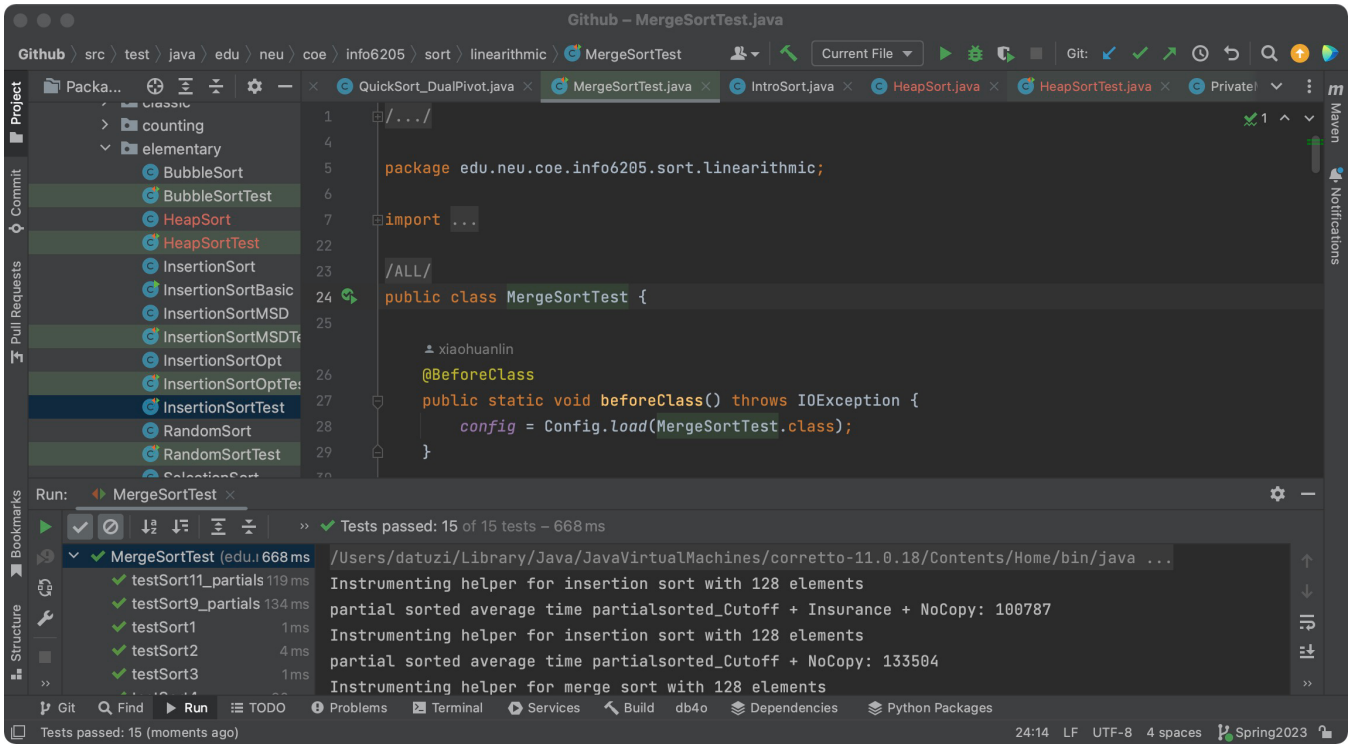
Assignment6

screenshot

The screenshot of mergesort test.



For each experiment (a sort method of a given size), you will run it twice: once for the instrumentation and the timing under MergeSortTest, QuickSortDUalPivotTest and HeapSortTest.java.

- HeapSort Timing

MergeSort.java | MergeSortTest.java | QuickSortDualPivotTest.java | HeapSortTest.java

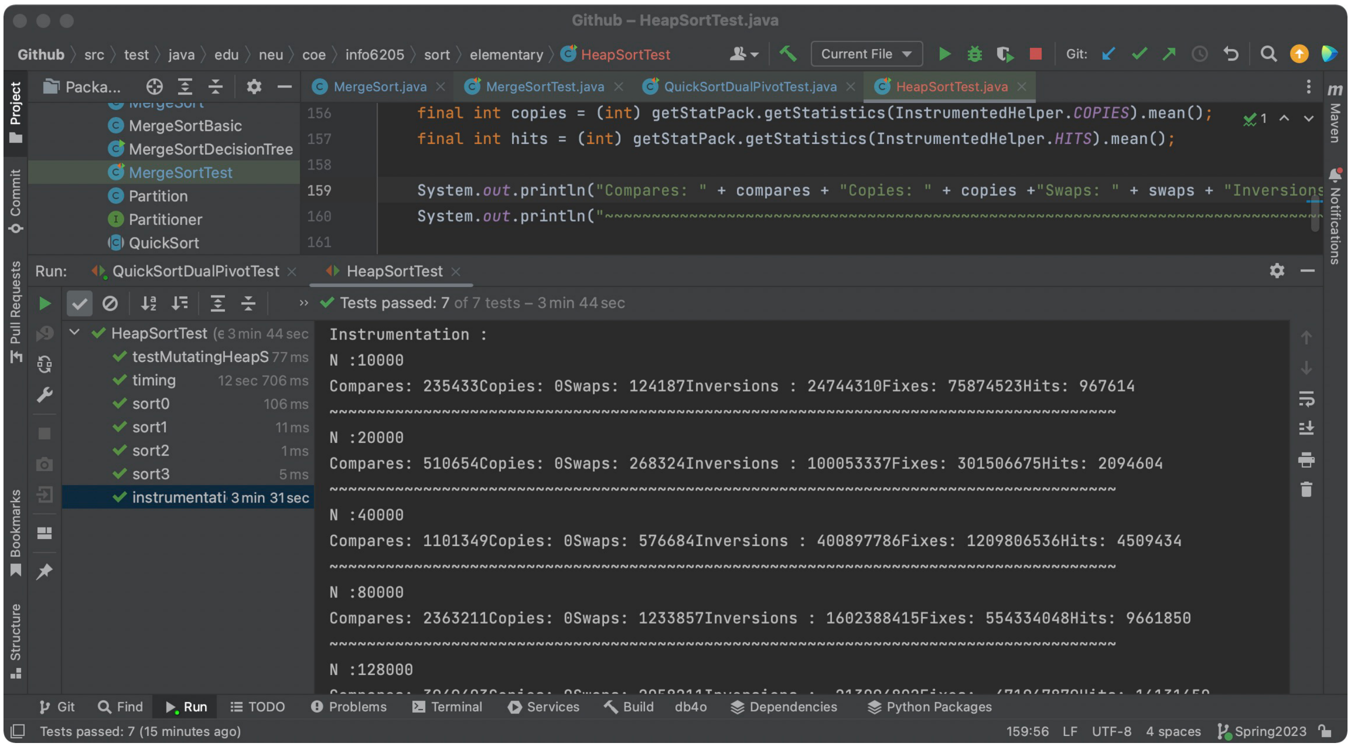
```java
        final int copies = (int) getStatPack.getStatistics(InstrumentedHelper
        final int hits = (int) getStatPack.getStatistics(InstrumentedHelper.

        System.out.println("Compares: " + compares + "Copies: " + copies +"S
        System.out.println("~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

