Data Structures (CS201)

Lab Assignment 4 (Graded)

August 21, 2023

Instructor: Anil Shukla
Due: August 27, 11:59 pm Total Marks: 20

Note: Graded means the marks will be counted for the final grading. Place proper comments in your source code. Write in C only. C++ is not allowed.
Note: Plagiarism is strictly prohibited. An appropriate disciplinary action will be taken if you are found to be involved in plagiarism.
Note: The instructions for submitting the assignment is mentioned in the Google classroom. Carefully read the same and follow the instructions.
Note: At the end, find some test cases for each problem.

Question 1 The problem is to implement the median-of-medians Algorithm in C. Refer Chapter 9 in the following book: Introduction to Algorithms, Third Edition by CLRS. For quicksort please see Chapter 7 in the following book: Introduction to Algorithms, Third Edition by CLRS. For simplicity you assume that the input array contains all distinct numbers.

- Your program needs to read the 'ExampleFile.txt' file. The first line in the file will contain the total number of inputs (Say, N). Define an array 'Arr' with the size of this N. The second line in the file will contain the value of K (i.e your program needs to find this K^{th} smallest number). Continue reading the file for the input numbers and store them in this 'Arr' array.
- You need to define two functions func1 and func2 defined as follows:
  - $func1$: Before calling this function, create a new array 'Arr1' and copy the contents of Arr into Arr1. Call this function as func1(Arr1, N, K). This function should perform quicksort on the array Arr1 by taking the last element as pivot always. The function finally returns the element in the $(K-1)^{th}$ index in the final sorted array (since array indices starts from 0).
  - $func2$: Call this function as func2(Arr, N, K). This function should perform the median-of-medians Algorithm as taught in class and return the element which is the K^{th} smallest in the array.
- In the main function you should call these functions as follows: First scan the input file and store values in $N, K, Arr, Arr1$. Then start a timer, call $func1$, stop the timer. Then print the returned value of $func1$ and the time taken by the function. Again, reset the timer to 0, call $func2$, stop

the timer. Then print the returned value of $func2$ and the time taken by the function. Look at the Test Case below for an example. Also, find attached an 'ExampleFile.txt'.

Test Case

The size of the array is 1000
The value of K is 7
Calling func1:
The 7th smallest element returned by func1 is 24
The time taken by func1 is 3.5
Calling func2:
The 7th smallest element returned by func2 is 24
The time taken by func2 is 1.2