Program Structures and Algorithms
Spring 2024

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GITHUB LINK: https://github.com/gauthamkris7neu/INFO6205Assignment

Task:

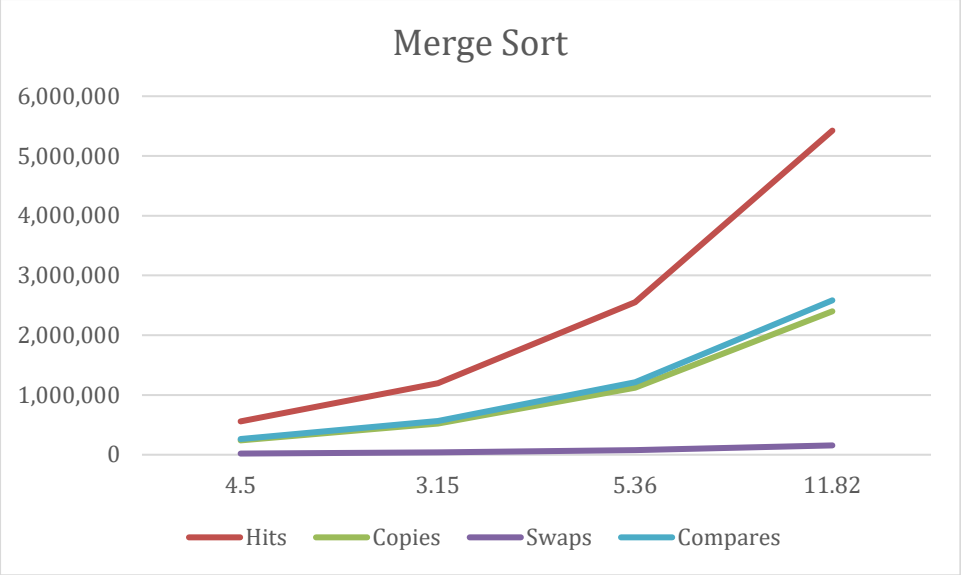
Assignment 6 : Determine for sorting algorithms , What is the best predictor of total execution time: comparisons, swaps/copies, hits (array accesses), memory used, or some combination of these.

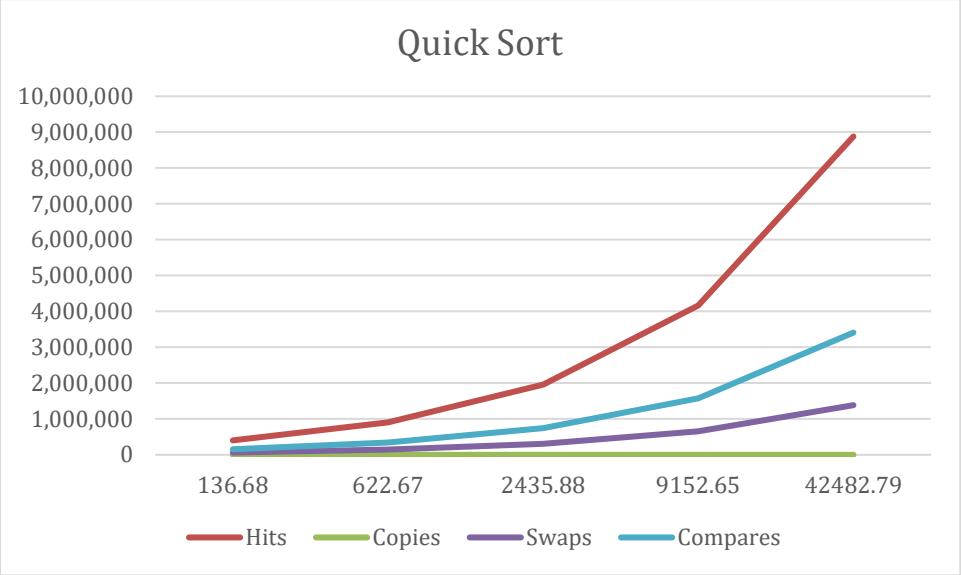
Relationship Conclusion:

