

KonoSuba: Kazuma's Stealing

Data Structures Assignment 5

Sorting



2021.5.24

NTHU EECS

Background

- Kazuma is an adventurer who is good at stealing, a skill he learned from “his friend” Chris.
- One day, he stole stacks of enchanted gloves from the Devil King’s army.
- The gloves are mismatched in some way. To sell all the gloves in pair, Kazuma wants to ask his friend Wiz to correct the gloves (in a price, of course).

Objective

- Given a stack of n gloves, correct the gloves with minimum costs so that they make exactly $n/2$ matching pairs.
 - A glove can be either left-handed or right-handed.
 - Each single glove is equipped with a gem g_i .
 - A left-handed glove and a right-handed glove with the same gem form a matching pair.

Glove Correction Rules

- Turn the gem on a glove into another gem
- Turn a left-handed glove into a right-handed glove (the gem will not be changed)
- Turn a right-handed glove into a left-handed glove (the gem will not be changed)
- Each of the correction procedures cost c Eris (currency), which will be given in the input instructions.

IO Format

- First line - **Number of test cases t**
 - Each test case contains two lines of input

Sample Input

```
4
4 2 2 10000
5 5 5 6
6 2 4 1000
2 2 1 1 1 1
6 4 2 100
1 2 3 4 6 6
4 4 0 10
3 3 3 2
```

Sample Output

```
10000
3000
400
30
```

IO Format

- First line in each test case -
Number of gloves n ,
left-handed gloves l ,
right-handed gloves r ,
and cost of each
correction c

Sample Input

```
4
4 2 2 10000
5 5 5 6
6 2 4 1000
2 2 1 1 1 1
6 4 2 100
1 2 3 4 6 6
4 4 0 10
3 3 3 2
```

Sample Output

```
10000
3000
400
30
```

IO Format

- Second line in each test case - The gems of the gloves
(the first l gloves are **left-handed**, while the remaining ones are **right-handed**)

Sample Input

```
4
4 2 10000
5 5 5 6
6 2 4 1000
2 2 1 1 1 1
6 4 2 100
1 2 3 4 6 6
4 4 0 10
3 3 3 2
```

Sample Output

```
10000
3000
400
30
```

Example 1

- Minimum 1 correction needed
 - Turn the gem on the 2nd glove into Gem 6 (555 6 → 5656)
- Another possible way
 - Turn the gem on the 4th glove into Gem 5 (5 5 56 → 5 5 55)
 - Also only 1 correction needed
- Total Cost – 1*10000 = 10000 (minimum)

Sample Input

```
4
4 2 2 10000
5 5 5 6
6 2 4 1000
2 2 1 1 1 1
6 4 2 100
1 2 3 4 6 6
4 4 0 10
3 3 3 2
```

Sample Output

```
10000
3000
400
30
```


Example 2

- Minimum 3 corrections needed
 - Turn the gem on the 4th glove into gem 2 (2 2 1 1 1 1 → 2 2 1 2 1 1)
 - Turn the gem on the 5th glove into gem 2 (2 2 1 2 1 1 → 2 2 1 2 2 1)
 - Turn the 3rd glove into left-handed (2 2 1 2 2 1 → 2 2 1 2 2 1)
- Another possible way
 - Turn the gem on the 1st and 2nd glove into gem 1. Then, turn the 3rd glove into left-handed
 - 2 2 1 1 1 1 → 1 1 1 1 1 1
 - Also only 3 corrections
- Total Cost - 3*1000 = 3000
(minimum)

Sample Input

```
4
4 2 2 10000
5 5 5 6
6 2 4 1000
2 2 1 1 1 1
6 4 2 100
1 2 3 4 6 6
4 4 0 10
3 3 3 2
```

Sample Output

```
10000
3000
400
30
```

Example 3

- Minimum 4 corrections needed
 - Turn the 4th glove into right-handed (1 2 3 4 6 6 → 1 2 3 4 6 6)
 - Turn the gem on the 1st glove into gem 4 (1 2 3 4 6 6 → 4 2 3 4 6 6)
 - Turn the gem on the 2nd glove into gem 6 (4 2 3 4 6 6 → 4 6 3 4 6 6)
 - Turn the gem on the 3rd glove into gem 6 (4 6 3 4 6 6 → 4 6 6 4 6 6)
- Also other possible ways to fulfill the objective in 4 corrections
- Total Cost - $4 * 100 = 400$
(minimum)

Sample Input

```
4
4 2 2 10000
5 5 5 6
6 2 4 1000
2 2 1 1 1 1
6 4 2 100
1 2 3 4 6 6
4 4 0 10
3 3 3 2
```

Sample Output

```
10000
3000
400
30
```

Example 3 - Solution with additional cost

- A 5-corrections way
 - Turn the 5th glove into left-handed
(1 2 3 4 6 6 → 1 2 3 4 6 6)
 - Turn the 4th glove into right-handed
(1 2 3 4 6 6 → 1 2 3 4 6 6)
 - Turn the 2nd glove into right-handed
(1 2 3 4 6 6 → 1 2 3 4 6 6)
 - Turn the gem on the 1st glove into gem 2
(1 2 3 4 6 6 → 2 2 3 4 6 6)
 - Turn the gem on the 3rd glove into gem 4
(2 2 3 4 6 6 → 2 2 4 4 6 6)
- Total Cost - 5*100 = 500
- However, the total cost is not minimum!

Sample Input

```
4
4 2 2 10000
5 5 5 6
6 2 4 1000
2 2 1 1 1 1
6 4 2 100
1 2 3 4 6 6
4 4 0 10
3 3 3 2
```

Sample Output

```
10000
3000
400
30
```

Example 4

- Minimum 3 corrections needed
 - Turn the gem on the 2nd glove into gem 2 (3 3 3 2 → 3 2 3 2)
 - Turn the 3rd glove into right-handed (3 3 3 2 → 3 2 3 2)
 - Turn the 4th glove into right-handed (3 2 3 2 → 3 2 3 2)
- Also other possible ways to fulfill the objective in 3 corrections
- Total Cost - $3 * 10 = 30$ (minimum)

Sample Input

```
4
4 2 2 10000
5 5 5 6
6 2 4 1000
2 2 1 1 1 1
6 4 2 100
1 2 3 4 6 6
4 4 0 10
3 3 3 2
```

Sample Output

```
10000
3000
400
30
```

Constraints & Hints

Constraints

- Built-in Sorting function and C++ containers are forbidden.
 - **No credit** if you use any of it. That is, you need to implement the sorting algorithm by yourself.
 - Ask for TA if you are not sure about it.
- Register the contest before deadline.
- Plagiarism is not allowed.

Hint

- Make sure you implement the sorting algorithm correctly.
- Refer to [13213](#) for detailed explanations and IO constraints.

HW5 Timeline

- HW5 Registration: 5/24 9a.m. ~ 5/25 9a.m.
- HW5 Deadline: 6/7 12:00p.m.
- Quiz5: 6/7 18:30 ~ 20:30