Module 3: Critical Thinking

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Sorting algorithms like Bubble Sort and Merge Sort can play a key role in organizing patient data in the healthcare industry. Both algorithms vary in terms of time complexity and optimal conditions for best use cases.

Time Complexity

The bubble sort algorithm has a time complexity of O(n^2). This is because there is an integrated for loop in the algorithm. We will have to pass through the list as many times as there are elements in the list for both the inner and outer loops. This makes bubble sort very inefficient for large datasets (geeksforgeeks, 2024, October 6).

The merge sort algorithm has a time complexity of O(n log n). This algorithm performs well on large datasets because it uses the “divide and conquer” strategy (Marini, J., 2018, November 8). The merge sort algorithm continuously divides the list in half, sorts it, then merges it back together.

Optimal Conditions

Bubble Sort is beneficial because it is easy to understand and implement, requiring no additional memory overhead. This makes it ideal for smaller datasets. In the medical field, Bubble Sort can be useful for sorting a patient’s medication list. Since a single patient’s medication list is typically small, the computational complexity of Bubble Sort is negligible, making it a simple and efficient choice for such cases.

Merge Sort is particularly well-suited for sorting large datasets, and it can be especially effective when used with linked lists rather than arrays. This is because, in a linked list, merge sort can efficiently merge elements without needing random access, which is more challenging with arrays. Given its consistent time complexity of O(n log n) in both the best and worst cases, Merge Sort is a more reliable and efficient choice for large datasets, such as those in large hospitals with many patients.

Problem with Sorting in Healthcare

In healthcare, it is important to respect patient data and privacy. Sorting algorithms must ensure that sensitive information, such as personal identifiers, is handled securely and appropriately. If these sorting processes are not carefully managed, they could lead to potential issues, such as medical errors or incorrect dosages. For instance, sorting patient records incorrectly could result in the wrong treatment or medication being assigned.

The healthcare industry is also a fast-paced environment, where decisions must be made quickly and accurately. In large hospitals, efficient sorting algorithms are essential for processing large volumes of data. These algorithms must not only handle data quickly but also ensure that the information is organized in a way that allows healthcare professionals to make timely, informed decisions.

Chosen Data Structures and Lower Bound

For data structures in healthcare, arrays are ideal for static, smaller datasets where elements can be quickly accessed. In large, dynamic environments like hospitals, linked lists are more suitable for real-time data that changes more often. Linked lists work well with Merge Sort due to their ability to efficiently handle dynamic updates without requiring random access to elements.

External factors like data volume and privacy concerns also influence the choice of data structure. Large datasets with frequent updates require efficient algorithms like Merge Sort to ensure quick and accurate sorting. Is the case, the lower bound of sorting algorithms is the minimum time the algorithm will take to sort the data. Thus, for larger healthcare datasets, more efficient algorithms like Merge Sort are necessary to handle the complexity and ensure optimal performance.

Program

Given a dummy dataset, the dataset is sorted based on a hardcoded key. If these programs were taken further, I could create a simple input that prompts the user to enter the key that they would want to sort by. This applies for both the bubble sort algorithm and merge sort algorithm programs that were created.

An obstacle that was faced during the development of the program was using a list of dictionaries rather than just a list of numbers that much of the examples were given in. This only was a minor setback as I had to find where in the algorithms I could add the key to sort by.

While many programming languages have built in sort algorithms, learning how the algorithm work are important. There could be cases where the built in sort algorithms are not as efficient as other sort algorithms. It is an important skill to know and understand the best use cases for each algorithm and the time complexities so that our programs can perform more efficiently.

Conclusion

Selecting the right sorting algorithm and data structure is crucial for efficiently managing patient data in healthcare systems. Like many software engineering applications, data privacy will always have to be considered when implementing algorithms. Ultimately, for large-scale healthcare environments, algorithms like Merge Sort will be the better choice to handle the demands of vast datasets while maintaining accuracy and performance compare to bubble sort.

References

geeksforgeeks.org, (2024, October 6) *Bubble Sort Algorithm.* https://www.geeksforgeeks.org/bubble-sort-algorithm/

Marini, J., (2018, November 8) *The Merge Sort.* LinkedIn. https://www.linkedin.com/learning/programming-foundations-algorithms/the-merge-sort?autoAdvance=false&u=2245842