1 \leq x_i < y_i \leq n$  for  $i = 1, 2, \dots, k$
- When sorted in ascending order, the sequence of operations will sort  $a$  in increasing order.

If there are multiple possible solutions, print any.

## Technical Specification

- $1 \leq T \leq 200$
- $2 \leq n \leq 10^5$
- $\sum n \leq 10^6$
- $1 \leq a_i \leq n$  for  $i = 1, 2, \dots, n$
- $a_i \neq a_j$  for  $i \neq j$

## Sample Input 1

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



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### Sample Output 1

```
3
2 3
2 4
4 5
5
3 4
2 5
1 2
1 6
1 2
0
```

### Note

To sort the pairs in ascending order means to sort the pairs in the increasing order of the first element and the increasing order of the second element in case of ties.



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## Problem E

### Exterior

Time limit: 1 second

Memory limit: 2048 megabytes

### Problem Description

Shokuhou (食蜂) is a girl who lives in Academy City. The Academy City comprises  $n$  districts numbered  $1, 2, \dots, n$ . There are  $m$  bidirectional roads between the districts. The  $i$ -th road connects city  $u_i$  and  $v_i$ , and traversing it takes exactly  $c_i$  minutes. In addition, each district has a portal; the portal in the  $i$ -th city has power  $a_i$ . With these portals, one can travel from the  $i$ -th city to the  $j$ -th city in  $a_i + a_j$  minutes for  $i = 1, 2, \dots, n$  and  $j = 1, 2, \dots, n$ .

Shokuhou is currently at district 1, and her home is at district  $n$ . Since she learned she had just had a break-in at her house, she would like to return home immediately. She can go back home using any number of roads and portals. What is the minimum number of minutes she must spend to return home?

### Input Format

The first line of the input contains two integers  $n, m$ . The second line contains  $n$  integers  $a_1, a_2, \dots, a_n$ .

$m$  lines follow. The  $i$ -th line contains three integers  $u_i, v_i, c_i$  denoting the  $i$ -th road.

### Output Format

Print the minimum number of minutes Shokuhou must spend to return home. It can be shown that Shokuhou can always return home using some number of roads and portals.

### Technical Specification

- $2 \leq n \leq 10^5$
- $0 \leq m \leq \min(10^5, \frac{n(n-1)}{2})$
- $1 \leq a_i \leq 10^5$  for  $i = 1, 2, \dots, n$
- $1 \leq u_i < v_i \leq n$  for  $i = 1, 2, \dots, m$
- Each pair of  $(u_i, v_i)$  appears in the input at most once.
- $1 \leq c_i \leq 10^5$  for  $i = 1, 2, \dots, m$



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### Sample Input 1

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

### Sample Output 1

```
6
```

### Sample Input 2

```
5 4
12 23 34 45 56
1 2 1
2 3 1
3 4 1
4 5 1
```

### Sample Output 2

```
4
```

### Sample Input 3

```
6 7
8 5 1 7 8 6
2 3 1
2 5 1
3 5 4
2 6 3
4 5 17
3 4 10
5 6 2
```



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### Sample Output 3

13
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## Problem F Formidable Team

Time limit: 1 second

Memory limit: 2048 megabytes

### Problem Description

As a PCCA winter camp staff member, you have been tasked with creating teams of  $m$  members from a list of  $n$  participants. Each participant has  $m$  skills; the  $i$ -th participant has skill level  $a_{i,j}$  for the  $j$ -th skill for  $i = 1, 2, \dots, n$  and  $j = 1, 2, \dots, m$ .

To facilitate team selection, you define the metrics for evaluating the teams' skills. For a team  $b$  consisting of  $m$  members  $b_1, b_2, \dots, b_m$ , define the **strength** of  $S$  as  $\max_{p \in P_m} \sum_{i=1}^m a_{b_i, p_i}$ , where  $P_m$  is the set of all possible permutations of  $1, 2, \dots, m$ . That is, the strength of a team is the maximum possible sum of skill levels, considering all possible combinations of the  $m$  skills from the  $m$  team members.

Your goal is to build a formidable team by maximizing the team's strength.

