Indian Institute of technology, Guwahati

Department of Computer Science and Engineering

Data Structure Lab: (CS210)

Assignment: 3

Date: 28th August, 2016 **Total Marks: 20**

1) [Bubble Sort]

a) [Simple] Implement **Bubble sort on a** given array of integers. **[6]**

b) [Improvement 1] Improve Bubble sort by removing unnecessary outer loop iterations when the elements are already sorted. **[6]**

c) **[Improvement 2]** Improve Bubble sort over Improvement 1 by reducing number of outer loop iterations by making successive passes go in opposite direction so that small element moves faster to the front and the large element moves faster to the rear. **[8]**

Input: First line will contain an integer N denoting number of elements in array.
Second line will contain N space separated integers.

Output:

Line1 will have a single number denoting number of outer loop iteration for case a.
Line2 will be sorted array.
Line3 will contain a single integer denoting improvement in the number of iterations of outer loop for case b over Simple bubble sort i.e. difference in number of outer loop for simple bubble sort and the improved one.
Line4 will be sorted array which you got by improvement 1.
Line5 will contain a single integer denoting improvement in the number of iterations of outer loop for case cover Simple bubble sort i.e. difference in number of outer loop for simple bubble sort and the improved one.
Line6 will be sorted array which you got by improvement 2.

Test1:
Input:
15
109 28 30 34 56 78 112 46 21 10 84 66 98 14 59

Output:
14
10 14 21 28 30 34 46 56 59 66 78 84 98 109 112
1
10 14 21 28 30 34 46 56 59 66 78 84 98 109 112
9
10 14 21 28 30 34 46 56 59 66 78 84 98 109 112

Test2:

Input:
20
119 19 91 31 49 72 63 23 80 42 32 48 70 64 35 81 16 24 40 56

Output:
19
16 19 23 24 31 32 35 40 42 48 49 56 63 64 70 72 80 81 91 119
2
16 19 23 24 31 32 35 40 42 48 49 56 63 64 70 72 80 81 91 119
12
16 19 23 24 31 32 35 40 42 48 49 56 63 64 70 72 80 81 91 119

Test3:

Input:
25
1 114 86 90 15 2 44 11 5 52 7 9 47 105 34 54 126 61 144 3 17 29 13 75 27

Output:
24
1 2 3 5 7 9 11 13 15 17 27 29 34 44 47 52 54 61 75 86 90 105 114 126 144
6
1 2 3 5 7 9 11 13 15 17 27 29 34 44 47 52 54 61 75 86 90 105 114 126 144
17
1 2 3 5 7 9 11 13 15 17 27 29 34 44 47 52 54 61 75 86 90 105 114 126 144

Evaluation Criteria:
1. Do not use any global variable. Penalty: -4.
2. All outputs are correct: Full marks.