1st Malaysian Computing Olympiad

MCO 2013

CONTEST

6 Questions in 6 Pages

3 Hours

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10 JamadiAwal 1434 Hijrah

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Problem A - String Operations (Points: 10, Time Limit: 1 second)

Problem Description

Given a string **S** of length **N** and **M** string operations, determine the final string after applying those **M** operations. There are two types of string operations in this problem:

- **1 x y** : replace the **x**-th character in the current string to another character **y.**
  For instance, string "abc" will become "akc" after applying operation "**1 2 k**".
- **2 x** : append a character **x** to the current string.
  For instance, string "abc" will become "abcd" after applying operation "**2 d**".

Input

- The first line of the input gives the number of test cases **T** ($1 \le T \le 10$).
- For each test case:
  - The first line contains two integers, **N** ($1 \le N \le 1{,}000$) and **M** ($1 \le M \le 100$).
  - The second line contains a string **S** of length **N**.
  - Each of the next **M** lines contains one of the string operations (type 1 or 2).

Output

For each test case, output the final string.

Sample Input

```
2
5 3
abcde
1 2 n
2 f
1 5 c
3 4
ceg
1 2 o
1 3 w
2 n
1 3 i
```

Sample Output

```
ancdcf
coin
```

Explanation

- There are 2 test cases in the sample input.
- For the 1st test case, the initial string is `abcde`, and the 3 string operations are:
  `abcde` -> a**n**cde -> ancde**f** -> ancd**c**f
- For the 2nd test case, the initial string is `ceg`, and the 4 string operations are:
  `ceg` -> c**o**g -> co**w** -> cow**n** -> co**i**n

Problem B – Kth Element (Points: 20, Time Limit: 1 second)

Problem Description

Your task is to determine the **K**-th smallest number from a list of integers **L**.

For instance, **L** = {1, 5, 2} and K = 2, then:

1. The smallest number is 1.
2. The 2nd smallest number is 2.
3. The 3rd smallest number is 5.

Input

- The first line of the input gives the number of test cases **T** ($1 \leq \mathbf{T} \leq 10$).
- For each test case:
  - The first line contains two integers **N** ($1 \leq \mathbf{N} \leq 1{,}000$) and **K** ($1 \leq \mathbf{K} \leq 2{,}000{,}000{,}000$), where **N** denotes the number of distinct integers in **L** and **K** is as stated above.
  - The next **N** lines contains two integers $\mathbf{A_i}$ ($1 \leq \mathbf{A_i} \leq 1{,}000$) and $\mathbf{B_i}$ ($1 \leq \mathbf{B_i} \leq 2{,}000{,}000$), where $\mathbf{A_i}$ denotes one of the values in **L** and $\mathbf{B_i}$ denotes the number of occurrences of $\mathbf{A_i}$ in **L**. It is guaranteed that $\mathbf{A_i} \neq \mathbf{A_j}$ for any pair of distinct indexes **i** and **j**.

Output

For each test case, output the **K**-th smallest number in **L**.

Sample Input

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

.

Sample Output

```
3
4
```

Explanation

There are 2 test cases in the sample input.

Test Case 1:
L = {1, 1, 3, 3}
K = 4
The 4th smallest number is 3.

Test Case 2:
L = {1, 1, 3, 4, 4, 4}
K = 5
The 5th smallest number is 4.

Problem C - Processing Words (Points: 30, Time Limit: 1 second)

Problem Description

You are given a list **L** containing **N** words and **Q** queries. For each query, you should find the number of words in **L** whose prefix is **P**.

Input

- The first line of the input gives the number of test cases **T** ($1 \le \mathbf{T} \le 10$).
- For each test case:
  - The first line contains two integers **N** ($1 \le \mathbf{N} \le 20{,}000$) and **Q** ($1 \le \mathbf{Q} \le 1{,}000$), where **N** denotes the number of words in **L** and **Q** denotes the number of queries.
  - Each of the next **N** lines contains a string **S** ($1 \le |\mathbf{S}| \le 30$). Each of the next **Q** lines contains a string **P** ($1 \le |\mathbf{P}| \le 10$).

