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CSCI 311

Professor Challenger

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Program 2

The results of the sorting was very interesting and helped connect the methods we were using in class with our program. As I went up in size of the files it got significantly longer to sort each file. By the last file with 80,000 records I was taking over five minutes to sort. If you compare average time complexity for each sorting algorithm with the fastest times of each sort on each file size you can tell that it matches up. The average time complexity for Merge Sort and Quick Sort is $\Theta(n \log(n))$ which explains why the times between those two sorting methods are very similar; then you look at the average time complexity for Insertion sort which is $O(n^2)$ which is the same as its worst case and explains why it takes significantly longer on each sorting method. The comparison graphs are hard to read due to Insertion sort taking so much time on the larger files, however, it is very interesting to see how similar merge and quicksort are throughout the different file sizes and both of them in general staying under a second even on the largest file while insertion sort was around 300 seconds. It also seemed that there was more deviation comparing the fastest and slowest time when looking at Insertion Sort specifically; often the other two sorts fastest and slowest were incredibly close together. Thanks to this project and especially having it visualized in graph form has made it very clear on how efficient quick and merge sort are; especially in comparison to insertion sort.

Timings for each file with each sorting method

CENSUS2010POP-Alabama-Alabama.csv							
Run Number	Insertion Sort - Name	Insertion Sort- Population	Merge Sort - Name	Merge Sort - Population	Quick Sort - Name	Quick Sort - Population	Total Records
1	0.0329638	0.00212636	0.00271391	0.00187477	0.0014952	0.000320922	1102
2	0.045041	0.00300216	0.00367945	0.00306284	0.00157094	0.000456162	
3	0.0379345	0.00344454	0.00329239	0.00213379	0.00168218	0.000525368	
Fastest Times	0.0329638	0.00212636	0.00271391	0.00187477	0.0014952	0.000320922	
Slowest Times	0.045041	0.00344454	0.00367945	0.00306284	0.00168218	0.000525368	

CENSUS2010POP-Alabama-California.csv							
Run Number	Insertion Sort - Name	Insertion Sort- Population	Merge Sort - Name	Merge Sort - Population	Quick Sort - Name	Quick Sort - Population	Total Records
1	0.351691	0.0214524	0.0106715	0.00690814	0.00664928	0.00126887	3920
2	0.367057	0.0254082	0.0125611	0.00835908	0.00681675	0.00144203	
3	0.385676	0.0359815	0.0113735	0.00771762	0.00708597	0.00150774	
Fastest Times	0.351691	0.0214524	0.0106715	0.00690814	0.00664928	0.00126887	
Slowest Times	0.385676	0.0359815	0.0125611	0.00835908	0.00708597	0.00150774	
CENSUS2010POP-Alabama-Idaho.csv							
Run Number	Insertion Sort - Name	Insertion Sort- Population	Merge Sort - Name	Merge Sort - Population	Quick Sort - Name	Quick Sort - Population	Total Records
1	1.54872	0.146288	0.0230267	0.0141319	0.0135558	0.00283232	7932
2	1.54336	0.147694	0.0232229	0.0139742	0.0135997	0.00287017	
3	1.54485	0.140729	0.0229983	0.0142068	0.0144248	0.00288151	
Fastest Times	1.54336	0.140729	0.0229983	0.0139742	0.0135558	0.00283232	
Slowest Times	1.54872	0.147694	0.0232229	0.0142068	0.0144248	0.00288151	
CENSUS2010POP-Alabama-Iowa.csv							
Run Number	Insertion Sort - Name	Insertion Sort- Population	Merge Sort - Name	Merge Sort - Population	Quick Sort - Name	Quick Sort - Population	Total Records
1	13.2107	1.31197	0.0919371	0.0919371	0.0500437	0.0108495	21236
2	13.4646	1.60406	0.0779763	0.0481854	0.0597682	0.0096337	
3	16.8437	1.39351	0.0852014	0.050095	0.0669474	0.0103375	
Fastest Times	13.2107	1.31197	0.0779763	0.0481854	0.0500437	0.0096337	
Slowest Times	16.8437	1.60406	0.0919371	0.0919371	0.0669474	0.0108495	
CENSUS2010POP-Alabama-Missouri							
Run Number	Insertion Sort - Name	Insertion Sort- Population	Merge Sort - Name	Merge Sort - Population	Quick Sort - Name	Quick Sort - Population	Total Records
1	60.6598	8.03881	0.190879	0.114606	0.10975	0.0268894	41712

