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A1 Analysis

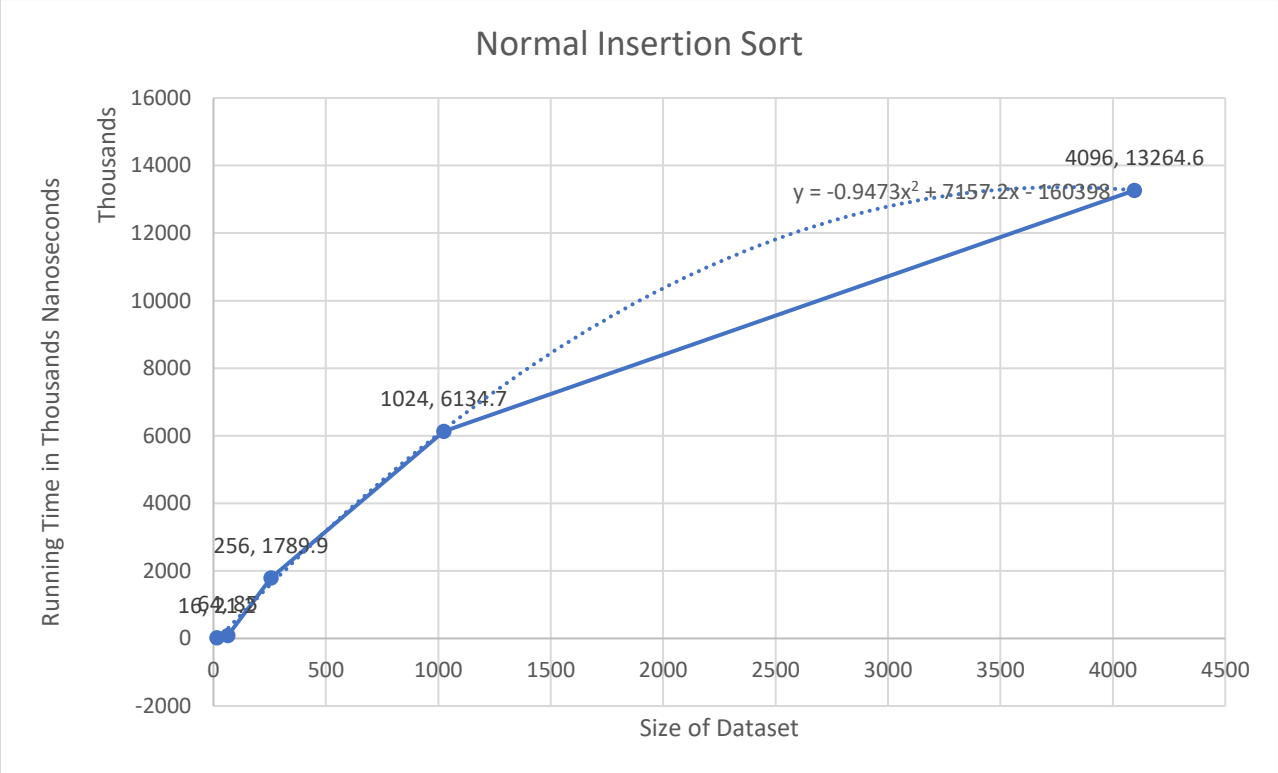
Algorithms Running Time for Various Dataset Sizes:

Size of Dataset	Execution Time of Sorting Algorithms (in nanoseconds)							
	Insertion			Merge		Quick		Heap
	Normal	Comparable	Binary	TD	BU	Normal/ Basic	Median Three Partition	Normal
2^4	21200	9100	27800	7500	10600	11700	71800	14700
2^6	85000	49700	459500	17000	85600	41100	116400	69000
2^8	1789900	761600	1409200	87100	569000	156600	395000	258000
2^{10}	6134700	4619000	16369400	691600	2964100	635000	1106500	478600
2^{12}	13264600	31440400	85867800	9477600	46785500	2131100	1478000	1427600

3.1.1 Normal and Log-Log Graphs of Sorting Algorithms

Note : Log base 2 used and scale for y-axis is in thousands nanoseconds to look cleaner

Normal Insertion Sort:



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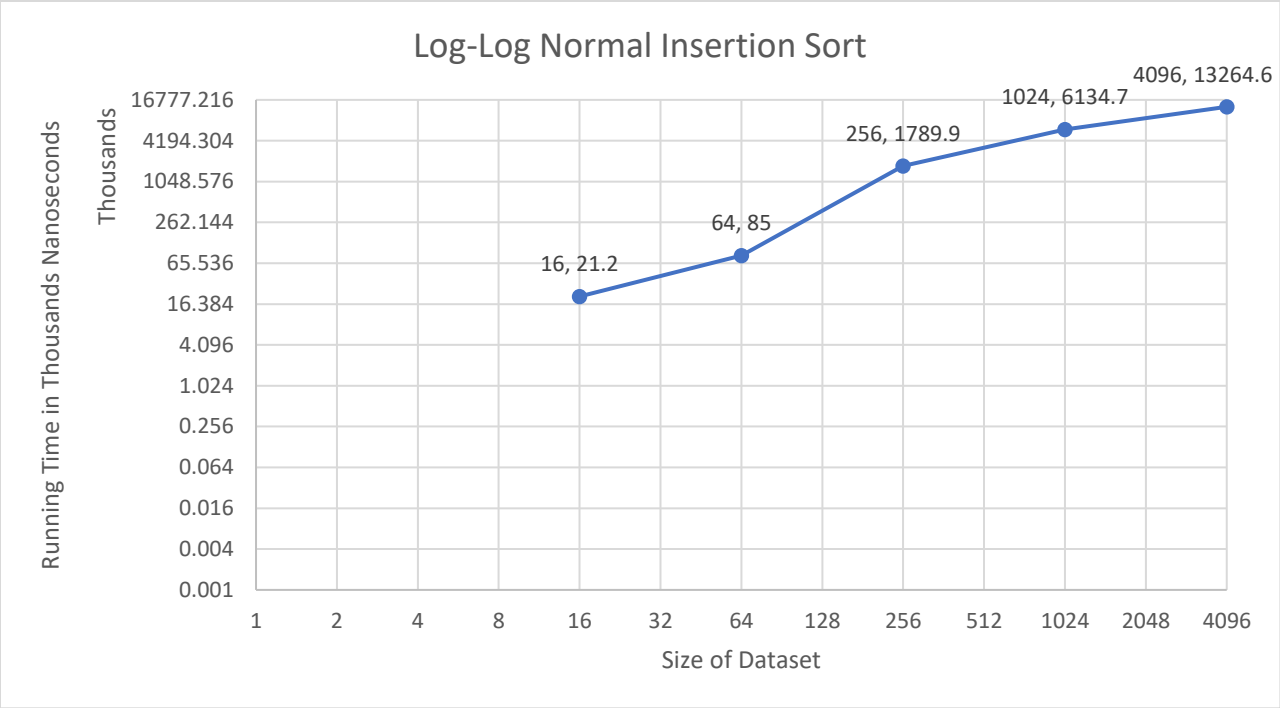
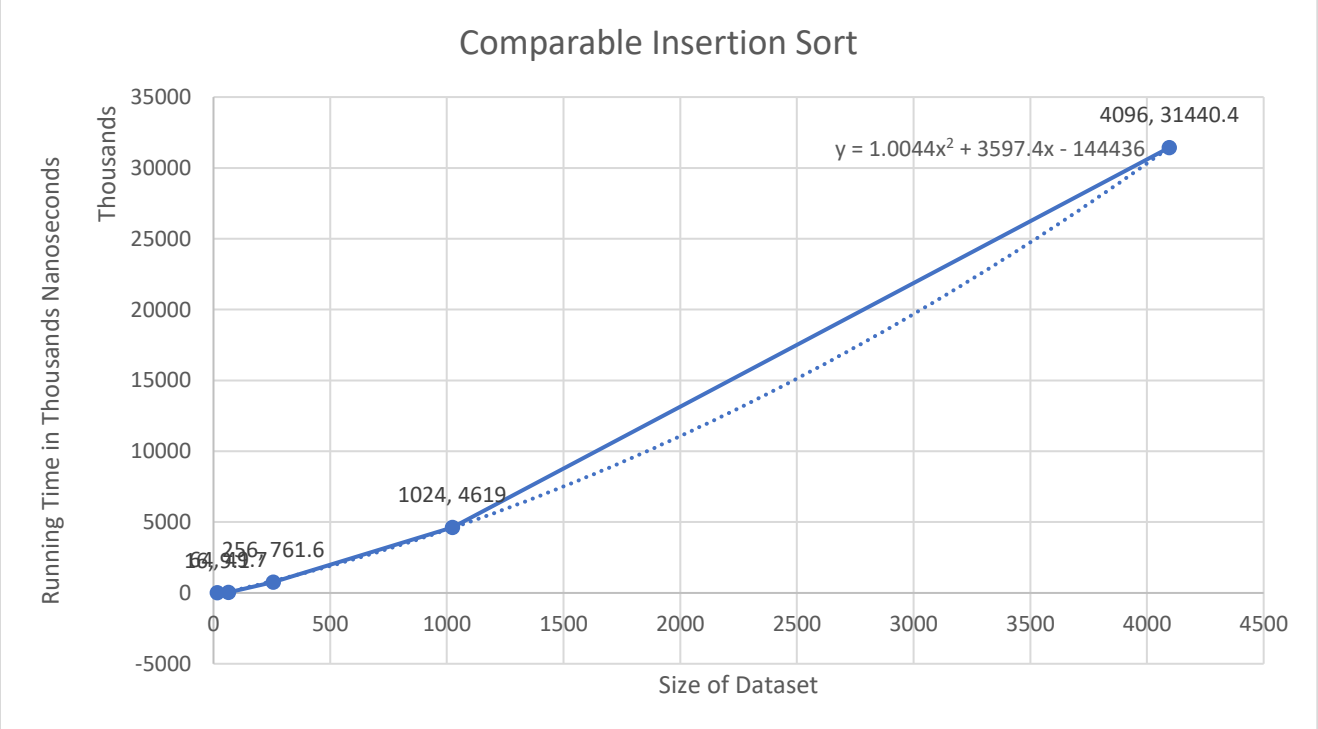


Comparable Insertion Sort:



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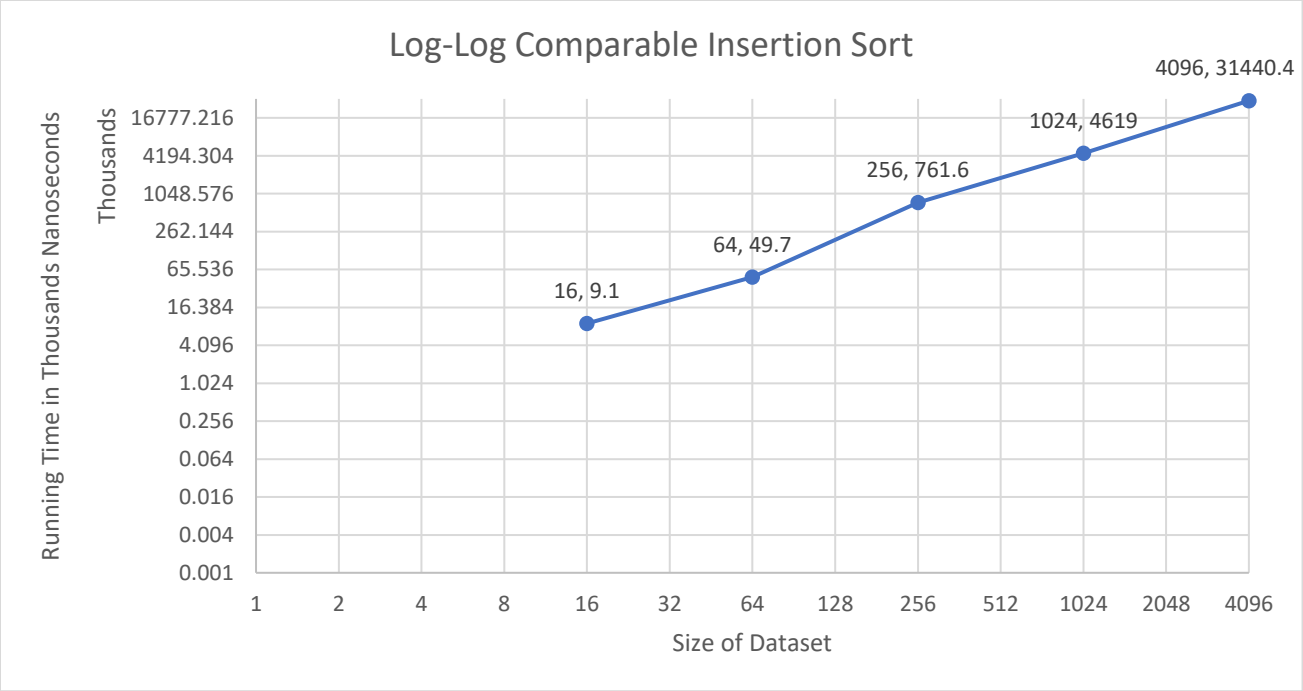
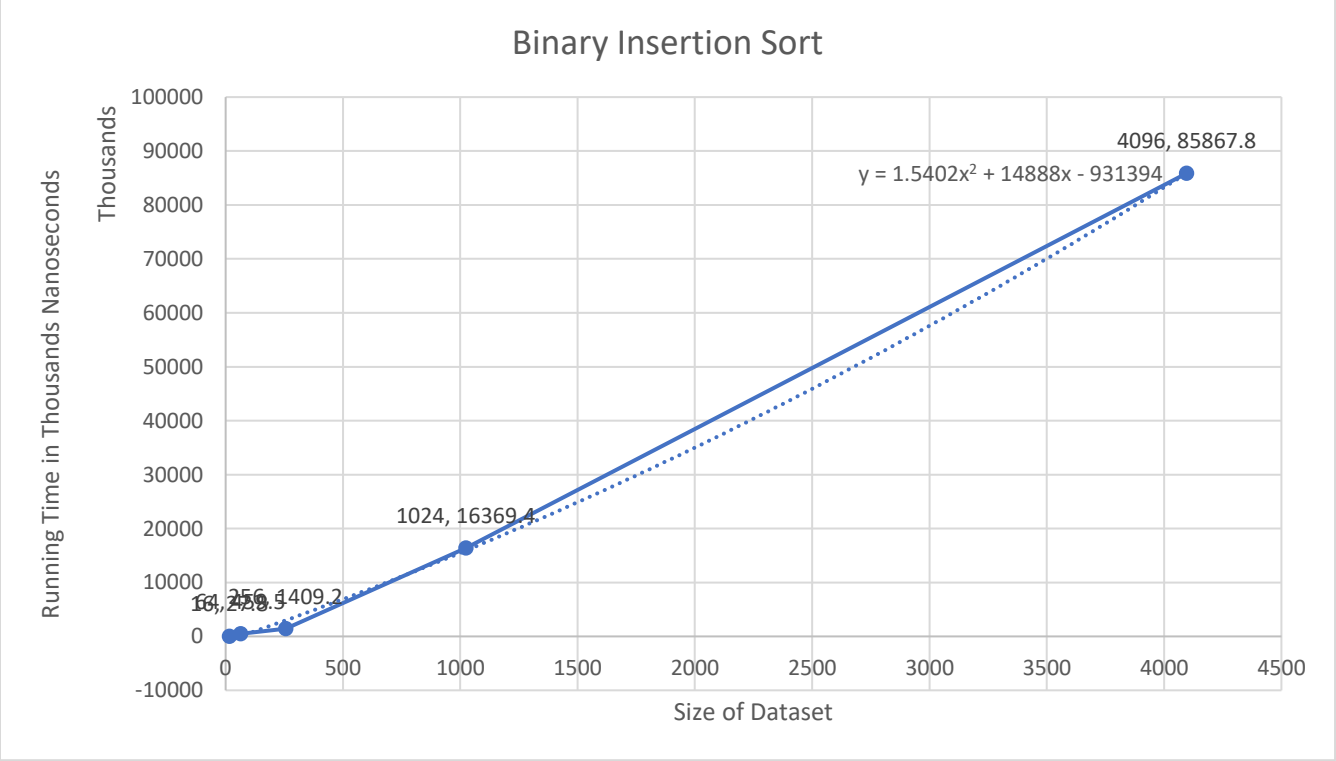


Binary Insertion Sort:



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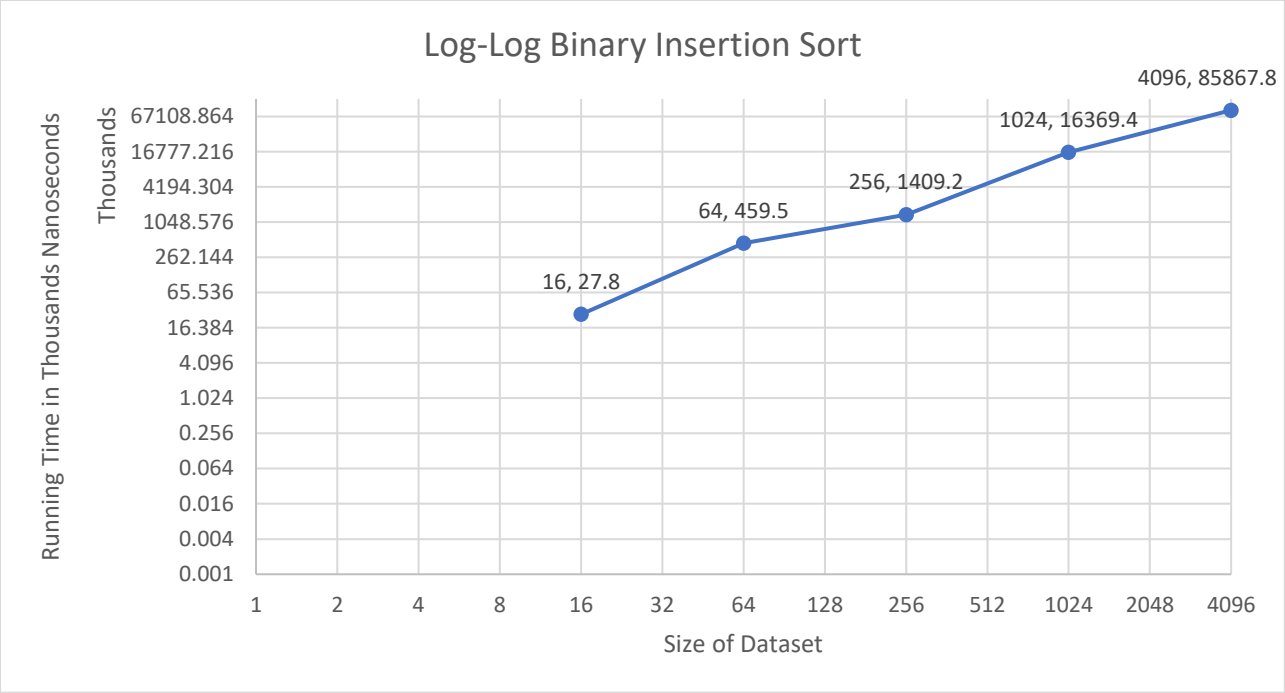
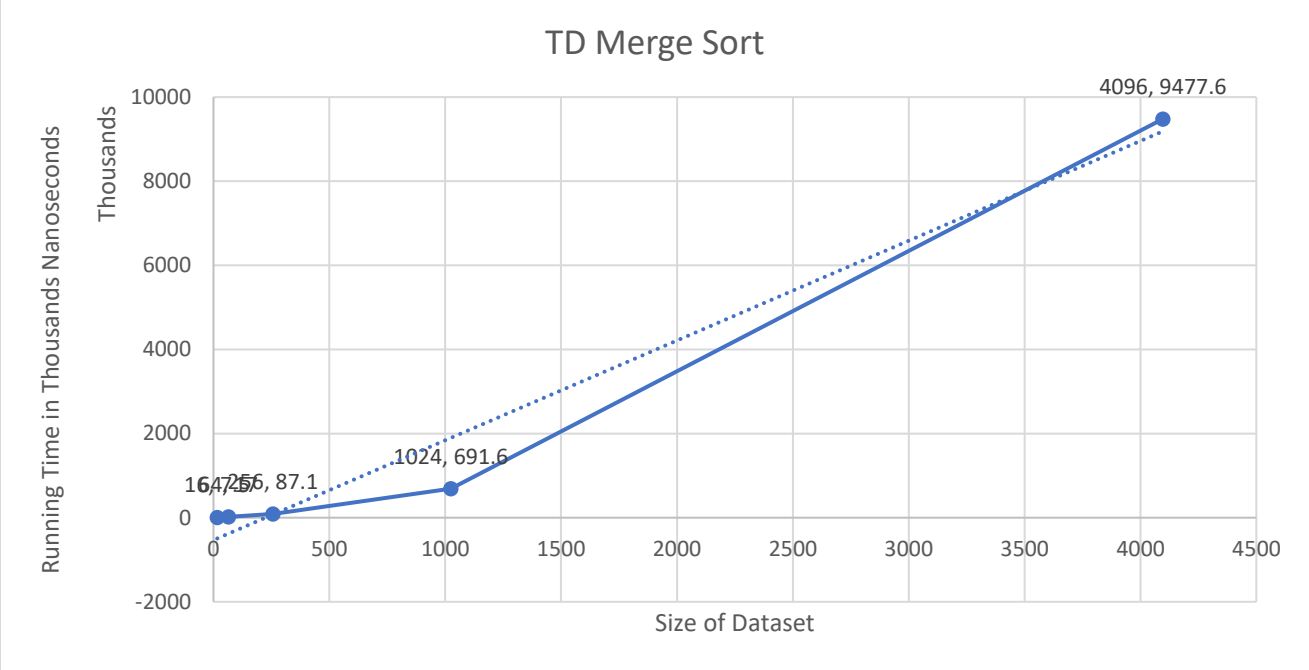