```

HeapSortTest

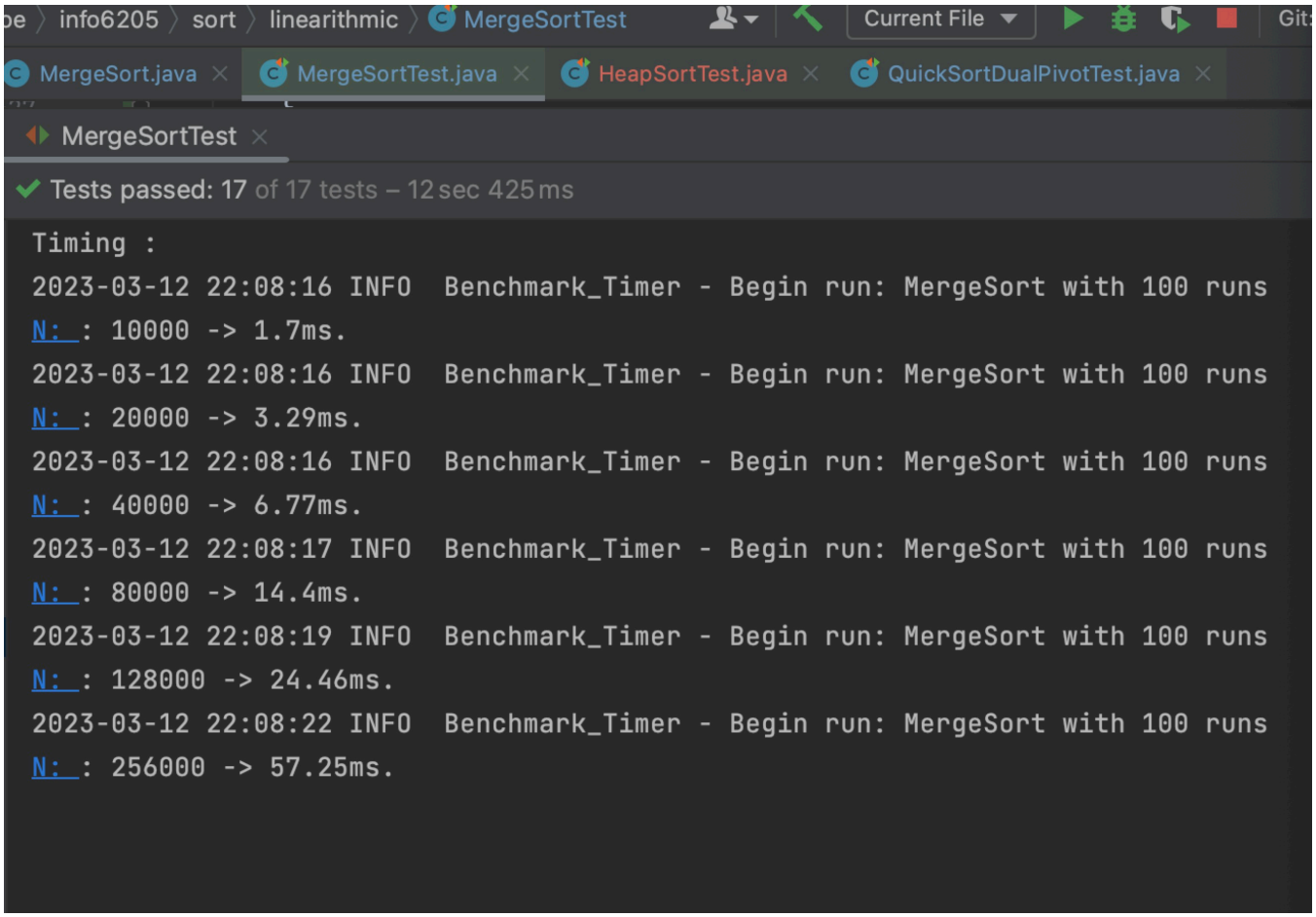
Tests passed: 7 of 7 tests – 3 min 44 sec

```
Timing :
2023-03-12 21:35:18 INFO  Benchmark_Timer - Begin run: HeapSort with 100 runs
N: 10000 -> 1.43ms
2023-03-12 21:35:18 INFO  Benchmark_Timer - Begin run: HeapSort with 100 runs
N: 20000 -> 3.18ms
2023-03-12 21:35:18 INFO  Benchmark_Timer - Begin run: HeapSort with 100 runs
N: 40000 -> 6.94ms
2023-03-12 21:35:19 INFO  Benchmark_Timer - Begin run: HeapSort with 100 runs
N: 80000 -> 15.26ms
2023-03-12 21:35:21 INFO  Benchmark_Timer - Begin run: HeapSort with 100 runs
N: 128000 -> 26.08ms
2023-03-12 21:35:23 INFO  Benchmark_Timer - Begin run: HeapSort with 100 runs
N: 256000 -> 62.34ms
```

