Eliejah Walker

Analysis

Bubble Sort:

| Size of N time	Avg Time to complete	Factor Increase in
10	2.3e-05	
100	0.000727	31.61
1000	0.090656	124.52
10000	13.634352	150.32
100000	722.34	52.97
1000000	X	X

Eliejah Walker

Time vs. Size of N
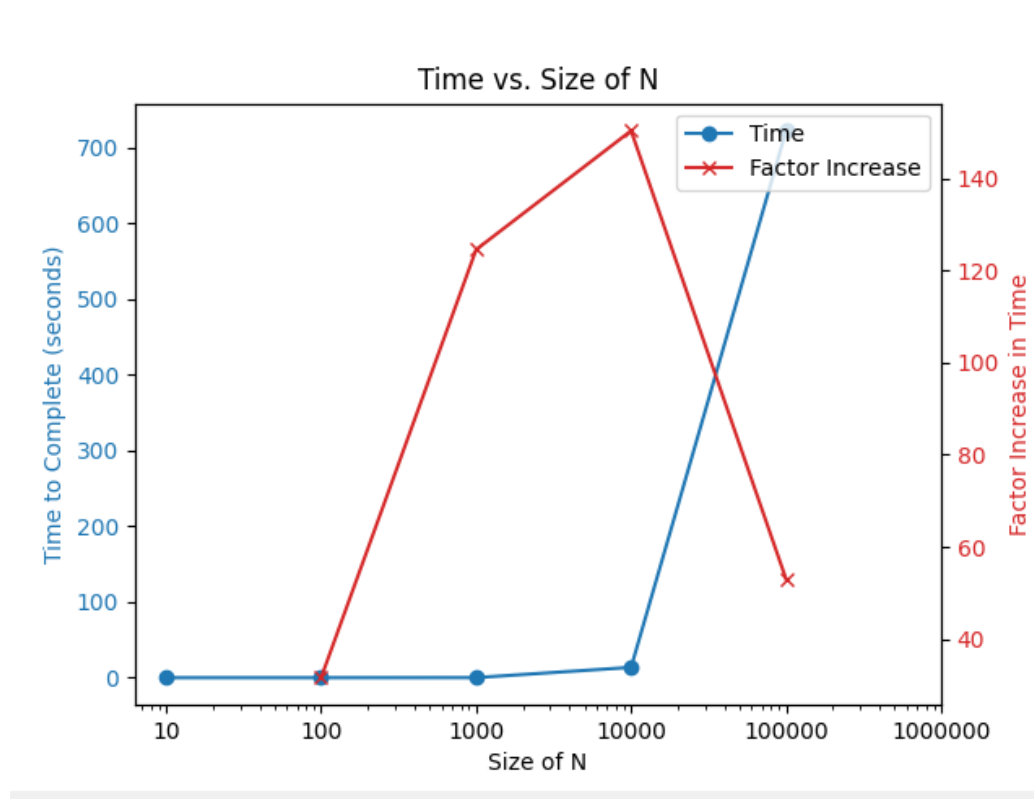
Insertion Sort:

Size of N time	Avg Time to complete	Factor Increase in
10	1.5e-06s	
100	5.33e-06s	3.55
1000	5.59e-05s	10.49
10000	0.000388s	6.95
100000	0.007476s	19.26
1000000	0.074615	10.00

