**Assignment 6: Medians and Order Statistics & Elementary Data**

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MSCS 532 – Algorithms and Data Structures

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**Part 1: Implementation and Analysis of Selection Algorithms**

**Implementation of Medians of Medians algorithm – Deterministic Algorithm**

Many deterministic and randomized algorithms are used to find the kth smallest element in an unordered array. Median-of-Medians is a deterministic algorithm that helps find the kth smallest element in an unsorted array. In this deterministic algorithm, the array is divided into subarrays and sorted, and the median of each subarray is found. The median of the array formed using the medians of all the subarrays is found using recursive methods. The median acts as the pivot, and recursively applying this algorithm, the kth smallest element in the array is found (Mao, 2024).

As the steps involved in the median-of-medians algorithms are,

1. Diving the array into subgroups of 5 – O (n)
2. Finding the median of each subgroup – O (n)
3. Finding the median of the new median groups – O (n)
4. Partitioning the array – O (n)
5. Recursively searching the correct partition – O (0.7n)

**Overall** = O (n) + O (n) + O (n) + O (n) + O (0.7n) = O (n)

The recurrence relation is given by:

T(n) = T (n/5) + T (0.7n) + O (n)

As in this median-of-median deterministic algorithm, at each level, O(n) work is done regardless of the best or worst case, and the overall time complexity remains O (n). The disadvantage of this algorithm is that it recursively sorts the arrays in groups of 5 and creates a new array of medians, which can add up memory overheads (“What are the advantages and disadvantages of median-of-median algorithms,” 2023).

References

Mao, L. (2024, February 18). *Median-of-medians selection algorithm*. Lei Mao’s Log Book. https://leimao.github.io/blog/Median-of-Medians-Select-Algorithm/

www.linkedin.com. (2023, March 29). *What are the advantages and disadvantages of median-of-medians algorithm?*. Median-of-Medians Algorithm: Pros and Cons for Quicksort. https://www.linkedin.com/advice/0/what-advantages-disadvantages-median-of-medians-algorithm