

## Computing Structures – Fall 2022

### Project-6 Report

In this project, we explored two sorting methods – Bubble sort, Shell sort and explored how approximate sorting functions and how the quality of an array of items' sorting can be evaluated.

Number of inversions and Chebyshev distance quality measures are used to measure the sortedness of the sorted array.

Following are the line charts comparing the quality metrics and number of comparisons for 1000,5000,10000,20000,30000 elements

#### Number of Inversions:

Chart for number of inversions for 1000 elements:

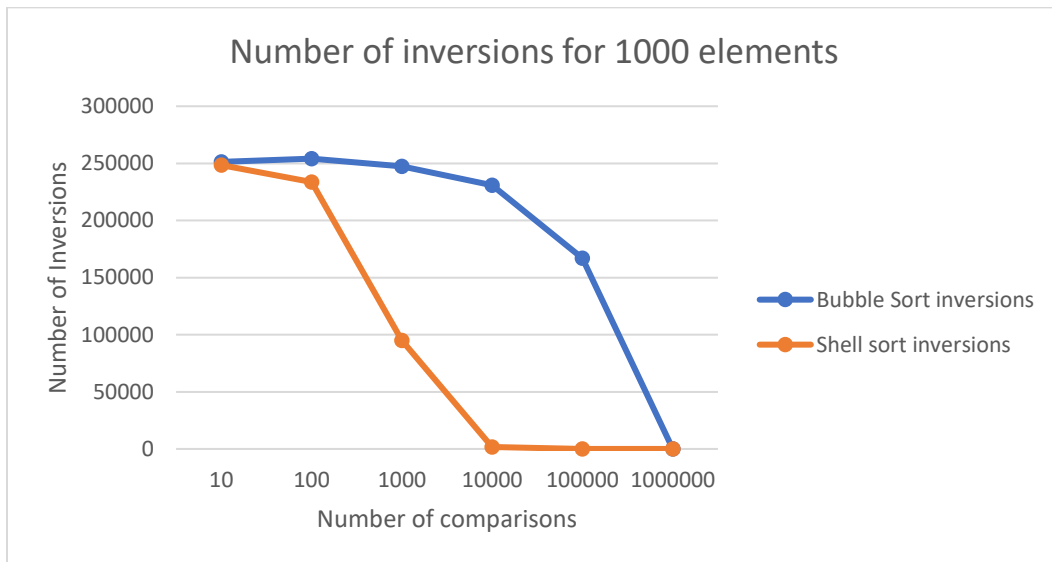
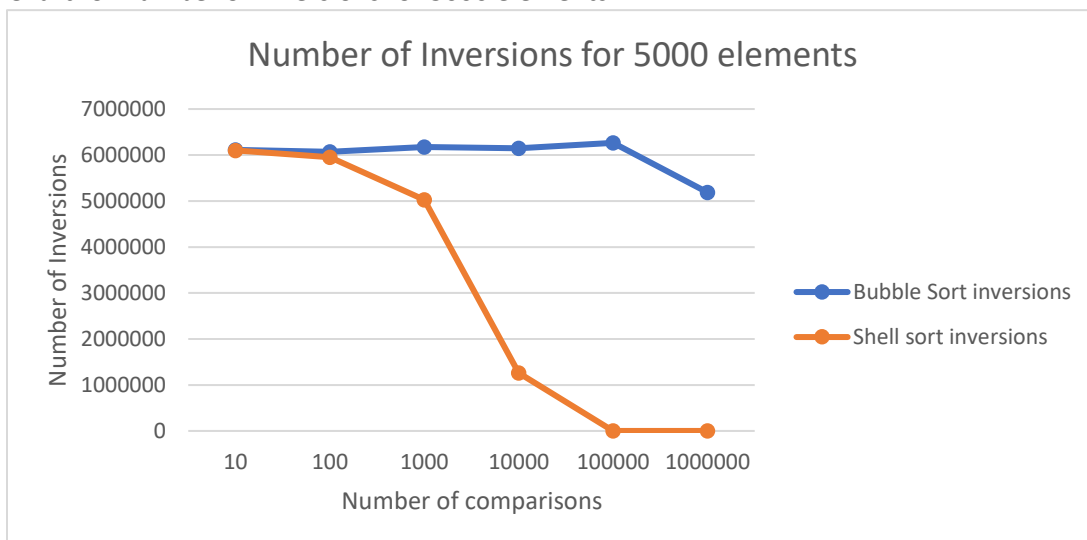
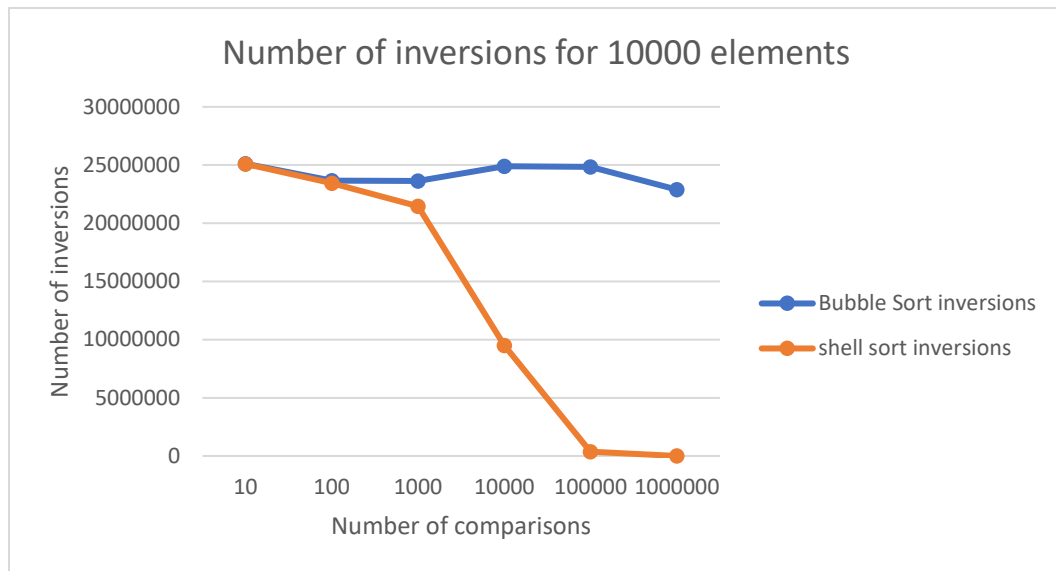


