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Algorithms

Bubble Sort

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I decided to choose my algorithm to study in an unusual way. I asked my computer science roommate which one to do and he said bubble sort!

After building a simple implementation of bubble sort using Python, I began testing different input sizes and allowed user input to adjust the size. This option tracks the amount of time the algorithm takes, # of comparison, and # of swaps. After this, I wanted to create a visualization as a part of the project. To begin, I used Claude and matplotlib to display a graph of the initial algorithm. As the algorithm runs, the graph will update automatically. This is done by refreshing and plotting each swap before and after they occur. To make viewing this possible, I utilized time.sleep to slow the rendering of the plots. To extend on this, I created a manually controlled version allowing individual steps to be viewed. Also, there is a text generated version that does not use matplot.

Bubble sort is a simple sorting algorithm that repeatedly steps through a list, compares adjacent elements, and swaps them if they are in the wrong order. The process continues until no more swaps are needed, indicating the list is sorted. It gets its name because smaller elements "bubble" to the top (beginning) of the list with each iteration. While easy to understand and implement, bubble sort has a time complexity of O(n²), making it inefficient for large datasets compared to more advanced algorithms like quicksort or mergesort. This is because the outer loop runs n-1 times, and the inner loop always does one fewer comparison on each new pass. Therefore, the number of comparisons in the inner loop is (n-1)+(n-2)+(n-3)+…..+2+1. Or: i=1∑n−1​i=1+2+3+⋯+(n−1). Or. (n-1)n/2 -> (n^2-n)/2. From this we can say the worst case scenario is O(n²). There is, however, one other scenario that results in a runtime of O(n). This is when the list is already sorted and there is a check for if any swaps were made, allowing the algorithm to end early. In conclusion, while bubble sort is useful for educational purposes and small datasets due to its simplicity, its inefficiency for large lists—except in the best-case scenario—makes it impractical compared to more efficient sorting algorithms.