Session - 4

Sorting

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Introduction to Sorting

Introduction to Sorting

- The process of arranging data in a specific order (ascending or descending).
- It helps in searching, organizing, and optimizing data processing.
- Common use cases:
  - Database indexing
  - Searching algorithms
  - Data analysis

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Sorting Algorithms

Types of Sorting Algorithms

1. Bubble Sort
2. Selection Sort
3. Insertion Sort
4. Merge Sort
5. Quick Sort
6. Heap Sort

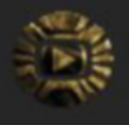
Bubble Sort (Basic Sorting Algorithm)

- Compare adjacent elements and swap if needed.
- Time Complexity:
  - Best: O(n) (already sorted)
  - Worst: $O(n^2)$
- Use Case: Small datasets, simple scenarios

Example:

Before: [5, 3, 8, 1]

After Pass 1: [3, 5, 1, 8]
After Pass 2: [3, 1, 5, 8]
After Pass 3: [1, 3, 5, 8]



Selection Sort

- Find the smallest element and swap it with the first element.
- Time Complexity: $O(n^2)$
- Use Case: Small datasets, less swapping required

Example:

Insertion Sort

- Pick an element and place it in the correct position in the sorted part.
- Time Complexity:
  - Best: O(n)
  - Worst: $O(n^2)$
- Use Case: Nearly sorted lists

Merge Sort (Divide and Conquer Approach)

- Split the array, sort recursively, and merge.
- Time Complexity: O(n log n)
- Use Case: Large datasets, stable sorting
- Example: Merge Sort

Quick Sort (Divide and Conquer Approach)

- Choose a pivot, partition the array, and recursively sort.
- Time Complexity:
  - Best: O(n log n)
  - Worst: $O(n^2)$ (if poor pivot selection)
- Use Case: Efficient for large datasets
- Example: Quick Sort

Choosing the Right Sorting Algorithm

Algorithm	Best case	Worst Case	Space complexity	stability	Use case
Bubble Sort	O(n)	$O(n^2)$	O(1)	Yes	Small data, easy implementation
Selection Sort	$O(n^2)$	$O(n^2)$	O(1)	No	Small data, fewer swaps
Insertion Sort	O(n)	$O(n^2)$	O(1)	Yes	Nearly sorted data
Merge Sort	O(n log n)	O(n log n)	O(n)	Yes	Large datasets
Quick Sort	O(n log n)	$O(n^2)$	O(log n)	No	General-purpose, efficient

03

Activity

Activity

</> Sort an Array

</> Minimum Absolute Difference

</> Next Greater Element

</> Wiggle Sort