Batch: B4 Roll. No.: 16010122828

Experiment: 10

Grade: AA / AB / BB / BC / CC / CD /DD

Title: Using virtual labs to understand the data structures

Objective: Use of virtual labs to understand the concepts and theory with examples and verify the same with practice questions.

Expected Outcome of Experiment:

CO	Outcome
CO1	Explain the different data structures used in problem solving
CO2	Apply linear and non-linear data structure in application development
CO3	Demonstrate sorting and searching methods.

Abstract: the virtual lab experiments help in understanding how various data structures work. They also emphasize on some important applications of various data structures and enable students to get familiarized with how certain applications can benefit from the choice of data structures.

Assigned data structure: (Teacher would assign one of the following to one student)

1. Stack - https://ds1-iiith.vlabs.ac.in/exp/stacks-queues/stacks/stackdemo.html
2. Infix and postfix - https://ds1-iiith.vlabs.ac.in/exp/infix-postfix/evaluation-ofpostfix-expressions/postfix_eval.html
3. Queue - https://ds1-iiith.vlabs.ac.in/exp/stacks-queues/stacks/stackdemo.html
4. Bubble sort - https://ds1-iiith.vlabs.ac.in/exp/bubble-sort/bubblesort/bsexercise.html
5. Graph DFS - https://ds1-iiith.vlabs.ac.in/exp/depth-first-search/index.html
6. Graph BFS - https://ds1-iiith.vlabs.ac.in/exp/breadth-first-search/index.html
7. Binary search tree - https://ds1-iiith.vlabs.ac.in/exp/binary-search-trees/bstinsert/bstInsert.html
8. Hash tables - https://ds1-iiith.vlabs.ac.in/exp/hash-tables/quadraticprobing/qp_practice.html
9. Linked list - https://ds1-iiith.vlabs.ac.in/exp/linked-list/singly-linkedlist/sllpractice.html

Aim / learning objective of the assigned expt:

- Given an unsorted array of numbers, generate a sorted array of numbers by applying Bubble Sort.
- Optimise the Bubble Sort algorithm to achieve better performance.
- Demonstrate knowledge of time complexity of Bubble Sort by counting the number of operations involved in each iteration.
- Compare Bubble Sort with other sorting algorithms and realise Bubble Sort as a stable comparison sorting algorithm

Concept and algorithm of the application/activity followed:

Concept of Bubble Sort

Bubble Sort works on the concept that the adjacent elements must be in the correct order, i.e., if the left element is smaller than the right one, they are in the correct relative order, if not they are swapped to bring them in the correct relative order. So, all the elements are checked in pairs and swapped as and when needed to sort them. In the end, all the elements on the left are smaller than the ones on the right.

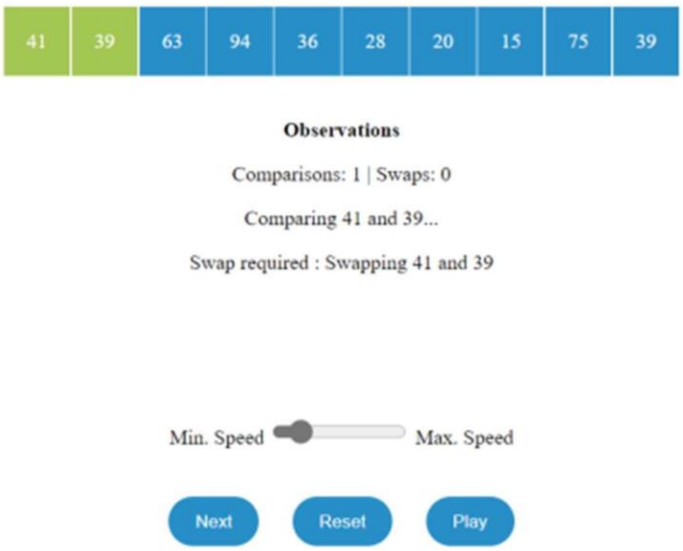
Algorithm of Bubble Sort

Let's have a final look at the consolidated algorithm to sort an array of N elements:

- STEP 1: Compare the i th and (i+1) th element, where i=first index to i=second last index.
- STEP 2: Compare the pair of adjacent elements. If i th element is greater than the (i+1) th element, swap them.
- STEP 3: Run steps 1 and 2 a total of N-1 times to attain the final sorted array.

