**Sorting Method Analysis**

Each sorting method was tested with ten different sets of data starting from 2,000 items and incrementing by 2,000 up to 20,000 items of data. For each run of a sorting method the number of times the main loop of the sorting method iterates, as well as the number of times data is moved is recorded.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Bubble Sort | | Selection Sort | | Shell Sort | | | Quick Sort | |
| **Items of Data** | **Number of Iterations** | **Number of Swaps** | **Number of Iterations** | **Number of Swaps** | **Number of Iterations** | **Number of Swaps** | | **Number of Iterations** | **Number of Swaps** |
| 2000 | 1999000 | 1000867 | 1999000 | 1999 | 24629 | | 11457 | 20152 | 5236 |
| 4000 | 7998000 | 4038777 | 7998000 | 3999 | 60720 | | 23457 | 32553 | 11581 |
| 6000 | 17997000 | 9055016 | 17997000 | 5999 | 108403 | | 35457 | 56172 | 17886 |
| 8000 | 31996000 | 15930678 | 31996000 | 7999 | 141921 | | 47457 | 80030 | 24640 |
| 10000 | 49995000 | 24865580 | 49995000 | 9999 | 211712 | | 59457 | 108337 | 31984 |
| 12000 | 71994000 | 35849524 | 71994000 | 11999 | 282442 | | 71457 | 117332 | 38649 |
| 14000 | 97993000 | 48862216 | 97993000 | 13999 | 346637 | | 83457 | 133114 | 46052 |
| 16000 | 127992000 | 64196570 | 127992000 | 15999 | 421064 | | 95457 | 163980 | 53056 |
| 18000 | 161991000 | 81105494 | 161991000 | 17999 | 506915 | | 107457 | 171260 | 61490 |
| 20000 | 199990000 | 99947876 | 199990000 | 19999 | 612173 | | 119457 | 194918 | 69295 |

*Table 1 Iteration and Data Swap*

*Figure 1 Bubble Sort Plot*

*Figure 2 Selection Sort Plot*

*Figure 3 Shell Sort Plot*

*Figure 4 Quick Sort Plot*

Given the four sorting algorithms (bubble, selection, shell, and quick), bubble sort and selection sort were identical in loop count and had the worst sorting performance with a time complexity slightly below O(n^2), see Figures 1 and 2. Shell sort had the next worst time complexity between O(n^(3/2)) and O(n), see Figure 3. Quick sort had the best time complexity of O(n), see Figure 4.

Bubble sort uses significantly more swaps than the other methods. Shell sort had the second most swaps followed by quick sort. The standout in terms of number of swaps was selection sort, as it only moves each piece of data once to its sorted position.

Bubble and selection sort in this experiment had the expected time complexity of O(n^2) (The average expected performance of the two sorting methods). Shell sort had better than expected results, almost achieving the best-case scenario of O(n). Finally, quick sort performed worse than the average expected time complexity of O(n log(n)), only achieving O(n) in these test cases.