**CS2023 - Data Structures and Algorithms**

**In-class Lab Exercise**

Week 5

Index: 200381U

**Question 1**

* Implement Recursive Quick Sort algorithm.
* Watch the following video to get to know how does quick sort work.

o <https://www.youtube.com/watch?v=Vtckgz38QHs&ab_channel=BroCode>(Watch until

7.45 minutes)

* Try to implement non-recursive quick sort algorithm.
* Compare time taken for execution and plot the graph.

**Answer 1**

Total elements in array: 500

Time taken by recursive approach: 109441 nanoseconds

Time taken by iterative approach: 90378 nanoseconds

Total elements in array: 1000

Time taken by recursive approach: 212566 nanoseconds

Time taken by iterative approach: 164001 nanoseconds

Total elements in array: 2000

Time taken by recursive approach: 480870 nanoseconds

Time taken by iterative approach: 470414 nanoseconds

Total elements in array: 5000

Time taken by recursive approach: 1420823 nanoseconds

Time taken by iterative approach: 1908817 nanoseconds

Total elements in array: 10000

Time taken by recursive approach: 46933922 nanoseconds

Time taken by iterative approach: 60266139 nanoseconds

Total elements in array: 15000

Time taken by recursive approach: 87563238 nanoseconds

Time taken by iterative approach: 143850694 nanoseconds

Total elements in array: 20000

Time taken by recursive approach: 119825698 nanoseconds

Time taken by iterative approach: 315206747 nanoseconds

Comparison: Up until array length is 5000 both algorithms have taken roughly same amount of time. Non-recursive algorithm has shown better performance when sorting these small arrays. But as array length increases, time taken by non-recursive approach is increasing rapidly while time taken by recursive approach increases linearly. It is quite obvious from our observations that recursive algorithm has a better performance when considering time factor of sort large arrays.

**Question 2: Find running median.**

* The median of a set of integers is the midpoint value of the data set for which an equal number of integers are less than and greater than the value. To find the median, you must first sort your set of integers in non-decreasing order, then:
  + - If your set contains an odd number of elements, the median is the middle element of the sorted sample. In the sorted set {1, 2, 3}, 2 is the median.
    - If your set contains an even number of elements, the median is the average of the two middle elements of the sorted sample. In the sorted set {1, 2, 3, 4}, (2+3)/2=2.5 is the median.
* Given an input stream of n integers, perform the following task for each ith integer: o Add the ith integer to a running list of integers.

o Find the median of the updated list (i.e., for the first element through the ith element). o Print the updated median on a new line. The printed value must be a double-precision number scaled to 1 decimal place (i.e., 12.3 format).

* Example:

o *Input*: a = [7, 3,5, 2] o *Output*:

|  |  |
| --- | --- |
| Sorted | Median |
| [7] | 7.0 |
| [3, 7] | 5.0 |
| [3, 5, 7] | 5.0 |
| [2,3,5,7] | 4.0 |

**Answer:**

**Test 1 -**

**Text

Description automatically generated**

**Test 2 –**

**Text

Description automatically generated**

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