Demo execution screenshots:

First Iteration:



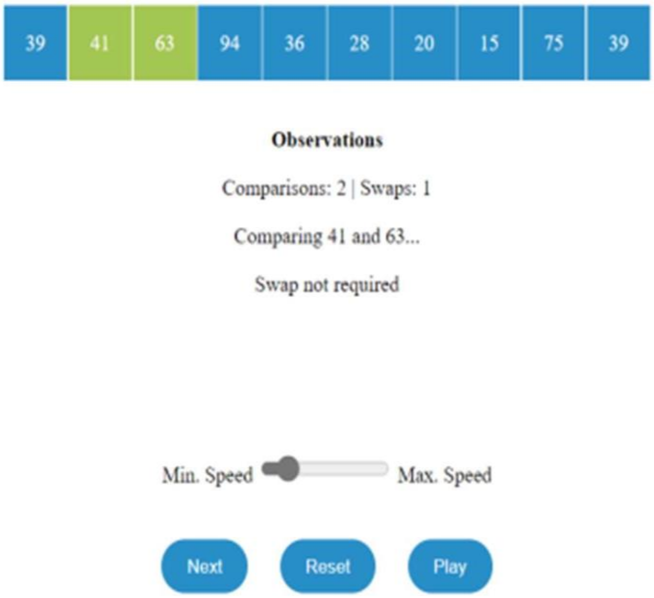
41	39	63	94	36	28	20	15	75	39

Observations

Comparisons: 1 | Swaps: 0

Comparing 41 and 39...

Swap required : Swapping 41 and 39



39	41	63	94	36	28	20	15	75	39

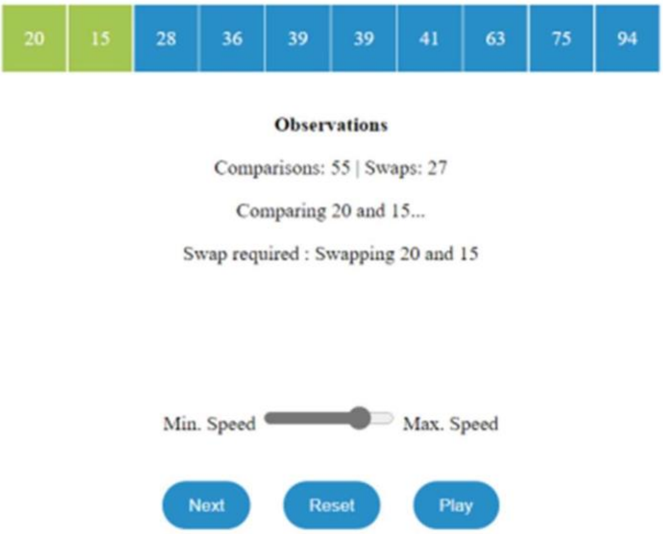
Observations

Comparisons: 2 | Swaps: 1

Comparing 41 and 63...

Swap not required

Last Iteration:



20	15	28	36	39	39	41	63	75	94

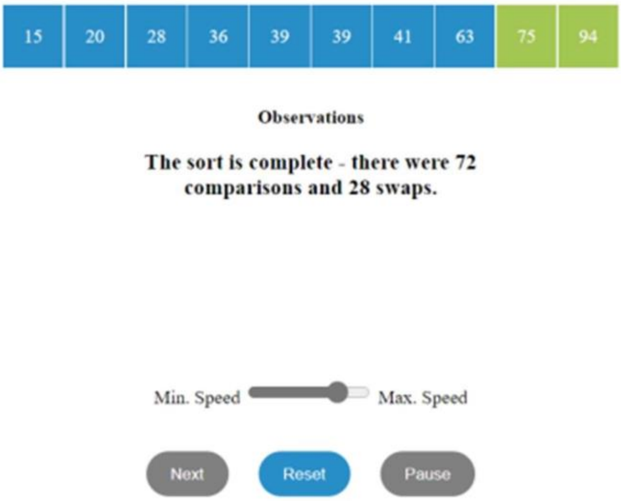
Observations

Comparisons: 55 | Swaps: 27

Comparing 20 and 15...

Swap required : Swapping 20 and 15

Sorted Array:

