Assignment 3 Writeup

After completing this assignment, I can definitely say that my understanding of all 3 (could be consider 4) sorts is definitely a lot stronger than it was before.

Time Complexity of the different Sorts

Bubble Sort

Bubble Sort has a time Complexity of O(n^2). This is quite a bad time complexity, and this is easily seen in the various graphs throughout this document. I think that the constant is negligible as this sort performs worse than all other sorts from nearly the beginning.

Shell Sort

I don't know if I can provide a clear time complexity for this sort. On one hand, it performs slightly worse than quick sort, and yet much better than bubble sort. From examining the algorithm, I am not able to determine the correct time complexity. The best I can do is say that it is bounded between O(*n * log n*) and O(n^2).

Quick Sort

I will be covering both the queue and stack implementations of this algorithm as they perform identically in terms of iterations. Looking at the graphs, the complexity looks nearly logarithmic, and indeed, the time complexity is O(*n * log n*). I believe that the constant is negligible in this case as it seems to be fastest since the very beginning.

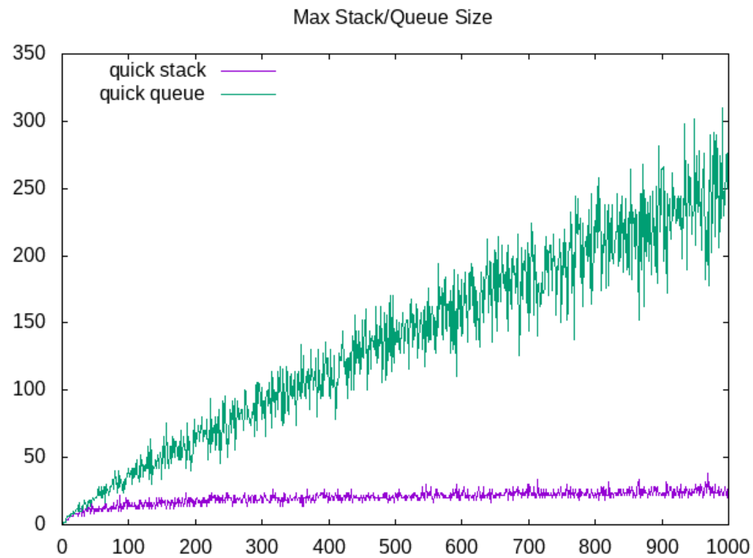
What I Learned

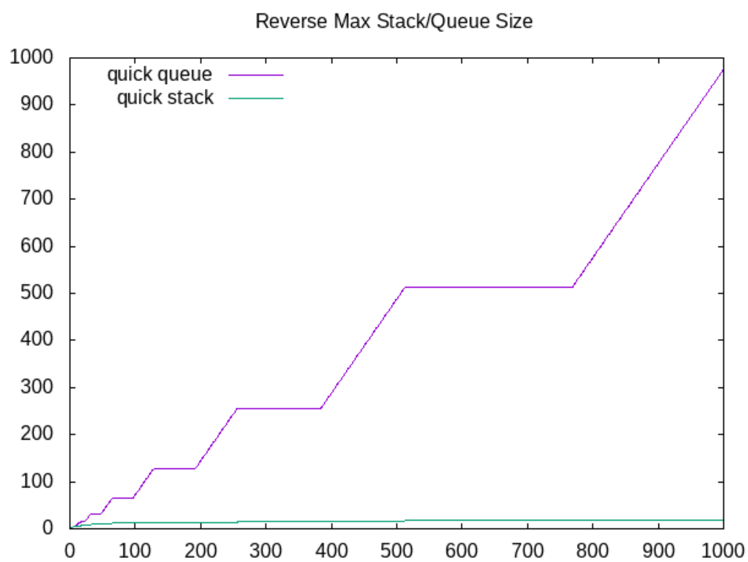
While programming these sorting algorithms, I learned what I think is an important lesson. First of all, I feel that the programming of the different sorts was in fact the easiest part of this lab. What was really the hard part was programming the supporting code, such as the queue and the stack. Since the pseudocode for all the sorts was given, coding up these was rather trivial.

Sort Experimentation

Personally, I did not do much experimenting with the various sorts. I think that the majority of the experimenting that I did was while I was producing the data necessary to create the graphs for this writeup.

Stack and Queue Size

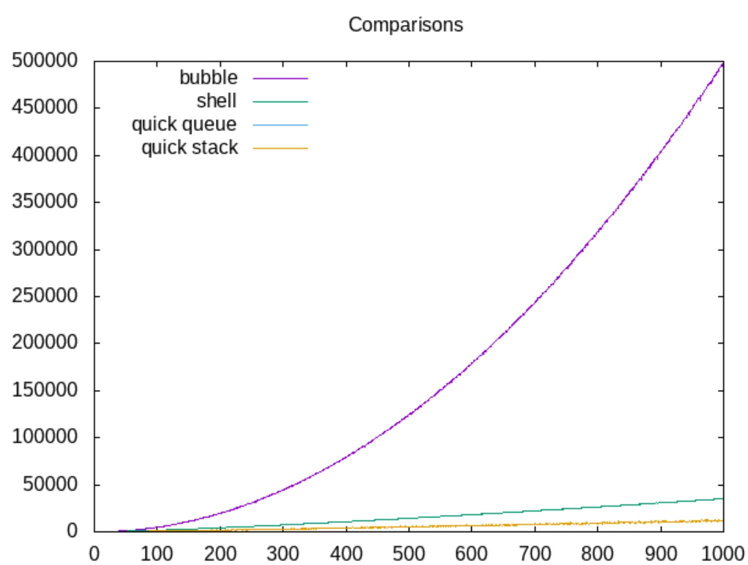


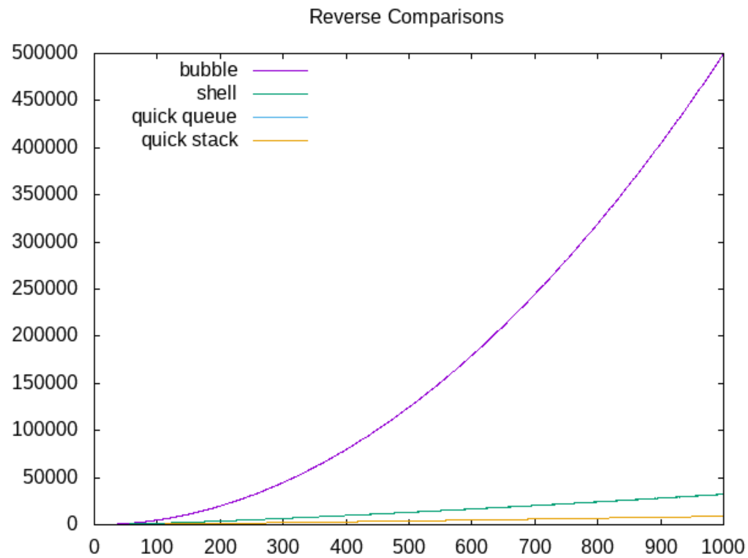


This part of the data analysis was very interesting for me as there were some unexpected results. First of all, stacks seem like an obvious choice for any given situation. I am not quite sure why the size of stacks seems to be so useful for this problem. Perhaps because we are using a stack instead of recursive calls to solve this problem, the stack is being utilized as a stack of function calls, and thus fits most naturally with this problem. I can say definitively that the maximum ize of the queue is relative to the number of elements in the array. It seems like linear growth to me, although I cannot know for sure. Stacks on the other hand, seem to remain relatively stable in their maximum size. I am not sure if this behavior would continue as the size of the input grows, but I suspect it will.

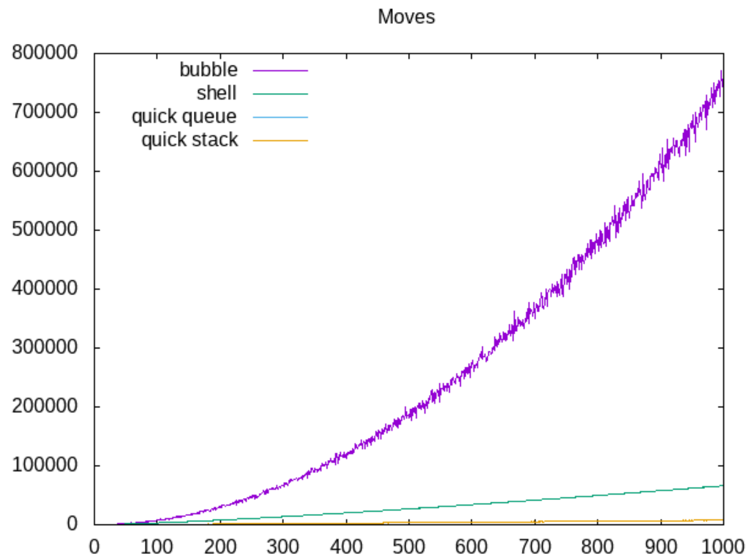
I found the maximum stack and queue sizes for a reverse sorted list to be very interesting. As the graph shows, the maximum queue size shows strange, almost fractal-like behavior. As the size of the input grows, the maximum queue size finds longer periods of stability and periods of growth, alternating between the two. I am not sure how this behavior came to be.

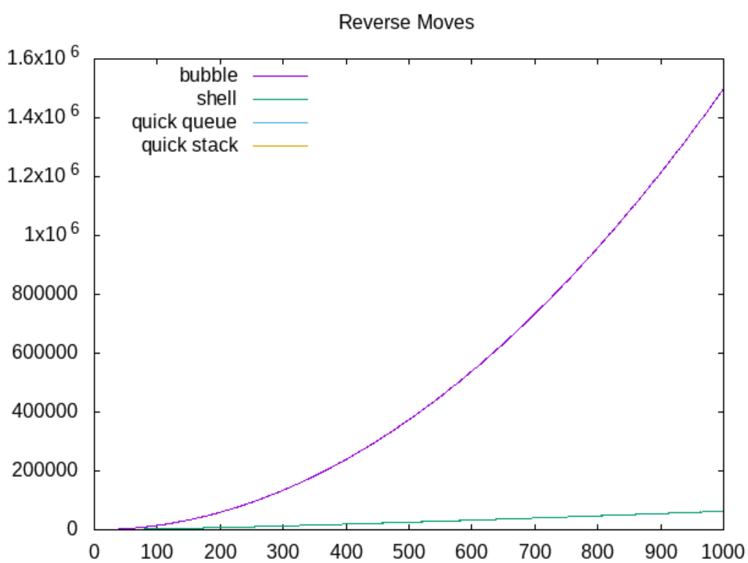
Graphs





Above are the graphs of the number of comparisons between the four sorts with randomly generated lists, and reverse sorted lists. Both graphs are essentially identical, with slight variation. As the graphs show, bubble sort is considerably worse than all the other sorts, and shell sort is only slightly worse than quick sort. Both quick queue and quick stack have identical behavior as the are only slightly different implementations of the same algorithm.





Above are the graphs of the number of moves between the four sorts with randomly generated lists, and reverse sorted lists. Like the comparisons, there is very little differences between these two lists. However, there is one noticable difference. It seems like quick sort is not present on the graph of the reverse sorted lists moves. However, this is simply due to the fact that this just so happens to be one of the best cases for this particular implementation of quicksort. Since the inital pivot is chosen to be the middle elment of the array, Every partition of the array will result in each side having an equal number of elements. This results in a best case scenario for quicksort, where very few moves need to be done. This is why the the moves for this sort do not appear on the graph.