Optimized Bubble Sort

In simple bubble sort algorithm, the time complexity will remain O(n^2) every time, even if the given array is already sorted.
Your task is to optimized the bubble sort such that its best case time complexity becomes O(n).

Input Format

In the function an integer vector is passed.

Output Format

Return an integer vector in non decreasing order.

Sample Input

```
{1, 3, 5, 7, 9}
```

Sample Output

```
{1, 3, 5, 7, 9}}
```

Explanation

```
given vector is already sorted
```

Solution: optimizedBubbleSort.cpp

Sorting with Comparator

Given an integer vector and a bool variable flag, your task is to sort the vector in accordance to the boolean value. If the bool value passed is true then sort it in non-decreasing order or vice versa.
You can use any sorting technique of your choice.

Input Format

In the function an integer vector and a boolean is passed.

Output Format

Return an integer vector.

Sample Input

```
{111, 33, 5, 7, 29}, flag = 1
```

Sample Output

```
{5, 7, 29, 33, 111}
```

Solution: sortWithComparator.cpp

Sorting Cartesian Points

Given co-ordinates of N points on X-Y axis, your task is to sort them in accordance to the x-coordinate. If the x-coordinates are same then compare y-coordinates.

Input Format

In the function an integer vector of pairs is passed.

Output Format

Return the vector in sorted order.

Sample Input

```
{ (3, 4), (2, 3), (3, 7), (1, 5), (3, 4) }
```

Sample Output

```
{ (1, 5), (2, 3), (3, 4), (3, 4), (3, 7) }
```

Solution: sortCoords.cpp

Chopsticks

Given **N** sticks and an array **length** where each **length[i]** represents length of each stick. Your task is to make maximum number of pairs of these sticks such that the difference between the length of two sticks is at most **D.** A stick can't be part of more than one pair of sticks.

Input Format

In the function an integer vector length and number D is passed.

Output Format

Return an integer representing total number of such pairs.

Sample Input

```
{1, 3, 3, 9, 4}, x = 2
```

Sample Output

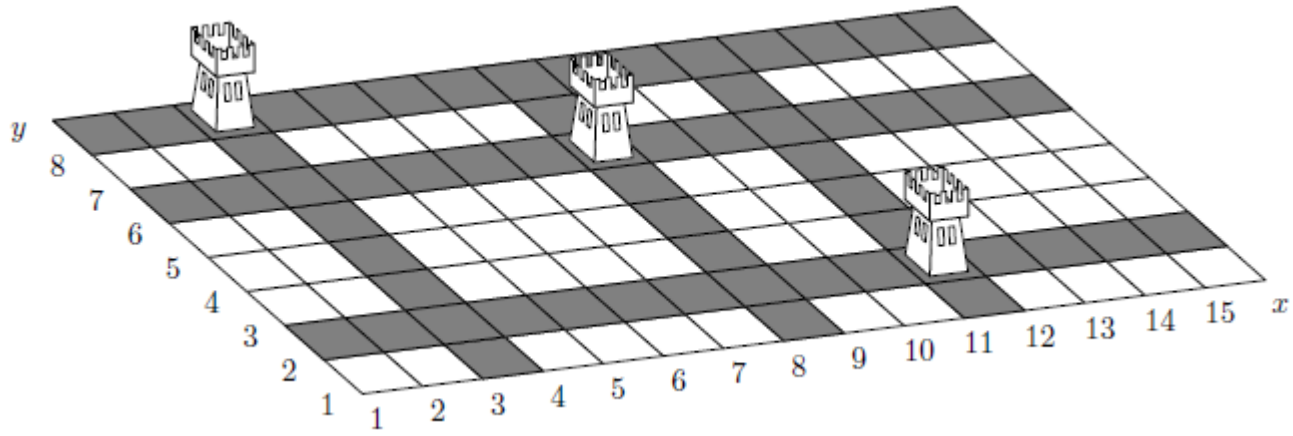
```
2
```

Solution: chopsticks.cpp

Defense Kingdom

Theodore implements a new strategy game “Defense of a Kingdom”. On each level a player defends the Kingdom that is represented by a rectangular grid of cells. The player builds crossbow towers in some cells of the grid. The tower defends all the cells in the same row and the same column. No two towers share a row or a column.

The penalty of the position is the number of cells in the largest undefended rectangle. For example, the position shown on the picture has penalty 12.



Your task is to find the penalty of the give position.

Input Format

In the function an width and height of the kingdom and a vector of pairs representing positions of towers is passed.

Output Format

Return an integer representing the number of cells in the largest rectangle that is not defended by the towers.

Sample Input

```
15 8 {(3, 8), (11, 2), (8, 6)}
```

Sample Output

12

Solution: defenceKingdom.cpp

Staircase Search

You are given a M x N matrix which is row wise and column wise sorted. You have to search the index of a given integer K in the matrix.

Input Format:

Function contains integer M, integer N ,2D vector containing integers and an integer k.

Output Format:

Return a pair of integers {x,y} where x is the row index and y is column index of k in the matrix.

Expected Complexity:

Linear

Sample Testcase:

Input:

3 3

1 4 9

2 5 10

6 7 11

10

Output:

{1,2}

Solution: staircaseSearch.cpp

ICPC Standings

Usually, results of competitions are based on the scores of participants. However, we are planning a change for the next year of ICPC. During the registration each team will be able to enter a single positive integer : their preferred place in the ranklist. We would take all these preferences into account, and at the end of the competition we will simply announce a ranklist that would please all of you.

But wait... How would that ranklist look like if it won't be possible to satisfy all the requests?

Suppose that we already have a ranklist. For each team, compute the distance between their preferred place and their place in the ranklist. The sum of these distances will be called the **badness** of this ranklist.

Goal

Given team names and their preferred placements find one ranklist with the minimal possible badness.

Input

The input is stored in a `vector<pair<string,int> >` where the each pair stores the team name & its preferred rank.

```
WinOrBooze 1BallOfDuty 2WhoKnows 2BholeChature 1DCECoders 5StrangeCase 7WhoKnows 7
```

Output

```
5
```

Explanation

A possible rank list can be like this, which has a total badness of 5.

```
1. WinOrBooze2. BallOfDuty3. WhoKnows4. BholeChature5. DCECoders6. WhoKnows7. StrangeCase
```

Solution: icpcStandings.cpp