### Input Format

The first line of the input contains two integers  $n, m$ .  $m$  lines follow,  $i$ -th of which contains  $m$  integers  $a_{i,1}, a_{i,2}, \dots, a_{i,m}$ .

### Output Format

Print the maximum possible strength  $k$  in the first line. In the  $i$ -th line of the following  $m$  lines, print two integers  $s_i, t_i$  denoting that the team contains  $s_i$ -th member with  $t_i$ -th skill.

Your solution will be considered correct if it satisfies all the following conditions:

- $1 \leq s_i \leq n$  for  $i = 1, 2, \dots, m$
- $s_i \neq s_j$  for  $i \neq j$
- $1 \leq t_i \leq m$  for  $i = 1, 2, \dots, m$
- $t_i \neq t_j$  for  $i \neq j$
- $\sum_{i=1}^m a_{s_i, t_i} = k$



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If there are multiple possible solutions, print any.

### Technical Specification

- $1 \leq n \leq 1.5 \times 10^5$
- $1 \leq m \leq 60$
- $m \leq n$
- $n \times m \leq 2 \times 10^6$
- $1 \leq a_{i,j} \leq 10^9$

### Sample Input 1

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

### Sample Output 1

```
19
1 5
2 3
3 4
4 1
5 2
```



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## Problem G

# Genetic Sequence Searching

Time limit: 1 second

Memory limit: 2048 megabytes

### Problem Description

Recently scientists have been looking into a new kind of pathogenic virus. To learn more about this virus, they did DNA sequencing on the samples and identified a typical pattern  $t$  in all the virus samples.

The scientists then want to identify the pattern in other DNA sequences. They just collected a DNA sequence  $s$  from cells of other organisms and were eager to discover all the occurrences of  $t$  in  $s$ . However, since DNA sequencing can go wrong, they want to find out the occurrences that differ in at most 1 character.

More formally, Let  $s = s_1s_2 \dots s_{|s|}$  and  $t = t_1t_2 \dots t_{|t|}$  are two DNA sequences. The scientists want to know all integers  $i$  between 1 and  $|t| - |s| + 1$ , such that substrings  $s_is_{i+1} \dots s_{i+|t|-1}$  and  $t_1t_2 \dots t_{|t|}$  have at most 1 different character.

Note that unlike usual DNAs,  $s$  and  $t$  may contain characters other than ATCG.

### Input Format

The first line of the input contains the string  $s$ . The second line of the input contains the string  $t$ .

### Output Format

Print the number of occurrences in the first line. If there is at least one occurrence in  $t$ , in the second line, print all  $i$  such that substrings  $s_is_{i+1} \dots s_{i+|t|-1}$  and  $t_1t_2 \dots t_{|t|}$  have at most 1 different character. Print the answers in increasing order.

### Technical Specification

- $1 \leq |t| \leq |s| \leq 10^6$
- Each character in  $s$  and  $t$  has an ASCII code in the range  $[33, 126]$ . In other words, each character is one of `!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[_`abcdefghijklmnopqrstuvwxyz{|}~`.



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### Sample Input 1

```
PCCA_Winter_Camp_2023
AC
```

### Sample Output 1

```
4
1 2 4 12
```

### Sample Input 2

```
meowmeow
owo
```

### Sample Output 2

```
1
3
```



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## Problem H

### Heritage in the PCCA Kingdom

Time limit: 4 seconds

Memory limit: 2048 megabytes

#### Problem Description

The PCCA kingdom has a world heritage site everybody knows: The Triangular Cave. Legend says there was an ancient civilization of triangles in the cave, and they left a powerful relic somewhere nobody knows. One day, you find a mysterious triangular stone plate, and it turns out to be the legendary relic of the Holy Triangle!

The relic is divided into  $n$  layers of small triangles which are enclosed by imprints. You notice that some imprints have been charged with ancient power while others have not. To fully empower the relic, you must restore it by making all the imprints charged.

However, you cannot charge the imprints directly. Instead, you can replace the small triangles with the energy runestones you prepared beforehand. An energy runestone is also in the shape of a triangle and can charge the imprints on the three sides of it once it is put onto the relic.

The figures below show examples of a relic before and after restoration:

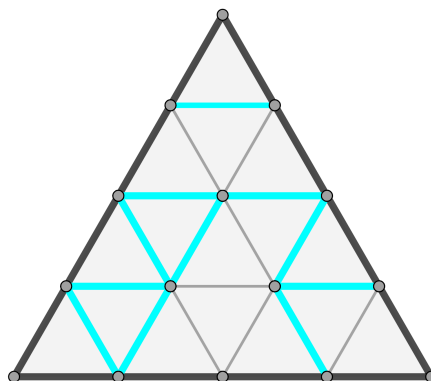


Figure 2: A partially charged relic before restoration. The blue edges are charged imprints and the grey edges are imprints not charged yet.

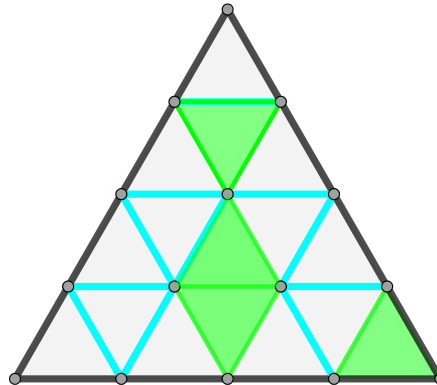


Figure 3: A fully charged relic after restoration. After putting 4 runestones onto the relic, all of the imprints are charged.

Here comes the problem: What is the minimum number of energy runestones required to empower the relic fully?

## Input Format

The first line contains an integer  $n$ .

The following  $2n$  lines indicate the status of the imprints. For each  $i = 1, 2, \dots, n$ , two lines follow, indicating the status of the imprints of the  $i$ -th layer. The format for the  $i$ -th layer is the following:

- Both of the two lines begin with  $n - i$  spaces.
- Exactly  $2i$  characters follow the spaces in the first line. Each character represents an imprint. `\` or `/` denotes a charged imprint, while `.` denotes an uncharged imprint.
- Exactly  $2i$  characters follow the spaces in the second line. A consecutive pair of characters represents an imprint. `..` denotes an uncharged imprint, while `--` denotes a charged imprint.

The imprints on the boundary of the relic are guaranteed to be charged.

## Output Format

Print the minimum number of runestones required.

## Technical Specification

- $1 \leq n \leq 500$



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### Sample Input 1

```
4
  /\
  --
 /\.\
 ----
 /\./.\
 --.---
 /\./.\.\
 -----
```

### Sample Output 1

```
4
```

### Sample Input 2

```
4
  /\
  ..
 /\.\
 ....
 /\....\
 .....
 /\.....\
 -----
```

### Sample Output 2

```
6
```



### Sample Input 3

```
6
  /\
  ..
 /\./\
  ..--
 /\....\
  --.....
 /\./.../\
  -----
 /\/\..../\
  -----
 /\..././\.../\
  -----
```

### Sample Output 3

```
14
```

### Note

The first sample corresponds to the figure in the statement.





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## Problem I Interval Cover

Time limit: 1 second

Memory limit: 2048 megabytes

### Problem Description

Ian has a multiset  $S$  of intervals on the number axis,  $i$ -th of which is  $[l_i, r_i]$ . Surprisingly, he found that every interval is within the  $[0, l]$  range, where  $l$  is Ian's favorite positive integer.

As Ian thinks everything should be perfectly balanced, he wants to add the minimum number of intervals to  $S$ , so that the same number of intervals cover every non-integer coordinate between 0 and  $l$ . The newly added intervals should also be within the  $[0, l]$  range. Let  $f(S)$  be the minimum number of intervals to be added. Note that  $S$  is not changed after calculating  $f(S)$ .

For example, consider the case that  $S$  contains intervals  $[0, 3], [2, 8], [7, 10]$  and  $l = 10$ . Then Ian can add 3 intervals  $[0, 2], [3, 7], [8, 10]$  to  $S$ , and then every non-integer coordinate between 0 and 10 are covered by 2 intervals. Therefore  $f(S) = 3$  in this case.

