CS 61BL	Lab 20
Summer 2019	August 8, 2019

Name: *JA* 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.

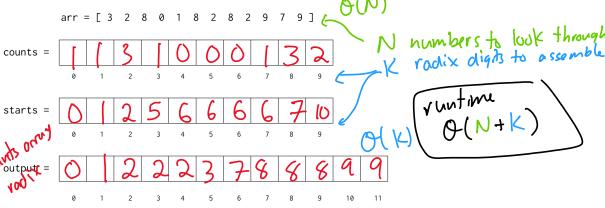Section Number: (01) (02) (03) (04) (05) (06) (07) (08) (09) (10) (11) (12)

1 Sorting

1.1 Run counting sort on the `arr` array below. Fill in the `counts` and `starts` arrays as you have seen in lab. Then, use `counts` and `starts` to fill in the `output` array.

arr = [3 2 8 0 1 8 2 8 2 9 7 9]

O(N) ← *N numbers to look through*

K radix digits to assemble

counts =

1	1	3	1	0	0	0	1	3	2
0	1	2	3	4	5	6	7	8	9

starts =

0	1	2	5	6	6	6	6	7	10
0	1	2	3	4	5	6	7	8	9

O(K)

runtime
O(N+K)

Fill in counts array using counts array for each radix

output =

0	1	2	2	2	3	7	8	8	8	9	9
0	1	2	3	4	5	6	7	8	9	10	11

1.2 Sort the following list using LSD radix sort with counting sort by writing down the contents of the array after each pass of counting sort. Level 0 is the original list, level 1 will be the output after the first pass of counting sort (use the **rightmost** digit), level 2 will be the output after the second pass of counting sort, and so on.

0	395	326	392	315	388	331	309	320	347
1	320	331	392	395	315	326	347	388	309
2	309	315	320	326	331	347	388	392	395
3	309	315	320	326	331	347	388	392	395

Runtime:
O(N+K) each pass, D passes
⟹ O((N+K)D)

1.3 Sort the following list using MSD radix sort with counting sort by writing down the contents of the array after each pass of counting sort. Level 0 is the original list, level 1 will be the output after the first pass of counting sort (use the **leftmost** digit), level 2 will be the ouptut after the second pass of counting sort, and so on.

0	395	326	392	315	388	331	309	320	347
1	395	326	392	315	368	331	309	320	347
2	309	315	326	320	331	347	388	395	392
3	309	315	320	326	331	347	388	392	395

1.4 Complete the chart for LSD and MSD radix sort by writing down the best case and worst case runtimes in $\Theta()$ notation and whether or not the sort is stable. You may write any notes about the sort in the "Notes" column; this column will not be graded.

Assume we have N elements, a radix R, and at most W digits in an element.

	Runtime (best)	Runtime (worst)	Stable? (Y/N)	Notes (not graded)
LSD radix sort	$O(N+K)$	$O(N+K)$	Y	
MSD radix sort	$O(N+K)$	$O(N+K)$	Y	

all unique first digits, i.e.

100   210 380   426 511

sort by first digit ⇒ done.