2	77.0108	9.62469	0.180363	0.0931747	0.140605	0.0298779	
3	75.8467	9.65171	0.160845	0.0891629	0.114256	0.0304048	
Fastest Times	60.6598	8.03881	0.160845	0.0891629	0.10975	0.0268894	
Slowest Times	77.0108	9.65171	0.190879	0.114606	0.140605	0.0304048	
CENSUS2010POP							
Run Number	Insertion Sort - Name	Insertion Sort- Population	Merge Sort - Name	Merge Sort - Population	Quick Sort - Name	Quick Sort - Population	Total Records
1	264.123	38.4409	0.323112	0.186887	0.262399	0.0581319	81746
2	296.67	37.2565	0.364811	0.205694	0.28097	0.0644014	
3	291.466	38.5689	0.536255	0.342748	0.450823	0.102625	
Fastest Times	264.123	37.2565	0.323112	0.186887	0.262399	0.0581319	
Slowest Times	296.67	38.5689	0.536255	0.342748	0.450823	0.102625	

Graph and individual sort timing Section

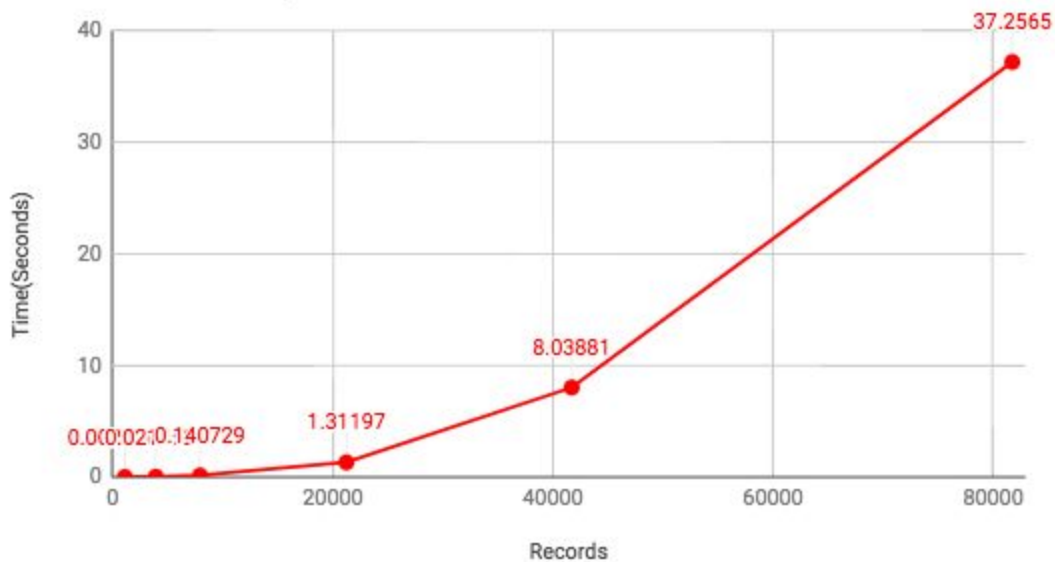
Each Sorting type and sorting method is split into its own page below.

