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CSC 372
Assignment 1
Fall 2014
Best / Worst Case of Quicksort

To create the worst case list for a median of three quicksort you need to create an array that is in order where you take the second index and put it to the end of the list, then shift the array down. An example of an array size ten would look like 0234567891.

This is the worst case because every time a median is chosen it will end up being at the either end of the list. An example would be:
n=7
0 2 3 4 5 6 1 Mo3(0,4,1) = 1
Swap 1 and 0
1 2 3 4 5 6 0
Swap 0 and 2
1 0 3 4 5 6 2
Swap 1 and 0
0 1 3 4 5 6 2 This is the list after first pass
Do another pass on underlined portion of list and once again you see the Mo3(3,5,2) = 3
The chosen pivot will always be lowest it can possibly be.

Using the worst case Array defined above

n size	QMo3 time	QMo3 Comparisons	Q_Left Time	Q_Left Comparisons	$4(n^2)$
1,000,000	432.746(s)	250,005,500,003	432.154(s)	250,006,000,000	400
800,000	275.667(s)	160,004,400,003	276.67(s)	160,004,800,000	324
600,000	154.63(s)	90,003,300,003	156.306(s)	90,003,600,000	144
400,000	67.3235(s)	40,002,200,003	67.6257(s)	40,002,400,000	64
200,000	17.0169(s)	10,001,100,003	16.89559(s)	10,001,200,000	16
100,000	4.28998(s)	2,500,550,003	4.20503(s)	2,500,600,000	4

As you can see, the worst case is time $O(n^2)$. To see this more easily, lets divide n by 100,000 so that the test cases are 10, 8, 6, 4, 2, 1 respectively. Since O ignores constant multiples, we can multiply n^2 by 4 and we see that the QMo3 Column and the $4(n^2)$ column are similar. This shows that the worst case list for the median of 3 quick sort runs in roughly $O(n^2)$ time.