

Cs501

Mansi Shah

(19526)

WEEK10 = Homework 10

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1, 5, 3, 1, 2, 4, 5, 5, 1, 2 (Histogram sort)

Step 1: Find the Histogram

Index	Count
0	0
1	0 → 1 → 2 → 3
2	0 → 1 → 2
3	0 → 1
4	0 → 1
5	0 → 1 → 2 → 3
6	0
7	0
8	0
9	0

Step 2: Sorting

1
1
1
2
2
3
4
5
5
5

Histogram or Bucket sort time complexity in worst case
 $O(n+K) \Rightarrow O(n+K)$

Counting Sort

Step 1: 1, 5, 3, 1, 2, 4, 5, 5, 1, 2

Step 1: Counting

Index :	0	1	2	3	4	5	6	7	8	9
Count :	0	3	2	1	1	3	0	0	0	0

Note:

There are 3 items in bucket 1
 There are 2 items in bucket 2
 There are 1 items in bucket 3
 There are 1 items in bucket 4
 There are 3 items in bucket 5

Step 2: Modify the Count array by adding the previous counts

Index :	0	1	2	3	4	5	6	7	8	9
count :	0	3	5	6	7	10	10	10	10	10

Processing the input data "1, 5, 3, 1, 2, 4, 5, 5, 1, 2"
 based on the result of step 2.

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Index : 0 1 2 3 4 5 6 7 8 9
Count : 0 3 5 6 7 10 10 10 10 10

 $i = 1, \text{count}[\text{input}[i]] = \text{count}[1] = 3$

Input Array

Index : 1 2 3 4 5 6 7 8 9 10
value : 1 5 3 1 2 4 5 5 1 2

Count Array

Index : 0 1 2 3 4 5 6 7 8 9
Count : 0 3 5 6 7 10 10 10 10 10

Put data 1 at index 3 in output array.

Output array

Index : 1 2 3 4 5 6 7 8 9 10
value : 1

Decrease count Array of index 1 by 1.

Index : 0 1 2 3 4 5 6

Count array : 0 2 5 6 7 10

$i = 5, \text{count}[\text{input}[i]] = \text{count}[5] = 10$

Output array

Index : 1 2 3 4 5 6 7 8 9 10
value : 1 5

Decrease count array of index 5 by 1

Index : 0 1 2 3 4 5

Count array : 0 2 5 6 7 9

$$i = 3 \quad \text{count}[\text{input}[i]] = \text{count}[3] = 6$$

Output Array.

Index :	1	2	3	4	5	6	7	8	9	10
Value :			1			3				5

Decrease count array of index 3 by 1

count array

Index :	0	1	2	3	4	5
count array :	0	2	5	5	7	9

$$i = 4 \quad \text{count}[\text{input}[i]] = \text{count}[1] = 2$$

Output Array

Index :	1	2	3	4	5	6	7	8	9	10
Value :		1	1			3				5

Decrease count array of index 1 by 1

count array

Index :	0	1	2	3	4	5
count array :	0	1	5	5	7	9

$$i = 5 \quad \text{count}[\text{input}[i]] = \text{count}[2] = 5$$

Output Array

Index :	1	2	3	4	5	6	7	8	9	10
Value :		1	1		2	3				5

Decrease count array of index 2 by 1

Index :	0	1	2	3	4	5
count array :	0	1	4	5	7	9

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$i=6$ (count (input (i)) = count [4] = 7

~~Count Array~~

Output Array

Index :	1	2	3	4	5	6	7	8	9	10
Value :		1	1		2	3	4			5

Decress Count Array of index 4 by 1

Index :	0	1	2	3	4	5
Count Array :	0	1	4	5	6	9

$i=7$ (count (input (i)) = count [5] = 9

Output Array

Index :	1	2	3	4	5	6	7	8	9	10
Value :		1	1		2	3	4		5	5

Decress Count Array of index 5 by 1

Index :	0	1	2	3	4	5
Count Array :	0	1	4	5	6	8

$i=8$ (count (input (i)) = count [5] = 8

Output Array

Index :	1	2	3	4	5	6	7	8	9	10
Value :		1	1		2	3	4	5	5	5

Decress Count Array of index 5 by 1

Index :	0	1	2	3	4	5
Count Array :	0	1	4	5	6	7

$i=9$ (count (input (i)) = count [1] = 1

Output Array

Index :	1	2	3	4	5	6	7	8	9	10
Value :	1	1	1		2	3	4	5	5	5

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Decrease count array of index 1 by 1

Index : 0 1 2 3 4 5
count array : 6 0 4 5 6 7

$i = 10$ (count [input(i)] = count[2] = 4

output array:

Index : 1 2 3 4 5 6 7 8 9 10
Value : 1 1 1 2 2 3 4 5 5 5

Decrease count array of index 2 by 1
Index : 0 1 2 3 4 5
count array : 0 0 3 5 6 7

Step : 3 output each object from the input sequence followed by decreasing its count by 1, eventually you will get the following output array:

Index :	1	2	3	4	5	6	7	8	9	10
Input array :	1	5	3	1	2	4	5	5	1	2
Output array :	1	1	1	2	2	3	4	5	5	5

Time Complexity : $O(n+k)$ where n is the number of elements in input array and k is the range of input. where time complexity of histogram (bucket sort) is also $O(n+k)$

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