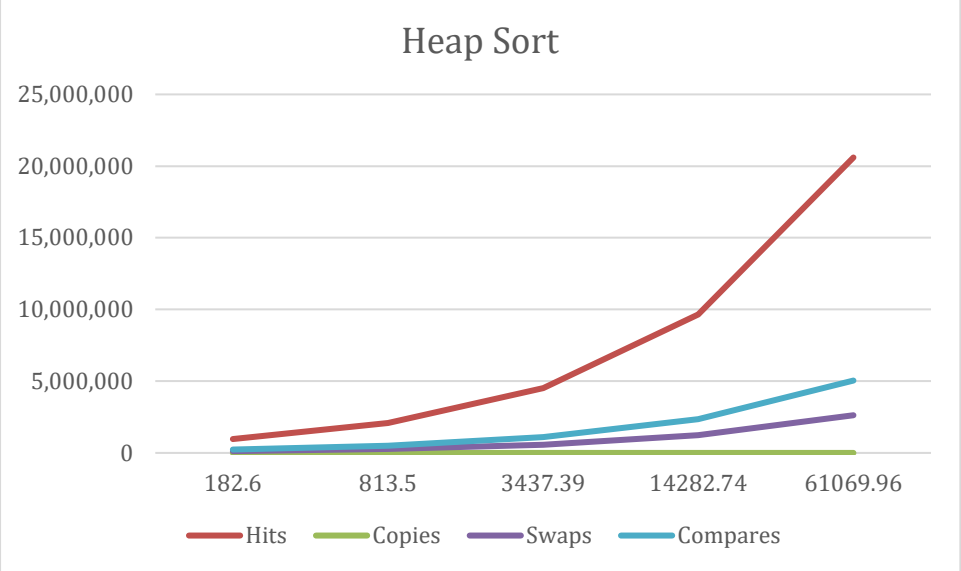
When we do a regression analysis with the below data it reveals a high coefficient of determination (R^2) value of approximately 0.961, suggesting a strong relationship between the chosen metrics and the instrumented run time of sorting algorithms. Specifically, 'Hits' (array accesses) have the most significant positive correlation with run time, indicating they are a strong predictor of performance. 'Copies' and 'Swaps' have a negative correlation with run time. 'Compares' also show a positive correlation, but to lesser extent than 'Hits.' Overall, while 'Hits' seem to be the best single predictor, the combination of all the metrics provides a robust prediction of the sorting algorithms execution time.

Evidence to support that conclusion:

Sorting Algorithm	Array Size	Instrumented Run Time(mSec)	Hits	Copies	Swaps	Compares	Run Time(mSec)
Merge Sort	10000	4.5	259,064	110,000	9,766	121,508	4
	20000	3.15	558,078	240,000	19,520	262,982	3
	40000	5.36	1,196,508	520,000	39,127	566,038	5.45
	80000	11.82	2,552,116	1,120,000	78,029	1,211,946	13.19
	160000	28.53	5,424,472	2,400,000	156,118	2,583,975	28.4
Quick Sort Dual Pivot	10000	136.68	403,231	0	63,224	154,723	2
	20000	622.67	902,065	0	142,565	340,465	3.64
	40000	2435.88	1,958,361	0	307,241	746,867	3.87
	80000	9152.65	4,160,868	0	655,659	1,572,976	7.19
	160000	42482.79	8,879,390	0	1,384,792	3,409,662	18.62
Heap Sort	10000	182.6	967,353	0	124,178	235,320	1
	20000	813.5	2,095,179	0	268,410	510,769	2.52
	40000	3437.39	4,510,220	0	576,811	1,101,488	5.59
	80000	14282.74	9,660,877	0	1,233,683	2,363,073	12.83
	160000	61069.96	20,599,917	0	2,627,058	5,045,842	30.12


Merge Sort
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
4.5
3.15
5.36
11.82
Hits
Copies
Swaps
Compares


Quick Sort
10,000,000
9,000,000
8,000,000
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
136.68
622.67
2435.88
9152.65
42482.79
Hits
Copies
Swaps
Compares


Heap Sort
25,000,000
20,000,000
15,000,000
10,000,000
5,000,000
0
182.6
813.5
3437.39
14282.74
61069.96
Hits
Copies
Swaps
Compares

Unit Test Screenshots: