Programming Assignment #1

Find Kth smallest element in an input array

Due: 10/20 23:59

Problem Description

Given an input array $(a_1, a_2, \ldots, a_N)$ of size $N \geq$10,000,000 and use the SELECT algorithm to find the *K*thsmallest element. In the SELECT algorithm, compare the running time of your algorithm with the input elements divided into G groups (3, 5, 7, 9) and Randomized- Select algorithm. Average the execution time of 50~100 experiments for each group size and Randomized-Select algorithm.

a) Use SELECT algorithm.

b) Use iterative method.

I/O Format

Use standard I/O. (stdin, stdout)

Test case Constraints

- $10^7 \leq N \leq 10^8$ (C++ use dynamic memory allocation to store)
- $1 \leq K \leq N$
- $G \in \{3,5,7,9\}$ if the test case is SELECT algorithm. Otherwise, empty.
- $1 \leq a_i \leq 10^7$
- $All\ input\ values\ are\ integers.$

Input

There is only one test case per input file.
If the test case is for SELECT algorithm, the first line contains 3 integers: N, K, G.
If the test case is for iterative method, the first line contains 2 integers: N, K.
The second line contains N integers: $a_1, a_2, \ldots, a_N$, each separated by a single space.

Output

Output the *k*th smallest element.
Note that it is the *k*th smallest element in the sortedorder, not the *k*th distinct element.
Remember to output a newline character after the number.

Sample Input for SELECT algorithm
10 4 3
10 9 8 7 6 5 4 3 2 1

Sample Output for SELECT algorithm
4

Sample Input for iterative method
10 4
10 9 8 7 6 5 4 3 2 1

Sample Output for iterative method
4

Program Submission

1. Please use C/C++17/Python and write your program in different files.
2. The source files name must be "<Student_ID>_method name.cpp" and please make sure that all characters of the filename are in lower case. For example, if your student id is 111062000, the name of your program file should be 111062000_select.cpp or 111062000_iterative.cpp.
3. The source file must be uploaded directly, without compressing the file.
4. Plagiarism will get 0 points. NEVER SHOW YOUR CODE to others, and you must write your code by yourself. If the codes are similar to others and you cannot correctly explain your code, you will be identified as a Plagiarism.

Report

1. Your report must contain the flowchart or the pseudo code of your program. You have to describe how your approach works.
2. You should compare the running time of your algorithm with the input elements are divided into groups 3, 5, 7, 9, and Randomized-Select. Average the execution time of 50~100 experiments for each group size and Randomized-Select. Besides, you must analyze the time complexity in different group sizes and show your results.
3. The report filename must be "<Student_ID>_bonus1.pdf". 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.

- Hidden test cases 50%
- Report 50%