CS261L Data Structures and Algorithms (Pr)

Lab Manual (Week 6)

Instructor:

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Registration No._____

Name: _____

Guide Lines/Instructions:

You may talk with your fellow CS261-ers about the problems. However:

- Try the problems on your own *before* collaborating.
- Write up your answers yourself, in your own words. You should never share your typed-up solutions with your collaborators.
- If you collaborated, list the names of the students you collaborated with at the beginning of each problem.

Today's Task:

- Linear Time Sorting

Part 1: Linear Time Sorting

Counting Sort Algorithm

Counting sort is a sorting technique based on keys between a specific range. It works by counting the number of objects having distinct key values (kind of hashing). Then doing some arithmetic to calculate the position of each object in the output sequence.

Pseudo Code

```
function CountingSort(input)
k =  range of elements of array
count ← array of k + 1 zeros
   output ← array of same length as input

   for i = 0 to length(input) - 1 do
      j = key(input[i])
      count[j] += 1

   for i = 1 to k do
      count[i] += count[i - 1]

   for i = length(input) - 1 down to 0 do
      j = key(input[i])
count[j] -= 1
      output[count[j]] = input[i]

   return output
```

Radix Sort Implementation

The idea of Radix Sort is to do digit by digit sort starting from least significant digit to most significant digit. Radix sort uses counting sort as a subroutine to sort.

Algorithm

Do following for each digit i where i varies from least significant digit to the most significant digit.
Sort input array using counting sort (or any stable sort) according to the i'th digit.

Bucket Sort

Bucket sort is mainly useful when input is uniformly distributed over a range.

Algorithm

```
bucketSort(arr[], n)
    1)   Create n empty buckets (Or lists).
    2)   Do following for every array element arr[i].
.......a) Insert arr[i] into bucket[n*array[i]]
    3)   Sort individual buckets using insertion sort.
    4)   Concatenate all sorted buckets.
```

Exercise

Sort the array using counting sort algorithm.	Input: arr[] = [-5, -10, 0, -3, 8, 5, -1, 10] Output:[-10, -5, -3, -1, 0, 5, 8, 10]
Sort the array using radix sort.	Input: arr[] =[110, 45, 65,50, 90, 602, 24, 2, 66] Output: [2,24,45,50,65,66,90,110,602]
Sort the array using Bucket Sort	Input: arr[]=[0.897, 0.565, 0.656, 0.1234, 0.665, 0.3434] Output: [0.1234, 0.3434, 0.565, 0.656, 0.665, 0.897]