Due to the instability of  $S$ , Ian observes that  $S$  is prone to change. He wonders if the value of  $f(S)$  can be changed. More formally, there are  $q$  queries of three types:

1.  $ql_i \ qr_i$  —Add an interval  $[ql_i, qr_i]$  to  $S$ .
2.  $2 \ ql_i \ qr_i$  —Remove an occurrence of  $[ql_i, qr_i]$  from  $S$ . It is guaranteed that  $[ql_i, qr_i]$  appears in  $S$  at least once.
3. 3 —Ian wants to know the value of  $f(S)$ .

Can you help Ian answer all the queries?

### Input Format

The first line of the input contains two integers  $n, l$ . The  $i$ -th of the following  $n$  lines contains two integers  $l_i, r_i$ .

The following line contains an integer  $q$ . The  $i$ -th of the following  $q$  lines contains the  $i$ -th query in the format as in the problem description.

### Output Format

For each query of type 3, print the value of  $f(S)$  in one line.



## Technical Specification

- $1 \leq n, l \leq 2 \times 10^5$
- $0 \leq l_i < r_i \leq l$  for  $i = 1, 2, \dots, n$
- $1 \leq q \leq 2 \times 10^5$
- $0 \leq ql_i < qr_i \leq l$  for  $i = 1, 2, \dots, q$  of query type 1, 2
- It is guaranteed that there is at least one query of type 3 in the input.

## Sample Input 1

```
5 10
0 3
3 4
4 10
0 7
7 10
7
3
1 1 6
3
1 0 1
3
2 4 10
3
```

## Sample Output 1

```
0
2
1
2
```



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## Problem J

# Jewelry Box

Time limit: 1 second

Memory limit: 2048 megabytes

### Problem Description

Jen has a jewelry box with  $n$  rows and  $m$  columns. The rows are numbered from 1 to  $n$  from top to bottom, and the columns are numbered from 1 to  $m$  from left to right. Each cell is identified by a pair  $(x, y)$ , which means it is located in the  $x$ -th row and the  $y$ -th column.

There are some jewels located in some cells of the box. Each cell contains, at most, one jewel. Surprisingly, no two jewels are located in adjacent cells. In this problem, two cells are considered adjacent if they share an edge.

For some reason, Jen would like to form some pairs of jewels. Each pair of jewels must be connected by a strand of rope, which may occupy some other cells of the jewelry box. More formally, suppose a strand of rope connects jewels located in  $(a_1, b_1)$  and  $(a_k, b_k)$ , and then the rope can be viewed as a sequence of  $k$  cells  $(a_1, b_1), (a_2, b_2), \dots, (a_k, b_k)$ . Each pair of consecutive cells in the sequence must be adjacent, and all the  $k$  cells should be distinct. Due to aesthetics, no jewels should be attached to more than one rope, and no two ropes should occupy the same cell.



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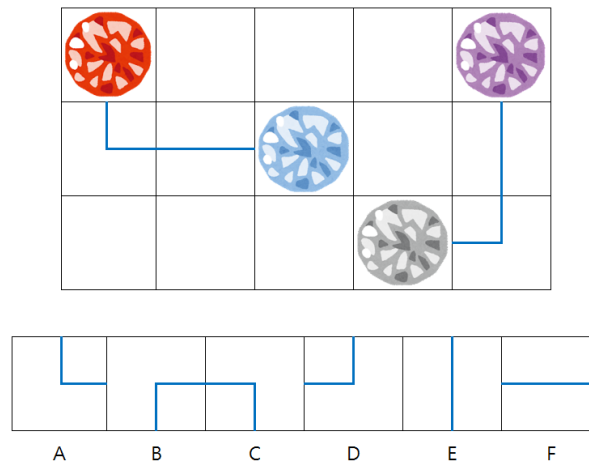


Figure 4: A valid configuration of jewels and ropes. There are 2 pairs of jewels in the figure: One pair is  $(1, 1), (2, 3)$ , and the other is  $(1, 5), (3, 4)$ .

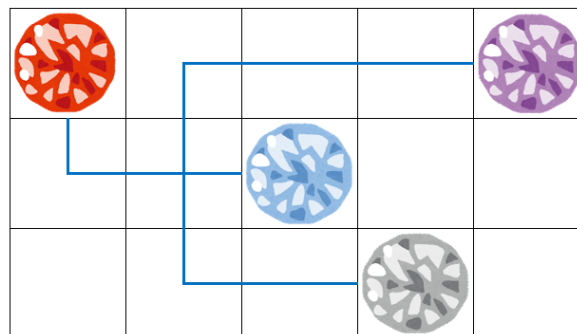


Figure 5: An invalid configuration of jewels and ropes because the two ropes share a common cell.