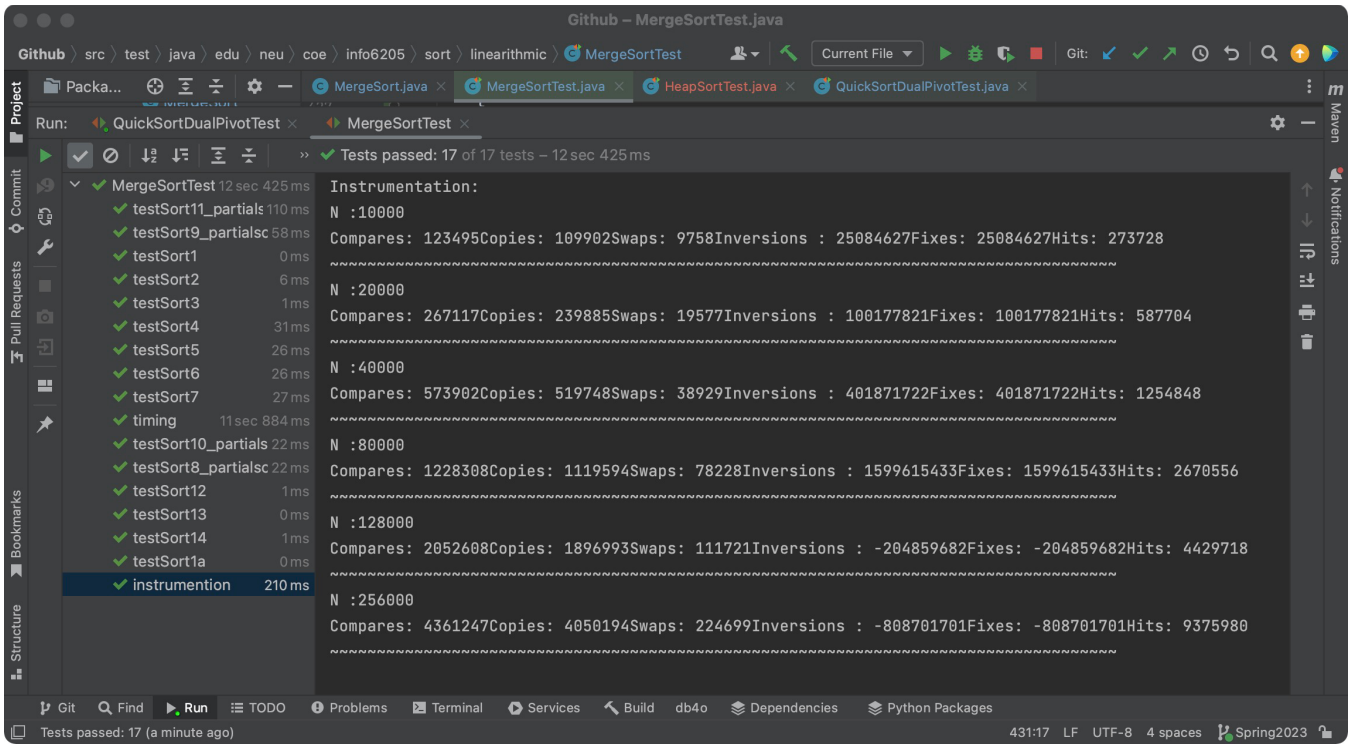
- HeapSort instrument:



- MergeSort Timing



- MergeSort instrument



- QuickSort Timing

```
Timing;
2023-03-12 22:27:44 INFO  Benchmark_Timer - Begin run: QuickSort Dual Pivots
:N 10000 -> 0.0ms
2023-03-12 22:27:44 INFO  Benchmark_Timer - Begin run: QuickSort Dual Pivots
:N 20000 -> 0.0ms
2023-03-12 22:27:44 INFO  Benchmark_Timer - Begin run: QuickSort Dual Pivots
:N 40000 -> 0.0ms
2023-03-12 22:27:44 INFO  Benchmark_Timer - Begin run: QuickSort Dual Pivots
:N 80000 -> 0.0ms
2023-03-12 22:27:44 INFO  Benchmark_Timer - Begin run: QuickSort Dual Pivots
:N 128000 -> 0.0ms
2023-03-12 22:27:44 INFO  Benchmark_Timer - Begin run: QuickSort Dual Pivots
:N 256000 -> 0.0ms
```

- QuickSort instrument

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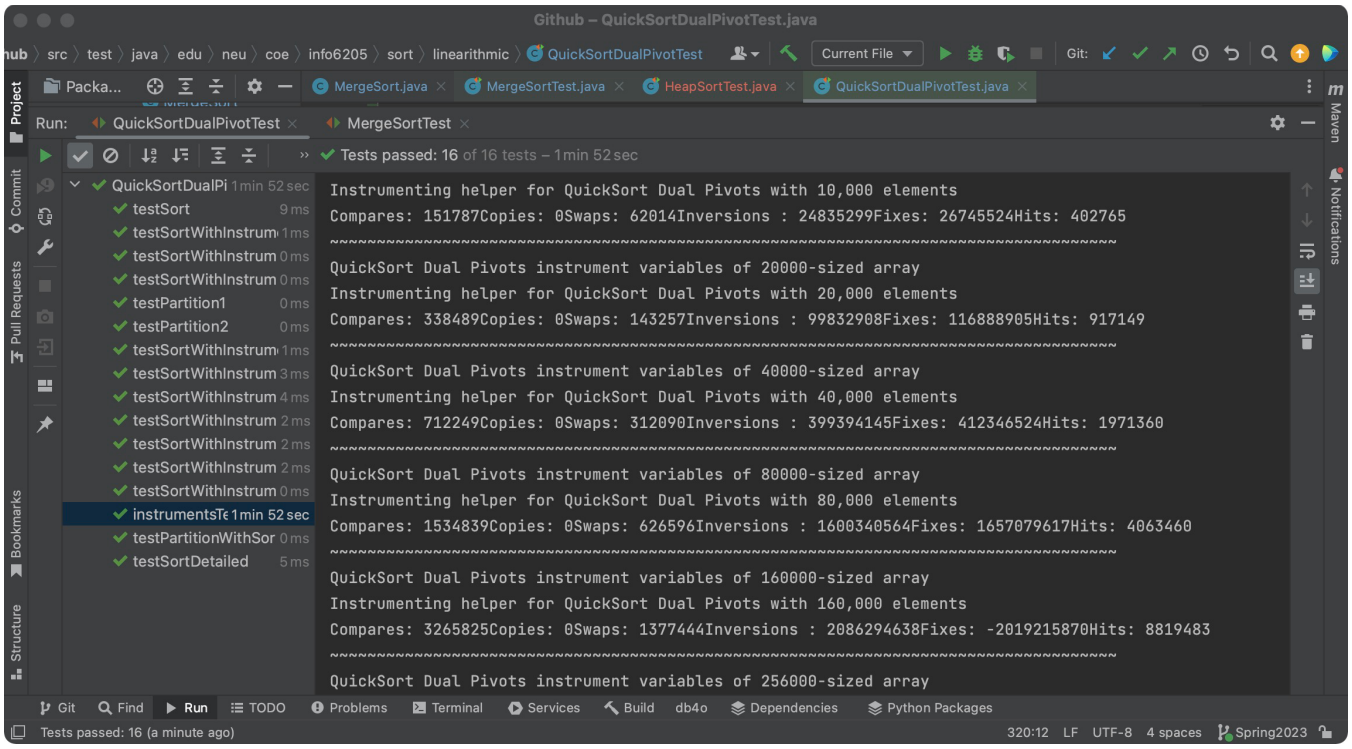

Graph & conclusion

HeapSort							
N	time	comparisons	copies	swaps	inversions	fixes	hits
10000	1.42	235334	0	124155	25008297	75655881	966808
20000	3.1	510984	0	268616	99614148	303623413	2095048
40000	6.77	1101322	0	576704	398266242	1.209E+09	4509452
80000	14.79	2363008	0	1233709	1.605E+09	1.855E+09	9660044
160000	33.72	5046625	0	2627510	2.097E+09	2.111E+09	20600986
256000	57.74	8410576	0	4372009	2.897E+09	2.294E+09	34310038

QuickSort Dual Pivots							
N	time	comparisons	copies	swaps	inversions	fixes	hits
10000	1.35	151787		62014	24835299	26745524	402765
20000	2.14	338489		143257	99832908	116888905	917149
40000	5.01	712249		312090	399394145	412346524	1971360
80000	9.92	1534839		626596	1.6E+09	1.657E+09	4063460
160000	20.67	3265825		1377444	2.086E+09	2.019E+09	8819483
256000	33.51	5525002		2190632	2.878E+09	2.367E+09	14357631

MergeSort							
N	time	comparisons	copies	swaps	inversions	fixes	hits
10000	1.51	123551	109952	9756	24977728	24977728	273506
20000	2.65	267137	239904	19700	100301422	100301422	588108
40000	5.48	574123	519843	39076	400388388	400388388	1254976
80000	11.69	1228303	1119683	77917	1.599E+09	1.599E+09	2671284
160000	27.6	2616355	2399350	155942	2.105E+09	2.105E+09	5663610
256000	47.61	4361293	4049954	224277	2.905E+09	2.905E+09	9374866