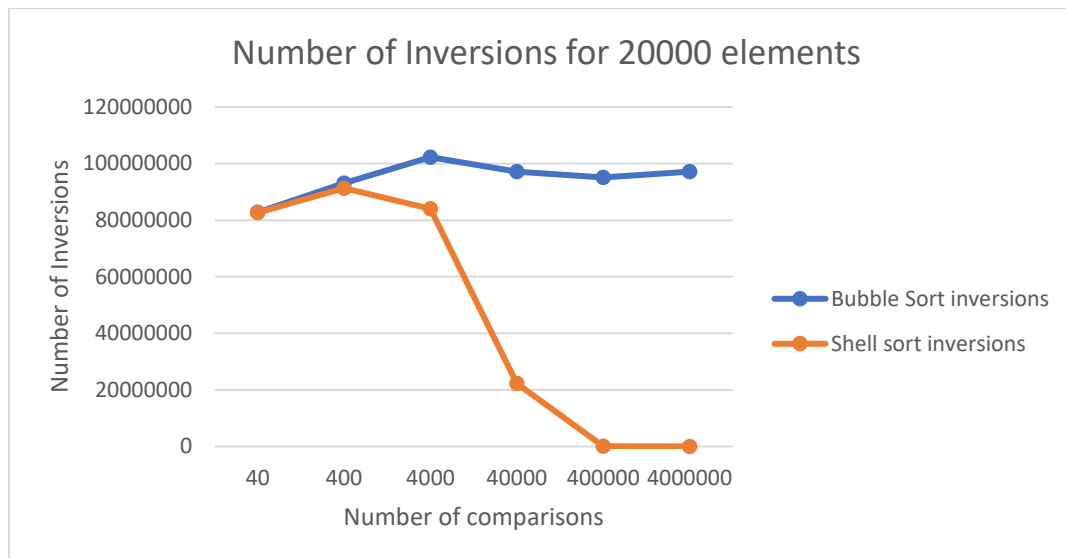
Chart for number of inversions for 5000 elements:



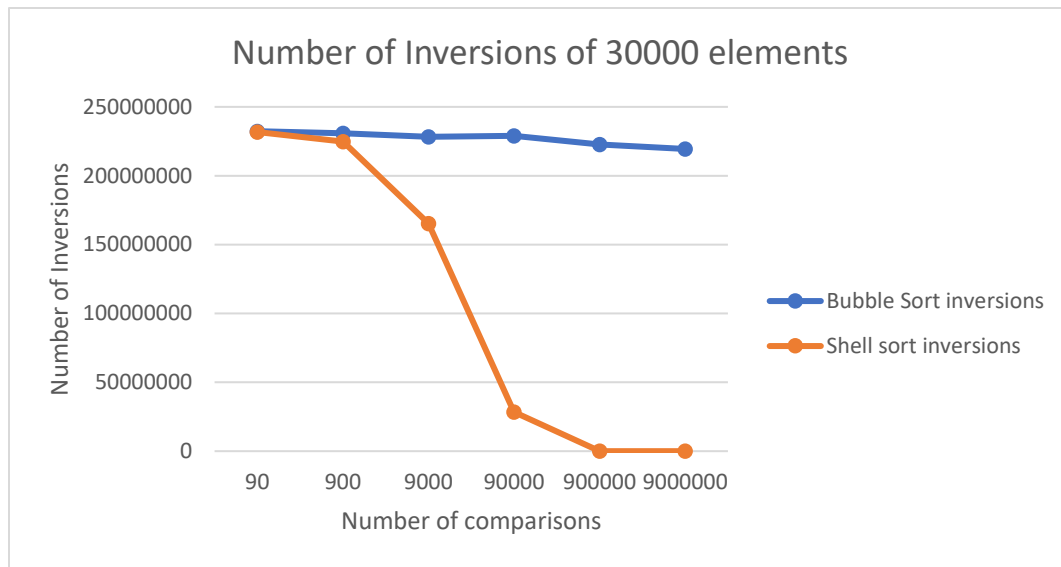
**Chart for number of inversions for 10000 elements:**



