CSC 330 Assignment 3 Written Observations

Throughout my completion of this assignment, I observed the behavior of the Quicksort sorting algorithm to sort arrays of 15 randomly selected integers. I observed the behavior of quicksort when using 3 different methods of selecting a pivot. These three methods were as follows:

1. Selecting the middle element as the pivot
2. Selecting a random element as the pivot
3. Selecting the median of the low, middle, and high elements as the pivot

For each of these methods, I ran and measured the time to sort for increasing sizes of arrays, from 2^4 elements up to 2^15 elements. I ran 3 tests at each size, on 3 unique randomly generated arrays, and averaged their elapsed times. These measurements were recorded, added to arrays, and then formatted in an organized table-like layout. Next, I averaged the times for each method, and found that on average, for varying array sizes, median of 3 tends to be the fastest pivot selection method. The fastest method varies from run to run, but most often the median of 3 method is calculated to be the fastest.

Some reasons for this occurrence include:

The median of 3 method increases the likelihood of choosing a value that is closer to the actual median of the data, reducing the likelihood of unbalanced partitions of the data.

The median of 3 method reduces the likelihood of creating a worst-case scenario array partition, such as choosing the first element when the data is sorted in ascending/descending order, resulting in many more partitions needing to me made.

The median of 3 method generally leads to balanced partitions where one partition is not much larger or smaller than the other, leading to faster sorting.

In addition to observing the median of 3 method, I also observed the behavior of the random and middle element selection methods. We can visualize the behavior of all three methods in this graph: