Project 1 Report

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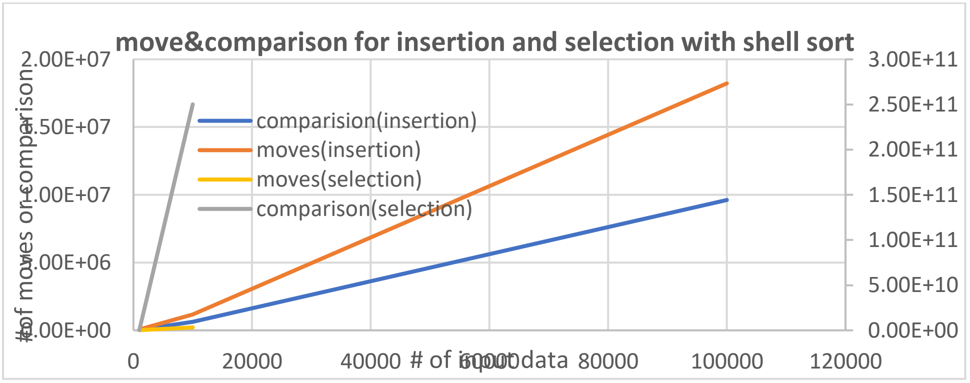
1.For my algorithm of the sequence, its time complexity is O((log(n))^2) and its space complexity is O(1).

2.

# of elements	1000	10000	100000	300000	500000	1000000
shellsort with insertion	comparisons: 3.556800e+04 moves: 6.652300e+04	comparisons: 6.227570e+05 moves: 1.173468e+06	comparisons: 9.617893e+06 moves: 1.822330e+07	comparisons: 3.443823e+07 moves: 6.543018e+07	comparisons: 6.199436e+07 moves: 1.178865e+08	comparisons: 1.373963e+08 moves: 2.613834e+08
shellsort with selection	comparisons: 2.515015e+08 moves: 1.383900e+04	comparisons: 2.501501e+11 moves: 2.161380e+05	comparisons: moves: **N/A**	comparisons: moves: N/A	comparisons: moves: N/A	comparisons: moves: N/A

When using shellsort with insertion, the number of comparisons and moves goes around 17 times larger as the number of elements to be sorted is multiplied by 10 every time, which is an exponential relationship. Also, from the graph below, for the same number of elements to be sorted, the shellsort with insertion beats the shellsort with selection for the number of comparisons, and the shellsort with selection beats the shellsort with insertion for the number of moves. The reason why my selection algorithm run very large size input data inefficiently is that its big notation is O(n^2), which would grow extremely fast when input data become very large. By contrast, the time complexity for insertion is O(n(log(n))^2), which cost very less steps to run. Also, selection already has the least the number of moves. There is no need to continue reduce it using shellsort. One optimization method is to obtain the index of maximum and minimum data and completing swap in one iteration simultaneously. In summary, the shellsort with insertion is more efficient.



3.

For the space complexity of my selection and insertion algorithm, they have the same big O notation which is O(n).

Reference

Wikipedia contributors. "Shellsort." *Wikipedia, The Free Encyclopedia*. Wikipedia, The Free Encyclopedia, 4 Jun. 2018. Web. 26 Jun. 2018.