

Assignment 6 (Hits as time predictor)

Problem Description: Determine the best predictor for total execution time.

1. MergeSort (Array Copy with No insurance)

In MergeSort, compares and copies are the best predictors for the execution time. The slope for compares and copy operations is 1.1 and the slope for the time is 1.16, making them the best predictors for the execution time.

Size	Time	Normalized Time	Hits	Copies	Swaps	Compares
16000	3.47	2.89	434,695	189,312	14,018	204,954
32000	8.22	3.17	933,448	410,624	28,050	441,917
64000	18.40	3.30	1,994,887	885,248	56,098	947,829
128000	40.46	3.39	4,245,379	1,898,496	112,097	2,023,575
256000	86.81	3.42	9,002,965	4,052,992	224,245	4,303,164

Table 1: The table shows the Time (ms), Normalized time (msec), Hits, Copies, Swaps, and Compares completed for MergeSort for various sized inputs

Time, Hits, Copies, Swaps and Compares in MergeSort

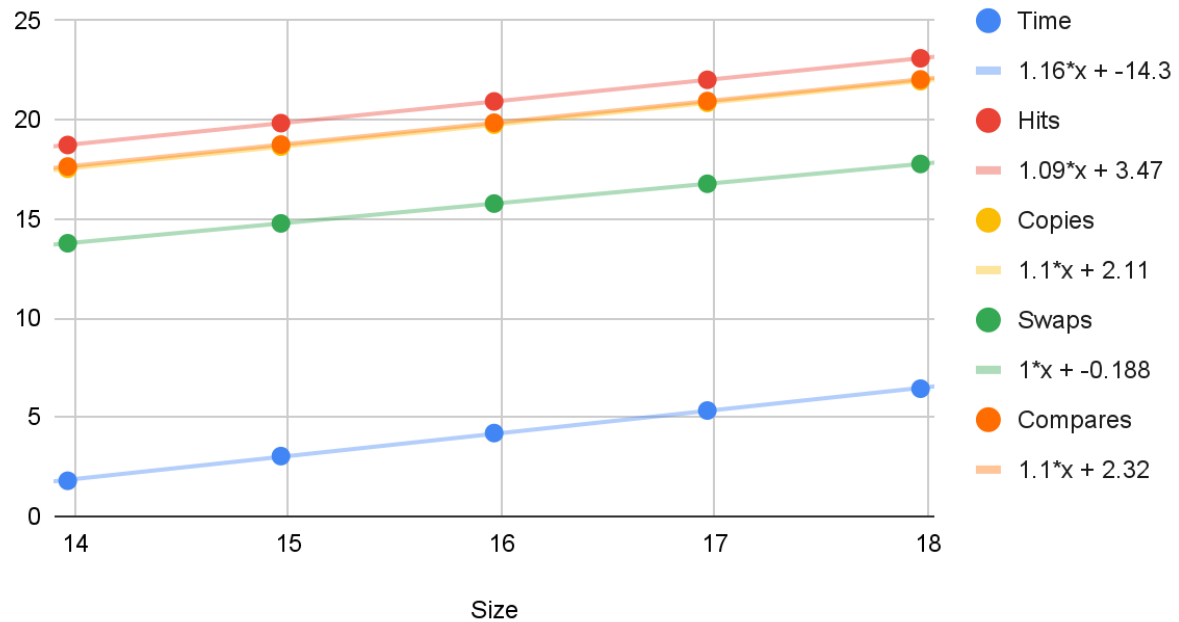


Figure 1: The chart shows the log/log scatter plot for all predictors in MergeSort

2. QuickSort

In QuickSort, the slope of all predictors, is approximately equal. As per the data collected, the slope of the log/log chart for time is 1.18 and the slope for all predictors is 1.1. Thus, no single predictor is best.

Size	Time	Normalized Time	Hits	Swaps	Compares
16000	2.70	3.25	702,512	111,160	265,136
32000	6.71	2.59	1,532,359	242,542	577,337
64000	14.63	2.62	3,275,204	516,193	1,239,156
128000	35.07	2.94	6,950,028	1,099,427	2,612,587
256000	70.71	2.79	14,835,902	2,336,032	5,605,731

Table 1: The table shows the Time (ms), Normalized time (msec), Hits, Copies, Swaps, and Compares completed for QuickSort for various sized inputs.