Eliejah Walker

Insertion graph:
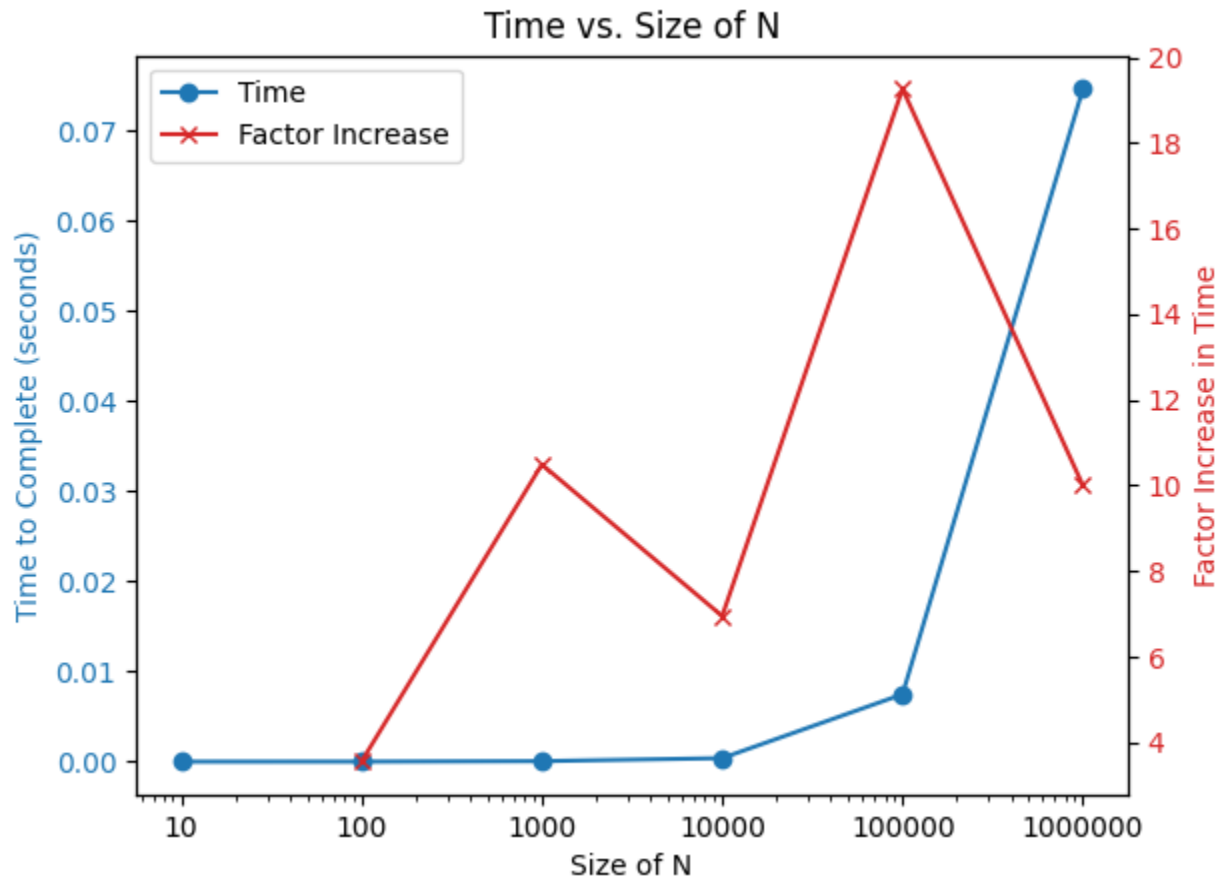
Selection Sort:

Size of N time	Avg Time to complete	Factor Increase in
10	7e-06	
100	3.5e-05	5.00
1000	3.65e-04	10.43
10000	0.003864	10.57

Eliejah Walker

| 100000 | 0.038154 | 9.88 |
| 1000000 | 0.393882 | 10.31 |

Selection Sort Graph:

Time vs. Size of N
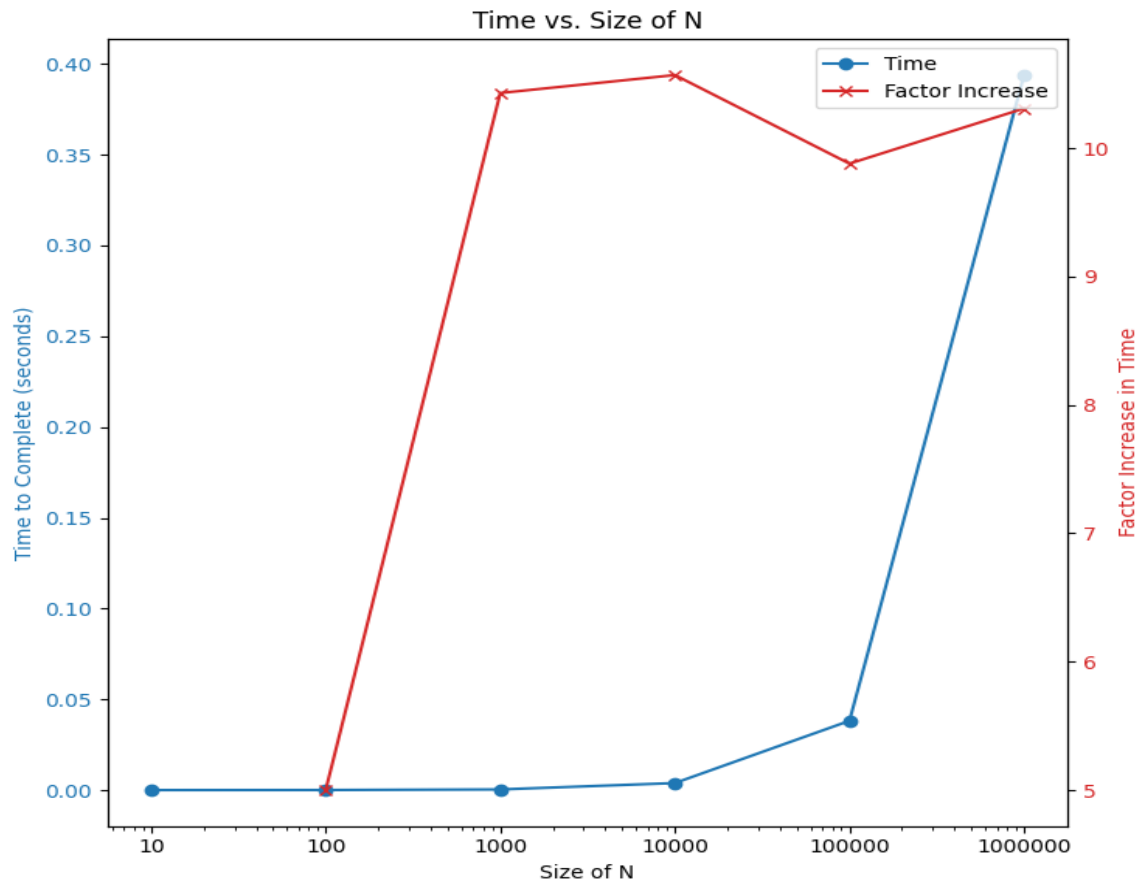
Shell Sort:

Size of N time	Avg Time to complete	Factor Increase in
10	7.7e-06	
100	0.000173	22.47
1000	0.004368	25.25
10000	0.089614	20.56

