Lab 19 Notes

CS 61BL — Lab 19

Summer 2019 — August 6, 2019

Name: | SID:

Please complete this worksheet during your lab, and turn it in to your TA by the end of your section. You are encouraged to work with your neighbors collaboratively.

Section Number: (01) (02) (03) (04) (05) (06) (07) (08) (09) (10) (11) (12)

1 Sorting

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

`0, 4, 2, 7, 6, 1, 3, 5`

sorted | unsorted

(a) Insertion sort

INSERTION — insert first item into correct spot

0 | 4 2 7 6 1 3 5
0 4 | 2 7 6 1 3 5
0 2 4 | 7 6 1 3 5
0 2 4 7 | 6 1 3 5
0 2 4 6 7 | 1 3 5
0 1 2 4 6 7 | 3 5
0 1 2 3 4 6 7 | 5
0 1 2 3 4 5 6 7 |

sorted | unsorted

(b) Selection sort

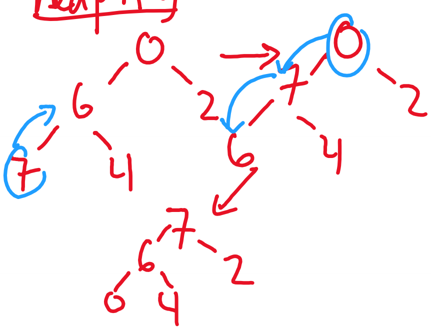
SELECTION — swap in smallest unsorted item

| 0 4 2 7 6 1 3 5
0 | 4 2 7 6 1 3 5
0 1 | 2 7 6 4 3 5
0 1 2 | 7 6 4 3 5
0 1 2 3 | 6 4 7 5
0 1 2 3 4 | 6 7 5
0 1 2 3 4 5 | 7 6
0 1 2 3 4 5 6 | 7
0 1 2 3 4 5 6 7 |

(c) Use heapsort to sort the following array (hint: draw out the heap). Draw out the array at each step:

`0, 6, 2, 7, 4`

heapify



| 7 | 6 | 2 | 0 | 4 |

"remove" max (but leave in last spot)

1. 7 6 2 0 4 size: 5
   bubble 4 down → 4 6 2 0 7 size 4
2. 6 4 2 0 7
   bubble 0 down → 0 4 2 6 7 size 3
4 0 2 6 7
2 0 4 6 7 size 2
0 2 4 6 7 size 1
0 2 4 6 7 done

(d) Merge sort

1.2 Sort the following unordered list using stable Quicksort. Assume that we always choose first element as the pivot and that we use the 3-way merge partitioning process described in lecture and lab. Show the steps taken at each partitioning step.

`18, 7, 22, 34, 99, 18, 11, 4`

7 11 4 | 18 18 | 22 34 99

4 | 7 | 11 | 18 18 | 22 34 99

return → 4 7 11 18 18 | 22 | 34 99

4 7 11 18 18 | 22 | 34 | 99 ← return

4 7 11 18 18 22 34 99

1.3 When choosing an appropriate algorithm, there are often several trade-offs that we need to consider. Complete the chart for the following sorting algorithms: give the expected time complexity in the worst case, in the best case, and whether or not each sort is stable.

	Time Complexity (Best)	Time Complexity (Worst)	Stability
Selection Sort	$\Theta(n^2)$	$\Theta(n^2)$	No
Insertion Sort	$\Theta(n)$	$\Theta(n^2)$	Yes
Heapsort	$\Theta(n)$	$\Theta(n \log n)$	No
Merge sort	$\Theta(n \log n)$	$\Theta(n \log n)$	yes
Quicksort (Three-way Partitioning)	$\Theta(n)$	$\Theta(n^2)$	yes

to put elems inside, has to do a swap ⇒ e.g. 12 | 4 4 3 — 4 swaps sides ⇒ not stable

bubble down not stable

all items equal