Program Structures and Algorithms
Spring 2023(SEC –8)
Assignment 6

NAME: Krishnna Sarrdah

NUID: 002771329

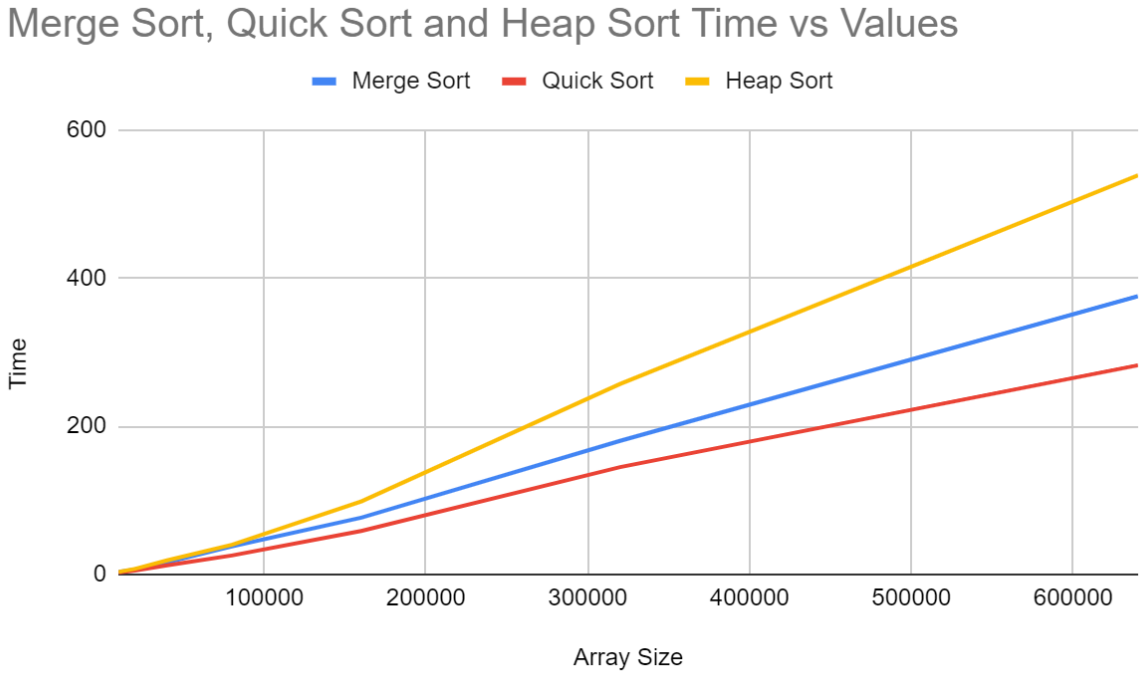
Task:

To determine--for sorting algorithms--what is the best predictor of total execution time: comparisons, swaps/copies, hits (array accesses), or something else.

Graphical Representation:

Raw Time Comparison for Merge, Quick and Heap sort using array sizes 10k, 20k, 40k, 80k, 160k, 320k, 640k;

Values	Merge Sort	Quick Sort	Heap Sort
10000	3.38	2.43	3.36
20000	6.74	5.21	7.4
40000	16.36	12.21	19.04
80000	37.79	25.54	39.94
160000	76.72	58.72	98.41
320000	180.32	144.84	257.05
640000	375.56	282.33	538.67


Merge Sort, Quick Sort and Heap Sort Time vs Values
Merge Sort
Quick Sort
Heap Sort
600
400
200
0
Time
100000
200000
300000
400000
500000
600000
Array Size