TD Merge Sort:



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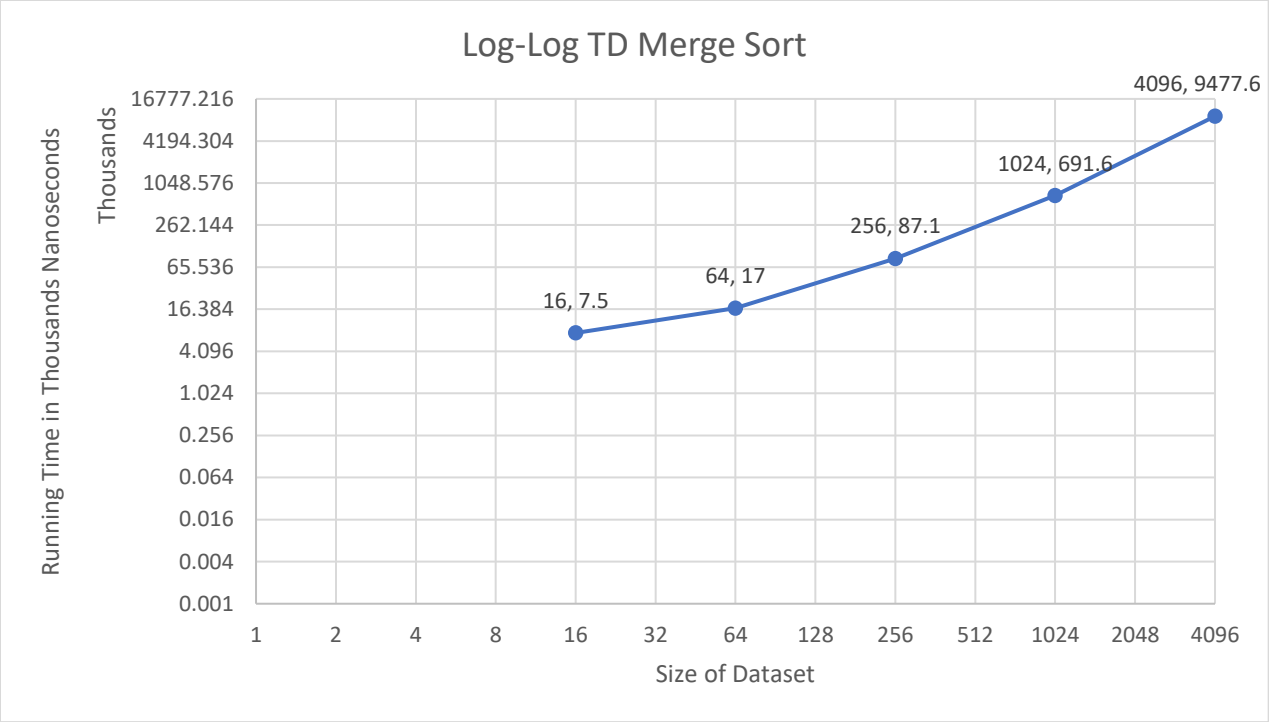
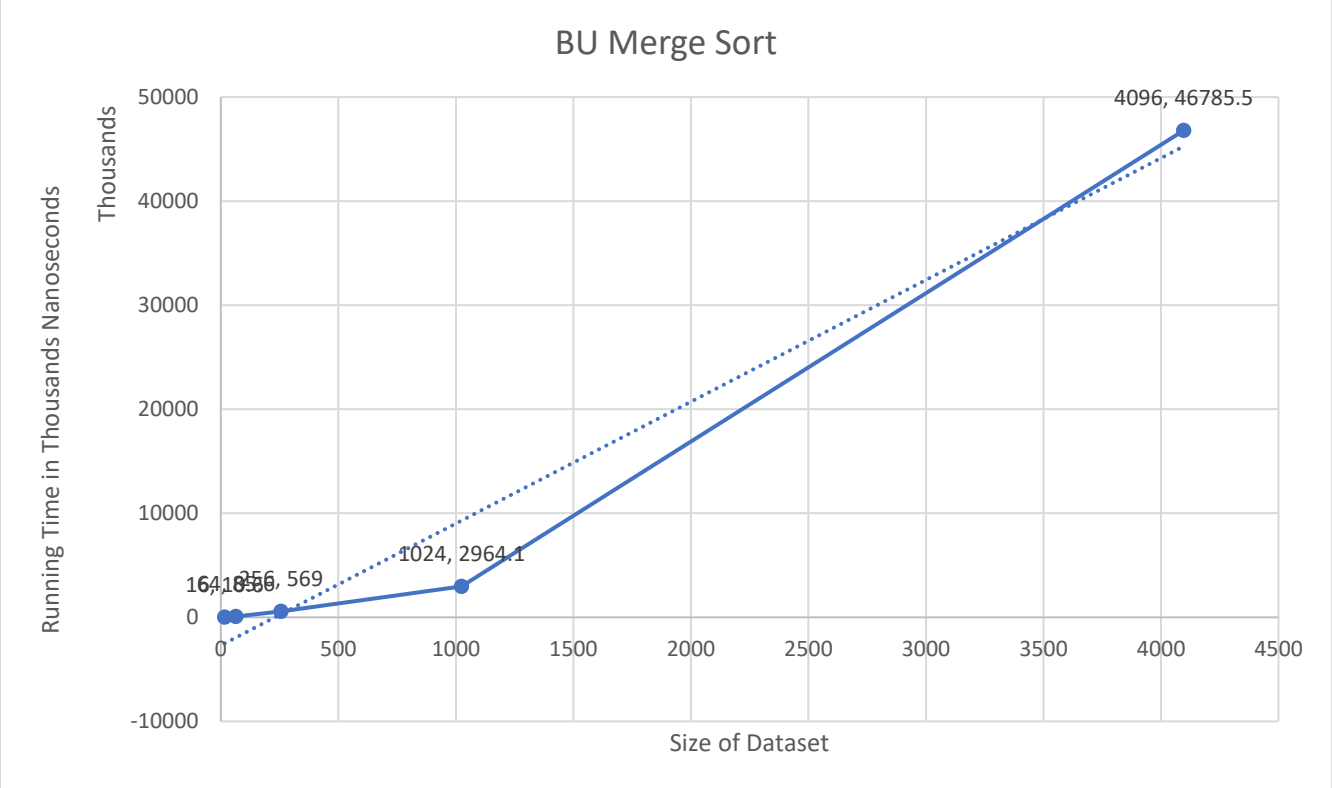