**Chart for number of inversions for 20000 elements:**

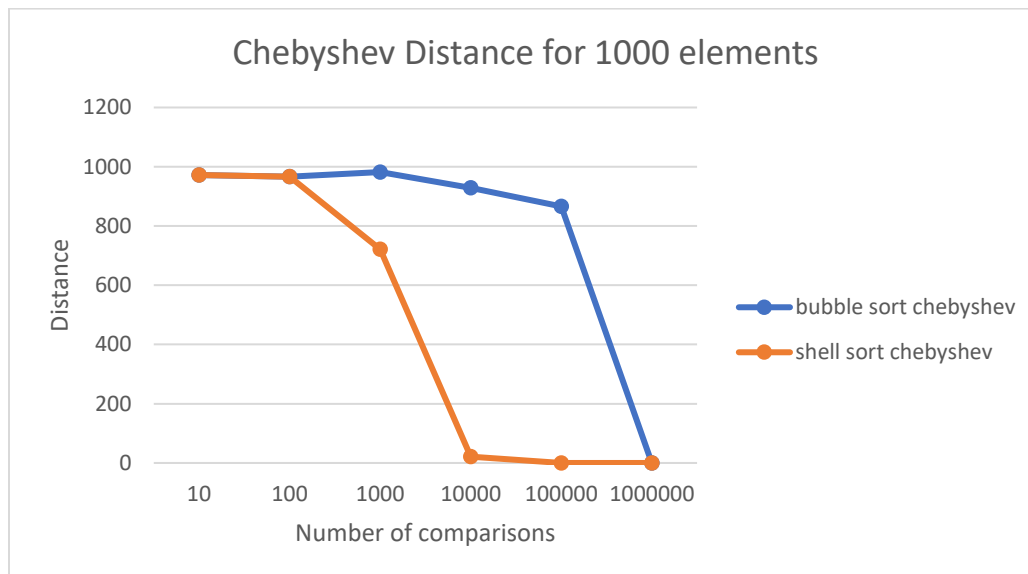


**Chart for number of inversions for 30000 elements:**

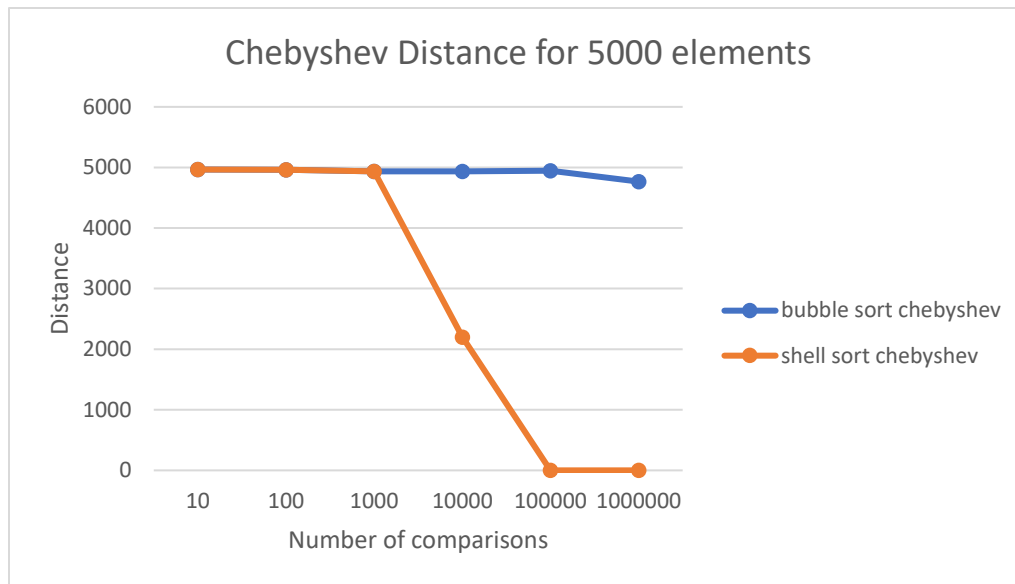


**Chebyshev distance:**

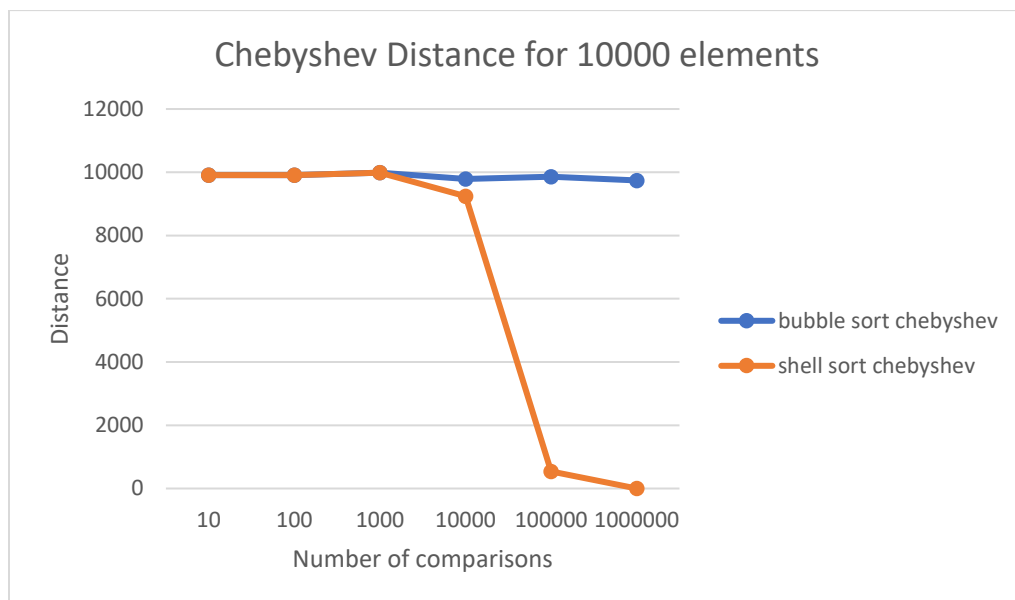
**Chart for Chebyshev distance for 1000 elements:**



