

**Language used:** JavaScript

**GUI:** HTML, CSS

**System:** AMD Ryzen 7 5700U with Radeon Graphics 1.80 GHz, RAM = 12.0 GB

### Why JavaScript?

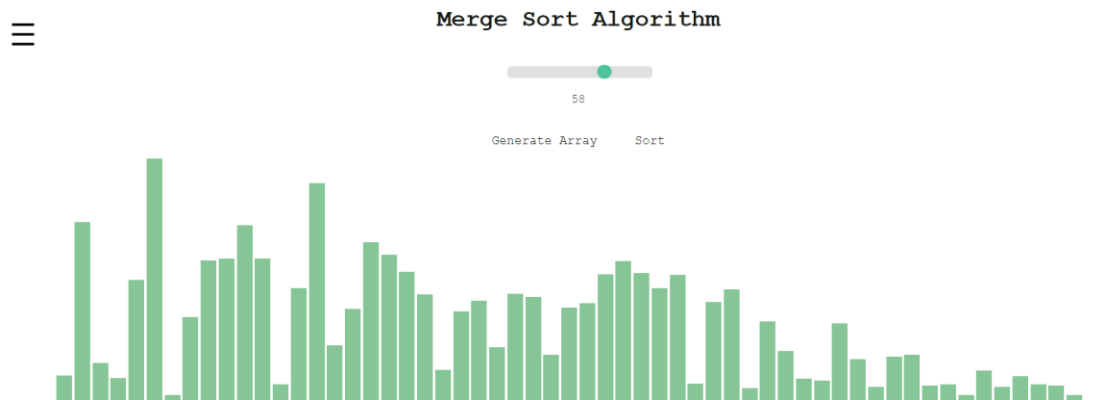
We used JS because it can easily be integrated using HTML to a web page and can show interactive animations for our sorting algorithms.

### Instructions to run the code

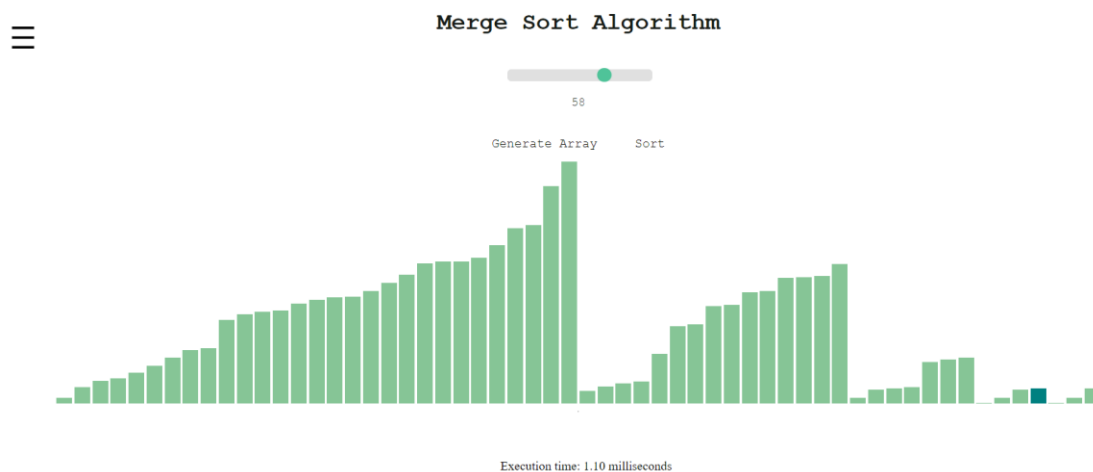
The home page has a sidebar, which is very easy to use. All algorithms, and empirical analysis are provided, with run times and chart displayed to visualize the impact of different algorithms.

### Example -> Merge Sort

Provided is an unsorted random array



Array being sorted



Final sorted array

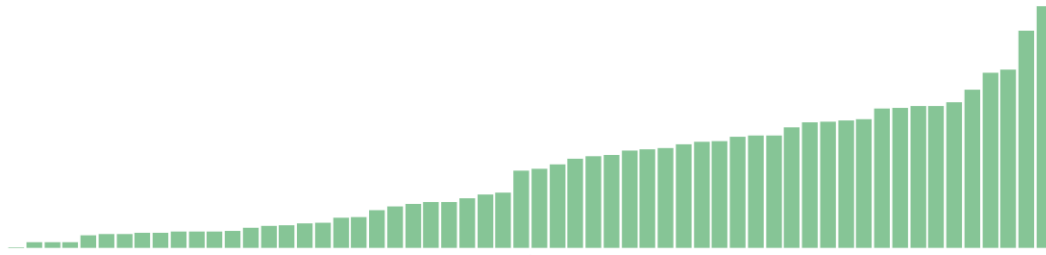


### Merge Sort Algorithm



58

Generate Array   Sort



Execution time: 1.10 milliseconds

## Empirical Analysis



### Empirical Analysis

\*For Worst Case Scenario

Array Size	Bubble	Insertion	Selection	Merge	Quick	Heap	Radix	Bucket	Count
100	1.30	0.20	0.10	0.00	1.10	0.20	0.10	0.00	0.00
500	0.40	0.40	0.40	0.20	3.60	0.20	0.10	0.00	0.00
1000	1.20	0.40	0.40	0.20	0.90	0.70	0.00	0.20	0.00
5000	23.50	6.70	7.20	1.30	12.10	0.60	0.10	0.20	0.10
10000	1345.60	26.60	30.70	2.10	46.40	1.10	0.20	1.10	0.00
50000	NaN*	670.30	667.40	5.60	1117.70	7.30	0.70	1.90	1.10
100000	NaN*	2688.60	2797.70	10.50	4521.60	11.70	1.50	4.30	1.20

