CS 61B Spring 2022

Sorting

Discussion 12: April 11, 2022

1 Mechanical Practice

Show the steps taken by each sort on the following unordered list:

```
106, 351, 214, 873, 615, 172, 333, 564
```

(a) Quicksort. After each partition during the algorithm, write the ordering of the list, circle the pivot that was used for that partition, and box the sub-array being partitioned. Assume that the pivot is always the first item in the sublist being sorted and that the array is sorted in place.

(b) Merge sort. Show the intermediate merging steps.

(c) LSD radix sort. Show the ordering of the list after each round of counting sort.

2 Identification

Match the sorting algorithms to the sequences, each of which represents several intermediate steps in the sorting of an array of integers. Assume that for quicksort, the pivot is always the first item in the sublist being sorted. Note: these steps are not necessarily the first few intermediate steps and there may be steps which are skipped.

***Algorithms**: Quicksort, Merge Sort, Heapsort, MSD Radix Sort, Insertion Sort.*

(a)
```
12, 7, 8, 4,  10, 2,  5,  34, 14
7,  8, 4, 10, 2,  5,  12, 34, 14
4,  2, 5, 7,  8,  10, 12, 14, 34
```

(b)
```
23, 45, 12, 4, 65, 34, 20, 43
4, 12, 23, 45, 65, 34, 20, 43
```

(c)
```
12, 32, 14, 11, 17, 38, 23, 34
12, 14, 11, 17, 23, 32, 38, 34
```

(d)
```
45, 23, 5,  65, 34, 3,  76, 25
23, 45, 5,  65, 3,  34, 25, 76
5,  23, 45, 65, 3,  25, 34, 76
```

(e)
```
23, 44, 12, 11, 54, 33, 1, 41
54, 44, 33, 41, 23, 12, 1, 11
44, 41, 33, 11, 23, 12, 1, 54
```

3 Conceptual Sorts

Answer the following questions regarding various sorting algorithms that we've discussed in class. If the question is T/F and the statement is true, provide an explanation. If the statement is false, provide a counterexample.

(a) (T/F) Quicksort has a worst case runtime of $\Theta(NlogN)$, where N is the number of elements in the list that we're sorting.

(b) We have a system running insertion sort and we find that it's completing faster than expected. What could we conclude about the input to the sorting algorithm?

(c) Give a 5 integer array that elicits the worst case runtime for insertion sort.

(d) (T/F) Heapsort is stable.

(e) Give some reasons as to why someone would use mergesort over quicksort.

(f) You will be given an answer bank, each item of which may be used multiple times. You may not need to use every answer, and each statement may have more than one answer.

A. QuickSort (in-place using Hoare partitioning and choose the leftmost item as the pivot)

B. MergeSort

C. Selection Sort

D. Insertion Sort

E. HeapSort

N. (None of the above)

List all letters that apply. List them in alphabetical order, or if the answer is none of them, use N indicating none of the above. All answers refer to the entire sorting process, not a single step of the sorting process. For each of the problems below, assume that N indicates the number of elements being sorted.

_____ Bounded by Ω(NlogN)lower bound.

_____ Has a worst case runtime that is asymptotically better than Quicksort's worstcase runtime.

_____ In the worst case, performs Θ(N) pairwise swaps of elements.

_____ Never compares the same two elements twice.

_____ Runs in best case Θ(logN)time for certain inputs