Time, Hits, Swaps and Compares

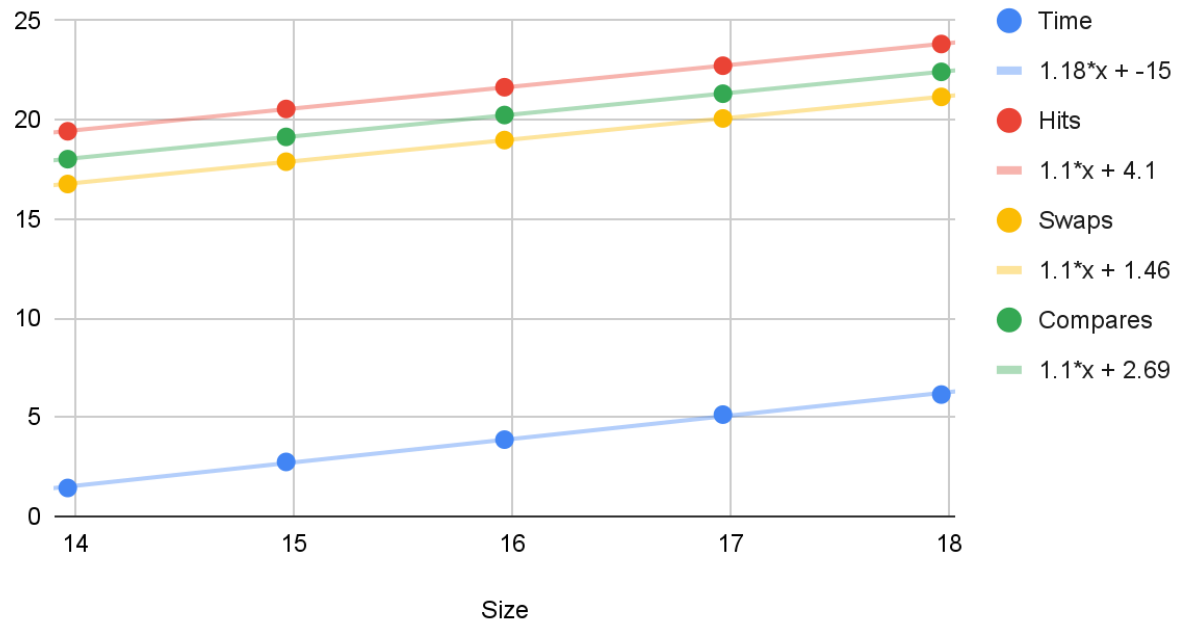


Figure 2: The chart shows the log/log scatter plot for all predictors in QuickSort

3. HeapSort

In HeapSort, the slope of all predictors, is approximately equal. As per the data collected, the slope of the log/log chart for time is 1.19 and the slope for all predictors is 1.1. Thus, no single predictor is best.

Size	Time	Normalized Time	Hits	Swaps	Compares
16000	4.12	3.43	1,632,290	209,248	397,650
32000	9.55	3.68	3,520,651	450,507	859,312
64000	21.01	3.77	7,553,205	964,997	1,846,608
128000	51.39	4.31	16,129,884	2,057,911	3,949,120

256000	110.00	4.33	34,308,651	4,371,964	8,410,397
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Table 3: The table shows the Time (ms), Normalized time (msec), Hits, Copies, Swaps, and Compares completed for HeapSort for various sized inputs.

