

# Data Structures and Algorithms

## Problem Set 1 (Fall 2023)

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**Deadline:** September 25, 2023

### Insertion Sort

1. Dry run the `InsertionSort` on the following inputs. Use the code given in CLRS Section 2.1. Show the detailed iteration.  
A= {5,43,76,2,98,23,12,32}  
B= {6,7,8,9,10}

### Merge Sort

2. Dry run the `MergeSort` on the following inputs. Use the code given in CLRS Section 2.3. Show in detail what happens in each recursive function.  
A= {1,3,54,2,72,23,12,32,76,12}
3. Visualize the function calls in the memory for the above input.
4. Do you think that `MergeSort` always takes same number of operations in sorted and unsorted array. Justify your answer.
5. Change the pseudo code of `MergeSort` to arrange elements in decreasing order rather than increasing order. Write down the modified pseudo code.

### Selection Sort

6. Consider the following code of `SelectionSort`. Provide the detailed asymptotic analysis of code similar to that of `InsertionSort` discussed in class.

```
1: function SELECTION-SORT(A, n)
2:   for i = 1 to n-1 do
3:     min ← i
4:     for j = i + 1 to n do
5:       if A[j] < A[min] then
6:         min ← j
7:       end if
8:     end for
9:     swap A[i], A[min]
10:  end for
11: end function
```

7. Discuss the Loop Invariant of `SelectionSort`.

### Bubble Sort

8. Write down one paragraph description of Bubble Sort in your own words.
9. Provide pseudo code of `BubbleSort`.
10. Run your algorithm on the following input.  
A= {9,8,7,6,4,3,2,1}

**What to submit:** All solutions should be typed in MS word document PS1.docx. For diagrams, use a proper tool, do not add snapshots of handwritten working. Assignments will be collected on Monday, September 25, 2023 any time.