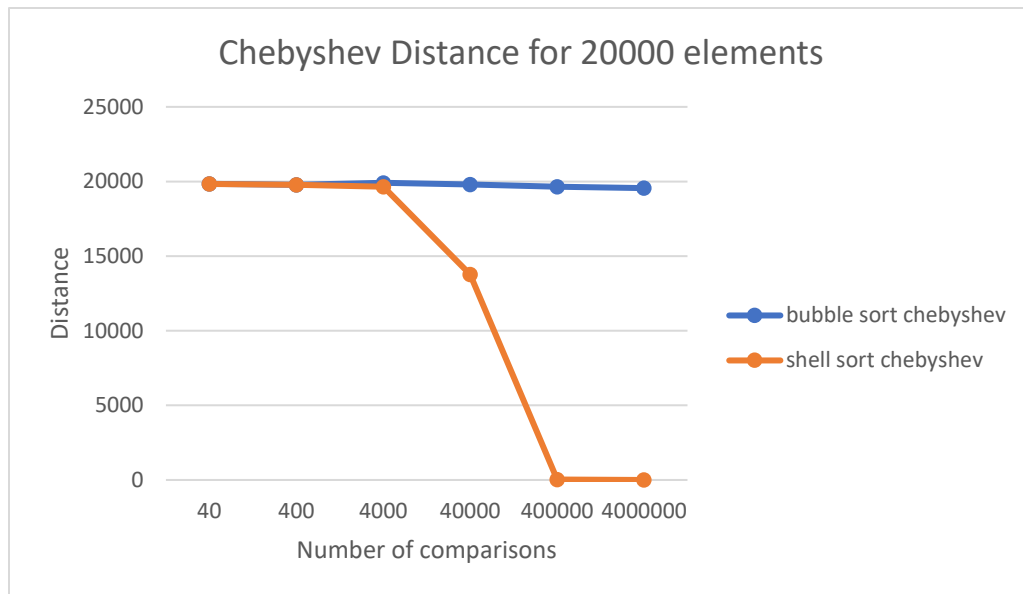
**Chart for Chebyshev distance for 5000 elements:**



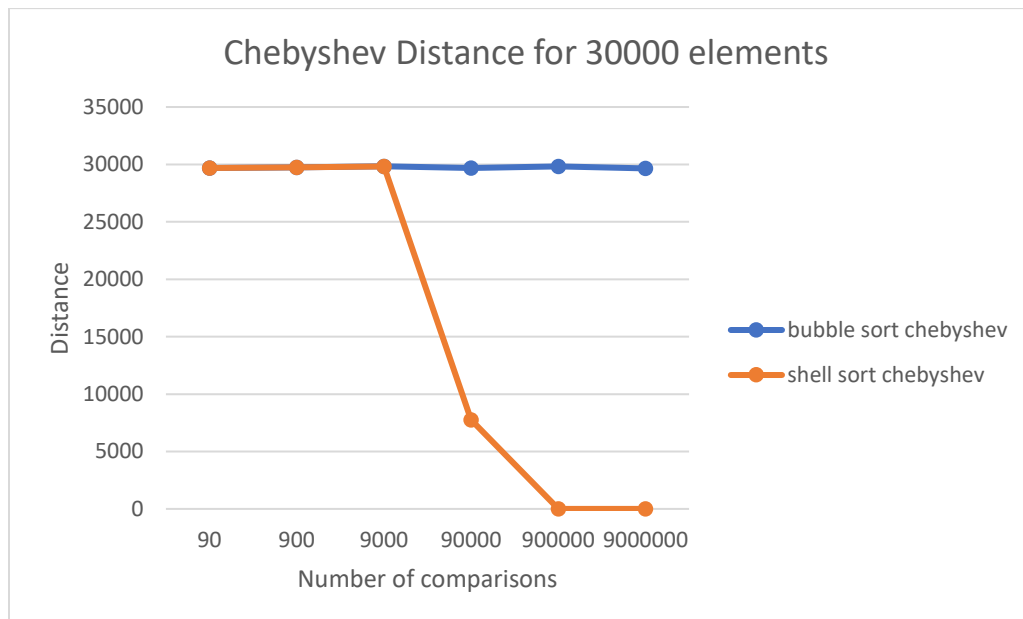
**Chart for Chebyshev distance for 10000 elements:**



**Chart for Chebyshev distance for 20000 elements:**



**Chart for Chebyshev distance for 30000 elements:**



**Results from graphs for Number of Inversions:**

- Based on these graphs, shell sorting results in fewer inversions than bubble sorting.
- The number of inversions for shell sort is progressively decreasing as the number of comparisons rises. As opposed to bubble sort, it is constant until a certain point, then it starts to decrease.
- When there have been approximately  $n^2$  comparisons, where  $n$  is the number of elements, the number of inversions for bubble sort becomes zero. Before the bubble sort reaches zero, the shell sort hits zero at certain value.

**Results from graphs for Chebyshev distance:**

- Based on these graphs, shell sort has a lower Chebyshev distance than bubble sort.
- As more comparisons are made, the Chebyshev distance for shell sort rapidly decreases. While in the case of bubble sort, it is steady at first before falling.
- When there have been approximately  $n^2$  comparisons, where  $n$  is the number of elements, the Chebyshev distance for bubble sort becomes zero. Before the bubble sort reaches zero, the shell sort hits zero at certain value.