CMSC 401 – Fall 2024

Programming Assignment 2 (due Sun 10/6 – 11:59pm)

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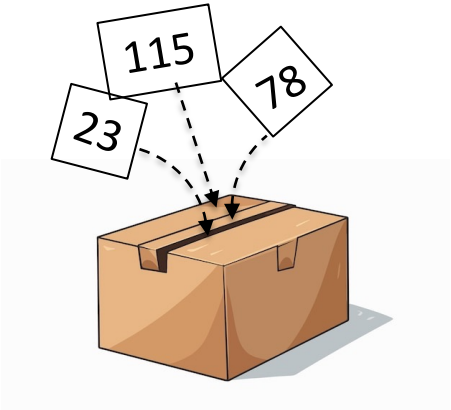
CMSC 401- Algorithm Analysis with Advanced Data Structures

VCU College of Engineering

Lucky Student

- A teacher asks her students to write down a number and their name on a piece of paper and put it in a box
- The teacher then decides to pick the student which has the X^{th} largest number to give a gift.
- However, she wants to do it <u>without sorting</u> the student numbers.



Lucky Student

- Your task is to write an algorithm that will run in O(N) time and find the X^{th} largest number (N is the total student count).

Input Format

- First line: a single integer number N>=3, N<=1,000,000, showing the number of students
- Second line: A single integer number X>=1 and X<=N, showing the order of the lucky number
- Following N lines: each contains a single integer containing the numbers written by students
  - Each integer will be <=1,000,000,000 and >=-1,000,000,000

Output Format

- A single number showing the X^{th} largest one
  - just one number, no comments, prompts etc.

Input 1:

```
6
4
81
-12
100
-40
0
24
```

Input 2:

```
9
6
62
62
-75
-5
-321
5
123
1003
-434
```

Output 1:

```
0
```

Output 2:

```
-5
```

Hints

- Design a divide & conquer algorithm like quicksort
  - Use recursive approach with an appropriate ***Partition-like*** method
- Your solution **should** have linear time O(N) complexity on average.
  - **Slower methods will get max 2 out of 10** even if it is correct.

- Use standard I/O to read input (System.in, System.out) and write the result
- Make sure the program compiles

Submission

- Date due: Sun, Oct 6th, 11:59 pm

- Submission through Canvas
  - Just submit the single Java source code file named CMSC401_A2.java
    - **No need to zip. Don't worry about "-1", "-2" added to your file by Canvas for new versions.**
    - The file should have *your name* in a comment in the first line
    - Remember: in Java, class name should match the file name, and is case sensitive

- Please do NOT create your own packages
- Use standard I/O to read input (System.in, System.out) and output
- Make sure the **program compiles and WORKS!**
- Late submissions are accepted up to 2 days **only** with penalties!

- **Resubmission after grading:** I It is allowed if you can fix your code with a minor change (1-2 lines of code change) ONLY. You can resubmit only ONE time and a penalty of 0.5 points will be deducted.