

1. 131. Describe the Selection Sort algorithm's process of sorting an array. Selection Sort works by dividing the array into a sorted and an unsorted region. Initially, the sorted region is empty, and the unsorted region contains all elements. The algorithm repeatedly selects the smallest element from the unsorted region and swaps it with the leftmost unsorted element, then moves the boundary of the sorted region one element to the right. Explain why Selection Sort is simple to understand and implement but is inefficient for large datasets. Provide examples to illustrate step-by-step how Selection Sort rearranges the elements into ascending order, ensuring clarity in your explanation of the algorithm's mechanics and effectiveness.

**Sorting a Random Array:**

**Input:** [5, 2, 9, 1, 5, 6]

**Output:** [1, 2, 5, 5, 6, 9]

**Sorting a Reverse Sorted Array:**

**Input:** [10, 8, 6, 4, 2]

**Output:** [2, 4, 6, 8, 10]

**Sorting an Already Sorted Array:**

**Input:** [1, 2, 3, 4, 5]

**Output:** [1, 2, 3, 4, 5]

Code:

```
def selection_sort(arr):  
    n = int(len(arr))
```

```
    for i in range(n):
```

```
        min_idx = i  
        for j in range(i+1, n):  
            if arr[j] < arr[min_idx]:  
                min_idx = j
```

```
        arr[i], arr[min_idx] = arr[min_idx], arr[i]  
    return arr
```

```
random_array = [5, 2, 9, 1, 5, 6]  
print("Random Array - Before Sorting:", random_array)  
sorted_random_array = selection_sort(random_array)  
print("Random Array - After Sorting:", sorted_random_array)
```

```
reverse_sorted_array = [10, 8, 6, 4, 2]  
print("Reverse Sorted Array - Before Sorting:", reverse_sorted_array)  
sorted_reverse_array = selection_sort(reverse_sorted_array)  
print("Reverse Sorted Array - After Sorting:", sorted_reverse_array)
```

```
sorted_array = [1, 2, 3, 4, 5]  
print("Already Sorted Array - Before Sorting:", sorted_array)  
sorted_sorted_array = selection_sort(sorted_array)  
print("Already Sorted Array - After Sorting:", sorted_sorted_array)
```

output:

```
PS C:\Users\karth>
PS C:\Users\karth> & c:/Users/karth/AppData/Local/Programs/Python/Python312/python.exe c:/Users/karth/OneDrive/Documents/OriginLab/problems.py
Random Array - Before Sorting: [5, 2, 9, 1, 5, 6]
Random Array - After Sorting: [1, 2, 5, 5, 6, 9]
Reverse Sorted Array - Before Sorting: [10, 8, 6, 4, 2]
Reverse Sorted Array - After Sorting: [2, 4, 6, 8, 10]
Already Sorted Array - Before Sorting: [1, 2, 3, 4, 5]
Already Sorted Array - After Sorting: [1, 2, 3, 4, 5]
PS C:\Users\karth>
```

Time complexity:

$F(n)=o(n^2)$