Time, Hits, Swaps and Compares in HeapSort

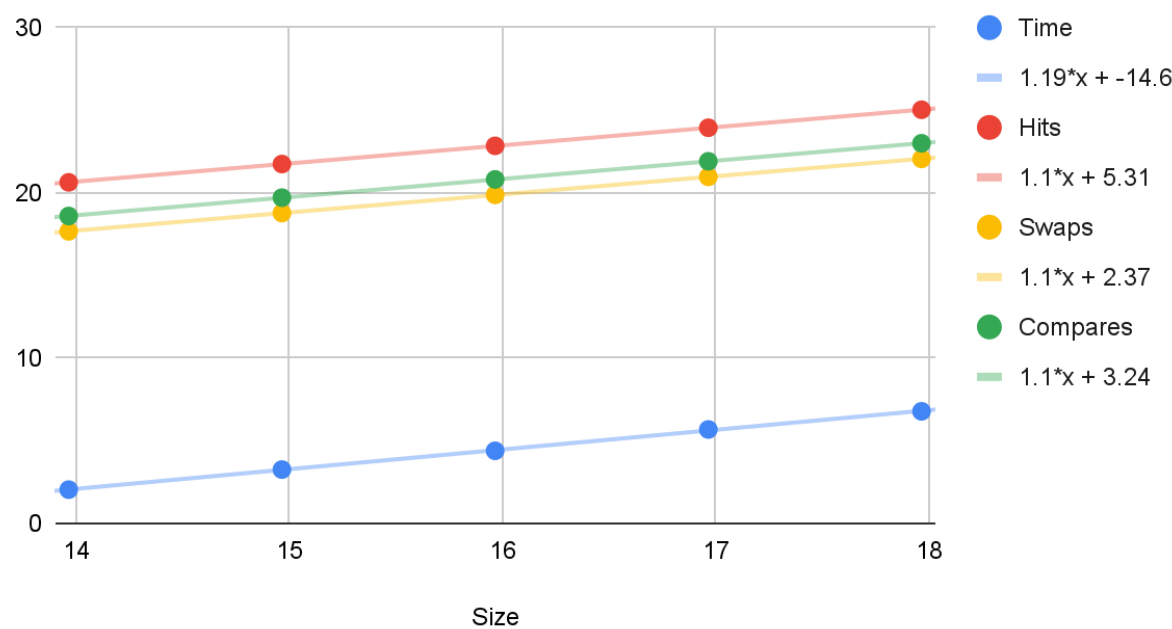
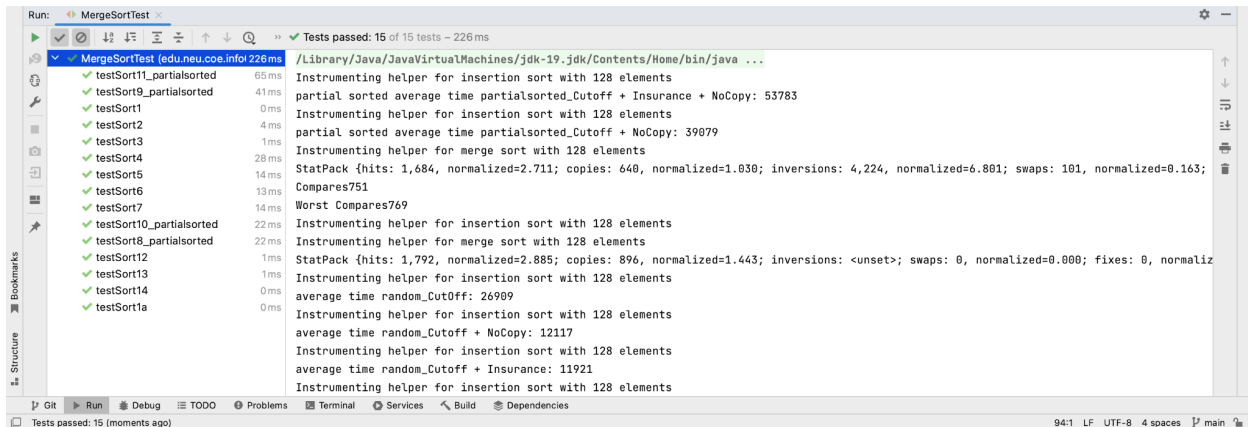


Figure 3: The chart shows the log/log scatter plot for all predictors in HeapSort

