CS203B Assignment 2: Median

$Start\ time: Nov.3th$
$DDL: Nov.21th, 11:59PM$
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Problem Description

Given an array of length N: $A_1, A_2 \dots A_N$, for every $1 \leq i \leq N$, you are asked to figure out the median of $A_1, A_2 \dots A_i$, which is defined as the $\lceil i/2 \rceil^{th}$ element of $\{A_i\}$ after it is sorted.

Method Input

An array containing N integers $A_1, A_2 \dots A_N$ where $1 \leq N \leq 5 \times 10^5$ and $1 \leq A_i \leq 10^9$.

Method Output

An array containing N integers, the i^{th} element of which represents the median of $A_1, A_2 \dots A_i$.

Sample

Parameter input:

```
[2, 5, 1, 4, 7]
```

Return:

```
[2, 2, 2, 2, 4]
```

Hint

Using two $Priority\ Queue$ to solve this problem. (one max-heap and one min-heap)

Requirement as homework

1. You need to **accomplish the method** `public static int[] findMedians(int[] array)` in `Median.java`. Please **don't modify** the function name or any parameter.
2. Please **explain your algorithm** and **analyze its time complexity correctly** in a file, which can be `.txt`, `.doc`, `.md` or any type of file you like. (It's OK to write in Chinese.)
   If the complexity analysis does not correspond to the algorithm you wrote, you will lose some points.
3. You are recommended to **use** $Priority\ Queue$ in your implementation. Otherwise, the complexity of the algorithm would be high. If you use another data-structure, unless the time complexity of the algorithm is less or equal than the expected complexity $O(NlogN)$, you will lose some points according to the complexity of your algorithm.
   Pay attention to the time complexity of some extreme cases, such as [0, 0,...,0], [1,2,...,N] and [N, N-1,...,2,1].

4. Although we will give you **a sample test and ten big- data tests for your local check**, please **generate random new test data** to test your program and proves its correctness. The test codes need to be written in another `.java` instead of mixing them in `Median.java`.
   You cannot use $Balanced\ BST$ to solve this problem, but you can use it to generate the testing data.
   You should invoke your testing code in the main method `public static void main(String[] args)`.
5. Please submit `Median.java`, explanation file, testing code and any data you use to test in a `.zip` file.