Selection Sort Correctness

```
procedure selectionSort(arr):
    Input: An array arr of length n
    Output: The array arr sorted in non-decreasing order
    n ← length of arr
    for i from 0 to n - 1 do
        minIndex ← i
        // Find the index of the minimum element in the unsorted sublist
        for j from i + 1 to n - 1 do
        if arr[j] < arr[minIndex] then
        minIndex ← j
        // Swap the minimum element with the first element of the unsorted sublist
        swap arr[i] and arr[minIndex]
    // The array arr is now sorted
```

The selection sort preserves the invariant that the elements before the current index are sorted in non-decreasing order at each iteration, it is an appropriate sorting algorithm. It chooses the smallest element from the unsorted sublist and accurately inserts it into the sorted sublist at the proper location. Furthermore, when selection sort is being executed, it does not change the order in which the elements have already been sorted.

System Configuration

Processor : AMD Ryzen 7 7730U with Radeon Graphics @2.00 GHz

Installed RAM: 16.0 GB (15.3 GB usable)

Storage Capacity: 512GB SSD

OS: Windows 11 Home

Runtime of each sorting

```
Insertion Sort for input size 5: 3.100000003541936e-05 s
Selection Sort for input size 5: 3.519999995660328e-05 s
Bubble Sort for input size 5: 6.47000000526532e-05 s

Insertion Sort for input size 50: 0.0010459000000082597 s
Selection Sort for input size 50: 0.0009814999999662177 s
Bubble Sort for input size 50: 0.0019526999999470718 s

Insertion Sort for input size 100: 0.004449500000077933 s
Selection Sort for input size 100: 0.0035422000000835396 s
Bubble Sort for input size 100: 0.008587899999952242 s

Insertion Sort for input size 500: 0.10761460000003353 s
Selection Sort for input size 500: 0.08276439999997365 s
Bubble Sort for input size 500: 0.21078179999994973 s

Insertion Sort for input size 1000: 0.48985499999992044 s
Selection Sort for input size 1000: 0.35162719999993897 s
Bubble Sort for input size 1000: 0.8953015000000732 s

Insertion Sort for input size 2500: 2.8503043000000616 s
Selection Sort for input size 2500: 2.0490568999999823 s
Bubble Sort for input size 2500: 4.776624800000036 s

Insertion Sort for input size 5000: 9.10839969999995 s
Selection Sort for input size 5000: 6.752433999999994 s
Bubble Sort for input size 5000: 17.97942610000007 s
```

Input size vs. Run time