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Theory: Bubble sort

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Bubble sort is one of the simplest sorting algorithms. It repeatedly goes through the array to be sorted, compares each pair of adjacent elements and swaps them if they are in the wrong order.

The wrong and correct orders depend on the required sorting order. If an array must be sorted in the ascending order, the wrong order is when the previous element is greater than the next one. If an array must be sorted in the descending order, the wrong order is the case when the previous element is less than the next one.

The algorithm is not suitable for large arrays since its average and worst case time complexity is $O(n^2)$, where **n** is the array length.

The algorithm is **stable**: it doesn't change the relative order of identical elements.

§1. Example

Suppose we have an unsorted array of integers and we want to sort it in the ascending order.

0	1	2	3	4	5
21	23	19	30	11	28

The array has six elements, the first element has the index 0, the last one has the index 5.

The following image illustrates how the bubble sort algorithm works step by step. The array is sorted in the ascending order.

In a loop, the algorithm compares each pair of adjacent array elements and swaps them if they are in the wrong order (dark blue color). If the order is correct (blue color), it does nothing.

As you can see, the max elements gradually float to the end of the array, which justifies the name of the algorithm. The algorithm doesn't swap elements in the right sorted part.

To get a better idea of how the algorithm works, see a visualization.

§2. Conclusion

The algorithm is named "**Bubble sort**" because it moves the smallest or largest elements to the end of the array. It compares adjacent elements in pairs and swaps them if they are in the wrong order.

Although bubble sort is one of the simplest sorting algorithms to understand and implement, its $O(n^2)$ complexity means that its efficiency decreases dramatically on arrays that contain many elements.

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