Generate Graph

\*Due to large array size, Bubble sort could not be computed

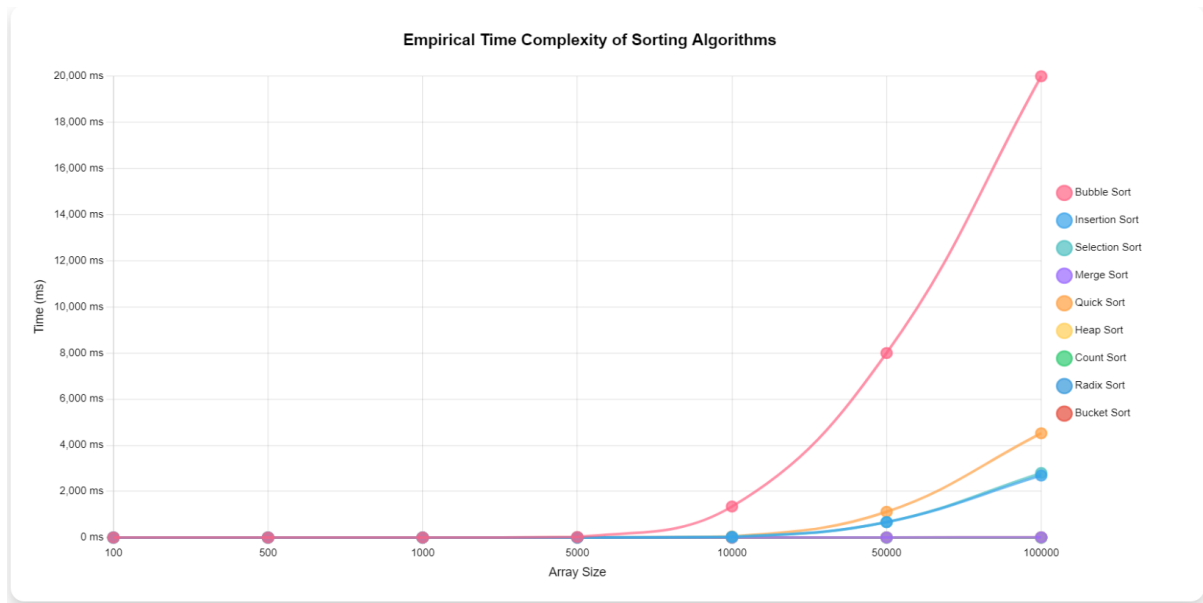
### Problems with Empirical Analysis

One major issue we faced was extracting the time for Bubble Sort Algorithm for array sizes 50,000 and 100,000. The web page would become unresponsive as it took too long a time. However, the time can be easily calculated on console using C++.

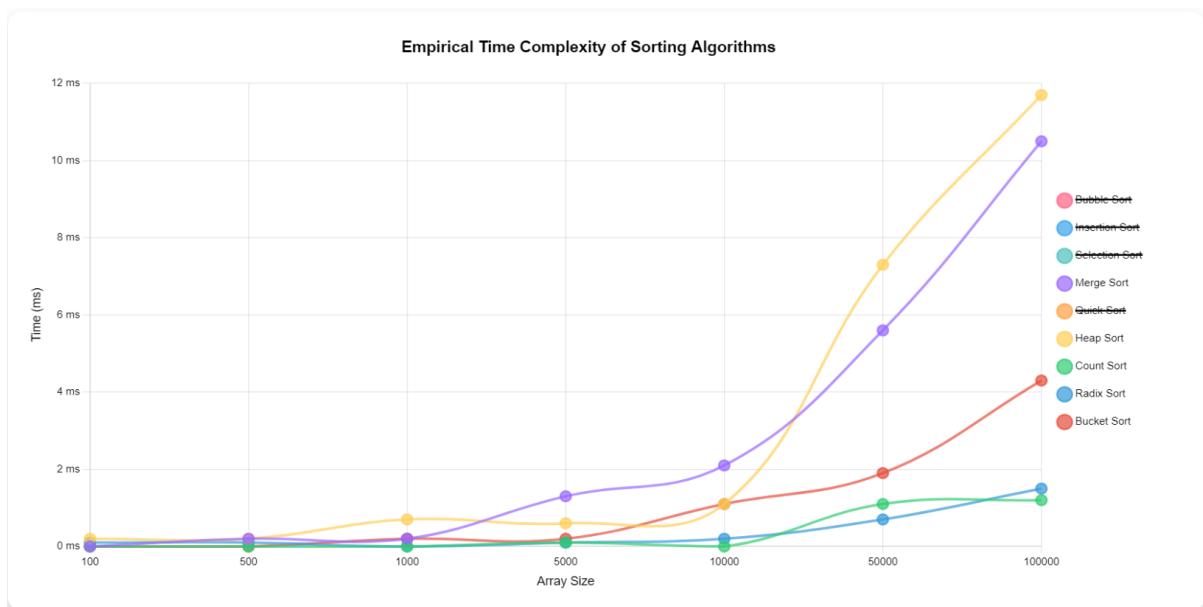
To cater this issue, we simply put NaN value in the Empirical Analysis table, and provided estimated value for graph, for array sizes exceeding 50,000.

Below are the line graphs that show how different algorithms behave under same conditions.

## Graph – All Sorting Algorithms



## Graph - \*Excluding All $O(n^2)$ Algorithms



## References

<https://www.w3schools.com/>

[https://www.youtube.com/watch?v=\\_AwSIHlpFuc&t=507s&pp=ygUbYnViYmxlIHNVcnQgYW5pbWF0aW9uIHZpZGVv](https://www.youtube.com/watch?v=_AwSIHlpFuc&t=507s&pp=ygUbYnViYmxlIHNVcnQgYW5pbWF0aW9uIHZpZGVv)