

Programming Assignment #2

Median of Two Sorted Arrays

Due: 23:59 Friday, October 11

Problem Description

There are 2 sorted arrays A and B of size n each, your task is to find the **median** of the array obtained after merging the above 2 arrays (i.e. array of length $2n$).

The median of an array is defined as **the mean of the two middlemost elements** in the array if the array's length is **even**.

For example, given that

$A = \{1, 12, 15, 26, 38\}$ and $B = \{2, 13, 17, 30, 45\}$,

the merged array will be

$\{1, 2, 12, 13, 15, 17, 26, 30, 38, 45\}$.

The two middlemost elements are 15 and 17, so the median of the merged array should be $(15 + 17)/2 = 16$.

It is easy to come up with an algorithm that runs in $O(n \lg n)$ or $O(n)$ to solve this problem. However, in this assignment, you need to develop another algorithm that runs in $O(\lg n)$.

Implement **two version of algorithm** to find the median of two sorted arrays, one runs in $O(n \lg n)$ or $O(n)$ and the other runs in $O(\lg n)$.

I/O Format

Use standard I/O. (stdin, stdout)

Input

The 1st line contains one integer N ($N \geq 1$), representing the length of the arrays.

The 2nd line has N integers, representing the elements of one array and the 3rd line also has N integers, representing the elements of the other array.

Output

Output the median of the two arrays and a new line after it.

Note that if the median you get is not integer, round it down to the nearest integer. For example, $A = \{2, 10\}$ and $B = \{7, 16\}$, the median should be $(7 + 10) / 2 = 8.5 \rightarrow 8$ (rounded down).

Examples

Input 1

```
5
1 12 15 26 38
2 13 17 30 45
```

Output 1

```
16
```

Input 2

```
2
2 10
7 16
```

Output 2

```
8
```

Program Submission

1. Please use C/C++ and write your program in **a single source file**.
2. Your source file must be named as “**<Student_ID>_hw2.cpp**” (You only need to submit the **$O(\lg n)$** version) and please make sure that all characters of the filename are in **lower case**. For example, if your student id is 106062000, the name of your program file should be 106062000_hw2.cpp.
3. Your program will be compiled in a GNU/Linux environment with:
`g++ -O2 -std=c++14 <Student_ID>_hw2.cpp`
4. The source file must be uploaded directly, without compressing the file.
5. **0 points will be given to Plagiarism. NEVER SHOW YOUR CODE** to others and you must write your code by yourself. If the codes are similar to other people and you can't explain your code properly, you will be identified as plagiarism.

Report

1. Your report must contain the flowchart or the pseudo code of your program. You must describe how your approach works. The analysis of time complexity should be included as well.
2. Also, you should provide your **answer** and **the screenshots** to prove your answer to the following questions in your report:
 - i Show how much the time of **finding median** increases when input size grows for the $O(n \lg n)/O(n)$ version and the $O(\lg n)$ version. For example, you can measure the time when input size is 10^4 , 10^5 and 10^6 .
 - ii Give a proper reason to explain what you have found in question 2-i.
(*You can refer to this [webpage](#) to see how to measure execution time of a function.)
3. The report filename must be “<Student_ID>_hw2.pdf” and please make sure that all characters of the filename are in lower case.

Grading Policy

You must submit both your source code and report. Remember the submission rules mentioned above, or you will be punished on your grade.

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| ● Unique and compilable source code | 10% |
| ● Test cases | 50% |
| ● Report | 40% |