Program Structures and Algorithms

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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 |

**Unit Test Screenshots:**