Eliejah Walker

| 100000 | 1.270466 | 14.17 |
| 1000000 | 20.432389 | 16.09 |

Shell Sort Graph:
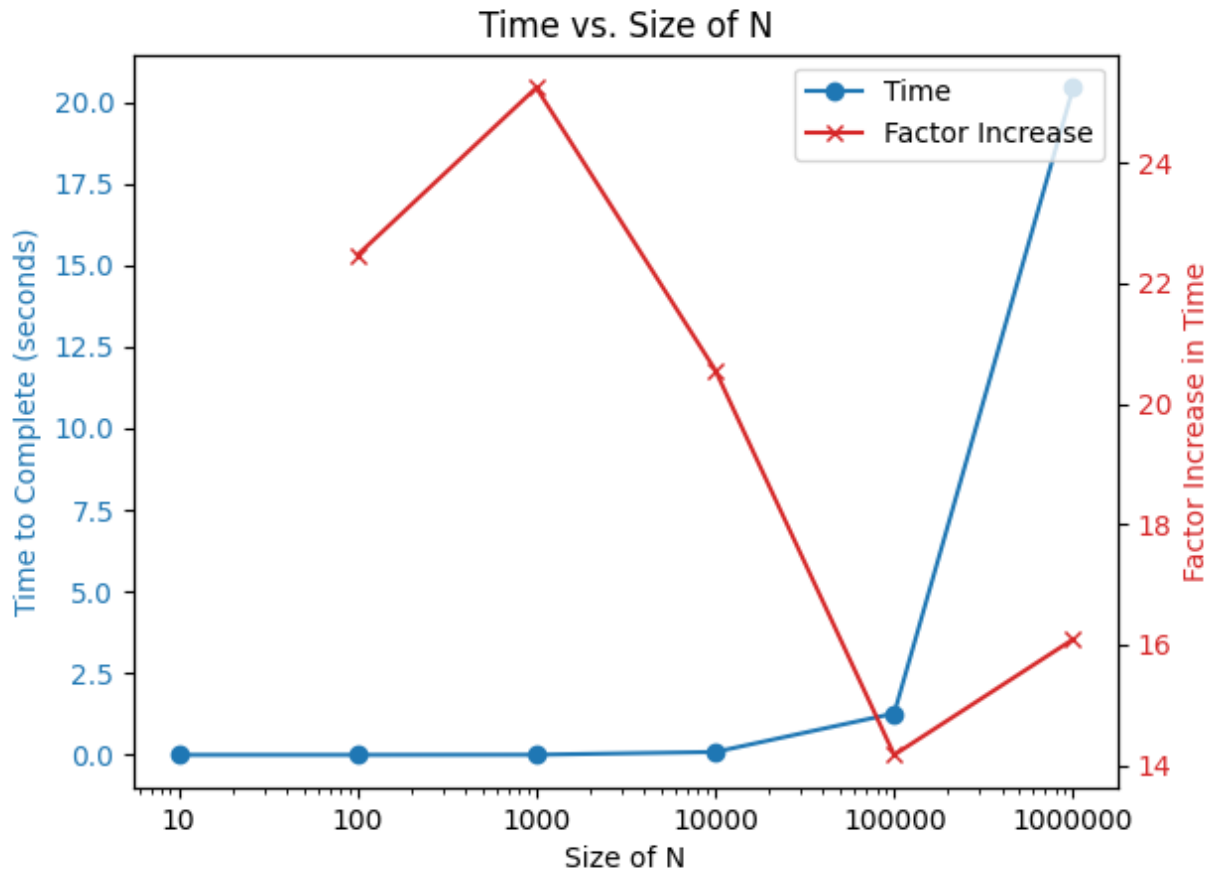
The results of the time complexity measurements for the four sorting algorithms (Insertion Sort, Selection Sort, Shell Sort, and Bubble Sort) generally match the expected mathematical complexities of these algorithms.

1. **Insertion Sort**:

- In the results, Insertion Sort exhibited a quadratic increase in time (O(N^2)), which is expected since Insertion Sort has a worst-case time complexity of O(N^2).

- The factor increase in time was much more significant as N increased, consistent with the mathematical prediction for a quadratic algorithm.

2. **Selection Sort**:

- The time complexity of Selection Sort is also quadratic (O(N^2)), and the results reflected this mathematical complexity.

- The factor increase in time closely matched the quadratic growth, indicating a consistent performance.

3. **Shell Sort**:

- Shell Sort is more efficient than Insertion Sort, Selection Sort, and Bubble Sort. It has an average time complexity that varies depending on the gap sequence used, but it's generally better than O(N^2).

- In the results, we can see that the factor increase in time is smaller than the quadratic increase, demonstrating the efficiency of Shell Sort compared to the quadratic algorithms.

4. **Bubble Sort**:

- Bubble Sort is a particularly inefficient sorting algorithm with a worst-case time complexity of O(N^2).

- The results showed a clear quadratic increase in time, aligning with the mathematical prediction for a quadratic algorithm.