Output

For each query, output in one line, the number of words in **L** which prefix is **P**.

Sample Input

```
2
3 2
bar
book
bob
b
bo
5 3
apple
simple
english
every
england
s
e
eng
```

Sample Output

```
3
2
1
3
2
```

Explanation

There are 2 test cases in the sample input.

Test Case 1:
For the 1st query, there are 3 words with prefix "**b**" (those words starting with a string "b"), namely {"**b**ar", "**b**ook", "**b**ob"}.

For the 2nd query, there are 2 words with prefix "**bo**", namely { "**bo**ok", "**bo**b"}

Test Case 2:
For the 1st query, there is 1 word with prefix "**s**", namely {"**s**imple"}.

For the 2nd query, there are 3 words with prefix "**e**", namely {"**e**nglish", "**e**very", "**e**ngland"}.

For the 3rd query, there are 2 words with prefix "**eng**", namely {"**eng**lish", "**eng**land"}

Problem D – Game (Points: 40, Time Limit: 1 second)

Problem Description

There are **N** items to be divided between two players, **A** and **B**. Each item **i** has a value $\mathbf{v_{i,A}}$ to **A** and value $\mathbf{v_{i,B}}$ to **B**. Each player chooses the items one by one in turn until all the items are chosen. The players use the following strategy:

1. Player **A** chooses the most valuable item for himself (of the remaining items).
2. Player **B** chooses an item that will result in the maximization of his final total value.

In other words, **A** plays the greedy strategy whereas **B** plays the optimal strategy.

Input

- The first line of the input gives the number of test cases **T** ($1 \le \mathbf{T} \le 20$).
- For each test case:
  - The first line contains an integer **N** ($1 \le \mathbf{N} \le 1{,}000$), denoting the number of items at the start of the game.
  - The next line contains a character **A** or **B**, denoting the first player to start the game.
  - The next **N** lines contains $\mathbf{v_{i,A}}$ and $\mathbf{v_{i,B}}$ ($0 \le \mathbf{v_{i,A}}, \mathbf{v_{i,B}} \le 1{,}000$), where $\mathbf{v_{i,A}}$ and $\mathbf{v_{i,B}}$ are the values of item i to A and B, respectively. It is guaranteed that the $\mathbf{v_{i,A}}$'s take distinct values. In other words, no two items can be worth the same to A.

Output

For each test case, output in one line $\mathbf{V_B}$, where $\mathbf{V_B}$ denotes the final total value for **B**.

Sample Input

```
2
2
B
3 10
1 10
4
A
10 1
1 10
6 6
4 4
```

Sample Output

```
10
16
```

Explanation

Test Case 1:
B can pick item 1 or 2 to get the optimal value 10. Hence, $\mathbf{V_B} = 10$

Test Case 2:
A picks item 1, $\mathbf{V_A} = 10$, $\mathbf{V_B} = 0$
B picks item 3, $\mathbf{V_A} = 10$, $\mathbf{V_B} = 6$
A picks item 4, $\mathbf{V_A} = 14$, $\mathbf{V_B} = 6$
B picks item 2, $\mathbf{V_A} = 14$, $\mathbf{V_B} = 16$

Problem E - Building Highways (Points: 40, Time Limit: 4 seconds)

Problem Description

There are **N** towns in your country. Currently none of the towns are connected via highways. As the country's government, your job is to construct N – 1 highways so that all towns are connected via highways.

Each town is located on a Cartesian coordinate plane. The cost of constructing a highway from town A to town B is equal to the distance between A and B. Specifically if the locations of A and B are (x_A, y_A) and (x_B, y_B) respectively, the cost of building a highway from A to B is $\sqrt{(x_A - x_B)^2 + (y_A - y_B)^2}$.

There is an important small twist – a special contractor will construct exactly **one** highway between any two towns (of your choice) for the total amount of money stored at the two towns. Each town has certain amount of money stored.

Your job is to find the minimum cost to get all N – 1 highways constructed, including the money paid to the special contractor.