Code Snippets

1. MergeSortTest.java

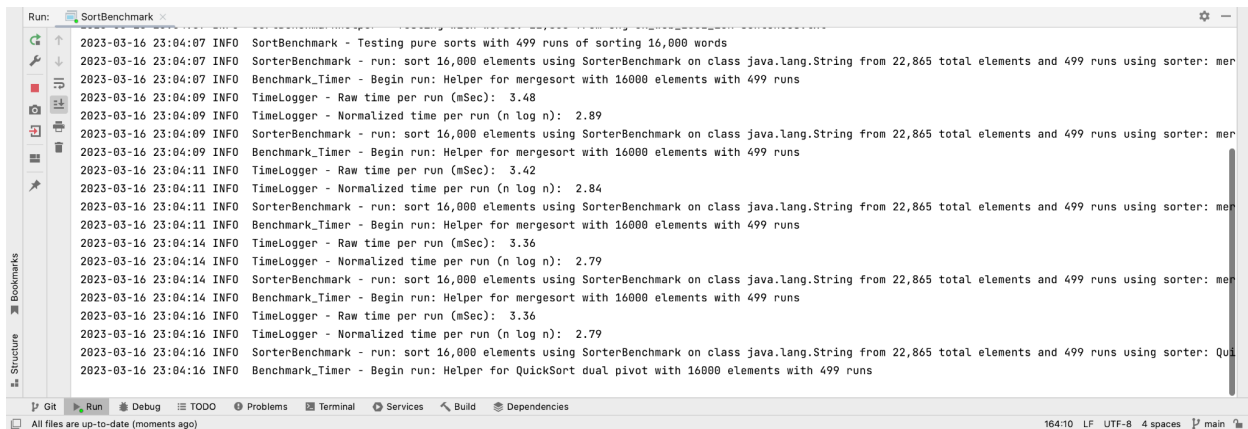


```
Run: MergeSortTest
Tests passed: 15 of 15 tests - 226 ms

MergeSortTest (edu.neu.coe.info) 226 ms
  testSort11_partialsorted 65 ms
  testSort9_partialsorted 41 ms
  testSort1 0 ms
  testSort2 4 ms
  testSort3 1 ms
  testSort4 28 ms
  testSort5 14 ms
  testSort6 13 ms
  testSort7 14 ms
  testSort10_partialsorted 22 ms
  testSort8_partialsorted 22 ms
  testSort12 1 ms
  testSort13 1 ms
  testSort14 0 ms
  testSort1a 0 ms

/Library/Java/JavaVirtualMachines/jdk-19.jdk/Contents/Home/bin/java ...
Instrumenting helper for insertion sort with 128 elements
partial sorted average time partialsorted_Cutoff + Insurance + NoCopy: 53783
Instrumenting helper for insertion sort with 128 elements
partial sorted average time partialsorted_Cutoff + NoCopy: 39079
Instrumenting helper for merge sort with 128 elements
StatPack {hits: 1,684, normalized=2.711; copies: 640, normalized=1.030; inversions: 4,224, normalized=6.801; swaps: 101, normalized=0.163;
Compares751
Worst Compares769
Instrumenting helper for insertion sort with 128 elements
Instrumenting helper for merge sort with 128 elements
StatPack {hits: 1,792, normalized=2.885; copies: 896, normalized=1.443; inversions: <unset>; swaps: 0, normalized=0.000; fixes: 0, normaliz
average time random_Cutoff: 26909
Instrumenting helper for insertion sort with 128 elements
average time random_Cutoff + NoCopy: 12117
Instrumenting helper for insertion sort with 128 elements
average time random_Cutoff + Insurance: 11921
Instrumenting helper for insertion sort with 128 elements
```

2. SortBenchmark.java with argument 16000



```
Run: SortBenchmark
2023-03-16 23:04:07 INFO SortBenchmark - Testing pure sorts with 499 runs of sorting 16,000 words
2023-03-16 23:04:07 INFO SorterBenchmark - run: sort 16,000 elements using SorterBenchmark on class java.lang.String from 22,865 total elements and 499 runs using sorter: mer
2023-03-16 23:04:07 INFO Benchmark_Timer - Begin run: Helper for mergesort with 16000 elements with 499 runs
2023-03-16 23:04:09 INFO TimeLogger - Raw time per run (mSec): 3.48
2023-03-16 23:04:09 INFO TimeLogger - Normalized time per run (n log n): 2.89
2023-03-16 23:04:09 INFO SorterBenchmark - run: sort 16,000 elements using SorterBenchmark on class java.lang.String from 22,865 total elements and 499 runs using sorter: mer
2023-03-16 23:04:09 INFO Benchmark_Timer - Begin run: Helper for mergesort with 16000 elements with 499 runs
2023-03-16 23:04:11 INFO TimeLogger - Raw time per run (mSec): 3.42
2023-03-16 23:04:11 INFO TimeLogger - Normalized time per run (n log n): 2.84
2023-03-16 23:04:11 INFO SorterBenchmark - run: sort 16,000 elements using SorterBenchmark on class java.lang.String from 22,865 total elements and 499 runs using sorter: mer
2023-03-16 23:04:11 INFO Benchmark_Timer - Begin run: Helper for mergesort with 16000 elements with 499 runs
2023-03-16 23:04:14 INFO TimeLogger - Raw time per run (mSec): 3.36
2023-03-16 23:04:14 INFO TimeLogger - Normalized time per run (n log n): 2.79
2023-03-16 23:04:14 INFO SorterBenchmark - run: sort 16,000 elements using SorterBenchmark on class java.lang.String from 22,865 total elements and 499 runs using sorter: mer
2023-03-16 23:04:14 INFO Benchmark_Timer - Begin run: Helper for mergesort with 16000 elements with 499 runs
2023-03-16 23:04:16 INFO TimeLogger - Raw time per run (mSec): 3.36
2023-03-16 23:04:16 INFO TimeLogger - Normalized time per run (n log n): 2.79
2023-03-16 23:04:16 INFO SorterBenchmark - run: sort 16,000 elements using SorterBenchmark on class java.lang.String from 22,865 total elements and 499 runs using sorter: Qu
2023-03-16 23:04:16 INFO Benchmark_Timer - Begin run: Helper for QuickSort dual pivot with 16000 elements with 499 runs
```

