

Selection Sort

Selection Sort is a **simple comparison-based sorting algorithm**.

It works by repeatedly finding the **minimum element** (in case of ascending order) from the unsorted part of the array and placing it at the beginning.

It divides the array into two parts:

- **Sorted part** (built from left to right)
- **Unsorted part** (remaining elements)

♦ **How Selection Sort Works (Step by Step)**

1. Start with the first element, assume it as the minimum.
2. Compare this element with the rest of the array.
3. If a smaller element is found, update the minimum index.
4. After scanning the unsorted part, swap the minimum element with the first element of the unsorted part.
5. Move the boundary between sorted and unsorted by one and repeat until the whole array is sorted.

♦ **Example**

Sort [29, 10, 14, 37, 13] using Selection Sort (Ascending order):

- **Pass 1:** Minimum = 10 → Swap with 29 → [10, 29, 14, 37, 13]
- **Pass 2:** Minimum = 13 → Swap with 29 → [10, 13, 14, 37, 29]
- **Pass 3:** Minimum = 14 → Already in correct place → [10, 13, 14, 37, 29]

- **Pass 4:** Minimum = 29 → Swap with 37 → [10, 13, 14, 29, 37]
- **Pass 5:** Sorted array = [10, 13, 14, 29, 37]

♦ Algorithm (Ascending Order)

```
for i = 0 to n-2
    minIndex = i
    for j = i+1 to n-1
        if arr[j] < arr[minIndex]
            minIndex = j
    Swap arr[i] and arr[minIndex]
```

♦ Time Complexity

- **Best Case:** $O(n^2)$
- **Average Case:** $O(n^2)$
- **Worst Case:** $O(n^2)$

Even if the array is already sorted, it still scans all elements (no early termination like Bubble Sort).

♦ Space Complexity

- **$O(1)$** (In-place sorting, only uses a few variables)

♦ Characteristics

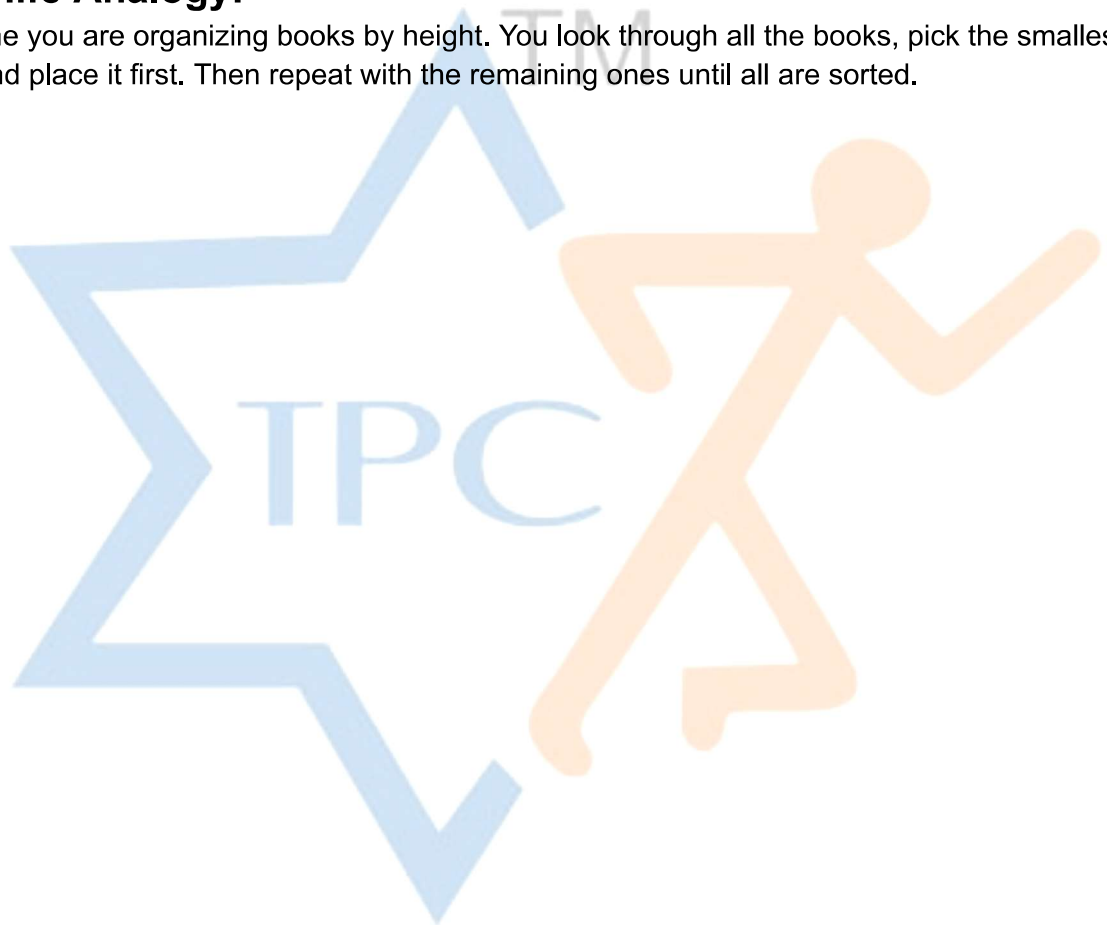
Easy to understand and implement
Works well for small arrays

Inefficient for large datasets

Not stable (relative order of equal elements may change)

Real-life Analogy:

Imagine you are organizing books by height. You look through all the books, pick the smallest one, and place it first. Then repeat with the remaining ones until all are sorted.



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