BU Merge Sort:



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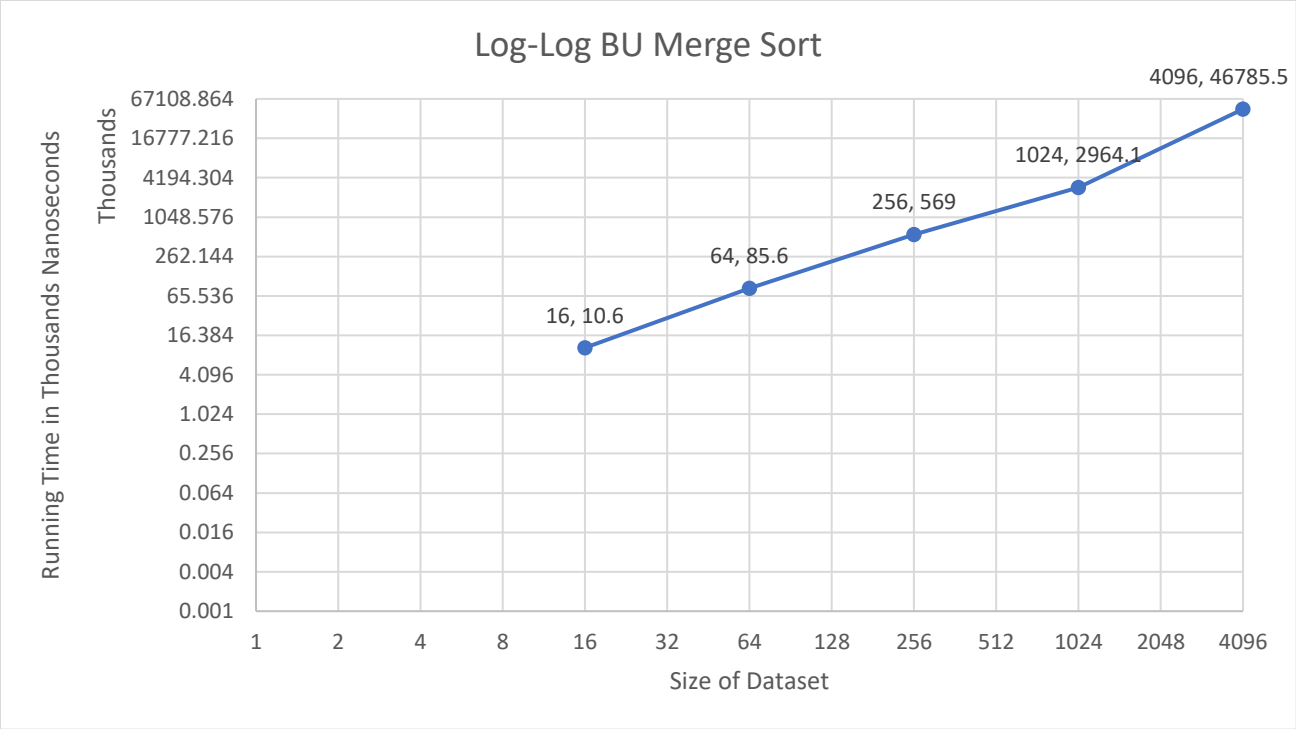
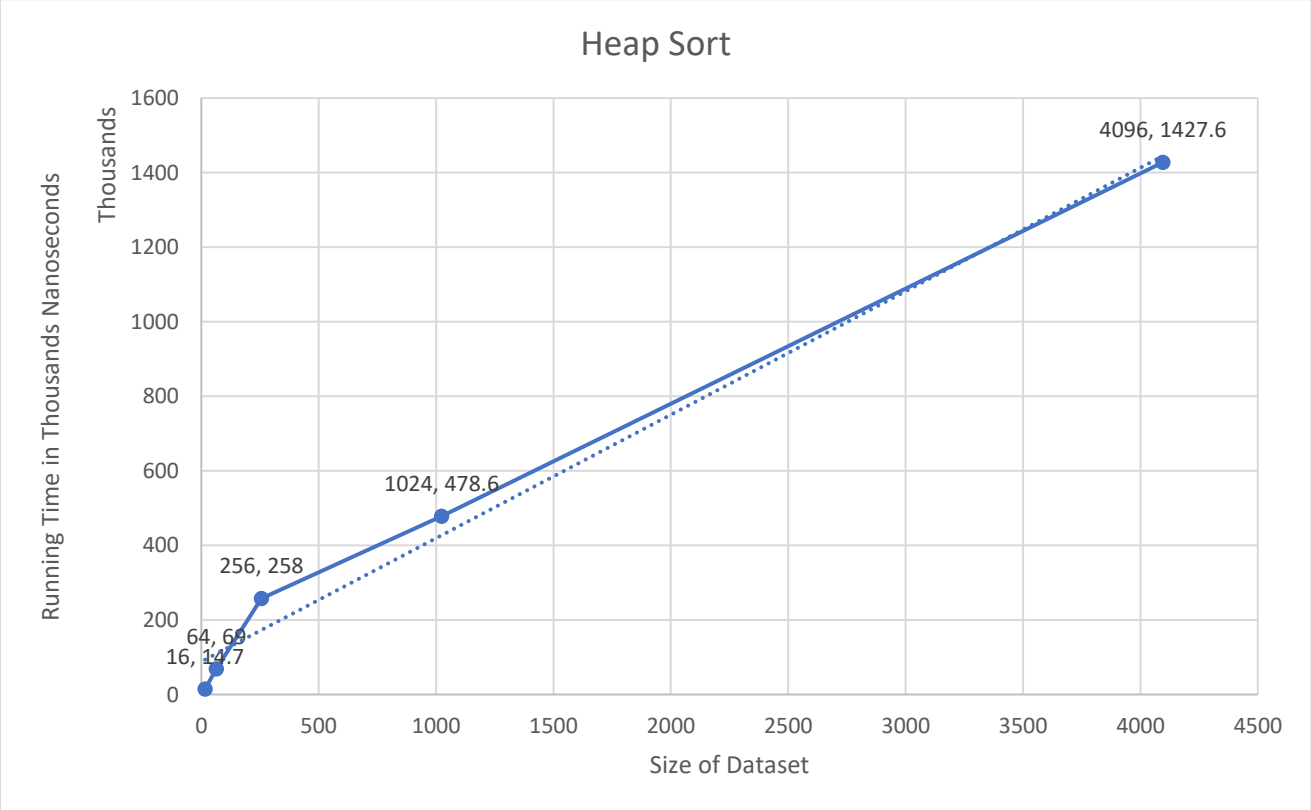