Jen hopes to form as many pairs of jewels as possible. She also wonders about a way to place these strands of ropes. Can you help her out?

### Input Format

The first line of the input contains an integer  $T$ , denoting the number of test cases.

The first line of each test case consists of two integers  $n, m$ . Each of the following  $n$  lines contains  $m$  characters. For each  $i = 1, 2, \dots, n$ , the  $j$ -th character denotes whether there is a jewel in cell  $(i, j)$  for  $j = 1, 2, \dots, m$ .  $\#$  denotes a cell containing a jewel, while  $.$  denotes a cell not containing a jewel. It is guaranteed that no two jewels are adjacent.



## Output Format

For each test case, print  $n$  lines containing  $m$  characters denoting the configuration of the jewels and the ropes. The jewel pairs should be as many as possible.

Each character should be one of the following:

- `#` denotes a cell with jewels. The locations of the jewels should be the same as those in the input.
- Any of `ABCDEF` denotes a cell with ropes. Refer to the figure in the problem description to know the meaning for each character. In formal:
  - `A` denotes a cell connecting the cell to the top and to the right.
  - `B` denotes a cell connecting the cell to the bottom and to the right.
  - `C` denotes a cell connecting the cell to the bottom and to the left.
  - `D` denotes a cell connecting the cell to the top and to the left.
  - `E` denotes a cell connecting the cell to the top and to the bottom.
  - `F` denotes a cell connecting the cell to the left and to the right.
- `.` denotes a cell with nothing.

## Technical Specification

- $1 \leq T \leq 10$
- $1 \leq n, m \leq 100$

## Sample Input 1

```
2
2 2
# .
. #
3 4
# . . #
. . # .
# . . #
```



## Sample Output 1

```
#C
.#
#FF#
BF#.
#..#
```



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## Problem K

### $k$ -restricted Induced Subgraphs

Time limit: 1 second

Memory limit: 2048 megabytes

#### Problem Description

You are given an undirected graph  $G$  of  $n$  vertices and  $m$  edges. The vertices in  $G$  are numbered from 1 to  $n$ . For each vertex  $i$  in  $G$ , a weight  $a_i$  is associated with it.

Given an integer  $k$ , define a  $k$ -restricted induced subgraph of  $G$  are induced subgraphs satisfying all the following conditions:

- The induced subgraph is connected.
- For every pair of vertices  $u, v$  in the induced subgraph,  $|a_u - a_v| \leq k$  should hold. Note that an edge does not necessarily connect  $u$  and  $v$ .

What is the maximum possible number of vertices in a  $k$ -restricted induced subgraph of  $G$ ?

#### Input Format

The first line of the input contains three integers  $n, m, k$ . The  $i$ -th of the next  $m$  lines contains two integers  $u_i$  and  $v_i$  denoting an edge  $(u_i, v_i)$ .

#### Output Format

Print the maximum number of vertices in a  $k$ -restricted induced subgraph of  $G$ .

#### Technical Specification

- $1 \leq n, m, k \leq 10^5$
- $1 \leq a_i \leq 10^5$  for  $i = 1, 2, \dots, n$
- $1 \leq u_i, v_i \leq n$  for  $i = 1, 2, \dots, m$



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### Sample Input 1

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

### Sample Output 1

```
4
```

### Sample Input 2

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

### Sample Output 2

```
5
```





### Sample Input 3

```
4 4 1
100 100 100 100
1 2
2 3
3 4
4 1
```

### Sample Output 3

```
4
```

### Note

An induced subgraph of  $G$  is formed by some non-empty subset of vertices  $S$  of  $G$ , and all edges in  $G$  such that both endpoints are in  $S$ . In this problem, we view  $G$  also as an induced subgraph of  $G$  itself.

