Design and Analysis of Algorithms
PhD Coursework, Semester-II, Session: 2023-24
Assignment-I

Maximum Marks $\in \{5, 6, \cdots, 10\}$ Submission Deadline: **2023-Mar-10**

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Comparing Sorting Algorithms

1. Consider all sorting algorithms taught in the classes. For example, Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Quick Sort, Heap Sort, Counting Sort, and Radix Sort.

2. **Time Complexity Analysis:**

    a. Best-case: Identify the scenario where the algorithm performs the fastest and analyze its time complexity in terms of Big O notation (e.g., $O(n)$).

    b. Average-case: Analyze the expected time complexity for a randomly ordered input. Most efficient algorithms have an average-case complexity of $O(n \log n)$.

    c. Worst-case: Determine the scenario leading to the slowest performance and analyze its time complexity (e.g., $O(n^2)$).

3. **Space Complexity Analysis:**

    a. Analyze the additional memory space required by each algorithm during the sorting process. This could be constant ($O(1)$) for in-place algorithms or linear ($O(n)$) for algorithms using extra data structures.

4. **Additional Considerations:**

    a. Stability: Discuss whether the algorithm preserves the original order of elements with equal values.

    b. Adaptability: Analyze if the algorithm performs better when the input is partially sorted or has limited unique values.

    c. Parallelizability: Discuss the potential for implementing the algorithm on multiple processors to improve performance.

5. **Deliverables:**

    a. Report: Summarize your findings in a **comparison table**, in Latex2e.

    b. Individual Algorithm Analysis: For each algorithm, dedicate a section analyzing:
        i. Time complexity (best, average, worst case)
        ii. Space complexity
        iii. Stability, adaptability, and parallelizability considerations

    c. Conclusion: Summarize the key differences between the analyzed algorithms, highlighting their strengths and weaknesses in different scenarios.

    d. References (Mandatory): Include references to any resources used during your research.

6. **Submission:** Send the latex code to the submission portal together with pdf in a zip file (filename format `assign1_firstname.zip`)

7. **Collaboration:** Collaboration is allowed with at most two friends. In such cases, each collaborator will receive at most 75% of the marks obtained. The contribution of each collaborator, in percentage, should be specified in the submitted document.

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