Sorting Algorithms

> 💡 *A sorting algorithm is used to arrange elements in a specific order* such as **ascending, descending** or any other user specified order like sorting strings by lengths.

→ The sorting algorithm is important in Computer Science because it reduces the complexity of a problem. There is a wide range of applications for these algorithms, including searching algorithms, database algorithms, divide and conquer methods, and data structure algorithms.
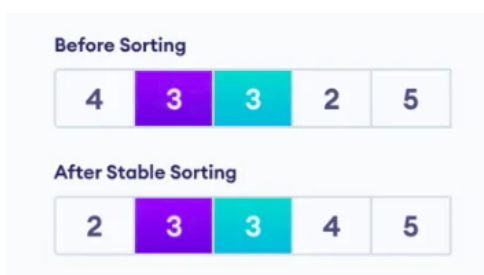
Types of Sorting Techniques

There are various sorting algorithms are used in data structures. The following two types of sorting algorithms :
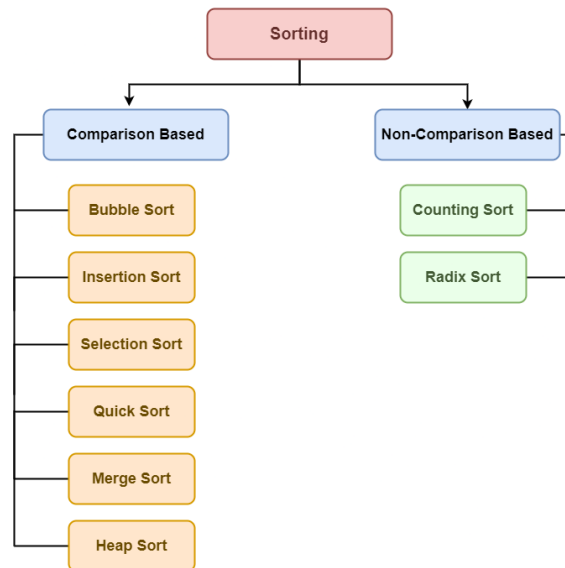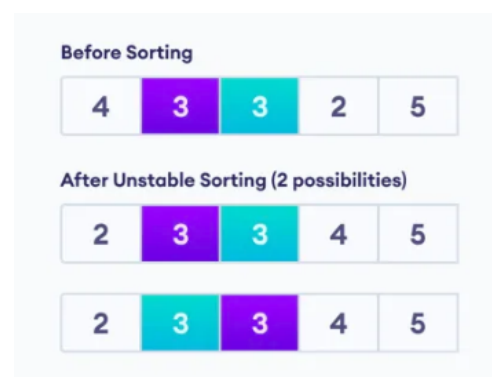

Stability of Sorting Algorithm

A sorting algorithm is considered stable if the two or more items with the same value maintain the same relative positions even after sorting.

→ Stable Sorting Algorithm

→ Unstable Sorting Algorithm

→ Algorithm Stability

Sorting Algorithm	Stability
Bubble Sort	Yes
Selection Sort	No
Insertion Sort	Yes
Merge Sort	Yes
Quicksort	No
Counting Sort	Yes
Radix Sort	Yes
Bucket Sort	Yes
Heap Sort	No
Shell Sort	No

Complexity and Evaluation of Algorithms

→ Evaluation of these Sorting techniques is done by checking the running time.

→ There are three different cases of time complexity in which a program can run.