Input

- The first line of the input gives the number of test cases **T** ($1 \le T \le 10$).
- For each test case:
  - The first line gives the number of towns **N** ($3 \le N \le 1{,}000$).
  - The next **N** lines contains X_A, Y_A, and M_A ($0 \le X_A, Y_A \le 1{,}000$; $1 \le M_A \le 100{,}000$), where (X_A, Y_A) is the location of town A and M_A is the amount of money stored at town A. Every town has distinct coordinates (location).

Output

For each of the test case, output the minimum cost (rounded to 2 digits after decimal point) for the construction of all the highways.

Sample Input

```
2
3
1 1 20
1 2 30
2 2 40
4
1 1 20
1 2 30
200 2 80
201 1 100
```

Sample Output

```
51.00
102.41
```

Explanation

Test Case 1:
The 3 towns are at (1, 1), (1, 2) and (2, 2).
The special contractor's highway connects (1, 1) with (1, 2). It costs 20 + 30 = 50.
The other highway connects (1,2) with (2,2) costing 1.
Hence, minimum cost is 51.00.

Test Case 2:
The 4 towns are at (1, 1), (1, 2), (200, 2) and (200, 1).
The special contractor's highway connects (1, 1) and (200, 2). It costs 20 + 80 = 100.
The other 2 highways connects (1,1) with (1,2) and (200,2) with (201,1) costing a total of 1+1.41 = 2.41.
Hence, minimum cost is 102.41.

Problem F - The Hungry Bear (Total Points: 60, Time Limit: 4 seconds)

Note that this problem has two different subtasks.

Problem Description

Little Bear had just come back from school. He was very hungry that time and wanted at least **K** units of honey to satisfy his hunger. He immediately went to a rectangular field of size **N** x **M** to collect some honey. He wanted to collect honey only in a special sub-rectangle which has size **S** x **T** where **S** ≤ **A** and **T** ≤ **B**, for some fixed **A** and **B**. He has **Q** queries; each query contains **A** and **B**. For each query, he wanted to know how many special sub-rectangles contain at least **K** units of honey.

Input

- The first line of the input gives the number of test cases **T** (1 ≤ **T** ≤ 3).
- For each test case:
  - The first line contains two integers **N**, **M** and **K** (1 ≤ **N**, **M** ≤ 300, 1≤ **K** ≤ **N** x **M**).
  - The next **N** lines contain M characters (either 'H' or '.'). 'H' means there is honey in that cell, while '.' means there is no honey in that cell.
  - The next line contains an integer **Q** (1 ≤ **Q** ≤ 100,000).
  - The next **Q** lines contain integers **A** and **B** (1 ≤ **A** ≤ **N**, 1≤ **B** ≤ **M**).

Output

For each of the test case, output **Q** lines; each line contains the number of special sub-rectangles which satisfy the requirement. (The amount of honey is at least **K** inside the special sub-rectangle).

Sample Input

```
2
5 5 4
H.H..
..H..
H...H
HHHH.
HH..H
2
1 1
2 3
2 3 1
HHH
HHH
2
2 1
1 2
```

Sample Output

```
0
4
9
10
```

Explanation

Test Case 1, Query 2 (A = 2, B = 3)

`#: means the chosen cell`

The possibilities are:

```
1. Size 2 x 3
H.H..
..H..
###.H
###H.
HH..H

2. Size 2 x 3
H.H..
..H..
H...H
###H.
###.H

3. Size 2 x 3
H.H..
..H..
H...H
H###.
H###H

4. Size 2 x 2
H.H..
..H..
H...H
##HH.
##..H
```

Note that in the 2nd query, the **possible** special sub-rectangles are of size `1x1`, `1x2`, `1x3`, `2x1`, `2x2`, `2x3`. Also note that `2x3` is different from `3x2`

Subtask 1:
(Points 20, Time limit 4s)
- **1 ≤ N, M ≤ 100**

Subtask 2:
(Points 40, Time limit 4s)
- **1 ≤ N, M ≤ 300**