For example, the following are all induced subgraphs of  $G$  in Sample Input 2:

- Vertices 1, 2, 6 with edges  $(1, 6)$ ,  $(2, 6)$
- Vertices 1, 3, 4 with edge  $(1, 3)$
- Vertex 5
- Vertices 1, 2, 3, 5, 6, 7 with edges  $(1, 3)$ ,  $(1, 6)$ ,  $(2, 6)$ ,  $(2, 3)$ ,  $(6, 7)$ ,  $(2, 7)$ ,  $(2, 5)$



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## Problem L

### Linear Classifiers

Time limit: 1 second

Memory limit: 2048 megabytes

#### Problem Description

There are  $n$  points on the Cartesian plane. The  $i$ -th point has coordinate  $(x_i, y_i)$ . No two points coincide and no three points are collinear.

Define a **linear classifier** as a straight line with equation  $\frac{q_a}{p_a}x + \frac{q_b}{p_b}y = \frac{q_c}{p_c}$ , where  $p_a, q_a, p_b, q_b, p_c, q_c$  are integers.

Suppose we have two linear classifiers. If the two classifiers have exactly one intersection, they divide the Cartesian plane into 4 regions. Can you find two linear classifiers so that each of the 4 regions contains an equal number of points? Of course, no points should lie on the linear classifiers, so each region should have exactly  $\frac{n}{4}$  points.

#### Input Format

The first line contains an integer  $n$ . Each of the following  $n$  lines contains two integers  $x_i, y_i$ .

#### Output Format

Print two lines. In each line, print six integers  $p_a, q_a, p_b, q_b, p_c, q_c$  denoting a linear classifier with equation  $\frac{q_a}{p_a}x + \frac{q_b}{p_b}y = \frac{q_c}{p_c}$ .

Your solution will be considered correct if it satisfies all the following conditions:

- $-10^{18} \leq p_a, q_a, p_b, q_b, p_c, q_c \leq 10^{18}$  for each linear classifier.
- $p_a, p_b, p_c \neq 0$  for each linear classifier.
- No points lie on the linear classifiers.
- The two linear classifiers have exactly one intersection.
- Each of the 4 regions contains exactly  $\frac{n}{4}$  points.

If there are multiple possible solutions, print any. It can be proved that a solution always exists under these constraints.



## Technical Specification

- $4 \leq n \leq 2024$
- $0 \leq x_i, y_i \leq 10^4$  for  $i = 1, 2, \dots, n$
- $4 \mid n$
- No two points coincide and no three points are collinear.

## Sample Input 1

```
8
0 0
7 2
4 0
5 7
3 9
8 10
1 6
7 10
```

## Sample Output 1

```
5 52 -1 3 5 156
1 1 2 20 1 70
```

## Sample Input 2

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

## Sample Output 2

```
1 0 1 1 2 1
1 -1 1 1 2 -1
```



## Note

Here is the figure for the first example. Note that point  $D(5, 7)$  does not lie on the green line.