Heap Sort:



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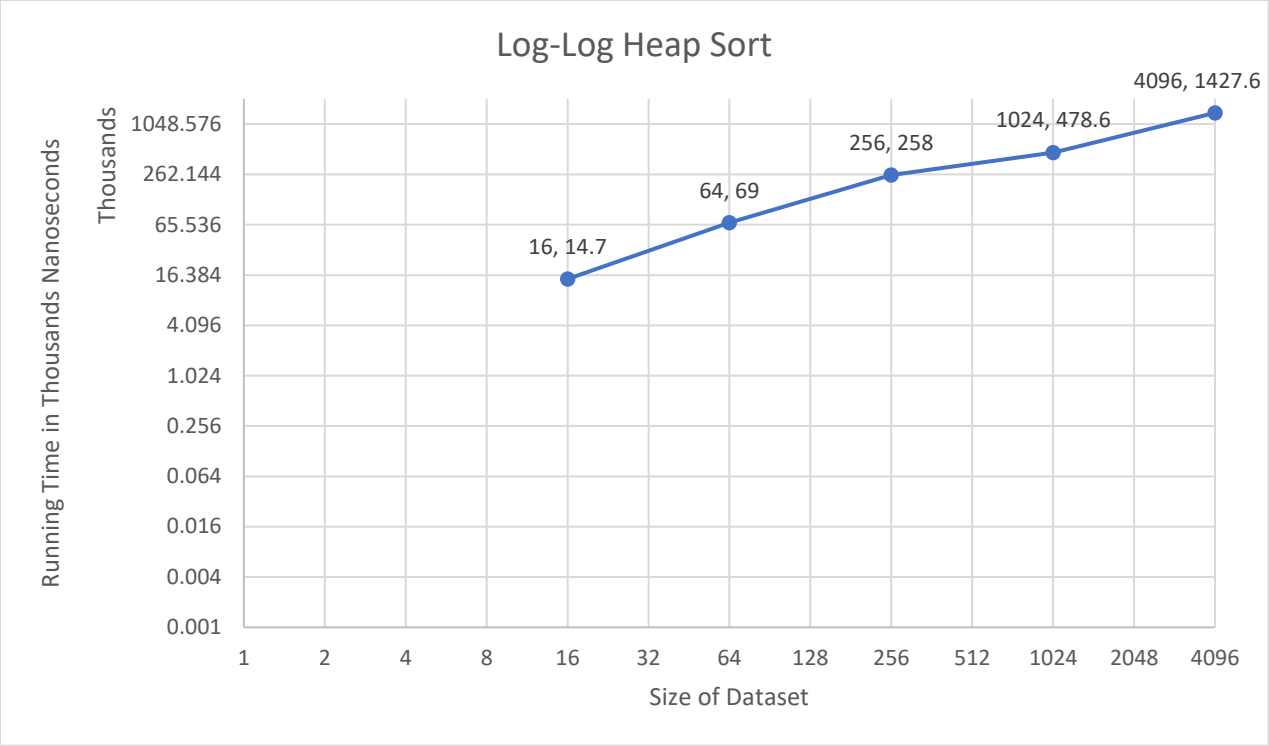
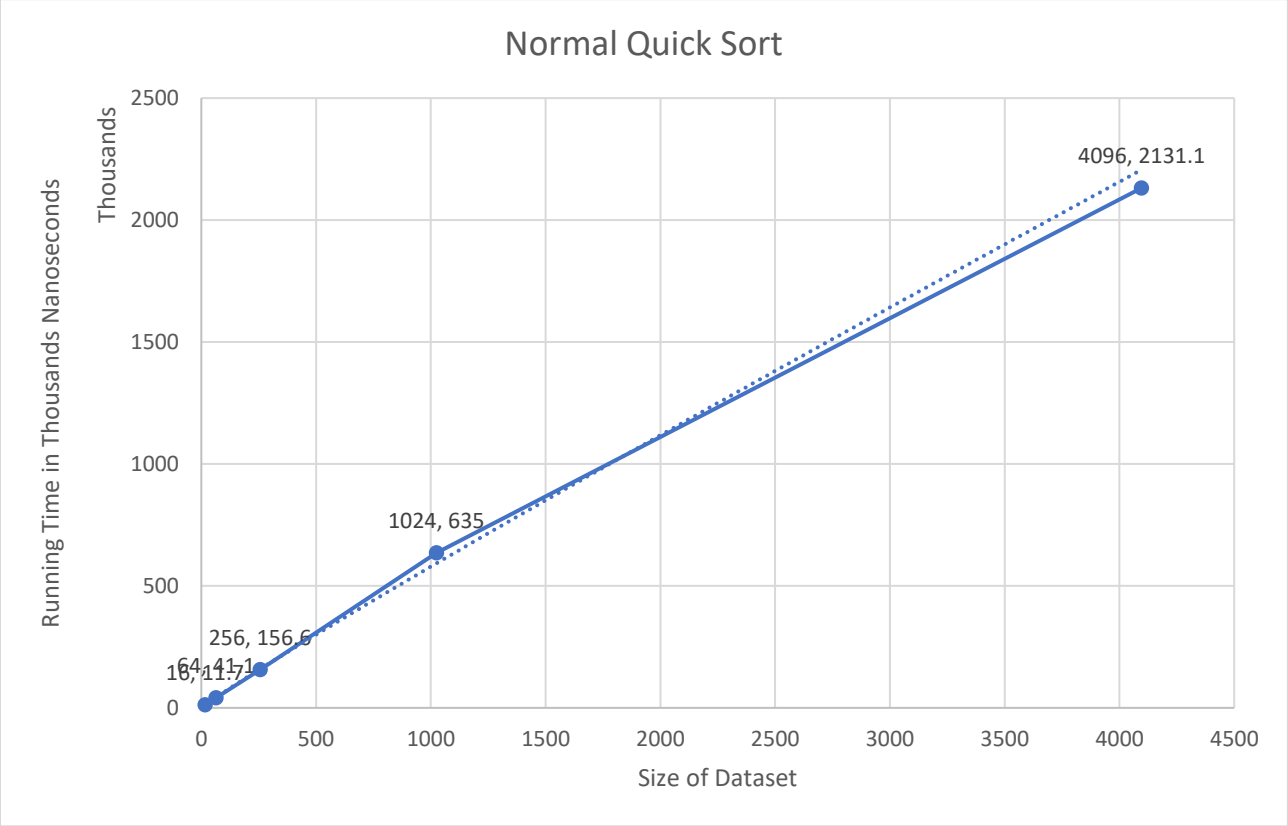


