**Programming Assignment #1**

# Find Kth smallest element in an input array

**Due: 10/26 23:59**

## Problem Description

Given an input array of $N > 10{,}000{,}000$ and use the SELECT algorithm to find the $K$th smallest element. In the SELECT algorithm, compare the running time of your algorithm with the input elements divided into groups 3, 5, 7, 9, and Randomized-Select algorithm. Average the execution time of 20 experiments for each group size and Randomized-Select algorithm.

## I/O Format

Use standard I/O. (stdin, stdout)

### Input

There is only one test case per input file.
The first line contains three integers $N$, $K$, and group size G.

For all of the test cases, $N > 10{,}000{,}000$.
You can randomly generate $N$ numbers in [1, 10,000,000], your numbers can repeat.

### Output

Output the $k$th smallest element. Note that it is the $k$th smallest element in the sorted order, not the $k$th distinct element.

Remember to output a newline character after the number.

## 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>_hw1.cpp" 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_hw1.cpp.
3. Your program will be compiled in a GNU/Linux environment with:
   g++ -O2 -std=c++14 <Student_ID>_hw1.cpp
4. The source file must be uploaded directly, without compressing the file.
5. 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 20 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>_hw1.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.

- Test cases 50%
- Report 50%