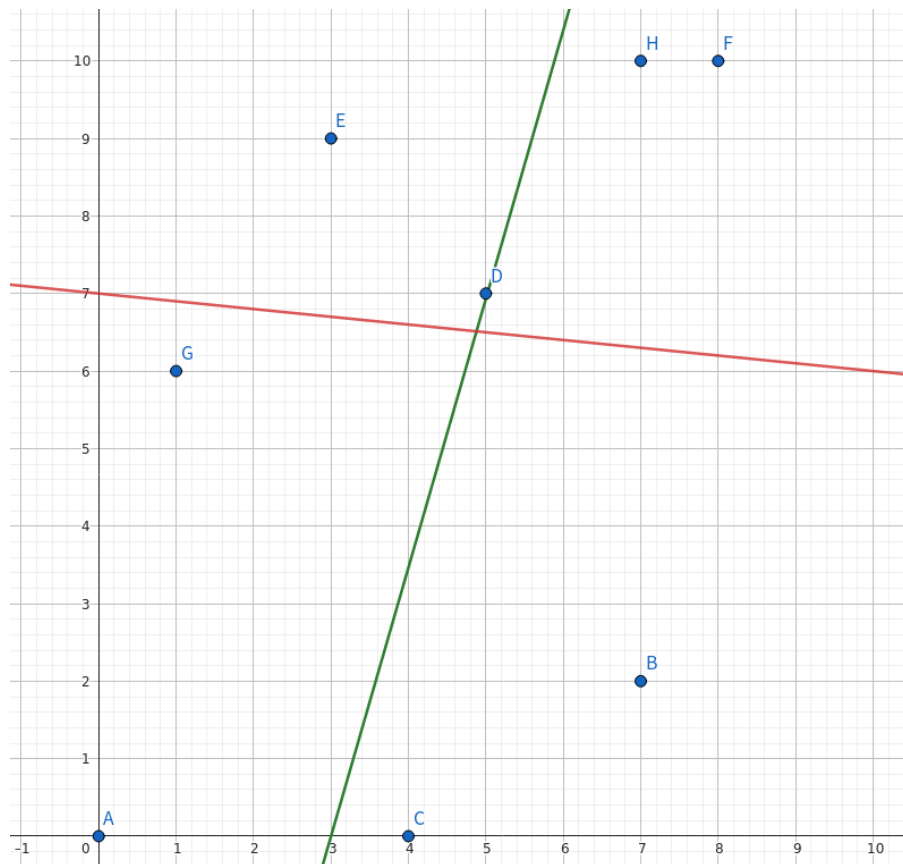


Figure 6: The figure for the first example. The two lines are the linear classifiers.



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## Problem M

### Mini Factorization Challenge

Time limit: 1 second

Memory limit: 2048 megabytes

#### Problem Description

Factorizing huge integers has caught more and more people's interest since it is unknown whether fast algorithms to factorize huge integers exist. Despite the difficulty, Mia challenges you to factorize a huge positive integer  $n$ . As a hint, she also gives you  $k$ , the number of positive factors of  $n$ .

Soon, you realize that Mia only learns primes less than 100, so all the prime factors in  $n$  are less than 100. You also noticed that Mia intentionally miswrote exactly one digit in both  $n$  and  $k$ . Now you are given  $n'$  and  $k'$  (the miswritten  $n$  and  $k$ ), and you are to find  $n$  and  $k$  so that you can successfully factorize  $n$ .

#### Input Format

The first line contains the number of test cases  $T$ . Each test case contains two integers  $n'$  and  $k'$  in one line.

#### Output Format

Print each test case's a possible value of  $n$  and  $k$  in one line.  $n$  and  $k$  should have the same number of digits as  $n'$  and  $k'$ , respectively.  $n$  and  $k$  should not contain leading zeros.

If there are multiple possible solutions, print the one with the minimum  $n$ . It is guaranteed that a solution always exists.

#### Technical Specification

- $1 \leq T \leq 100$
- $10^5 \leq n' \leq 10^{100} - 1$
- $10 \leq k' \leq 10^{18} - 1$
- $n'$  and  $k'$  do not contain leading zeros.



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**Sample Input 1**

```
1
100000 10
```

**Sample Output 1**

```
102000 80
```

**Sample Input 2**

```
2
931072 98
223830 47
```

**Sample Output 2**

```
131072 18
223839 48
```





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## Problem N Nancy's Numbers

Time limit: 1 second

Memory limit: 2048 megabytes

### Problem Description

Nancy has a huge collection of  $n$  positive integers  $a_1, a_2, \dots, a_n$ . Unfortunately, she is not satisfied since there are duplicate integers in them.

To make Nancy happy, you can perform the following operation any number of times (possibly zero): Select an integer  $a_i$  from  $a_1, a_2, \dots, a_n$ , and add 1 to  $a_i$ .

What is the minimum number of operations required so that all the integers in  $a_1, a_2, \dots, a_n$  are distinct (in other words, all integers are different)?

### Input Format

The first line of the input contains an integer  $n$ . The second line of the input contains  $n$  integers  $a_1, a_2, \dots, a_n$ .

### Output Format

Print the minimum number of operations required to make all integers in  $a_1, a_2, \dots, a_n$  distinct.

### Technical Specification

- $1 \leq n \leq 2 \times 10^5$
- $1 \leq a_i \leq 10^9$  for  $i = 1, 2, \dots, n$

### Sample Input 1

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

### Sample Output 1

```
5
```



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**Sample Input 2**

```
1
77777
```

**Sample Output 2**

```
0
```

**Sample Input 3**

```
5
100 100 100 100 100
```

**Sample Output 3**

```
10
```