Basic Quick Sort:



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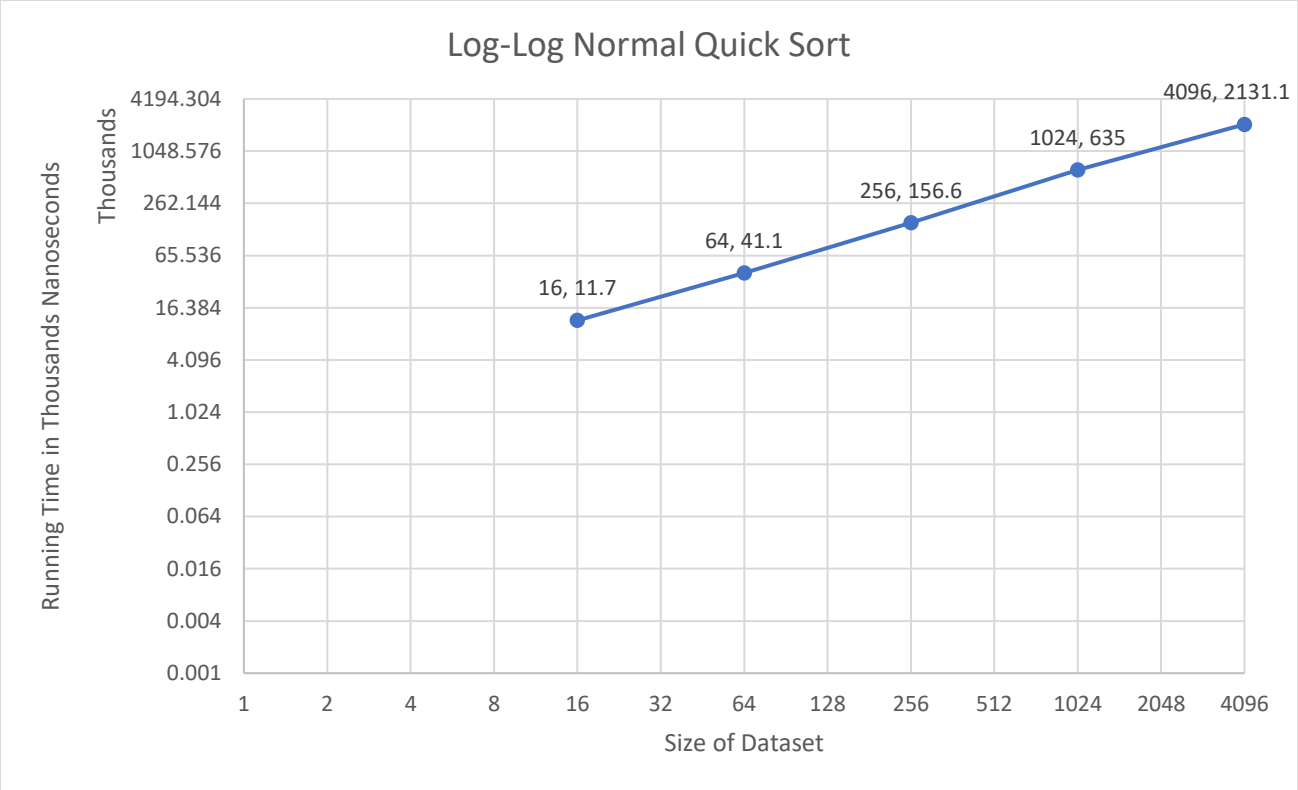
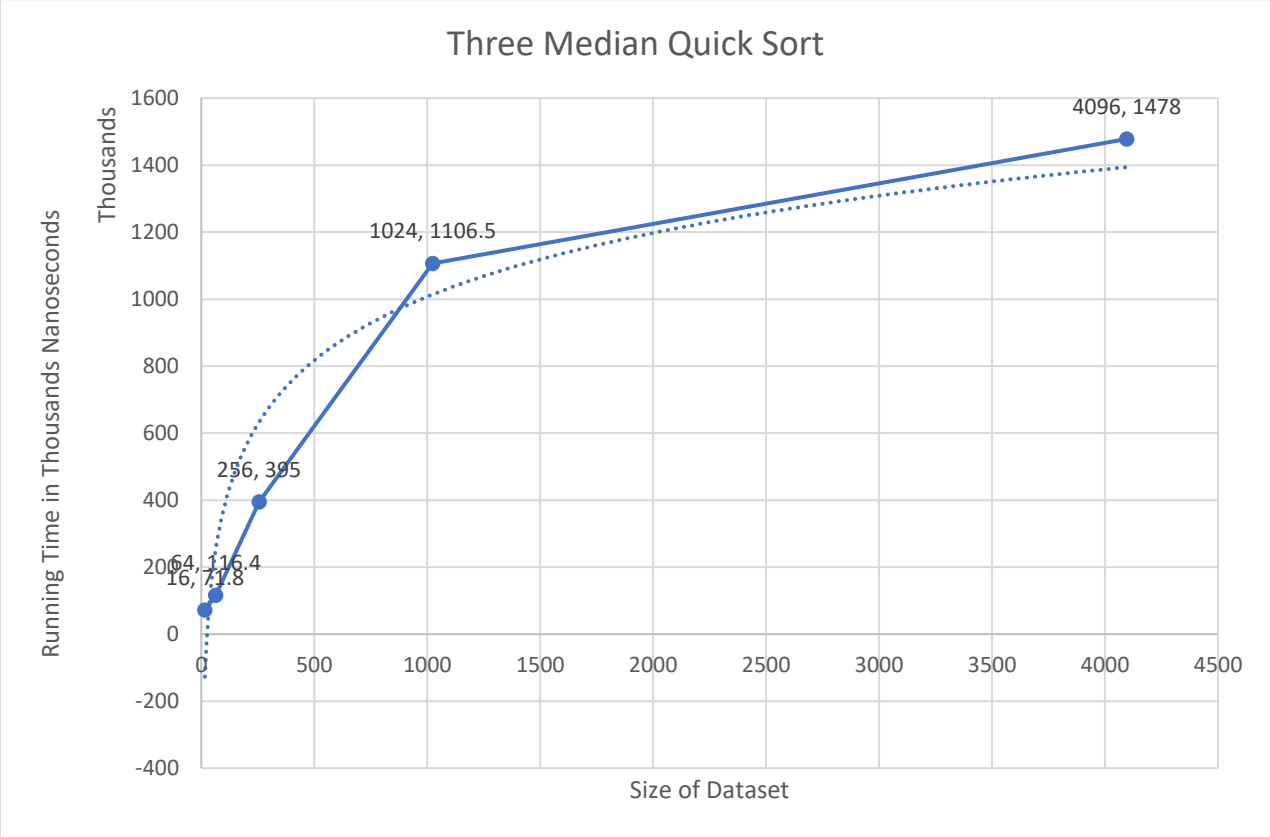
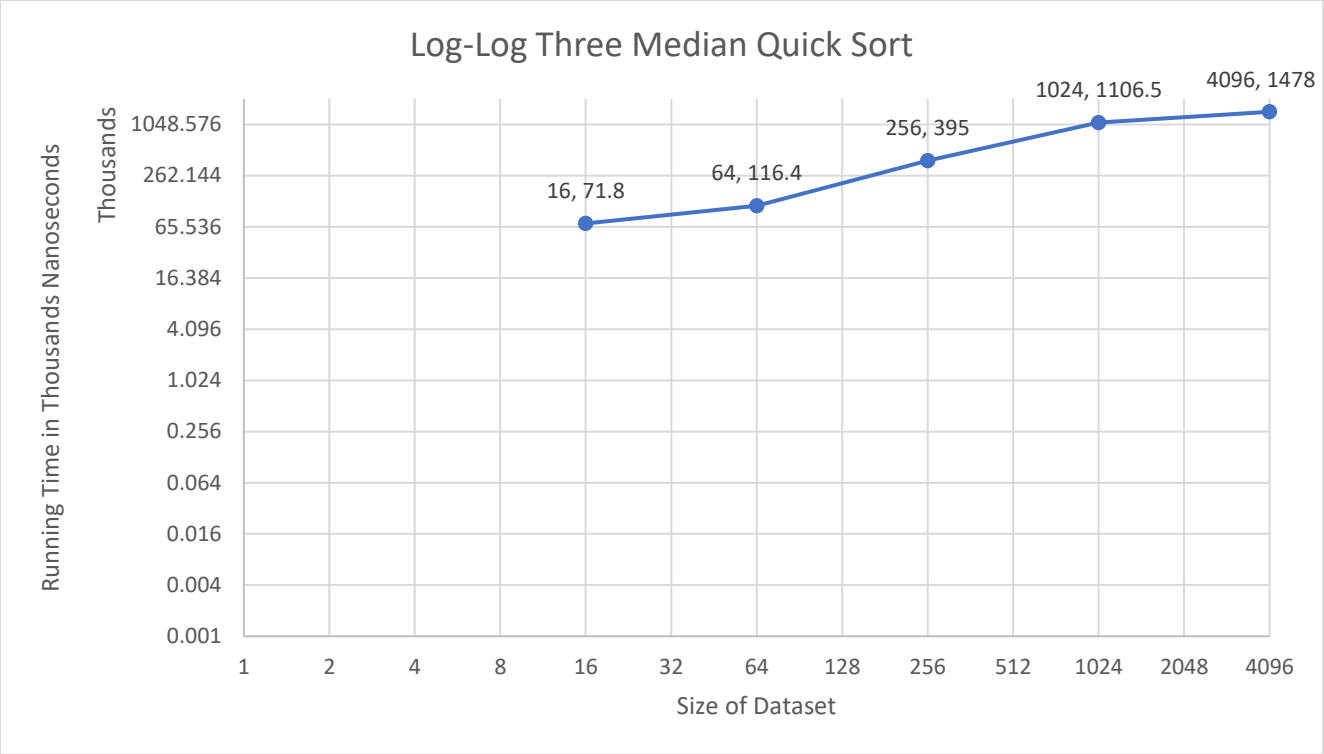


