Performance of Advanced Sorting Algorithms

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October 13, 2019

1 Data

The 'repeated' test data has one unique entry every 50 entries.

Merge Sort	**1024**	**2048**	**4096**
Ascending	0.019	0.040	0.082
Descending	0.021	0.041	0.099
Random	0.19	0.36	0.74
Repeated	0.026	0.056	0.12

Quicksort Left Pivot	**1024**	**2048**	**4096**
Ascending	0.19	0.74	2.79
Descending	0.37	1.43	5.85
Random	0.17	0.34	0.69
Repeated	0.020	0.043	0.090

Quicksort Median of 3	**1024**	**2048**	**4096**
Ascending	0.0089	0.018	0.041
Descending	0.015	0.033	0.082
Random	0.19	0.34	0.69
Repeated	0.021	0.045	0.092

3 Way Quicksort	**1024**	**2048**	**4096**
Ascending	0.024	0.062	0.18
Descending	0.019	0.050	0.13
Random	0.19	0.34	0.70
Repeated	0.0094	0.022	0.048

2 Discussion

Mergesort has a time complexity of $O(n \log n)$ on all inputs. Quicksort has a time complexity of $O(n \log n)$ on average, with a worst case time complexity of $O(n^2)$.

Mergesort performs significantly better on data with some kind of structure. This is likely due to branch prediction significantly increasing the performance while merging.

Quicksort with a median of three pivot performs equivalently to the left pivot on random and repeated datasets. However, on already sorted (ascending and descending) datasets, the median of three pivot performs significantly better than the left pivot. This is due to the performance of quicksort with left pivot decreasing to worst case $O(n^2)$ on these datasets.

3 way quicksort (dutch flag algorithm) (with median of three pivot) performs equivalently to the other quicksort algorithms on random data. However, it has much better performance on repeating data, performing about twice as fast as ordinary quicksort. It has lower performance on already sorted data than quicksort with median of three pivot, which is likely due to the fact that it must swap almost all elements desite the data already being sorted. However, the overall algorithmic complexity does not degrade in these cases.