Timings of Insertion Sort by Population

	Insertion Sort- Population	Insertion Sort- Population	Insertion Sort- Population	Insertion Sort- Population	Insertion Sort- Population	Insertion Sort- Population
	Total Records	Total Records	Total Records	Total Records	Total Records	Total Records
	1102	3920	7932	21236	41712	81746
Time	0.00212636	0.0214524	0.146288	1.31197	8.03881	38.4409
	0.00300216	0.0254082	0.147694	1.60406	9.62469	37.2565
	0.00344454	0.0359815	0.140729	1.39351	9.65171	38.5689
Lowest Time	0.00212636	0.0214524	0.140729	1.31197	8.03881	37.2565

Graph of Insertion Sort by Population

Insertion Sort-Population

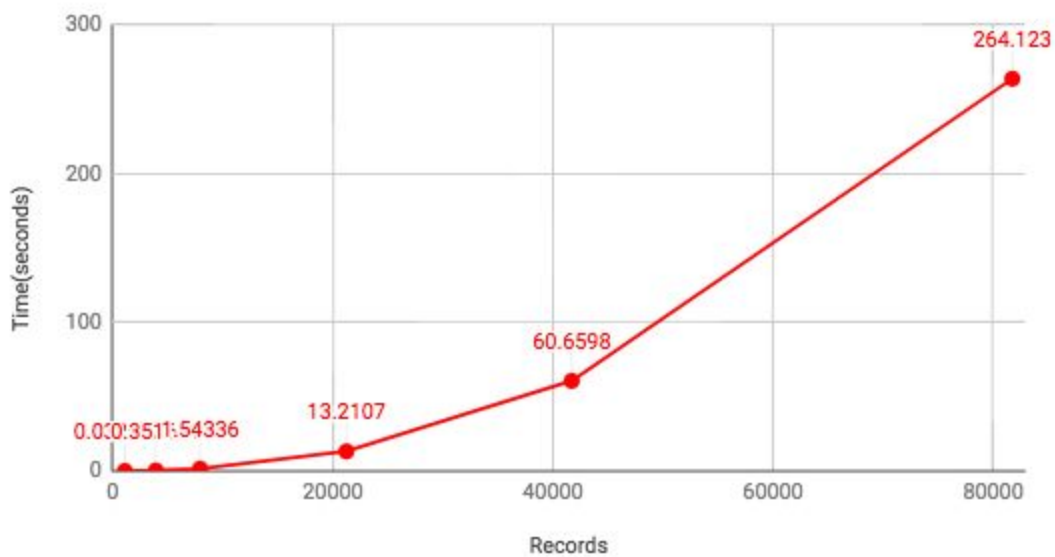


Timings of Insertion sort by name

	Insertion Sort - Name	Insertion Sort - Name	Insertion Sort - Name	Insertion Sort - Name	Insertion Sort - Name	Insertion Sort - Name
	Total Records	Total Records	Total Records	Total Records	Total Records	Total Records
	1102	3920	7932	21236	41712	81746
Time	0.0329638	0.351691	1.54872	13.2107	60.6598	264.123
	0.045041	0.367057	1.54336	13.4646	77.0108	296.67
	0.0379345	0.385676	1.54485	16.8437	75.8467	291.466
Lowest Time	0.0329638	0.351691	1.54336	13.2107	60.6598	264.123