Median of Three Quick Sort:





3.1.2 Running Time of Four Types of Sorting Algorithms

Insertion Sort:

The trend line that best matches the curve of points for the three insertions sort algorithms running time graph is a polynomial of base 2. The equation of the graph shows that the trend of the data points correlates to that of a quadratic. Therefore, the running time complexity of insertion sort is $O(N^2)$.

Merge Sort:

The line graph of the points for both types of merge correspond to a function of equation Nlog(N). Therefore, the running time complexity of merge sort is O(Nlog(N)).

Quick Sort:

The line graph of the points for both types of Quick sort correspond to a function of equation Nlog(N). Therefore, the running time complexity of Quick sort is O(Nlog(N)).

Heap Sort:

The line graph of the points for both types of heap correspond to a function of equation Nlog(N). Therefore, the running time complexity of heap sort is O(Nlog(N)).

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3.1.3 Predicted Execution time for 2^{14} & 2^{16}:

Size of Dataset	PREDICTED Execution Time of Sorting Algorithms (in nanoseconds)							
	Insertion			Merge		Quick		Heap
	Normal	Comparable	Binary	TD	BU	Normal/ Basic	Median Three Partition	Normal
2^{14}	132646100	97319200	731938400	13172930	572147200	45813200	4613700	3627200
2^{16}	1326460900	9832015300	83092946000	3725299000	31824278200	152567200	68213300	53278200

3.1.4 Running Time on array sizes 2^{14} & 2^{16}:

Size of Dataset	Execution Time of Sorting Algorithms (in nanoseconds)							
	Insertion			Merge		Quick		Heap
	Normal	Comparable	Binary	TD	BU	Normal/ Basic	Median Three Partition	Normal
2^{14}	1571460600	493304300	1650140300	301912900	328316800	10274400	8302300	8969500
2^{16}	28396546700	16684189900	31359960900	28897596300	12315396700	21291600	86323800	31695300