Lab 9 report

EECS 268

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**BubbleSort**

As we observed here, bubble sort is extremely good at sorting ordered array but it has the slowest processing speeding when doing the unsorted array. The reason for this is that bubble sort will go through the whole array n times, and for each time, it will go through the array n-i times in the worst case. We can also see that the trace of the graph looks like an n2 function, which is one way of demonstrating that the big-O of bubble sort is n2. The prediction of the time processing of 1000000 size array is 2500s for random order and 2000s for descending order.

**SelectionSort**

The character for selection sort is really obvious that for all the three different sorting, the time consumption is mostly the same, which proves the Big-O of selection sort of O(n2) for all cases. The reason for this is that selection sort will go over the whole array no matter what sorting order it is, therefore the processing is the same in all cases besides that sorted array doesn’t need to switch the order, which is why ascending takes a little less time than other order. The prediction for 1000000 size is 950s for all cases.

**InsertionSort**

The time consume of insertion sort is a little close to bubble sort. Since for every spots the insertion sort is going through, it will compare with every spot at the left side of the array; therefore, in the worst case, it is going to compare and switch at every spot, which is going to consume a long time. The time consumption drops significantly when the order complexity drops a little bit. Even though the big-O of insertion in average case is O(n2), but it makes a lot of difference compared to the worst case. The prediction of 1000000 size is 1250s for descending, 550s for random order, and 0.005s for ascending order.

**MergeSort**

Merge sort consumes significant time when processing sorting compare to the previous sorting algorithm, the reason of this is that merge sort takes O(n) extra space complexity while the previous algorithm takes only O(1) extra space complexity, which means that merge sort takes significantly bigger memory than the previous three algorithm. Furthermore, we observed that the graph is like a linear line, however, the time complexity is not O(n) but O(nlog(n)), my explanation is that since it’s a log function, the change of n should be way bigger than 1000000 to make the graph looks like a curve line, otherwise logn will be just like a constant which will make the graph looks like a linear function.

**QuickSort**

Quick sort is the fastest sorting algorithm we have observed so far, besides the sorted array. The space complexity is O(logn), which isn’t too much space required. The reason why quick sort is so fast is that there are a really big chance that the pivot value on the right side is so small to make the sorting so efficient. However, it will be really bad in a sorted array since the pivot value will always be the biggest if we choice the right side. That’s why we observe a really slow time in ascending. We can also observe that the graph present a linear line, which demonstrate the time complexity is O(nlog(n)), the same thing happens to quick sort, the size of the array is too small that makes it looks like a linear function. For the ascending, since the worst case in quicksort is sorted array, which makes the time complexity to O(n2).

**Raw Data**

|  |  |  |  |
| --- | --- | --- | --- |
| BubbleSort |  |  |  |
| Size | Ascending Time | descending Time | Random Time |
| 50000 | 0.000128 | 7.1337 | 8.21215 |
| 70000 | 0.000565 | 13.9615 | 16.3163 |
| 90000 | 0.000622 | 23.0655 | 27.2964 |
| 100000 | 0.001122 | 28.5221 | 33.7526 |
| 110000 | 0.000315 | 34.4157 | 40.7654 |
| 120000 | 0.000361 | 40.8937 | 48.816 |
| 140000 | 0.000892 | 55.87 | 66.7031 |
| 160000 | 0.000892 | 72.9599 | 87.0639 |
|  |  |  |  |
| Insertion |  |  |  |
| Size | Ascending Time | descending Time | Random Time |
| 50000 | 0.000266 | 3.58334 | 1.80699 |
| 70000 | 0.000299 | 7.00662 | 3.54725 |
| 90000 | 0.001458 | 11.8515 | 5.83664 |
| 100000 | 0.000376 | 14.3417 | 7.16443 |
| 110000 | 0.000425 | 17.3655 | 8.66079 |
| 120000 | 0.000467 | 20.6628 | 10.2941 |
| 140000 | 0.000574 | 28.1422 | 14.0386 |
| 160000 | 0.000831 | 36.7567 | 18.287 |
|  |  |  |  |
| Selection |  |  |  |
| Size | Ascending Time | descending Time | Random Time |
| 50000 | 2.54671 | 2.71331 | 2.82801 |
| 70000 | 5.06032 | 5.24921 | 5.5443 |
| 90000 | 8.24548 | 8.70045 | 9.15644 |
| 100000 | 10.2025 | 10.7394 | 11.2832 |
| 110000 | 12.3337 | 13.0123 | 13.6774 |
| 120000 | 14.6599 | 15.5071 | 16.3153 |
| 140000 | 19.9604 | 21.0671 | 22.1775 |
| 160000 | 25.9836 | 27.5 | 28.941 |
|  |  |  |  |
| Quicksort |  |  |  |
| Size | Ascending Time | descending Time | Random Time |
| 100000 | 0.010137 | 0.00607 | 0.012129 |
| 200000 | 0.04171 | 0.01269 | 0.025043 |
| 500000 | 0.038732 | 0.035856 | 0.064863 |
| 600000 | 0.056539 | 0.042884 | 0.079927 |
| 700000 | 0.052549 | 0.048484 | 0.093104 |
| 800000 | 0.058482 | 0.056271 | 0.107604 |
| 900000 | 0.068633 | 0.066386 | 0.120893 |
| 1000000 | 0.077253 | 0.074298 | 0.135374 |
|  |  |  |  |
| MergeSort |  |  |  |
| Size | Ascending Time | descending Time | Random Time |
| 100000 | 0.013934 | 0.07896 | 0.016504 |
| 200000 | 0.017901 | 0.02023 | 0.034281 |
| 500000 | 0.049763 | 0.047472 | 0.091906 |
| 600000 | 0.057728 | 0.057792 | 0.111203 |
| 700000 | 0.068719 | 0.068129 | 0.131592 |
| 800000 | 0.07896 | 0.079661 | 0.150653 |
| 900000 | 0.090331 | 0.089008 | 0.170709 |
| 1000000 | 0.100231 | 0.099389 | 0.191976 |