HeapSort													
N	time	comparisons	copies	swaps	inversions	fixes	hits	time_norm	comparisons_	copies_norm	swaps_norm	inversions_nc	fixes_norm	hits_norm
10000	1.42	235334	0	124155	25008297	75655881	966808	0.02521307	0.02878618	0	0.0292277	0.00870666	0.03411071	0.02899563
20000	3.1	510984	0	268616	99614148	303623413	2095048	0.05504261	0.06250384	0	0.0632357	0.03468076	0.13689365	0.06283278
40000	6.77	1101322	0	576704	398266242	1209254052	4509452	0.12020597	0.1347143	0	0.13576361	0.13865676	0.54521226	0.13524341
80000	14.79	2363008	0	1233709	1604925631	1855272297	9660044	0.26260653	0.28904441	0	0.29043112	0.55875635	0.8364803	0.2897153
160000	33.72	5046625	0	2627510	2097423099	2110730899	20600986	0.59872159	0.61730589	0	0.61854998	0.7302198	0.95165806	0.61784614
256000	57.74	8410576	0	4372009	2897325801	2293606843	34310038	1.02521307	1.02878618	0	1.0292277	1.00870666	1.03411071	1.02899563

QuickSort Dual Pivots														
N	time	comparisons	copies	swaps	inversions	fixes	hits	time_norm	comparisons_	copies_norm	swaps_norm	inversions_nc	fixes_norm	hits_norm
10000	1.35	151787		62014	24835299	26745524	402765	0.04197761	0.02824882	0	0.02913346	0.00870407	0.01142627	0.02886198
20000	2.14	338489		143257	99832908	116888905	917149	0.06654229	0.06299562	0	0.06730047	0.03498861	0.04993747	0.06572252
40000	5.01	712249		312090	399394145	412346524	1971360	0.15578358	0.13255546	0	0.14661626	0.13997635	0.17616335	0.14126685
80000	9.92	1534839		626596	1600340564	1657079617	4063460	0.30845771	0.2856463	0	0.29436752	0.5608741	0.70794026	0.29118588
160000	20.67	3265825		1377444	2086294638	2019215870	8819483	0.64272388	0.60779719	0	0.64710718	0.73118726	0.8626527	0.63200055
256000	33.51	5525002		2190632	2878132621	2367450977	14357631	1.04197761	1.02824882	0	1.02913346	1.00870407	1.01142627	1.02886198

MergeSort														
N	time	comparisons	copies	swaps	inversions	fixes	hits	time_norm	comparisons_	copies_norm	swaps_norm	inversions_nc	fixes_norm	hits_norm
10000	1.51	123551	109952	9756	24977728	24977728	273506	0.03275488	0.02915491	0.02790658	0.04547807	0.00867139	0.00867139	0.03005111
20000	2.65	267137	239904	19700	100301422	100301422	588108	0.05748373	0.06303758	0.06088931	0.0918325	0.03482114	0.03482114	0.0646176
40000	5.48	574123	519843	39076	400388388	400388388	1254976	0.11887202	0.13547852	0.13193978	0.18215466	0.13900081	0.13900081	0.13788884
80000	11.69	1228303	1119683	77917	1599495509	1599495509	2671284	0.25357918	0.28984846	0.28418336	0.36321386	0.55528875	0.55528875	0.29350383
160000	27.6	2616355	2399350	155942	2105372485	2105372485	5663610	0.59869848	0.61739365	0.60897177	0.72693116	0.7309115	0.7309115	0.62228172
256000	47.61	4361293	4049954	224277	2905452988	2905452988	9374866	1.03275488	1.02915491	1.02790658	1.04547807	1.00867139	1.00867139	1.03005111