3. info6205.log

1	2023-03-16 21:10:36 INFO	SortBenchmark - SortBenchmark.main: null with word counts: [128000]	✓
2	2023-03-16 21:10:36 INFO	Benchmark_Timer - Begin run: intArraysorter with 100 runs	
3	2023-03-16 21:10:37 INFO	TimeLogger - Raw time per run (mSec): 4.20	
4	2023-03-16 21:10:37 INFO	TimeLogger - Normalized time per run (n log n): .46	
5	2023-03-16 21:10:37 INFO	Benchmark_Timer - Begin run: integerArraysorter with 100 runs	
6	2023-03-16 21:10:39 INFO	TimeLogger - Raw time per run (mSec): 13.33	
7	2023-03-16 21:10:39 INFO	TimeLogger - Normalized time per run (n log n): 1.46	
8	2023-03-16 21:10:39 INFO	SortBenchmark - Beginning String sorts	
9	2023-03-16 21:10:40 INFO	SortBenchmarkHelper - Testing with words: 303,172 from eng-uk_web_2002_1M-words.txt	
10	2023-03-16 21:10:40 INFO	SortBenchmark - Testing pure sorts with 50 runs of sorting 128,000 words	
11	2023-03-16 21:10:40 INFO	SorterBenchmark - run: sort 128,000 elements using SorterBenchmark on class java.lang.String from 303,172	
12	2023-03-16 21:10:40 INFO	Benchmark_Timer - Begin run: Helper for mergesort with 128000 elements with 50 runs	
13	2023-03-16 21:10:42 INFO	TimeLogger - Raw time per run (mSec): 40.22	
14	2023-03-16 21:10:42 INFO	TimeLogger - Normalized time per run (n log n): 3.37	
15	2023-03-16 21:10:42 INFO	SorterBenchmark - run: sort 128,000 elements using SorterBenchmark on class java.lang.String from 303,172	
16	2023-03-16 21:10:42 INFO	Benchmark_Timer - Begin run: Helper for mergesort with 128000 elements with 50 runs	
17	2023-03-16 21:10:45 INFO	TimeLogger - Raw time per run (mSec): 39.29	
18	2023-03-16 21:10:45 INFO	TimeLogger - Normalized time per run (n log n): 3.30	
19	2023-03-16 21:10:45 INFO	SorterBenchmark - run: sort 128,000 elements using SorterBenchmark on class java.lang.String from 303,172	
20	2023-03-16 21:10:45 INFO	Benchmark_Timer - Begin run: Helper for mergesort with 128000 elements with 50 runs	
21	2023-03-16 21:10:47 INFO	TimeLogger - Raw time per run (mSec): 37.68	
22	2023-03-16 21:10:47 INFO	TimeLogger - Normalized time per run (n log n): 3.16	
23	2023-03-16 21:10:47 INFO	SorterBenchmark - run: sort 128,000 elements using SorterBenchmark on class java.lang.String from 303,172	
24	2023-03-16 21:10:47 INFO	Benchmark_Timer - Begin run: Helper for mergesort with 128000 elements with 50 runs	
25	2023-03-16 21:10:49 INFO	TimeLogger - Raw time per run (mSec): 37.82	
26	2023-03-16 21:10:49 INFO	TimeLogger - Normalized time per run (n log n): 3.17	
27	2023-03-16 21:10:49 INFO	SorterBenchmark - run: sort 128,000 elements using SorterBenchmark on class java.lang.String from 303,172	
28	2023-03-16 21:10:49 INFO	Benchmark_Timer - Begin run: Helper for QuickSort dual pivot with 128000 elements with 50 runs	
29	2023-03-16 21:10:52 INFO	TimeLogger - Raw time per run (mSec): 33.63	
30	2023-03-16 21:10:52 INFO	TimeLogger - Normalized time per run (n log n): 2.82	
31	2023-03-16 21:10:52 INFO	SorterBenchmark - run: sort 128,000 elements using SorterBenchmark on class java.lang.String from 303,172	
32	2023-03-16 21:10:52 INFO	Benchmark_Timer - Begin run: Helper for Heapsort with 128000 elements with 50 runs	
33	2023-03-16 21:10:55 INFO	TimeLogger - Raw time per run (mSec): 49.88	
34	2023-03-16 21:10:55 INFO	TimeLogger - Normalized time per run (n log n): 4.18	
35	2023-03-16 21:10:55 INFO	SortBenchmark - Beginning LocalDateTime sorts	
36	2023-03-16 23:03:54 INFO	SortBenchmark - SortBenchmark.main: null with word counts: [128000]	
37	2023-03-16 23:03:54 INFO	Benchmark_Timer - Begin run: intArraysorter with 100 runs	