SUPERIOR UNIVERSITY

Data Structure and Algorithm (Lab)

Assignment – 3

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Question # 1:

Objective: Write a Python function that implements the **optimized Bubble Sort** algorithm. The optimization should include a **flag** that stops the algorithm if the array is already sorted before completing all iterations.

Code:

```
arr=[5,4,2,9,3,0]
def bubble(arr):
    counter=0
    print(f"Default Array: {arr}.")
    for i in range(len(arr)-1):
        flag = False
        for j in range(len(arr)-1-i):
            if arr[j]>arr[j+1]:
                flag = True
                counter+=1
                arr[j],arr[j+1]=arr[j+1],arr[j]
                print(f"Pass {counter}: {arr}.")
        if flag == False:
            print("Not swapped exiting early.....")
            break
    print(f"Total swaps: {counter}")
    return(counter)
bubble_sort=bubble(arr)
```

Output:

```
E:\Uni\3rd Semester\4) Data Structures & Algorithms (Lab)\Assignments\Assignment 3>python task.py
Default Array: [5, 4, 2, 9, 3, 0].
Pass 1: [4, 5, 2, 9, 3, 0].
Pass 2: [4, 2, 5, 9, 3, 0].
Pass 3: [4, 2, 5, 3, 9, 0].
Pass 4: [4, 2, 5, 3, 0, 9].
Pass 5: [2, 4, 5, 3, 0, 9].
Pass 6: [2, 4, 3, 5, 0, 9].
Pass 7: [2, 4, 3, 0, 5, 9].
Pass 8: [2, 3, 4, 0, 5, 9].
Pass 9: [2, 3, 0, 4, 5, 9].
Pass 10: [2, 0, 3, 4, 5, 9].
Pass 11: [0, 2, 3, 4, 5, 9].
Total swaps: 11
```

Question # 2:

Objective: Write a Python program that:

1. Sorts an array using **Bubble Sort** and counts the **total number of swaps** performed.
2. Sorts the same array using **Insertion Sort** and counts the **total number of swaps** performed.
3. Compares the number of swaps in both sorting algorithms.

Code:

```
arr=[5,4,2,9,3,0]
def bubble(arr):
    counter=0
    print(f"Default Array: {arr}.")
    for i in range(len(arr)-1):
        flag = False
        for j in range(len(arr)-1-i):
            if arr[j]>arr[j+1]:
                flag = True
                counter+=1
                arr[j],arr[j+1]=arr[j+1],arr[j]
                print(f"Pass {counter}: {arr}.")
        if flag == False:
            print("Not swapped exiting early.....")
            break
    print(f"Total swaps: {counter}")
    return(counter)
bubble_sort=bubble(arr)
```

```
arr=[5,4,2,9,3,0]
def insertion(arr):
    shifts=0
    print(f"Default Array: {arr}.")
    for i in range(1, len(arr)):
        shifts+=1
        key=arr[i]
        j=i - 1
        while j>=0 and arr[j]>key:
            arr[j + 1]=arr[j]
            j-=1
        arr[j + 1]=key
        print(f"Pass {i}: {arr}.")
    print(f"Total swaps: {shifts}")
    return(shifts)
insertion_sort=insertion(arr)

if bubble_sort<insertion_sort:
    print("Bubble sort is better")
elif insertion_sort<bubble_sort:
    print("Insertion sort is better")
else:
    print("Both are same")
```

Output:

```
E:\Uni\3rd Semester\4) Data Structures & Algorithms (Lab)\Assignments\Assignment 3>python task.py
Default Array: [5, 4, 2, 9, 3, 0].
Pass 1: [4, 5, 2, 9, 3, 0].
Pass 2: [4, 2, 5, 9, 3, 0].
Pass 3: [4, 2, 5, 3, 9, 0].
Pass 4: [4, 2, 5, 3, 0, 9].
Pass 5: [2, 4, 5, 3, 0, 9].
Pass 6: [2, 4, 3, 5, 0, 9].
Pass 7: [2, 4, 3, 0, 5, 9].
Pass 8: [2, 3, 4, 0, 5, 9].
Pass 9: [2, 3, 0, 4, 5, 9].
Pass 10: [2, 0, 3, 4, 5, 9].
Pass 11: [0, 2, 3, 4, 5, 9].
Total swaps: 11
Default Array: [5, 4, 2, 9, 3, 0].
Pass 1: [4, 5, 2, 9, 3, 0].
Pass 2: [2, 4, 5, 9, 3, 0].
Pass 3: [2, 4, 5, 9, 3, 0].
Pass 4: [2, 3, 4, 5, 9, 0].
Pass 5: [0, 2, 3, 4, 5, 9].
Total swaps: 5
Insertion sort is better
```