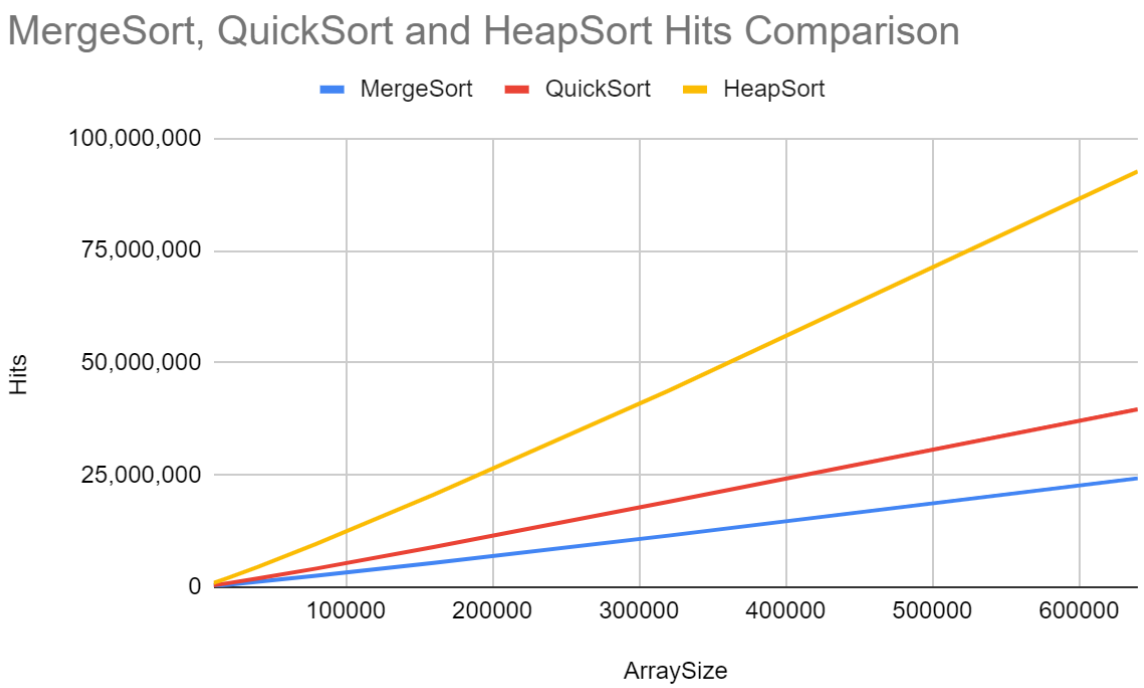
Merge sort Array Size	Raw Time	Hits	Swaps	Compares
10000	3.38	259,042	9761	121503
20000	6.74	558079	19520	263003
40000	16.36	1196150	39037	566000
80000	37.79	2552243	78061	1211991
160000	76.72	5424406	156101	2584007
320000	180.32	11488999	312250	5488054
640000	375.56	24257726	624432	11616125

Quick sort Array Size	Raw Time	Hits	Swaps	Compares
10000	2.43	417,381	66540	155918
20000	5.21	901631	142489	340550
40000	12.21	1949902	308793	733397
80000	25.54	4156225	654778	1572033
160000	58.72	8940447	1408508	3380649
320000	144.84	19010228	2980453	7226468
640000	282.33	39641318	6148609	15280293

Heap sort Array Size	Raw Time	Hits	Swaps	Compares
10000	3.36	967,556	124203	235371
20000	7.4	2095056	268396	510736
40000	19.04	4510166	576797	1101488
80000	39.94	9660290	1233593	2362959
160000	98.41	20600863	2627215	5046001
320000	257.05	43761478	5574414	10731911
640000	538.67	92643134	11788848	22743871

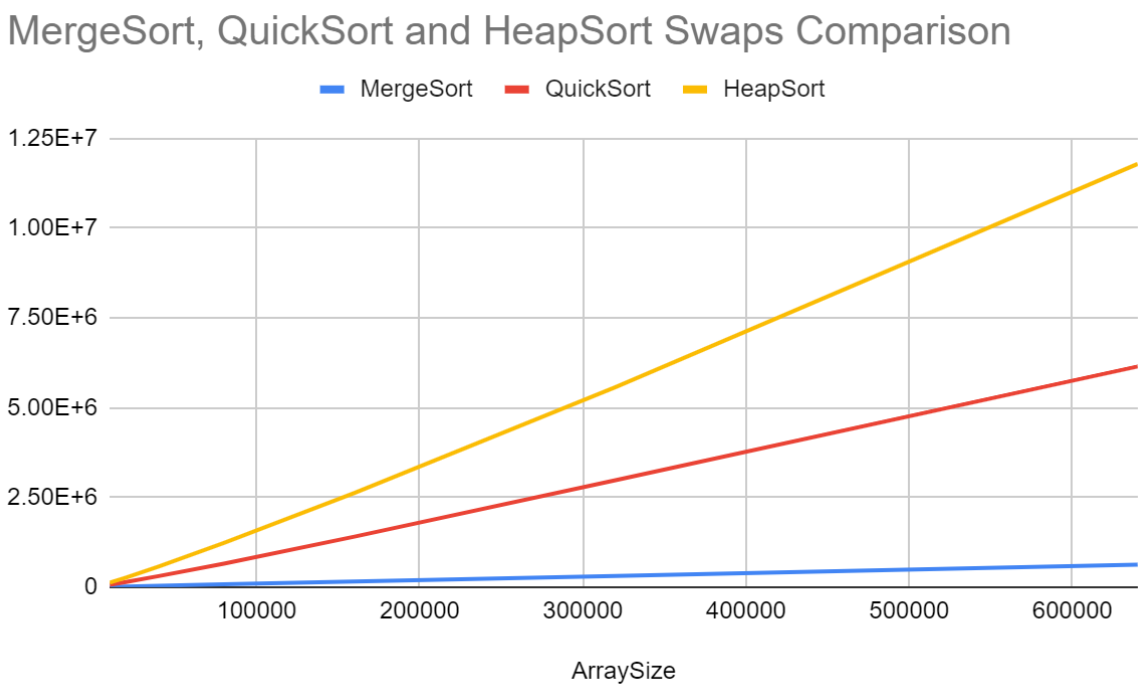
Hits Comparison for the three algorithms:

Hits Comparison			
ArraySize	MergeSort	QuickSort	HeapSort
10000	259,042	417,381	967,556
20000	558079	901631	2095056
40000	1196150	1949902	4510166
80000	2552243	4156225	9660290
160000	5424406	8940447	20600863
320000	11488999	19010228	43761478
640000	24257726	39641318	92643134



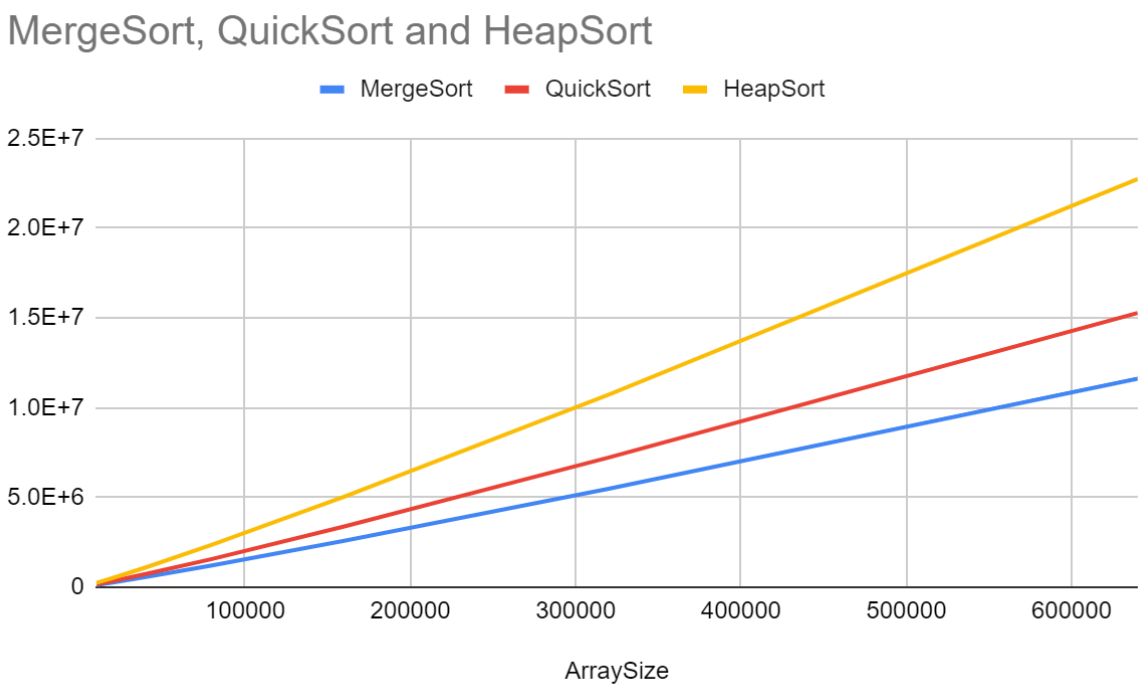
Swaps Comparison:

Swaps Comparison			
ArraySize	MergeSort	QuickSort	HeapSort
10000	9761	66540	124203
20000	19520	142489	268396
40000	39037	308793	576797
80000	78061	654778	1233593
160000	156101	1408508	2627215
320000	312250	2980453	5574414
640000	624432	6148609	11788848

