# Merge Sort: Counting Inversions ☆

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**Problem** 

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In an array, arr, the elements at indices i and j (where i < j) form an inversion if arr[i] > arr[j]. In other words, inverted elements arr[i] and arr[j] are considered to be "out of order". To correct an inversion, we can swap adjacent elements.

For example, consider the dataset arr = [2, 4, 1]. It has two inversions: (4, 1) and (2, 1). To sort the array, we must perform the following two swaps to correct the inversions:

$$arr = [2,4,1] \xrightarrow{swap(arr[1],arr[2]) \rightarrow swap(arr[0],arr[1])} [1,2,4]$$

Given  $m{d}$  datasets, print the number of inversions that must be swapped to sort each dataset on a new line.

#### **Function Description**

Complete the function countlnversions in the editor below. It must return an integer representing the number of inversions required to sort the array. countlnversions has the following parameter(s):

• arr: an array of integers to sort .

#### **Input Format**

The first line contains an integer,  $oldsymbol{d}$ , the number of datasets.

Each of the next d pairs of lines is as follows:

- 1. The first line contains an integer, **n**, the number of elements in **arr**.
- 2. The second line contains  $m{n}$  space-separated integers,  $m{arr}[m{i}]$

#### Constraints

- $1 \le d \le 15$
- $1 \le n \le 10^5$
- $1 \le arr[i] \le 10^7$

#### **Output Format**

For each of the d datasets, return the number of inversions that must be swapped to sort the dataset.

## Sample Input

2

1 1 1 2 2

5

2 1 3 1 2

### Sample Output

0

4



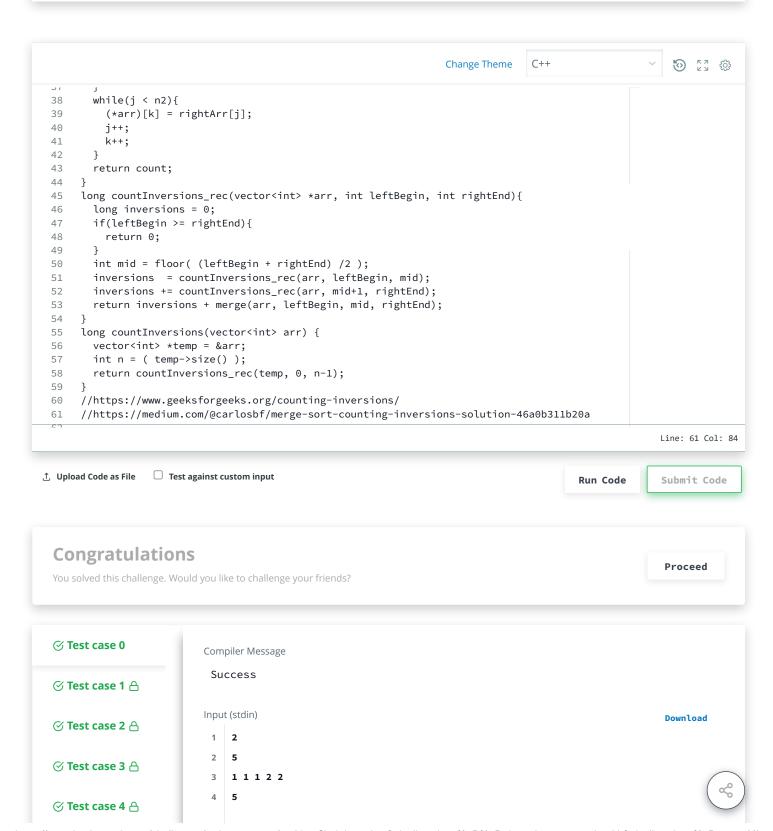
```
Explanation
```

```
We sort the following oldsymbol{d}=\mathbf{2} datasets:
```

1. arr = [1, 1, 1, 2, 2] is already sorted, so there are no inversions for us to correct. Thus, we print 0 on a new line.

2. 
$$arr = [2,1,3,1,2] \xrightarrow{\text{1 swap}} [1,2,3,1,2] \xrightarrow{\text{2 swaps}} [1,1,2,3,2] \xrightarrow{\text{1 swap}} [1,1,2,2,3]$$

We performed a total of  $\mathbf{1}+\mathbf{2}+\mathbf{1}=\mathbf{4}$  swaps to correct inversions.



⊗ Test case 5 🖰		2 1 3 1 2  cted Output	ownload
⊗ Test case 6 🖰	1	0	
	2	4	

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