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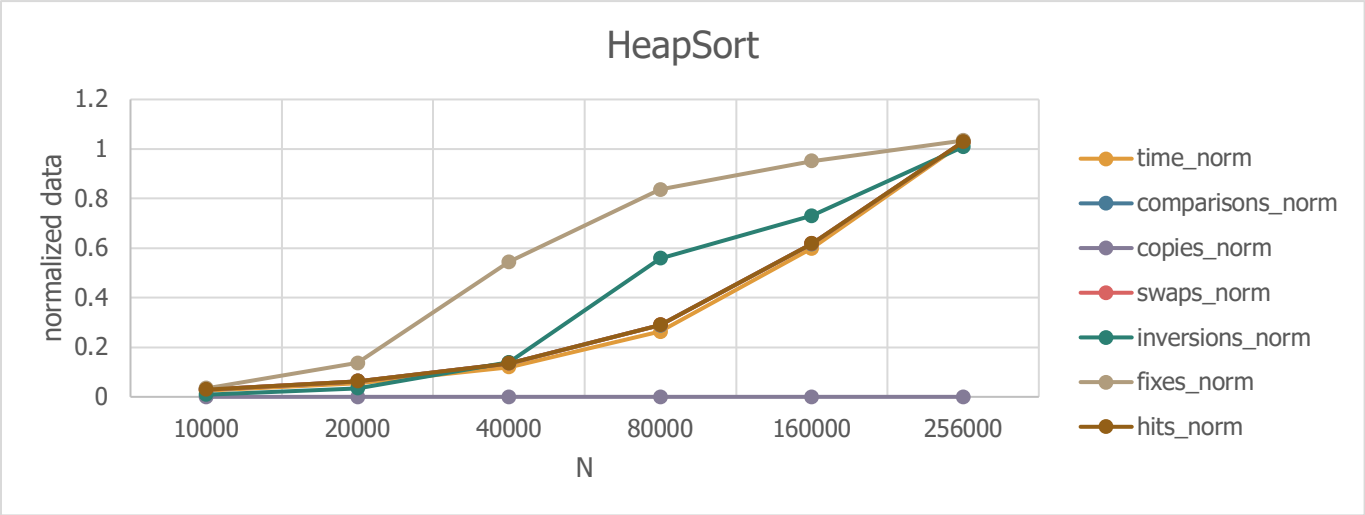
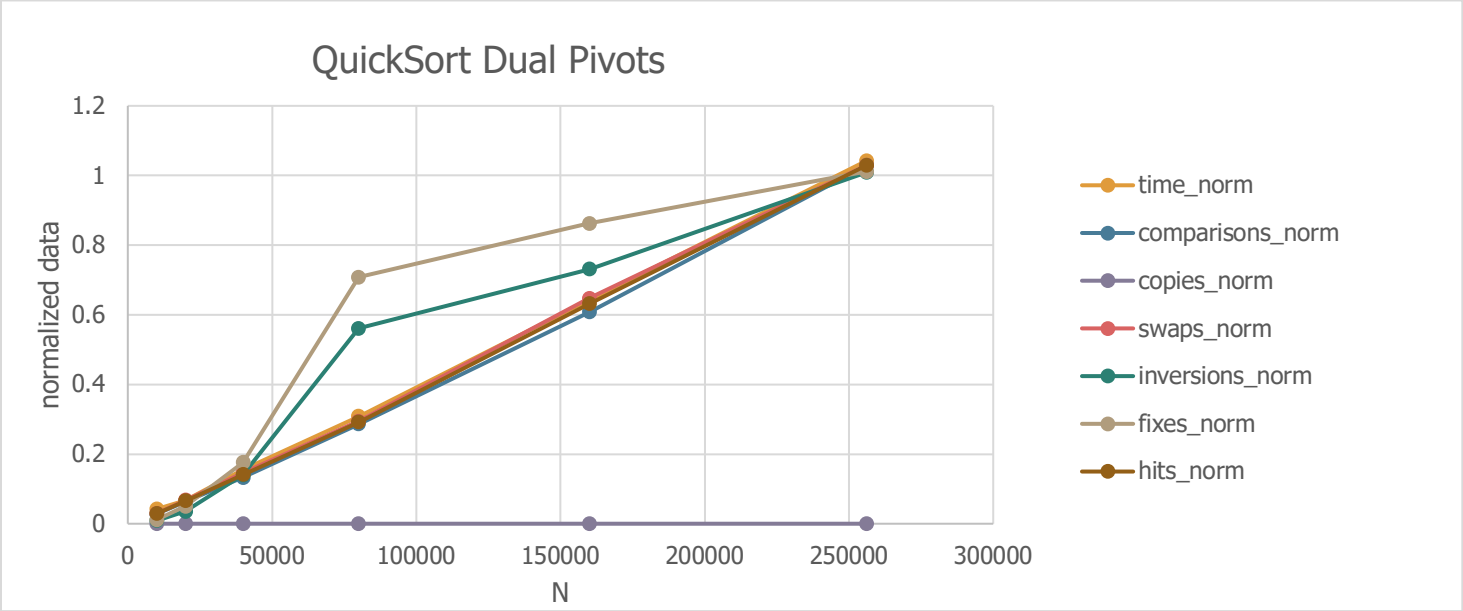