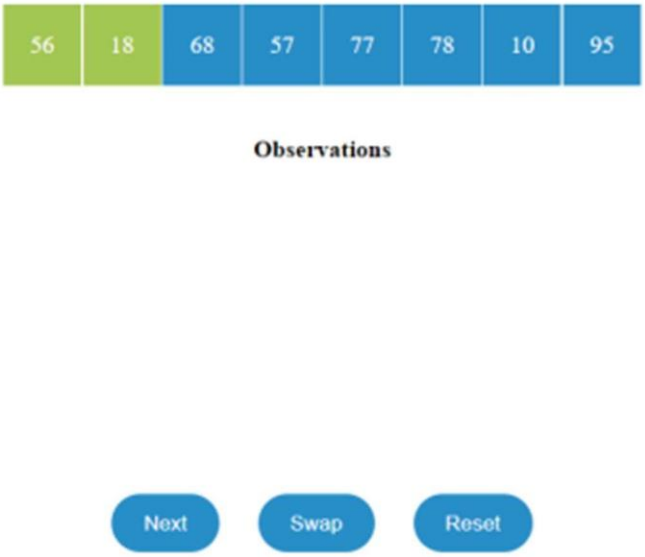


15	20	28	36	39	39	41	63	75	94

Observations

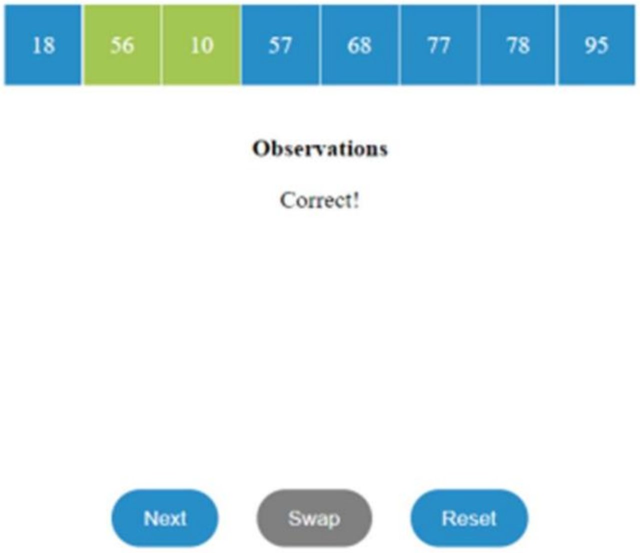
The sort is complete - there were 72 comparisons and 28 swaps.

Practice problem screenshots:



56	18	68	57	77	78	10	95

Observations

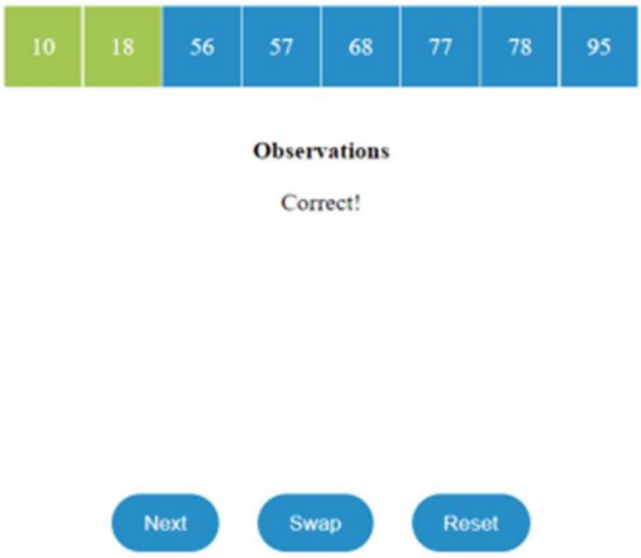


18	56	10	57	68	77	78	95

Observations

Correct!

Sorted Array:

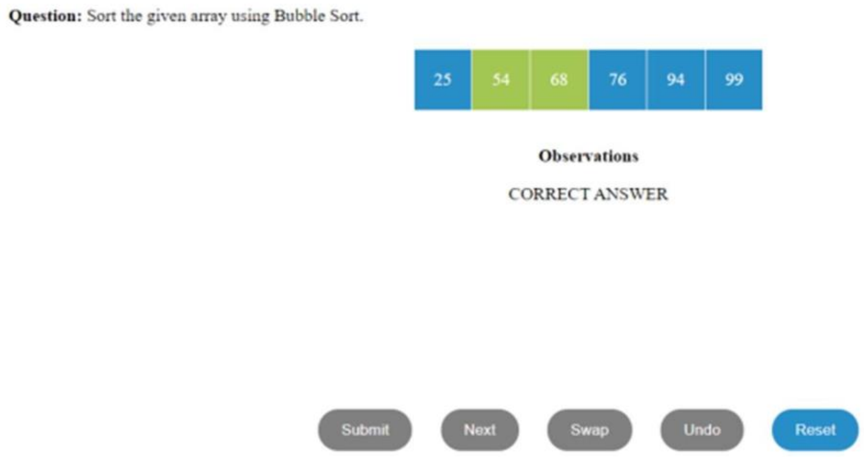


10	18	56	57	68	77	78	95

Observations

Correct!

Exercise:



Question: Sort the given array using Bubble Sort.

25	54	68	76	94	99

Observations

CORRECT ANSWER

Conclusion and your takeaway after performing the virtual lab experiment: -

From this virtual lab experiment, the concept of bubble sort was understood and implemented. We analysed each step of bubble sort to ultimately obtain the sorted array.