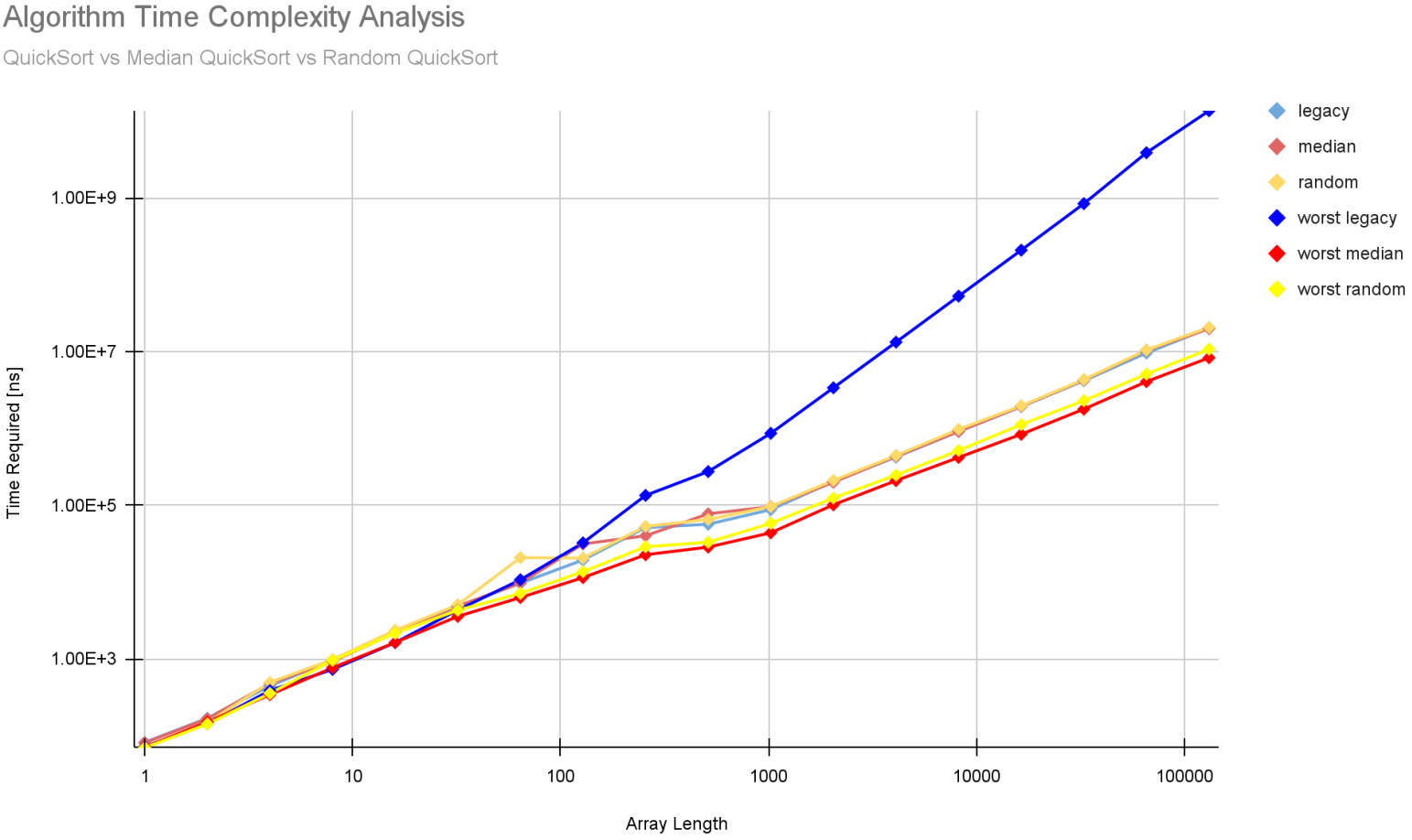
Quicksort Algorithm Comparison



The above chart plots the time required for sorting various sized arrays using several implementations of the Quicksort algorithm. The x-axis has the length of the array plotted logarithmically. The y-axis has the time required to complete the sort in nanoseconds plotted logarithmically. Only powers of 2 were used for array lengths, as this provides a good distribution of array sizes.

"Legacy" Quicksort uses the element at index 0 of the subarray as the pivot element. "Median" Quicksort uses the median of the elements at the top, middle, and bottom elements of the array as the pivot element. "Random" Quicksort uses a random element in the subarray as the pivot element. Both Median and Random Quicksort will default to using the element at index 0 of the subarray when the subarray has a length less than five.

Each of the three algorithms were timed with arrays composed of random integers in range [0, n], where *n* is the length of the array. Following that, each of the

algorithms are timed while sorting the array that was previously sorted. This is the worst case for the Legacy Quicksort, requiring the maximum number of comparisons.

Looking to the data we find each of the algorithms perform very similarly for the random arrays. Legacy Quicksort is the fastest, followed closely by Median, then Random. However, with the worst case arrays we find Median and Random vastly outperforms the Legacy Quicksort. At array length 131,072 Legacy Quicksort requires over 1600% more time to sort the worst case arrays than Median Quicksort.

n	legacy	median	random	worst legacy	worst median	worst random
1	82	81	71	72	71	70
2	169	166	148	143	151	142
4	445	480	494	387	342	356
8	967	928	984	730	767	955
16	2195	2196	2359	1629	1634	2161
32	4756	4866	5072	4324	3576	4298
64	9658	9730	20802	10718	6288	7117
128	19380	31359	20566	32399	11428	13666
256	51196	40071	53084	134300	22695	28822
512	56595	77330	65328	274385	28508	32995
1024	87662	95949	96091	863553	43842	58221
2048	204416	199324	210507	3378542	101365	124311
4096	423366	433964	444481	13271545	209115	246901
8192	910631	915953	972160	52677219	418975	516732
16384	1918493	1938040	1970566	209101031	838908	1124645
32768	4170743	4260967	4319760	842226110	1782398	2300299
65536	9597859	10365114	10484489	3876873638	4061408	5107915
131072	20209474	19872414	20664118	13633469515	8317339	10753603