- Best Case
- Average Case
- Worst Case

Sorting Algorithm	Time Complexity - Best	Time Complexity - Worst	Time Complexity - Average	Space Complexity
Bubble Sort	n	n^2	n^2	1
Selection Sort	n^2	n^2	n^2	1
Insertion Sort	n	n^2	n^2	1
Merge Sort	$n\log n$	$n\log n$	$n\log n$	n
Quicksort	$n\log n$	n^2	$n\log n$	$\log n$
Counting Sort	$n+k$	$n+k$	$n+k$	max
Radix Sort	$n+k$	$n+k$	$n+k$	max
Bucket Sort	$n+k$	n^2	n	$n+k$
Heap Sort	$n\log n$	$n\log n$	$n\log n$	1
Shell Sort	$n\log n$	n^2	$n\log n$	1

→ A runtime visualization of various sorting algorithms is available at the provided URL, showcasing different scenarios such as nearly sorted, completely reversed, and more.

https://www.toptal.com/developers/sorting-algorithms

→ Some of the example sorting algorithms

- Bubble Sort
- Selection Sort
- Insertion Sort
- Merge Sort
- Quicksort
- Counting Sort
- Radix Sort
- Bucket Sort
- Heap Sort
- Shell Sort

Applications of Sorting Algorithms:

- **Searching Algorithms**
- **Data management**
- **Database optimization**
- **Machine learning**
- **Data Analysis**
- **Operating Systems**

Advantages of Sorting Algorithms:

- **Efficiency:** Sorting algorithms help in arranging data in a specific order, making it easier and faster to search, retrieve, and analyze information.
- **Improved Performance:** By organizing data in a sorted manner, algorithms can perform operations more efficiently, leading to improved performance in various applications.
- **Simplified data analysis:** Sorting makes it easier to identify patterns and trends in data.
- **Reduced memory consumption:** Sorting can help reduce memory usage by eliminating duplicate elements.
- **Improved data visualization:** Sorted data can be visualized more effectively in charts and graphs.

Disadvantages of Sorting Algorithms:

- **Insertion**: If we wish to keep data sorted, then insertion operation becomes costly as we have to maintain sorted order. If we do not have to maintain sorted order, we can simply insert at the end.
- **Algorithm selection:** Choosing the most appropriate sorting algorithm for a given dataset can be challenging.

- For a lot of problems hashing works better than sorting, for example, finding distinct elements, finding a pair with given sum.

📚 References

Sorting Algorithm

A sorting algorithm is used to arrange elements of an array/list in a specific order. In this article, you will learn what sorting algorithm is and different sorting algorithms.

https://www.programiz.com/dsa/sorting-algorithm

Introduction to Sorting Techniques – Data Structure and Algorithm Tutorials - GeeksforGeeks

A Computer Science portal for geeks. It contains well written, well thought and well explained computer science and programming articles, quizzes and practice/competitive programming/company interview Questions.

https://www.geeksforgeeks.org/introduction-to-sorting-algorithm/
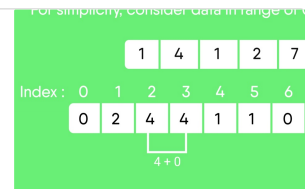
Applications, Advantages and Disadvantages of Sorting Algorithm - GeeksforGeeks

A Computer Science portal for geeks. It contains well written, well thought and well explained computer science and programming articles, quizzes and practice/competitive programming/company interview Questions.
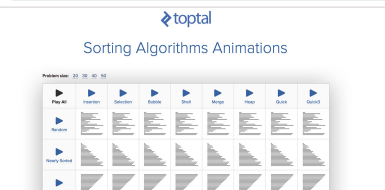
https://www.geeksforgeeks.org/applications-advantages-and-disadvantages-of-sorting-algorithm/
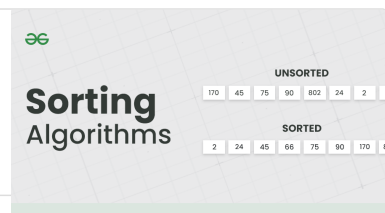
Sorting Algorithms Animations

Animation, code, analysis, and discussion of 8 sorting algorithms on 4 initial conditions.

https://www.toptal.com/developers/sorting-algorithms

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SerhatKumas - Overview

Computer engineering student who loves coding in different fields instead of focusing on a one spesific area. - SerhatKumas

https://github.com/SerhatKumas