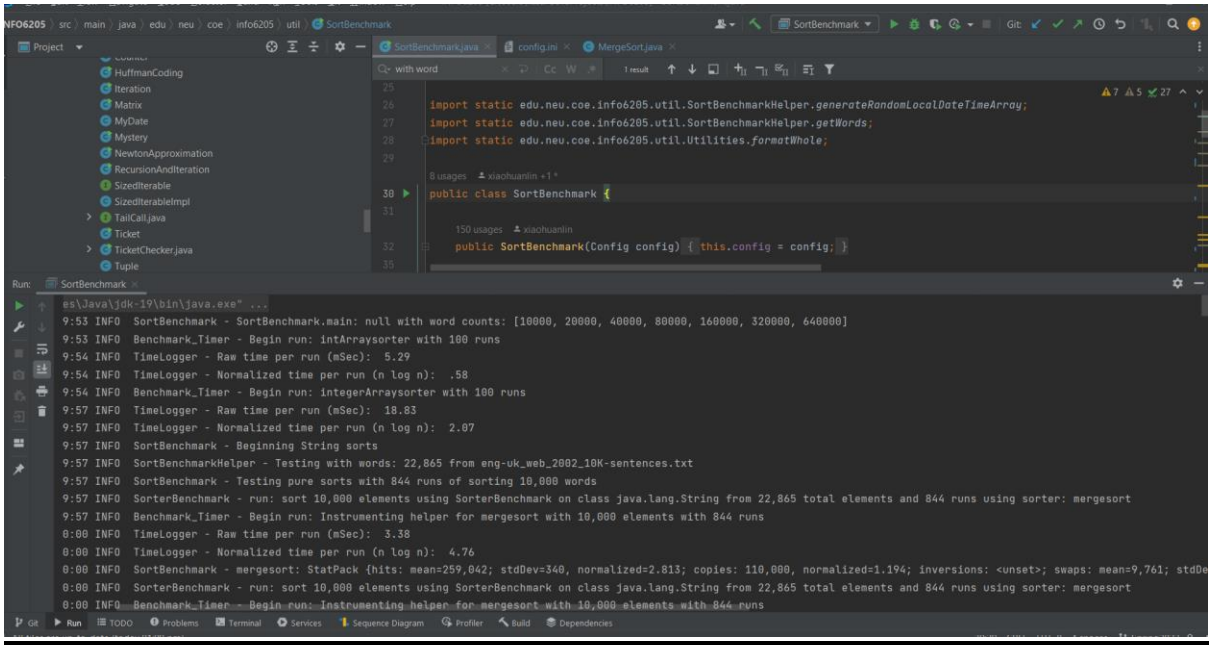


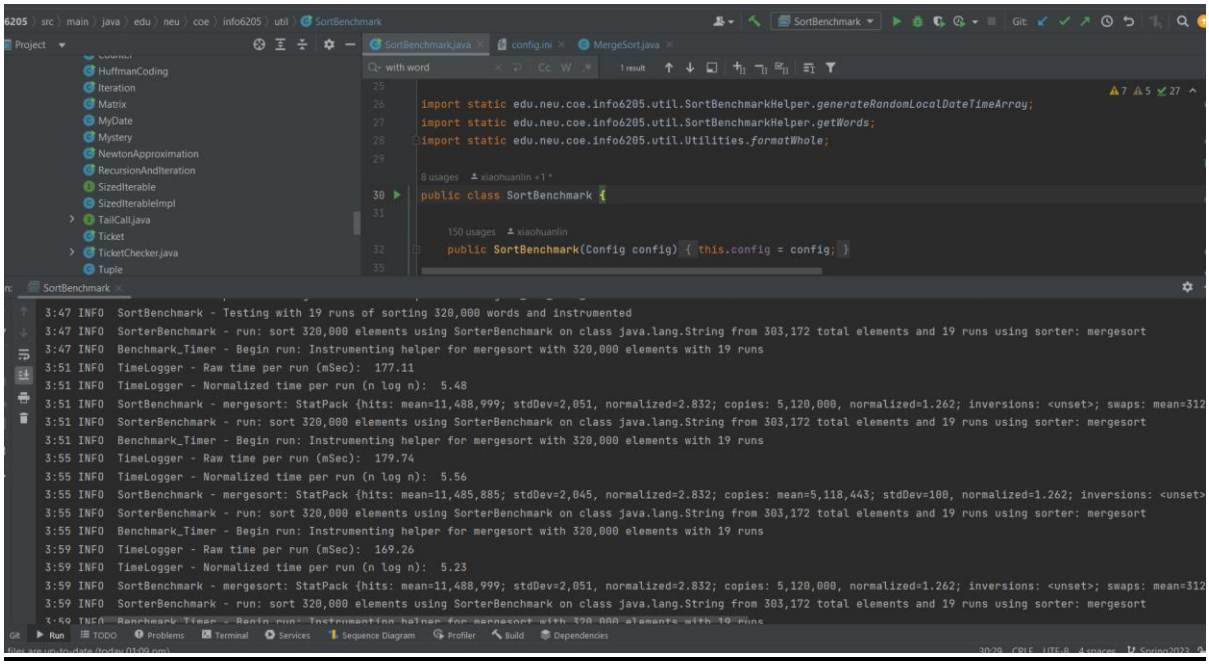
Compares Comparison:

Compares Comparison			
ArraySize	MergeSort	QuickSort	HeapSort
10000	121503	155918	235371
20000	263003	340550	510736
40000	566000	733397	1101488
80000	1211991	1572033	2362959
160000	2584007	3380649	5046001
320000	5488054	7226468	10731911
640000	11616125	15280293	22743871



Execution Screenshots:





Conclusion:

The performance of sorting algorithms can be evaluated based on different factors such as comparisons, swaps/copies, and array hits. Quick sort relies heavily on comparisons and swaps/copies, heap sort requires a large number of swaps/copies, while merge sort does not involve swaps or copies. Array hits can be a fair technique to compare algorithms, where a higher number of hits implies worse performance. Therefore, the best time predictor, in this case, would be hits.