Graph of Insertion sort by name

Insertion Sort - Name

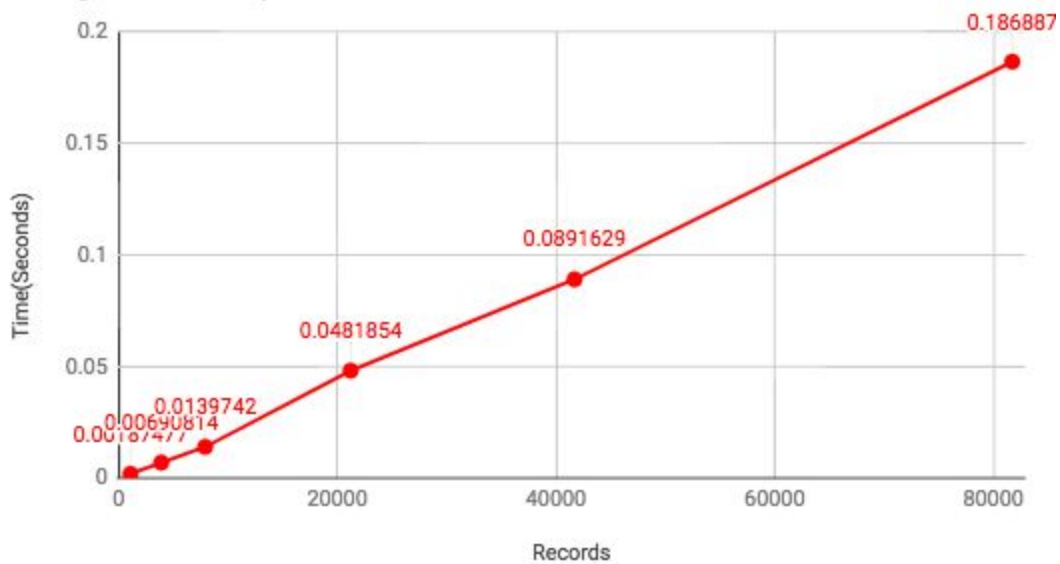


Timings of Merge Sort by population

	Merge Sort - Population	Merge Sort - Population	Merge Sort - Population	Merge Sort - Population	Merge Sort - Population	Merge Sort - Population
	Total Records	Total Records	Total Records	Total Records	Total Records	Total Records
	1102	3920	7932	21236	41712	81746
Time	0.00187477	0.00690814	0.0141319	0.0919371	0.114606	0.186887
	0.00306284	0.00835908	0.0139742	0.0481854	0.0931747	0.205694
	0.00213379	0.00771762	0.0142068	0.050095	0.0891629	0.342748
Lowest Time	0.00187477	0.00690814	0.0139742	0.0481854	0.0891629	0.186887

Graph of Merge Sort by population

Merge Sort - Population

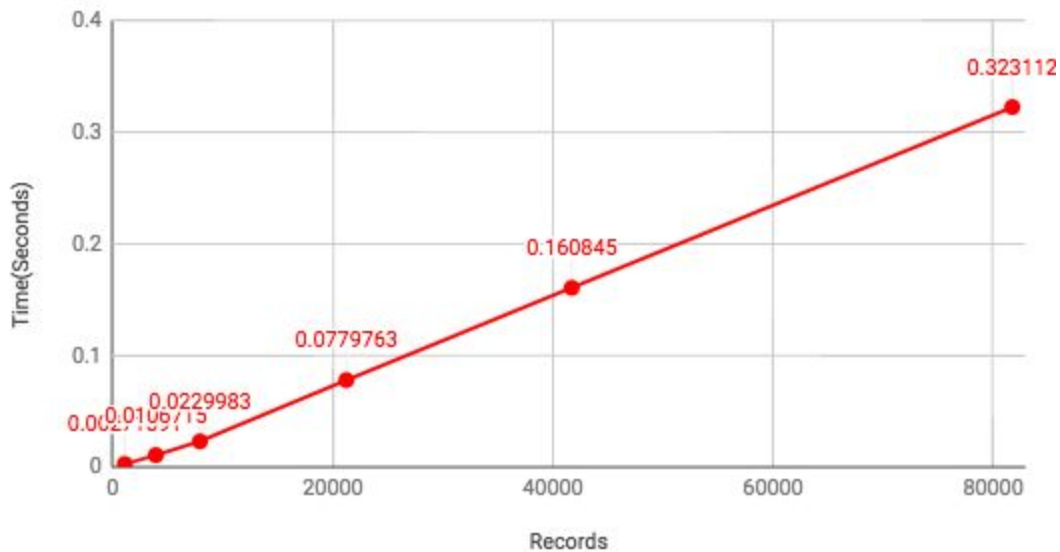


Timings of Merge Sort by Name

	Merge Sort - Name	Merge Sort - Name	Merge Sort - Name	Merge Sort - Name	Merge Sort - Name	Merge Sort - Name
	Total Records	Total Records	Total Records	Total Records	Total Records	Total Records
	1102	3920	7932	21236	41712	81746
Time	0.00271391	0.0106715	0.0230267	0.0919371	0.190879	0.323112
	0.00367945	0.0125611	0.0232229	0.0779763	0.180363	0.364811
	0.00329239	0.0113735	0.0229983	0.0852014	0.160845	0.536255
Lowest Time	0.00271391	0.0106715	0.0229983	0.0779763	0.160845	0.323112

