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Algorithms

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PA1 Report

I. Runtime/Memory Table

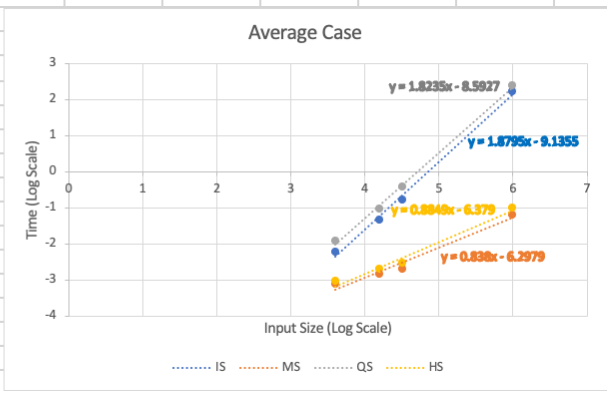
Input size	IS		MS		QS		HS	
	CPU time (s)	Memory (KB)	CPU time (s)	Memory (KB)	CPU time (s)	Memory (KB)	CPU time (s)	Memory (KB)
4000.case2	0.000144	5904	0.000477	5904	0.019926	5972	0.000829	5904
4000.case3	0.010408	5904	0.0005	5904	0.015037	5904	0.000747	5904
4000.case1	0.007444	5904	0.001291	5904	0.001074	5904	0.000969	5904
16000.case2	0.000138	6056	0.001135	6056	0.157212	6672	0.002552	6056
16000.case3	0.089938	6056	0.000783	6056	0.120642	6308	0.001575	6056
16000.case1	0.04711	6056	0.002327	6056	0.002261	6056	0.001716	6056
32000.case2	0.000125	6188	0.00131	6188	0.653586	7480	0.002855	6188
32000.case3	0.33986	6188	0.001563	6188	0.482688	6740	0.002471	6188
32000.case1	0.167848	6188	0.003307	6188	0.003765	6188	0.003674	6188
1000000.case2	0.001978	12144	0.035874	13876	377.717	39588	0.079543	12144
1000000.case3	323.687	12144	0.039175	13872	359.16	28124	0.076405	12144
1000000.case1	159.256	12144	0.118901	13880	0.088545	12144	0.138971	12144

(results given are run on the edaU6 server)

II. Graph Case Analysis

Average Case

Average				
Input Size	IS time	MS time	QS time	HS time
4000	0.005999	0.000756	0.012012	0.000848
16000	0.045729	0.001415	0.093372	0.001948
32000	0.169278	0.00206	0.380013	0.003
1000000	160.9817	0.06465	245.6552	0.098306
Log(AVG)				
Input Size	IS time	MS time	QS time	HS time
3.60206	-2.221945	-3.121478	-1.920373	-3.071433
4.20412	-1.339811	-2.849244	-1.029785	-2.710485
4.50515	-0.7714	-2.686133	-0.420202	-2.522879
6	2.206776	-1.189431	2.390326	-1.007419

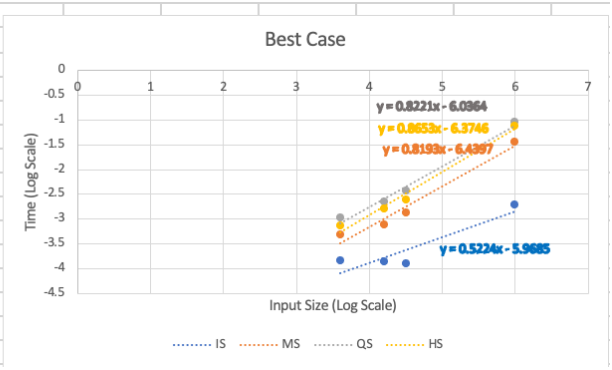


For the average case, IS and QS have similar slope which are roughly close to 2. On the other hand, MS and HS have similar slope that are really close to 1. Theoretically, the

average case time complexity for IS is Θ (n^2) and Θ(nlogn) for the other ones. This is true for all but the quick sort graph. I think its average might have been thrown off by the 1 million case results causing it's time complexity to worsen.

Best Case

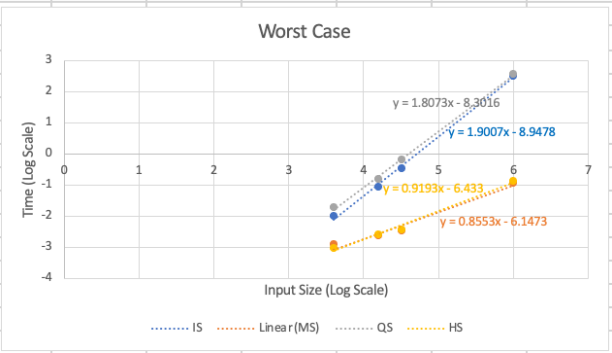
Best Case				
Input Size	IS time	MS time	QS time	HS time
4000	0.000144	0.000477	0.001074	0.000747
16000	0.000138	0.000783	0.002261	0.001575
32000	0.000125	0.00131	0.003765	0.002471
1000000	0.001978	0.035874	0.088545	0.076405
Log(B)				
Input Size	IS time	MS time	QS time	HS time
3.60206	-3.841638	-3.321482	-2.968996	-3.126679
4.20412	-3.860121	-3.106238	-2.645699	-2.802719
4.50515	-3.90309	-2.882729	-2.424235	-2.607127
6	-2.703774	-1.44522	-1.052836	-1.116878



For the best case, the slope for MS and HS stayed about the same while the slope for QS decreased and the slope for IS decreased by a ton. This kind of does make sense since the worst cases that pulled the data way off are omitted which will result in better result for IS and QS.

Worst Case

Worst Case				
Input Size	IS time	MS time	QS time	HS time
4000	0.010408	0.001291	0.019926	0.000969
16000	0.089938	0.002327	0.157212	0.002552
32000	0.33986	0.003307	0.653586	0.003674
1000000	323.687	0.118901	377.717	0.138971
Log(W)				
Input Size	IS time	MS time	QS time	HS time
3.60206	-1.982633	-2.889074	-1.70058	-3.013676
4.20412	-1.046057	-2.633204	-0.803514	-2.593119
4.50515	-0.4687	-2.480566	-0.184697	-2.434861
6	2.510125	-0.924814	2.577167	-0.857076



For the worst case, there are two groups. Group one, with slope close to two, consisting IS and QS, and group two, with slope of approximately one, consisting of MS and HS.

This fits the theoretical worst-case estimation with group one time complexity of Θ(n^2), and group two with time complexity of Θ(nlogn).

III. Conclusion

After running through this programming assignment, I can see that quick sort and merge sort are quite stable despite the data size. But the other two varies depending on what kind of inputs the user gives them. Thus, if we have no idea what kind on input we will be given, we should pick results that perform better in average case. But if we know that the data is close to sorted, we should use algorithms that perform well in best case. On the contrary, if the data given is scramble in a way that's almost inversely sorted then we should use the sorting method that perform really well in the worst-case scenario.