Because each instrumentation is different, we need to normalize each value before drawing. We can see from the figure that the curve of comparisons, swaps, hits and time is the closest, so the best predictor of total execution time is comparisons, swaps and hits.



Because each instrumentation is different, we need to normalize each value before drawing. We can see from the figure that the curve of comparisons, swaps, hits and time is the closest, so the best predictor of total execution time is swaps and hits.

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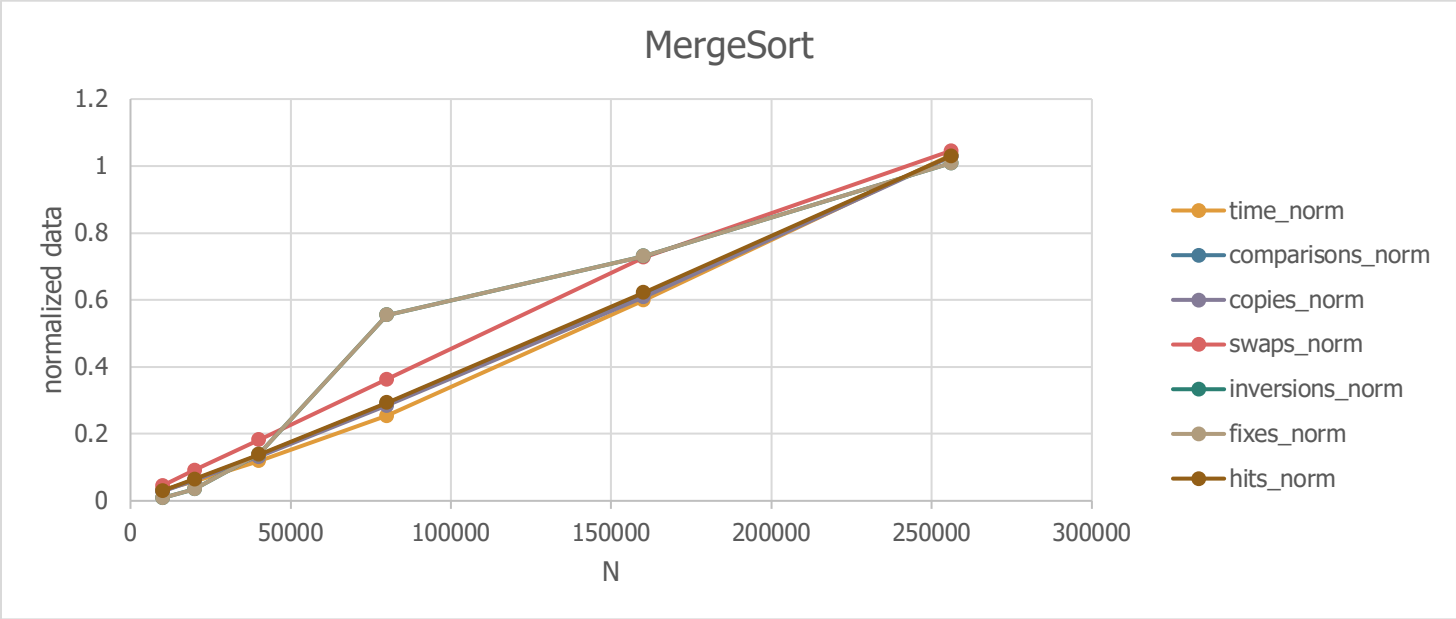

Because each instrumentation is different, we need to normalize each value before drawing. We can see from the figure that the curve of comparisons, swaps, hits, copies and time is the closest, so the best predictor of total execution time is comparisons, swaps, copies and hits.