Graph of merge sort by name

Merge Sort - Name

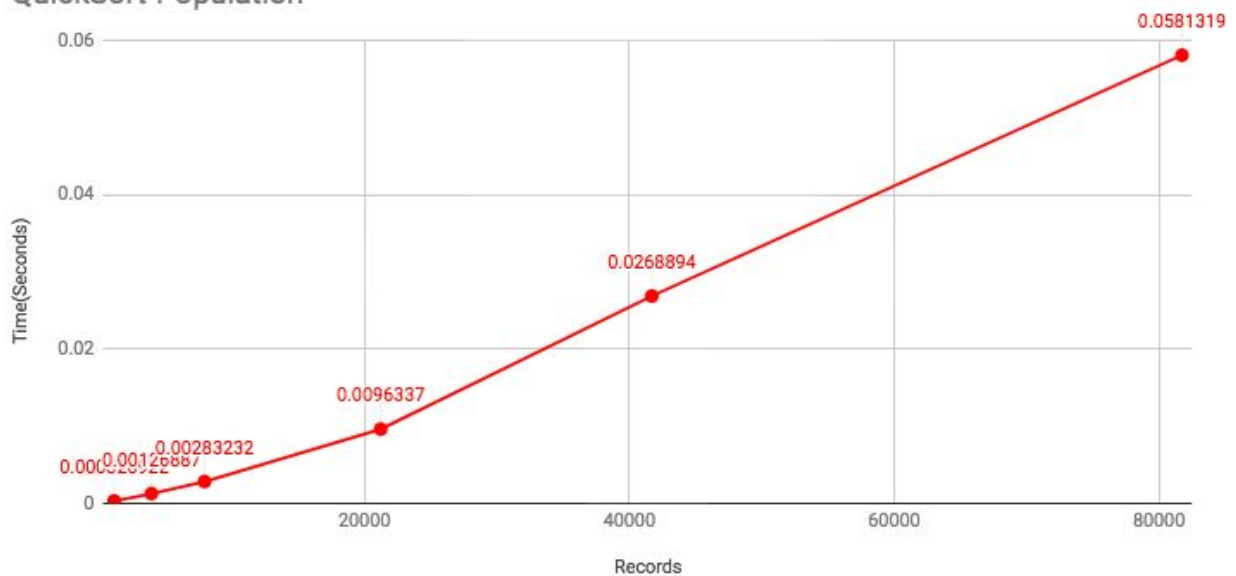


Timings of Quick Sort By Population

	Quick Sort - Population	Quick Sort - Population	Quick Sort - Population	Quick Sort - Population	Quick Sort - Population	Quick Sort - Population
	Total Records	Total Records	Total Records	Total Records	Total Records	Total Records
	1102	3920	7932	21236	41712	81746
Time	0.000320922	0.00126887	0.00283232	0.0108495	0.0268894	0.0581319
	0.000456162	0.00144203	0.00287017	0.0096337	0.0298779	0.0644014
	0.000525368	0.00150774	0.00288151	0.0103375	0.0304048	0.102625
Lowest Time	0.000320922	0.00126887	0.00283232	0.0096337	0.0268894	0.0581319

Graph of quick sort by population

QuickSort-Population

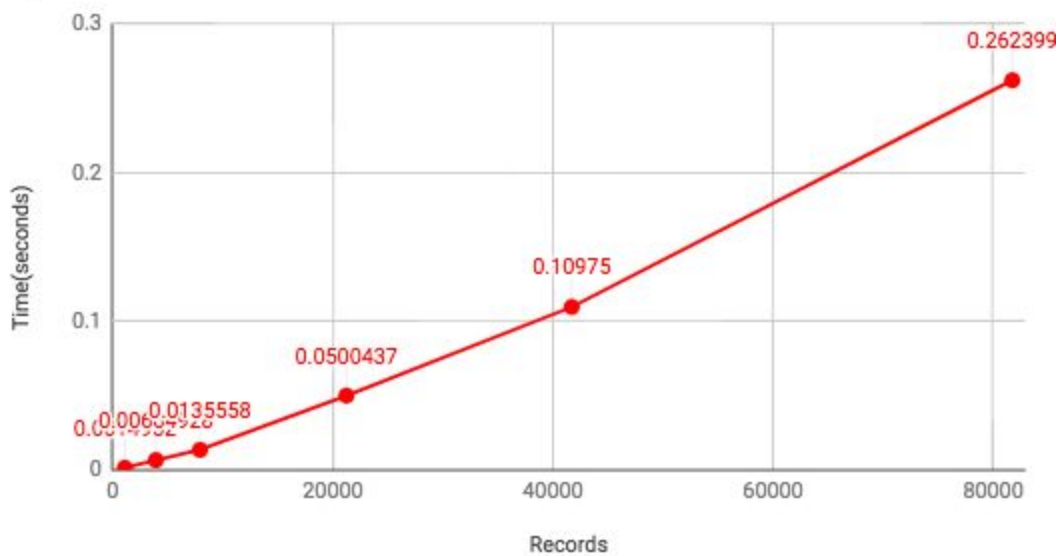


Timings of Quick Sort by Name

	Quick Sort - Name	Quick Sort - Name	Quick Sort - Name	Quick Sort - Name	Quick Sort - Name	Quick Sort - Name
	Total Records	Total Records	Total Records	Total Records	Total Records	Total Records
	1102	3920	7932	21236	41712	81746
Time	0.0014952	0.00664928	0.0135558	0.0500437	0.10975	0.262399
	0.00157094	0.00681675	0.0135997	0.0597682	0.140605	0.28097
	0.00168218	0.00708597	0.0144248	0.0669474	0.114256	0.450823
Lowest Time	0.0014952	0.00664928	0.0135558	0.0500437	0.10975	0.262399

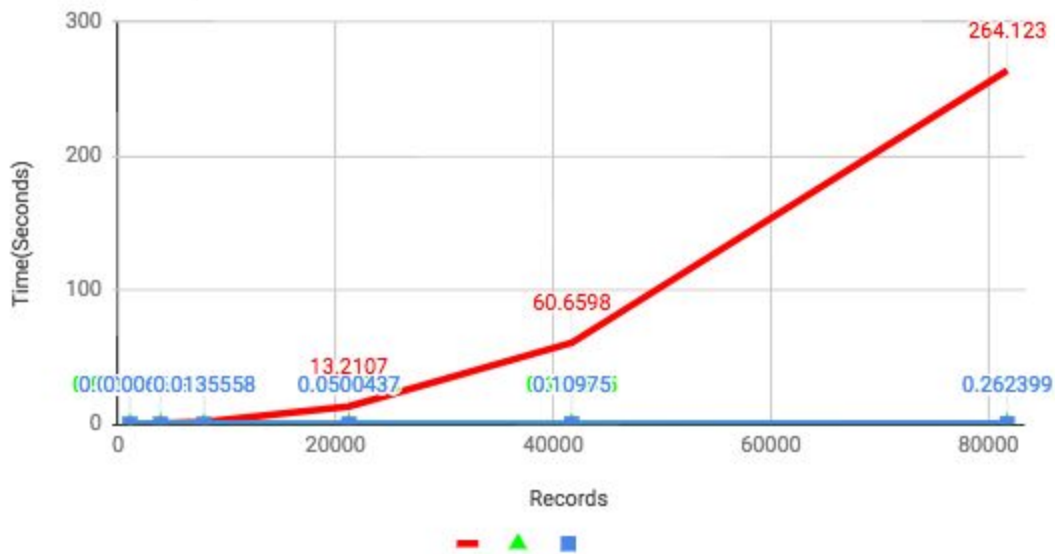
Graph of quick sort by name

QuickSort - Name



Comparison Graph of Names

Name Comparisons



Comparison Graph of Populations

Comparison - Populations

